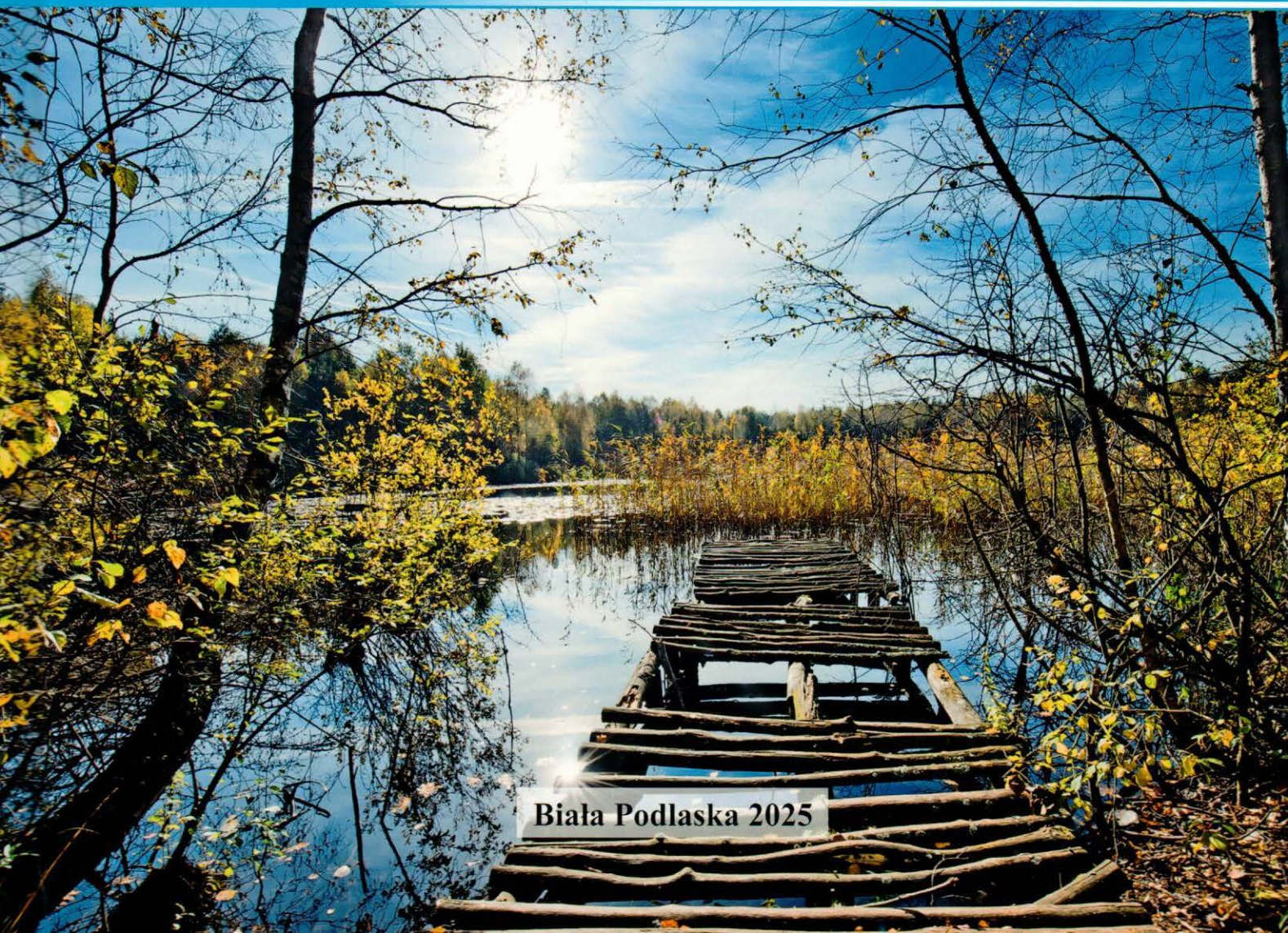
John Paul II University in Biała Podlaska

Recent and fossil freshwater diatoms of Poland: taxonomy, distribution and their significance in the environmental reconstruction

Part 2

Eunotiales, Achnanthales and Cymbellales

Abdelfattah A. Zalat, Jerzy Nitychoruk, Marta Chodyka, Irena A. Pidek, Fabian Welc



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Preface

Diatom investigation from sediments of some lakes in northern Poland and Eemian paleolake deposits in central Poland, conducted since 2017 to the present, has resulted in the identification and imaging of a great number of diatom taxa. As a result of diatom data, and its significance in the paleoenvironmental and paleoclimate reconstructions, the Faculty of Technical Sciences, John Paul II University in Biała Podlaska, Poland, in collaboration with the Department of Geomorphology and Paleogeography at the Institute of Earth and Environmental Sciences, Maria Curie-Sklodowska University, Lublin, Poland and the Geology Department, Faculty of Science, Tanta University, Egypt, initiated a project aimed at documenting the Polish diatom flora. This initiative seeks to enhance our understanding of native species, to serve as an introduction to the common species found in Polish ecosystems and offer essential data for sustainable biodiversity conservation. The main aim of this project was to create a comprehensive series of monographs that provide detailed information about the taxonomy, ecology, and distribution of diatoms found in various Polish ecosystems, as well as those preserved as fossils in Pleistocene-Holocene deposits. In 2022, the first part of this work was published, which included descriptions of 269 diatom species belonging to the central diatom classes Coscinodiscophyceae and Mediophyceae, as well as the pennales group of the subclass Fragilariophycidae.

The current work represents the second part of the diatom monographs covering three orders of pennales: Eunotiales, Achnanthales and Cymbellales, which comprise 562 diatom species. Overall, this research serves as an essential resource for geologists, biologists, and botanists interested in the biogeographic distribution of diatoms, their taxonomy, and the reconstruction of paleoenvironmental and paleoclimate conditions, particularly throughout the Quaternary period. It also acts as a reference for Polish researchers and a practical identification guide for freshwater diatoms recorded in Poland. Furthermore, the diatom data provided are designed to support future biomonitoring and paleolimnological studies, potentially serving as a valuable environmental marker for diatomists worldwide, particularly for researchers in Europe.

Authors

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The authors would also like to thank Prof. Maksim Bahdasarau from the Department of Geography and Environmental Management at Pushkin University, Belarus, and Dr. Sviatlana Dziamidava from the Institute of Geology, Belarus, for their critical reviews of the manuscript, combined with their insightful comments and suggestions, which significantly enhanced the quality of this research.

Abstract

The current work presents a continuation of the diatom investigation conducted in the Polish ecosystem, encompassing some lakes in northern Poland, the Eemian paleolake deposits in central Poland, and the recorded diatom taxa from numerous published studies. The study contributes to our understanding of diatom floristics, ecology, biogeography and their significance in environmental and climate reconstruction in Poland. This publication is the second part in a series of monographs focused on the diatom taxa from three orders of pennales: Eunotiales, Achnanthales, and Cymbellales. A total of 562 diatom species and varieties belonging to 39 genera have been identified. The documented diatoms include 93 entries from the Eunotiales, 139 taxa from the Achnanthales, and 330 taxa from the Cymbellales. Notably, 203 of these diatom taxa represent new records for Poland, along with 3 new species, 30 new varieties, and 5 new combinations. The volume features detailed descriptions of diatoms, their distribution in Poland, and autecological information, providing a comprehensive overview of the subject. It includes an extensive iconography of 2556 high-quality light micrographs of the diatom taxa, showing a range of variations and morphological details that enhance understanding and aid in identification, and are illustrated in 144 plates. Additionally, the majority of diatom species recorded in the prior literature are mentioned in this work, which helps create a complete list of diatoms from various Polish ecosystems. This research aims to provide a general overview of the rich diatom biodiversity characteristic of Polish ecosystems and offers a revised diatom checklist for Poland. Furthermore, it includes a taxonomic and autecological catalogue that will be valuable for assessing water quality, interpreting paleoenvironmental conditions, and understanding paleoclimate changes.

1. Introduction

This work represents a significant continuation of the diatom investigation within the Polish ecosystem, focusing on various lakes in northern Poland, as well as the Eemian paleolake deposits found in central Poland, and incorporating the recorded diatom taxa from a wide array of published literature, covering historical and contemporary studies of diatom taxa. By synthesising data from several key studies, this research significantly enhances our knowledge of diatom floristics, taxonomy, ecology, and biogeography, while also highlighting their crucial role in environmental monitoring and climate reconstructions. The first monograph (Zalat et al. 2022) documented diatom taxa belonging to the planktonic classes Coscinodiscophyceae, Mediophyceae and the pennales subclass Fragilariophycidae. In total, 269 diatom species and varieties belonging to 38 genera were identified. Notably, of these, 97 diatom taxa were recorded as new for Poland, alongside 12 novel combinations and newly described varieties. In addition, it is further distinguished by the inclusion of 2,423 exceptional light micrographs of diatom taxa, meticulously arranged in 120 informative plates that provide a visual reference for identifying these flora.

As the second part in a dedicated series of monographs, the current volume meticulously focuses on the diatom taxa that belong to three prominent orders of the Pennales: Eunotiales, Achnanthales, and Cymbellales. This volume offers comprehensive descriptions of these diatoms, detailing their distribution patterns across various habitats in Poland and providing crucial autecological information. The book boasts an extensive collection of 2,556 spectacular light micrographs that distinctly illustrate the morphological diversity of the diatom taxa. These images are presented across 144 meticulously curated plates, greatly enhancing the ease and accuracy of species identification for future researchers. Additionally, this work cites a substantial majority of diatom species documented in existing literature, thereby completing a thorough catalogue of diatoms across various Polish ecosystems. This comprehensive effort aims not only to highlight the exceptional biodiversity inherent to Polish diatoms but also to provide an updated diatom checklist that is essential for advancing research. Furthermore, the taxonomic and autecological catalogue presented in this volume will prove to be a significant resource for paleoenvironmental interpretations and the reconstruction of paleoclimate changes, making a significant contribution to ecological and environmental sciences in Poland.

1.1. Materials of study

A comprehensive collections of 821 samples were obtained from the studied sites. Among these, 352 samples were collected from lakes in northern Poland, while 469 sediment samples were taken from the significant late Saalian-Eemian palaeolake deposits in the Garwolin Plain of central Poland (see Zalat et al. 2022). Each sediment core was cut into 5 cm sections, with some samples sliced into 1-2 cm pieces. The sediment cores collected from the lakes in northern Poland are securely stored in a specialised cold container at the Department of Geology, John Paul II University in Biała Podlaska. Meanwhile, the sediments obtained from the Eemian palaeolake deposits in the Garwolin Plain are preserved in a cold storage room at the Institute of Earth and Environmental Sciences of Maria Curie-Skłodowska University in Lublin, Poland. Portions of all investigated samples have been packed in plastic bags and transported to the Geology Department, Faculty of Science, Tanta University in Egypt for diatom analysis. The samples under investigation are described as follows:

- Jeziorak Lake: 20 sediment samples were collected from the surface sediments of the lake in October 2018. These samples are composed mainly of greenish to greyish sandy mud and muddy silt.
- Młynek Lake: 34 sediment samples were obtained from the core JW-1, with a total length of 3.45 m, that were recovered from the central northern bank of Młynek Lake, northern Poland. Lithologically, the sediments from the depth 0.00 to 0.40 m were composed of gray-brown, hydrated gyttja, 0.40

to 1.10 m were gray-brown, gyttja, 1.10-1.45 m gray-brown, very plastic gyttja, 1.45-1.80 m gray-brown, organogenic gyttja, and 1.80-3.45 m gray-brown gyttja with organic matter.

- Radomno Lake: 87 sediment samples were obtained from the core sequence at the depth of 0.40 to 9.00 m. Most of the studied samples are composed of grey-brown, highly plastic gyttja and organogenic gyttja, with short intervals of sandy gyttja.
- Kamionka Lake: 70 sediment samples were obtained from the core section with a total depth of 6.90 m. The examined samples were gray-brown gyttja, with some samples consisting of grey gyttja with organic matter and a few sandy gyttja.
- Francuskie Lake: 71 sediment samples taken from the profile at the depth interval from 1.00 to 4.92 m. The samples consisted mainly of dark grey gyttja with organic matter and fragments of plant remains at some intervals.
- Zielone Lake: 70 sediment samples from the core section with a total depth of 6.85 m. The samples were composed of gray-brown, gyttja, plastic gyttja, and somewhat sandy gyttja at some intervals.
- Struga core section (G-120) was represented by 117 samples within the depth interval from 1.39 to 6.52 m. The investigated samples were composed of dark grey gyttja with peat, slightly carbonate, olive to grey-brown gyttja with layering of various sand, black and brown gyttja with silty sand.
- Struga core section (St-19) comprised 119 samples within the depth interval from 2.10 to 8.00 m. The samples are mainly peat mud, peat gyttja, black peat poorly decomposed with layers of sand, and dark brown carbonate gyttja with fragments of malacofauna.
- Kozlow 2 core section (K2-19**)** encompassed 107 samples from depth interval 2.50 to 7.80. The samples are composed mainly of the gyttjas traces of peat at the bottom of the core. The biogenic sediments attain ca 7.5 m thick and there is a layer of gyttja-shales between 7.80 and 8.15 m.
- Żabieniec core section (Za-19) included 57 samples from depth interval 9.60 to 12.40m, which consist of dark grey gyttja with peat.
- Parysów core section (Pa-19) covered 29 samples from a depth interval of 10.80 to 13.15 m, which contains dark grey gyttja and peat gyttja.
- Puznówka core section (Pu-19) embraced by 17 samples obtained from the depth interval 2.40-3.20 m. The samples are composed of dark grey-brown gyttja with a few layers of fine sand.
- Jagodne core section (Ja-19) contained 23 samples taken from depth intervals 5.70-6.80 m, which comprise dark grey to olive gyttja with peat.

(for more details about the materials of study, see Zalat et al. 2022).

1.2. Diatom preparation

Laboratory treatment of sediments for diatom analysis was conducted following the technique proposed by Battarbee et al. (2001). One gram of dry sediment from each sample was processed using a disintegration method involving hydrochloric acid (HCl) and hydrogen peroxide (H2O2). The sample was treated with 30% hydrogen peroxide and boiled on a hot plate until the reaction was complete and all organic material was digested. Subsequently, the sample was treated with 10% hydrochloric acid to remove carbonates and washed several times with distilled water until all peroxide and most clay fractions were eliminated. Permanent slide preparations were made from the residue of a 50 ml sample. Approximately 0.1 ml was taken from the centre of the homogenised suspension, placed randomly on coverslips (22 x 50 mm), allowed to dry at low temperature, and then mounted on glass slides using Naphrax for microscopic observation. The prepared

diatom slides were deposited in the Geology Department at the Faculty of Science, Tanta University, Egypt, while some slides related to the Polish lakes were stored at the Faculty of Technical Sciences, John Paul II University in Biała Podlaska.

For scanning electron microscopy (SEM) observations, one drop of the final cleaned diatom suspension was spread over a small coverslip (20 x 20 mm) and left to dry in a desiccator containing silica gel for 24 hours to ensure it was completely dry. The dried coverslip was then fixed onto an aluminium microscope stub using carbon tape and sputter-coated with gold. The coated coverslips were examined using a Field Emission Scanning Electron Microscope (FE-SEM), Quanta FEG 250, FEI, along with a Jeol scanning microscope 5300, operating under high vacuum at 20 and 30 kV, which are suitable voltages for examining diatoms to reveal fine details. The SEM studies were conducted at the electron microscope unit at the National Research Centre in Dokki, Egypt.

1.3. Diatom identification

The diatom assemblages were quantitatively examined using an Optika light photomicroscope, enhanced with a high-resolution 10-megapixel digital camera, which allowed for detailed imaging of the specimens. The microscope was fitted with both Brightfield and Differential Interference Contrast (DIC) optics. Detailed observations were conducted at a magnification of 1200x, using 100x oil immersion. Diatom species were identified at the species level, employing taxonomic keys and reference collections to ensure accuracy. The ecological context of the identified diatom taxa was derived from a comprehensive review of extensive literature and comparisons with the most up-to date references (e.g., Hustedt, 1925-1957; Patrick & Reimer, 1966, 1975; Krammer & Lange-Bertalot, 1986-1991; Denys, 1991-1992; Lange-Bertalot & Metzeltin, 1996; Metzeltin & Witkowski, 1996; Douglas & Smol, 1999; Lange-Bertalot & Genkal, 1999; Witkowski et al., 2000; Krammer, 2002; Zalat & Servant-Vildary, 2005, 2007; Tanaka, 2007; Levkov, 2009; Hofmann et al., 2011; Houk et al., 2010, 2014; Ector et al., 2015; Lange-Bertalot et al., 2017; Bahls et al., 2018; Ribeiro et al., 2019).

The ecological preferences of the identified diatom taxa are categorised into four distinct pH groups based on the classifications of Ehrlich (1973, 1975). These categories include Acidophilous (pH < 7 to 5.5), Circumneutral (pH around 7), Alkaliphilous (pH over 7 to 8.5), and Alkalibiontic (pH over 8.5). In terms of salinity, the majority of recognised diatom taxa have been classified as oligohalobous (freshwater forms), with a few exceptions that fall into the mesohalobous category (Brackish water forms). The oligohalobous species are further divided into three subcategories based on their salinity preference: halophobous, indifferent, and halophilous (Hustedt, 1953, 1957). These classifications help to provide a better understanding of the ecological niches occupied by various diatom taxa and their adaptability to different environmental conditions.

The organization and presentation of the various taxa presented in the text, as well as throughout the 144 plates of this monograph, have been thoughtfully arranged according to the current diatom classification. This classification is presented in alphabetic order wherever possible, ensuring accessibility and ease of reference for researchers and enthusiasts alike. Furthermore, all taxonomic information has been accurately updated to reflect the most current algae databases (Guiry & Guiry, 2025). To facilitate a more precise and direct visual comparison among taxa of varying sizes, micrographs are presented with a magnification of X 1200, and a scale bar equal to 10 microns, unless otherwise specified.

2. Results

The diatom assemblages from the investigated sediments of the studied lakes and the Eemian paleolake deposits in central Poland were not only abundant but also exceptionally well preserved, allowing for a thorough examination of these taxa. This monograph specifically focuses on the diatom taxa across three notable orders of Pennales: Eunotiales, Achnanthales, and Cymbellales. Our comprehensive investigation, which involved detailed sampling and meticulous analysis, identified an impressive total of 562 diatom species and varieties that belong to 39 distinct genera. The documented diatom assemblages include 93 entries from the order Eunotiales, 139 taxa from Achnanthales, and a substantial 330 taxa from the order Cymbellales. Among these findings, an astounding 203 diatom taxa have been documented as new records for Poland. This includes three newly identified species, 30 novel varieties, and five new combinations of existing taxa. These findings not only expand the known biodiversity of diatoms in Poland but also contribute significantly to our understanding of the ecological and evolutionary dynamics of Polish freshwater ecosystems.

A comprehensive collection of 2,556 high-quality light micrographs of the identified diatoms are presented across 144 precisely arranged plates, all prepared at the same scale. Each plate with a scale bar of 10 microns provided for accurate size comparison. There are a few exceptions where particularly small or exceptionally large diatoms are depicted at a different scale. The plates are systematically organized in alphabetical order by genera for each Order and family. Within each genus, the illustrations of the species are also arranged in alphabetical order, with only a few notable exceptions for certain taxa that may have unique considerations. Each taxon in the text of the plates is accompanied by the author's name, year of publication, and its occurrence.

2.1. Classification of the documented diatoms

Order *Eunotiales* Silva 1962

Family *Eunotiaceae* Kützing 1844

Genus *Eunotia* (92 taxa)

Family *Peroniaceae* (Karsten) Topachevs'kyj & Oksiyuk 1960

Genus *Peronia* (one taxon)

Order *Achnanthales* Silva 1962

Family *Achnanthaceae* Kützing 1844

Genus *Achnanthes*

Family *Achnanthidiaceae* Mann 1990

Genus *Achnanthidium*

Genus *Crenotia*

Genus *Gogorevia*

Genus *Karayevia*

Genus *Kolbesia*

Genus *Planoplatessa*

Genus *Planothidium*

Genus *Platessa*

Genus *Psammothidium*

Genus *Skabitschewskia*

Genus *Eucocconeis*

Genus *Lemnicola*

Family Cocconeidaceae Kützing 1844
Genus *Anorthoneis*
Genus *Cocconeis*

Order *Cymbellales* Mann 1990
Family *Rhoicospheniaceae* Chen & Zhu 1983
Genus *Rhoicosphenia*
Genus *Gomphosphenia*
Family *Anomoeoneidaceae* Mann 1990
Genus *Anomoeoneis*
Genus *Pauliella*
Genus *Staurophora*
Family *Cymbellaceae* Greville 1833
Genus *Brebissonia*
Genus *Cymbella*
Genus *Cymbellafalsa*
Genus *Cymbopleura*
Genus *Encyonema*
Genus *Encyonopsis*
Genus *Gomphocymbellopsis*
Genus *Delicata*
Genus *Kurtkrammeria*
Genus *Paraplaconeis*
Genus *Placoneis*
Genus *Witkowskia*
Family *Gomphonemataceae* Kützing 1844
Genus *Didymosphenia*
Genus *Gomphoneis*
Genus *Gomphonella*
Genus *Gomphonema*
Genus *Reimeria*

New species
Eunotia radomnoensis Zalat nov. sp.
Karayevia jeziorakensis Zalat nov. sp.
Cymbella radomnoensis Zalat nov. sp.

New varieties
Eunotia minor var. *undulata* Zalat nov. var.
Eunotia parallela var. *polinica* Zalat & Pidek nov. var.
Karayevia clevei var. *minor* Zalat nov. var.
Planoplatessa joursacensis var. *elongatum* Zalat nov.var.
Planoplatessa joursacensis var. *ovatum* Zalat nov.var.
Planothidium frequentissimum var. *minutum* Zalat & Nitychoruk nov. var.
Platessa conspicua var. *minuta* Zalat & Welc nov. var.
Cymbella lange-bertalotii var. *lanceolata* Zalat nov. var.
Cymbella neocistula var. *radomnoensis* Zalat nov. var.
Cymbella neoleptoceros var. *rhombica* Zalat & Chodyka nov. var.
Cymbella stigmaphora var. *polonica* Zalat nov. var.

Cymbella subaspera var. *fabianii* Zalat nov. var.
Cymbella subleptoceros var. *rostrata* Zalat nov. var.
Cymbella tumida var. *nitychorukii* Zalat nov. var.
Cymbopleura cuspidata var. *compacta* Zalat nov.var.
Cymbopleura inaequalis var. *ellipticum* Zalat nov. var.
Cymbopleura inaequalis var. *rhomboidea* Zalat & Nitychoruk nov. var.
Cymbopleura lata var. *jeziorakensis* Zalat nov. var.
Cymbopleura subaequalis var. *chodykai* Zalat nov. var.
Paraplaconeis ohridana var. *lanceolatum* Zalat nov. var.
Paraplaconeis ohridana var. *rostrata* Zalat nov. var.
Paraplaconeis placentula var. *cuneatum* Zalat nov. var.
Placoneis elginensis var. *elliptica* Zalat nov. var.
Gomphonema brebissonii var. *cuneata* Zalat nov. var.
Gomphonema brebissonii var. *grosspunctata* Zalat nov. var.
Gomphonema contraturris var. *pideki* Zalat nov. var.
Gomphonema insigniforme var. *elongatum* Zalat nov. var.
Gomphonema laticollum var *truncata* Zalat & Pidek nov. var.
Gomphonema longiceps var. *radomnoensis* Zalat nov. var.
Gomphonema montanum var. *broadness* Zalat nov. var.

New Combinations

Gogorevia exilis var. *angustirostrata* Zalat comb. nov.
Gogorevia exilis var. *constricta* Zalat & Pidek comb. nov.
Eucocconeis quadratarea var. *ninckei* (Guermeur & Manguin) Zalat comb. nov.
Paraplaconeis placentula var. *jenisseyensis* (Bukhtiyarova) Zalat comb. nov.
Gomphonella olivaceoides var. *lanceolata* (Manguin) Zalat comb. nov.

3. Diatom taxonomy

The classification system used in this study is based on the framework proposed by Medlin & Kaczmarska (2004), which was later modified by Medlin (2016). This updated classification integrates both molecular and morphological data to provide a more comprehensive understanding of diatom diversity and relationships. It divides diatoms into two primary subdivisions: Coscinodiscophytina and Bacillariophytina. The first subdivision (Coscinodiscophytina) encompasses the revised class Coscinodiscophyceae, which includes all radial centric diatoms known for their symmetrical, circular valve shapes. The second subdivision (Bacillariophytina) is further divided into the class Mediophyceae and the updated class of Bacillariophyceae. The Mediophyceae includes bipolar centric diatoms and members of the order Thalassiosirales, while the Bacillariophyceae comprises all pennate diatoms that are described by their elongated shapes and distinct bilateral symmetry. This new classification is regarded as a more natural arrangement of diatoms compared to that proposed by Round et al. (1990). This improvement is largely due to its alignment with recent findings from the fossil record, as demonstrated by the work of Sims et al. (2006).

In this comprehensive study, we present a detailed examination of the morphological, ecological characteristics, and distribution data for 562 diatom taxa found in the Eemian paleolake deposits in central Poland and modern Polish ecosystems. For each taxon, data on valve characteristics are compiled from our meticulous measurements and existing literature to ensure accuracy. The terminology employed in the descriptions of the frustule and raphe structure follows the established definitions provided by Ross et al. (1979), Round et al. (1990), Cox (1996) and Krammer & Lange-Bertalot (2000), ensuring clarity and consistency in our descriptions of these intricate structures.

Kingdom: Chromalveolata Adl et al. 2005
Subkingdom: Chromobiota Cavalier-Smith 1991
Phylum: Ochrophyta (Cavalier-Smith 1986) Cavalier-Smith 1995
Subphylum: Diatomeae (Dumortier 1821) Cavalier-Smith 1995
Division: Bacillariophyta Engler & Gilg 1924
Subdivision: Bacillariophytina Medlin & Kaczmarska 2004
Class: Bacillariophyceae Haeckel 1878 emend. Medlin & Kaczmarska 2004
Subclass: Eunotiophyceae Mann 1990

3.1. Order *Eunotiales* Silva 1962

Family *Eunotiaceae* Kützing 1844

Genus *Eunotia* Ehrenberg 1837

Diagnosis: Valves are dorsiventral and asymmetric to the apical axis, typically having an arcuate to crescent shape with rounded to capitate apices. Margins may be smooth or undulate. Raphe is poorly developed, almost appears as shortened slits located at the valve ends and is difficult to resolve in LM. One rimoportula is typically present on each valve. Terminal nodules are commonly conspicuous.

Ecologically, the genus is found in freshwater and is especially abundant in the epiphyton and metaphyton of oligotrophic and acidic waters (Round et al. 1990; Krammer & Lange-Bertalot 1991). The genus is considered an indicator of waters with good ecological quality, as well as oligotrophic and dystrophic waters, including those of springs and peat bogs (Kwandrans 1993; DeNicola 2000). Abundant in waters with low pH and conductivity and restricted to clear water corresponding to these environments.

Holotype species: *Eunotia arcus* Ehrenberg 1837

***Eunotia ambivalens* Lange-Bertalot & Tagliaventi 2011**

(Pl. 1, figs. 1-4)

Ref. Krammer & Lange-Bertalot 1991, p. 180, pl. 137, figs. 13-16; Veselá 2009, p. 23, pl. 16, figs. 1-3; Lange-Bertalot et al. 2011, p. 49, pl. 11, figs. 1-11; pl. 12, figs. 1-6; pl. 13, figs. 1-11; Bahls et al. 2018, p. 77, pl. 40, figs. 8-11; p. 78, pl. 41, figs. 17-18; p. 124, pl. 87, figs. 3-4.

Status of name: accepted taxonomically.

Synonyms: *Eunotia flexuosa* var. *linearis* Okuno 1952

Eunotia curvata var. *linearis* (Okuno) H.Kobayashi, Ando & Nagumo 1981

Eunotia bilunaris var. *linearis* (Okuno) Lange-Bertalot & Nörpel-Schempp 1991

Diagnosis: Valves are linear-elongated to slightly arched with convex dorsal margin, concave ventral margin and rounded apices. Terminal nodules near the apices. Transapical striae are parallel, slightly radiate at the ends, about 10-12 in 10 μm in the middle part of the valve, up to 14-16 in 10 μm near the apices. Rimoportula and areolae are not detectable in LM. Length of the valve 75-190 μm and the breadth 4.2-5.5 μm.

Remarks: The valve outline of *Eunotia ambivalens* is similar to that of *Eunotia bilunaris* (Ehrenberg) Schaarschmidt, but *Eunotia ambivalens* is distinguished by slightly arched valves, almost parallel margins, not protracted apices, lower striae density, and by the presence of marginal spines. *Eunotia bilunaris* has attenuated apices and terminal raphe fissures closest to the valve margin (Lange-Bertalot et al. 2011).

Ecological preference: Acidophilus, mainly occurring at pH<7, fresh brackish form (Van Dam et al. 1994); benthic, oligohalobous-indifferent, acidophilous (Barinova et al. 2023).

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, NW Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), southeastern Poland (Noga et al. 2013d); Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Eunotia arcubus* Nörpel & Lange-Bertalot 1993**

(Pl. 1, figs. 5-7)

Ref. Nörpel & Lange-Bertalot 1993, p. 24, pl. 16, figs. 1-6; pl. 19, figs. 1-10; pl. 20, figs. 1-6; pl. 21, figs. 1-11; Bąk et al. 2012, p. 127, pl. 12; Delgado et al. 2013, p. 96, figs. 69-72; Pavlov & Levkov 2013, p. 7, pl. 32 figs. 1-13; pl. 33, figs. 1-7; pl. 40, figs 5, 6; Bahls et al. 2018, p. 95, pl. 58, figs. 7-13; p. 150, pl. 113, figs. 13-16.

Status of name: accepted taxonomically.

Diagnosis: Valves weakly curved with a convex dorsal margin and a weakly concave ventral margin. Apices are protracted, subcapitate, vary from rounded-truncate to rectangularly-truncate, separated from the valve body, and curved towards the dorsal margin. Apical terminal nodules are conspicuous. Transapical striae are parallel, somewhat wider and evenly spaced in the central part of the valve and irregularly spaced, slightly converging at the ends, about 8-10 in 10 μm at the valve centre up to 10-14 near the apices. Length of the valve 25-90 μm, and the breadth 4-9 μm.

Remarks: *Eunotia arcubus* is quite similar to *Eunotia arcus*, but the valves are more arched, striae density is lower, and striae on the dorsal valve margin are shorter (Lange-Bertalot et al. 2011).

Ecological preference: According to Van Dam et al. (1994), this taxon is an aquatic to aerophilic, sensitive N-autotrophic, neutrophilic, halophobous, oligosaprobous and oligo-mesotrophic species. The species inhabit alkaline waters (Lange-Bertalot et al. 2011); it prefers low light and very low flow conditions (Cantonati et al. 2017); found in circumneutral, fresh, oligo-mesotrophic (Malinowska-Gniewosz et al. 2018); Occurring in carbonate-rich, oligo- to mesotrophic lakes and springs (Mašić & Barudanović 2020).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland; Młynek, Jeziorak and Zielone Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011). Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013d); The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); the Magura National Park in the mountainous landscape of the Low Beskids, south Poland (Poradowska 2020).

***Eunotia arcubus* var. *bidens* (Grunow) Lange-Bertalot 2011**

Ref: Hustedt 1930, p. 175, fig. 217; Hustedt 1959, p. 284, fig. 748 d; Patrick & Reimer 1966, p. 213. pl. 13, fig. 12; Krammer & Lange-Bertalot 1991 a, p. 185. pl. 147, fig. 18; Joh 2011, p. 18, figs. 4-5; Lange-Bertalot et al. 2011, p. 55, pl. 187, figs. 3, 9, 10, 15, 16; Pavlov & Levkov 2013, p. 8, pl. 38 fig. 3; pl. 39, figs. 19-25; pl. 40 , figs. 3, 4; pl. 41, figs 1-4.

Status of name: accepted taxonomically.

Synonyms: *Eunotia arcus* var. *bidens* Grunow 1881

Eunotia arcus f. *bidens* (Grunow) Hustedt 1957

Diagnosis: Valves are dorsiventral, weakly arched. Ventral margin is more or less straight to slightly concave, and two distinct shoulders or weak undulations towards the apices of the ventral margin. Two swellings or undulations are fairly prominent on the dorsal margin and are more clear at smaller sizes. Apices are broadly rounded to truncate. Terminal nodules and the distal raphe endings are close to the apices. Transapical striae are parallel at the valve centre, radiate towards the ends, about 8-10 in 10 μm at the valve centre up to 14 in 10 μm near the apices. Length of the valve 20-90 μm and the breadth 3-8 μm.

Remarks: The main difference between this variety and the nominate variety is the two undulations on the dorsal margin.

Ecological preference: Halobien-indifferent, pH-indifferent, cosmopolitan (Foged 1959); slightly acid or circumneutral water of low conductivity (Patrick & Reimer 1966); pH-indifferent, acidophilous (Kaczmarska 1976); found in oligotrophic and dystrophic waters of North and Middle Europe (Krammer & Lange-Bertalot 1991a).

Occurrence: Infrequent in Radomno and Jeziorak Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Eunotia arculus* Lange-Bertalot & Nörpel 1993**

Ref: Krammer & Lange-Bertalot 1991a, p. 213, pl. 157, figs. 4-12; Lange-Bertalot & Nörpel 1993, p. 26, pl. 157, figs. 4-12; Bąk et al. 2012, p. 127, pl. 12; Bahls et al. 2018, p. 60, pl. 23, fig. 32; p. 115, pl. 78, figs. 10-13.

Status of name: accepted taxonomically.

Synonym: *Eunotia paludosa* var. *arculus* Grunow 1880

Diagnosis: Frustules are narrowly rectangular in girdle view. Valves are weakly arched with a markedly convex dorsal margin, weakly concave, and somewhat relatively straight ventral margin. Ventral margins are straight in smaller specimens and moderately concave in mid-size to large specimens. Valve apices are capitate, rounded and dorsally reflexed. Helictoglossae are located close to the apices. Transapical striae are parallel in the middle part of the valve, slightly radiate towards the apices, about 15-17 in 10 μm. Length of the valve 22-50 μm, and the breadth 3-4 μm.

Ecological preference: Acidophilous, freshwater, oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); acidophilous preferring the pH < 7 (Szulc & Szulc 2012).

Occurrence: Infrequent in Kamionka and Młynek Lakes.

Distribution in Poland: Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012).

***Eunotia arcus* Ehrenberg 1837**

(Pl. 1, figs. 8-9)

Ref. Hustedt 1930, p. 175, fig. 216; Hustedt 1959, p. 282, fig. 748 a; Patrick & Reimer 1966, p. 212, pl. 13, fig. 11; Germain 1981, p. 90, pl. 31, fig. 27; Krammer & Lange-Bertalot 1991 a, p. 184, pl. 147, fig.1; Lange-Bertalot 1993, p. 26. pl. 16, fig. 7; Hartley et al. 1996, p. 204, pl. 94, figs. 2, 3; Lange-Bertalot & Metzeltin 1996, p. 142, pl. 12, figs. 14.-17; Metzeltin & Witkowski 1996, p. 98, pl. 33, figs. 13, 15; Krammer & Lange-Bertalot 2004, p. 184, pl. 147, figs. 1-17; Bąk et al. 2012, p. 128, pl. 12; Pavlov & Levkov 2013, p. 9, pl. 34, figs. 1-28; pl. 35, figs. 1-7; pl. 38, figs. 1, 4-6; pl. 41 figs. 5, 6; Bahls et al. 2018, p. 39, pl. 2, fig. 15; p. 94, pl. 57, figs. 10, 11; p. 115, pl. 78, figs. 6-9; p. 150, pl. 113, figs. 9-12.

Status of name: accepted taxonomically.

Synonyms: *Himantidium arcus* (Ehrenberg) Ehrenberg 1840

Eunotia arcus Meister 1912

Diagnosis: Valve is slightly arched, the ventral margin is slightly concave, parallel with the convex dorsal margin, or straight in the middle of the valve, producing a swollen appearance. Dorsal margin is strongly bent back at apices, causing the apices to be sharply cut off from the main body of the valve and producing rounded

or truncate capitate, strongly reflexed apices. In small forms, the apices are formed by a narrowing of the valve, giving a rostrate appearance. Terminal nodules are large and occur at the end of the ventral margin. Transapical striae are not equidistant, about 12-14 in 10 μm. Length of the valve 25-90 μm, and the breadth 4-9 μm.

Remarks: *Eunotia arcus* has distinct capitate apices that have an angular appearance. This taxon resembles the apices of *Eunotia exigua* and its complex, while the valve of *Eunotia arcus* is longer and more slender than that of *Eunotia exigua.*

Ecological preference: The species grows in the presence of calcium, it is a calciphobes, in acid to circumneutral water (Patrick & Reimer 1966). It is generally abundant in lime-rich waters with low to high conductivity, circumneutral to slightly acidic waters (Hustedt 1959; Lange-Bertalot 1993); common in sulfur-fumigated and high acidic ponds from pH 2.8 to 3.6 in tundra regions (Sheath et al. 1982); an aquatic to aerophilic, sensitive N-autotrophic, neutrophilic, halophobous, oligosaprobous and oligo-mesotrophic (Van Dam et al. 1994); abundant in a pH between 2.8 and 3.5 (De Nicola 2000); oligotrophic to slightly mesotrophic waters, even at a moderately high electrolyte content, often associated with mosses (Krammer & Lange- Bertalot 2004); circumneutral mainly occuring at pH about 7 (Szulc & Szulc, 2012); abundant in undisturbed oligo- to dystrophic habitats (Cantonati et al. 2017); benthic, temperate, standing and streaming water, oligohalobous-indifferent, acidophilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Recorded frequently in Radomno, Zielone, Jeziorak and Młynek lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019)**;** the Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia arcus* var. *fallax* Hustedt 1930**

(Pl. 1, figs. 10-16)

Ref. Hustedt 1930, p. 175, fig. 219; Hustedt 1959, p. 284, fig. 748 f, g; Patrick & Reimer 1966, p. 213, pl. 13, fig. 14.

Status of name: accepted taxonomically.

Diagnosis: Valve with slightly concave ventral margin and distinctly convex dorsal margin. Apices of the valve are capitate, somewhat reflexed. Terminal nodules are large and located on the ventral margin at the apices. Transapical striae are coarse, parallel at the valve centre, slightly radiate towards the ends, about 8-10 in 10 μm. Length of the valve 25-40 μm, and the breadth 6-7 μm.

Ecological preference: It prefers acid water of low nutrient content (Patrick & Reimer 1966); pH indifferent, aerophilous (Kaczmarska 1976); reported from the benthic habitats of slightly acidic to slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Zielone Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Eunotia arcus* var. *uncinata* (Ehrenberg) Grunow 1881**

(Pl. 1, figs. 17-25)

Ref. Hustedt 1930, p. 175, fig. 218; Patrick & Reimer 1966, p. 213, pl. 13, fig. 12.

Status of name: accepted taxonomically.

Synonym: *Eunotia uncinata* Ehrenberg 1843

Diagnosis: valve is arcuate, in all respects like the type, but differs in that the valve is more arched and the length-to-breadth ratio is a little greater. Terminal nodules are sited on the ventral margin, a short distance from the apices. Transapical striae are usually 10-12 in 10 μm at the valve centre, sometimes finer at the ends.

Ecological preference: Fresh, slightly acidic water of low conductivity (Patrick & Reimer 1966), it is recorded as associated with the type species; reported from the benthic habitats of slightly acidic to slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno, Zielone, Jeziorak and Młynek lakes.

Distribution in Poland: New record.

***Eunotia bidens* Ehrenberg 1843**

(Pl. 2, fig. 1)

Ref. Patrick & Reimer 1966, p. 194, pl. 10, fig. 13; Krammer & Lange-Bertalot 1991 a, p. 187, pl. 148, figs. 11-12; Hartley et al. 1996, p. 212, pl. 98, fig. 7; Lange-Bertalot 1996, p. 142, pl. 12, figs. 4-5; Lange-Bertalot & Metzeltin 1996, p. 45, pl. 12, figs. 4-5; Veselá 2009, p. 20, figs. 12-14; Bąk et al. 2012, p. 128, pl. 13; Costa 2015, p. 43, pl. 64, figs. 5-9; Bahls et al. 2018, p. 76, pl. 39, figs. 12-14; p. 148, pl. 111, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Himantidium bidens* (Ehrenberg) Kützing 1844
Eunotia praerupta var. *bidens* (Ehrenberg) Grunow 1880
Eunotia praerupta f. *minor* Grunow 1881
Eunotia praerupta-bidens f. *compressa* A.Berg 1939

Diagnosis: Valves are weakly arcuate with a slightly concave ventral margin, somewhat with two weak undulations and a convex dorsal margin that has two fairly prominent undulations, sometimes slightly concave at the truncated ends. The apices vary from rounded-truncate to rectangularly-truncate, protracted capitate, separated from the valve body, and reflexed dorsally. Terminal raphe fissures are quite short, ending near the ventral valve margin. Apical terminal nodules are distinct, extending upwards along the apices. Transapical striae are parallel, somewhat irregularly spaced at the valve centre and slightly converge at the ends, about 8-12 striae in 10 μm. Length of the valve 28-94 μm and the breadth 6-15 μm.

Remarks: The species can easily be recognised by two weak undulations of the dorsal margin and characteristic truncate-rostrate to capitate ends. The apices of the valve are variable from rounded to rectangular and truncate.

Ecological preference: The specie prefers acid to circumneutral water of low mineral content (Patrick & Reimer 1966); it presents periphytic life form (Denys 1991); freshwater, acidophilic, continuously high oxygen requirements, oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994) and low electric conductance (Lange-Bertalot et al. 2011); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); slightly acidic to alkaline (pH 6.2-7.6), low electric conductance (40-156 μS cm^{-1}) and meso- to eutrophic waters with total phosphorus 23.5-82.5 μg L-1 (Costa 2015); benthic, aerophiles, cool water, standing and streaming water, oligohalobes-halophobous, acidophilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Infrequent in Radomno and Jeziorak Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015).

***Eunotia bigibba* Kützing 1849**

(Pl. 2, figs. 2-3)

Ref. Hustedt 1930, p. 175, fig. 214; Hustedt 1959, p. 282, fig. 747 B; Schoeman 1973, p. 74, fig. 3: 50; Krammer & Lange-Bertalot 1991 a, p. 188, pl. 150, figs. 1-7; Hartley et al. 1996, p. 204, pl. 94, figs. 6, 7; Lange-Bertalot et al. 2011, p. 224, pl. 83, figs. 16, 17; pl. 95, figs. 1-28; pl. 96, figs. 1-6.

Status of name: accepted taxonomically.

Synonyms: *Eunotia praerupta* var. *bigibba* (Kützing) Grunow 1881
Eunotia curta var. *bigibba* (Kützing) Fontell 1917
Eunotia sarek f. *bigibba* (Kützing) A.Berg 1939
Eunotia sarekensis var. *bigibba* (Kützing) Cleve-Euler 1953
Eunotia praerupta f. *biggiba* Krammer & Lange-Bertalot 1991
Eunotia subherkiniensis Lange-Bertalot 2011

Diagnosis: Valves are dorsiventral with moderately concave to almost straight ventral margins. The dorsal margin is convex, strongly to slightly bi-gibbous and bi-undulate in medium-sized to larger valves and weakly bi-

undulate to straight in smaller valves. The apices are more or less protracted obliquely capitate and dorsally reflexed in medium-sized to larger valves and truncate in smaller valves. Helictoglossae are located somewhat distant from the apices. The distal raphe endings are curved onto the valve face and are visible in the LM. One apical rimoportula is present just dorsal to the centre of the apex. Transapical striae are radiate throughout, about 12-15 in 10 μm, little denser spaced at the ends than in the middle of the valve. Length of the valve 10-30 μm, and the breadth 5-8 μm.

Remarks: This species is recorded in some literature as *Eunotia subherkiniensis* Lange-Bertalot 2011 and *Eunotia praerupta* var. *bigibba* (Kützing) Grunow 1881.

Ecological preference: freshwater, acidophilic, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994).

Occurrence: Infrequent in Młynek Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid, Western Carpathians, the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts, south Poland (Kwandrans, 1993).

***Eunotia bilunaris* (Ehrenberg) Schaarschmidt 1880**

(Pl. 2, figs. 4-8)

Ref. Patrick & Reimer 1966, p. 189, pl. 10, figs .4, 5; Germain 1981, p. 94, pl. 32, figs. 7-10; Thomas 1983, p. 35, pl. 3, fig. 4; Holland & Clark 1989, p. 15, pl. 8, fig. 4; Krammer & Lange-Bertalot 1991 a, p. 180, pls. 137, 139, figs. 1-4; Lange-Bertalot & Metzeltin 1996, p. 136, pl. 9, figs. 1-4; Metzeltin & Witkowski 1996, p. 98, pl.33, fig. 14; Bąk et al. 2012, p. 128, pl. 17; Pavlov & Levkov 2013, p. 13, pl. 3, figs. 1-21; pl. 4, figs. 1-26; pl. 5, figs. 1-4; Bahls et al. 2018, p. 39, pl. 2, fig. 14; p. 59, pl. 22, fig. 9; p. 125, pl. 88, figs. 1-4; Costa 2015, p. 44, pl. 10, figs. 1-7; pl. 12, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Synedra bilunaris* Ehrenberg 1832
Exilaria lunaria Jenner 1845
Synedra lunaris var. *bilunaris* Brun 1880
Synedra ulna var. *bilunaris* (Ehrenberg; Ehrenberg) Brun 1880
Eunotia lunaris var. *excisa* Grunow 1881
Eunotia lunaris var. *bilunaris* (Ehrenberg) Grunow 1885
Pseudo-eunotia lunaris var. *bilunaris* (Ehrenberg) De Toni 1892

Diagnosis: Valve is slender, strongly to moderately arched, lunate or arcuate, usually gradually narrowing towards the ends, with a strongly concave ventral margin, which is parallel to the dorsal margin. Valve apices are broadly to acutely rounded, slightly rostrate, occasionally swollen or with a slight dorsal indentation. Terminal nodules are sited near the apices. Distal raphe endings are strongly curved onto the valve face. One rimoportula is present near the apex. Transapical striae are parallel, evenly spaced in the centre, denser near the apices, about 13–16 in 10 μm in the valve centre. Length of the valve 28-120 μm, and the breadth 3-5.5 μm.

Remarks: According to Lange-Bertalot et al. (2011), the species have a heterogeneous concept and a confusing taxonomy due to their wide morphological variability, mostly related to shape and dimensions. It is characterized by its lunate appearance, the small terminal nodules, and often produces abnormal forms which have the margins indented in various ways.

Ecological preference: *Eunotia bilunaris* is a circumneutral and slightly acidophilous species. It is widely distributed in water of low mineral content, commonly found in acidic water, but may also occur in neutral to slightly alkaline water. The species recorded from fresh acidic waters, but may occur in slightly alkaline waters (Patrick & Reimer 1966); in pH values which are almost equally developed in pH 4.0-4.3, and around pH 7 (Alles et al. 1991); Halobein indifferent, acidophilous, fresh-brackish, fairly high oxygen requirements, β-mesosaprobic, hyper-eutraphentic (Van Dam et al. 1994); Its maximum abundance in water with pH: 5.9-6.7, conductivity 28.7-46 μS/cm (Ortíz-Lerín & Cambra 2007); common in the epilithon on stones (Furey 2008); it was found in greatest relative abundance in naturally acidic and moderately impacted streams (Schowe 2012); Freshwater with pH had an alkaline character or close to circumneutral reaction (6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a); Dystrophic, humic water, acidophilous

pH (4.8-6), low specific conductivity (15.2-51.6 µS/cm) and low concentrations of most ions (Grabowska et al. 2014); Benthic, oligohalobous indifferent, acidophilous, mesotraphenthic-oligotraphenthic, β-mesosaprobous (Witak & Jankowska 2014); in periphytic assemblages from low conductivity (optimum of 90 µS cm^{-1})), slightly acidic (pH optimum of 6.6) and mesotrophic waters (total phosphorus optimum of 37.2 µg L-1 and total nitrogen optimum of 818.9 µg L-1) (Costa 2015); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska, 2015); it is reported from the water of ponds, circumneutral to slightly alkaline pH (6.7-7.9). Conductivity ranged between 412 and 892 µS cm-1 (Pociecha et al. 2020); benthic, temperate, standing and streaming water, oligohalobous–indifferent, acidophilous (Barinova et al. 2023).

Occurrence: Common in Radomno, Kamionka, Młynek and Zielone Lakes, and frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range (in the Sudetic Mts), south Poland (Kwandrans 1993); Lake Kąpielowe and Lake Żółwia Błoć in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); forest dystrophic Lake Sęczek located in the Masurian Lake District, north-east Poland (Grabowska et al. 2014); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Gołębiówka, Szuwarka, Różanka, Morwawa, Baryczka, Stobnica, Mleczka, Strug, Ryjak, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village, south-east Poland (Szczepocka & Rakowska 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Mining lake, on the Łuk Mużakowa, theWzniesienia Łużyckie macroregion west Poland (Sienkiewicz & Gąsiorowski 2016); Epiphytic mosses overgrowing the bark of white poplar tree trunk in the northern part of the Stalowa Wola city, south-east Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Eunotia boreotenuis* Nörpel-Schempp & Lange-Bertalot 1996**

Ref. Lange-Bertalot & Metzeltin 1996, p. 46, pl. 9, figs. 21-23; Grabowska et al. 2014, p. 342, figs. 3 f-g.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately arched with a moderate to weakly concave ventral margin and broadly convex dorsal margin. Apices are subprotracted, attenuated to acutely rounded. The distal raphe endings are curved onto the valve face. Helictoglossae is positioned somewhat distant from the apices. Transapical striae are parallel in the middle of the valve, slightly radiate near the apices, about 15-18 in 10 µm. Length of the valve 20-40 µm, and the breadth 3.5-4 µm.

Ecological preference: Dystrophic, humic water, acidophilous pH (4.8-6), low specific conductivity (15.2-51.6 µS/cm) and low concentrations of most ions (Grabowska et al. 2014); benthic, oligohalobous-halophobous, acidophilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Frequently distributed in the Francuskie and Zielone Lakes.

Distribution in Poland: commonly occurring in small forest dystrophic Lake Sęczek located in the Masurian Lake District, north-east Poland (Grabowska et al. 2014)

***Eunotia botuliformis* Wild, Nörpel & Lange-Bertalot 1993**

(Pl. 3, figs. 1-18)

Ref. Lange-Bertalot 1993, p. 29, pl. 33, figs. 2-15; Lange-Bertalot & Metzeltin 1996, p. 152, pl. 17, figs. 39-42; Lange-Bertalot & Genkal 1999, p. 120, pl. 6, figs. 1, 2; Werum & Lange-Bertalot 2004, p. 196, pl.5,

figs. 13-15; Liu et al. 2011, p. 209, figs. 7-8; Bąk et al. 2012, p. 129, pl. 18; Bahls et al. 2018, p. 39, pl. 2, fig. 16; p. 60, pl. 23, figs. 39-41; p. 125, pl. 88, figs. 17-22; p. 149, pl. 112, figs. 14-16.

Status of name: accepted taxonomically.

Diagnosis: Valve is club-shaped, slightly dorsiventral, isopolar; dorsal margin is convex, ventral margin is slightly concave. The apices are simply rounded or slightly capitate or reflexed towards the dorsal margins, not protracted. Raphe is weakly developed, and the distal raphe endings are not reflexed or recurved. Terminal nodules are distinct and close to the terminal ends. Transapical striae are parallel, equidistant, about 16-18 in 10 μm. Length of the valve 15-40 μm, and the breadth 3.5-4 μm.

Ecological preference: *Eunotia botuliformis* has been found in relatively low conductivity waters and prefers slightly to highly acidic and oligotrophic waters (Joh 2011). It is recorded from water's pH was characterized by an alkaline character or close to neutral (6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, and temperature 3.0-17.5 (Noga et al. 2013 b); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); benthic, oligohalobous-halophobous, acidophilous, oligotraphentic (Barinova et al. 2023); reported from the benthic habitats of neutral to slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al., 2013 b); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Eunotia cantonatii* Lange-Bertalot & Tagliaventi 2011**

(Pl. 2, figs. 9-11)

Ref. Lange-Bertalot et al. 2011, p. 72, pl. 28, figs. 1-17; pl. 29, figs. 1-10; Pavlov & Levkov 2013, p. 17, pl. 1, figs. 1-13; pl. 2, figs. 1-6.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly curved, clearly dorsiventral, with a strongly convex dorsal margin and strongly concave ventral margin. Valve margins are consistently parallel. Apices are slightly protracted and acutely rounded. Distal raphe fissures are short, curved towards the valve centre, close to the dorsal valve margin in shorter valves, and near the mid-point of apices in longer valves, and interrupt the striae at valve apices. Terminal nodules are fairly small, positioned slightly distant from the valve apices. Narrow hyaline area surrounding the raphe slits on the ventral valve mantle. Transapical striae are parallel, evenly spaced throughout, about 10-14 in 10 μm in mid-valve and slightly denser at valve apices, about 12-16 in 10 μm. Areolae are densely spaced within a stria, not clearly discernible in LM view. Length of the valve 50-100 μm, and the breadth 4-6 μm.

Ecological preference: This taxon was reported as epiphytic on the moss vegetation of a peat bog and as epilithic in a river (Pavlov & Levkov 2013); reported from the benthic habitats of slightly acidic to slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno, Młynek and Zielone Lakes.

Distribution in Poland: New record.

***Eunotia curtagrunowii* Nörpel-Schempp & Lange-Bertalot 1996**

(Pl. 2, figs. 12-13)

Ref. Lange-Bertalot & Metzeltin 1996, p. 48, pl. 12, figs. 6-11; Veselá 2009, p. 26, pl. 3, figs. 3-7; Pavlov & Levkov 2013, p. 20, pl. 28, figs. 1-17; pl. 29, figs. 1-4; Bahls et al. 2018, p. 115, pl. 78, figs. 1-5; p. 119, pl. 82, fig. 9; p. 149, pl. 112, fig. 13.

Status of name: accepted taxonomically.

Synonyms: *Eunotia praerupta* var. *curta* Grunow 1881
Eunotia praerupta f. *curta* (Grunow) A. Cleve 1895
Eunotia praerupta var. *musicola* Petersen 1928

Eunotia praerupta-bidens f. *musicola* (Petersen) Å.Berg 1939
Eunotia praerupta-monos var. *curta* (Grunow) A.Cleve 1948
Eunotia praemonos var. *curta* (Grunow) A.Cleve 1953
Eunotia praemonos var. *musicola* (Petersen) Cleve-Euler 1953

Diagnosis: Valves dorsiventral, arcuate, with more convex dorsal and weakly concave ventral margins at the centre, more or less straight at the ends of the valve. Valve apices are broadly protracted, more rostrate to broadly rounded, not reflexed dorsally and somewhat truncate-capitate. Terminal nodules are distinct at the ends, extending upward along the apices. Raphe is short filiform slits on the ventral valve mantle; the distal raphe endings terminate by small round pores at the apices. Transapical striae are distant, finely punctate, evenly spaced, parallel at the centre, slightly radiate towards the ends, about 10-12 in 10 μm. Puncta: 29-32 in 10 μm. Length of the valve 15-40 μm, and the breadth 6-8 μm.

Remarks: This taxon is relatively similar to *E. praerupta* var. *musicola* Petersen, but differs in that the apices are not reflexed dorsally.

Ecological preference: Circumneutral water reactions (pH around 7); epipelic and epiphytic on the moss vegetation (Pavlov & Levkov 2013); low conductivity of about 100 μS/cm (Noga et al. 2014a); it is reported from the acidic water (Stanek-Tarkowska et al. 2015); Planktonic/benthic, oligohalobous-halophobous, acidophilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Frequent in Młynek and Zielone Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); San (near Jarosław) and Morwawa streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015).

***Eunotia curtiraphe* Metzeltin & Lange-Bertalot 2007**

(Pl. 2, figs. 14-16)

Ref. Metzeltin & Lange-Bertalot 2007, p. 90, pl. 50, figs. 1-6; pl. 51, figs. 1-7.

Status of name: accepted taxonomically.

Diagnosis: Valves moderately dorsiventral, with weakly convex dorsal and weakly concave ventral margins which are parallel throughout. Valve apices are barely set off or inflated, mostly broadly rounded, not reflexed. Terminal nodules are distinct at the ends, extending upward along the apices. Raphe is short filiform slits on the ventral valve mantle; the distal raphe endings are not visible in the valve face. Transapical striae are punctate, evenly spaced, distant, parallel at the centre, slightly radiate towards the ends, about 10-12 in 10 μm, interrupted by the fine line-like ventral side. Puncta: 22-24 in 10 μm. Length of the valve 65-140 μm, and the breadth 9-10 μm.

Ecological preference: reported from the benthic habitats of neutral to slightly alkaline, mesotrophic freshwater environments.

Occurrence: Common in Młynek and Radomno Lakes.

Distribution in Poland: New record.

***Eunotia denticulata* (Brébisson ex Kützing) Rabenhorst 1864**

(Pl. 2, fig. 17)

Ref. Krammer & Lange-Bertalot 1991a, p. 206, pl. 157, figs. 19-28; Hartley et al. 1996, p. 204, pl. 94, figs. 10-11; Lange-Bertalot 1996, p. 154, pl. 18, figs. 10-11; Tremarin et al. 2008, p. 850, fig. 13; Bahls et al. 2018, p. 120, pl. 83, figs. 22-24.

Status of name: accepted taxonomically.

Synonyms: *Himantidium denticulatum* Brébisson ex Kützing 1849
Eunotia denticulata var. *genuina* Cleve-Euler 1953

Diagnosis: Valves are arcuate with slightly convex dorsal and slightly concave ventral margins. Spines are distinctly visible on the dorsal margin in LM. Apices are protracted, broadly rounded, subcapitate to capitate. The

distal raphe endings are short, straight, and terminate below the apices. Ventrally, raphe fissures are relatively long, clearly curved away from the valve margin. Transapical striae are more or less parallel, equidistant throughout the valve, slightly radiate at the apices, about 13-18 in 10 μm. Length of the valve 35-65 μm, and the breadth 5-7 μm.

Ecological preference: freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligotrophic (Van Dam et al. 1994); freshwater of acidic character (pH 5.4-6.5), low electrolytic conductivity ranged from 130 to 136 μS cm-1, temperature 15-17.1°C, dissolved oxygen 4.2 to 5.4 mg/l^{-1} (Sienkiewicz & Gąsiorowski 2016); reported from the benthic habitats of slightly acidic to alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Zielone and Kamionka Lakes.

Distribution in Poland: Mining lake, on the Łuk Mużakowa, the Wzniesienia Łużyckie macroregion west Poland (Sienkiewicz & Gąsiorowski 2016); reported from the sediments of postmining Lake ŁK-46 in the Łuk Mużakowa, south-west Poland (Sienkiewicz et al. 2023).

***Eunotia diadema* Ehrenberg 1837**

(Pl. 2, figs. 18-19)

Ref. Patrick & Reimer 1966, p. 201, pl. 12, fig. 3; Krammer & Lange-Bertalot 1991 a, p. 219, pl. 146, figs. 3-4; Hartley et al. 1996, p. 214, pl. 99, fig. 7; Metzeltin & Witkowski 1996, p. 98, pl. 33, fig. 12;Veselá 2009, p. 26, pl. 1, figs. 5, 6; Bąk et al. 2012, p. 129, pl. 15; Costa 2015, p. 47, pl. 94, figs. 1-8; pl. 95, figs. 1-4; Bahls et al. 2018, p. 58, pl. 21, fig. 1; p. 121, pl. 84, fig. 1.

Status of name: accepted taxonomically.

Synonyms: *Eunotia robusta* var. *diadema* (Ehrenberg) Carruthers 1864
Eunotia diadema var. *genuina* Cleve-Euler 1953
Eunotia serra var. *diadema* (Ehrenberg) R.M.Patrick 1958

Diagnosis: Valves are highly arched. The dorsal margin is strongly convex with six blunt undulations, and the ventral margin is concave and follows the same curvature as the dorsal margin. The apices are protracted, obtusely rounded. Distal raphe endings lie along the valve face very close and parallel to each end. Terminal nodules are distinct. Transapical striae are distinctly punctate, radiate throughout the valve, somewhat include many short striae on the dorsal margin, about 12-15 striae in 10 μm, and puncta 22-25 in 10 μm. A fine transparent line runs close and parallel to the ventral margin. Striae on either side of this line may be continuous or displaced. Length of the valve 36-73 μm, and the breadth 14-15 μm in the centre, 17.5-18 μm at the widest point.

Ecological preference: The species occurs in oligotrophic or dystrophic swamps and bogs (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligotrophic (Van Dam et al. 1994); acidophilous (Lange-Bertalot et al. 2011). It reached its highest abundance in an oligotrophic reservoir (total phosphorus 13.7 μg L-1), although also occurring in mesotrophic environments (total phosphorus 21-37.5 μg L-1) (Costa 2015).

Occurrence: Recorded frequently in Młynek Lake.

Distribution in Poland: Poland (Bąk et al. 2012)

***Eunotia diodon* Ehrenberg 1837**

Ref. Hustedt 1930, p. 173, fig. 207; Hustedt 1959, p. 276, fig. 742; Patrick & Reimer 1966, p. 204, pl. 12, fig. 7; Germain 1981, p. 86, pl. 29, fig. 4; Krammer & Lange-Bertalot 1991 a, p. 191, pl. 149, figs. 8-19; Hartley et al. 1996, p. 204, pl. 94, fig. 12; Lange-Bertalot & Metzeltin 1996, p. 148, pl. 15, figs. 1-2; Bahls et al. 2018, p. 122, pl. 85, figs. 1, 2; p. 148, pl. 111, fig. 20.

Status of name: accepted taxonomically.

Synonym: *Eunotia diodon* f. *minor* Grunow 1881

Diagnosis: Valves are arched, with a slightly concave ventral margin, and strongly convex dorsal margin beside double undulations and presence of spines. Valve is abruptly narrowed at the ends to form rostrate, subcapitate, broadly rounded apices. Large terminal nodules are sited on the ventral margin close to the apices. Transapical striae are parallel throughout the valve, about 10-12 in 10 μm at the centre up to 14-16 in 10 μm at the ends. Length of the valve 10-80 μm, and the breadth 5-15 μm.

Ecological preference: The species is an acidophilous preferring cool water (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligotrophic (Van Dam et al. 1994); pH circumneutral, electrolytic conductivity ranged from 100 µS/cm to 528 µS/cm, temperature 3.0-17.5 (Noga et al. 2013 b).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: Baryczka stream left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia eurycephaloides* Nörpel-Schempp & Lange-Bertalot 1996**

(Pl. 4, fig. 1)

Ref. Lange-Bertalot & Metzeltin 1996, p. 48, pl. 9, figs. 18-20; pl. 112, figs. 2, 3.

Status of name: accepted taxonomically.

Diagnosis: are elongate, sublinear to slightly arcuate and narrowing gradually from the centre to the ends. Apices are distinctly dorsally inflated and broadly rounded. Raphe is sited on the valve mantle and curves back on the valve face, centred concerning the main axis of the valve. The distal raphe end is visible on the external portion of the valve. Transapical striae are finely punctate and parallel throughout the valve, about 15-17 in 10 µm in the middle portion of the valve, denser at the apices, about 18-19 in 10 µm. Puncta about 35-40 in 10 µm. Length of the valve 110-150 µm and the breadth 3.5- 4.0 µm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequently in Młynek Lake.

Distribution in Poland: New record.

***Eunotia exigua* (Brébisson ex Kützing) Rabenhorst 1864**

(Pl. 4, figs. 2-4)

Ref. Hustedt 1930, p. 176, fig. 223; Hustedt 1959, p. 285, fig. 751: a-r; Patrick & Reimer 1966, p. 215, pl. 13, figs. 17-18; Krammer & Lange-Bertalot 1991 a, p. 199, pl. 153, figs. 5-43; Hartley et al. 1996, p. 204, pl. 94, fig. 14; pl. 95, fig. 1; Veselá 2009, p. 28, pl. 30, figs. 12-72; Pavlov & Levkov 2013, p. 21, pl. 61, figs. 67-76; Bąk et al. 2012, p. 130, pl. 16; Noga et al. 2013, p. 139, fig. 3: 9; Bahls et al. 2018, p. 149, pl. 112, fig. 24; Juttner et al. 2018, p. 433, figs. 130-137, 76, 77.

Status of name: accepted taxonomically.

Synonyms: *Himantidium exiguum* Brébisson ex Kützing 1849
Eunotia gracilis W.Smith 1853
Eunotia minuta Hilse 1861
Eunotia monodon var. *minuta* (Hilse) Rabenhorst 1864
Eunotia exigua var. *minuta* (Hilse) Ant.Mayer 1913

Diagnosis: Valve is dorsiventral, arcuate, with a more concave ventral margin and strongly convex dorsal margin. The margins are almost parallel, broadened toward the centre and narrow gradually toward the ends. The apices of the valve are broadly rounded, capitate, more or less truncate or reflexed towards the dorsal margin. Terminal raphe fissures are short, positioned very close to the apices. Terminal nodules are located on the ventral margin at the apices. Transapical striae are parallel throughout the valve, slightly radiate towards the apices, about 18-22 in 10 µm. Length of the valve 13- 25 µm, and the breadth 3-4 µm

Remarks: This species is similar in morphology to *Eunotia meisteri* Hustedt, *Eunotia nymanniana* Grunow, *Eunotia steineckei* Petersen and *Eunotia fallax* A. Cleve (Alles et al. 1991). Both sides of the valve of *E. exigua* and *E. meisteri*are are almost parallel; however, the latter has a more curved dorsal margin than the former. This species differs from *E. nymanniana* and *E. fallax* in the form of a more arcuate valve and a shorter ratio of the valve length and breadth. *Eunotia exigua* is distinguished by its capitate, dorsally deflected apices

Ecological preference: *Eunotia exigua* is widespread in various freshwaters. Often found associated with mosses in acid water of low mineral content (Patrick & Reimer 1966); abundant in both oligotrophic and eutrophic environments. The species is resistant to pollution with acids, aluminium and other heavy metals, which is frequently found in acidmine drainage (Hargreaves et al. 1975); a cosmopolitan species and acidophilic diatom, it is strongly bound to acidic habitats of pools, lakes, bogs and streams of lowlands and mountains (Van Dam et al. 1981); acidobiontic, optimal occurrence at pH < 5.5, fresh-brackish, fairly high oxygen requirements, ά-mesosaprobic, mesotrophic (Van Dam et al. 1994); tolerates high and abrupt variations of pHvalues and recorded in the artificially acidic lakes (Alles 2002); it is rcorded from oligotrophic lakes with acidic water (Sienkiewicz et al. 2006); Dystrophic, humic water, acidophilous pH (4.8-6), low specific conductivity (15.2-51.6 µS/cm) and low concentrations of most ions (Grabowska et al. 2014); freshwater with pH close to circumneutral reaction (6.5-7), electrolytic conductivity ranged from 100 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b; 2014 a).

Occurrence: Distributed frequently in Radomno, Zielone, Kamionka and Młynek Lakes.

Distribution in Poland: The species was dominant in upper mountain streams of the Vistula River, polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range (in the Sudetic Mts), south Poland (Kwandrans 1993); Lakes Mały and Wielki Staw in the northeastern part of Karkonosze Massif, west Poland (Sienkiewicz et al. 2006); Lake Piaski, Lake Żółwia Błoć and Lake Kąpielowe in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Morwawa, Baryczka, Stobnica, and Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Mining lake, on the Łuk Mużakowa, theWzniesienia Łużyckie macroregion west Poland (Sienkiewicz & Gąsiorowski 2016); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Międzyrzeki peatbog, Roztocze National Park, southeast Poland (Noga 2019); on peat bogs in south Poland (Noga & Poradowska 2022); sediments of postmining Lake ŁK-46 in the Łuk Mużakowa, south-west Poland (Sienkiewicz et al. 2023).

***Eunotia exsecta* (A.Cleve) Nörpel-Schempp & Lange-Bertalot 1996**

(Pl. 4, figs. 6-5)

Ref. Cleve-Euler 1953, p. 113, fig. 450 c-e; Lange-Bertalot & Metzeltin 1996, p. 50, pl. 16, figs. 21-24.

Status of name: accepted taxonomically.

Synonym: *Eunotia veneris* var. *exsecta* A.Cleve 1953

Diagnosis: Valves are moderately dorsiventral with a convex dorsal margin, weakly straight ventral margin, and gradually contracted ends turned to the ventral valve side. The apices are acutely rounded, short-protracted rostrate, appearing 'nose-like'. Terminal nodules are distinct, appearing as a notch close to the ends in the ventral margin. The raphe fissures are short, filiform arcuate slits on the hyaline area of the ventral valve mantle. The distal raphe endings lie on the valve mantle, and the terminal raphe nodules are well set in from the apices. Transapical striae are uniseriate, finely punctate, parallel at the valve centre, slightly radiate at the ends, about 11-13 in 10 µm. Length of the valve 27-60 µm, and the breadth 4-5 µm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequently in Radomno, Kamionka and Młynek Lakes.

Distribution in Poland: New record.

***Eunotia faba* Ehrenberg 1837**

(Pl. 4, figs. 7-11)

Ref. Hustedt 1930, p. 183, fig. 246; Patrick & Reimer 1966, p. 210, pl. 13, fig. 7; Germain 1981, p. 92, pl. 31, figs. 20-21; Krammer & Lange-Bertalot 1991 a, p. 225, pl. 164, figs. 1-10; Lange-Bertalot & Metzeltin 1996,

p. 150, pl. 16, figs. 16-20; Veselá 2009, p. 29, pl. 8, figs. 1-13; Lange-Bertalot et al. 2011, p. 97, pl. 44, figs. 1-23; pl. 45, figs. 1-6; Bąk et al. 2012, p. 130, pl. 12; Bahls et al. 2018, p. 77, pl. 40, fig. 1; p. 149, pl. 112, figs. 20, 21.

Status of name: accepted taxonomically.

Synonyms: *Himantidium faba* Ehrenberg 1854
Eunotia soleirolii f. *faba* (Ehrenberg) Ant.Mayer 1918
Eunotia vanheurckii Patrick 1958

Diagnosis: Valves are asymmetric to the apical axis and variably asymmetric to the transverse axis. The dorsal margin is moderately convex, and the ventral margin is straight or weakly concave. The valve is gradually narrowed towards the ends. The apices are broadly rounded, with a deep notch on the ventral side. Terminal nodules are distinct, moderate in size, and may be near or a short distance behind the apices. Terminal raphe fissures are very short at the junction of the valve face and mantle. Transapical striae are finely punctate, parallel at the centre, slightly radiate at the apices; more widely spaced at the centre than at the ends, about 14-18 striae in 10 μm at the centre, up to 18-20 at the ends; punctae 31-34 in 10 μm. Length of the valve 28-57 μm, and the breadth 6-9 μm.

Ecological preference: Patrick & Reimer (1966) report this taxon as *Eunotia vanheurckii* Patrick from soft, somewhat dystrophic ponds, lakes and swamps in Maine and Pennsylvania, USA. Freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); benthic, temperate, standing and streaming water, alkaliphilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Common in Młynek Lake and frequent in Jeziorak Lake.

Distribution in Poland: Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020)

***Eunotia fallax* Cleve-Euler 1895**

(Pl. 4, figs. 12-14)

Ref. Hustedt 1930, p. 177, fig. 226; Hustedt 1959, p. 260, fig. 753a; Patrick & Reimer 1966, p. 214, pl. 13, fig. 15; Krammer & Lange-Bertalot 1991a, p. 206, pl. 150, fig. 10; Hartley et al. 1996, p. 206, pl. 95, fig. 7; Bąk et al. 2012, p. 130, pl. 19**;** Bahls et al. 2018, p. 79, pl. 42, fig. 11; p. 149, pl. 112, fig. 8.

Status of name: accepted taxonomically.

Diagnosis: Valves are narrowly linear and almost straight. The ventral margin is almost straight or weakly curved, the dorsal margin is slightly convex, and both sides of the valve are nearly parallel. The apices of the valve are strongly capitate and somewhat reflexed dorsally. Terminal nodules are distinct on the ventral margin at the apices. Transapical striae are parallel in the middle of the valve, slightly radiate towards the ends, about 13-15 in 10 μm in the middle, up to 17-19 in 10 μm at the ends. Length of the valve 15-45 μm, and the breadth 2.5-5 μm.

Ecological preference: It seems to prefer cool, acid water **(**Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligotrophic (Van Dam et al. 1994); dominant and frequently encountered as an epiphytic or subaerial diatom (Van Kerckvoorde et al. 2001); it prefers cool and somewhat acidic water, and oligotrophic to dystrophic environments (Joh 2011); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Młynek and Zielone Lakes, and infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range (in the Sudetic Mts), south Poland (Kwandrans 1993); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia fennica* (Hustedt) Lange-Bertalot 2004**

(Pl. 4, fig. 15)

Ref. Hustedt 1932, p. 291, fig. 757 e-i; Hamilton & Siver 2010, p. 90, figs. 1-11, 16-29; Noga 2019, p. 10, fig. 3A-I; fig. 5C-E.

Status of name: accepted taxonomically.

Synonym: *Eunotia denticulata* var. *fennica* Hustedt 1932

Diagnosis: Valves are dorsiventral with concave to almost straight ventral margin and convex dorsal margin; spines may or may not be visible along the dorsal margin. Apices are constricted, asymmetrically rounded, and strongly deflected dorsally near the point where the raphe extends onto the valve face. Terminal nodules are distinct on the ventral margin at the end of the valve. Transapical striae are parallel, about 16-18 in 10 μm. Length of the valve 25-55 μm, and the breadth 3-4.5 μm.

Ecological preference: According to Foged (1981), *Eunotia denticulata* var. *fennica* is a halophobic and acidophilic species. It may be restricted to acidic sphagnum bog-like environments with pH < 5 (Hamilton & Siver 2010). *Eunotia fennica* normally develops in ombrotrophic peatbogs or dystrophic lakes associated with *Sphagnum* spp. (Lange-Bertalot et al. 2011). This species is reported from the organic sediments in shallow, small depressions in peat bogs and found in the oligotrophic, acidic waters of the Międzyrzeki peatbog (Noga 2019).

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: The species is reported from Międzyrzeki peat bog, Roztocze National Park, south-east Poland (Noga 2019).

***Eunotia flexuosa* (Brébisson ex Kützing) Kützing 1849**

(Pl. 5, figs. 1-2)

Ref. Hustedt 1930, p. 186, fig. 258; Hustedt 1932, p. 312, fig. 778; Patrick & Reimer 1966, p. 187, pl. 10, fig. 1; Gasse 1986, p. 53, pl. 11, figs. 15-16; Krammer & Lange-Bertalot 1991 a, p. 182, pl. 140, figs. 8-18; Hartley et al. 1996, p. 206, pl. 95, fig. 9; Lange-Bertalot & Metzeltin 1996, p. 50, pl. 10, figs. 1-4; pl. 112, fig. 4; Veselá 2009, p. 29, pl. 14, figs. 1-10; Bąk et al. 2012, p. 131, pl. 19; Bahls et al. 2018, p. 59, pl. 22, figs. 1-4; p. 77, pl. 40, fig. 4.

Status of name: accepted taxonomically

Synonyms: *Synedra flexuosa* Brébisson ex Kützing 1846

Eunotia pseudoflexuosa Hustedt 1949

Diagnosis: Frustules are linear in girdle view. Valve is linear, usually slightly arched, somewhat swollen to form more or less capitate, weakly protracted, broadly rounded apices; the breadth of the valve at the ends is usually a little larger than at the centre. Spines are present throughout the dorsal, ventral and apical valve margins. Terminal nodules are distinct, close to the ends of the ventral margin. The distal raphe endings are long, abruptly curved and extend toward the centre of the valve from the dorsal margin of the terminal nodules. Transapical striae are equidistant, finely punctate, parallel throughout the valve, slightly radiate at the ends, about 12-14 in 10 μm at the valve centre, up to 17 in 10 μm near the apices. Length of the valve 90-160 μm, and the breadth 5.5-3 μm.

Remarks: This species is easily recognised by its capitate apices and its linear appearance, and reversely running distal raphe extending from the terminal nodules at the ends toward the valve centre.

Ecological preference: The species has its development in acid to cicumneutral waters of low mineral content and low current, found in lakes, ditches, swamps and ponds (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); cosmopolitan in northern Europe and is distributed from tropical to high-Arctic regions, occurs in the ultra-oligotrophic lake (Cremer & Wagner 2003); this species is frequent in stagnant to slow flowing waters lakes, ditches, swamps and ponds, in oligotrophic environments (Joh 2011); in water's pH close to circumneutral reaction, electrolytic conductivity ranged from 100 μS/cm to 528 μS/cm, temperature 3.0-17.5 (Noga et al. 2013 b); benthic, temperate, standing and streaming water, oligohalobous-indifferent, acidophilous (Barinova et al. 2023); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Młynek and Zielone Lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Baryczka stream, left bank tributary of the River San, south-east Poland (Noga et al. 2013 b).

***Eunotia formica* Ehrenberg 1843**

(Pl. 4, fig. 22)

Ref. Hustedt 1930, p. 186, fig. 257; Hustedt 1959, p. 308, fig. 775; Patrick & Reimer 1966, p. 190, pl. 10, fig. 7; Germain 1981, p. 90, pl. 31, figs. 29-31; Krammer & Lange-Bertalot 1991 a, p. 209, pl. 152, figs. 8-12 A; Hartley et al. 1996, p. 206, pl. 95, fig. 8; Lange-Bertalot & Metzeltin 1996, p. 144, pl. 13, figs. 1-2; Veselá 2009, p. 31, pl. 4, figs. 1, 2; Costa 2015, p. 49, pl. 97, figs. 1-11; pl. 98, figs. 1-2; pl. 99, figs. 1-4.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly arcuate to linear, sometimes slightly bent; swollen in the middle, particularly on the ventral margin. The dorsal margin is convex, and the ventral margin is concave. Apices are usually broader than the main body of the valve, cuneate-capitate and acutely rounded. Terminal nodules are large, distinct on the ventral margin near the apices. Terminal raphe fissures are visible on the valve face, around the apices to the dorsal margin. Transapical striae are parallel, finely punctate, irregularly spaced, about 8-10 in 10 μm at the centre, up to 14 in 10 μm at the ends; punctae 25- 28 in 10 μm. Length of the valve 40-170 μm and the breadth 7-13 μm.

Remarks: This species is quite similar to *Eunotia tautoniensis* Hustedt ex Patrick, but differs by the presence of a swollen median area and a more straight line of the ventral valve margin (Patrick & Reimer 1966). It is easily recognised by its wedge-capitated ends and the swelling at the centre of the valve.

Ecological preference: It is typically found in acid to circumneutral soft waters, standing or usually slow-flowing waters (Patrick &Reimer 1966; Foged 1978); the species is known as periphytic (Lowe 1974; Denys 1991); eutrophic environments (Guzkowska & Gasse 1990). Acidophilus, mainly occurring at pH < 7, fresh-brackish, continuously high oxygen requirements, oligosaprobous, mesotrophic (Van Dam et al. 1994); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Taylor et al. 2007; Szczepocka & Rakowska 2015); it was found in slightly acidic to alkaline waters (pH 6.3-7.6) in a wide trophic gradient (from oligo- to eutrophic reservoirs) (Costa 2015).

Occurrence: Infrequent in Młynek Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); found in Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015).

***Eunotia formicina* Lange-Bertalot 2011**

(Pl. 4, figs. 19-21)

Ref. Lange-Bertalot et al. 2011, p. 105, pl. 222, figs. 1-7; pl. 223, figs.1-7; Bąk et al. 2012, p. 131, pl. 11; Costa 2015, p. 50, pl. 100, figs. 1-5; Bukhtiyarova 2019, p. 9, figs. 10-11.

Status of name: accepted taxonomically.

Synonyms: *Eunotia formica* var. *elongata* Hustedt 1909

Eunotia formica f. *elongata* (Hustedt) Ant.Mayer 1918

Eunotia formica sensu Germain, 1981

Diagnosis: Valves are weakly arcuate, with parallel margins at least in longer specimens. Ventral margin is slightly concave with a gentle gibbosity at the centre; the dorsal margin is convex without gibbosity. Apices are subcapitate and bluntly rounded to cuneate. Terminal nodules and terminal raphe fissures are not significantly different. Terminal raphe fissures are visible on the valve face, around the apices to the dorsal margin. Transapical striae are finely punctate, parallel, evenly to irregularly spaced along the valve, about 8-12 in 10 μm in the middle part of the valve, up to 15-16 in 10 μm at the ends, puncta 23-28 in 10 μm. Length of the valve 20-170 μm, the breadth 6-8 μm and at the central inflation 7-10 μm.

Remarks: *Eunotia formicina* exhibits narrower valves and a higher striae density than *Eunotia formica* sensu stricto, besides the rounded apices. The species also shows a slight gibbosity at the centre in the ventral margin, but this feature was not always observed.

Ecological preference: Freshwater benthic species, occurs in moderately acidic, dystrophic or oligosaprobic, oligo- to mesotrophic waters, with low to medium conductivity (Lange-Bertalot et al. 2011);

ultraoligotrophic to mesotrophic (total phosphorus < 36 µg cm^{-1}), acidic to alkaline (pH 5.4-7.9) and low conductivity (10-58 µS cm^{-1}) waters (Costa 2015); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Recorded frequently in Radomno, Jeziorak and Młynek Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia fureyae* Lange-Bertalot 2011**

(Pl. 4, figs. 16-18)

Ref. Lange-Bertalot et al. 2011, p. 107, pl. 10, figs. 1-12; Genkal & Yarushina 2014, p. 552, fig. 1: 3, 4.

Status of name: accepted taxonomically

Diagnosis: Valve is dorsiventral, lunate or arcuate, usually gradually narrowing towards the ends, with a marked concave ventral margin, which is parallel to the dorsal margin. Valve apices are broadly to bluntly rounded. Terminal nodules are positioned near the apices close to the ventral margin. Distal raphe endings are curved onto the valve face. Transapical striae are parallel, evenly spaced in the centre, denser and radiate near the apices, about 12-14 in 10 µm in the valve centre. Length of the valve 60-90 µm, and the breadth 5-7 µm.

Ecological preference: Reported from the shallow, benthic habitats of slightly acidic, dystrophic to oligotrophic freshwater environments.

Occurrence: Infrequent in Zielone Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia gallica* Lange-Bertalot & Witkowski 2011**

(Pl. 5, figs. 3-4)

Ref. Lange-Bertalot et al. 2011, p. 108, pl. 5, figs. 7-9; pl. 6, figs. 1-10.

Status of name: accepted taxonomically.

Diagnosis: Valves dorsiventral, long, narrow, arcuate, with parallel margins and large, swollen, rounded apices. Raphe with slightly longer terminal fissures turning back from the apices. Terminal nodules of the raphe are distinct on the ventral margin of the apices. Transapical striae are distinctly punctate, parallel throughout the valve, slightly radiate near the ends, about 14-16 in 10 µm. Punctate striae are interrupted near the middle of the valves, closer to the ventral margins. Puncta round, about 34-36 in 10 µm. Length of the valve 110-160 µm, and the breadth 4.5-6 µm.

Ecological preference: Reported from the shallow, benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Infrequent in Młynek and Zielone Lakes.

Distribution in Poland: New record.

***Eunotia genuflexa* Nörpel-Schempp 1996**

(Pl. 5, fig. 5)

Ref. Lange-Bertalot & Metzeltin 1996, p. 50, pl. 9, figs. 14-17; Veselá 2009, p. 31, pl. 20, figs. 1-13; Bąk et al. 2012, p. 132, pl. 17, figs. 1, 2, 5; Costa 2015, p. 51, pl. 14, figs. 1-11; Kulikovskiy et al. 2016, p. 121, pl. 20, figs. 10-14; Bukhtiyarova 2019, p. 10, figs. 4-6b.

Status of name: accepted taxonomically.

Synonym: *Eunotioforma genuflexa* (Nörpel-Schemp) Kociolek & Burliga 2013

Diagnosis: Valves are arcuate, slender, slightly dorsiventral, with subparallel margins at least in longer specimens; the ventral margin is slightly concave, and the dorsal margin is slightly convex. Apices are subcapitate, narrowly, acutely rounded. Terminal raphe fissures are short filiform slits curved on the ventral valve mantle at the ends. Transapical striae are finely punctate, parallel, evenly spaced along the valve, about 20-23 in 10 µm. Length of the valve 70-160 µm, the breadth 2-3 µm.

Remarks: *Eunotia genuflexa* resembles *E. naegelii sensu lato* in its valve outline, but it can be easily distinguished from *Eunotia naegelii* by its slender shape, slightly straight to straight valves, and from *Eunotia bilunaris* it differs by the wider valves in the latter taxon.

Ecological preference: The taxon was reported in acidic (pH: 5.4-6.7) and low conductivity (32-110 μS cm-1) waters (Bicca & Torgan 2009); it was mainly found in periphytic assemblages, and its ecological preference occurred in slightly acidic (pH optimum of 6.3), low conductivity waters (optimum value of 48 μS cm-1), low nutrient conditions (Costa 2015); freshwater benthic species occurs in moderately acidic, dystrophic or oligosaprobic waters (Bukhtiyarova 2019); The species was reported from freshwater with temperature ranges from 13.3 to 16.7°C, pH was neutral to slightly alkaline (pH 6.65-7.51), low suspended matter, high dissolved oxygen content from 8.7 to 10.47 mg/l^{-1}, low and mild salinity levels, hydrocarbonate-water (Barinova et al. 2023).

Occurrence: Infrequent in Młynek and Radomno Lakes.

Distribution in Poland: Lake Kąpielowe and Lake Żółwia Błoć in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Eunotia glacialifalsa* Lange-Bertalot 2000**

(Pl. 5, figs. 6-10)

Ref. Krammer & Lange-Bertalot 2000, p. 594, pl. 151, fig. 6; pl. 151 A, figs. 3-6; Bąk et al. 2012, p. 132, pl. 18; Pavlov & Levkov 2013, p. 23, pl. 58, figs. 1-6; pl. 59, figs. 1-5; Noga 2019, p. 10, Fig. 3AD, AE.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear, long, and arcuate. The dorsal and ventral margins are relatively parallel and reflexed at the apices. The ventral margin is more concave, and the dorsal margin is broadly convex. Apices are somewhat swollen to form capitate, weakly protracted, quite broadly rounded ends. Terminal nodules are distinct on the ventral margin at the ends. Terminal raphe fissures are quite long, extending beyond the mid-point of the valve apex and ending towards the dorsal valve margin. Transapical striae are finely punctate, parallel throughout the valve, about 9-12 in 10 μm at the valve centre, and slightly more dense, about 13-16 in 10 μm at valve apices; Puncta 30-34 in 10 μm. Length of the valve 72-110, and the breadth 6.5-8 μm.

Ecological preference: The species is dominant in electrolyte-poor acidic waters as well as in bicarbonate-buffered alkaline, oligotrophic usually standing freshwaters (Bąk et al. 2012; Cantonati et al. 2017; Noga 2019); this species can also tolerates mesotrophic conditions (Hofmann et al. 2011; Bąk et al., 2012); it developed in waters with a pH from slightly acidic to slightly alkaline, low nitrate content, and very low conductivity (Wojtal 2013); acidophilous, fresh, oligo-mesotrophic (Malinowska-Gniewosz et al. 2018); it is reported from the organic sediments in small and shallow depressions in the peat bogs (Noga 2019).

Occurrence: Frequent in Młynek Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: This taxon is reported from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); it is known from a few localities in the East Tatra Mountains, and spring waters from various geological formations, south Poland (Wojtal 2013); Industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Międzyrzeki peat bog, Roztocze National Park, south-east Poland (Noga 2019).

***Eunotia glacialis* Meister 1912**

(Pl. 6, figs. **7-1**)

Ref. Patrick & Reimer, 1966, p. 188, pl. 10, fig. 3; Krammer & Lange-Bertalot 1991 a, p. 207, pl. 151, figs. 1-10 A; Hartley et al. 1996, p. 206, pl. 95, fig. 10; Lange-Bertalot & Metzeltin 1996, p. 144, pl. 13, figs. 3-7; Veselá 2009, p. 32, pl. 7, figs. 1-7; Bąk et al. 2012, p. 132, pl. 18; Pavlov & Levkov 2013, p. 24, pl. 31, figs. 1-8; Bahls et al. 2018, p. 149, pl. 112, fig. 12.

Status of Name: accepted taxonomically.

Synonyms: *Himantidium gracile* Ehrenberg 1843

Eunotia glacialis var. *genuina* Cleve-Euler 1953

Diagnosis: Valve is dorsiventral, linear and slightly arcuate with parallel margins. The dorsal and ventral margins are reflexed at the ends, swollen to form sub-capitate, broadly rounded apices that differentiate from the rest of the valve. Terminal nodules are distinct on the ventral margin. Terminal raphe fissures are quite long, extending beyond the mid-point of the valve apex and ending close to the dorsal valve margin. Transapical striae

are parallel, evenly spaced in the middle of the valve, about 10-12 in 10 μm, slightly more dense and radiate towards the ends, about 14-17 in 10 μm near the apices; Puncta 28-30 in 10 μm. Length of the valve 78-150 μm and the breadth 7-9 μm.

Remarks: This species can be distinguished from other representatives of *Eunotia* by its longer, slender valve, a straight ventral margin and more broadly rounded ends.

Ecological preference: It occurs in acid to circumneutral cool water of low mineral content usually in cooler waters (Patrick & Reimer 1966; Joh 2011); the species was common in acidic ponds from pH 1.8 to 3.6 in tundra regions (Sheath et al. 1982); in habitats with low to slightly high electrolytic concentrations (Krammer &Lange-Bertalot 1991); acidophilous, freshwater, continuously high oxygen requirements, oligosaprobous, oligo-mesotrophic (Van dam et al. 1994); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Młynek, Radomno, Zielone and Kamionka Lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia glacialispinosa* Lange-Bertalot & Cantonati 2010**

(Pl. 7, figs. 1-7)

Ref. Cantonati & Lange-Bertalot 2010, p. 269, figs. 68-71, 73-85.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear, long, and arcuate. The dorsal and ventral margins are relatively parallel and slightly reflexed at the apices. The ventral margin is concave, and the dorsal margin is broadly convex. Apices are somewhat swollen to form capitate, broadly rounded ends. Terminal nodules are distinct on the ventral margin close to the ends. long terminal raphe fissures in the valve face approaching the dorsal margin. On the edge of each pole, a single spine is visible in girdle view and by focusing likewise in valve view. Transapical striae are finely punctate, parallel throughout the valve, about 12-14 in 10 μm; Puncta 30-35 in 10 μm. Length of the valve 85-160 μm, and the breadth 4.5-5.5 μm.

Ecological preference: freshwater, acidophilous, oligotrophic, found in low to medium conductivity, dystrophic environments (Cantonati & Lange-Bertalot 2010); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Młynek, Zielone and Radomno Lakes.

Distribution in Poland: New record.

***Eunotia gracilis* (Ehrenberg) Rabenhorst 1864**

(Pl. 7, figs. 8-10)

Ref. Hustedt 1930, p. 185, fig. 253; Cleve-Euler 1953, p. 92, fig. 417 a-c; Foged 1966, p. 55, pl. 3, fig. 1.

Status of name: Uncertain.

Synonyms: *Himantidium gracile* Ehrenberg 1843

Diagnosis: Valve is dorsiventral, narrowly linear, slender and slightly arcuate with parallel margins. The dorsal and ventral margins are slightly reflexed at the ends, swollen to form capitate, bluntly rounded apices. Terminal nodules are distinct, close to the ventral margin. Terminal raphe fissures are extending beyond the mid-point of the valve apex and ending close to the dorsal valve margin. Transapical striae are parallel, evenly spaced in the middle of the valve, about 9-11 in 10 μm, slightly dense towards the ends, about 12-14 in 10 μm near the apices. Length of the valve 135-180 μm, and the breadth 3-4 μm.

Remarks: This species is relatively similar to *Eunotia glacialis* Meister**,** but it can be distinguished by its longer and slender valve than *Eunotia glacialis*.

Ecological preference: halophobous, acidophilous, cosmopolitan (Foged 1959); reported from the benthic habitats of acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Radomno and Zielone Lakes.

Distribution in Poland: New record.

***Eunotia groenlandica* Nörpel-Schempp & Lange-Bertalot 1996**

Ref. Krammer & Lange-Bertalot 1991a, p. 207, pl. 150, figs. 10-15; Lange-Bertalot & Metzeltin 1996, p. 51, pl. 17, figs. 25-27; Pavlov & Levkov 2013, p. 25, pl. 66, figs. 32-50; pl. 67, figs. 5, 6; Bahls et al. 2018, p. 79, pl. 42, fig. 10; Noga 2019, p. 10, fig. 3P-T; fig. 5F.

Status of name: Uncertain.

Synonyms: *Eunotia paludosa* var. *groenlandica* Grunow in Van Heurck 1885
Eunotia fallax var. *gracillima* Krasske, 1929
Eunotia fallax var. *groenlandica* (Grunow) Lange-Bertalot & Nörpel-Schempp 1991
Eunotia neofallax Nörpel-Schempp & Lange-Bertalot in Lange-Bertalot et al. 1996

Diagnosis: Valves are dorsiventral, isopolar; rarely linear. The dorsal margin is weakly to moderately convex; the ventral margin is slightly concave to more or less straight. Apices are sub-capitate, short, protracted, moderately rounded, often dorsally reflexed, and detached from the valve. Terminal nodules are fairly small, positioned slightly distant from valve apices. Proximal raphe endings are also noticeable on the ventral valve margin below valve ends. Transapical striae are parallel throughout the valve, evenly spaced, slightly radiate at valve apices, about 16-19 in 10 μm. Length of the valve 20-33 μm, and the breadth 2.5-3.5 μm.

Remarks: *Eunotia groenlandica* exhibits valve morphology similar to *Eunotia horstii* Furey, Lowe & Johansen, *Eunotia paludosa* Grunow and *Eunotia pseudogroenlandica* Lange-Bertalot and Tagliaventi. However, in *Eunotia horstii*, the valve ends are bent towards the dorsal side and are more detached from the valve body (Furey et al. 2011), and *Eunotia paludosa* shows greater striae density, about 18-25 in 10 μm (Lange-Bertalot et al. 2011).

Ecological preference: freshwater, acidophilous, continuously high oxygen requirements**,** oligosaprobous, oligotrophic (Van Dam et al. 1994); this species reported from water's pH characterized by an alkaline character or close to circumneutral reaction (6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 3.0-17.5 (Noga et al. 2013 b); occurred in organic sediments in small and shallow depressions and among the mosses in peat bogs, it was noted in streams among mosses growing on stones partly or completely submerged in water, it prefers low pH (circumneutral or slightly alkaline), low conductivity, and semiaquatic habitats on intermittently wet silicate rocks and bryophytes (Noga 2019); benthic, standing and streaming water, oligohalobous-halophobous, acidophilous (Barinova et al. 2023).

Occurrence: Distributed infrequently in Radomno Lake.

Distribution in Poland: *Eunotia groenlandica* was reported from the Roztoka stream, the Tatra Mountains as *Eunotia fallax* var. *groenlandica* (Kawecka 2012); Baryczka stream, left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Bieszczady National Park, Kłopotnica River, Magura National Park, south-east Poland (Noga 2019).

***Eunotia hexaglyphis* Ehrenberg 1854**

(Pl. 8, figs. 1-2)

Ref. Hustedt 1930, p. 180, fig. 235; Patrick & Reimer 1966, p. 203, pl. 12, fig. 6; Krammer & Lange-Bertalot 1991a, p. 227, pl. 166, figs. 1-4; Hartley et al. 1996, p. 206, pl. 95, fig. 11; Bąk et al. 2012, p. 133, pl. 14.

Status of name: accepted taxonomically.

Synonyms: *Eunotia tetraglyphis* Ehrenberg 1854
Climacidium hexaglyphis (Ehrenberg) Ehrenberg 1871
Climacidium tetraglyphis (Ehrenberg) Ehrenberg 1873
Eunotia polyglyphis Grunow in Van Heurck 1881
Eunotia polyglyphis var. *hexaglyphis* (Ehrenberg) Grunow 1881
Eunotia polyglyphis var. *tetraglyphis* (Ehrenberg) Grunow 1881
Eunotia ehrenbergii var. *hexaglypha* (Ehrenberg) Mayer 1918
Eunotia polyglyphis f. *hexaglyphis* (Ehrenberg) Cleve-Euler 1953

Diagnosis: Valves are weakly arched with a straight to slightly concave ventral margin and a moderately convex, undulate dorsal margin that has 4 to 6 bluntly pointed undulations. The apices are rostrate to narrowly protracted and bluntly rounded, slightly bent in a downward direction. On the dorsal side, apices are set off from

the valve by a shallow notch, resulting in 'nose-like' ends. On the ventral side, the apices are separated from the valve by a broad, shallow notch where the raphe is positioned on the valve face. Transapical striae are punctate, radiate throughout the valve, about 12-15 in 10 µm, and the puncta are about 34-40 in 10 µm. Length of the valve 33-80 µm, and the breadth 6-11 µm.

Ecological preference: Common in cool mountainous areas (Patrick & Reimer 1966); it occurs in acid to circumneutral waters of extremely low conductivity.

Occurrence: Distributed infrequently in Radomno Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia implicata* Nörpel-Schempp, Lange-Bertalot & Alles 1991**

(Pl. 8, figs. 3-11)

Ref. Alles et al. 1991, p. 206, pl. 7, figs. 19-32**;** Krammer and Lange-Bertalot 1991, p. 197, pl. 143, figs. 1-7; Lange-Bertalot & Metzeltin 1996, p. 148, pl. 15, figs. 10-15; Veselá 2009, p. 33, pl. 24, figs. 2-14; Lange-Bertalot et al. 2011, p. 119, pl. 97, figs. 1-39; pl. 225, figs. 16-19; Bąk et al. 2012, p. 133, pl. 16, figs.1, 5; Costa 2015, p. 54, pl. 27, figs. 1-7; pl. 28, figs. 1-5; Bahls et al. 2018, p. 148, pl. 111, fig. 15; Bukhtiyarova 2019, p. 12, figs. 15, 16.

Status of name: accepted taxonomically.

Synonym: *Eunotia impressa* var. *angusta* Grunow 1881

Diagnosis: Valves are weakly dorsiventral, linear with a slightly concave ventral margin, and the dorsal margin is weakly convex to linear in most of its length, somewhat has two slight undulations. Valves are narrower at the ends than at the centre. The apices are long, protracted, wedge-shaped, and moderately rounded. Terminal nodules are subapical, close to the ends of the valve. Terminal raphe fissures are short, filiform and are situated on the ventral part of the mantle, terminating before the mid-point of the valve apex. Transapical striae are parallel, evenly spaced along the valve and condensed, sometimes curved or slightly radiate at the ends, about 14-16 in 10 µm at the valve centre, up to 20-22 in 10 µm at the ends. Length of the valve 25-60 µm, and the breadth 4-6.5 µm

Ecological preference: *Eunotia implicata* prefers low conductivity, circumneutral and oligotrophic to slightly dystrophic waters; it is abundant in highly dystrophic streams in the Arnsberger Mountain, Sauerland, Germany, where the pH ranges from 4 to 7 (Alles et al. 1991). Acidophilous, occurring at pH < 7 (Van Dam et al. 1994); freshwater, acidophilous, epiphytic species, inhabits moss vegetation, green filamentous algae; optimum conditions with pH 5.3-6.8, conductivity 28.7-51 µS/cm, (Ortiz-Lerín & Cambra 2007). it is a cosmopolitan taxon, preferring oligo-dystrophic waters with low inorganic content (Werum & Lange-Bertalot 2004; Veselá & Johansen 2009). Acidophilous preferring the pH < 7 (Szulc & Szulc 2012); reported from slightly acidic (5.9-6.5) but also with neutral pH (7.1) and oligo to mesotrophic waters (Costa 2015); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Common occurrence in Radomno, Kamionka, Zielone and Młynek Lakes; the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Gołębiówka and Szuwarka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Czarna Staszowska River near the Smyków village, south-east Poland (Szczepocka & Rakowska 2015).

***Eunotia incisa* Smith ex Gregory 1854**

(Pl. 8, figs. 12-14)

Ref. Patrick & Reimer 1966, p. 208, pl. 13, fig. 4; Krammer & Lange-Bertalot 1991a, p. 221, pl. 161, figs. 8-19; pl. 163, figs. 1-7; Metzeltin & Witkowski 1996, p. 100, pl. 34, fig. 1; Veselá 2009, p. 33, pl. 9, figs. 3-26; Wojtal 2009, p. 206, pl. 4, fig. 9; Bąk et al. 2012, p. 134, pl. 16; Costa 2015, p. 55, pl. 22, figs .1-21; pl. 23, figs. 1-5; Bahls et al. 2018, p. 60, pl. 23, figs. 19-28; p. 77, pl. 40, figs. 2, 3; p. 124, pl. 87, figs. 11, 12; p. 149, pl. 112, figs. 17-19; Bukhtiyarova 2019, p. 13, figs. 21-23.

Status of name: accepted taxonomically.

Synonyms: *Eunotia sudetica* var. *incisa* (W.Smith ex W.Gregory) Manguin 1950
Eunotia veneris var. *incisa* (W.Smith ex W.Gregory) Cleve-Euler 1953

Diagnosis: Valves are dorsiventral with a convex dorsal margin, a more or less straight ventral margin, and gradually contracted ends turned to the ventral valve side. The apices are acutely rounded, somewhat sub-protracted rostrate, appearing 'nose-like' due to the inset position of the helictoglossae. Terminal nodules are distinct, appearing as a notch close to the ends in the ventral margin. One apical rimoportula is present, just dorsal to the centre of the apex. The raphe system consists of two short filiform arcuate slits on the hyaline area of the ventral valve mantle. The distal raphe endings lie on the valve mantle, and the terminal raphe nodules are well set in from the apices. Transapical striae are uniseriate, finely punctate, parallel throughout the valve, becoming slightly radiate at the ends, distant, gradually compacted from the valve centre to the ends, about 16-19 in 10 μm. Length of the valve 20-50 μm, and the breadth 4-6 μm.

Remarks: *Eunotia incisa* is a diverse taxon in terms of length, width, and striae density, but it always possesses a very distinct shape concerning the valve outline and apices.

Ecological preference: Cosmopolitan species; often found in clear cool water, associated with moss and in water of low dissolved minerals (Patrick & Reimer 1966); an acidophilous, mainly occurring at pH < 7, oligosaprobous, oligotraphentic, aquatic and subaerophilous (Van Dam et al. 1994); freshwater benthic species occurs in upland streams in acidic, xeno-oligosaprobic waters with poor electrolytes content, pH 5.3-6, conductivity 38-51 μS/ cm (Ortiz-Lerín & Cambra 2007; Taylor et al. 2007); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); found in oligo- and eutrophic waters, total phosphorus < 71.4 mg/cm^3, conductivity 13-142 μS/cm and pH 5.3-9.3 (Costa 2015); Planktonic/benthic, temperate, standing and streaming water, oligohalobous-indifferent, acidophilous, oligomesotraphentic (Barinova et al. 2023).

Occurrence: Recorded frequently in Zielone, Młynek, Radomno and Kamionka Lakes.

Distribution in Poland: Reported from Sudety Mts, south Poland (Kwandrans 1995); Central Poland (Rakowska 2001); Tatra Mts lakes south Poland (Kawecka & Galas 2003); Lakes Mały and Wielki Staw in the northeastern part of Karkonosze Massif, west Poland (Sienkiewicz et al. 2006); peat bog in Central Poland (Rakowska & Sitkowska 2007); Kobylanka stream, south Poland (Wojtal 2009); Lake Żółwia Błoć in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015); Mining lake, on the Łuk Mużakowa, the Wzniesienia Łużyckie macroregion, west Poland (Sienkiewicz & Gąsiorowski 2016).

***Eunotia incisadistans* Lange-Bertalot & Sienkiewicz 2011**

(Pl. 8, figs. 15-17)

Ref. Lange-Bertalot & Sienkiewicz 2011, p. 122, pl. 38, fig.s 1-40; pl. 40, figs. 6-8; Pavlov & Levkov 2013, p. 26, pl. 44, figs. 1-24; Desianti & Potapova 2019, pl. 97, figs. 22-25.

Status of name: accepted taxonomically.

Diagnosis: Frustules are rectangular to quadratic in girdle view. Valves are linear, dorsiventral, with a convex dorsal margin, straight ventral margin, but weakly concave in larger specimens and gradually contracted ends turned to the ventral valve side. Apices are acutely rounded, sub-protracted, rostrate, g 'nose-like'. Terminal nodules are distinct, appearing as a notch close to the ends in the ventral margin. Raphe fissures are short, filiform arcuate. The distal raphe endings lie on the valve mantle, and the terminal raphe nodules are well set in from the apices. Transapical striae are finely punctate, parallel throughout the valve, more distant and evenly spaced at the centre of the valve than at the ends, about 11-13 in 10 μm, slightly radiate and more dense at the ends, about 13-16 in 10 μm. Length of the valve 21-50 μm, and the breadth 4.5-6 μm

Ecological preference: reported from the benthic habitats of slightly acidic, dystrophic and oligotrophic freshwater environments.

Occurrence: Frequent in Zielone, Francuskie and Młynek Lakes.

Distribution in Poland: Lake Mały Staw (Lange-Bertalot et al. 2011).

***Eunotia inflata* (Grunow) Nörpel-Schempp & Lange-Bertalot 1996**

Ref. Cleve-Euler 1953, p. 115, fig. 452 g, h; Patrick & Reimer 1966, p. 194, pl. 10, fig.15; Hartley et al. 1996, p. 212, pl. 98, fig. 8; Lange-Bertalot & Metzeltin 1996, p. 52, pl. 12, figs. 1-3.

Status of name: accepted taxonomically.

Synonyms: *Eunotia praerupta* var. *inflata* Grunow 1881
Eunotia praerupta f. *inflata* (Grunow) Frenguelli 1924
Eunotia praemonos var. *inflata* (Grunow) A.Cleve 1953
Eunotia bidens var. *inflata* (Grunow) Aysel 2005
Eunotia praerupta-monos Å.Berg 1939

Diagnosis: Valves are dorsiventral, arcuate, with more convex dorsal and weakly concave to almost straight ventral margins. Valve apices are rostrate, subcapitate, broadly rounded, and reflexed slightly dorsally. Terminal nodules are distinct at the ends, extending upward along the apices. Raphe is short filiform, located on the ventral valve mantle; the distal raphe endings finish valve face ends by small round pore-like outer connected with helictoglossae. Transapical striae are distant, irregularly spaced, parallel at the centre, slightly radiate towards the ends, about 5-8 in 10 μm at the centre, 9-12 in 10 μm at the ends. Length of the valve 25-60 μm, and the breadth 10-15 μm.

Ecological preference: the species prefers acid, cool water, associated with moss (Patrick & Reimer 1966); acidophilous, aerophilous (Kaczmarska 1976).

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Eunotia intermedia* (Krasske ex Hustedt) Nörpel & Lange-Bertalot 1993**

(Pl. 8, figs. 18-19)

Ref. Patrick & Reimer 1966, p. 211, pl. 13, fig. 8; Krammer & Lange-Bertalot 1991a, p. 215, pl. 143, figs. 10-15; Hartley et al. 1996, p. 210, pl. 97, fig. 9; Tremarin et al. 2008, p. 852, figs. 27-28; Bąk et al. 2012, p. 134, pl. 19; Bahls et al. 2018, p. 149, pl. 112, fig. 11.

Status of name: accepted taxonomically.

Synonyms: *Eunotia pectinalis* f. *intermedia* Krasske ex Hustedt 1932
Eunotia faba var. *intermedia* (Krasske) A.Cleve 1933
Eunotia vanheurckii var. *intermedia* (Krasske ex Hustedt) Patrick 1958

Diagnosis: Valves are slightly arcuate to crescentic with more or less straight ventral margin and convex dorsal margin. Apices are broadly rounded, not distinctly formed, but confluent with the rest of the valve. Terminal nodules are distinct, located near the ends of the valve. Raphe is short filiform slits sited close to the apices and curved dorsally on the valve face. A rimoportula is present at one end of the valve. Transapical striae are parallel at the centre of the valve, about 14-16 in 10 μm, slightly radiate towards the ends and are more numerous. Length of the valve 14-45 μm, and the breadth 3.5-5 μm.

Ecological preference: The species prefers oligotrophic water (Patrick & Reimer 1966); freshwater, acidophilus, occurring at pH < 7, oligotrophic (Van Dam et al. 1994; Szulc & Szulc 2012).

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland and Francuskie Lake.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012).

***Eunotia islandica* Østrup 1918**

(Pl. 8, figs. 20-21)

Ref. Metzeltin & Witkowski 1996, p. 98, pl. 33, fig. 2; Cantonati & Lange-Bertalot 2011, p. 213, figs. 68-74; Pavlov & Levkov 2013, p. 27, pl. 12, figs. 8-17; pl. 13, figs. 6-18; pl. 15, figs. 1-3; pl. 17, figs. 2-4; pl. 18, figs. 1-5; Bahls et al. 2018, p. 57, pl. 20, fig. 22; p. 94, pl. 57, figs. 1-4; p. 122, pl. 85, figs. 3-7.

Status of name: accepted taxonomically.

Diagnosis: Valve is distinctly dorsiventral with a moderately concave ventral margin, and a moderate to strongly convex dorsal margin that has two distinct undulations in medium-sized of larger valves and weakly bi-

undulate in smaller valves. The double undulations on the dorsal margins are often quite variable in height and shape, from consistently rounded to more pointed. The apices are protracted, slightly capitate to truncate, broadly rounded, and dorsally reflexed. Terminal nodules are distinct, located distant from the apices. The distal raphe endings are fairly long, curved onto the valve face and extending to the dorsal margin. Transapical striae are parallel in the middle part of the valve, radiate at the ends, evenly spaced, about 11-14 in 10 μm at the valve centre, and are denser, about 14-16 in 10 μm at the ends. Length of the valve 20-64 μm, and the breadth 6.5-9 μm.

Ecological preference: The species is reported from water's pH close to circumneutral reaction, electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 3.0-17.5 (Noga et al. 2013 b); benthic, oligohalobous-indifferent, acidophilous, oligotraphentic (Barinova et al. 2023).

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland and Radomno Lake.

Distribution in Poland: Baryczka stream left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b).

***Eunotia juettnerae* Lange-Bertalot 2011**

(Pl. 9, fig. 1)

Ref. Lange-Bertalot et al. 2011, p. 127, pl. 26, figs. 1-17; pl. 27, figs. 1-6; Bahls et al. 2018, p. 175, pl. 2, fig. 14; pl. 87, figs. 6, 7; Favaretto et al. 2021, p. 11, fig.3 c-f; fig. 6d.

Status of name: accepted taxonomically.

Diagnosis: Valves dorsiventral, long, arcuate, with convex dorsal margin, and concave ventral margin. The valve is gradually tapering to slightly protracted narrow rounded apices. In large valves, the ends can appear very slightly inflated. Short raphe near the valve ends; the distal raphe fissure curved on the valve face, extending to the middle of the valve, proximal raphe ends are located on the mantle. A rimoportula is present at one end of the valve. Transapical striae are parallel, slightly radiate near the valve ends, about 16-18 in 10 μm, denser towards the ends. Length of the valve 50-120 μm, and the breadth 2.5-3.5 μm.

Ecological preference: Reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Zielone and Młynek Lakes.

Distribution in Poland: New record.

***Eunotia lapponica* Grunow ex A. Cleve 1895**

(Pl. 9, fig. 5)

Ref. Hustedt 1930, p. 180, fig. 236; Hustedt 1959, p. 295, fig. 762; Patrick & Reimer 1966, p. 192, pl. 10, fig. 10; Krammer & Lange-Bertalot 1991 a, p. 212, pl. 151, figs. 11-13; Lange-Bertalot & Metzeltin 1996, p. 154, pl. 18, fig. 1; Veselá 2009, p. 35, pl. 22, figs. 1-5; Bahls et al. 2018, p. 120, pl. 83, fig. 16.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly arcuate, rarely almost linear, with slightly or moderately convex dorsal margin and slightly concave or almost straight ventral margin, somewhat swollen at the ends. Apices are protracted, capitate-truncate and broadly rounded. Terminal nodules are large. Terminal raphe fissures are moderately long, positioned close to apical valve margins, terminating in the middle of the apical valve width. Transapical striae are finely punctate, parallel throughout along the valve, becoming slightly radiate at the apices, about 16-19 in 10μm at the valve centre, up to 20-23 in 10μm near the ends. Length of the valve 42-70 μm, and the breadth 5.0-8μm.

Ecological preference: Found in northern Europe, mountain areas in springs and bogs (Patrick & Reimer 1966); mainly in low electrolyte, oligotrophic waters (Krammer & Lange-Bertalot 2004).

Occurrence: Recorded infrequently in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia longicollis* Metzeltin & Lange-Bertalot 1998**

(Pl. 9, figs. 3-4)

Ref. Metzeltin & Lange-Bertalot 1998, p. 66, pl. 15, figs. 6-8; Costa 2015, p. 59, pl. 38, figs. 1-11.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, slightly arcuate. The ventral margin is moderately concave, and the dorsal margin is parallel or convex. Valve apices are protracted, narrowly or broadly rounded, subcapitate, and weakly reflexed dorsally. The distal raphe endings are short, arched at the valve apices, and slightly expanded. Helictoglossae are conspicuous, rimoportula is small and located on the mantle at the end of the valve. Transapical striae are punctate, equidistant, parallel in the middle portion of the valve, slightly raiate towards the ends, about 9-11 in 10 μm; Puncta about 26-28 in 10 μm. Length of the valve 72-85 μm, and the breadth 7-8 μm

Ecological preference: It was reported from acidic to alkaline waters (pH 6.2-9.5) in a wide conductivity range (46-287 μS cm^{-1}) and a wide trophic gradient (total phosphorus 22.6-85.3 μg L-1) (Costa 2015).

Occurrence: Recorded infrequently in the Eemian palaeolake deposits of central Poland and Francuskie Lake.

Distribution in Poland: New record.

***Eunotia lunaris* (Ehrenberg) Grunow 1877**

(Pl. 9, fig. 2)

Ref. Hustedt 1930, p. 183, fig. 249; Cleve-Euler 1932, p. 30, fig. 52; Kaczmarska 1977, p. 39-40, pl. 8, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Synedra lunaris* Ehrenberg 1832
Exilaria lunaris (Ehrenberg) Hassall 1845
Ceratoneis lunaris (Ehrenberg) Grunow 1865
Pseudo-eunotia lunaris (Ehrenberg) De Toni 1892
Eunotia lunaris var. *genuina* F. Meister 1912

Diagnosis: Valves are usually lunate or arcuate, with more or less parallel margins gradually narrowed towards rounded ends or with only a slightly descending dorsal margin, slim (larger valves relatively narrower than smaller valves). Terminal nodules are small and distinct near the apices. Terminal raphe fissures are simple, almost reaching the apex centre, somewhat indistinct. A fine line running out from the terminal nodules towards the centre of the valve. Transapical striae are fine, equidistant, parallel at the valve centre, becoming radiate towards the ends, about 12-15 in 10 μm. Length of the valve 38-85 μm, and the breadth 3-4 μm.

Ecological preference: pH-indifferent, aerophilous (Kaczmarska 1976); reported infrequently in the benthic habitats of slightly acidic to slightly alkaline, oligotrophic to mesotrophic freshwater environments.

Occurrence: Infrequent in Zielone and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Eunotia major* (W.Smith) Rabenhorst 1864**

(Pl. 11, figs. 13-14)

Ref. Hustedt 1930, p. 186, fig. 255; Patrick & Reimer 1966, p. 196, pl. 11, fig. 5; Hartley et al. 1996, p. 210, pl. 97, figs. 4-5; Tremarin et al. 2008, p. 853, figs. 31-32; Pavlov & Levkov 2013, p. 29, pl. 60, figs. 1-5; Bahls et al. 2018, p. 149, pl. 112, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Himantidium majus* W.Smith 1856
Himantidium arcus var. *majus* (W.Smith) Brun 1880
Eunotia arcus var. *major* (W.Smith) Brun ex Petit 1888
Eunotia monodon var. *major* (W.Smith) Hustedt 1930

Diagnosis: Valve is dorsiventral, arcuate to linear; ventral margin is slightly concave, sometimes slightly swollen at the centre. The dorsal margin is slightly convex, parallel to the ventral. Apices of the valve are protracted, subcapitate, broadly rounded, and almost broad as the main body of the valve. Terminal nodules are quite large, close to the ends. Terminal raphe fissures are long, continue on the valve face, curving around the apices, ending close to the dorsal valve margin. Transapical striae are parallel, evenly spaced at the centre, about 9-11 in 10 μm, slightly radiate and more dense at the ends, about 13-15 in 10 μm. Striae are interrupted at the valve face/mantle junction by a marginal ridge and continue further onto the mantle. Length of the valve 55-135 μm, and the breadth 6-14 μm.

Ecological preference: It prefers slightly acid water with low mineral content, found in swamps, bogs, lakes and flowing water (Patrick & Reimer 1966); benthic, standing and streaming water, oligohalobous-halophobous, acidophilous pH 6.7 (Barinova et al. 2023).

Occurrence: Recorded infrequently in Radomno Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia meisteri* Hustedt 1930**

(Pl. 8, fig. 22)

Ref. Hustedt 1930, p. 179, fig. 230; Hustedt 1959, p. 261, fig. 755; Patrick & Reimer 1966, p. 216, pl. 14, fig. 2; Krammer & Lange-Bertalot 1991a, p. 202, pl. 154, fig. 1; Veselá 2009, p. 36, pl. 29, figs. 21-27; Bąk et al. 2012, p. 134, pl. 16.

Status of name: accepted taxonomically.

Diagnosis: Valve is distinctly arcuate, with a strongly convex dorsal margin that gives the valve a swollen appearance, and straight or slightly concave, undulate, or smooth ventral margin. Apices are constricted to be produced and capitate, slightly rounded or truncate, strongly reflexed dorsally. Terminal nodules are distinct. Short raphe on the mantle, and short terminal fissures visible on the valve face, remarkably close to the ends. Transapical striae are finely punctate, parallel at the centre, slightly radiate towards the ends, about 18-20 in 10 μm. Length of the valve 12-16 μm, and the breadth 3-4.5 μm.

Remarks: *Eunotia meisteri* is similar to *Eunotia exigua* in valve morphology, but in *Eunotia exigua*, the dorsal margin is parallel to slightly convex with the ventral margin; however, it is not strongly arched.

Ecological preference: The species was found on wet rocks in drainage ditches, also in marshes in Central Europe (Hustedt 1959); it prefers acid water (Patrick & Reimer 1966); abundant in highly dystrophic flowing waters or streams with optimum pH values are around 4 (Alles et al. 1991); freshwater, acidophilous, continuously high-oxygen requirements, oligosaprobous, oligotrophic (Van dam et al. 1994); common in lakes with low alkalinity waters (Camburn & Charles 2000); acidophilous preferring the pH < 7 (Szulc & Szulc 2012); freshwater with pH close to neutral water reactions, conductivity ranged between 100 to above 700 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); Planktonic/benthic, streaming water, oligohalobous-indifferent, acidophilous close to neutral with pH 4.5-7.2 (Barinova et al. 2023); reported from the benthic habitats of slightly acidic dystrophic freshwater environments.

Occurrence: Recorded infrequently in Francuskie Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Lake Żółwia Błoć in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream, a right-bank tributary of Strug River, district of Tyczyn, south Poland (Noga et al. 2013a); Różanka, Żołynianka and Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

Eunotia meridiana Metzeltin & Lange-Bertalot 1998

(Pl. 8, figs. 23-25)

Ref. Metzeltin & Lange-Bertalot 1998, p. 67, pl. 59, figs. 7-10; Tremarin et al. 2008, p. 853, figs. 33-35; Cavalcante et al. 2014, p. 7, figs. 37-45, 54, 55; Costa 2015, p. 60, pl. 32, figs. 5-14.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly arcuate, with a convex dorsal margin and linear to slightly concave ventral margin. Apices are attenuate-rounded, not detached from the valve. Terminal nodules are distinct in the ventral margins. Transapical striae are not equidistant, with more spaced median striae, parallel at the centre, about 14-16 in 10 μm, slightly radiate, and denser near the apices, about 17-20 μm. Length of the valve 17-35 μm, and the breadth 4-5.5 μm.

Remarks: *Eunotia meridiana* is similar to the small valves of *Eunotia incisadistans* Lange-Bertalot & Sienkiewicz, but it can be distinguished by the terminal raphe nodules being more distant from the apices in the second.

Ecological preference: this species is known for tropical and subtropical regions, including Brazil (Tremarin et al. 2008, Cavalcante et al. 2014); occurred in low conductivity (optimum of 66-81 μS cm^{-1}), neutral pH (7.0), and mesotrophic waters (total nitrogen optimum of 672-837 μg L^{-1} and total phosphorus optimum of 36-44 μg L^{-1}) (Costa 2015); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Zielone, Kamionka and Młynek Lakes.

Distribution in Poland: New record.

***Eunotia metamonodon* Lange-Bertalot 2011**

(Pl. 9, figs. 6-8)

Ref. Lange-Bertalot et al. 2011, p. 153, pl. 217, figs. 1-10; pl. 218, figs. 1-7; Bąk et al. 2012, p. 135, pl. 10; Bahls et al. 2018, p. 58, pl. 21, figs. 6-8; p. 118, pl. 81, figs. 1-5; p. 149, pl. 112, fig. 4.

Status of name: accepted taxonomically.

Diagnosis: Valves are arcuate, with a concave ventral margin, a convex dorsal margin that is broadly arched about the centre of the valve. The margins are more or less parallel. Apices are rostrate to subcapitate-broadly rounded, slightly bent towards the dorsal margin, detached from the valve body. A slight constriction is present between the apices and the dorsal swelling of the main body. Terminal nodules are close to the apices, terminal raphe fissures in the valve face are long, extending to the dorsal margin. Transapical striae are interrupted by the sternum near the ventral margin, unevenly spaced, slightly radiate, about 8-11 in 10 μm, becoming slightly denser near the ends, about 11-13 in 10 μm. Puncta about 25–27 in 10 μm. Length of the valve 48-235 μm, and the breadth 11-13 μm.

Remarks: This taxon is morphologically similar to *Eunotia monodon* Ehrenberg and *Eunotia maior* (W. Smith) Rabenhorst, but *Eunotia metamonodon* does not have a spine on the ends or along the dorsal margin. Moreover, *Eunotia metamonodon* has larger dimensions (Lange-Bertalot et al. 2011).

Ecological preference: *Eunotia metamonodon* reported as *Eunotia monodon*, which is a cosmopolitan species distributed across North America in slightly acid to circumneutral water (Foged 1981, Siver et al. 2005, Siver & Hamilton 2011) and is regarded as a halophobous (Foged 1981); reported from shallow, benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Recorded frequently in Zielone, Francuskie and Radomno Lakes; the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia michaelii* Metzeltin, Witkowski & Lange-Bertalot 1996**

(Pl. 9, figs. 9-12)

Ref. Metzeltin & Witkowski 1996, p. 14, pl. 34, figs. 2-8; pl. 70, figs. 18, 19; pl. 90, figs. 5, 6; Luo et al. 2019, p. 141, figs. 47-54.

Status of name: accepted taxonomically.

Diagnosis: Valves are arcuate with a strong convex dorsal margin, and the ventral margin is moderately concave to almost straight proximally. Apices slightly or barely protracted and broadly rounded. Terminal raphe fissure oblique to the poles, and visible on the valve face. Transapical striae uniseriate, parallel and widely spaced in the middle portion of the valve, about 13-15 in 10 μm, becoming denser and radiate towards the ends, about 16-18 in 10 μm. Puncta are round and about 40-45 in 10 μm. Length of the valve 15-20 μm, and the breadth 4-6 μm.

Ecological preference: Epiphytic on filamentous algae or floating viscous (Luo et al. 2019); reported from the benthic habitats of slightly acidic, dystrophic to oligotrophic freshwater environments.

Occurrence: Infrequent in Zielone and Francuskie Lakes.

Distribution in Poland: New record.

***Eunotia minor* (Kützing) Grunow 1881**

(Pl. 10, figs. 1-9)

Ref. Hustedt 1930, p. 182, fig. 238; Hustedt 1959, p. 298, fig. 763: d-f; Patrick & Reimer 1966, p. 207, pl. 12, figs. 13-14; Foged 1978, p. 59, pl. 11, fig. 13,15; John 1983, p. 68, pl. 28, fig. 13; Jensen 1985, p. 268, figs. 763d-f; Gasse 1986, p. 54, pl. 10, figs. 2-4; pl. 11, fig. 7; Krammer & Lange-Bertalot 1991 a, p. 196, pl. 142, figs. 7-15;

pl. 144, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 144, pl. 13, figs. 18-21; pl. 103, fig. 11; Bąk et al. 2012, p. 135, pl. 15; Pavlov & Levkov 2013, p. 32, pl. 48, figs. 1-17; pl. 49, figs. 1-8; pl. 50, figs. 1-4; pl. 52, figs. 6, 7; Bahls et al. 2018, p. 60, pl. 23, figs. 33-36; p. 76, pl. 39, figs. 9, 10; p. 120, pl. 83, fig. 13; p. 150, pl. 113, fig. 8.

Status of name: accepted taxonomically.

Synonyms: *Himantidium minus* Kützing 1844
Himantidium pectinale var. *minus* (Kützing) Rabenhorst 1846
Eunotia pectinalis var. *minor* (Kutzing) Rabenhorst 1864
Eunotia pectinalis f. *minor* (Kützing) O.Müller 1910
Eunotia pectinalis f. *minor* (Kützing) A.Berg 1939

Diagnosis: Valves are dorsiventral, arcuate, more or less linear with a slightly concave ventral margin that weakly inflated at the centre and distinctly convex dorsal margin, often with two shallow undulations. The valve is somewhat narrower at the ends than at the centre. Apices are protracted, wedge-shaped, subrostrate rounded, detached from the valve body. Terminal nodules are distinct, slightly distant from the apices. The distal raphe endings are short, close to the ends of the valve. Transapical striae are parallel throughout, evenly spaced, about 11-14 in 10 μm at the valve centre, slightly radiate and denser towards the ends, about 14-19 in 10 μm. Length of the valve 25-60 μm and the breadth 5-7 μm.

Ecological preference: Found in acid to circumneutral water; tolerates more calcium than many *Eunotia* species (Patrick & Reimer 1966); epiphytic, periphytic, aerophilous, halophobous, pH indifferent to acidophilous (Lowe 1974); found in waters of pH 6.5 to 7.5, with an optimal abundance around pH 7 (Alles et al. 1991); acidophilous: mainly occurring at pH < 7 (Van Dam et al. 1994); abundant in neutral to slightly acidic, low conductivity streams, occurs frequently in circumneutral freshwaters (Joh 2011); reported from the water's pH was close to circumneutral reaction, electrolytic conductivity low to relatively high ranged from 100 μS/cm to 528 μS/cm, temperature 3.0-17.5 (Noga et al. 2013 b); an acidic water (4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 μS cm^{-1} (Pociecha et al. 2020); benthic, temperate water, standing and streaming water, oligohalobous–halophobous, acidophilous to alkaliphilous with pH 4.5-8.2 (Barinova et al. 2023); reported from the benthic habitats of slightly acidic to slightly alkaline, oligotrophic to mesotrophic freshwater environments.

Occurrence: Common occurrence in Zielone and Młynek Lakes, infrequent in Francuskie, Radomno and Kamionka Lakes; infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b, c); Wisłok river, and Zalew Rzeszowski, Różanka, Baryczka, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia minor* var. *undulata* Zalat nov. var.**

(Pl. 10, figs. 10-19)

Diagnosis: Valves are dorsiventral, weakly arched. Ventral margin is more or less straight to slightly concave, and two weak undulations towards the apices of the ventral margin. Two swellings or undulations are fairly prominent on the dorsal margin and are more clear at a smaller size. Apices are broadly rounded to truncate. Terminal nodules are distinct at the apices. The raphe fissures are short, filiform, and located on the ventral valve

margin close to the apices. Transapical striae are parallel and evenly spaced at the valve centre, about 8-10 in 10 μm, radiate and denser at the ends, about 13-14 in 10 μm. Length of the valve 18-30 μm and the breadth 3-5 μm.

Remarks: The main difference between this variety and the nominate variety is bi-undulated of the bi-undulated dorsal margin. This variety is similar to *Eunotia circumborealis* Lange-Bertalot & Norpel 1993 and *Eunotia dorofeyukiae* Lange-Bertalot & Kulikovskiy 2010, but the latter species has distinct protracted, subcapitate, broadly rounded apices.

Ecological preference: This variety was commonly recorded associated with *Eunotia minor,* and it may have the same ecological preference as the nominate species.

Etymology. The epithet of the new variety refers to the undulation of the valve margins.

Holotype: the specimens illustrated in plate 10, figures 10-19.

Type locality: Młynek Lake.

Occurrence: Recorded common in Młynek Lake, frequent in Zielone Lake.

Distribution in Poland: New record.

***Eunotia minutula* Grunow 1862**

(Pl. 9, figs. 13-15)

Ref. Potapova 2014, p. 20, figs. 127-128; Noga 2019, p. 11, fig. 3U-Z, fig. 6A, B.

Status of name: accepted taxonomically.

Diagnosis: Valve is arcuate, with shallow bi-undulate or tri-undulate dorsal margin, markedly concave ventral margin. The valve apices are capitate to subcapitate, broadly rounded and recurved to the dorsal margin. Terminal nodules are distinct at the apices on the ventral margin. Terminal raphe endings curved and reached about one third to one half of the valve face, ending close to the ventral margin. Transapical striae are finely punctate, almost evenly spaced, slightly radiate throughout, about 20-24 in 10 μm.

Ecological preference: *Eunotia minutula* is a rare species in Europe, occurring in oligotrophic or dystrophic habitats (Lange-Bertalot et al. 2011); reported from the organic sediments in small and shallow peat pits under oligotrophic conditions with low pH (below 3.5) and low or medium conductivity (Noga 2019).

Occurrence: Recorded frequently in Zielone and Młynek Lakes.

Distribution in Poland: Bieszczady National Park, Kłopotnica River, Magura National Park, Międzyrzeki peatbog, Roztocze National Park, south-east Poland (Noga 2019).

***Eunotia monodon* Ehrenberg 1843**

(Pl. 10, fig. 20)

Ref. Hustedt 1930, p. 185, fig. 254; Hustedt 1959, p. 305, fig. 772 a-b; Patrick & Reimer 1966, p. 198, pl. 11, fig. 6; Germain 1981, p. 88, pl. 30, figs. 1-6; Krammer & Lange-Bertalot 1991 a, p. 210, pl. 158, figs. 1-6; Hartley et al. 1996, p. 208, pl. 96, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 154, pl. 18, fig. 2; Veselá 2009, p. 37, pl. 5, figs. 1-3; Costa 2015, p. 62, pl. 103, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Climacidium monodon* (Ehrenberg) Ehrenberg 1872

Eunotia monodon var. *genuina* Cleve-Euler 1953

Diagnosis: Valves are slightly arcuate, with a concave ventral margin and distinctly convex dorsal margin. Valve sometimes with slight swelling at the centre and narrows gradually toward the ends. Valve apices are subprotracted, broadly rounded, with a weak point at the termination. A slight constriction is present between the apices and the dorsal swelling of the main body. Terminal nodules are distinct, close to the apices on the ventral margin. The terminal raphe fissures curved around the apices onto the ventral margin. Transapical striae are finely punctate, parallel at the centre, about 8-11 in 10 μm; slightly radiate at the ends, about 12-14 in 10 μm. Puncta about 24-26 in 10 μm. The length of the valve 35-180 μm, and the breadth 7-15 μm.

Ecological preference: the species is regarded as being halophobous, acidophilous (Foged 1964); mostly common in swamps in cool to cold acid water and high in humates (Patrick & Reimer 1966); it was found in lakes and thermal springs (Gasse 1986); freshwater, acidophilous, continuously high -oxygen requirements, oligosaprobous, oligotrophic (Van dam et al. 1994); it is common in swamps that are oligotrophic to dystrophic,

showing low conductivity (Joh 2011); it occurred in acidic to alkaline (pH 6.3-7.6), low electric conductance waters (39-136 μS cm^{-1}) and oligo-mesotrophic to eutrophic conditions (total phosphorus 19.2-82.5 μg L^{-1}) (Costa 2015).

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia mucophila* (Lange-Bertalot, Nörpel & Alles) Lange-Bertalot 2007**

(Pl. 10, figs. 21-23)

Ref. Alles et al. 1991, p. 196, pl. 5, figs. 12-21; Krammer & Lange-Bertalot 1991 a, p. 180, pl. 138, figs. 20-24; Lange-Bertalot & Metzeltin 1996, p. 136, pl. 9, figs. 5-7; Veselá 2009, p. 39, pl. 19, figs. 1-32; Bąk et al. 2012, p. 136, pl. 18; Costa 2015, p. 63, pl. 15, figs. 1-20; pl. 16, figs. 1-4; Bahls et al. 2018, p. 78, pl. 41, figs. 11-13; p. 94, pl. 57, fig. 6; p. 149, pl. 112, fig. 7.

Status of name: accepted taxonomically.

Synonym: *Eunotia bilunaris* var. *mucophila* Lange-Bertalot, Nörpel-Schempp & Alles 1991

Diagnosis: Valves are slender, arcuate gradually narrow towards the ends. Margins are parallel throughout the valve, with constant width. The ventral margin is concave, and the dorsal margin is convex. Apices are rounded, indistinctly subcapitate with small helictoglossae, slightly reflexed to the dorsal margin. Distal raphe fissures are extremely short, terminating in helictoglossae. The terminal end of the raphe forms a simple arc or bow shape, and less backwardly extends towards the centre from the ends. Transapical striae are parallel in the middle part of the valve, slightly radiate near the apices, about 20-25 in 10 μm. Length of the valve 16-63 μm, and the breadth 2-3.5 μm.

Remarks: *Eunotia mucophila* is similar to *Eunotia bilunaris* and *Eunotia pararepens* Kulikovskiy, Lange-Bertalot & Witkowski but differs by its narrower valves and higher striae density. According to Kulikovskiy et al. (2010), *Eunotia mucophila* is also close to *Eunotia mongolica* Kulikovskiy, Lange-Bertalot & Witkowski and can be distinguished by the terminal raphe fissures rather long, curving back from the apices in the latter taxon.

Ecological preference: acidophilous, mainly occurring at pH < 7 (Van Dam et al. 1994; Szulc & Szulc 2012); dominant in an acidic and oligotrophic water in Poland (Buczkó 2006); found in peat bogs and dystrophic lakes (Lange-Bertalot et al. 2011); distributed in acidic and oligo-mesotrophic environments (Siver & Hamilton 2011); freshwater with pH close to circumneutral reaction, electrolytic conductivity ranged from 100 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b; 2014 a); it reported from water with pH 5.1-6.8 and total phosphorus < 18 μg L^{-1} (Costa 2015); Planktonic/benthic, temperate water, standing and streaming water, oligohalobous-halophobous, acidophilous with pH 5.25-6.4 (Barinova et al. 2023); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Zielone, Francuskie, Kamionka and Młynek Lakes.

Distribution in Poland: Holocene sediments of Vistula Lagoon, northern Poland (Witak et al. 2005); Lake Piaski and Lake Kąpielowe in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b); Gołębiówka, Szuwarka, Lubcza, Baryczka, Stobnica, Mleczka, Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Eunotia naegelii* Migula 1905**

(Pl. 10, fig. 24)

Ref. Hustedt 1930, p. 185, fig. 252; Patrick & Reimer 1966, p. 190, pl. 10, fig. 6; Gasse 1986, p. 54, pl. 11, figs. 9-10; Krammer & Lange-Bertalot 1991 a, p. 182, pl. 140, figs. 1-6; Hartley et al. 1996, p. 204, pl. 94, fig. 1; pl. 98, fig. 10; Lange-Bertalot & Metzeltin 1996, p. 136, pl. 9, figs. 8-13.Veselá 2009, p. 41, pl. 21, figs. 1-9; Bąk et al. 2012, p. 136, pl. 17; Costa 2015, p. 65, pl. 13, figs. 1-13; Bahls et al. 2018, p. 59, pl. 22, figs. 5-8; p. 125, pl. 88, figs. 8-12.

Status of name: accepted taxonomically.

Synonyms: *Synedra alpina* Naegeli ex Kützing 1849
Eunotia lunaris var. *alpina* (Nägeli ex Kützing) Grunow 1881
Pseudo-eunotia alpina (Nägeli) De Toni 1892
Eunotia alpina (Nägeli) Hustedt 1913

Diagnosis: Valves are moderately arcuate, long and slender. The ventral margin is concave, while the dorsal margin is convex. The valves become progressively narrower toward the apices. Vave spices are acutely rounded, somewhat capitate to subcapitate, slightly inflated and slightly recurved toward the dorsal margin. Terminal nodules and raphe are distinct, but generally small. Helictoglossae are located close to the apices. The distal raphe endings curve onto the valve face and continue a short distance toward the proximal raphe ends. Transapical striae are parallel at the valve centre, slightly radiate towards the ends, evenly spaced, about 16-20 in 10 μm. Length of the valve 53-128 μm, and the breadth 2-3.5 μm.

Remarks: *Eunotia naegelii* is similar to *Eunotia bilunaris*, *Eunotia genuflexa* and *Eunotia juettnerae* but differs mainly by the narrower arched valves. This species is quite similar to *Eunotia curvata* Lagerstedt, but it differs in its greater length/breadth ratio.

Ecological preference: acidophilous, halobien indifferent (Foged 1964); it prefers acid water with low mineral content (Patrick & Reimer 1966); found in subaerial habitats (Gasse 1986); the species was reported as freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van dam et al. 1994); acidophilous preferring the pH < 7 (Szulc & Szulc 2012); it was found in slightly acidic waters (pH 5.1-6.3) and from ultraoligotrophic to oligotrophic conditions (total phosphorus < 15.4) (Costa 2015); freshwater of acidic character (pH 5.4-6.5), low electrolytic conductivity ranged from 130 to 136 μS cm^{-1}, temperature 15-17.1°C, dissolved oxygen 4.2 to 5.4 mg/l^{-1} (Sienkiewicz & Gąsiorowski 2016); Planktonic/benthic, temperate water, streaming water, oligohalobous-halophobous, acidophilous with pH 4.5-6.0, oligotraphentic (Barinova et al. 2023).

Occurrence: Infrequent in Kamionka and Zielone Lakes.

Distribution in Poland: Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Mining Lake on the Łuk Mużakowa, the Wzniesienia Łużyckie macroregion west of Poland (Sienkiewicz & Gąsiorowski 2016).

***Eunotia neocompacta* Mayama 1998**

(Pl. 11, fig. 1)

Ref. Lange-Bertalot et al. 2011, p. 173, pl. 123, figs. 1, 2-16, 25-28, 32-34; Bąk et al. 2012, p. 137, pl. 19; Kulikovskiy et al. 2016, p. 126, pl. 25, figs. 7-11; Bahls et al. 2018, p. 120, pl. 83, figs. 8, 9; Bukhtiyarova 2019, p. 16, figs. 30, 30a; Noga 2019, p. 11, (Fig. 3J-O, Fig. 5A,B).

Status of name: accepted taxonomically.

Synonyms: *Eunotia exigua* var. *compacta* Hustedt 1930
Eunotia compacta (Hustedt) Mayama 1997

Diagnosis: Valves are dorsiventral, weakly arcuate, uniform in width, with a slightly convex dorsal margin and a weakly concave ventral margin. Valve apices are capitate, truncated, broadly rounded, and strongly deflected dorsally. Terminal nodules are distinct. Distal raphe endings are short filiform, curved on the ventral valve mantle. Transapical striae are finely punctate, distant, evenly spaced, parallel in the middle part of the valve, slightly radiate towards the ends, about 18-21 in 10 μm. Length of the valve 25-34 μm, and the breadth 3.5-4 μm.

Ecological preference: The species develops in fens, lakes, springs, and streams on sandstones, mainly in oligotrophic, acidic waters with low conductivity and occurring mainly in peat bogs (Lange-Bertalot et al., 2011); it is an acidophilic species and a dystrophy indicator (Hofmann 2014); freshwater epiphytic species, reported from the organic sediments in small and shallow peat pits, the species was always found in acidic pH (below 3.5) and low to medium conductivity, only in the Międzyrzeki peatbog (Noga 2019).

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Międzyrzeki and Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Wołosaty stream and its tributaries – the Terebowiec and Rzeczyca streams, as well as the Wołosate peat bog, Międzyrzeki peat bog, south Poland (Noga 2019).

***Eunotia novaisiae* Lange-Bertalot & Ector 2011**

Ref. Lange-Bertalot et al. 2011, p. 179, pl. 52, figs. 1-48; pl. 53, figs. 1-6; pl. 54, figs. 1-38; Rivera-Rondón & Catalan 2017, p. 196, pl. 28, figs. 4-5; pl. 30, figs. 1-10.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly arcuate, linear with slightly convex dorsal margin and slightly concave to more or less straight ventral margin. Valve apices are protracted more or less nose-like, obtusely rounded, and bent slightly towards to ventral margin. Terminal nodules are distinct, close to the ventral margin. Transapical striae are parallel at the centre to slightly radiate toward the ends, about 16-19 in 10 μm. Length of the valve 32-54 μm, and the breadth 3-4 μm.

Ecological preference: the species known only from a peat bog in Canada and from an acidic lake in the USA (Lange-Bertalot et al. 2011); reported from the benthic habitats of slightly acidic, dystrophic to oligotrophic freshwater environments.

Occurrence: Infrequent in Francuskie and Zielone Lakes.

Distribution in Poland: In small forest dystrophic Lake Sęczek located in the Masurian Lake District, north-east Poland (Grabowska et al. 2014); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b).

***Eunotia nymanniana* Grunow 1881**

(Pl. 11, figs. 2-3)

Ref. Patrick & Reimer 1966, p. 214, pl. 13, fig. 16; Krammer & Lange-Bertalot 1991 a, p. 201, pl. 154, figs. 31-43; Lange-Bertalot & Metzeltin 1996, p. 152, pl. 17, figs. 35-38; Veselá 2009, p. 42, pl. 28, figs. 30-31; Pavlov & Levkov 2013, p. 34, pl. 42, figs. 1-22; pl. 43, figs. 1-8; pl. 64, figs 5, 6; Żelazna-Wieczorek & Knysak 2017, p. 329, fig.16; Rivera-Rondón & Catalan 2017, p. 208, pl. 34, figs. 1-19, 25; Bahls et al. 2018, p. 176, pl. 41, figs. 3-9; pl. 112, figs. 22, 23.

Status of name: accepted taxonomically.

Synonyms: *Eunotia exigua* var. *nymanniana* Grunow 1912
Eunotia nymanniana var. *genuina* Mayer 1918
Eunotia steineckei Petersen 1930
Eunotia repens var. *steineckei* (Petersen) Cleve-Euler 1953

Diagnosis: Valves are strongly arched, with markedly concave ventral margin, and more convex dorsal margin. For most of the length of the valve, the margins are similar in shape, parallel and equally spaced. Valve apices are protracted, capitate, rounded and reflexed dorsally. Terminal nodules are large, distinct on the ventral margin close to the apices. The distal raphe ends are short, curve onto the valve face, extending a little to the dorsal margin and then curving back slightly toward the centre of the valve face. Transapical striae are evenly spaced, parallel throughout the valve, becoming radiate at the apices, about 18-22 in 10 μm. Length of the valve 18-42 μm, and the breadth 5.5-3.5 μm.

Remarks: The species is similar in shape to *Eunotia fallax* A. Cleve. It differs only in that the striae are much finer.

Ecological preference: In water of low mineral content (Patrick & Reimer 1966); freshwater, acidophilous, oligosaprobous, oligotrophic (Van dam et al. 1994); freshwater of acidic character (pH 5.4-6.5), low electrolytic conductivity ranged from 130 to 136 μS cm^{-1}, temperature 15-17.1°C, dissolved oxygen 4.2 to 5.4 mg/l^{-1} (Sienkiewicz & Gąsiorowski 2016); reported from the benthic habitats of slightly acidic to slightly alkaline, oligotrophic to mesotrophic freshwater environments.

Occurrence: Recorded frequently in Zielone, Kamionka and Młynek Lakes.

Distribution in Poland: The species was reported as *Eunotia steineckei* in Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); small forest dystrophic Lake Sęczek located in the Masurian Lake District, north-east Poland (Grabowska et al. 2014); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Mining lake, on the Łuk Mużakowa, theWzniesienia Łużyckie macroregion west Poland

(Sienkiewicz & Gąsiorowski 2016); Spring at the Goprowska Pass (Bieszczady National Park), south east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); sediments of postmining Lake ŁK-46 in the Łuk Mużakowa, south-west Poland (Sienkiewicz et al. 2023).

***Eunotia palatina* Lange-Bertalot & Krüger 2004**

(Pl. 9, figs. 16-21)

Ref. Pavlov & Levkov 2013, p. 34, pl. 51, figs. 14-20; Rivera-Rondón & Catalan 2017, p. 186, pl. 23, figs. 1-14; Żelazna-Wieczorek & Knysak 2017, p. 329, fig.17; Luo et al. 2019, p. 135, fig. 91.

Status of name: accepted taxonomically.

Diagnosis: Valves are broad, linear to weakly arcuate, with parallel margins. Dorsal margin is slightly convex to almost straight, somewhat slightly undulate. The ventral margin is slightly concave to straight. Valve apices are weakly protracted, subcapitate, broadly rounded and slightly reflexed dorsally. Terminal nodules are small and distinct on the ventral margin at the apices. Transapical striae are parallel, evenly spaced at the valve centre, about 12-14 in10 μm; slightly radiate at the ends, about 15-18 in10 μm. Length of the valve 23-48 μm, and the breadth 4.5-7 μm.

Ecological preference: It is reported from a poorly mineralized, well-oxygenated freshwater, pH was slightly acidic, and the temperature was low and inducing oligotrophic and oligosaprobic water (Beauger et al. 2020); Aereophilc species, acidophilous with optimum pH 5.23 (Foets et al. 2021); reported from the benthic habitats of slightly acidic, dystrophic to oligotrophic freshwater environments.

Occurrence: Recorded frequently in Zielone Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Eunotia paludosa* Grunow 1826**

(Pl. 11, fig. 4)

Ref. Hustedt 1930, p. 178, fig. 228; Krammer & Lange-Bertalot 1991, p. 203, pl. 155, figs. 1-20, 22-37; Hartley et al. 1996, p. 210, pl. 97, fig. 2; Lange-Bertalot & Metzeltin 1996, p. 152, pl. 17, figs. 48-19; pl. 103, fig. 12; Veselá 2009, p. 43, pl. 27, fig. 34; Pavlov & Levkov 2013, p. 35, pl. 42, figs. 23-38; pl. 47, figs. 5, 6; Costa 2015, p. 67, pl. 17, figs. 1-10; Rivera-Rondón & Catalan 2017, p. 210, pl. 35, figs. 1-3; Bahls et al. 2018, p. 60, pl. 23, figs. 9-15; p. 125, pl. 88, figs. 24, 25.

Status of name: accepted taxonomically.

Synonym: *Himantidium paludosum* (Grunow) Lagerstedt 1873

Diagnosis: Valves are isopolar, linear to slightly arcuate. The ventral margin is slightly concave, and the dorsal margin is parallel or convex. Valve apices are narrowly or broadly rounded, subcapitate, and weakly reflexed dorsally. Terminal nodules are small, dot-like, terminally positioned, and slightly distant from valve apices. Proximal raphe ends are sited on the ventral valve margin, below valve ends, towards the middle. The distal raphe endings are short, arched or bow-shaped at the valve apices, and slightly expanded. Helictoglossae conspicuous, rimoportula small and located on the mantle at the end of the valve. Transapical striae are parallel throughout, equidistant, slightly radiate at one end, about 15-18 in 10 μm. Length of the valve 23-45 μm, and the breadth 3.5-5 μm.

Remarks: *Eunotia paludosa* is similar to *Eunotia leptopaludosa* Lange-Bertalot in the valve outline, but the latter presents narrower valves and higher striae density about 28-30/10 μm (Lange-Bertalot et al. 2011).

Ecological preference: *Eunotia paludosa* often found associated to mosses in acid waters of low mineral content, also in bogs and small streams (Patrick & Reimer, 1966); it prefers very low conductivity and strongly dystrophy in stagnant pools or channels, it occurs at pH values from 4 to 7, however, its optimum abundance is around pH 4, it is usually found in high moor and peat lands, and springs covered with *Sphagnum* (Alles et al. 1991). Acidobiontic, optimal occurrence at pH < 5.5; freshwater, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); the species occur in a ultra-oligotrophic high-Arctic lake, El'gygytgun (Cremer & Wagner 2003); it is classified as a sensitive taxon to human disturbance in herbaceous wetlands in Florida (Lane

& Brown 2007); it is reported as acidophilous or acidobiontic (Lange-Bertalot et al. 2011; Van de Vijver et al. 2014); Benthic, oligohalobous indifferent, acidobiontic, oligotraphentic, oligosaprobous (Witak & Jankowska 2014); it was found in low abundances with slightly acidic water (pH 5.4-6.6), low to median electric conductance (10-117 μS cm^{-1}) and ultraoligo- to eutrophic conditions (total phosphorus < 80 μg L^{-1}) (Costa 2015); it is recorded from peat bog areas that characterized by low pH (<5) and low conductivity (Noga & Poradowska 2022).

Occurrence: Infrequent in Zielone and Radomno Lakes.

Distribution in Poland: Lake Piaski, Lake Żółwia Błoć and Lake Kąpielowe in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Bieszczady National Park; Międzyrzeki peat bog, Roztocze National Park, south-east Poland (Noga 2019; Noga & Poradowska 2022).

***Eunotia panda* Veselá & Johansen 2014**

(Pl. 12, figs. 1-3)

Ref. Veselá & Johansen 2014, p. 189, fig. 56-103

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, narrow and distinctly arcuate, isopolar. Ventral and dorsal valve margins are parallel through most of the valve, tapering near the apices, and slightly reflexed dorsally at the ends. Valve apices are weakly protracted, acutely rounded. Raphe is distinct, short, begins on the valve mantle, and curves subapically on the valve face back towards the main part of the valve. Helictoglossa is small, visible at the ends. A single rimoportula is placed at the apex near the helictoglossa. Transapical striae are parallel in the valve centre, radiating towards the apices, about 15-17 in 10 μm in the centre valve, up to 21 in 10 μm near the apices. Length of the valve 40-100 μm, and the breadth 3-4 μm.

Remarks: *Eunotia panda* is similar in shape to *Eunotia bilunaris* (Ehrenberg) Schaarschmidt but differs in the apices, which are slightly recurved dorsally. According to Veselá & Johansen 2014, *Eunotia panda* shares some features with *Eunotia juettnerae* Lange-Bertalot or *Eunotia mucophila* (Lange-Bertalot, Nörpel-Schempp et Alles) Lange-Bertalot.

Ecological preference: The species was reported from ponds, streams and wetlands in Europe, dystrophic habitat, and a peat bog environment (Lange-Bertalot et al. 2011); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Zielone, Francuskie and Radomno Lakes.

Distribution in Poland: It is reported from a peat bog in Tatra Mountains, south Poland (Lange-Bertalot et al. 2011).

***Eunotia parallela* Ehrenberg 1843**

(Pl. 11, figs. 5-6)

Ref. Hustedt 1930, p. 183, fig. 247; Cleve-Euler 1934, p. 24, pl. 1, fig. 24; Hustedt 1959, p. 302, fig. 768; Patrick & Reimer 1966, p. 193, pl. 10, fig. 12; Krammer & Lange-Bertalot 1991 a, p. 208, pl. 152, figs. 1-7; Cavalcante et al. 2014, p. 8, figs. 47, 48; Luo et al. 2019, p. 135, figs. 86-89.

Status of name: accepted taxonomically.

Synonyms: *Himantidium parallelum* (Ehrenberg) Lagerstedt 1873
Eunotia media A. Cleve 1895
Eunotia pseudoparallela Cleve-Euler 1934
Eunotia parallela var. *media* Cleve-Euler 1953.

Diagnosis: Valves are dorsiventral, linear, curved or slightly arched, with a convex dorsal margin, slightly concave ventral margin, and the margins are parallel. Valve apices are broadly rounded, not expanded or swollen and not detached from the valve. Terminal nodules are small and distinct near the apices. Terminal raphe fissures

are simple, almost reaching the apex centre. Transapical striae are not equidistant, parallel in the middle, becoming radiate towards the ends, about 12-15 in 10 μm. Length of the valve 38-95 μm, and the breadth 7-13 μm.

Remarks: This species is distinguished by the parallel margins of the valve and the rounded ends.

Ecological preference: In cool water (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); common in North European regions and in cool to cold waters, often associated with *Sphagnum* in swamps, found as epiphytic on bryophyte substrates in streams of the Rocky Mountains and with pH ranges from 4.5 to 5.0 (Furey 2008).

Occurrence: Frequent in Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia parallela* var. *polinica* Zalat & Pidek nov. var.**

(Pl. 11, figs. 7-11)

Diagnosis: Valves are weakly to moderately arcuate, with parallel dorsal and ventral margins. The dorsal margin is broadly convex, and the ventral margin is broadly concave. Apices are weakly cuneate, broadly rounded, not or extremely weakly differentiated from the body of the valve. Terminal raphe endings occur as short curves hooked onto the valve face close to the mid-point of the apices. Tansapical striae are punctate, parallel throughout the valve, evenly spaced, about 10-11 in 10 μm, denser at the apices, about 14-15 in 10 μm. Length of the valve 55-80 μm, and the breadth 7-8 μm.

Remarks: This variety is relatively similar to *Eunotia parallela* var. *hinganica* Skvertzov 1976, but differs by having denser parallel striae at the apices and cuneate to broadly rounded ends.

Etymology. The epithet of the new variety refers to Poland.

Holotype: the specimens illustrated in plate 11, figures 7-11.

Type locality: The Eemian palaeolake deposits from the Struga site in central Poland.

Occurrence: Recorded frequently from the Eemian palaeolake deposits of central Poland, and infrequently from Młynek Lake.

Distribution in Poland: New record.

***Eunotia paralleladubia* Lange-Bertalot & Mayama 2011**

(Pl. 11, fig. 12)

Ref. Cleve-Euler 1953, p. 83, fig. 408 a-c; Lange-Bertalot et al. 2011, p. 190, pl. 202, figs. 1-9; pl. 203, figs 4-5; Bahls et al. 2018, p. 117, pl. 80, figs. 1-7; p. 149, pl. 112, fig. 5.

Status of name: accepted taxonomically.

Synonym: *Eunotia parallela* var. *pseudoparallela* (Cleve-Euler) Cleve-Euler 1953

Diagnosis: Valves are arcuate. The ventral and dorsal margins are curved and parallel. The valves may have a very shallow distal depression in the dorsal margin near the apex. Apices are broadly rounded. Terminal raphe fissures are hooked over the ventral margin of the apices, appearing like short curves deflected toward the dorsal margin near the distal valve face. Helictoglossae are distinct on the ventral margin near the valve end. Transapical striae are finely punctate, regularly spaced and parallel in the middle part of the valve, about 13-14 in 10 μm; becoming radiate and irregular near the apices, about 15-18 in 10 μm. Puncta 28-30 in 10 μm. length of the valve 48-100 μm, and the breadth 8-10 μm.

Remarks: *Eunotia paralelladubia* Lange-Bertalot & Mayama also differs by being wider (8-11 μm) and having terminal nodules closer to ends (Lange-Bertalot et al. 2011). This species is similar in shape to *Eunotia pseudoparallela* Cleve 1934.

Ecological preference: The species was reported from freshwater with temperature ranges from 13.3 to 16.7°C, pH was neutral to slightly alkaline (pH 6.65-7.51), low suspended matter, high dissolved oxygen content from 8.7 to 10.47 mg/l^{-1}, low and mild salinity levels, hydrocarbonate-water (Barinova et al. 2023); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: Poland (Bąk et al. 2012).

***Eunotia paratridentula* Lange-Bertalot & Kulikovskiy 2010**

(Pl. 12, fig. 4)

Ref. Krammer & Lange-Bertalot 1991, p. 217, pl. 156, figs. 12, 22; Hartley et al. 1996, p. 216, pl. 100, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 148, pl. 15, figs. 27-30; Veselá & Johansen 2009, p. 31, figs. 22, 23; Bąk et al. 2012, p. 138, pl. 16; Costa 2015, p. 81, pl. 69, figs. 1-5; pl. 70, figs. 1-3; Bahls et al. 2018, p. 76, pl. 39, figs. 5, 6.

Status of name: accepted taxonomically.

Synonyms: *Eunotia muscicola* var. *tridentula* Nörpel & Lange-Bertalot 1993
Eunotia quaternaria Ehrenberg 1843
Eunotia quinaria Ehrenberg 1843:
Eunotia septena Ehrenberg 1843
Eunotia ehrenbergii Ralfs in Pritchard 1861

Diagnosis: Valves are slightly arcuate. The dorsal margin is convex with three undulations. The ventral margin is concave, with slight swelling near the ends or pronounced undulation. Valve apices are protracted, capitate or subcapitate, rounded and narrower than the undulations, and slightly deflected dorsally. Terminal nodules are sited near the ends of the valve. Distal raphe endings are curved toward the dorsal margin close to the valve ends. The rimoportula is located midway along one valve apex. Transapical striae are slightly radiate throughout the entire of valve, about 16-18 in 10 μm. Length of the valve 19-35 μm, and the breadth 4-5 μm.

Remarks: The species is similar to *Eunotia perminuta* (Grunow) Patrick, which also presents ventral undulations and lower striae density (14-19/10 μm).

Ecological preference: *Eunotia muscicola* var. *tridentula* was reported from cool, acidic waters of New England States and Montana (Patrick & Reimer 1966); it is reported from water's pH close to circumneutral reaction; electrolytic conductivity ranged from 100 μS/cm to 528 μS/cm, (Noga et al. 2013 b; 2014 a); the species is a typical constituent of low conductivity waters (<100 μS cm-1) and occurs in periphytic and sediment samples (Van de Vijver et al. 2014); found in ultraoligo- to oligo-mesotrophic conditions, acidic to slightly acidic (pH 5.4-6.8), low conductivity (10-39 μS cm^{-1}) and low phosphorus content (< 20.3 μg L^{-1}) (Costa 2015).

Occurrence: Infrequent from the Eemian palaeolake deposits of central Poland.

Distribution in Poland: as *Eunotia tridentula* from Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); Wisłok river and Baryczka stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a)

***Eunotia pectinalis* (Kützing) Rabenhorst 1864**

(Pl. 11, figs. 15-18)

Ref. Hustedt 1930, p. 180, fig. 237; Hustedt 1959, p. 296, fig. 763a,k; Patrick & Reimer 1966, p. 204, pl. 12, figs. 8, 10; Foged 1978, p. 59, pl. 12, fig. 10; Foged 1979, p. 49, pl. 9, fig. 15; pl. 11, fig. 5; John 1983, p. 67, pl. 28, figs. 10-12; Jensen 1985, p. 267, fig. 763a,k; Krammer & Lange-Bertalot 1991, p. 193, pl. 141, figs. 1-7; pl. 143, fig. 1; Metzeltin & Witkowski 1996, p. 98, pl.. 33, fig. 1; Lange-Bertalot & Metzeltin 1996, p. 146, pl. 14, figs. 5-7; Bahls et al. 2018, p. 116, pl. 79, figs. 6-8.

Status of name: accepted taxonomically.

Synonyms: *Himantidium pectinale* Kützing 1844
Conferva pectinalis Dillwyn 1809
Temachium pectinale (Dillwyn) Wallroth 1831
Eunotia depressa Ehrenberg 1843
Himantidium strictum Rabenhorst 1853
Eunotia pectinalis var. *stricta* (Rabenhorst) Rabenhorst 1864
Eunotia pectinalis f. *elongata* Grunow 1881
Eunotia pectinalis var. *impressa* O.Müller 1898
Himantidium pectinale var. *impressum* (O.Müller) Schonfeldt 1907
Eunotia pectinalis f. *impressa* (O.Müller) Ant.Mayer 1913

Diagnosis: Valves are weakly arcuate, elongate. The ventral margin is slightly concave, sometimes slightly swollen at the centre. The dorsal margin is slightly convex and has 3-5 undulations, usually almost parallel to the ventral margin. In some smaller specimens, the dorsal undulations are weakly expressed. Valve apices are broadly attenuated, truncately rounded and slightly recurved to the dorsal margin. Terminal nodules are distinct. The raphe curves around the apical margin and along the dorsal valve. Transapical striae are punctate, parallel at the centre, about 8-11 in 10 µm, becoming radiate at the apices, about 12-14 in 10 µm, usually coarser at the centre than at the ends. Puncta 25-27 in 10 µm. Length of the valve 20-140 µm, and the breadth 5-10 µm.

Ecological preference: It is regarded as being pH-indifferent (Foged 1964); it prefers water of low mineral content and oligotrophic to eutrophic (Patrick & Reimer 1966); the species occurred as epiphytic, epipelic or aerophilous in peat-bogs, swamps, lakes and rivers, observed in slightly acidic water with low to medium-low alkalinity (Gasse 1986); epiphytic, periphytic; halophobous, acidophilous (Lowe 1974); a cosmopolitan species (Foged 1981); acidophilus: mainly occurring at pH<7, β-mesoaprobic, mesotrophic (Van Dam et al. 1994); the species is acidophilic and has been found living in the epiphyton, epilithon, and metaphyton of oligotrophic to eutrophic lakes (Siver & Hamilton 2011), streams (Foged 1981), and wetlands (Burge 2014); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak, Radomno, Francuskie, Zielone and Kamionka Lakes, and infrequently in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia pectinalis* var. *ventricosa* (Ehrenberg) Grunow 1881**

(Pl. 11, figs. 19-20)

Ref. Hustedt 1911, p. 276, pl. 3, figs. 26- 27; Hustedt 1957, p. 241; Patrick & Reimer 1966, p. 205, pl. 12, fig. 9; Kaczmarska 1977, p. 40, pl. 8, fig. 4.

Status of name: accepted taxonomically.

Synonyms: *Heterocampa ventricosa* Ehrenberg 1869
Eunotia ventralis Ehrenberg 1843
Eunotia parallela var. *ventralis* (Ehrenberg) Grunow 1865
Eunotia major var. *ventralis* (Ehrenberg) Tempère & Peragallo 1889
Eunotia pectinalis var. *ventralis* (Ehrenberg) Hustedt 1911
Eunotia pectinalis f. *ventralis* (Ehrenberg) Hustedt 1957

Diagnosis: Valves are arcuate. The dorsal margin is slightly concave in the middle of the valve; the ventral margin with a distinct swelling at the valve centre. The valve narrowed toward the broadly attenuated rostrate rounded ends. A clear line formed by a break in the striae is often seen near the ventral margin in the region of the ventral swelling. Terminal nodules are distinct. Raphe fissure curves around the apical margin and along the dorsal valve. Transapical striae are punctate, parallel at the centre, about 9-10 in 10 µm, becoming radiate at the apices, about 12-14 in 10 µm. Length of the valve 28-110 µm, and the breadth 5-8 µm.

Ecological preference: According to Patrick & Reimer (1966), this variety is often found with the species; reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Infrequent in Radomno and Młynek Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Eunotia pomeranica* Lange-Bertalot, Bak & Witkowski 2011**

(Pl. 12, figs. 5-10)

Ref. Lange-Bertalot et al. 2011, p. 198, pl. 224, figs. 1-13; pl. 225, figs. 1-15; pl. 226, figs. 1-5; Luo et al. 2019, p. 139, figs. 39-46.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderately dorsiventral, arcuate, with a convex dorsal margin and the ventral margin is moderately concave to almost straight and parallel to the dorsal margin. Valve apices are subprotracted, broadly rounded. Terminal raphe ends are oblique to the polar end. Transapical striae are uniseriate, finely punctate, parallel at the middle valve, becoming radiate at the apices, about 13-16 in 10 μm, and up to 18-20 in 10 μm near the ends. Puncta about 37-40 in 10 μm. Length of the valve 30-55 μm, and the breadth 5 -8 μm.

Ecological preference: Epiphytic on filamentous algae and floating viscous or flocculent substance (Luo et al. 2019); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Kamionka Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: The species was recorded from Piaski Lake, in Western Pomerania, north-west Poland (Lange-Bertalot et al. 2011).

***Eunotia praerupta* Ehrenberg 1843**

(Pl. 12, figs. 11-15)

Ref. Hustedt 1930, p. 174, fig. 211; Hustedt 1959, p. 280, fig. 747 A: a-e; Patrick & Reimer 1966, p. 193, pl. 10, fig. 14; Krammer & Lange-Bertalot 1991, p. 186, pl.148, figs. 1-3; pl. 149, figs. 1-7; Ehrlich 1995, p. 49, pl. 8, figs. 12-13; Lange-Bertalot & Metzeltin 1996, p. 142, pl.12, figs. 12-13; Metzeltin & Witkowski 1996, p. 98, pl.33, fig. 6; Bąk et al. 2012, p. 139, pl. 13; Pavlov & Levkov 2013, p. 35, pl. 18, fig. 7; pl. 19, figs. 1-10; Bahls et al. 2018, p. 79, pl. 42, figs. 8, 9; p. 150, pl. 113, figs. 17-21; Bukhtiyarova 2019, p. 17; fig. 31.

Status of name: accepted taxonomically.

Synonyms: *Himantidium praeruptum* (Ehrenberg) Ralfs 1861
Eunotia praerupta f. *curta* (Grunow) Mayer 1917
Eunotia bidens var. *praerupta* (Ehrenberg) Aysel 2005
Eunotia praerupta var. *genuina* Grunow 1881

Diagnosis: Valves are dorsiventral, arcuate, with convex dorsal and weakly concave to more or less straight ventral margins. Valve apices are rostrate to truncate-capitate, broadly rounded, and reflexed slightly dorsally. Terminal nodules are distinct at the ends, extending upward along the apices. Raphe short filiform slits on ventral valve mantle, distal raphe endings terminated at the apices by small round pore-like outer connected with helictoglossae. Transapical striae are distant, irregularly spaced, parallel at the centre, about 7-9 in 10 μm and denser, slightly radiate towards the apices, about 8-12 in 10 μm. Length of the valve 32-70 μm, and the breadth 8-14 μm.

Ecological preference: The species is regarded as an acidophilous (Hustedt 1957), its pH-optimum around 5.5 (Cholnoky 1968); acidophilous, aerophilous (Kaczmarska 1976); it is reported from oligo-mesotrophic and slightly acidic waters (Foged 1978); It was found as an epiphytic on mosses in subaerial habitats (Gasse 1986); acidophilous, mainly occurring at pH < 7, oligosaprobic, oligo-mesotrophic (Van Dam et al. 1994; Szulc & Szulc 2012); circumneutral water, electrolytic conductivity ranged from 100 μS/cm to 528 μS/cm, temperature 3.0-17.5 (Noga et al. 2013 b; 2014 a); freshwater epiphytic species, observed in slightly acidic (pH 6.4), electrolyte-poor (40 μS cm^{-1}) and mesotrophic condition (total phosphorus 34 μg cm^{-1}) (Costa 2015).

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); in springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia pseudominor* Pavlov & Levkov 2013**

(Pl. 12, figs. 16-20)

Ref. Pavlov & Levkov 2013, p. 37, pl. 49, figs 9-46; pl. 50, figs. 5, 6; pl. 66, figs. 1-22.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly arcuate with a weakly convex dorsal margin and weakly concave or straight ventral margin. Apices are slightly protracted, broadly rounded. Distal raphe endings are quite short, slightly curved to linear, rarely extending to the mid-point of the valve apex, and terminated with prominent helictoglossa. Proximal raphe endings are placed on the ventral valve margin, below valve ends. Terminal nodules are small, apically positioned. Transapical striae are finely punctate, parallel, evenly spaced at the valve centre, 11-13 in 10 µm, becoming slightly radiate at valve apices, about 13-17 in 10 µm. Length of the valve 15-30 µm, and the breadth 3.5-5 µm.

Remarks: *Eunotia pseudominor* is distinguished from *Eunotia minor* by its shorter protracted valve ends, less curved dorsal valve margin and lower valve breadth (Pavlov & Levkov 2013).

Ecological preference: An epiphyte taxon on moss vegetation from a peat bog environment (Pavlov & Levkov 2013); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Recorded frequently in Zielone and Radomno Lakes; infrequently in Kamionka and Młynek Lakes.

Distribution in Poland: New record.

***Eunotia pseudopaludosa* Van de Vijver, Haan & Lange-Bertalot 2014**

(Pl. 12, figs. 21-22)

Ref. Van de Vijver et al. 2014, p. 274, pl. 12, figs. A-Z; Jüttner et al. 2018, p. 434, figs. 138-152.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly arcuate with a moderately concave ventral margin and a parallel to slightly convex dorsal margin. Valve apices are more or less set off, protracted, subcapitate, rounded, and deflected dorsally. Terminal raphe nodules are distinct, close to the ends; distal raphe fissures are rather long. Transapical striae are parallel at the valve centre, becoming slightly radiate towards the apices, about 18-20 in 10 µm. Length of the valve 25-34 µm, and the breadth 2.5-3.5 µm.

Ecological preference: It is found in the sediment of a small coastal pool with a circumneutral pH and low specific conductance value (<100 µS/cm) (Van de Vijver et al. 2014).

Occurrence: Recorded infrequently in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Eunotia radomnoensis* Zalat nov. sp.**

(Pl. 13, figs. 1-10)

Diagnosis: Valves are linear for most of the length. The dorsal and ventral margins are parallel, straight along the valve and slightly arched towards the ends. Apices consistently distinctly broadly rounded, not protracted or reflexed to the dorsal margin. Terminal nodules are quite moderate in size, slightly distant from valve apices. Short terminal raphe fissures are visible in valve view at the ends of the ventral margin close to valve apices. Transapical striae are consistently evenly spaced and parallel along the valve, about 10-12 in 10 µm at the valve centre, denser at the apices, about 12-15 in 10 µm. Length of the valve 67-79 µm, and the breadth 6-8 µm.

Remarks: This species is relatively similar to *Eunotia gracilis* f. *densestriata* Sarode & Kamat 1948, and *Eunotia ruzickae* Bílý & Marvan 1962, but the new taxon differs by having parallel straight margins throughout most of the valve that curved weakly towards broadly rounded, not reflexed apices. *Eunotia ruzickae* has a valve clearly dorsiventral, weakly curved with a slightly convex and weakly undulate dorsal margin, and the apices are weakly deflected dorsally.

Etymology: the epithet of the new species refers to Radomno Lake.

Holotype: the specimens illustrated in plate 13, figures 1-10.

Type locality: Radomno Lake, south of Iława, within Warmia-Masuria district, northern Poland.

Ecological preference: Reported from the shallow**,** benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Eunotia rhomboidea* Hustedt 1950**

(Pl. 13, figs. 11-13)

Ref. Hustedt 1950, p. 435, pl. 36, figs. 34-41; Krammer & Lange-Bertalot 1991 a, p. 223, pl. 162, figs. 3-4; pl. 164, figs. 12-20; Hartley et al. 1996, p. 214, pl. 99, figs. 1, 2; Lange-Bertalot & Metzeltin 1996, p. 150, pl. 16, figs. 5-7; Joh 2011, p. 65, figs. 59, 60; Bąk et al. 2012, p. 140, pl. 16; Costa 2015, p. 75, pl. 45, figs. 1-32; pl. 46, figs. 1-5; Bahls et al. 2018, p. 39, pl. 2, fig. 17; p. 125, pl. 88, fig. 23.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear to weakly arcuate, heteropolar, more or less asymmetric to the apical and transapical axes, with straight to weakly concave ventral margin and slightly convex dorsal margin. Valve apices are slightly produced, bluntly rounded. Subapical terminal nodules are often positioned at different distances from each end, close to the ventral margin. The raphe on the valve face is very short, and the major parts of the raphe on the mantle. Transapical striae are distinct, evenly spaced, becoming slightly denser near the valve apices, about 15-18 in 10 μm. Length of the valve 12-25 μm and the breadth 2-4 μm.

Remarks: This species is characterized by its heteropolar valves, rhombic or oblique rectangular shape in girdle view and some asymmetry along the transapical axis of the valve.

Ecological preference: Common in oligotrophic and low-conductivity waters (Krammer & Lange-Bertalot 1991a); it was reported in acid, oligotrophic to dystrophic lakes (Hofmann 1994); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); prefers eutrophic waters with optimum conductivity of 108 μS cm^{-1} and slightly alkaline (pH optimum of 7.3) (Costa 2015); benthic, temperate water, streaming water, oligohalobous–halophobous, acidophilous with pH 4.8-6.4 (Barinova et al. 2023); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno, Kamionka and Młynek Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011), rivers and streams in the valley of the Wisłok River and on cultivated soils of the podkarpacie Province, south Poland (Noga et al. 2014a); Mining lake, on the Łuk Mużakowa, the Wzniesienia Łużyckie macroregion west Poland (Sienkiewicz & Gąsiorowski 2016); springs at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia rhynchocephala* Hustedt 1936**

(Pl. 13, fig.14)

Ref. Hustedt 1936, p. 170, figs. 5, 6; Veselá 2009, p. 46, pl. 29, fig. 28; Bąk et al. 2012, p. 140, pl. 16.

Status of name: accepted taxonomically.

Diagnosis: Valves are very strongly dorsiventral; ventral margin is almost straight to moderately concave; the dorsal margin is strongly convex, somewhat weakly undulated. Apices are protracted, capitate and dorsally reflexed. Apices of shorter specimens are more obtusely rounded. Helictoglossae are positioned close to the apices. Terminal nodules are small, distinct close to the ends. The terminal ends of the raphe are difficult to observe accurately with a light microscope. Transapical striae are parallel at the centre, slightly radiate towards the ends, about 14-18 in 10 μm. Length of the valve 12-20 μm, and the breadth 3.5-4.5 μm.

Remarks: This taxon is distinguished from *Eunotia meisteri* by its highly convex, almost flattened dorsal valve margin. Striae density is lower compared to *E. meisteri* as well.

Ecological preference: This species co-occurs with other acidophilic species in oligo- to dystrophic waters with low electrolytic conductivity (Bąk et al. 2012); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Infrequent in Młynek and Zielone Lakes.

Distribution in Poland: (Bąk et al. 2012).

***Eunotia seminulum* Nörpel-Schempp & Lange-Bertalot 1996**

(Pl. 13, fig. 15)

Ref. Lange-Bertalot & Metzeltin 1966, p. 53, pl. 17, figs. 43-47; Van de Vijver et al. 2014, p. 260, fig. 2L-U; Rivera-Rondón & Catalan 2017, p. 202, pl. 31, figs. 17-25.

Status of name: accepted taxonomically.

Diagnosis: Valves are arcuate, with a slightly concave ventral margin to almost less straight, and moderately convex dorsal margin. Valve apices are acutely rounded to subcuneate, very slightly protracted in larger valves. Terminal nodules are small, distinct close to the ends. Distal raphe endings are short, curved onto the valve face close to the apices. Transapical striae are parallel in the valve centre, becoming slightly radiate towards the apices, about 20-22 in 10 μm. Length of the valve 8-23 μm, and the breadth 2.5-3.5 μm.

Ecological preference: found in small acidic pools with a pH range of 4.2-5.6 and low specific conductance values (<100 μs/cm) (Van de Vijver et al. 2014); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Eunotia septentrionalis* Østrup 1897**

(Pl. 13, figs. 16-17)

Ref. Hustedt 1930, p. 179, fig. 232; Hustedt 1959, p. 292, fig. 758; Cleve-Euler 1953, p. 131, fig. 478a-p; Patrick & Reimer 1966, p. 212, pl. 13, fig. 10; Krammer & Lange-Bertalot 1991 a, p. 213, pl. 157, figs. 13-18; Hartley et al. 1996, p. 214, pl. 99, fig. 4; Lange-Bertalot & Metzeltin 1996, p. 150, pl. 16, figs. 25-30; Noga et al. 2014 a, p. 22, pl. 1, fig. 34; Bahls et al. 2018, p. 120, pl. 83, fig. 10.

Status of name: accepted taxonomically.

Synonym: *Eunotia septentrionalis* f. *genuina* Cleve-Euler 1953

Diagnosis: Valves are arcuate, with a concave ventral margin, and a strongly convex dorsal margin which suddenly slopes near the ends. Valve apices are rostrate and capitate, rounded, strongly reflexed towards the dorsal margin. Terminal nodules are fairly large, close to the ventral margin at the valve ends. Transapical striae are parallel at the centre, slightly radiate towards the ends, about 16-20 in 10 μm. Length of the valve 14-37 μm, and the breadth 4-6 μm.

Remarks: *Eunotia septentrionalis* is morphologically similar to the *Eunotia exigua* Rabenhorst complex and can be separated by a strongly convex dorsal margin and wide valves. Also, the species is similar in many characteristics to *Eunotia tenella* Hustedt but differs in more arch-formed valves with slightly reflexed ends.

Ecological preference: Found in cool acid water of low mineral content (Patrick & Reimer 1966); acidophilous with pH 5 to 6, it does not tolerate dystrophic environments (Alles et al. 1991); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); it is reported as an acidophilic species in waters of high sulfur content (De Nicola 2000), neutral water reactions, conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); Planktonic/benthic, streaming water, oligohalobous–halophobous, acidophilous to alkaliphilous with pH 4.5-7.5, oligotraphentic (Barinova et al. 2023); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Infrequent in Kamionka and Zielone Lakes.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Wisłok river and Różanka stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia serra* Ehrenberg 1837**

(Pl. 14, figs. 1-3)

Ref. Hustedt 1959, p. 273, fig. 740; Patrick & Reimer 1966, p. 200, pl. 12, fig. 2; Krammer & Lange-Bertalot 1991 a, p. 219, pl. 146, figs. 1-2; Hartley et al. 1996, p. 214, pl. 99, fig. 6; pl. 101, fig. 3; Lange-Bertalot & Metzeltin 1996, p. 140, pl. 11, fig. 1; Veselá 2009, p. 49, pl. 2, figs. 1-5; Bąk et al. 2012, p. 140, pl. 14; Bahls et al. 2018, p. 76, pl. 39, fig. 11.

Status of name: accepted taxonomically.

Synonyms: *Eunotia robusta* var. *serra* (Ehrenberg) Meister 1912
Eunotia decaodon Ehrenberg 1840
Eunotia endecaodon Ehrenberg 1840
Eunotia enneodon Ehrenberg 1840
Eunotia heptodon Ehrenberg 1840
Eunotia icosodon Ehrenberg 1840
Eunotia octodon Ehrenberg 1840
Eunotia serrulata Ehrenberg 1840
Eunotia bioctonaria Ehrenberg 1840
Eunotia polyodon Ehrenberg 1845
Eunotia dodecaodon Ehrenberg 1854
Eunotia quatuordenaria Ehrenberg 1854
Eunotia quindenaria Ehrenberg 1854
Eunotia scalaris Ehrenberg 1854
Eunotia tredenaria Ehrenberg 1854
Eunotia undenaria Ehrenberg 1854
Eunotia prionotus Ehrenberg 1854
Eunotia robusta var. *serrulata* (Ehrenberg) Ralfs 1861
Eunotia robusta var. *dodecaodon* (Ehrenberg) Ralfs 1861
Climacidium decaodon Ehrenberg 1869
Himantidium polyodon (Ehrenberg) Brun 1880
Eunotia robusta var. *octodon* (Ehrenberg) Hustedt 1911
Eunotia robusta var. *decaodon* (Ehrenberg) Hustedt 1911
Eunotia robusta var. *dodecaodon* (Ehrenberg) Hustedt 1911
Eunotia robusta var. *heptodon* (Ehrenberg) Hustedt 1911
Eunotia robusta var. *polyodon* (Ehrenberg) Hustedt 1911
Eunotia ehrenbergii var. *undenaria* (Ehrenberg) Ant.Mayer 1918
Eunotia robusta var. *icosodon* (Ehrenberg) Boyer 1926
Eunotia robusta var. *scalaris* (Ehrenberg) Boyer 1926

Diagnosis: Valves are dorsiventral, large and highly arcuate. The dorsal margin is convex, distinctly undulated with several bluntly pointed, about 8-16 and evenly spaced undulations. The ventral margin is concave and follows the same curvature as the dorsal margin. Valve apices are rounded, not differentiated from the main body of the valve; occasionally, a terminal undulation will coalesce with the apex, which then becomes much wider and obtusely rounded. Terminal nodules are distinct on the ventral margin and distant from the apices of the valve. Raphe curving onto the valve face close to the valve ends, terminating approximately halfway between the ventral and dorsal margin. Transapical striae are finely punctate, radiate throughout and composed of shorter striae that occur along the dorsal margin and the complete striae that extend the full width of the valve. Striae mostly equidistant, about 10-12 in 10 μm. A fine transparent line runs along the ventral margin. Length of the valve 50-165 μm, and the breadth 12-15 μm.

Ecological preference: Oligotrophic or dystrophic water, it is also common in the cooler regions of North America (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Radomno, Kamionka and Zielone Lakes.

Distribution in Poland: Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia silvahercynia* Nörpel, Van Sull & Lange-Bertalot 1991**

Ref. Alles et al. 1991, p. 208, pl. 6, figs. 22-44; Krammer & Lange-Bertalot 1991 a, p. 216, pl. 156, fig. 35; Joh 2011, p. 71, figs. 65, 66; Bąk et al. 2012, p. 141, pl. 15.

Status of name: accepted taxonomically.

Diagnosis: Valves are arcuate, dorsiventral, with a slightly concave ventral margin and convex, somewhat undulated dorsal margin that has three or more small swellings. Valve apices are bluntly rounded, slightly protracted and capitate on the dorsal margin. Terminal nodules are distinct, close to the ends of the ventral margin. Transapical striae are parallel at the valve centre, slightly radiate towards the ends, quite evenly spaced, about 16-20 in 10 μm. Length of the valve 15-45 μm and the breadth 4-5 μm.

Remarks: This species is conspecific with *Eunotia pectinalis* var. *undulata*, *E. pectinalis* var. *intermedia*, *E. incisa* var. *undulata* and *E. tenella* (Alles et al. 1991).

Ecological preference: The species prefers highly dystrophic running waters and avoids stagnant waters even in moors (Alles et al. 1991); it is primarily found in European waters (Krammer & Lange-Bertalot 1991a); low electrolyte content, oligo- to moderately dystrophic, in upland streams on a silicate substrate, in stagnant waters or peat bogs, as well as in lowlands (Bąk et al. 2012).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Bąk et al. 2012.

***Eunotia soleirolii* (Kützing) Rabenhorst 1864**

Ref. Patrick & Reimer 1966, p. 208, pl. 13, figs. 1-2; Krammer & Lange-Bertalot 1991 a, p. 194, pl. 142, figs.1, 2-6; Joh 2011, p. 72, figs. 67-69; Bąk et al. 2012, p. 141, pl. 11; Pavlov & Levkov 2013, p. 39, pl. 51, figs. 1–13; pl. 53, figs. 1-16; pl. 54, figs. 1-7; pl. 57, figs. 1-3; Bahls et al. 2018, p. 115, pl. 78, fig. 14; Luo et al. 2019, p. 135, figs. 82-84.

Status of name: accepted taxonomically.

Synonyms: *Himantidium soleirolii* Kützing 1844

Eunotia pectinalis var. soleirolii (Kützing) Van Heurck 1896

Diagnosis: Valves are slightly arcuate, linear-lunate with weak concave ventral margin and convex dorsal margin. Both margins of a valve are more or less parallel in larger forms. Valve apices are not differentiated from the main part of the valve, weakly protracted, truncate, broadly rounded to rostrate, somewhat cuneate-rounded. Terminal raphe fissures are quite short, terminated before the mid-point of the valve apex, close to the ventral valve margin. Terminal nodules are small to moderately large, positioned slightly distant from valve apices. Transapical striae are distinctly punctate, parallel throughout, evenly and distantly spaced, about 10-14 in 10 μm at the valve centre, denser and radiate at the ends, about 14-17 in 10 μm. Length of the valve 28-65 μm, and the breadth 4.5-7 μm.

Ecological preference: Freshwater species, it occurs predominantly in periodic water-bodies as well as under alkaline or acidic conditions, high or low electrolyte content (Patrick & Reimer 1966); distributed in oligotrophic, low conductivity or circumneutral waters in European freshwaters (Krammer & Lange-Bertalot 1991 a); circumneutral, mainly occurring at pH values about 7, high oxygen requirements, β-mesosaprobic, oligotrophic (Van Dam et al. 1994); it occurs in a ultra-oligotrophic lake, El'gygytgun, a High Arctic lake (Cremer & Wagner 2003); neutral water reactions, conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga 2014a; Peszek et al. 2015).

***Eunotia subarcuatoides* Alles, Nörpel & Lange-Bertalot 1991**

Ref. Alles et al. 1991, p. 188, pl. 4, figs. 1-36; Krammer & Lange-Bertalot 1991 a, p. 214, pl. 138, figs. 1-9; pl. 145, fig. 6; Veselá 2009, p. 50, pl. 22, figs. 12-14; Pavlov & Levkov 2013, p. 41, pl. 48, figs. 18-31; pl. 52, figs. 1-5; pl. 61, figs. 1-28; Costa 2015, p. 77, pl. 17, figs. 14-30; Bahls et al. 2018, p. 60, pl. 23, fig. 44; p. 125, pl. 88, figs. 32-36; Jüttner et al. 2018, p. 425, figs. 64-75.

Status of name: accepted taxonomically.

Diagnosis: Valves are arcuate to crescentic, with slightly concave, or more or less straight ventral margin and moderately convex dorsal margin; the dorsal and ventral margins are somewhat parallel in larger valves. Valve apices are cuneate, very slightly protracted, and bluntly rounded. Terminal nodules are small and distinct. Raphe is slightly developed. Short terminal raphe fissures curving onto the valve face near the apices, terminating before the centre of apical valve width. Transapical striae are parallel entire the valve, slightly radiate towards the ends, about 17-20 in 10 μm. Length of the valve 15-35 μm, and the breadth 3-4.5 μm.

Remarks: The species is similar to the small valves of *Eunotia bilunaris,* differing only by the lower striae density in the latter (Lange-Bertalot et al. 2011). Also similar to *Eunotia boreotenuis* Nörpel-Schempp & Lange-Bertalot, but it differs by its slightly wider valves and lower striae density.

Ecological preference: The species presents a worldwide distribution. It tolerates high and strong variations of pH values (Alles et al. 1991). It is considered acidobiontic with optimal occurrence at pH < 5.5, freshwater, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994; Szulc & Szulc 2012); or acidophilous (Håkansson 1993); it occurred in a wide range of pH (5.1-8.1) and trophic states from ultra-oligo- to eutrophic (total phosphorus < 106 μg L^{-1}) with high abundance in ultra-oligotrophic (Costa 2015); benthic, streaming water, oligohalobous–halophobous, acidophilous with pH 6.7 (Barinova et al. 2023).

Occurrence: Infrequent in Zielone and Młynek Lakes.

Distribution in Poland: Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012).

***Eunotia sudetica* O.Müller 1898**

Ref. Hustedt 1930, p. 182, fig. 242; Hustedt 1959, p. 299, fig. 764: a-b; Patrick & Reimer 1966, p. 208, pl. 13, fig. 3; Foged 1974, p. 54, pl. 5, fig. 5; Germain 1981, p. 981, pl. 35, figs. 12-15; Krammer & Lange-Bertalot 1991 a, p. 224, pl. 161, figs. 1-7; Hartley et al. 1996, p. 214, pl. 99, fig. 8; Bąk et al. 2012, p. 142, pl. 16; Costa 2015, p. 78, pl. 25, figs. 15-17; Souza et al. 2015, p. 633, figs. 40-43.

Status of name: accepted taxonomically.

Synonym: *Himantidium sudetica* (O.Müller) Schonfeldt 1907

Diagnosis: Valves are dorsiventral, with moderately convex dorsal margin, somewhat bi-undulate, and weakly concave to nearly straight ventral margin. Valve apices are rostrate, attenuated, broadly rounded and distinctly detached from the valve body. Terminal nodules are distinct. Terminal raphe endings are positioned on the ventral margin, some distance from the apices. The distal raphe ending is slightly recurved. Transapical striae are punctate, nearly evenly spaced, parallel in the centre, radiate towards the ends, about 8-12 in 10 μm. Puncta about 28-32 in 10 μm. Length of the valve 15-60 μm and the breadth 5.5-9 μm.

Remarks: This species is similar to *Eunotia incisa,* but it is characterized by a coarsely punctate striate 8-12 in 10 μm, whereas *Eunotia incisa* is more finely striated, 14-17 in 10 μm. The apices of the valve are usually definitely narrower than the main body of the valve, whereas in *Eunotia incisa,* they are more or less differentiated from the main body.

Ecological preference: The species is abundant in acidic to circumneutral waters and is cosmopolitan in mountain streams. It is reported from acid to circumneutral waters (Patrick & Reimer 1966); it is widely cited in literature as an acidophilic taxon (e.g., Foged 1978, Håkansson 1993, Siver et al. 2005); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); prefers small, running waters or wet bryophyte habitats (Lange-Bertalot et al. 2011); moderately abundant in the waters of oligotrophic, acidic, with low content of electrolytes on silicate rocks on the upland areas, often on flooded mosses (Bąk et al. 2012); found in ultra-oligotrophic reservoir with low nutrient availability (total phosphorus 4 μg L^{-1}), acidic (pH 5.4) and electrolyte-poor (10 μS cm^{-1}) waters (Costa 2015).

Occurrence: Infrequently in Młynek and Zielone Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts (Kwandrans 1993).

***Eunotia suecica* A. Cleve 1895**

Ref. Hustedt 1930, p. 174, fig. 210; Hustedt 1959, p. 279, fig. 746; Patrick & Reimer 1966, p. 199, pl. 11, fig. 9; Pavlov & Levkov 2013, p. 42, pl. 16, figs. 16-22; Bahls et al. 2018, p. 176, pl. 85, figs. 8, 9; pl. 111, figs. 17-18.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, arcuate. The dorsal margin is strongly convex with two distinct, broadly rounded undulations, dividing the dorsal margin into about two equal parts. The ventral margin is more concave, curved upward at the apices. Valve apices are variable, broadly rostrate and truncate, about half the width of the valve at the broadest point of the swollen, squarely cut off, thus giving a very characteristic appearance. Terminal nodules are distinct, extending upward along the apices, somewhat variable in size. Distal raphe endings curved toward the dorsal margin close to the valve ends. Transapical striae are finely punctate, evenly spaced, parallel at the valve centre, about 12-14 μm in 10 μm, radiate and slightly more dense near the apices, about 15-17 in 10 μm. Length of the valve 30-50 μm, and the breadth 10-12 μm.

Ecological preference: the species prefers cool water (Patrick & Reimer 1966); acidophilous with pH value 6.5 -6.9 (Foged 1974).

Occurrence: Infrequent in Zielone Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976);

***Eunotia superpaludosa* Lange-Bertalot 2011**

Ref. Lange-Bertalot 2011, p. 231, pl. 147, figs. 48-58; pl. 148, figs. 1-23; pl. 149, figs. 1-7; Bahls et al. 2018, p. 60, pl. 23, figs. 16-18; p. 79, pl. 42, figs. 1-7; Luo et al. 2019, p. 143, figs. 68-79; Noga 2019, p. 11, fig. 3AA-AC, fig. 5G.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly arcuate to slightly linear with concave ventral margin, convex dorsal margin, and two margins of the valve almost parallel. Valve apices are capitated, truncate, rounded and reflected dorsally. Terminal nodules are distinct, and the terminal raphe ends are placed on the ventral margin, turn toward the dorsal margin up to the ends. Transapical striae are evenly spaced, parallel along the valve, slightly radiate at the ends, about 16-18 in 10 μm. Length of the valve 40-65 μm, and breadth of 4-5 μm.

Ecological preference: Organic sediments in small and shallow peat pits, always occurred in low pH (under 3.5) and low to moderate conductivity and occurred in ombrotrophic peatbogs with *Sphagnum* spp (Noga 2019).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Międzyrzeki peatbog, Roztocze National Park, south-east Poland (Noga 2019)

***Eunotia tenella* (Grunow) Hustedt 1913**

Ref. Hustedt 1930, p. 175, fig. 220; Hustedt 1959, p. 284, fig. 749; Germain 1981, p. 90, pl. 31, figs. 1-7, 22-26; Gasse 1986, p. 56, pl. 10, fig. 5; Krammer & Lange-Bertalot 1991 a, p. 202, pl. 154, figs. 23-30; Hartley et al. 1996, p. 216, pl. 100, figs. 1, 2; Veselá 2009, p. 52, pl. 27, figs. 26-27; Bąk et al. 2012, p. 143, pl. 16.

Status of name: accepted taxonomically.

Synonyms: *Eunotia arcus* var. *tenella* Grunow 1881
Himantidium arcus var. *tenella* (Grunow) Schonfeldt 1907
Eunotia exigua var. *tenella* (Grunow) Nörpel & Alles 1991

Diagnosis: Valves are arcuate, dorsiventral, with a slightly concave ventral margin and, convex dorsal margin. The margins are almost parallel, in some forms somewhat slightly swollen in the middle portion. Valve apices are protracted, rostrate, broadly rounded to truncate or capitate. Terminal nodules are distinct on the ventral margin close to the apices. Distal raphe endings are curved slightly onto the valve face. Transapical striae are parallel at the centre, radiate towards the ends, evenly spaced throughout the valve, about 16-18 in 10 μm. Length of the valve 10-35 μm, breadth 3-4.5 μm.

Remarks: The species is similar to *Eunotia arcus* but differs by the shape of the ends and the finer striation.

Ecological preference: The species is commonly found in subaerial habitats (Hustedt 1959); it is acidophilous and halophobous (Foged 1964); prefers somewhat acid soft water (Patrick & Reimer, 1966); it was best developed in the cold, acidic, nutrient poor conditions (Gasse 1986); acidophilous, mainly occurring at pH < 7, freshwater,

continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994; Szulc & Szulc 2012); in habitats with pH value 3.8-7.9, conductivity: 16-632µS/cm (Ortiz-Lerin & Cambra 2007); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Młynek, Francuskie and Zielone Lakes.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts, south Poland (Kwandrans 1993); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); small forest dystrophic Lake Sęczek located in the Masurian Lake District, north-east Poland (Grabowska et al. 2014); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Eunotia tetraodon* Ehrenberg 1838**

(Pl. 14, figs. 4-5)

Ref. Cleve-Euler 1953, p. 125, fig. 462 a; Foged 1974, p. 54, pl. 4, figs. 9-10; Veselá 2009, p. 52, pl. 1, figs. 1-4; Bąk et al. 2012, p. 143, pl. 15; Pavlov & Levkov 2013, p. 42, pl. 26, figs. 1-11; pl. 27, figs. 1-8; Kulikovskiy et al. 2016, p. 133, pl. 29, figs. 6-10; Bahls et al. 2018, p. 58, pl. 21, fig. 2; Bukhtiyarova 2019, p. 19, figs. 34-35.

Status of name: accepted taxonomically.

Synonyms: *Himantidium tetraodon* (Ehrenberg) Brébisson ex Kützing 1849
Eunotia robusta var. *tetraodon* (Ehrenberg) Ralfs, 1861
Eunotia robusta f. *abrupta* Hustedt 1914
Eunotia diadema var. *tetraodon* (Ehrenberg) A. Cleve, 1953
Eunotia serra var. *tetraodon* (Ehrenberg) Nörpel 1991

Diagnosis: Valves are biarcuate, dorsiventral with a strong concave ventral margin, and undulated, strongly convex dorsal margin that has four broadly rounded, strong undulations. The ventral margin follows the same curvature as the dorsal margin. Valve apices are wider than the undulations and weakly protracted, broadly rounded. Terminal nodules are distinct, close to the ends. Distal raphe endings lie along the valve face close and parallel to each end. Transapical striae are distant, irregularly spaced, parallel in the valve centre, becoming radiate and curved towards the ends, on the dorsal margin, shortened intermediate striae are present. Short striae are more numerous in the undulations where they fill the gaps between complete striae, about 8-12 striae in 10 µm on the ventral margin, 14-16 in 10 µm on the dorsal margin and near the apices. Length of the valve 32-48 µm, and the breadth 12-16 µm.

Ecological preference: freshwater, acidophilous with pH value 6.0-6.4 (Foged 1974); acidophilous, continuously high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); epiphytic species; found in circumneutral to somewhat alkaline pH, like most species of the genus *Eunotia*, it occurs in oligo- to dystrophic, electrolyte-poor, moderately acidic (Bąk et al. 2012); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Zielone, and infrequent in Radomno and Kamionka Lakes.

Distribution in Poland: New record.

***Eunotia torula* Hohn 1961**

(Pl. 13, figs. 18-19)

Ref. Hohn 1961, p. 160, pl. 1, fig. 10; Krammer and Lange-Bertalot 1991 a, p 552, pl. 161, fig. 20.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, arcuate, with a distinctly convex dorsal margin, more or less straight to weakly concave ventral margin. Apices are being undifferentiated from the main body of the valve, narrow, and bluntly rounded. Terminal nodules of moderate size, near or short distance behind the apices of the valve. Transapical striae are punctate, parallel at the centre, more widely spaced at the centre than at the ends of the valve, about 10-11 in 10 µm, radiate towards the ends, about 12-14 in 10 µm, puncta about 18-20 in 10 µm. Length of the valve 14-17, and the breadth 3.5-4.

Ecological preference: Reported from the benthic habitats of slightly acidic to slightly alkaline, oligotrophic to mesotrophic freshwater environments.

Occurrence: Infrequent in Zielone and Młynek Lakes.

Distribution in Poland: New record.

***Eunotia trinacria* Krasske 1929**

Ref. Krasske 1929, p. 349, fig. 1; Hustedt 1930, p. 176, fig. 221; Patrick & Reimer 1966, p. 217, pl. 14, fig. 4; Alles et al. 1991, p. 176, pl. 1, figs. 36-59; Krammer & Lange-Bertalot 1991 a, p. 204, pl. 155, figs. 22-37; Tremarin et al. 2008, p. 858, figs. 62-63; Bąk et al. 2012, p. 143, pl. 16; Pavlov & Levkov 2013, p. 44, pl. 63, figs. 69-84; pl. 64, figs. 1-3; pl. 65, fig. 5.

Status of name: accepted taxonomically.

Synonym: *Eunotia paludosa* var. *trinacria* (Krasske) Nörpel 1991

Diagnosis: Valves are weakly arcuate, elongate-triangular, becoming more linear in larger specimens. Ventral margin is straight to weakly concave, and the dorsal margin is slightly convex, somewhat pointed at the centre to produce a triangular appearance. Valve apices are weakly protracted, subcapitate, subrostrate and not separated from the main body of the valve. Terminal nodules are fairly small, dot-like, and close to the apices on the ventral margin. Terminal raphe fissures are quite short, terminated close to the ventral valve margin. Transapical striae are parallel throughout, evenly spaced, a little closer at the ends than at the centre, about 18-22 in 10 μm. Length of the valve 10-25 μm, and the breadth 2.5-3 μm.

Ecological preference: It prefers cool, acid water (Patrick & Reimer 1966); often abundant in anthropogenically intact raised bogs or mosses and optimum occurrence is found in acidic, similar to dystrophic mountain streams (Bąk et al. 2012); reported from the benthic habitats of slightly acidic, dystrophic freshwater environments.

Occurrence: Infrequent in Zielone Lake.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts, south Poland (Kwandrans 1993).

***Eunotia triodon* Ehrenberg 1837**

Ref. Hustedt 1930, p. 173, fig. 206; Cleve-Euler 1953, p. 105, fig. 437 h-m; Foged 1974, p. 55, pl. 4, figs. 12-13; Krammer & Lange-Bertalot 1991 a, p. 220, pl. 146, figs. 6-9; Hartley et al. 1996, p. 216, pl. 100, fig. 6; Lange-Bertalot & Metzeltin 1996, p. 140, pl. 11, figs. 8-9; Bąk et al. 2012, p. 144, pl. 14; Bahls et al. 2018, p. 76, pl. 39, fig. 15.

Status of name: accepted taxonomically.

Synonyms: *Eunotia pentodon* Ehrenberg 1837
Eunotia triglyphis Ehrenberg 1851
Eunotia robusta var. *pentodon* (Ehrenberg) Ralfs 1861
Eunotia robusta var. *triodon* (Ehrenberg) W.Carruthers 1864
Eunotia triodon var. *genuina* Cleve-Euler 1953

Diagnosis: Valves are dorsiventral, moderately arcuate. The dorsal margin is convex and has three broadly rounded undulations. The ventral margin is concave, curved upward at the apices and follows the same curvature as the dorsal margin. Valve apices are protracted, broadly rounded and narrower than the undulations. Terminal nodules are distinct at the apices. Distal raphe endings are curved toward the dorsal margin close to the valve ends. A clear fine hyaline line formed by the absence of punctae near the ventral margin. Transapical striae are finely punctate, radiate throughout, denser near the apices, about 14-18 in 10 μm. Length of the valve 35-120 μm, and the breadth 12-20 μm.

Ecological preference: Oligotrophic to somewhat acidic water (Patrick & Reimer 1966; Laws 1988); it prefers habitats with waters ranging from oligo- to dystrophic, moderately acidic (not ombrotrophic) with low electrolytic conductivity (Lange-Bertalot et al. 2011); reported from the benthic habitats of slightly acidic, dystrophic freshwater environments.

Occurrence: Infrequently in Zielone Lake.

Distribution in Poland: Bąk et al. 2012.

***Eunotia valida* Hustedt 1930**

(Pl. 14, figs. 8-14)

Ref. Hustedt 1930, p. 178, fig. 229; Hustedt 1959, p. 305, fig. 771; Patrick & Reimer 1966, p. 192, pl. 10, fig. 11; Foged 1974, p. 55, pl. 6, fig. 1; Germain 1981, p. 90, pl. 31, fig. 28; Hartley et al. 1996, p. 216, pl. 100, fig. 7; Pavlov & Levkov 2013, p. 45, pl. 46, figs. 1-17; pl. 47, figs. 1-4; Costa 2015, p. 83, pl. 18, figs. 1-4; Bahls et al. 2018, p. 125, pl. 88, figs. 5-7.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly arcuate to linear, with almost parallel margins, the dorsal margin is convex, and the ventral margin is concave. Valve apices are weakly protracted, broadly rounded, somewhat capitate, and slightly reflexed dorsally. Terminal nodules are distinct, positioned slightly distant from valve apices on the ventral margin. Terminal raphe fissures are quite long, terminated close to the dorsal valve margin, and often recurved towards the valve centre. Transapical striae are parallel at the valve centre, evenly spaced, about 10-12 in 10 μm, radiate and denser at the valve apices, about 14-16 in 10 μm. Puncta about 37-40 in 10 μm. Length of the valve 30-150 μm and the breadth 4.0-7.5 μm.

Remarks: The species is characterised by its linear, long, slender valve with a thicker wall than in other species, but it is not as long and slender as *Eunotia naegelii*.

Ecological preference: Like most *Eunotia* species, it is found in acid to circumneutral waters of low mineral content, usually in cooler waters. The species prefers cool, acid water (Patrick & Reimer 1966); it occurs in oligotrophic to dystrophic waters, with moderate pH and low specific conductivity (Hofmann 1994, Lange-Bertalot et al. 2011); found in ultra-oligo and oligotrophic conditions. Limnological features were acidic to slightly acidic (pH 5.4-6.3), low conductivity (10-15 μS cm-1) and low phosphorus content (< 13.8 μg L^{-1}) (Costa 2015); reported from the benthic habitats of slightly acidic to slightly alkaline, dystrophic to mesotrophic freshwater environments.

Occurrence: Frequent in Radomno, Kamionka, Francuskie and Zielone Lakes.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a, b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Eunotia veneris* (Kützing) De Toni 1892**

(Pl. 14, figs. 6-7)

Ref. Hustedt 1930, p. 182, fig. 245; Hustedt 1959, p. 300, fig. 766; Krammer & Lange-Bertalot 1991 a, p. 222, pl. 163, figs. 14-19; Ortiz-Lerin & Cambra 2007, p. 429, fig. 5 S; Tremarin et al. 2008, p. 858, fig. 64.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral with a convex dorsal margin, more or less straight ventral margin and gradually narrowed towards the apices that turned to the ventral valve margin. The apices are acutely rounded, somewhat subprotracted, and rostrate. Terminal nodules are small, close to the ends of the ventral margin. The raphe system consists of two short filiform arcuate slits on the hyaline area of the ventral valve mantle. The distal raphe endings sit on the valve mantle, and the terminal raphe nodules are well set close to the apices. Transapical striae are finely punctate, parallel throughout, slightly radiate towards the ends, distant, gradually compacted from the valve centre to the ends, about 13-15 in 10 μm. Length of the valve 15-50 μm, and the breadth 4-6 μm.

Ecological preference: Acidophilous, benthic (Foged 1974; Kaczmarska 1976); freshwater, acidophilous, mainly occurring at pH < 7, high oxygen requirements, oligosaprobic, oligo-mesotraphentic (Van Dam et al. 1994).

Occurrence: Frequent in Eemian palaeolake deposits, central Poland and Jeziorak Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

Family *Peroniaceae* (Karsten) Topachevs'kyj & Oksiyuk 1960

Genus *Peronia* Brebisson & Arnott ex Kitton 1868

Diagnosis: Frustules wedge-shaped in valve view with rounded to subcapitate apices and in girdle view without intercalary bands or septa. Valve asymmetrical and heteropolar to the transapical axis. One valve with short raphes extending from each apex, and the other valve with very short raphe, namely dash-like raphe. Central and distal nodules are indistinct. Transapical striae are perpendicular to the apical axis and interrupted by a fine pseudoraphe. Short spines are sometimes seen in the margin of the valve.

Holotype species: *Peronia erinacea* Brébisson and Arnott ex Kitton 1868
(=*Gomphonema fibula* Brébisson ex Kützing 1849, *Peronia fibula* (Brébisson ex Kützing) Ross 1956).

***Peronia fibula* (Brébisson ex Kützing) Ross 1956**

Ref. Hustedt 1959, p. 262, fig. 738; Patrick & Reimer 1966, p. 223, pl. 14, fig. 13; Krammer & Lange-Bertalot 1991 a, p. 230. pl. 165, fig. 15; Hartley et al. 1996, p. 414, pl. 199, figs. 6-8; Joh 2011, p. 81, fig. 76: A-M; Bąk et al. 2012, p. 266, pl. 20.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema fibula* Brébisson ex Kützing 1849
Licmophora fibula (Brébisson) Grunow 1867
Peronia erinacea Brébisson & Arnott ex Kitton 1868
Synedra spinulaeformis W.Smith 1868
Meridion erinaceum (Brébisson & Arnott ex Kitton) H.L. Smith 1876
Sceptroneis erinacea (L.A.Brébisson & G.A.W.Arnott) F.Schütt 1896
Gomphonema erinaceum (Brébisson & Arnott) Hustedt 1909
Sceptroneis fibula (Brébisson) Elmore 1921
Asterionella fibula (Brébisson) Hustedt 1952

Diagnosis: Frustules are cuneate, in both valve and girdle view. Valves are heteropolar in the headpole and heterovalvar in the raphe system. Valve club-shaped with linear margins that are slightly constricted below the head pole end. The headpole shape is broadly rounded, subcapitate, rostrate, or truncate-spatulate. The footpole is narrow and acutely rounded. Short spines are present along the valve margin. A true short raphe is present at one or both ends of the valve and differs on each valve. One valve has two raphe slits, extending along the sternum. The other valve has a rudimentary raphe evident at the poles, or the raphe may be absent. The proximal raphe endings curved slightly to one side. Terminal nodules are very small or indistinct. Transapical striae are parallel, irregularly spaced, becoming radiate or irregular at the ends, about 14-18 in 10 μm, Length of the valve 27-63 μm, breadth 3-5 μm.

Ecological preference: The species occurs rarely in *Sphagnum* swamps, bogs and springs throughout Europe (Hustedt 1959), in fresh, shallow water (Patrick & Reimer 1966); freshwater, acidophilous, continuously high oxygen requirements, oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); prefers oligotrophic and dystrophic waters (Joh 2011).

Occurrence: Infrequent in Zielone and Młynek Lakes.

Distribution in Poland: Poland (Bąk et al. 2012).

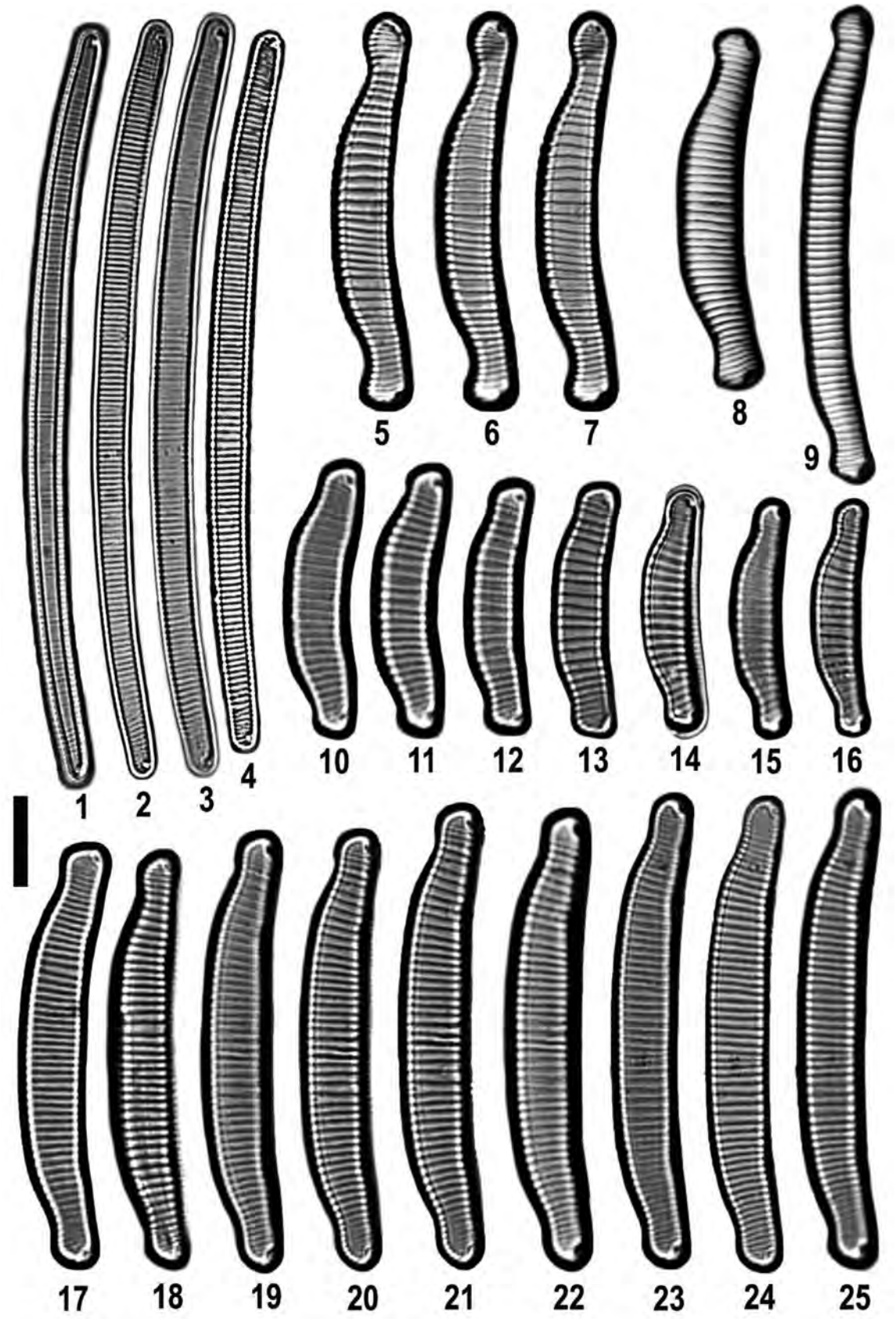


Plate 1: 1-4. *Eunotia ambivalens* Lange-Bertalot & Tagliaventi 2011, 1-3. Radomno Lake; 4. Młynek Lakes; 7-5. *Eunotia arcubus* Nörpel & Lange-Bertalot 1993, Eemian deposits; 8-9. *Eunotia arcus* Ehrenberg 1837**,** 8. Zielone Lake; 9. Młynek Lake; 10-16 *Eunotia arcus* var. *fallax* Hustedt 1930, Jeziorak Lake; 17-25. *Eunotia arcus* var. *uncinata* (Ehrenberg) Grunow 1881, Jeziorak Lake. Scale bar: 10 µm.

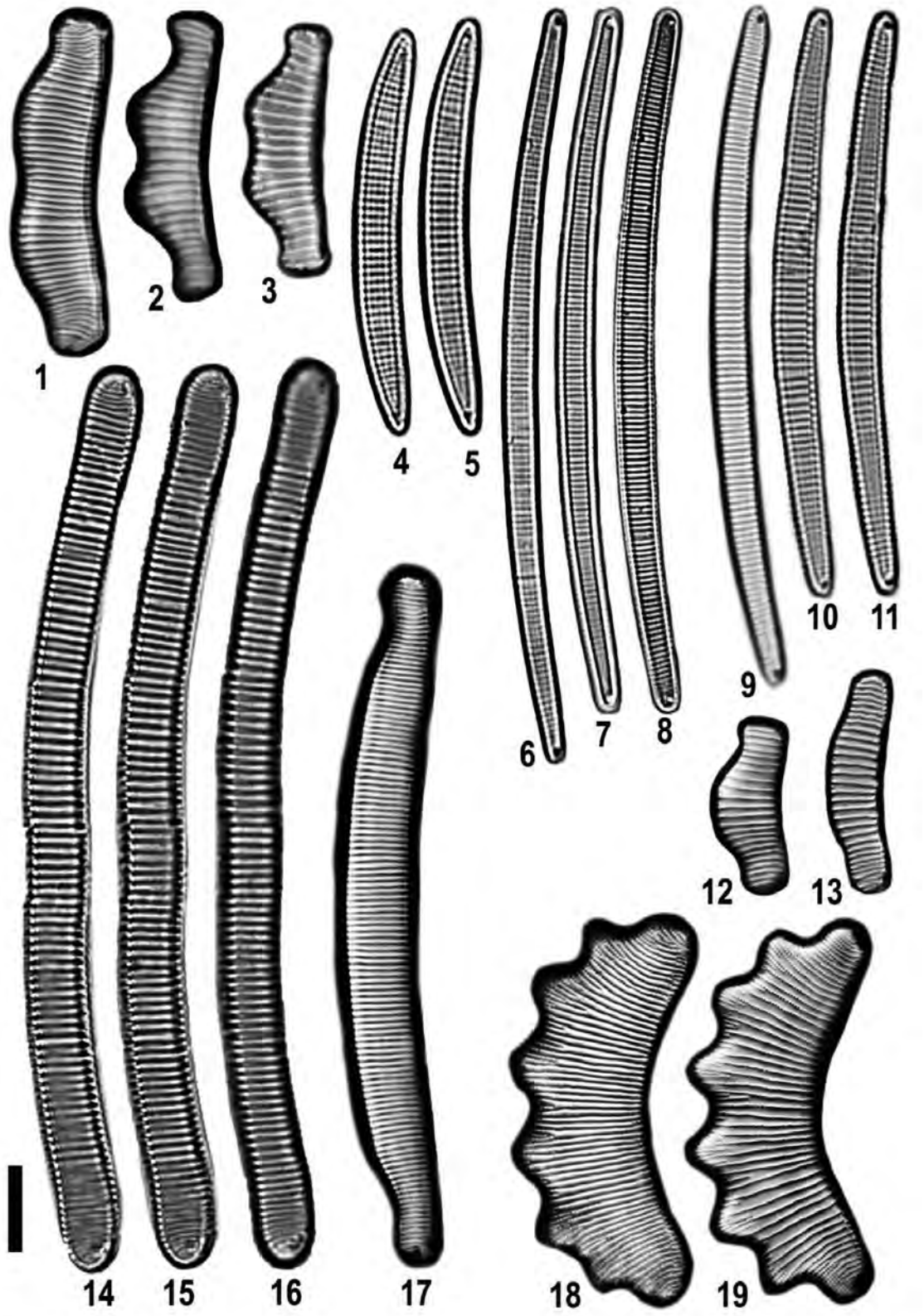


Plate 2: 1. *Eunotia bidens* Ehrenberg 1843, Radomno Lake; 2-3. *Eunotia bigibba* Kützing 1849, Młynek Lake; 4-8. *Eunotia bilunaris* (Ehrenberg) Schaarschmidt 1880, 4-5. Radomno Lake, 6-8. Młynek Lake; 9-11. *Eunotia cantonatii* Lange-Bertalot & Tagliaventi 2011, 9. Radomno Lake; 10-11. Młynek Lakes; 12-13. *Eunotia curtagrunowii* Nörpel-Schempp & Lange-Bertalot 1996, Zielone Lake; 14-16. *Eunotia curtiraphe* Metzeltin & Lange-Bertalot 2007, Młynek Lake; 17. *Eunotia denticulata* (Brébisson ex Kützing) Rabenhorst 1864, Zielone Lake; 18-19. *Eunotia diadema* Ehrenberg 1837, Młynek Lake. Scale bar: 10 μm.

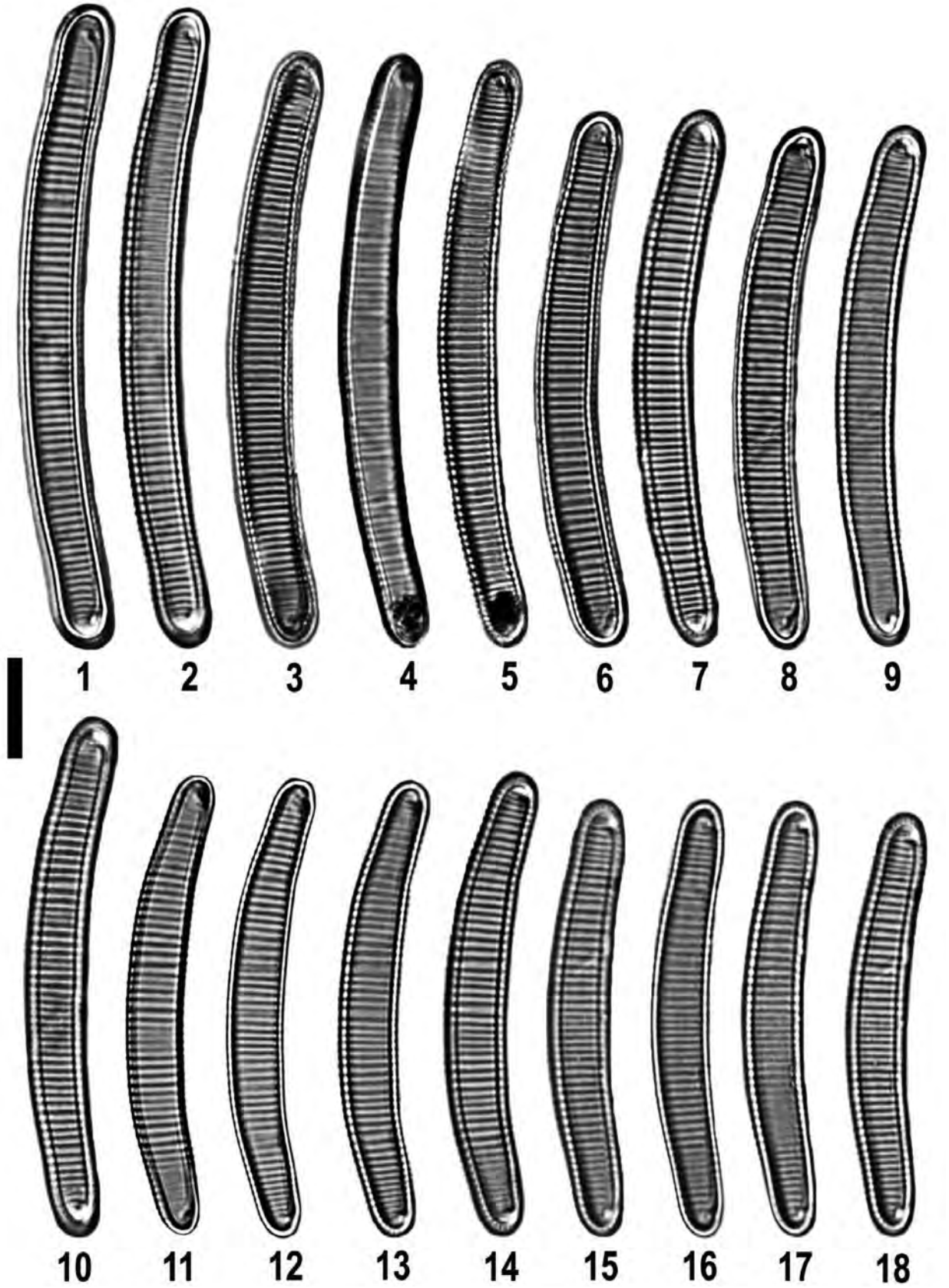


Plate 3: 1-18. *Eunotia botuliformis* Wild, Nörpel & Lange-Bertalot 1993, 1-10, 15-18. Jeziorak Lake; 11-14. Młynek Lake. Scale bar: 10 µm.

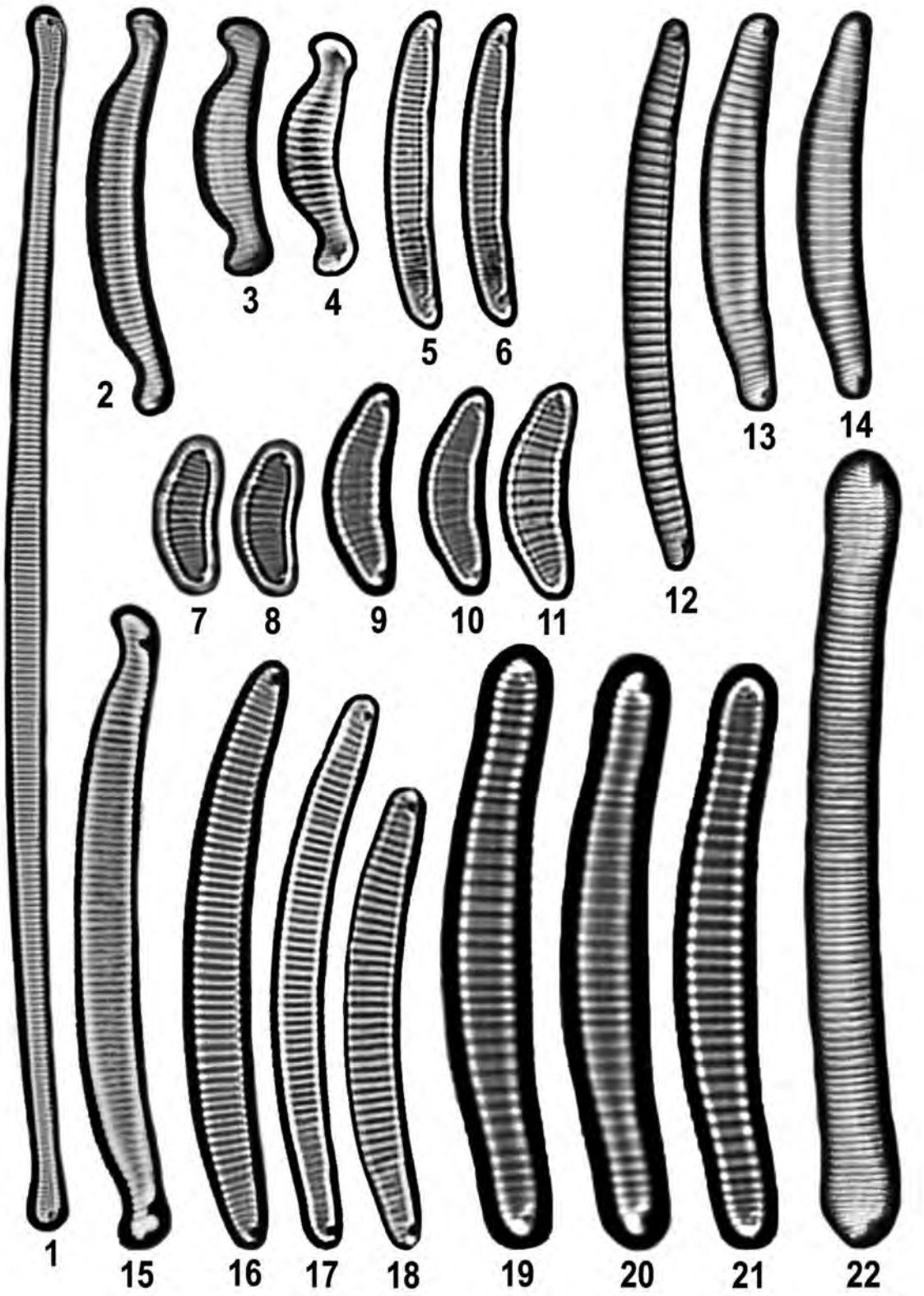


Plate 4: 1. *Eunotia eurycephaloides* Nörpel-Schempp & Lange-Bertalot 1996, Młynek Lake; 2-4. *Eunotia exigua* (Brébisson ex Kützing) Rabenhorst 1864, Radomno Lake; 5-6. *Eunotia exsecta* (A.Cleve) Nörpel-Schempp & Lange-Bertalot 1996, Radomno Lake; 7-11. *Eunotia faba* Ehrenberg 1837, Młynek Lake; 12-14. *Eunotia fallax* Cleve-Euler 1895, Zielone Lake; 15. *Eunotia fennica* (Hustedt) Lange-Bertalot 2004, Eemian deposits; 16-18. *Eunotia fureyae* Lange-Bertalot 2011, Zielone Lake; 19-21. *Eunotia formicina* Lange-Bertalot 2011, Jeziorak Lake; 22. *Eunotia formica* Ehrenberg 1843, Młynek Lake. Scale bar: 10 µm.

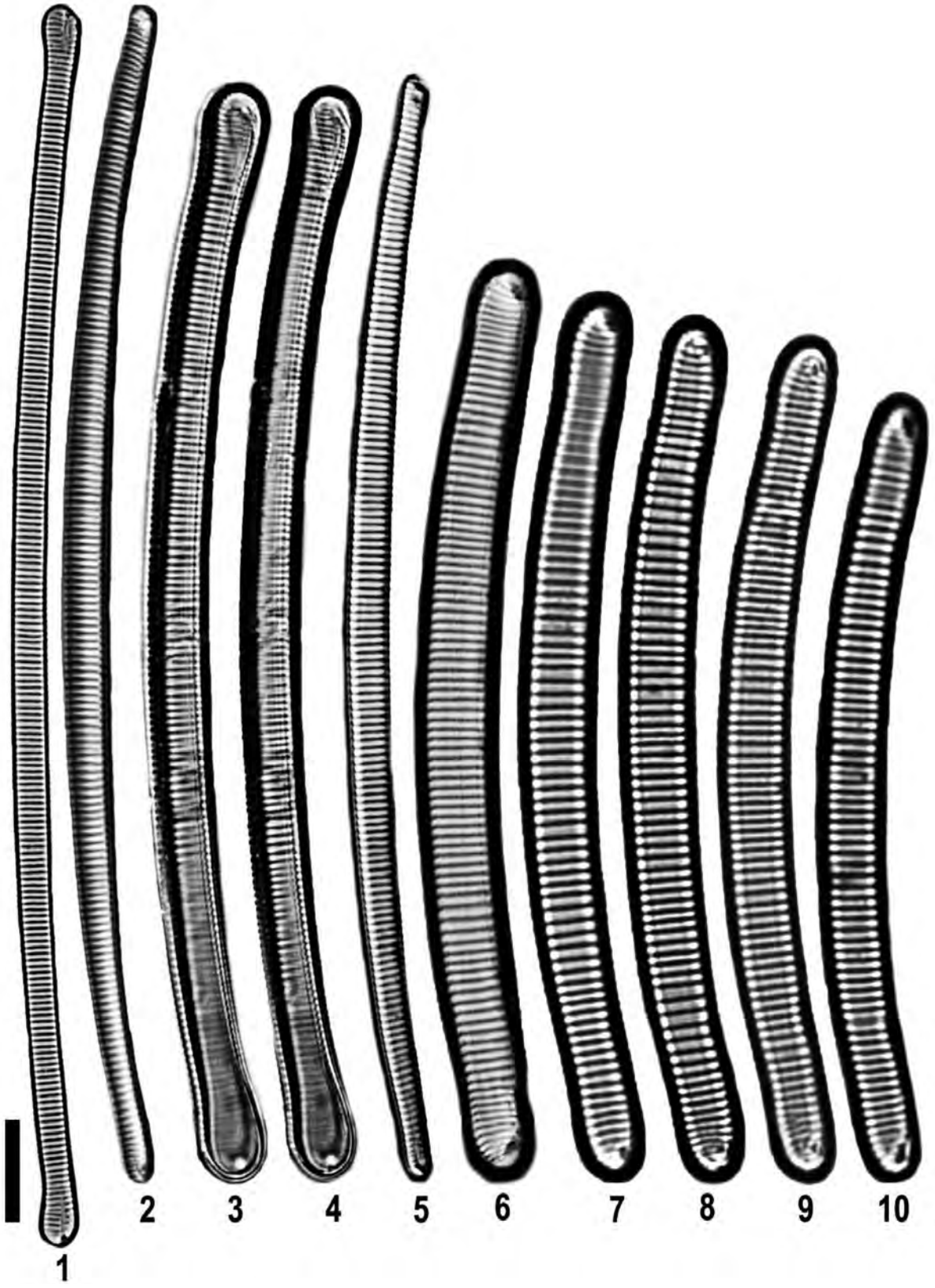


Plate 5: 1-2. *Eunotia flexuosa* (Brébisson ex Kützing) Kützing 1849, Zielone Lake; 3-4. *Eunotia gallica* Lange-Bertalot & Witkowski 2011, Młynek Lake; 5. *Eunotia genuflexa* Nörpel-Schempp 1996, Młynek Lake; 6-10. *Eunotia glacialifalsa* Lange-Bertalot 2000, 6. Eemian deposits; 7-9. Młynek Lake; 10. Radomno Lake. Scale bar: 10 µm.

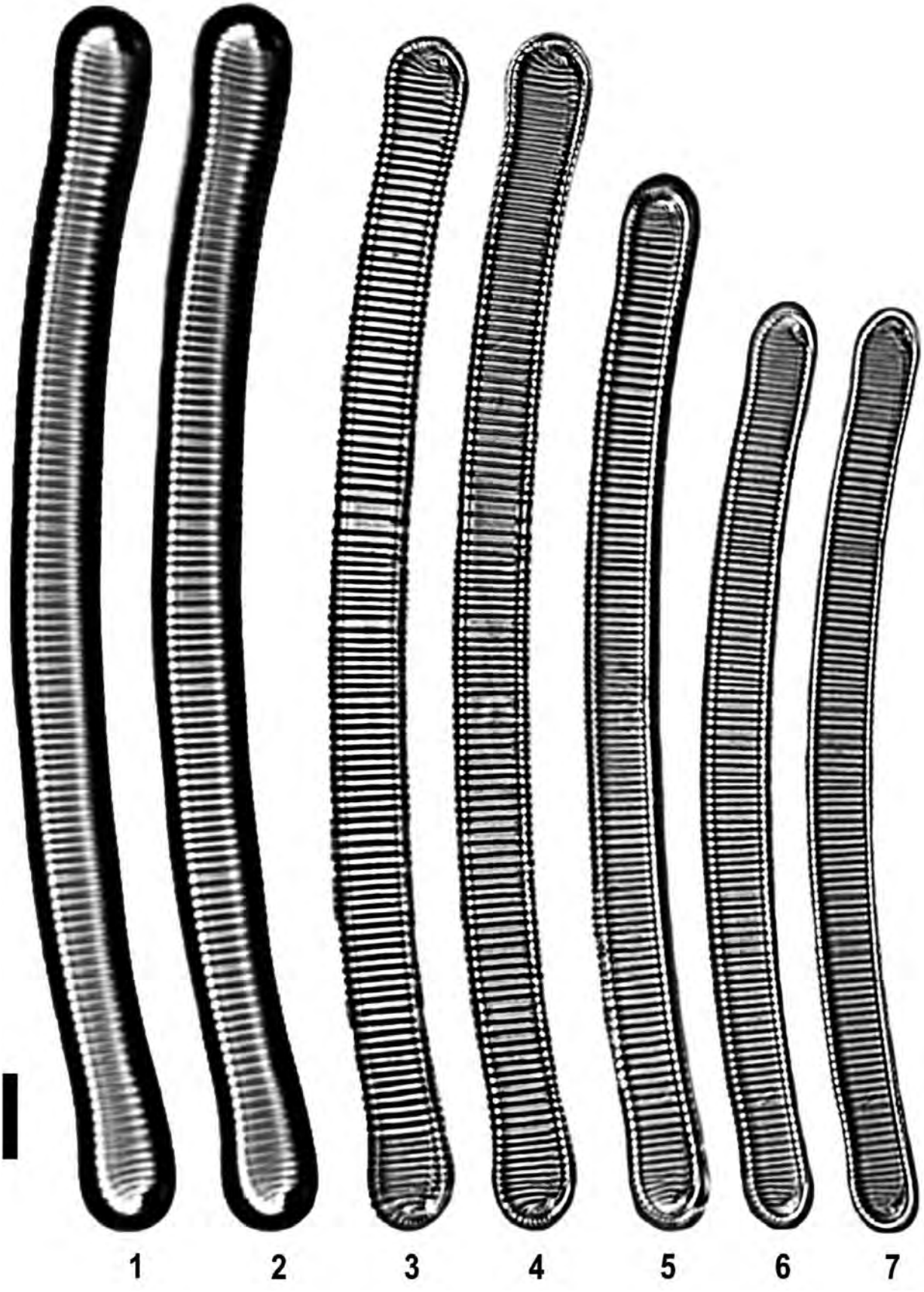


Plate 6: 1-7. *Eunotia glacialis* Meister 2-1 ,1912. Młynek Lake; 5-3. Radomno Lake, 7-6. Kamionka Lake. Scale bar: 10 µm.

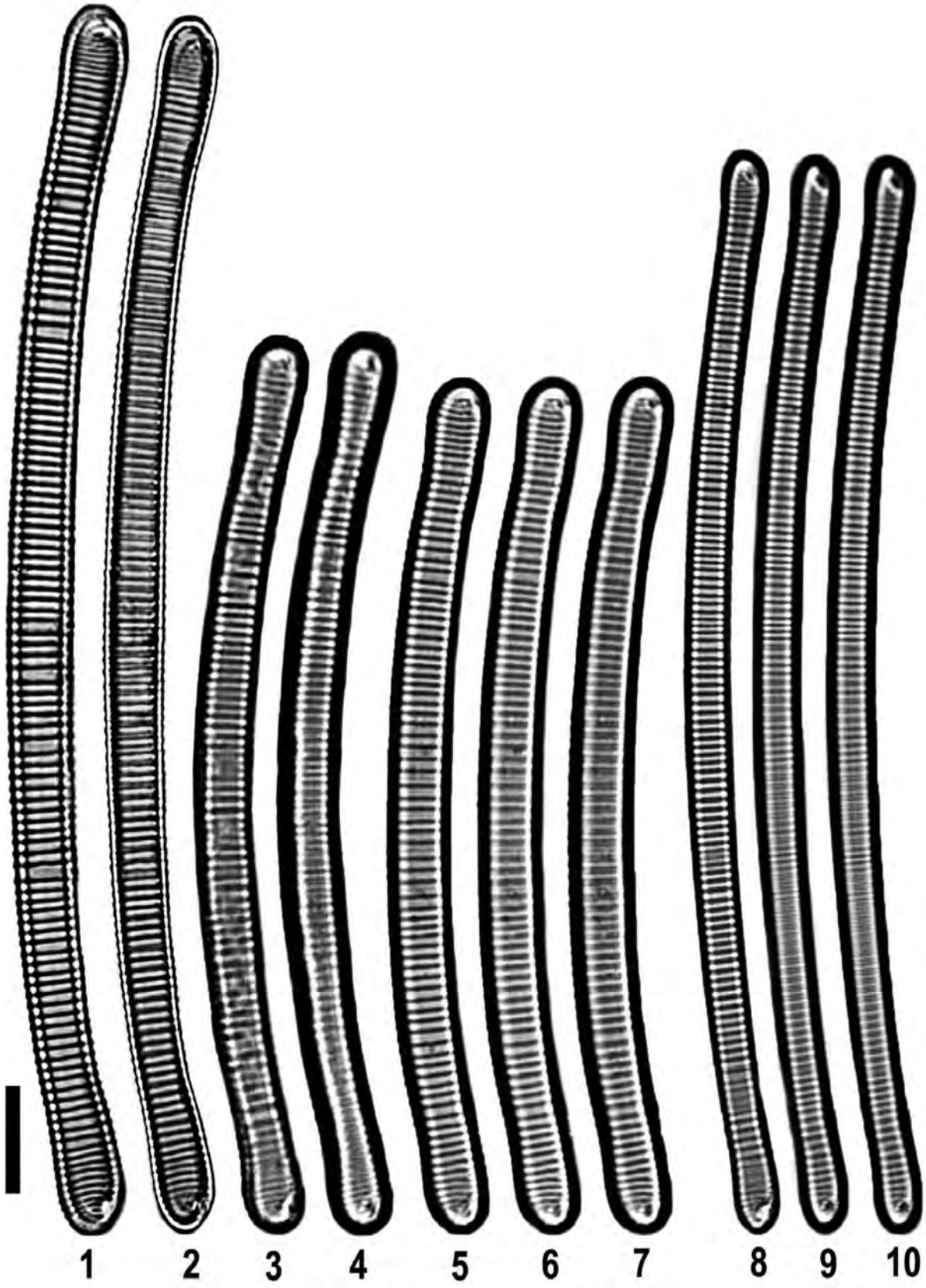


Plate 7: 1-7. *Eunotia glacialispinosa* Lange-Bertalot & Cantonati 2010, Młynek Lake; 8-10. *Eunotia gracilis* (Ehrenberg) Rabenhorst 1864, Radomno Lake. Scale bar: 10 µm.

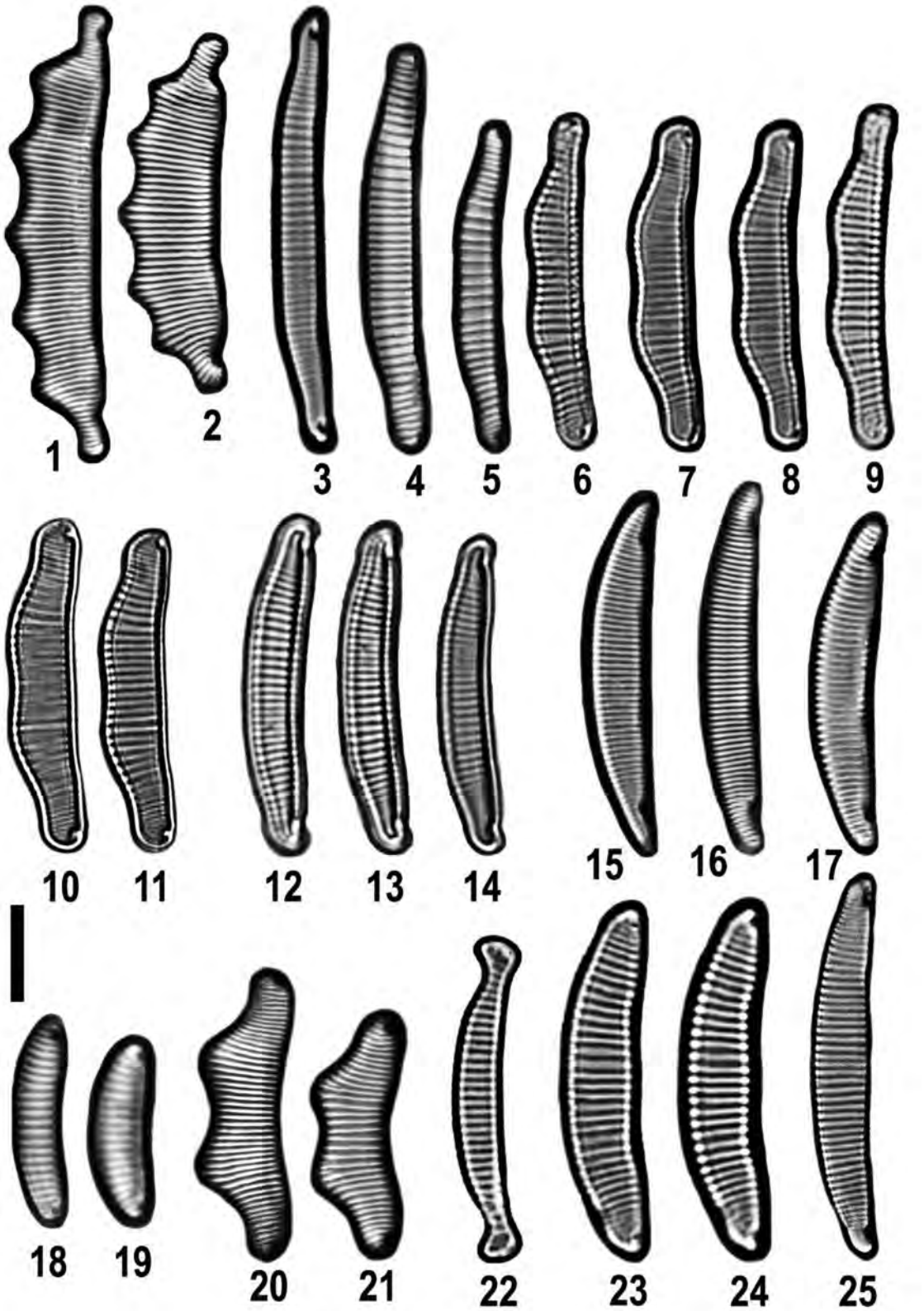


Plate 8: 1-2. *Eunotia hexaglyphis* Ehrenberg 1854, Radomno Lake; 3-11. *Eunotia implicata* Nörpel-Schempp, Lange-Bertalot & Alles 1991, 3-4. Eemian deposits; 5-11. Kamionka Lake; 12-14. *Eunotia incisa* Smith ex Gregory 1854, Kamionka Lake; 15-17. *Eunotia incisadistans* Lange-Bertalot & Sienkiewicz 2011, Zielone Lake; 18-19. *Eunotia intermedia* (Krasske ex Hustedt) Nörpel & Lange-Bertalot 1993, Eemian deposits; 20-21. *Eunotia islandica* Østrup 1918, Radomno Lake; 22. *Eunotia meisteri* Hustedt 1930, Francuskie Lake; 23-25. *Eunotia meridiana* Metzeltin & Lange-Bertalot, 1998, 23. Kamionka Lake; 24-25. Zielone Lake. Scale bar: 10 µm.

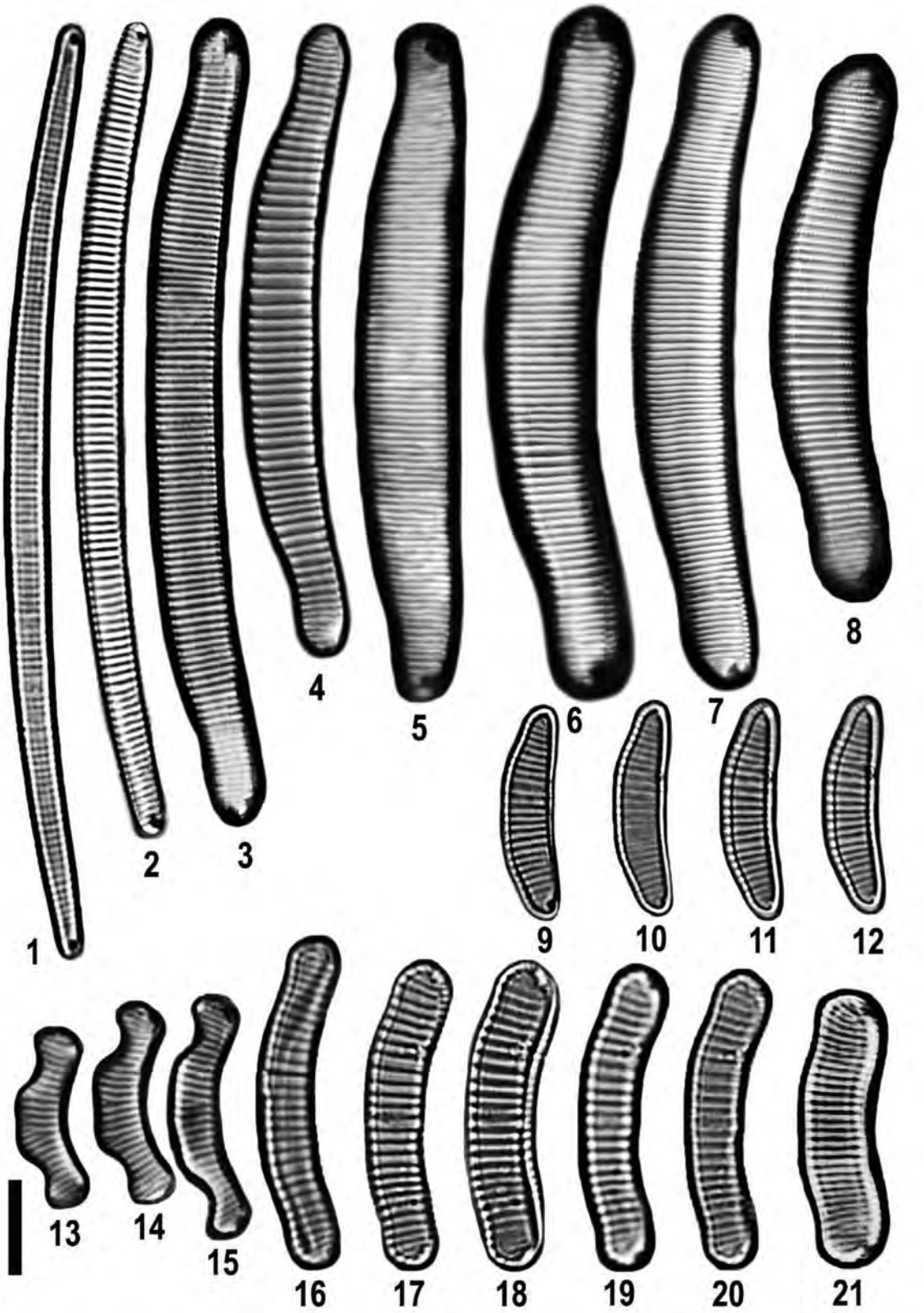


Plate 9: 1. *Eunotia juettnerae* Lange-Bertalot 2011, Młynek Lake; 2. *Eunotia lunaris* (Ehrenberg) Grunow 1877, Młynek Lake; 3-4. *Eunotia longicollis* Metzeltin & Lange-Bertalot 1998, Francuskie Lake; 5. *Eunotia lapponica* Grunow ex A.Cleve 1895, Eemian deposits; 6-8. *Eunotia metamonodon* Lange-Bertalot 2011, 6. Eemian deposits; 7-8. Radomno Lake; 9-12. *Eunotia michaelii* Metzeltin, Witkowski & Lange-Bertalot 1996, Francuskie Lake; 13-15. *Eunotia miutula* Grunow 1862, Zielone Lake; 16-21. *Eunotia palatina* Lange-Bertalot & Krüger 2004, Eemian deposits. Scale bar: 10 µm.

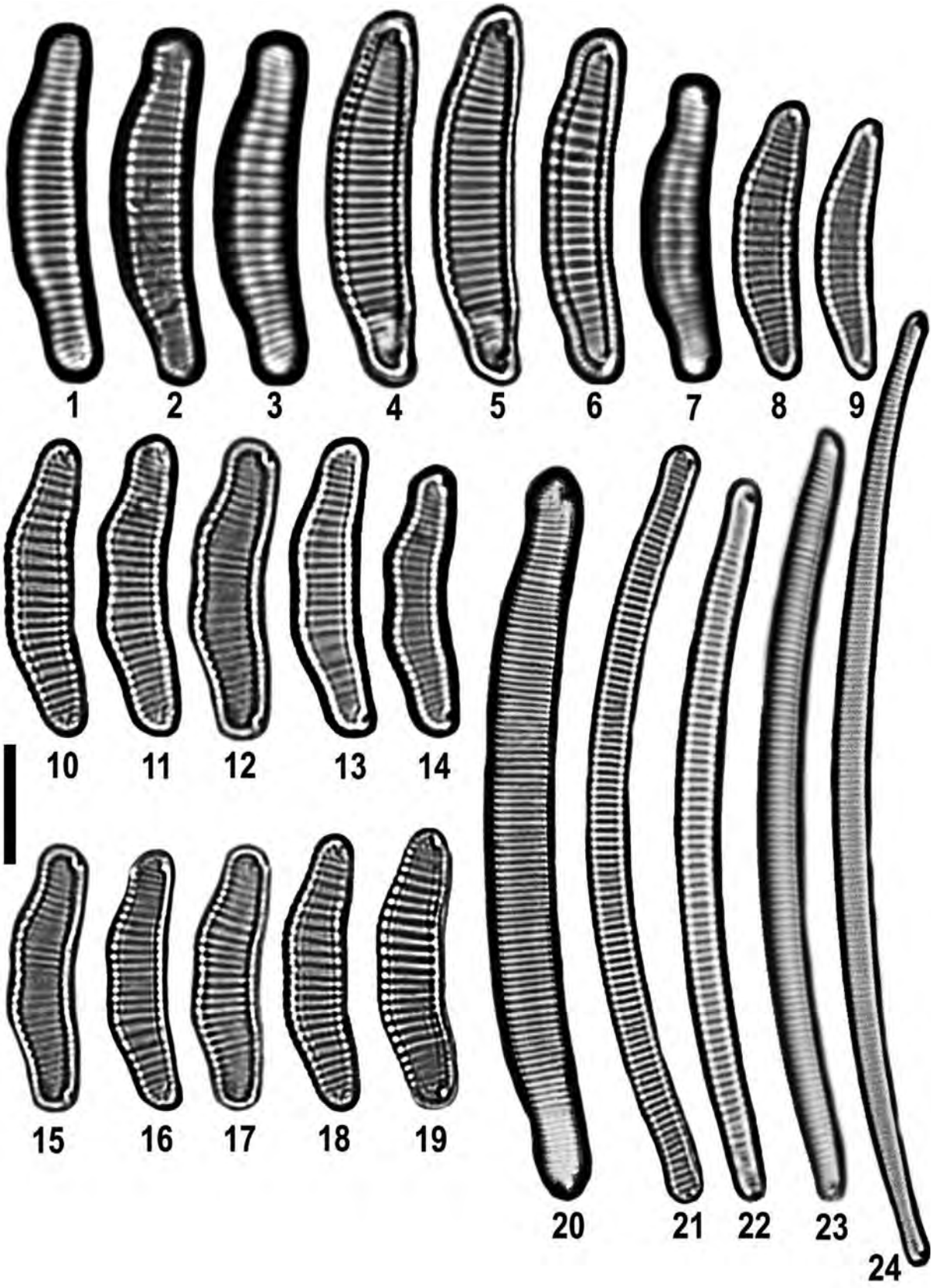


Plate 10: 1-9. *Eunotia minor* (Kützing) Grunow 1881, 1-3. Zielone Lake;4-9. Młynek Lake; 10-19. *Eunotia minor* var *undulata* Zalat nov. var., Młynek Lake; 20. *Eunotia monodon* Ehrenberg 1843, Eemian deposits; 21-23. *Eunotia mucophila* (Lange-Bertalot, Nörpel & Alles) Lange-Bertalot 2007, 21-22. Zielone Lake; 23. Kamionka Lake; 24. *Eunotia naegelii* Migula 1905, Kamionka Lake. Scale bar: 10 µm.

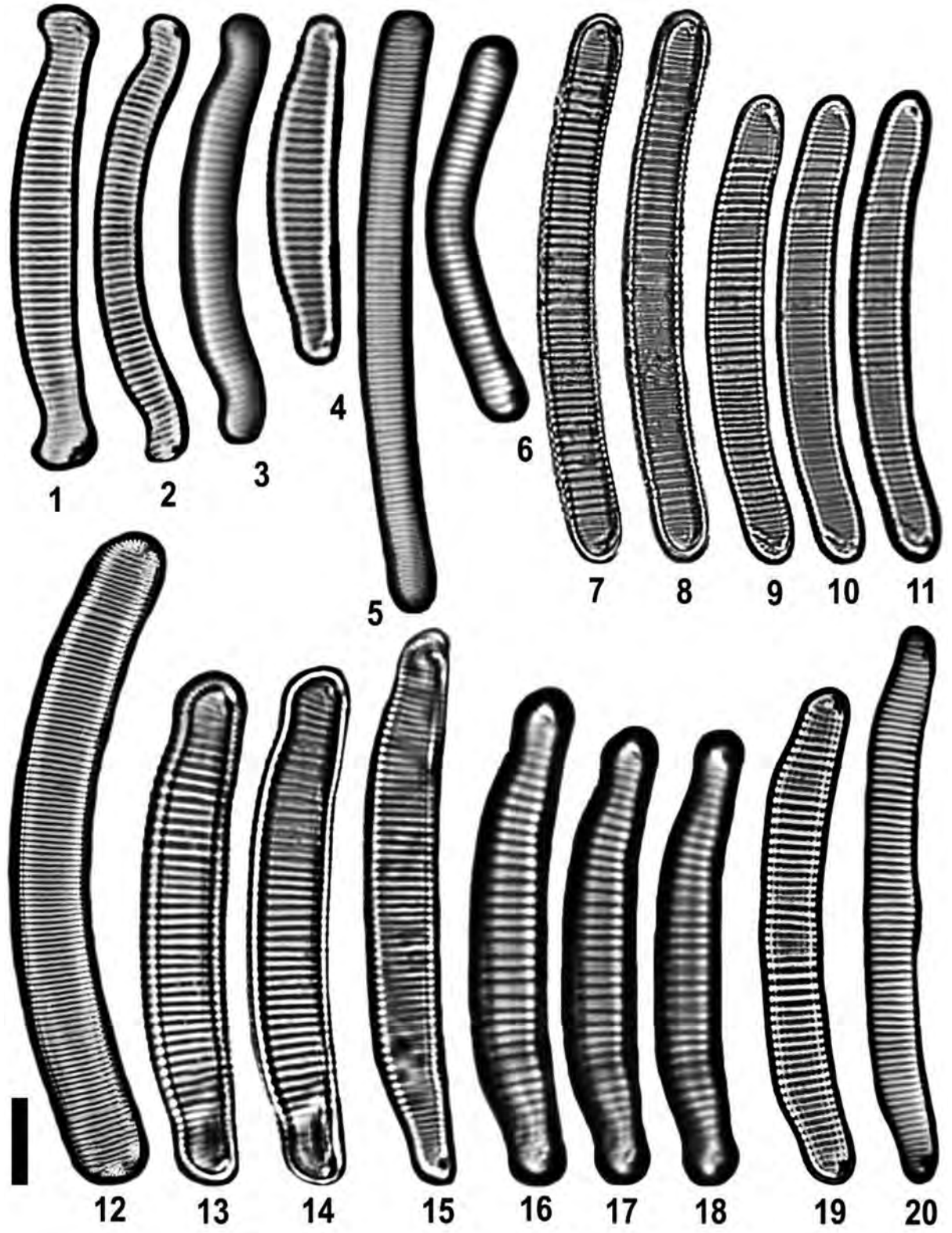


Plate 11: 1. *Eunotia neocompacta* Mayama 1998, Eemian deposits; 2-3. *Eunotia nymanniana* Grunow 1881, Młynek Lake; 4. *Eunotia paludosa* Grunow 1826, Radomno Lake; 5-6. *Eunotia parallela* Ehrenberg 1843, 5. Eemian deposits; 6. Jeziorak Lake; 7-11. *Eunotia parallela* var. *polinica* Zalat nov. var., 7-8. Młynek Lake; 9-11. Eemian deposits; 12. *Eunotia paralleladubia* Lange-Bertalot & Mayama 2011, Jeziorak Lake; 13-14. *Eunotia major* (W.Smith) Rabenhorst 1864, Radomno Lake; 15-18. *Eunotia pectinalis* (Kützing) Rabenhorst 1864, 15. Kamionka Lake; 16-18. Radomno Lake; 19-20. *Eunotia pectinalis* var. *ventricosa* (Ehrenberg) Grunow 1881, 19. Młynek Lake; 20. Eemian deposits. Scale bar: 10 μm.

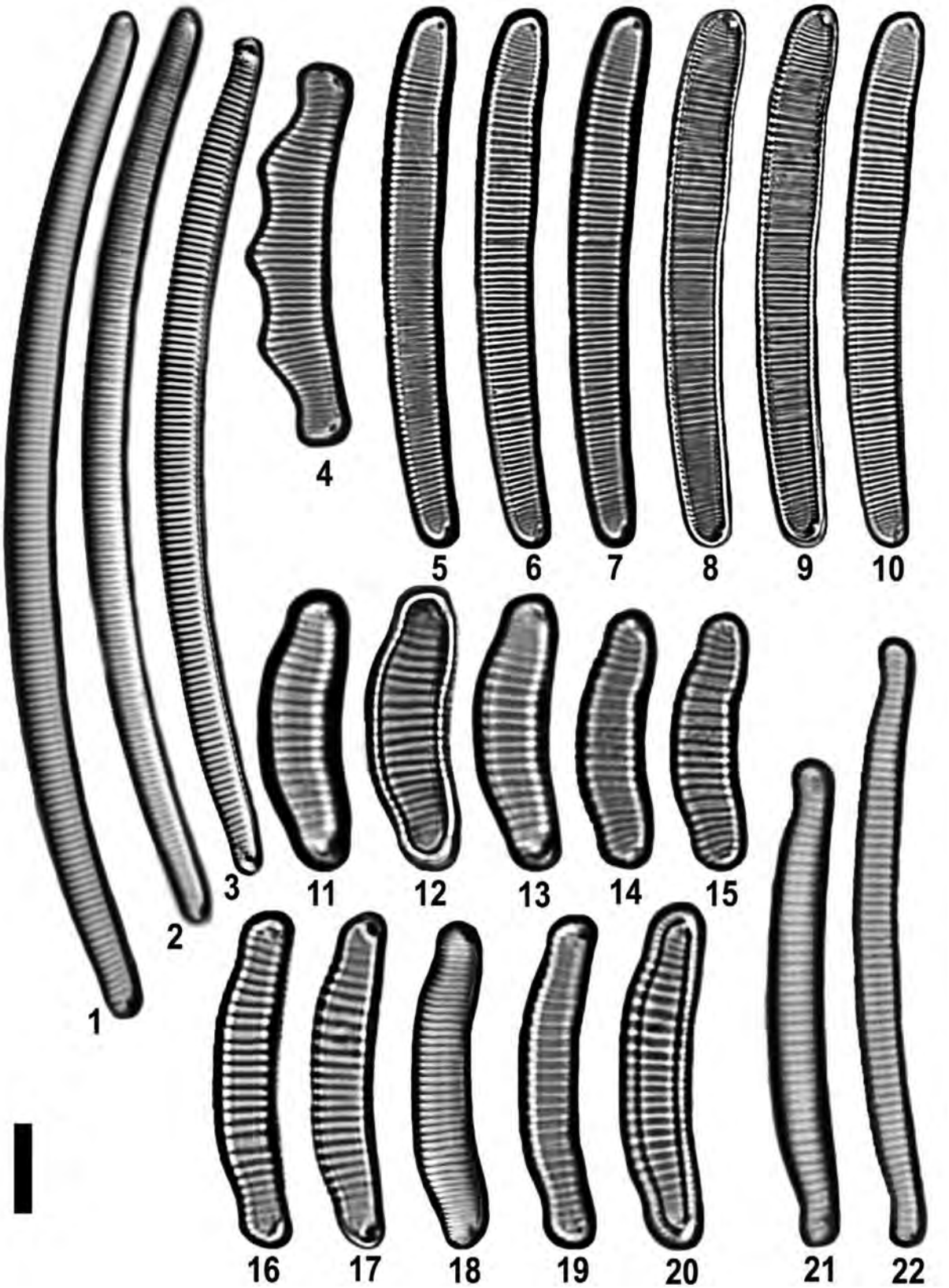


Plate 12: 1-3. *Eunotia panda* Veselá & Johansen 2014, Radomno Lake; 4. *Eunotia paratridentula* Lange-Bertalot & Kulikovskiy 2010, Eemian deposits; 5-10. *Eunotia pomeranica* Lange-Bertalot, Bak & Witkowski 2011, Kamionka Lake; 11-15. *Eunotia praerupta* Ehrenberg 1843, Jeziorak Lake; 16-20. *Eunotia pseudominor* Pavlov & Levkov 2013, 16-18. Radomno Lake; 19-20. Zielone Lake; 21-22. *Eunotia pseudopaludosa* Van de Vijver, Haan & Lange-Bertalot 2014, Eemian deposits. Scale bar: 10 µm

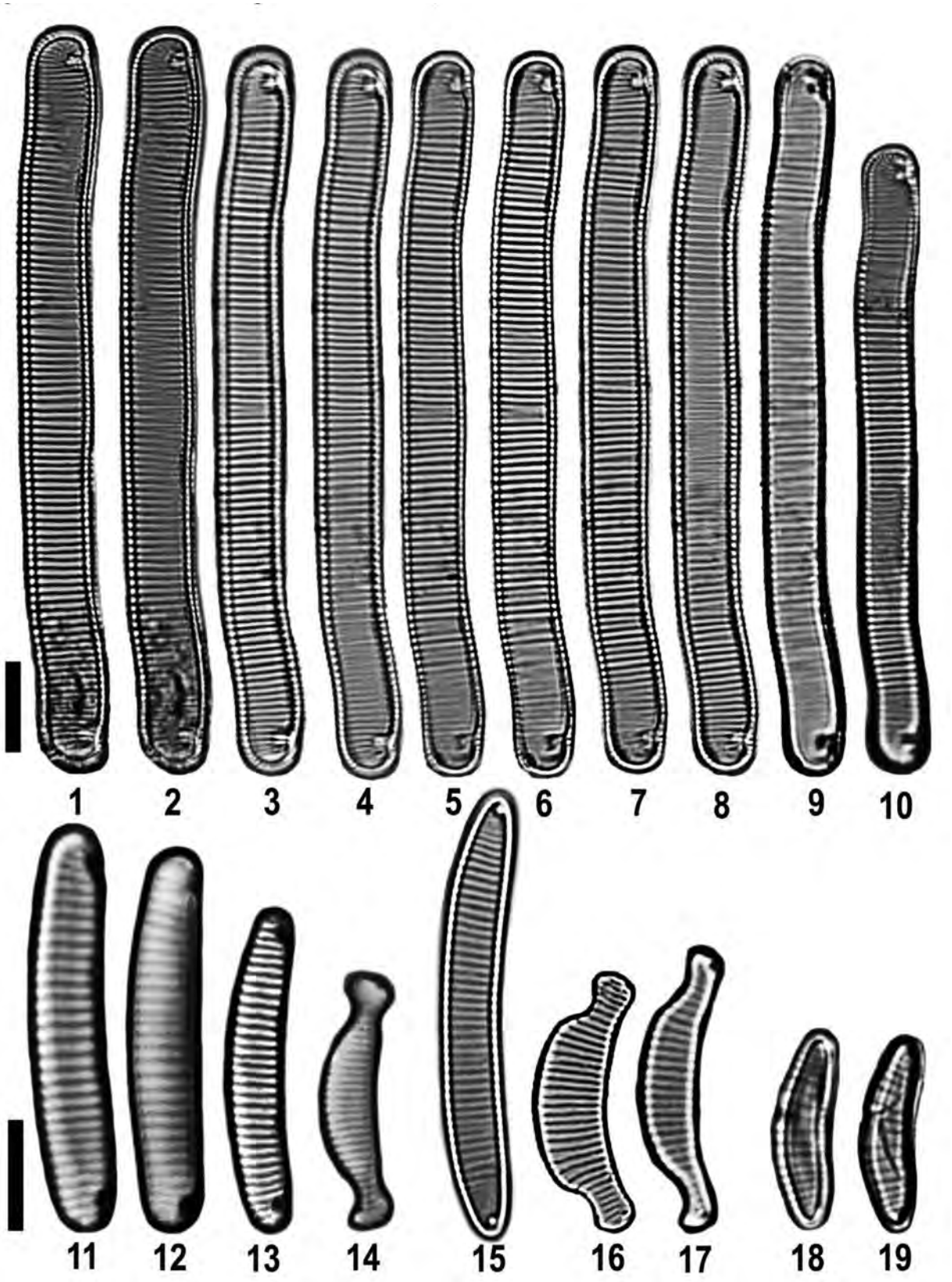


Plate 13: 1-10. *Eunotia radomnoensis* Zalat nov. sp., Radomno Lake; 11-13. *Eunotia rhomboidea* Hustedt 1950, 11-12. Kamionka Lake; 13. Młynek Lake; 14. *Eunotia rhynchocephala* Hustedt 1936, Młynek Lake; 15. *Eunotia seminulum* Nörpel-Schempp & Lange-Bertalot 1996, Radomno Lake; 16-17. *Eunotia septentrionalis* Østrup 1897, Kamionka Lake; 18-19. *Eunotia torula* Hohn 1961, Młynek Lake. Scale bar: 10 µm.

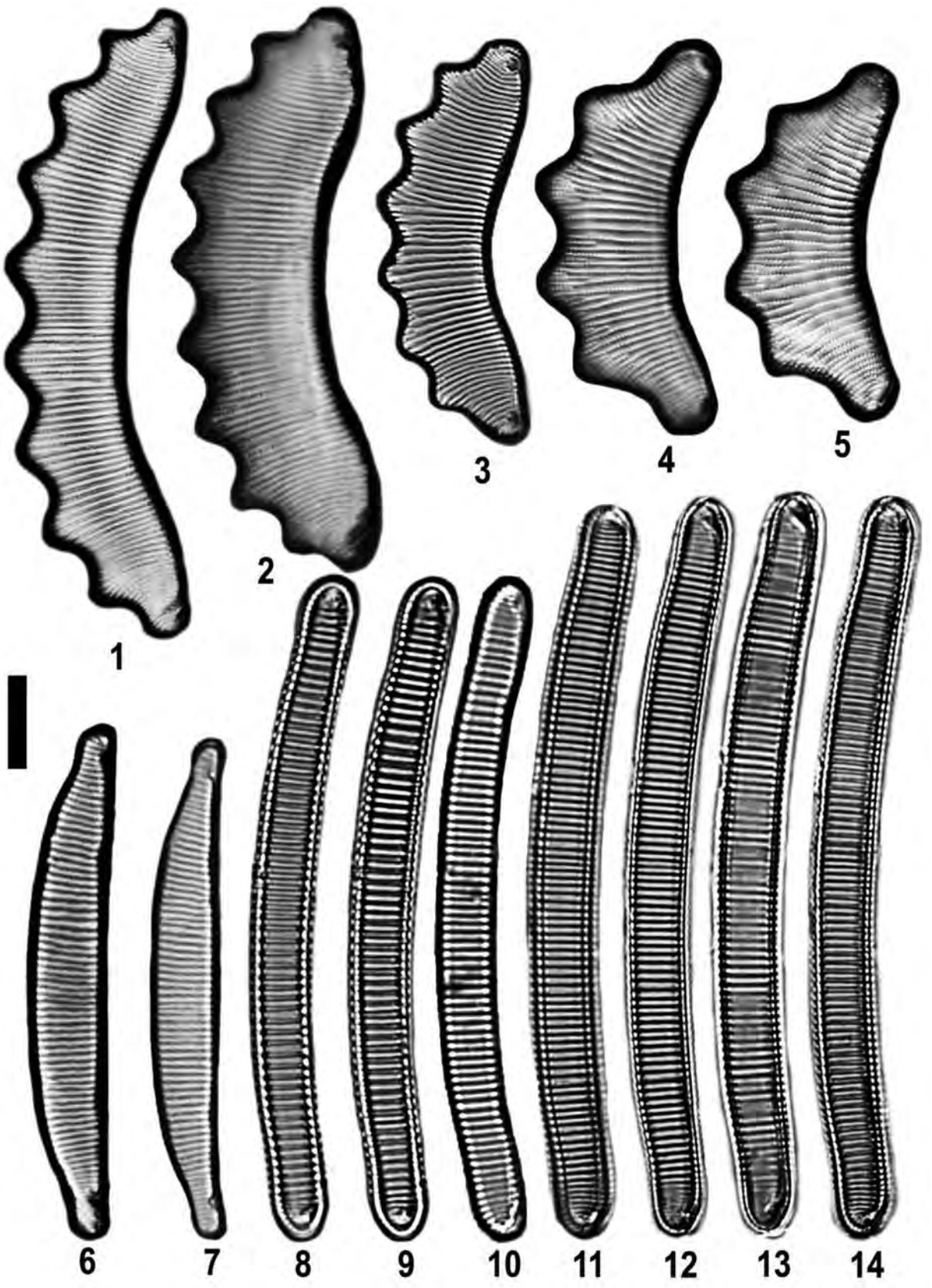


Plate 14: 1-3. *Eunotia serra* Ehrenberg 1837, 1. Radomno Lake, 2-3. Kamionka Lake; 4-5. *Eunotia tetraodon* Ehrenberg 1838, Radomno Lake; 6-7. *Eunotia veneris* (Kützing) De Toni 1892; 6. Eemian deposits; 7. Jeziorak Lake; 8-14. *Eunotia valida* Hustedt 1930, 8-10. Radomno Lake,11-14. Kamionka Lake. Scale bar: 10 μm.

3.2. Order *Achnanthales* Silva 1962

Family *Achnanthaceae* Kützing 1844

The diatoms of the family Achnanthaceae are heterovalvar forms with one raphe valve and the other rapheless valve. The valve is usually lanceolate to broadly elliptical in outline. The general agreement in diatom flora from the mid and late twentieth century by Hustedt (1932), Patrick and Reimer (1966) and Krammer and Lange-Bertalot (1991) was to use the genus *Achnanthes* for most or all heterovalvar diatoms, other than those placed in *Cocconeis*. Krammer and Lange-Bertalot (1991) classified the genus *Achnanthes* into two subgenera, *Achnanthes* and *Achnanthidium*, and the latter is divided into eight groups.

However, SEM studies have tended to suggest that there are a number of clusters of species within *Achnanthes sensu lato*, which might be eligible for a generic status (Round et al. 1990). To some extent, these divisions strengthen the opinions of earlier taxonomists, who recognized *Achnanthidium* and *Eucocconeis* as well as *Achnanthes*, with most freshwater species belonging to *Achnanthidium* rather than *Achnanthes*. More recently, Round and co-workers splitted *Achnanthidium* yet further, with at least six new genera and redefined the boundary of *Achnanthidium* (Bukhtiyarova & Round 1996; Round & Bukhtiyarova 1996; Round & Basson 1997). The new genera designated by them are as follows:

- *Achnanthidium* Kützing 1844 (Type: A*chnanthidium microcephalum* Kützing)
- *Eucocconeis* Cleve *ex* Meister 1912 (Type: *Eucocconeis flexella* (Kützing) Meister = *Cymbella flexella* Kützing)
- *Karayevia* Round *et* Bukhtiyarova *ex* Round 1998 (Type: *Karayevia clevei* (Grunow) Bukhtiyarova 1999 = *Achnanthes clevei* Grunow 1880)
- *Kolbesia* Round *et* Bukhtiyarova *ex* Round 1998 (Type: *Kolbesia kolbei* (Hustedt) Round *et* Bukhtiyarova *ex* Fourtanier and Kociolek = *Achnanthes kolbei* Hustedt 1930)
- *Lemnicola* Round *et* Basson 1997 (Type: *Lemnicola hungarica* (Grunow) Round *et* Basson = *Achnanthidium hungaricum* Grunow 1863)
- *Planothidium* Round *et* Bukhtiyarova 1996 (Type: *Planothidium lanceolatum* (Brébisson) Round *et* Bukhtiyarova 1996 = *Achnanthidium lanceolatum* Brébisson in Kützing 1849)
- *Psammothidium* Bukhtiyarova *et* Round 1996 (Type: *Psammothidium marginulatum* (Grunow) Bukhtiyarova *et* Round = *Achnanthes marginulata* Grunow *in* Cleve and Grunow 1880)
- *Rossithidium* Round *et* Buhtkiyarova 1996 (Type: *Achnanthes pusilla* Grunow *in* Cleve and Grunow 1880)

Genus *Achnanthes* Bory 1822

Frustules heterovalvar with raphe valve and rapheless valve, and flexed in girdle view. Raphe valve is concave, and the rapheless valve is convex. Valves mostly lanceolate or linear-lanceolate, sometimes elliptical or linear-elliptical with rounded to protracted apices. Some taxa with a horseshoe-shaped area on one side of the rapheless valve. Axial area narrow, straight or slightly curved; central area variable, sometimes a narrow or broad rectangular fascia or stauros. Sternum (pseudoraphe) on the rapheless valve is uniformly narrow, never expanded centrally, and sometimes clearly displaced towards the valve margin. Raphe and pseudoraphe are usually straight and mostly median, rarely submarginal. Striae coarsely to finely punctate, mostly radiate or parallel. Striae uni-, bi- or triseriate, similar in structure on both valves, but sometimes differing in orientation. The variable space of the central area has a variable shape and sometimes with developed hyaline stauros.

Holotype species: *Achnanthes adnata* Bory 1822

***Achnanthes adnata* Bory 1822**

Ref. Hustedt 1930, p. 210, fig. 309; Hustedt 1933, p. 424, fig. 877a-c; Hendey 1964, p. 174, pl. 28, fig. 7-8; Foged 1978, p. 23, pl. 15, figs. 13-13,18-20; pl. 16, figs. 2, 6-8, 17; Jensen 1985, p. 368, fig. b77d,e; Laws 1988, p. 152, pl. 17, fig. 22; Lee et al. 2013, p. 394, fig. 1A-1E, fig. 3A; Żelazna-Wieczorek et al. 2015, p. 59, fig. 9 D1-D6.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes brevipes* Agardh 1824
Achnanthidium brevipes (Agardh) Cleve 1895
Achnantella brevipes (Agardh) Gaillon 1833

Diagnosis: In girdle view, the valve is slightly bent geniculately with a convex rapheless valve and a concave raphe valve. Valves are linear-elliptical, slightly constricted in the middle, and cuneate at the apices. Transapical striae are uniseriate on both valves, slightly radiate, about 8-10 in 10 µm. Internal valves with thickened transverse costae. Length of the valve 22-96 µm, and the breadth 7-11 µm.

Ecological preference: Mesohalobous, euryhaline (Pankow 1976; Schrader 1978); epiphytic; a mesohalobous/polyhalobous (Hemphill-Haley 1995); reported as *Achnanthes brevipes* Agardh from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); benthic, mesohalobous, alkaliphilous, mesoeutraphentic (Barinova et al. 2023).

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Found in Górki Zachodnie – Vistula River estuary in North Poland (Majewska et al. 2012); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthes coarctata* (Brébisson) Grunow in Cleve & Grunow 1880**

Ref. Hustedt 1930, p. 210, fig. 308 a; Hustedt 1933, p. 419, fig. 872 a-c; Patrick & Reimer 1966, p. 277, pl. 19, figs. 10-11; Germain 1981, p. 115, fig. 43; Krammer & Lange-Bertalot 1991b, p. 5, pl. 2, figs. 1-8; pl. 4, figs. 1-2; Hartley et al. 1996, p. 20, pl. 2, fig. 6; Wojtal 2009, p. 133, pl 4, fig. 12; Tofilovska et al. 2014, p. 16, figs 1a-aa, 2a-f, 3a-f, 4a-ab, 5a-y, 6a-h;

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium coarctatum* Brébisson ex W.Smith 1855
Achnanthes coarctata var. *elliptica* Krasske 1929
Achnanthes coarctata var. *constricta* Krasske 1929

Diagnosis: Frustules are flexed in the girdle view, heterovalvar with concave raphe valve and convex rapheless valve. Valves are linear-elliptical to linear–lanceolate, constricted in the middle. Valve apices are attenuated, produced, broadly rounded, truncate, and somewhat narrowed rostrate. Raphe valve with narrow, linear axial area, which is slightly curved; central area is a rectangular stauros reaching the margins. Raphe is lateral, recurved near the proximal ends, which expanded into large, rounded central pores; distal raphe endings are unilaterally deflected, bent in the same direction. Transapical striae are uniseriate, coarsely punctate, radiate throughout, but strongly radiate near the ends, about 13-14 in 10 µm; puncta 18-20 in 10 µm. Rapheless valve with submarginal to marginal narrow pseudoraphe. Transapical striae are irregularly parallel at the centre, becoming radiate or curved radiate near the ends, about 12-14 in 10 µm. Length of the valve 22-50 µm, and the breadth 7-14 µm.

Ecological preference: The species found commonly in drainage ditches and on wet rocks from northern Europe (Hustedt 1931); cosmopolitan, oligohalobous- indifferent, pH: acidophilous, aerophilous species, which often occurs on moist mosses (Foged 1957); common in mosses and other aerophytic habitats, especially in springs (Krammer & Lange-Bertalot 1991b); tychoplanktonic (Denys 1991); a neutrophilous, oligosaprobous, oligo-mesotraphentic, terrestrial and fresh water diatom (Van Dam et al. 1994); oligotrophic, freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to high conductivity (100-764 µSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a, 2014 a); in water alkaline (pH 7.8-9.4) (Rybak et al. 2019).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: The species reported from the Wyżyna Krakowsko-Częstochowska Upland, springs in Dubie, south Poland (Skalska 1966 a, b); Zalew Szczeciński (Bąk et al. 2006); in Kobylanka stream, south Poland, in samples with *Vaucheria* sp. filaments (Wojtal 2009); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (Różanka, Morwawa, Baryczka, Stobnica, Mleczka, Ryjak, Wielopolka, Matysówka) of the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014b); Rzeszów, Przyrwa

stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); epiphytic mosses overgrowing the bark of white poplar tree trunk and drainage water in urban areas, northern part of the Stalowa Wola city, south-east Poland (Rybak et al. 2018, 2019).

***Achnanthes expressa* Carter 1986**

Ref. Carter & Bailey-Watts 1981, p. 532, pl. 1, figs. 40-43; pl. 23, figs. 15-16; Hartley et al. 1996, p. 22, pl. 3, fig. 10.

Status of name: accepted taxonomically.

Synonym: *Achnanthes exiloides* Carter in Carter & Bailey-Watts 1981

Diagnosis: Valve is linear-lanceolate with acute apices. In the raphe valve, the raphe is filiform, straight, with small proximal ends, axial area linear, narrow; central area is small, irregular, formed by shortened central striae. Transapical striae are radiate at the centre, becoming parallel near the apices, about 18-20 in 10 µm. In the rapheless valve, the axial area is linear, narrow; the central area is absent. Transapical striae are nearly parallel throughout, about 18-19 in 10 µm. Length of the valve 26-33 µm, and the breadth 5-5.5 µm.

Ecological preference: oligotrophic, alkaline or close to neutral water reactions (pH: 7-9), low to relatively high conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a, 2016a).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Wisłok River and the catchment area, including rivers and streams (Pielnica and Stobnica) of the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a).

***Achnanthes intermedia* Kützing 1833**

(Pl. 15, figs. 1-2)

Ref. Hustedt 1930, p. 210, fig. 310; Hustedt, 1933, p. 425, fig. 877 d, e; Mclntire & Reimer 1974, p. 171, pl. 2, fig. 8a, b; pl. 3, fig. 2a,b; Foged 1978, p. 23, pl. 15, figs. 13-14,18-20; John 1983, p. 68, pl. 29, figs. 10-11; Jensen 1985, p. 369, fig. 877d,e; Laws 1988, p. 152, pl. 17, figs. 17-19; Krammer & Lange-Bertalot 1991 b, p. 3, pl. 1, figs. 4-8; Ehrlich 1995, p. 49, pl. 10, figs. 9-18; Witkowski et al. 2000, p. 86, pl. 43, figs. 1-5; Wojtal 2009, p. 133, pl. 4, fig. 11.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes brevipes* var. *intermedia* (Kützing) Cleve 1895
Achnanthidium brevipes var. *intermedia* (Kützing) Cleve, VanLandingham 1967
Achnanthes subsessilis Kützing 1833

Diagnosis: Frustules are flexed in girdle view, with concave raphe valve and convex rapheless valve. Valve is linear-elliptical to lanceolate, somewhat more or less constricted in the middle portion, with broadly rounded apices. In the raphe valve, the raphe is sinuous, the axial area is narrowly linear, and the central area transversely extends into widening stauros. In the rapheless valve, the axial area is narrowly linear, eccentric from submarginal to marginal; the central area is not developed. Transapical striae are uniseriate on both valves, coarsely punctate, radiate throughout, about 9-10 in 10 µm on the rapheless valve, 11-12 in 10 µm on the raphe valve. Length of the valve 25-35 µm, and the breadth 6-10 µm.

Ecological preference: The species is widely distributed and lives in waters of lower salt concentration, as well as in brackish or marine waters (Hustedt 1931, 1932); epiphytic; a-mesohalobous/polyhalobous (Hemphill Haley 1995); Brackish water, benthic (Laws 1988); Cosmopolitan, halophilous diatom (Krammer & Lange-Bertalot 1991b); euplanktonic (Denys 1991).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Reported from Wyżyna Krakowsko- Częstochowska Upland. Spring in Dubie, south Poland (Skalska 1966a, b); Zatoka Gdańska, and Zatoka Pucka, north Poland (Witkowski 1994; Witak 2002); salt spring in Pełczyska, south Poland (Rakowska 1997, 2001), it is regarded as at risk of becoming endangered or vulnerable in Poland (Siemińska et al. 2006). In Kobylanka stream, in the epipelon sample from below Kobylany village (Wojtal 2009).

***Achnanthes lemmermannii* Hustedt 1933**

Ref. Hustedt 1933, p. 390, fig. 837; Patrick & Reimer 1966, p. 265, pl. 17, fig. 15; Lange-Bertalot & Krammer 1989, p. 94, pl. 79, figs.1-10; Krammer & Lange-Bertalot 1991 b, p. 44, pl. 26, fig. 33-40; Witkowski et al. 2000, p. 97; pl. 48, figs. 35-41; pl. 51, figs. 32-33

Status of name: accepted taxonomically.

Synonym: *Planothidium lemmermannii* (Hustedt) Morales 2006

Diagnosis: Valve is oblong-elliptical with slightly or rather strongly convex margins, narrowing abruptly to produce subcapitate or capitate apices. In the raphe valve, the axial area is narrow, linear, raphe filiform, and central raphe endings are slightly enlarged; central area is small, indistinct or lacking. Transapical striae are indistinctly lineate, radiate. The rapheless valve is similar to the raphe valve, with narrow lanceolate of the axial area. Central area is indistinct and united with the axial area. Transapical striae are radiate throughout, about 16-18 in 10 µm on both valves. Length of the valves 13-20 µm and the breadth 4-6 µm.

Ecological preference: Fresh to slightly brackish waters in coastal area (probably oligohalobous-indifferent) (Patrick & Reimer 1966); epipsammic species, frequently found in European coastal fine and medium sandy sediments but also in brackish water "Salinas" in Chile (Krammer& Lange-Bertalot 1991b); it is found in freshwaters to slightly brackish waters in coastal areas, and classified as brackish epipsammon (Vos & de Wolf 1993); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Górki Zachodnie and Swibno – Vistula River estuary in north Poland (Majewska et al. 2012); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Dunder 2007; Witak & Jankowska 2014); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthes leonardii* Witkowski & Lange-Bertalot 2000**

Ref. Witkowski et al. 2000, p. 92, pl. 50, figs. 1-12; Desianti & Potapova 2019, pl. 106, figs. 16-17.

Status of name: accepted taxonomically.

Diagnosis: Valve is linear elliptic with strongly convex margins, narrowing abruptly to produce protracted, capitate to rostrate rounded apices. In the raphe valve, the axial area is very narrow, linear, raphe filiform, straight; central raphe endings with small, indistinct central pores; central area large, rhombic to orbicular. Transapical striae are radiate throughout, about 24-26 in 10 µm. In the rapheless valve, the axial area is distinct, narrow, linear; central area is unilateral, forms a narrow transverse fascia, bordered at the valve margin by 2-3 short striae. Transapical striae are punctate, parallel in the middle, radiate towards the ends, about 22-24 in 10 µm. Length of the valve 18-25 µm, and the breadth 8-8.5 µm.

Ecological preference: This is a marine species.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Found in Górki Zachodnie – Vistula River estuary, north Poland (Majewska et al. 2012); Puck Lagoon, Gulf of Gdańsk, north Poland (Witak 2013); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthes minuscula* Hustedt 1945**

Ref. Hustedt 1945, p. 907, pl. 39, figs. 8-12; Plinski & Witkowski 2011, p. 119, fig. 123; Hartley et al., 1996, p. 26, pl. 5, fig. 15; Bąk et al. 2012, p. 29, pl. 22

Status of name: accepted taxonomically.

Synonym: *Planothidium minusculum* (Hustedt) Witkowski, Kulikovskiy & Pliński 2011

Diagnosis: Valves are broadly elliptical, linear-elliptical to elliptical-lanceolate with moderately convex margins, narrowing abruptly to produce protracted rostrate acutely rounded apices. In the raphe valve, the axial

area is narrow and linear, the raphe is straight, filiform, central raphe ends are indistinct; the central area is almost small or poorly developed due to shortening one or two striae. Transapical striae are fine, radiate, about 22-26 in 10 µm. The rapheless valve is similar to the raphe valve, with a very narrow linear to narrowly lanceolate axial area; central area is indistinct and united with the axial area. Transapical striae are fine, radiate, about 24-28 in 10 µm. Length of the valves 7-10 µm and the breadth 3.5-4.5 µm.

Ecological preference: Freshwater species, widespread in lakes, most often in waters rich in calcium. It is also quite common in artificial tanks with standing water; meso- to eutrophic waters (Bąk et al. 2012)

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); found in Górki Zachodnie and Swibno – Vistula River estuary, North Poland (Majewska et al. 2012); as *Planothidium minusculum* from Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthes parvula* Kützing 1844**

Ref. Hustedt 1933, p. 426, fig. 877 f-i; Krammer & Lange-Bertalot 1991 b, p. 5, pl. 1, figs. 1-15; Hartley et al. 1996, p. 30, pl. 7, fig. 3; Witkowski et al. 2000, p. 93, pl. 43, figs. 6-7; pl. 45, figs. 6-8; pl. 47, fig. 9; Lee et al. 2013, p. 399, fig. 1W-1Z, fig. 5A.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes brevipes* var. *parvula* (Kützing) Cleve 1895

Achnanthidium brevipes var. *parvulum* (Kützing) Mereschkowsky 1901

Diagnosis: In girdle view, the valve is slightly curved, with a convex rapheless valve and a concave raphe valve. Valves are linear-elliptical, slightly broad in the middle, with convex margins and broadly rounded apices. In the raphe valve, the axial area is narrow, linear; the raphe is straight, filiform; the central area is almost small, transverse, formed due to shortening one or two striae. Transapical striae are finely punctate, uniseriate, slightly radiate, about 14-16 in 10 µm. In the rapheless valve, the axial area is narrow and linear; the central area is indistinct and united with the axial area. Transapical striae are coarsely punctate, slightly radiate, about 9-11 in 10 µm. Length of the valves 10-21 µm and the breadth 4.5-8 µm.

Ecological preference: Brackish water, neritic, benthic (Laws 1988); brackish water, alkaliphilous, meso- to eutraphentic (Van Dam et al. 1994); freshwater, brackish and marine (Hartley et al. 1996).

Distribution in Poland: Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthes rupestoides* Hohn 1961**

(Pl. 15, figs. 4-6)

Ref. Hohn 1961, p. 154, pl. 1, figs. 3, 4; Patrick & Reimer 1966, p. 264, pl. 17, figs. 9-10; Lange-Bertalot & Krammer 1989, p. 157, pl. 29, figs. 1-6; Krammer & Lange – Bertalot 1991b, p. 31, pl. 17, figs. 35-42.

Status of name: accepted taxonomically.

Synonym: *Planothidium rupestoides* (Hohn) Round & Bukhtiyarova 1996

Achnanthes hustedtii (Krasske) Reimer 1966

Diagnosis: Valves are oblong, elliptical or elliptical-linear with broadly rounded ends. The raphe valve has a narrow-lanceolate axial area and a transversely large elliptical or rectangular central area. Raphe is straight, filiform, slightly broader toward the valve centre, proximal raphe endings are distant, with rounded central pores; distal raphe endings are indistinct. Transapical striae are radiate, finely punctate, about 17-19 in 10 µm. Rapheless valve with broad, elliptical lanceolate axial area. Transapical striae are parallel at the centre, about 16-18 in 10 µm, radiate and denser towards the ends, about 20-22 in 10 µm on both valves. Length of the valve 12-20 µm, and the breadth 5-8 µm.

Ecological preference: found in waterfalls area (aerophilous?), alkaliphilous (Patrick & Reimer 1966); fresh-brackish water, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); species found in flowing waters, lakes and springs, in oligotrophic and oligosaprobic waters; alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a).

Occurrence: Recorded frequently from the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Wisłok River in the Podkarpacie Province, south Poland (Noga et al. 2014a)

Family *Achnanthidiaceae* Mann 1990

Genus *Achnanthidium* Kützing 1844

Diagnosis: Frustules are small; valves are linear-lanceolate to lanceolate-elliptic. Raphe valve with a fine central raphe, hardly expanded at the centre and straight or turned to one side at the apex. The axial area is narrow at the apex, widening to the centre. Transapical striae are uniseriate**,** radiate or almost transverse, about 28-30 in 10 μm, often slightly wider spaced in the centre and closer towards the valve apices, about 34-37 in 10 μm. Raphe-less valve with striae usually more even and often slightly more spaced than on the raphe valve.

Type species: *Achnanthidium microcephalum* Kützing 1844

***Achnanthidium acsiae* Van de Vijver, Wojtal, Morales & Ector 2011**

Ref. Wojtal et al. 2011, p. 226, figs. 155-184

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-lanceolate, moderately inflated in the middle part, with subrostrate to subcapitate, protracted apices in larger specimens, while the smaller valves are linear-elliptical with broadly rounded apices. Raphe valve is concave with a narrow, lanceolate axial area, gradually widening towards the central area. Central area forming a rectangular fascia, sometimes with one shortened stria present on each side. Raphe is filiform, straight, with simple proximal endings, located close to each other. Distal raphe endings are slightly deflected, terminating on the hyaline area located at the junction of the mantle and valve face. Transapical striae are fine, moderately radiate throughout the valve, becoming strongly radiate near the apices, about 28-36 in 10 μm at the valve centre, up to 36-38 striae in 10 μm near the apices. Rapheless valve is convex with a narrow, lanceolate axial area widening towards the central area. Central area is very small, never forming a fascia. Transapical striae are moderately radiate throughout, about 30-31 in 10 μm at the valve centre, up to 38 striae in 10 μm near the apices. Length of the valve 7.0-15.8 μm, and the breadth 2.3-3.1 μm.

Remarks: *Achnanthidium acsiae* is mainly similar to *Achnanthidium saprophilum*, but it differs from *A. saprophilum* by more linear-lanceolate valve shape, raphe morphology and a lower number of areolae per stria (Wojtal et al. 2011).

Ecological preference: slightly alkaline waters of moderate specific conductance, rich in sulphur (Wojtal et al. 2011)

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: The species was found in sediments of springs in Polichty (Pogórze Rożnowskie), Źródto Paweł and Geologów springs in Polichty, south Poland (Wojtal et al. 2011)

***Achnanthidium affine* (Grunow) Czarnecki 1994**

(Pl. 15, figs. 7-8)

Ref. Hustedt 1930, p. 199, fig. 282; Hustedt 1933, p. 381, fig. 826; Patrick & Reimer 1966, p. 254, pl. 16, figs. 11-12; Germain 1981, p. 110, pl. 41, figs. 22-34; Jensen 1985, p. 332, fig. 826; Lange-Bertalot & Krammer 1989, p. 104, pl. 53, figs. 22-37; pl. 56, figs. 5-7; Krammer & Lange-Bertalot 1991b, p. 58, pl. 33, figs. 13-22; Wojtal 2009, p. 134, pl 4, fig. 13-16; Wojtal et al. 2011, p. 219, figs. 96-107; Bąk et al. 2012, p. 32, pl. 23; Noga et al. 2013 c, p. 137, fig. 2:7-9; p. 141, fig. 4: 3.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes affinis* Grunow 1880

Achnanthes minutissima var. *affinis* (Grunow) Lange-Bertalot 1989

Achnanthidium minutissimum var. *affinis* (Grunow) Bukhtiyarova 1995

Diagnosis: Valves are linear-lanceolate with slightly convex margins and not protracted, broad obtusely rounded subrostrate to rostrate ends. In the raphe valve, the axial area is narrow and linear; raphe is straight and filiform; proximal raphe endings are located distantly from each other and terminate at the stauros; distal raphe endings terminate on a hyaline margin of the valve face. Central area is developed through shortenings of 2-3 striae on both sides, not reaching up to the margin, somewhat forming an acute-angle fascia. Transapical

striae are slightly to moderately radiate throughout, widely spaced at the central part, about 24-26 in 10 µm, while at the ends, about 28-32 in 10 µm. In the rapheless valve, the axial area is narrow lanceolate, which occasionally widens in the centre. Central area is not distinct. Transapical striae are slightly radiate throughout, about 26-28 in 10 µm at the centre, up to 35 in 10 µm near the ends. Length of the valve 11-25 µm, and the breadth 2.5-4 µm.

Ecological preference: Cosmopolitan, salinity indifferent (halophilous), pH: alkaliphilous (Foged 1957); distributed throughout all of Europe in freshwater and in weakly saline waters (Hustedt 1933; Jensen 1985). It prefers ecologically oligosaprobic, oligotrophic, calcium-rich waters, slightly alkaline or moderately to high conductivity environments (Krammer & Lange-Bertalot 1991 b); it was dominant from the epiphytic community of *Cladophora glomerata* in the Colorado River (Hardwick et al. 1992); an alkaliphilous, oligosaprobous and fresh brackish water species (Van Dam et al. 1994); it occurred abundantly in a shallow eutrophic lake in Portugal (Abrantes et al. 2006). The species is classified as a low-nutrient indicator in rivers of the United States (Potapova & Charles 2007); widespread diatom, observed in oligotrophic waters of springs and streams; the species co-occurred commonly with *A. minutissimum* and was the most common in circumneutral and slightly alkaline waters, especially slowly moving waters of moderate specific conductance (Wojtal et al. 2011); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a).

Occurrence: Recorded frequently from the Eemian palaeolake deposits of central Poland.

Distribution in Poland: It is recorded from the Wyżyna Krakowskoczęstochowska Upland, Młynowka River (Gumiński 1947); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); reported from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); The species formed the largest populations in the Centuria and Wielki Las reserve (Wyżyna Krakowsko-Częstochowska upland), the areas covered by postglacial sands (Wojtal et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Found in Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014 a ; Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b). Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium anastasiae* (Kaczmarska) Chaudev & Gololobova 2016**

(Pl. 15, figs. 9-10)

Ref. Kaczmarska 1985, p. 38, pl. 1, fig. 47; pl. 2, figs. 3-5; Lange-Bertalot 1993, p. 7, pl. 37, figs. 19-23; Krammer & Lange-Bertalot 2004, p. 83, pl. 22, figs. 57-51; Bąk et al. 2012, p. 35, pl. 23; Chaudev & Gololobova 2016, p. 60, pl. 118, figs 72-94; pl. 121, figs 1-4.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes anastasiae* Kaczmarska 1985
Rossithidium anastasiae (Kaczmarska) Potapova 2012
Achnanthes lineariformis Lange-Bertalot 1993
Achnanthes linearioides Lange-Bertalot 1994
Achnanthidium linearioides Lange-Bertalot 2004

Diagnosis: Valves are linear or linear-elliptical with no protracted, blunt to broadly rounded ends. The raphe valve has a narrow, linear axial area that gradually widens into a small, transversely expanded or almost indistinct central area. The raphe is straight, filiform, and lacks terminal fissures; the proximal raphe endings are curved to opposite sides. Transapical striae are similar on both valves, uniseriate, parallel to slightly radiate, evenly spaced, about 24-28 in 10 µm. Length of the valve 10-25 µm, and the breadth 4-5 µm.

Remarks: This species is similar to *Achnanthes pusilla* and *Achnanthes nodosa* Cleve, which are distinguished by their thicker, less frequent striations (18-23 in 10 µm) and usually shorter, as well as slightly narrower covers.

Ecological preference: *Rossithidium anastasiae* is a widely distributed diatom, often found in colder waters in Europe (Mölder & Tynni 1972; Krammer & Lange-Bertalot 2004); distributed in oligo- to mesotrophic waters with low content of electrolytes, locally reaches a high abundance (Hofmann et al. 2011; Bąk et al. 2012); Circumneutral, mainly occurring at pH about 7 (Szulc & Szulc 2012); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon, very good water quality (Szczepocka & Rakowska 2015).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015).

***Achnanthidium atomoides* Monnier, Lange-Bertalot & Ector 2004**

Ref. Monnier et al. 2004, p. 130, figs. 1-72, 117-123; Monnier et al. 2007, p. 144, figs. 1-8.

Status of name: accepted taxonomically.

Diagnosis: Frustules in girdle view are heterovalvar, rectangular and bent with concave raphe valve and convex rapheless valve. Valves are isopolar, linear-elliptic to elliptic with rounded ends. In the raphe valve, the axial area is narrow, linear. Central area is an acute-angled subfascia, formed by shortened striae in the centre. Raphe is filiform, straight with slightly expanded proximal ends, and straight terminal raphe ends. Transapical striae are uniseriate, slightly radiate near the centre, about 25-30 in 10 μm, becoming strongly radiate and denser towards the valve ends. In the rapheless valve, the axial area is narrow, linear, with an indistinct central area. Transapical striae are uniseriate, parallel throughout the valve length, irregularly spaced, about 23-28 in 10 μm, and terminal short striae slightly radiate. Length of the valve 4.5-12 μm, and the breadth 2.2 to 3.5 μm.

Remarks: *Achnanthidium atomoides* is closely related to *Achnanthes atomus*, but it differs by consistently smaller valve sizes and by lesser spaced striae and areolae.

Ecological preference: This taxon was present in fairly cold (8.7 to 10.2°C), well-oxygenated waters (8.4 to 11.6 mg/l^{-1} O2) with conductivities from 587 to 771 μS.cm^{-1} and basic pH from 8.1 to 8.5 (Monnier et al. 2004).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, southern Poland (Rybak et al. 2019).

***Achnanthidium atomus* (Hustedt) Monnier, Lange-Bertalot & Ector 2004**

Ref. Hustedt 1937, p. 194, pl. 13, figs. 33-36; Simonsen 1987, pl. 325, figs. 32–38; Monnier et al. 2004, p. 128, figs. 73-116, 124-130; Ponader & Potapova 2007, p. 231, pl. 1, figs. 17-20; pl. 2, figs. 6-8.

Status of name: accepted taxonomically.

Synonym: *Achnanthes atomus* Hustedt 1937

Diagnosis: Valves are elliptical to linear-elliptical. The raphe valve is concave with a linear axial area, which widens slightly in the middle portion of the valve. Central area is a transverse fascia formed by shortened middle striae. The raphe is straight; the distal raphe endings are indistinct, and the proximal endings are simple and not expanded. Transapical striae are strongly radiate throughout the valve, about 24-26 in 10 μm in the middle and up to 34 in 10 μm at the apices. The rapheless valve is convex with a narrow, linear axial area and lacks a central area. Transapical striae are parallel throughout the valve, becoming slightly radiate at the apices, about 20-23 in 10 μm. Length of the valve 10-20 μm, and the breadth 3-3.5 μm.

Ecological preference: The species is widely distributed in Africa, in neutral to slightly alkaline river waters (Cholnoky 1957, 1962). This taxon was recorded from a great variety of running water environments and substrates such as waterfalls, rivers, stones, wood, mosses, especially on sprinkling waters, then considered rheophilous, living at temperatures between 10 and 25 °C, but rarely above 20°C, in waters with a fairly high mineral content and slightly alkaline pH 7-8, poor in calcium carbonate (Monnier et al. 2004). It was mostly found in nutrient-poor rivers within a narrow pH range from 8 to 8.3, but over a wide range of conductivity levels with a preference towards higher values (Ponader & Potapova 2007).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b)

***Achnanthidium caledonicum* (Lange-Bertalot) Lange-Bertalot 1999**

(Pl. 15, figs. 11-13)

Ref. Carter 1981, p. 534, pl. 1, fig. 31; Lange-Bertalot & Krammer 1989, p. 106, pl. 55, figs. 4-12; pl. 67, figs. 35-36; pl. 57, fig. 11; Wojtal et al. 2011, p. 219, figs. 78-95; Bąk et al. 2012, p. 32, pl. 23; Noga et al. 2013 c, p. 137, fig. 2: 10.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes caledonica* Lange-Bertalot 1994
Achnanthes microcephala f. *scotica* Carter 1981
Achnanthes microcephala var. *scotica* Lange-Bertalot & Krammer 1989
Achnanthes minutissima var. *scotica* (Carter) Lange-Bertalot 1989
Achnanthes scotica Lange-Bertalot 1993
Achnanthidium minutissimum var. *scoticum* (Carter) Cremer 2003

Diagnosis: Frustules are heterovalvar with concave raphe valve and convex rapheless valve. Valves are isopolar, bilaterally symmetrical, linear to linear-lanceolate with broad subcapitate to capitate rounded ends. Axial area is linear, slightly widening towards the valve centre on the raphe and rapheless valve, becoming weakly lanceolate. On the raphe valve, central area is subrounded to rhombic with shortened and wider spaced marginal striae or a transverse fascia, which can be present only on one side with 1 or 2 shortened striae. Raphe is simple, filiform, straight, with hardly expanded proximal and distal endings. On the rapheless valve, central area is oval or lanceolate with shortened, wider spaced striae, or a transverse fascia. Transapical striae are radiate at the valve centre, becoming more radiate close to the ends, about 27-30 in 10 μm in the middle part of the valve; up to 35-37 in 10 μm near the apices. Length of the valve 10-35 μm, and the breadth 2.5-4 μm.

Ecological preference: This taxon prefers oligotrophic, circumneutral waters of low or slightly elevated specific conductance (Krammer & Lange-BertaLot 1991 b, 2004); fresh-brackish water, circumneutral (Van Dam et al. 1994); dominant and widespread in the waters of oligo- to weakly mesotrophic mountain lakes, indicator for very good ecological conditions (Bąk et al. 2012). *A. caledonicum* was common in circumneutral and slightly alkaline waters with low specific conductance and low nutrient concentration; in springs, seepage areas and lakes on granitic bedrock (Wojtal et al. 2011).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Springs, seepage areas and lakes on granitic bedrock in the Tatra Mountains (e.g. the Morskie Oko lake); the highest abundances were observed in the epilithon of the Morskie Oko lake, south Poland (Wojtal et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium catenatum* (Bily & Marvan) Lange-Bertalot 1999**

Ref. Lange-Bertalot & Krammer 1989, p. 37, pl. 55, figs. 30-33; Krammer & Lange-Bertalot 1991 b, p. 62, pl. 34, figs. 23, 24; Coste & Ector 2000, p. 380, pl. 1, figs. 4-15; Monnier et al. 2007, p. 144, figs. 9-14; Noga et al. 2013c, p. 137, fig. 2: 12-13; Noga et al. 2014b, p. 16, pl. 1, figs. 8, 17-18; Marquardt et al. 2017, p. 322, figs. 6:AG-AV; 8 A-F.

Status of name: accepted taxonomically.

Synonym: *Achnanthes catenata* Bily & Marvan 1959

Diagnosis: Valves are linear to linear-lanceolate, with a widened central portion and rostrate or capitate broadly rounded ends. In the raphe valve, the axial area is narrowly linear, the central area is subrounded, developed with a few short striae or widely distant striae in the central portion; The raphe is filiform, straight, the proximal raphe endings with small central pores, the distal endings are indistinct. Transapical striae are radiate throughout the length of the valve, about 30-34 in 10 μm. Length of the valve 10-17.5 μm, and the breadth 3-3.5 μm.

Ecological preference: Freshwater species, reported from periphytic algal assemblages, preferring more oligotrophic or mesotrophic conditions (Krammer & Lange-Bertalot 1991 b); the species is an indicator of organic pollution (Berthon et al. 2011); oligotrophic, alkaline freshwater reaction (pH 6.8-8.2) and moderate electrolyte content (Noga et al. 2014 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013d); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south-east Poland (Noga et al. 2016 b).

***Achnanthidium delmontii* Pérès, Le Cohu & Barthès 2012**

(Pl. 15, figs. 14-21)

Ref. Pérès et al. 2012, p. 190, figs. 1-82

Status of name: accepted taxonomically.

Diagnosis: Valves are linear with bluntly rounded apices and elliptical in small individuals. On the raphe valve, the axial area is narrow; the central area is irregular, forming generally a rectangular fascia, but a shortened stria can be present on one of the margin sides. The raphe is filiform, straight; proximal raphe endings with distinct central pores; the distal raphe endings are deflected to the same side and terminate on the valve face near the valve margin. Transapical striae are slightly radiate throughout, about 20-26 in 10 μm, becoming 35 in ,10 μm at the apices. On the rapheless valve, the axial area is acicular. The central area is generally irregular, forming a more or less rectangular fascia. Transapical striae are parallel to slightly radiate at the apices, about 18-22 in 10 μm, becoming 25 in 10 μm at the apices; in most cases, two striae are slightly more spaced apart in the valve centre. Length of the valve 7-25 μm, and the breadth 3.5-5 μm.

Ecological preference: The species has its maximum relative abundance in a location characterised by an alkaline pH, high conductivity and calcium concentration, and indicates an eutrophic environment (Pérès et al. 2012); it is reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Recorded frequently from the Eemian palaeolake deposits of central Poland, and Radomno Lake.

Distribution in Poland: New record.

***Achnanthidium duriense* Novais & Ector 2015**

(Pl. 15, figs. 22-26)

Ref. Novais et al. 2015, p. 122, figs. 334-379, 395-402

Status of name: accepted taxonomically.

Diagnosis: Valves are elliptic to linear-elliptic with broadly rounded and not or very slightly protracted apices. Raphe valve with a narrow linear axial area slightly expanded towards the centre. Central area inconspicuous, bordered by one slightly more widely spaced stria on both sides. Raphe straight, filiform, externally with slightly expanded drop-like proximal raphe pores and internally slightly deflected in opposite directions. The distal endings are straight or slightly unilaterally deflected, slightly expanded. Transapical striae are almost parallel near the valve centre, elsewhere slightly radiate, about 33-35 in 10 μm. Rapheless valve with a narrow, linear axial area that is slightly widening towards the central area. Central area mostly absent, sometimes elliptical, bordered by one more widely spaced stria on both sides. Transapical striae equidistant, almost parallel near the valve centre, elsewhere slightly radiate, about 35 in 10 μm. Length of the valve 6–9 μm, and the breadth 2.0-2.5 μm.

Remarks: *Achnanthidium duriense* differs from *A. pseudolineare* by valve outline, striation and dimensions (Novais et al. 2015).

Ecological preference: This species was reported from slightly acidic pH (6.3), low conductivity (49 μS cm^{-1}), low oxygen content (50.1% saturation), low alkalinity (17 mg CaCO3 l^{-1}) and low nutrient concentrations (Novais et al. 2015); it is reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Recorded frequently from Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot 1999**

Ref. Krammer & Lange-Bertalot 1991b, p. 61, pl. 32, figs. 57-61; Lange-Bertalot & Metzeltin 1996, p. 25, pl. 78, figs. 29-38, Wojtal 2009, p. 134, pl 5, figs. 7, 8; Ponader & Potapova 2007, p. 231, pl. 1, figs. 11-16; pl. 2, figs. 4-5; Wojtal et al. 2011, p. 218, figs. 59-77.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes eutrophila* Lange-Bertalot 1996

Diagnosis: Frustules are heterovalvar with concave raphe valve and convex rapheless valve. Valves are isopolar, rhombic-elliptical to rhombic-lanceolate with broadly rounded to cuneate apices. The raphe valve with a linear axial area that widens slightly in the middle portion of the valve. Central area is subrounded to rhombic in shape, with few shortened striae or with distinct acute-angled fascia. The raphe is straight, filiform; distal raphe fissures are straight, terminating on the hyaline margin of the valve face; proximal raphe endings are slightly expanded externally, and curved to opposite sides internally. The rapheless valve with a narrow linear axial area widening slightly in the middle with lacking a central area. Transapical striae are uniseriate, radiate throughout both valves, about 28-30 in 10 μm in the middle part of a raphe valve, becoming up to 34-36 in 10 μm near the apices. Rapheless valves with 30-34 striae in 10 μm in the centre of the valve, becoming up to 36– 38 striae in 10 μm near the apices, few central striae are more distant from each other. Length of the valve 6-18 μm, and the breadth 3-5 μm.

Ecological preference: The species probably an eutraphentic (Wojtal et al. 2005); it was reported from water with pH (8.1-8.3) and conductivity (291-583), and by a wide range of nutrient concentrations (NO3 _+NO2_: 0.7-2.2mgL^{-1}; PO43^{-}: 0.010–0.026mgL^{-1}) (Ponader & Potapova 2007); widespread diatom, observed in waters of elevated nutrient concentration in large rivers but also in springs and streams in south Poland (Wojtal et al. 2011); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a).

Occurrence: Recorded infrequently from the sediments of Młynek Lake.

Distribution in Poland: Zakliczanka stream, south Poland (Wojtal et al. 2005); Kobylanka stream, south Poland. (Wojtal, 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Widespread diatom, observed in large rivers (Dunajec River, Rudawa River, San River, Wisła River), but also in springs and streams of southern Poland (Wojtal et al. 2011); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium exile* (Kützing) Heiberg 1863**

Ref. Hustedt 1930, p. 198, fig. 278; Hustedt 1933, p. 378, fig. 822; Hartley et al. 1996, p. 22, pl. 3, fig. 9; Wojtal et al. 2011, p. 222, figs.108-130; Hofmann et al. 2013, pl. 23, fig. 14; Kusber & Van de Vijver 2022, p. 2, figs. 1-46.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes exilis* Kützing 1833

Microneis exilis (Kützing) Meister 1912

Diagnosis: Valves are rhombic-lanceolate to narrowly lanceolate with broadly to bluntly rounded apices. Raphe valves with lanceolate axial area; central area is visible, rhombic to elliptical. Raphe is filiform, with straight proximal and distal endings. Proximal raphe endings are located distantly from each other, internally straight or slightly deflected. Distal raphe endings terminate on a hyaline margin of the valve face. Transapical striae are radiate throughout, about 25-30 in 10 μm in the middle part, up to 36 striae in 10 μm near the apices, and 3-6 areolae per each stria. Rapheless valve has a narrow linear-lanceolate axial area; the central area is apically elongate-elliptical to oval. Transapical striae are radiate, about 24-28 in 10 μm at the valve centre, up to 32-34 in 10 μm near the apices. Length of the valve 15-30 μm, and the breadth 3.5-6 μm.

Ecological preference: It is known from calcium-rich oligotrophic and mesotrophic waters, with moderate and elevated specific conductivity (Krammer & Lange-BertaLot 1991 b, 2004); an alkalibiontic, oligosaprobic

and oligo-mesotraphentic species (Van dam et al. 1994); in slightly alkaline, slowly moving waters with moderate specific conductivity (Wojtal et al. 2011). The species is characteristic of carbonate-enriched, somewhat meso-eutrophic lakes, and its main distribution is in Central Europe (Lange-Bertalot et al. 2017).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: in spring-fed areas of the Wielki Las reserve and Centuria (Wyżyna Krakowsko-Częstochowska upland), south Poland (Wojtal et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013d).

***Achnanthidium gracillimum* (Meister) Lange-Bertalot 2004**

Ref. Cleve-Euler 1953, p. 41, fig. 568f; Marciniak 1986, p. 261, pl. 4, figs. 1-3; Simonsen 1987, p. 101, pl. 160, figs. 3-12; Lange-Bertalot & Krammer 1989, p.104, fig. 54; Krammer & Lange-Bertalot 1991 b, p. 58, pl. 33, figs. 1-12; Bąk et al. 2012, p. 34, pl. 23.

Status of name: accepted taxonomically.

Synonyms: *Microneis gracillima* Meister 1912
Achnanthes minutissima f. *gracillima* (Meister) Cleve-Euler 1932
Achnanthes gracillima (Meister) Mills 1933
Achnanthes microcephala var. *gracillima* (Meister) Cleve-Euler 1953
Achnanthes minutissima var. *gracillima* (Meister) Lange-Bertalot 1989
Achnanthes alteragracillima Lange-Bertalot 1993
Achnanthidium minutissimum var. *gracillima* (Meister) Bukhtiyarova 1995
Achnanthidium alteragracillimum Round *et* Bukhtiyarova 1996

Diagnosis: Valves are linear or linear-lanceolate with narrow rostrate to subcapitate ends. The raphe valve is concave and the rapheless valve is convex. Both valves possess a linear axial area, which widens slightly in the middle portion of the valve. No central area is distinct. In the raphe valve, the raphe is filiform, straight; the distal raphe endings are sharply bent; the proximal raphe endings are teardrop-shaped and curved to opposite sides. Transapical striae are parallel or slightly radiate throughout both valves, about 22-25 in 10 μm in the valve centre, 30-35 in 10 μm at the valve apices. Length of the valve 12-40 μm, and the breadth 3.5-4.5 μm.

Ecological preference: As *Achnanthes gracillima,* this species is probably circumpolar; it occurs especially in oligotrophic, circumneutral to slightly acid localities (Foged 1968); an alkaliphilous, oligotrophic and fresh brackish water species (Van Dam et al. 1994); *Achnanthes alteragracillima* is distributed in oligotrophic and high alkalinity freshwaters in mountain regions in Europe and North America (Krammer & Lange-Bertalot 1991 b; Potapova 2006).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Late Glacial and Holocene sediments of the Przedni Staw lake in the Pieć Stawów Polskich Valley High Tatra Mts, south Poland (Marciniak 1986).

***Achnanthidium indistinctum* Van de Vijver & Kopalová 2014**

(Pl. 15, figs. 27-29)

Ref. Van de Vijver & Kopalová 2014, p. 4, figs. 2-28.

Status of name: accepted taxonomically.

Diagnosis: Frustules are short, rectangular in girdle view, bent around the transapical axis. Valves are narrowly lanceolate with distinctly protracted, rostrate apices. Raphe valve is concave with a very narrow linear axial area, almost not widening towards the central part of the valve. Central area is very small, indistinct, and bordered by more widely spaced striae. Raphe is straight, filiform, almost invisible, with simple proximal raphe endings. Distal raphe endings are straight. Transapical striae are moderately radiate throughout the entire valve, becoming denser near the apices. Rapheless valve is slightly convex with a narrow, linear axial area, not or very slightly widening towards the valve centre. Central area is almost lacking. Transapical striae weakly radiate throughout, densely spaced near the apices, about 30-35 in 10 μm. Length of the valve 8.5-13.0 μm, and the breadth 1.8-2.2 μm.

Ecological preference: The species was observed living on submerged mosses collected in a large lake had a slightly alkaline pH (7.35) with a low specific conductivity value (97 µS/cm) and a high phosphate level (5.2 mg/l) (Van de Vijver & Kopalová 2014); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Achnanthidium kranzii* (Lange-Bertalot) Round & Bukhtiyarova 1996**

Ref. Lange- Bertalot & Ruppel 1980, p. 25, pl. 11, figs. 314-319; Lange-Bertalot & Krammer 1989, p. 74, pl. 55, figs. 13-21; pl. 62, figs. 6-8; Krammer & Lange-Bertalot 1991 b, p. 64, pl. 34, figs. 25-33; Monnier et al. 2007, p. 144, figs. 15-22.

Status of name: accepted taxonomically.

Synonym: *Achnanthes kranzii* Lange-Bertalot 1989

Diagnosis: Valves are linear-lanceolate to linear-elliptical with broadly rounded no non-capitate ends. The raphe valve has a narrow axial area near the ends and broadens slightly at the valve centre. Central area is large rectangular, often extending to the valve margins. Raphe is filiform, straight; proximal raphe endings are simple; distal raphe endings are short and sharply curved to the same side. The rapheless valve has a narrow linear axial area and an apically elongated elliptical or rhomboid central area. Transapical striae are uniseriate, moderately radiate in the centre of both valves, becoming parallel at the apices, about 24-30 in 10 µm in the central valve, up to 40 in 10 µm at the apices. Length of the valve 8-20 µm, and the breadth 3-4 µm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994).

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b)

***Achnanthidium lineare* W. Smith 1855**

Ref. Hustedt 1930, p. 198, fig. 276; Hustedt 1933, p. 378, fig. 821a,b; Patrick & Reimer 1966, p. 251, pl. 16, figs. 3-4; Germain 1981, p. 110, fig. 35-37; Jensen 1985, p. 329, fig. 821 a, b; Lange-Bertalot & Krammer, 1989, p. 117, pl. 65, figs. 18-44; pl. 66, figs. 4-7; Krammer & Lange-Bertalot 1991 b, p.68, pl. 37, fig. 19; Van de Vijver et al. 2011, p. 170, figs. 1-35; Wojtal et al. 2011, p. 215, figs. 36-58.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes linearis* (W.Smith) Grunow 1880
Cocconeis linearis (W.Smith) Schonfeldt 1907
Microneis linearis (W.Smith) F.Meister 1912
Rossithidium lineare (W.Smith) Round & Bukhtiyarova 1996

Diagnosis: Valves are linear or linear-elliptical to narrowly lanceolate with almost parallel margins and broadly rounded, sometimes slightly rostrate apices. In the raphe valve, the axial area is narrow and linear, slightly widening towards the valve centre; the central area is small developed, forming a rectangular fascia due to the shortening of one or two central striae. Raphe is filiform; the distal raphe endings are almost straight, terminating on the hyaline margin of the valve face and the proximal endings are straight, not protruding into the central area. Transapical striae are slightly radiate, evenly spaced throughout valves, 34-36 in 10 µm. In the rapheless valve, the axial area is also narrow and linear, central area is lacking or only a small, linear elliptical space. Transapical striae are slightly radiate throughout the valve, about 30-33 in 10 µm at the centre, becoming 23-36 in 10 µm at the ends. Length of the valves 7-20 µm and the breadth 2.5-3.5 µm.

Ecological preference: Cosmopolitan, salinity indifferent, pH: indifferent (Foged 1957); the species is indifferent to pH and halophobous (Patrick & Reimer 1966); epipelic, oligohalobous-indifferent (Foged 1981); recorded at the downstream contaminated site with heavy metal in spring (Deniseger et al. 1986); dominated on some aquatic macrophytes and submerged slide glasses in streams and lakes (Blindow 1987); the species was common in circumneutral and slightly alkaline waters of low to moderate specific conductance values and low nutrient concentrations, in springs on calcareous bedrock, and lakes (Wojtal et al. 2011); circumneutral to weakly alkaline pH, low to moderate specific conductance, and low nutrient content (Van de VijVer et al. 2011); occurs

mostly in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Recorded infrequently from Młynek and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); recorded from springs on calcareous bedrock, and lakes in the Tatra Mountains (such as the Morskie Oko lake), on submerged mosses and stones (Wojtal et al. 2011); As *Rossithidium lineare* (W.Smith) from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium microcephalum* Kützing 1844**

(Pl. 15, figs. 30-31)

Ref. Lange-Bertalot & Ruppel 1980, pl. 3, figs. 83-96; pl. 9, figs. 278-281; Novais et al. 2015, p. 111, figs. 56-79, 153-158.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-elliptic to linear-lanceolate with subcapitate, broadly rounded apices. Raphe valve with a narrow linear axial area, slightly expanded towards the centre. Central area is almost absent or slightly elliptical. Raphe is straight, filiform and externally with straight, slightly expanded proximal pores. The distal raphe endings are slightly deflected in the same direction. Transapical striae are very fine, radiate throughout the entire valve, becoming slightly denser and more strongly radiate towards the apices, about 30-32 in 10 μm, up to 35 in 10 μm near the apices. Rapheless valve has a narrow, linear axial area that often slightly widens towards the central area. Central area is weakly elliptical or almost absent, usually bordered by one widely spaced stria on both sides. Transapical striae are radiate throughout the entire valve, becoming more strongly radiate and slightly denser near the apices, about 30 in 10 μm, up to 35 in 10 μm near the apices. Length of the valves 13 μm and the breadth 3.5 μm.

Occurrence: Eemian palaeolake deposits of central Poland

Distribution in Poland: New record.

***Achnanthidium minutissimum* (Kützing) Czarnecki 1994**

(Pl. 15, figs. 32-34)

Ref. Hustedt 1930, p. 198, fig. 274; Hustedt 1933, p.376, fig. 820; Patrick & Reimer 1966, p. 253, pl. 16, figs 9-10; Lange-Bertalot & Ruppel 1980, p.18, figs 74-112,126-132, 218-229; Germain 1981, p. 109, pl. 41, figs. 12-19; John 1983, p. 74, pl. 32, figs. 3, 4; Thomas 1983, p. 19, pl. 3, fig. 10; Schoeman & Archibald 1988, p. 224, figs. 7-10; Holland & Clark 1989, p. 9, pl. 1, figs 14-17; Krammer & Lange-Bertalot 1991 b, p. 56, pl. 32, figs. 1-24; pl. 33, figs. 1-22; pl. 34, figs. 1-22; pl. 35, figs. 1-3; Vyverman et al. 1995, p. 17, pl. 7, fig. 5; pl. 23, figs. 3-5, 8-9, 12; Wojtal 2009, p. 134, pl. 4, figs. 27–35; pl. 5, fig. 9a, b; pl. 56, figs. 1, 8, 9; pl. 57, figs. 1-8; Hofmann et al. 2011, p. 83, pl. 23, figs. 15-21; Wojtal et al. 2011, p. 214, figs. 1-15; Bahls et al. 2018, p. 61, pl. 24, figs. 2-4; p. 147, pl. 110, fig. 14.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes minutissima* Kützing 1833
Achnanthidium lanceolatum f. *minutissima* (Kützing) Tömösvary 1879
Achnanthes microcephala (Kützing) Grunow 1880
Achnanthes minutissima var. *cryptocephala* Grunow 1880
Achnanthes cryptocephala (Grunow) M.Peragallo 1897
Cocconeis minutissima (Kützing) Schönfeldt 1907
Cocconeis microcephala (Kützing) Schonfeldt 1907
Microneis minutissima (Kützing) Meister 1912
Microneis microcephala (Kützing) Meister 1912

Diagnosis: Valves are linear to linear-lanceolate or linear-elliptical with stump rounded, usually protracted, broadly rostrate, subcapitate or capitate apices. In the raphe valve, the axial area is narrowly linear or lanceolate. Raphe is filiform and straight in central and terminal ends, distal raphe fissures not sharply curved, the proximal raphe endings straight, slightly expanded externally and deflected in opposite directions internally. Central area has various shapes due to shortened 1-2 central striae on either side of the central nodule, to a wide transverse band, almost fasciate that often reaches the margins. In the rapheless valve, the axial area is narrowly linear and slightly widening near the valve centre. Central area is usually absent. Transapical striae are punctate, radiate throughout both valves, and strongly radiate and denser towards the ends, especially on the raphe valve, about 30-32 in 10 µm at the valve centre and 36-38 in 10 µm at the ends. Rapheless valve with 26-28 striae in 10 µm at the valve centre, reaching up to 32-33 in 10 µm near the apices. Length of the valve 8-25 µm, and the breadth 2.5-4 µm.

Ecological preference: Widespread species, it is found in a very wide range of pH, but has appeared in waters with a pH about 6.5-9.0, oligohalobous, probably "indifferent" (Patrick & Reimer 1966); it is regarded as being the best indicator of oxygen-rich conditions (Cholnoky 1968); epiphytic habitats on algae or macrophytes and for well-aerated waters (Schoeman 1973); epipelic, oligohalobous "indifferent", alkaliphilous (Foged 1980); it is highly sensitive towards organic pollution (Steinberg & Schiefele 1988); tychoplanktonic, mesosaprobous species, commonly abundant in a variety of habitats and conditions-from alkaline to acidic, from oligotrophic to hypertrophic waters (Denys 1991; Krammer & Lange-Bertalot 1991b; Van Dam et al. 1994); classified as a circumneutral or alkaliphilous diatom, it can be abundant in streams affected by heavy metal pollution, but is not common in environments below pH 5 (Van Dam et al. 1994). developed in highly eutrophic water, but much less loaded by organic pollutants (Kwandrans et al. 1998); epiphytic, slightly alkaline, meso-eutrophic and oxygen-saturated (Toporowska et al. 2008); resistant concerning organic water pollution (Szczepocka & Szulc 2009); found in water bodies such as springs and streams, showing a wide range of water chemistry values, including nutrients, mostly in circumneutral and slightly alkaline running waters, especially in the epilithon (Wojtal et al. 2011); eutraphentic and mesotraphentic, indicative of nutrient-rich waters (Witak et al. 2017); occurs mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018); reported from water of ponds, circumneutral to slightly alkaline pH (6.7-7.9). Conductivity 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Frequent in Jeziorak, Radomno and Młynek Lakes and rare in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: In the Wyżyna Krakowskoczęstochowska Upland. Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska1947); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 a); spring of Szklarka stream (Skalska 1966 a, b); ponds near Krakow (Hanak-Szmagier 1967); springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik 1970); Sanka stream (Kądziołka 1963; Hojda1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Vistula River (Pudo 1977); Biała Przemsza River (Wasylik 1985); Rivers in Kraków province, the Vistula, Raba and their affluents, south Poland (Kwandrans et al. 1998); formed large populations, especially in Czarny pod Rysami lake and the high mountain lakes under the stress of acidification, Tatra Mts, south Poland (Kawecka & Galas 2003); the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); peat bog in Modlniczka (Piątek 2007); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała central Poland (Szulc 2007); dominant in limnocrenic spring – Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); Lake Skomielno in Łęczyńsko-Włodawskie Lakeland, east Poland (Toporowska et al. 2008); dominated in the Pilica River- Central Poland, considered to be tolerant (Szczepocka & Szulc 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); distributed in Kobylanka stream, south Poland (Wojtal, 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Górki Zachodnie and Swibno-Vistula River estuary in north Poland (Majewska et al. 2012); Korzeń mir,

Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), Wisłok River, south-east Poland (Noga et al. 2013 a, b, c, d); Wisłok River and the catchment area including rivers and streams of the territory of the Podkarpacie Province; San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 a, b); The Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland and the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al., 2016 a, b); Wisłoka River, the Magura National Park and the Wołosaty River, the Bieszczady National Park, south Poland (Noga et al. 2017); Lake Zabinskie in the Masurian Lake District, north-east Poland (Witak et al. 2017); Spring at the Goprowska Pass (Bieszczady National Park), south east Poland (Żelazna-Wieczorek & Knysak 2017); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Upper sections of watercourses in south Poland; Bieszczady National Park, Kłopotnica River, Magura National Park, Wisłoka River, south-east Poland (Noga 2019); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, southern Poland (Pociecha et al. 2020); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, southeast Poland **(**Peszek et al. 2021); Lakes Łazduny and Rzésniki in the Masurian Lake District in northeast Poland (Szczerba et al. 2023).

***Achnanthidium minutissimum* f. *inconspicuum* (Østrup) Compère & Riaux-Gobin 2009**

Ref. Lange-Bertalot & Krammer 1989, p. 104, pl. 51, figs. 46-49; pl. 52, fig. 3; Krammer & Lange-Bertalot 1991b, p. 58, pl. 32, figs. 25, 26; Wojtal 2009, p. 136, pl. 4, figs. 17-21; Novais et al. 2015, p. 116, figs. 126-139, 171-174.

Status of name: accepted taxonomically.

Synonym: *Achnanthes minutissima* var. *inconspicua* Østrup 1910

Diagnosis: Frustules are rectangular and slightly arched in girdle view. Valves are linear to narrowly lanceolate with almost parallel margins and broadly rounded, mostly non-protracted, subrostrate apices. Raphe valve is concave with a narrow linear axial area slightly widening towards the valve centre. Central area forms a rectangular fascia. Raphe is straight, filiform and with slightly expanded proximal endings, which are straight or very slightly deflected in the same direction. Internally, the proximal endings are slightly deflected in opposite directions, and the distal raphe endings terminate in small helictoglossae. Transapical striae are weakly radiate throughout the entire valve, becoming slightly denser and more strongly radiate towards the apices, about 28-32 in 10 μm at the valve centre. Rapheless valve is slightly convex with a narrow, linear to narrowly lanceolate axial area that slightly widens towards the central area and broadly rounded, mostly with no protracted apices. Central area is weakly elliptical and almost absent. Transapical striae are weakly radiate throughout the entire valve, becoming more strongly radiate and slightly denser near the apices, about 30-32 in 10 μm at the centre of the valve. Length of the valve 7-15 μm, and the breadth 2.3-2.6 μm.

Ecological preference: Probably a cosmopolitan diatom of not well-known autecology (Krammer & Lange-Bertalot 1991b); it is reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Jeziorak and Młynek Lakes.

Distribution in Poland: This taxon was reported in epipelon and periphyton from Kobylanka stream, south Poland (Wojtal 2009).

***Achnanthidium minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot 1989**

(Pl. 15, figs. 35-37)

Ref. Lange-Bertalot & Ruppel 1980, p. 18, figs. 113-125, 133-202, 305-310, 332-338; Krammer & Lange-Bertalot 1991 b, p. 57, pl. 32, figs. 31-47; Hartley et al. 1996, p. 28, pl. 6, fig. 5; Potapova & Hamilton 2007, p. 561, fig. 3; Wojtal 2009, p. 134, pl. 5, fig. 10a, b; Morales et al. 2011, p. 117, figs. 150-163; Wojtal et al. 2011, p. 215, figs. 16-35; Van de Vijver et al. 2018, p. 1, figs. 1-22.

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium jackii* Rabenhorst 1861

*Achnanthes lineari*s var. *jackii* (Rabenhorst) Grunow *in* Van Heurck 1880

Achnanthes jackii (Rabenhorst) Tempère & Peragallo 1909

Achnanthes biasolettiana var. *jackii* (Rabenhorst) Cleve- Euler 1932

Achnanthes minutissima var. *jackii* (Rabenhorst) Lange-Bertalot & Ruppel 1980

Diagnosis: Frustules in girdle view are rectangular, weakly arched with slightly recurved apices. Valves are linear-lanceolate to weakly lanceolate with broadly rounded, protracted, rostrate to subrostrate apices. Raphe valve is concave with a narrow, linear axial area, only very weakly widening towards the valve centre. Central area forming a clear, often asymmetrical, fascia. Raphe is filiform, straight with indistinct proximal raphe endings, the distal raphe endings are almost straight or subtly unilaterally curved, terminating on the valve face. Transapical striae are weakly radiate to almost parallel throughout the entire valve, becoming more radiate towards the apices, about 28-30 in 10 μm, up to 36 in 10 μm near the apices. Rapheless valve is convex with a very narrow, linear-lanceolate axial area, widening near the valve centre. Central area may be absent or a small fascia. Transapical striae are weakly radiate throughout, more radiate near the apices, about 23-26 in 10 μm at the centre, up to 35 near the ends. Length of the valve 10-18 μm, and the breadth 3-4 μm.

Remarks: *Achnanthidium jackii* is similar to *A. neocryptocephalum* in terms of valve shape and ultrastructure. This taxon was easily recognized from raphe valves, which have a more or less acutely angled fascia, sometimes with very short, inserted striae and typically coarser striae.

Ecological preference: Known from circumneutral, oligosaprobic waters with moderate and high conductivity (Krammer & Lange-Bertalot 1991b); a neutrophilous, oligosaprobous and fresh brackish water species, living in circumneutral waters with high concentrations of organically bound nitrogen (Van Dam et al. 1994); widespread diatom, observed in springs, streams and rivers rich in nitrates, most common in circumneutral and slightly alkaline running waters, especially in the epilithon (Wojtal et al. 2011); the species occurs abundantly in epilithic diatoms collected from the alpine streams of Cloud Forest in Bolivia in South America (Morales et al. 2007); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Infrequent in Jeziorak and Młynek Lakes.

Distribution in Poland: This taxon was reported in epilithon and periphyton from Kobylanka stream, south Poland (Wojtal 2009); as *Achnanthes minutissima* var. *jackii* from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); widespread diatom, observed in springs, streams and rivers, southe Poland (Wojtal et al. 2011); Wisłok river and Matysówka stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village, south-east Poland (Szczepocka & Rakowska 2015).

***Achnanthidium nodosum* (Cleve) Tseplik & Chudaev 2020**

Ref. Hustedt 1933, p. 407, fig. 861; Foged 1974, p. 27, pl. 36, figs. 8a, b; Krammer & Lange-Bertalot 1991 b, p. 67, pl. 37, figs. 1-8; Hartley et al. 1996, p. 28, pl. 6, fig.8; Lange-Bertalot & Metzeltin 1996, p. 162, pl. 22, figs. 5-11; Potapova 2014, p. 75, figs. 352, 353.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes nodosa* Cleve 1900

Rossithidium nodosum (Cleve) Aboal 2003

Diagnosis: Valves are linear to linear-elliptic or elliptical with broadly rounded ends, which are slightly drawn-out. The raphe valve has a narrow axial area, which widens into a small central area. Raphe is filiform, straight. The distal raphe endings are slightly expanded and curved toward the same side of the valve. The

proximal raphe endings are slightly expanded and curved to opposite sides. The rapheless valve has a narrowly linear axial area, which sometimes widens at the valve centre. Central area is small, asymmetrical and unilateral. Transapical striae on both valves are biseriate, areolate, slightly radiate throughout both valves, about 16-20 in 10 μm. Length of the valve 9-12 μm, and the breadth 3-3.5 μm.

Ecological preference: Freshwater, reported from oligotrophic cold waters, neutrophilous at pH 6.76 (Bigler & Hall 2002)

Distribution in Poland: As *Planothidium nodosum* from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011)

***Achnanthidium petersenii* (Hustedt) Wetzel, Ector, Williams & Jüttner 2019**

Ref. Hustedt 1934, p. 378, figs. 3, 4; Hustedt 1937, p. 179, figs. 10-14; Hustedt 1945, p. 908, pl. 39, figs 26-31; Simonsen 1987, p. 205, pl. 317, figs. 11-17; Lange-Bertalot & Krammer 1989, p. 117, pl. 65, figs. 18-44; pl. 66, figs. 4-7; Krammer & Lange-Bertalot 1991 b, p. 67, pl. 37, figs. 24-40; Lange-Bertalot & Metzeltin 1996, p. 162, pl. 22, figs. 15-17; pl. 78, fig. 11;Wojtal 2009, p. 294, pl. 5, fig. 28; Bahls et al. 2018, p. 114, pl. 77, fig. 6; p. 147, pl. 110, figs. 15-17; Jüttner et al. 2019, p. 64, figs. 1-32.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes petersenii* Hustedt 1937
Achnanthes pusilla var. *petersenii* (Hustedt) Lange-Bertalot & Ruppel 1980
Rossithidium petersenii (Hustedt) Round & Bukhtiyarova 1996
Achnanthes petersenii var. *genuina* Cleve null
Navicula densistriata Hustedt 1922
Achnanthes kryophila var. *densistriata* Hustedt 1934
Achnanthes procera Hustedt 1945
Achnanthes jakovljevicii Hustedt 1945
Achnanthes pusilla var. *procera* (Hustedt) Lange-Bertalot & Ruppel 1980
Achnanthes grubei Simonsen 1987
Achnanthidium parallelum Carter ex Jüttner, Williams, Ector & Wetzel 2019

Diagnosis: Valves are linear-lanceolate or linear-elliptical with slightly protracted, broadly rounded apices. The raphe valve has a narrow linear axial area, Central area is large, rectangular or slightly acute-angled fascia, and almost reaches the valve margins. The raphe is straight, filiform, and lacks terminal fissures. Internally, the proximal raphe endings are curved to opposite directions; the distal raphe endings terminate in small helictoglossae. The rapheless valve has a narrowly rhomboid axial area and no distinct central area. Transapical striae are uniseriate and slightly radiate. Each stria in the middle part of the valve contains 5-7 areolae. Rapheless valve has a moderately broad axial area, widening towards a broad rhombic-lanceolate central area. Transapical striae are uniseriate, slightly radiate throughout on both valves, about 32-35 in 10 μm. Length of the valve 12-20 μm, and the breadth 4-5 μm.

Ecological preference: Cosmopolitan, oligotraphentic, inhabiting circumneutral waters of low or moderate conductivity (Krammer & Lange-Bertalot 1991b). A neutrophilous, high oxygen requirements, oligosaprobous, oligotraphentic and freshwater species (Van Dam et al. 1994); alkaline or close to neutral water reactions (pH: 7–9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Recorded infrequently in Radomno and Młynek Lakes.

Distribution in Poland: The Wyżyna Krakowskoczęstochowska Upland. Będkowka stream (Kłonowska 1986); reported from Central Poland (Rakowska 2001); Tatra Mts lakes (Kawecka & Galas 2003); Kobylanka stream, south Poland, in epilithon above Kobylany village (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); as *Rossithidium petersenii* from a peat bog and two carbonate streams (Wojtal & Sobczyk 2006); Gołębiówka stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthidium pfisteri* Lange-Bertalot 2004**

Ref. Werum & Lange-Bertalot 2004, p. 126, pl. 20, figs. 1-18; Peeters & Ector 2018, p. 40, figs. 1-12.

Status of name: accepted taxonomically.

Diagnosis: Valve is linear to linear-elliptic with not protracted, broadly rounded apices. Raphe valve is slightly concave with a narrow linear straight axial area. Central area is unilateral, often irregular on one side or rectangular and almost reaches the valve margin. Raphe is straight, filiform; the proximal raphe endings are distinct by small central pores and curved on the same sides at the distal ends. Transapical striae are weakly radiate to subparallel, somewhat convergent at the apices, about 18-20 in 10 µm in the middle part of the valve, becoming 30 in 10 µm close to the apices. The rapheless valve has a narrow linear axial area, which widens slightly in the valve centre with no distinct central area. Transapical striae are subparallel throughout, slightly radiate at the apices, about 20-24 in 10 µm. Length of the valve 7-12 µm, and the breadth 3-5 µm.

Ecological preference: This taxon prefers calcareous freshwaters, with medium conductivity, supporting low to moderate loads of nutrients and organic matter (Peeters & Ector 2018).

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b)

***Achnanthidium polonicum* Van de Vijver, Wojtal, Morales & Ector 2011**

Ref. Wojtal et al. 2011, p. 223, figs. 131-154.

Status of name: accepted taxonomically.

Diagnosis: Frustules in girdle view bent with slightly recurved apices. Valves are narrow, linear, clearly lanceolate with slightly convex margins and protracted subcapitate rounded apices. Raphe valve with linear axial area, gradually widening towards the valve centre. Central area is distinct, forming a rectangular fascia. Raphe is filiform, straight with weakly expanded, pore-like proximal endings and slightly deflected distal endings, terminating on the valve face at the apices. Transapical striae are radiate throughout the entire valve, strongly radiate near the apices, about 33-34 in 10 µm at the valve centre, up to 38-40 striae in 10 µm near the apices. Rapheless valve with narrow, linear axial area. Central area is small, never forming a fascia, with more spaced striae. Transapical striae are moderately radiate at the valve centre, about 28-30 in 10 µm, becoming strongly radiate towards the ends, about 35-38 in 10 µm. Length of the valve 11.4-21.5 µm, and the breadth 2.6- 4.0 µm.

Remarks: The species is morphologically the most similar to *Achnanthidium affine* (Grunow) Czarn. Both species overlap considerably in frustule size and striae pattern but differ in valve outline and central area morphology (Wojtal et al. 2011).

Ecological preference: Spring-fed area, covered with shallow, slowly flowing water (Wojtal et al. 2011)

Distribution in Poland: Found in a large spring-fed area in Centuria, Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal et al. 2011)

***Achnanthidium pusillum* (Grunow) Czarnecki 1996**

Ref. Hustedt 1933, p. 378, fig. 821 c, d; Patrick & Reimer 1966, p. 252, pl. 16, figs 5, 6; Lange-Bertatot & Krammer 1989, p. 127, pl. 64, figs. 31-43; pl. 65, fig. 1; Krammer & Lange-Bertalot 1991 b, p. 67, pl. 37, figs. 9-18; Lange-Bertalot & Metzeltin 1996, p. 162, pl. 22, figs. 1-4; Bąk et al. 2012, p. 30, pl. 24; Bahls et al. 2018, p. 40, pl. 3, figs. 10, 11; p. 61, pl. 24, figs. 5-11.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes pusilla* Grunow 1880

Rossithidium pusillum (Grunow) Round & Bukhtiyarova 1996

Lemnicola hungarica var. *pusilla* (Grunow) Bukhtiyarova 2006

Achnanthes hungarica var. *pusilla* Grunow 1880

Diagnosis: Valves are linear or linear-elliptical with broad, obtusely rounded ends. Raphe valve with narrow axial area. Central area is small, round or irregular, developed due to the length and distance of one or two central striae. Raphe is filiform, straight, the distal raphe fissures are absent, the proximal raphe endings are curved to

opposite sides internally, and not protruding into the central area. Rapheless valve with narrow linear axial area without a central area or with a very small asymmetrical central area. Transapical striae are uniseriate, slightly radiate throughout both valves, about 20-24 in 10 µm at the centre, becoming 28-29 in 10 µm at the apices. Length of the valve 10-20 µm, and the breadth 3-4 µm.

Ecological preference: aerophilous and pH indifferent (Kaczmarska 1976); fresh-brackish water, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); Circumneutral, mainly occurring at pH about 7 (Szulc & Szulc 2012); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); it is reported as *Rossithidium pusillum* (Grunow) Round & Bukhtiyarova from Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Czarna Staszowska River near the Drogowle village in south-eastern Poland (Szczepocka & Rakowska 2015); as *Achnanthidium pusillum* from the Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthidium pyrenaicum* (Hustedt) Kobayasi 1997**

(Pl. 15, fig. 38)

Ref. Hustedt 1939, p. 554, pl. 25, figs. 5-10; Simonsen 1987, p. 248, pl. 371, figs. 9-17; Krammer & Lange-Bertalot 1991b, p. 62, pl. 36, figs. 1-18; Kobayashi 1997, p. 148, figs. 1-18; Potapova 2006, p. 401, fig. 10; Wojtal 2009, p. 136, pl. 5, figs. 11-14; pl. 56, fig. 5; pl. 57, figs. 9-13; pl. 58, figs. 1, 2; Bąk et al. 2012, p. 36, pl. 24; Noga et al. 2013c, p. 137, pl. 2, fig.14; Rybak et al. 2019, pl. 2, figs. 14-15.

Status of name: accepted taxonomically.

Synonyms: *Synedra biasolettiana* Kützing 1844
Falcatella biasolettiana (Kützing) Rabenhorst 1863
Microneis biasolettiana (Kützing) Meister 1912
Achnanthes pyrenaica Hustedt 1939
Achnanthidium biasolettianum (Kützing) Bukhtiyarova 1995
Achnanthes biasolettiana Grunow *in* Cleve and Grunow 1880
Achnanthes minutissima var. *pyrenaica* (Hustedt) A.Cleve 1953

Diagnosis: Valves are linear-lanceolate, elliptical to elliptical-lanceolate, linear-elliptical with broadly rounded or rostrate ends. The raphe valve is concave, has a narrow linear to slightly lanceolate axial area, which widens slightly at the valve centre. Central area is rectangular, asymmetrical, reaches the valve margin and forms a facia, or subfascia. Raphe is straight; the distal raphe endings are hooked towards the same side of the valve, the proximal raphe endings are teardrop-shaped and internally, curved to opposite sides. Transapical striae are slightly radiate in the middle of the valve, mostly parallel to weakly radiate and denser towards the ends, about 20-25 in 10 µm at the centre, up to 35 in 10 µm at the apices. The rapheless valve is convex, with a narrow linear axial area that widens slightly in the middle. Central area is indistinct or developed with short one or two striae in the middle area. Transapical striae are parallel throughout or very slightly radiate at the centre and slightly convergent at the apices, about 20-28 in 10 µm in the centre and 32-38 in 10 µm at the apices. Length of the valve 10-16 µm, and the breadth 2.5-4.0 µm.

Remarks: *Achnanthidium pyrenaicum* is easily distinguishable by its lanceolate, often asymmetric valves with rostrate or subrostrate ends.

Ecological preference: As *Achnanthes biasolettiana* has its ecological optimum in oligotrophic to mesotrophic and calcium-rich waters with moderate to high conductivity (Krammer & Lange-Bertalot 1991 b); an alkaliphilous, mesotraphentic and fresh brackish water species (Van Dam et al. 1994); the species was classified into saproxenous taxa from Japanese epilithic diatoms (Asai & Watanabe 1999); it was most common and abundant in alkaline streams, especially in Europe and Mediterranean streams (Potapova 2006; Tornés et al. 2007); freshwater with pH had an alkaline character 7.1-8.3, relatively high conductivity (416-764 µSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a); it occurs mostly in in calcium-rich waters, alkaline or close-to-

neutral waters with medium or low electrolytic conductivity (78-530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm-1 (Pociecha et al. 2020).

Occurrence: Recorded infrequently in Młynek Lake.

Distribution in Poland: in the Wyżyna Krakowsko- Częstochowska Upland. Sąspowka stream (Kądziołka 1963); Rivers in Kraków province, the Vistula, Raba and their affluents, south Poland (Kwandrans et al. 1998); Common in Kobylanka stream, south poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); dominant in the Wisłok River; Duszatyńskie Lakes (Western Bieszczady Mts.); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b, c, d); the rivers and streams (Wisłoka, Zalew Rzeszowski, San, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, and San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 a, b); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland; the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 a, b); Wisłoka River, the Magura National Park and the Wołosaty River, the Bieszczady National Park, south Poland (Noga et al. 2017); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Bieszczady National Park, Kłopotnica River, Magura National Park, Wisłoka River, south-east Poland (Noga 2019); Rzeczyca stream and its tributarity Eastern Carpathians, south Poland (Rybak et al. 2019); The ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, south-east Poland **(**Peszek et al. 2021).

***Achnanthidium reimeri* (Camburn) Ponader & Potapova 2007**

(Pl. 16, figs. 1-4)

Ref. Camburn et al. 1978, p. 173, pl. 4, figs. 53-55; Ponader & Potapova 2007, p. 235, pl. 4, figs. 21-30; pl. 5, figs. 6-8.

Status of name: accepted taxonomically.

Synonym: *Achnanthes reimeri* Camburn 1978

Diagnosis: Valves are linear-elliptical to linear-lanceolate with subrostrate or subcapitate apices. Raphe valve concave with a narrow axial area; central area is rectangular and transversely expanded, irregularly bordered at the valve margin by a few shortened striae. Raphe is filiform; the distal raphe endings are indistinct, but appearing unilaterally deflected. The proximal raphe endings are not expanded. Rapheless valve with a narrow linear axial area, which abruptly flares at the central area. Central area is a small oval to transversely expanded, rectangular, somewhat rhomboid. Transapical striae on both valves are radiate in the middle with irregular length, becoming parallel toward the ends of the valves, about 26-29 in 10 µm in the middle and 38-44 in 10 µm at the apices. Length of the valve 10-18 µm, and the breadth 3.5-5.5 µm.

Ecological preference: *Achnanthidium reimeri* was found in silty rivers of relatively low nutrient and ionic content (Ponader and Potapova 2007); it is reported from the shallow, benthic habitats of slightly alkaline, meso- to eutrophic freshwater environments.

Occurrence: Recorded infrequently from the Eemian palaeolake deposits of central Poland and Jeziorak Lake.

Distribution in Poland: New record.

***Achnanthidium rosenstockii* (Lange-Bertalot) Lange-Bertalot 2004**

(Pl. 16, figs. 5-7)

Ref. Stoermer 1979, p. 281, figs. 22-27; Carter 1981, p. 530, pl. 23, figs. 17, 18; Lange-Bertalot 1989, p. 131, pl. 61, figs. 1-17; pl. 63, figs. 1-2, ?3-5; Lange-Bertalot 2004, pl. 61, figs. 1-17; Bąk et al. 2012, p. 37, pl. 23.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes didyma* f. *gibbosa* Carter 1981

Achnanthes rosenstockii Lange-Bertalot 1989

Psammothidium abundans f. *rosenstockii* (Lange-Bertalot) Bukhtiyarova 1996

Psammothidium rosenstockii (Lange-Bertalot) Lange-Bertalot 1999

Diagnosis: Valves are linear-elliptic to linear-lanceolate with a central inflation equal or larger in width and subcapitate broadly rounded ends. On the raphe valve, the axial area is narrow and linear. Central area is small and elliptic, distinctly bordered by two more widely spaced striae. Raphe is straight; the proximal raphe endings with distinct central pores; the distal raphe endings terminate on the valve face at the apices. On the rapheless valve, the axial area is wide and lanceolate, without a distinct central area. Transapical striae are slightly radiate throughout, with no increase in density toward the apices on both valves, about 24-26 in 10 μm in the middle part of the valve, up to 28 in 10 μm at the ends. Length of the valve 9-12, and the breadth 3.5-4.

Ecological preference: this taxon is characteristic of lakes that are moderate to high in specific conductance (Lange-Bertalot & Krammer 1989); freshwater, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); the species is widespread throughout the United States and in European countries, but typically occurs in low numbers (Bahls 2009).

Occurrence: Recorded infrequently from Kamionka Lake.

Distribution in Poland: as *Psammothidium rosenstockii* from the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Achnanthidium saprophilum* (Kobayasi & Mayama) Round & Bukhtiyarova 1996**

(Pl. 16, figs. 8-11)

Ref. Kobayasi & Mayama 1982, p. 195, fig. 2 a-h; Krammer & Lange-Bertalot 1991 b, p. 59, pl. 34, figs. 13-19A; Kobayasi et al. 2006, p. 128, pl. 161, Wojtal 2009, p. 136, pl. 5, figs. 29–31; pl. 56, fig. 3; Morales et al. 2011, p. 119, figs. 135-149; Bąk et al. 2012, p. 37, pl. 23.

Status of name: accepted taxonomically.

Synonym: *Achnanthes minutissima* var. *saprophila* Kobayasi & Mayama 1982

Diagnosis: Valve is linear, ovate to elliptical with broadly rounded subprotracted, subcapitate apices. In the raphe valve, the axial area is narrowly linear or slightly lanceolate. Raphe is filiform, straight, distal raphe endings are not sharply curved, the proximal raphe endings are straight, slightly expanded and deflected in opposite directions. Central area has various shapes due to shortened 1-2 central striae on either side, somewhat ovate. In rapheless valve, the axial area is narrowly linear-lanceolate and slightly widening towards the centre, gradually combined with the central one. Central area is usually lacking. Transapical striae are punctate, distant, slightly radiate throughout on both valves, and strongly radiate and denser towards the ends, about 28-30 in 10 μm at the valve centre, up to 36 in 10 μm at the ends. Rapheless valve with 26-28 striae in 10 μm at the valve centre, reaching up to 32-33 in 10 μm near the apices. Length of the valve 8-15 μm, and the breadth 3-4 μm.

Ecological preference: Ecological optimum corresponds to heavily polluted water with neutral to slightly alkaline pH 7-8 (Kobayasi & Mayama, 1982**);** normally abundant in circumneutral pH with higher conductivities (Mayama & Kobayasi 1984, Kobayasi et al. 1985); widespread, tolerating waters of high saprobity (Krammer & Lange-Bertalot 1991b); the species has a very high tolerance to organic pollution and often occurs as the dominant taxon even in poly-saprobic water (Taylor et al. 2005); it was found in a non-eutrophic stream with moderate conductivity and slightly alkaline pH (Morales et al. 2011); alkaline or close to neutral water reactions (pH: 7–9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a)

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Distributed in Kobylanka stream, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); San river, Lubcza, Baryczka, Pielnica, Stobnica, Strug, Ryjak, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a).

***Achnanthidium straubianum* (Lange-Bertalot) Lange-Bertalot 1999**

Ref. Krammer & Lange-Bertalot 1991 b, pl. 32, figs. 53–56; Lange-Bertalot & Metzeltin 1996, p. 26, pl. 78, fig. 21a-b, Wojtal 2004, p. 216, figs. 2-10; Wojtal 2009, p. 140, pl 5, figs. 24, 25; Delgado et al. 2013, p. 96, figs. 80-91, 96-98; Wetzel et al. 2019, p. 60, figs 362–385, 440–443.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes straubiana* Lange-Bertalot 1996

Planothidium straubianum Wetzel, Van de Vijver et Ector 2019

Diagnosis: Valves are elliptic-lanceolate or linear-elliptical with broadly rounded apices. Raphe valve has a narrow axial area that widens towards the central part of the valve. Central area is transapically elliptic, asymmetrically bordered on each side by one to two shortened striae. Raphe is straight with expanded, drop-like proximal raphe endings. The distal raphe endings are unilaterally deflected. Transapical striae are slightly radiate throughout the entire valve, about 26-30 in 10 μm. Rapheless valve with narrow, straight linear axial area, occasionally slightly expanded. Central area showing a unilateral small and narrow horseshoe-shaped with a cavum. Transapical striae are parallel or slightly radiate throughout the entire valve, about 24-28 in 10 μm at the valve centre. Length of the valve 7-14 μm, and the breadth 3.5-5 μm.

Ecological preference: The species has been reported from calcium-rich, mesotrophic and eutrophic waters (Krammer & Lange-Bertalot 1991 b; Lange-Bertalot & Metzeltin 1996).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: The species was recorded from waters of the Wyżyna Krakowsko-Częstochowska upland and Kobylanka stream, south Poland (Wojtal 2004; Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium subatomus* (Hustedt) Lange-Bertalot 1999**

Ref. Hustedt 1939, p. 554, pl. 25, figs. 1-2; Lange-Bertalot & Krammer 1989, p. 28, pl. 57, fig. 8; pl. 59, figs. 1-11; Simonsen 1987, p. 248, pl. 371, figs. 1-4; Krammer & Lange-Bertalot 1991 b, p. 63, pl. 36, figs. 24-31; pl. 35, fig. 6; Monnier et al. 2007, p. 148, figs. 37-42; Noga et al. 2014 b, p. 16, pl. 1, figs. 11-13, 15.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes subatomus* Hustedt 1939

Achnanthes biasolettiana var. *subatomus* Lange-Bertalot 1989

Diagnosis: Frustules are heterovalvar with concave raphe valve and convex rapheless valve. Valves are isopolar, bilaterally symmetrical, elliptic to linear-elliptic with slightly subrostrate to bluntly rounded apices. The raphe valve has **a** narrow linear axial area, gradually widening towards the valve centre. Central area is small, subrounded or rhombic, or indistinct. Raphe is straight, filiform with slightly expanded proximal endings that deflected in opposite directions, and the distal endings are terminated on the valve face at the apices. Transapical striae are more or less parallel in the central part of the valve, becoming slightly radiate and denser towards the apices, about 22-25 in 10 μm at the centre, up to 32 μm at the ends. The rapheless valve has a narrow, linear to slightly lanceolate axial area with a lack of a central area. Transapical striae are punctate, parallel at the centre, slightly radiate near the apices, almost equidistant throughout, about 19-22 in 10 μm. Length of the valve 6-17 μm, and the breadth 2.5-3 μm.

Ecological preference: Oligotrophic, alkaline, or close to neutral freshwater reactions (pH: 6.8-8.2), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a, b).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Wisłok River and Lubcza stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); San River on the San Valley Landscape Park area, south Poland (Nogaet al. 2014 b); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019)

***Achnanthidium thienemannii* (Hustedt) Lange-Bertalot 2004**

Ref. Hustedt 1942, p. 98, pl. 1, figs. 2-5; Noga et al. 2013c, p. 137, fig. 2:15; p. 141, fig. 4: 6; Rybak et al. 2019, pl. 2, fig. 16; Potapova 2006, p. 404, figs 19-27, 38-45.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes thienemannii* Hustedt 1942,

Achnanthes biasolettiana var. *thienemannii* (Hustedt) Lange-Bertalot 1989.

Diagnosis: Valve is linear to linear-elliptical or elliptical to elliptical-lanceolate, with rostrate subcapitate, broadly rounded apices. In the raphe valve, the axial area is narrow, linear to very slightly lanceolate; central area is indistinct, somewhat rounded, appearing by distantly spaced striae in the middle part of the valve. Raphe is linear, filiform; the distal raphe endings are acutely curved in the same direction; the proximal raphe endings are deflected in opposite directions. Transapical striae are slightly radiate at the centre, about 18-22 in 10 µm, and mostly parallel to slightly radiate and denser towards the ends, about 30-36 in 10 µm. In the rapheless valve, the axial area is linear to narrow lanceolate; central area is absent or developed with one or two shortened striae in the middle area. Transapical striae like that on the raphe valve. Length of the valves 8-30 µm and the breadth 3-5 µm.

Ecological preference: *Achnanthes biasolettiana* has its ecological optimum in oligotrophic to mesotrophic and calcareous waters with moderate to high conductivity (Krammer & Lange-Bertalot 1991 b). The species occurs mostly in calcium-rich waters, alkaline or close-to-neutral waters (pH 6.6-7.1) with medium or low electrolytic conductivity (78-530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2013c, 2018).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts), south-east Poland (Noga et al. 2013 c); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); San River, Wisłoka, Wołosaty rivers, and their tributaries, and Bieszczady National Park, south-east Poland (Noga et al. 2018; Noga 2019); Rzeczyca stream and its tributary eastern Carpathians, south Poland (Rybak et al. 2019).

***Achnanthidium trinodis* Ralfs 1861**

Ref. Hustedt 1930, p. 199, fig. 281; Hustedt 1933, p. 381, fig. 825; Krammer & Lange-Bertalot 1991 b, p. 43, pl. 8, figs. 3-4; Hartley et al. 1996, p. 32, pl. 8, fig. 12; Lange-Bertalot & Metzeltin 1996, p. 274, pl. 78, figs. 4-5; Bąk et al. 2012, p. 31, pl. 22.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes trinodis* (W.Smith.) Grunow in Van Heurck 1880

Navicula trinodis W.Smith 1856

Rhoikoneis trinodis (Ralfs) Grunow 1863

Microneis trinodis (Ralfs) Meister 1912

Diagnosis: Valves are isopolar, linear with distinctly inflated central part and subcapitate to capitate, broadly rounded apices. Raphe valve is slightly concave, has a narrow linear axial area. Central area is subrounded to elliptical, bordered by shortened central striae. Raphe is short, straight, filiform; the proximal and distal raphe endings are simple to very weakly inflated. Transapical striae are more or less parallel in the valve centre, slightly radiate towards the ends, about 35-40 in 10 µm. Rapheless valve is slightly convex, has a moderate linear axial

area that widens at the valve centre. Central area is larger, rounded, oval or slightly lanceolate, approximately 1/2 of the valve width. Transapical striae like that on the raphe valve, about 33-36 in10 μm. Length of the valve 10-25 μm, and the breadth 3-5 μm.

Ecological preference: the species is found occasionally in small numbers in oligotrophic, calcareous lakes in Germany, and it is regarded as an indicator of very good ecological quality (Hofmann et al. 2011).

Distribution in Poland: Rare in Poland (Bąk et al. 2012).

Genus *Crenotia* Wojtal 2013

Diagnosis: Valves are elliptical-lanceolate or linear, sometimes with a gibbous centre. Apices are broadly rounded, sometimes subcapitate. Axial area of both valves is lanceolate. Central area is not clearly differentiated, sometimes unilaterally expanded up to the valve margin. Transapical striae are moderately radiate at the valve centre, about 28–30 in 10 μm, becoming denser and more strongly radiate towards the apices, expanding onto the valve mantle.

Type species: *Crenotia thermalis* (Rabenhorst) Wojtal 2013

***Crenotia thermalis* (Rabenhorst) Wojtal 2013**

Ref. Krasske 1927, p. 272, pl. 10, figs. 12-14; Hustedt 1933, p. 400; Foged 1957, p. 45, pl. 1, fig. 17 a, b; Lai et al. 2019, p. 12, figs. 3 A-C.

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium thermale* Rabenhorst 1864
Achnanthes thermalis (Rabenhorst) Schoenfeld 1907
Achnanthidium zelleri Kirchner 1888
Achnanthes gibberula var. *angustior* Grunow 1895
Achnanthes grimmei var. *elliptica* Krasske 1927
Achnanthes grimmei var. *inflata* Krasske 1927
Achnanthes grimmei var. *hyalina* Hustedt 1949

Diagnosis: Valves are linear lanceolate with slight swelling in the middle and broadly subrostrate apices. The raphe valve is concave with lanceolate axial area and a wide central area, sometimes asymmetrically enlarged to the valve margin. The raphe is filiform, straight to slightly curved; proximal raphe endings are represented by central pores that deflected to opposite sides of the valve. Distal raphe endings are distinctly curved around the terminal stria to the same side externally. The rapheless valve is convex, with a lanceolate, mostly more extended axial area than the raphe valve. Transapical striae are parallel at the centre to slightly radiate towards the ends, and densely about 20-29 in 10 μm. Striae in the middle of the valve are interrupted on one side on both valves. Length of the valve 10-18 μm and the breadth 3.5-4 μm.

Ecological preference: Brackish-freshwater, circumneutral, high oxygen requirements, oligosaprobic (Van Dam et al. 1994); as *Achnanthes grimmei* var. *inflata* halobien-indifferent, pH: alkaliphilous (Foged 1957). The species occasionally encountered in running waters, was characteristic of electrolyte-rich inland habitats, particularly thermal and mineral springs (Wojtal 2013; Lange-Bertalot et al. 2017).

Distribution in Poland: found in Swibno-Vistula River estuary, North Poland (Majewska et al., 2012); spring waters from geological formations in south Poland (Wojtal 2013); as *Achnanthidium thermale* Rabenhorst from the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

Genus *Gogorevia* Kulikovskiy, Glushchenko, Maltsev & Kociolek 2020

Diagnosis: Frustules in girdle view are narrow, rectangular, and weakly curved. Valves are lanceolate, elliptical, with protracted, short, rostrate, broadly rounded apices. Axial area is very narrow, linear, opening abruptly to the central area. Central area is defined by visible sternum. Raphe valves with a central area forming an evident, narrow, rectangular to wedge-shaped fascia, reaching in some species to valve margins. Transapical striae are uniseriate and composed of small, rounded areolae, radiate throughout, and more strongly radiate near apices. Raphe is straight with clearly expanded proximal raphe endings. Distal raphe endings are deflected to opposite sides, terminating in

drop-like pores on the valve face. Rapheless valves with asymmetrical central area, on one side forming a hyaline area up to the valve margin; the other side formed by weak, more distant striae. Transapical striae are almost parallel, becoming more radiate toward apices. Areolae are elongated to rounded in shape.

Morphologically, *Gogorevia* differs from *Achnanthidium* and *Lemnicola* by the shape of the valves, possessing uniseriate striae, raphe morphology, and the presence of an evident sternum (Kulikovskiy et al. 2020)

Type species: *Gogorevia rinatii* Kulikovskiy, Glushchenko, Maltsev & Kociolek 2020

***Gogorevia australexigua* (Van de Vijver) Kulikovskiy & Kociolek 2020**

(Pl. 16, figs. 12-21)

Ref. Taylor et al. 2014, p. 47, figs. 65-92; Van de Vijver 2014, p. 47, figs. 65-92.

Status of name: accepted taxonomically.

Synonym: *Achnanthidium australexiguum* Van de Vijver 2014

Diagnosis: Frustules in girdle view are narrow, rectangular, and weakly curved in the middle. Valves are linear with parallel, slightly undulating margins and protracted, distinctly rostrate, acutely rounded apices. The axial area is very narrow, opening rather abruptly to the central area. Raphe valve has a very narrow axial area that widens abruptly at the valve centre. Central area forms a rather broad, rectangular, weakly asymmetrical fascia, reaching the valve margins and lacking any shortened striae bordering the central area. Raphe fissures are straight with clearly expanded proximal raphe endings. Distal raphe endings are deflected. Transapical striae are radiate throughout the valve, more strongly radiate near the apices, about 28-30 in 10 μm. Rapheless valve has a narrow axial area at the ends, widening gradually towards the centre to form a lanceolate area. Central area forming a narrow, rectangular, asymmetrical fascia, reaching to the valve margins and lacking any shortened striae. Irregular markings are sometimes present in the central area. Transapical striae are punctate, parallel at the valve centre, becoming radiate towards the apices, about 21-24 in 10 μm. Length of the valve 15-20 μm, and the breadth 6.5-7.5 μm.

Ecological preference: The species was observed in a large lake with circumneutral pH (7.24), a low specific conductance (120 $\mu S.cm^{-1}$) and low values of total phosphorus (9.7 $\mu g.l^{-1}$) and sulphate (14 $\mu g.l^{-1}$) (Taylor et al., 2014)

Occurrence: Common in Jeziorak Lake and frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record

***Gogorevia exilis* (Kützing) Kulikovskiy & Kociolek 2020**

(Pl. 16, figs. 22-34; pl. 17, figs. 1-16)

Ref. Hustedt 1930, p. 201, fig. 286; Hustedt 1933, p. 386, fig. 832 a, b; Patrick & Reimer 1966, p. 257, pl. 16, figs. 21, 22; Schoeman & Ashton 1982, p.84, figs. 1-8,75- 79,105-110; John 1983, p. 70, pl. 30, figs 5, 6; Thomas 1983, p. 18, pl. 3, figs. 17, 18; Schoeman & Archibald 1988, p.224, figs. 3-6; Holland & Clark 1989, p. 9, pl. 1, fig. 13; Krammer & Lange-Bertalot 1991 b, p. 38, pl. 6, fig. 4; pl. 23, figs. 1-27; Morales et al. 2011, p. 116, figs. 225-234; figs .291-293; Taylor et al. 2014, p. 45, figs. 2-46.

Status of name: accepted taxonomically.

Synonym: *Stauroneis exilis* Kützing 1844

Achnanthes exigua Grunow 1880

Achnanthes tylophora (Roichelt) Heiden 1903

Stauroneis tylophora Reichelt 1903

Achnanthidium exiguum (Grunow) Czarnecki 1994

Lemnicola exigua (Grunow) Kulikovskiy, Witkowski & Plinski 2011

Diagnosis: Valve is mostly elliptical, broadly elliptical to linear-elliptical, with nearly quadratic valve shape and narrow protracted, broadly rounded, rostrate to subcapitate ends. In the raphe valve, the axial area is narrow, widening towards the centre to form a slightly lanceolate space; central area is transverse, forming wedge-shaped fascia that reaches the valve margins. Raphe is filiform, straight; the proximal raphe endings are thickening, and the distal endings are curved in opposite directions. Transapical striae are almost parallel to slightly radiate in

the valve centre, becoming strongly radiate, denser and tending to subparallel at the ends, about 24-27 in 10 μm. In the rapheless valve, the axial area is narrowly linear, somewhat linear-lanceolate, widening towards the centre. Central area is absent or small, developed on one side of the valve by shortening of one or two striae at the centre. Transapical striae are slightly radiate like the raphe valve, 20-24 in 10 μm. Length of the valve 7-15 μm, and the breadth 4-7 μm.

Ecological preference: Cosmopolitan, salinity indifferent, pH: alkaliphilous, eurytopic as regards Cl and pH, also eurythermal (Foged 1957); widespread species, found in lakes, rivers and streams; alkaliphilous, eurythermal, euryphotic (Patrick & Reimer 1966); freshwater species, epiphytic, alkaliphilous with pH 7.5-8 (Ehrlich 1973); it was recorded in weakly acidic water, and it is tolerated a wide range of conductivity, pH, and alkalinity (Gasse 1986); cosmopolitan, the species was observed commonly from freshwater environments of low to high conductivity and alkalinity with pH values 6.8-7.5, hot springs over 40°C temperature, reduced light intensity such as 15-20 m depth in the Alps lakes (Krammer and Lange-Bertalot 1991 b); fresh-brackish, alkaliphilous, β-mesosaprobic and oligo- to eutraphentic (van Dam et al. 1994); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a).

Occurrence: Recorded commonly from Młynek, Kamionka and Radomno Lakes; frequently in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); as *Achnanthes exigua* Grunow from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and Żołynianka in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Gogorevia exilis* var. *angustirostrata* Zalat comb. nov.**

(Pl. 17, figs. 17-19)

Ref. Frenguelli 1934, p. 95, pl. 1, figs. 9-10; Krasske 1939, p. 371, pl. 11, figs. 5, 6;

Status of name: accepted taxonomically.

Synonyms: *Achnanthes heterovalvata* var. *angustirostrata* (Krasske) Frenguelli 1934
Achnanthes exigua f. *angustirostrata* Krasske 1939
Gogorevia angustirostrata (Krasske) Yu & You 2023

Diagnosis: Valves are linear-elliptic with narrow subcapitate, rostrate apices. The raphe valve has a very narrow axial area that widens abruptly into a transverse fascia. The fascia is shaped like a bow tie and sometimes bordered by a few shortened striae. The raphe is filiform, straight; the distal raphe endings appear to curve in opposite directions; the proximal raphe endings are expanded in the shape of teardrops. Transapical striae are strongly radiate throughout and a bit more closely spaced near the apices, about 27-29 in 10 μm at the valve centre. On the rapheless valve, the axial area is wider and expands gradually to merge with an asymmetric, irregular transverse central area. Transapical striae are nearly parallel at the valve centre, more closely spaced near the apices, about 22-25 in 10 μm at the valve centre. Length of the valve 14-17 μm, and the breadth 5-7 μm.

Remarks: The species is morphologically the most similar to *Gogorevia exilis* but differs by having rostrate, acutely rounded apices, and it can not be separated as a new species as reported by Yu & You (2023).

Ecological preference: The species was reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Recorded infrequently from Jeziorak Lake.

Distribution in Poland: New record.

***Gogorevia exilis* var. *constricta* Zalat & Pidek comb. nov.**

(Pl. 17, figs. 20-25)

Ref. Hustedt 1921, p. 145, pl. 1, figs. 7-8; Patrick & Reimer 1966, p. 258, pl. 16, figs. 23-24.

Synonyms: *Stauroneis exilis* var. *constricta* Grunow 1867
Achnanthes exigua var. *constricta* Hustedt 1921
Achnanthidium exiguum var. *constrictum* (Grunow) Andresen, Stoermer & .Kreis 2000
Gogorevia contracta Wang & Kim 2025

Diagnosis: Valves are elongated and linear-elliptic with narrowly capitate or subrostrate, acutely rounded apices. Raphe valve, with a narrow and linear axial area that widens abruptly at the valve centre. Central area is a bowtie-shaped cen. Raphe is filiform, straight; the proximal raphe endings with distinct drop-shaped central pores; the distal raphe endings are oppositely oriented and deflected, terminating at the valve margin. Transapical striae are uniseriate, slightly radiate, becoming more radiate toward the apices, about 26-28 in 10 μm. Rapheless valve with a narrow lanceolate axial area. Central area is asymmetric, rectangular, and has a unilateral extra stria. Transapical striae are slightly radiate, becoming more radiate toward the apices, about 18-22 in 10 μm. Length of the valve 14-17 μm, and the breadth 5-7 μm.

Remarks: The species is morphologically similar to *Gogorevia exilis* but differs by having a marked constriction at the valve centre.

Ecological preference: The species was reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland and Młynek Lake.

Distribution in Poland: New record.

***Gogorevia heterovalva* (Krasske) Tseplik & Chudaev 2023**

(Pl. 17, figs. 26-30)

Ref. Krasske 1923, p. 193, fig. 9a-b; Hustedt 1930, p. 202, fig. 228; Hustedt 1933, p. 387, fig. 832 c-f; Patrick & Reimer 1966, p. 258, pl. 16, figs. 25,26; Florin 1970, p. 103, pl. 12, fig. C 2; Siqueiros Beltrones et al. 2021, tab.1, figs. 16k-m; Sokolova et al. 2023, p. 152.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes exigua* var. *heterovalvata* Krasske 1923
Achnanthidium exiguum var. *heterovalvata* (Krasske) Czarnecki 1994

Diagnosis: Frustules are linear-elliptical with nearly quadratic valve shape and distinctly protracted rostrate apices. Raphe valve with narrow axial area, widening abruptly into the valve centre. Central area is extending to the valve margins as a flattened rectangle or wedge–shaped fascia. Raphe is filiform, straight; the proximal raphe endings are clearly expanded, and the distal raphe endings are deflected. Transapical striae are fine, radiate in the middle, slightly radiate to parallel at the ends; about 30-32 in 10 μm. Rapheless valve with a narrow, linear or somewhat linear-lanceolate axial area. Central area is a small, flattened rectangle caused by occasional shortening of one or two striae at the centre. Transapical striae are fine, slightly radiate in the middle to parallel at the ends, about 21-23 in 10 μm. Length of the valve 12-14 μm, and the breadth 5-6 μm.

Ecological preference: Littoral form, indifferent to Cl-content, and temperature, alkaline water (Hustedt 1938); in freshwater, eutrophic lakes (Cleve-Euler 1953); cosmopolitan, salinity indifferent, pH: alkaliphilous, eurytopic as regards Cl and pH, also eurythermic (Foged 1957); alkaliphilous, eurythermal and euryphotic (Patrick & Reimer 1966); freshwater, epiphytic, alkaliphilous with pH value 7.5-8 (Ehrlich 1973); fresh-brackish, alkaliphilous, β-mesosaprobic and oligo- to eutraphentic (van Dam et al. 1994).

Occurrence: Recorded infrequently from Kamionka Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

Genus *Karayevia* Round & Bukhtiyarova ex Round 1996

Valves are heteropolar, elliptic to lanceolate, linear-lanceolate with rounded rostrate to capitate, sometimes protracted apices. Striae on the raphe valve are radial, some shorter than others, elongated, often more so towards the margin. Raphe sternum lanceolate, hardly expanded at the centre. Raphe is filiform, straight, with terminal

ends curved in the same direction. Areolae are simple on the outside but covered by cribra internally. Raphe-less valve with coarser and parallel striae, narrow axial area and areolae circular with a different form of areolae. Valves are generally small to 40 µm. Commonly attached to sand grains in eutrophic, alkaline rivers and streams.

Type species: *Karayevia clevei* (Grunow) Bukhtiyarova 1999 (=*Achnanthes clevei* Grunow 1880)

***Karayevia amoena* (Hustedt) Bukhtiyarova 1999**

Ref. Hustedt, 1933, p. 390, fig. 838; Hustedt 1952, p. 386, figs. 66, 67; VanLandingham 1967, p. 54, fig. 67; Krammer & Lange-Bertalot 1991 b, p. 44, pl. 26, figs. 7-23; pl. 6, fig. 3; Chang 1992, p. 397, figs. 1-5; Witkowski et al. 2000, p. 85, pl. 51, figs. 34-36.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes amoena* Hustedt 1952
Achnanthes triconfusa VanLandingham 1967
Kolbesia amoena (Hustedt) Kingston 2000
Achnanthes orientalis Hustedt 1933

Diagnosis: Valves are linear-elliptical with capitate to rostrate apices. Both raphe and rapheless valves have a lanceolate axial area and no distinct central area. In the raphe valve, the raphe is straight. Transapical striae are radiate, becoming parallel to slightly convergent toward the apices, interrupted by a thin longitudinal line in the middle of the valve, about 22-26 striae in 10 µm. In the rapheless valve, the transapical striae are slightly radiate, becoming parallel to slightly convergent toward the apices, interrupted by a wide longitudinal hyaline area on each side of the valve, about 18-20 in 10 µm. Length of the valve 6-13 µm, and the breadth 3.5-5 µm.

Ecological preference: Brackish water species (Van Dam et al. 1994); Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); as *Kolbesia amoena* (Hustedt) Kingston found in Górki Zachodnie and Swibno – Vistula River estuary in North Poland (Majewska et al. 2012); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Karayevia clevei* (Grunow) Bukhtiyarova 1999**

(Pl. 18, figs. 1-27; pl. 19, figs. 1-17)

Ref. Hustedt 1930, p. 203, fig. 294; Hustedt 1933, p. 391, fig. 839 a,b; Patrick & Reimer 1966, p. 267, pl. 17, figs. 21, 22; Germain 1981, p. 114, pl. 42, figs. 8-9; Krammer & Lange-Bertalot 1991b, p. 35, pl. 21, figs. 1-17; Ehrlich 1995, p. 50, pl. 9, figs. 1-2; Round & Bukhtiyarova 1996, figs. 13-18; Hartley et al. 1996, p. 20, pl. 2, fig. 3; Lange-Bertalot & Metzeltin 1996, p. 324, pl. 103, figs. 17-18; Kulikovskiy et al. 2016, p. 231, pl. 34, figs. 36-41.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes clevei* Grunow 1880
Actinoneis clevei (Grunow) Cleve 1895
Achnanthidium clevei (Grunow) Czarnecki 1995

Diagnosis: Valves are lanceolate to elliptical-lanceolate with apiculate, obtusely rounded to subrostrate apices. Raphe valve has a narrow linear to linear-lanceolate axial area and no distinct central area. The raphe is filiform, straight, with terminal fissures deflected to the same side. The proximal raphe endings are slightly expanded externally and deflected toward opposite sides internally. Transapical striae are punctate, strongly radiate, about 20-24 in 10 µm, alternating of long and short striae in the middle part, denser towards the apices. The rapheless valve has a narrow linear-lanceolate axial area and no distinct central area. Transapical striae are coarsely punctate, parallel in the centre and slightly radiate towards the apices, 9-12 in 10 µm. Length of the valve 10-22 µm, and the breadth 5-7 µm.

Ecological preference: salinity indifferent, pH: alkaliphilous, widely distributed in central and northern Europe (Foged 1957). *Achnanthes clevei* is common in freshwaters at higher pH or alkaline conditions and prefers clear waters (Patrick & Reimer 1966; Foged 1978). The species was more abundant in the periphytic

diatoms of Otter Creek, a small spring fed stream in the Sand Hills region of western Nebraska (DeNicola et al. 1992); preferring eutrophic conditions, ά or β -mesosaprobic (Witkowski 1994, Stachura-Suchoples 1999, Bąk et al. 2000); alkaliphilous, fairly high oxygen requirements, oligo-mesosaprobous, meso-eutrophic (Van Dam et al. 1994); freshwater, low alkaline of some springs (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013c); Benthic, oligohalobous indifferent, alkaliphilous, mesotraphenthic-eutraphenthic, β-mesosaprobous (Witak & Jankowska 2014).

Occurrence: Recorded common in Radomno, Kamionka and Jeziorak Lakes, and frequently abundant in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, north Poland **(**Bąk et al. 2004); freshwater, low alkaline of some springs in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Dominant in limnocrenic spring – Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz, 2007); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Swibno – Vistula River estuary in North Poland (Majewska et al. 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013c); Wisłok River in the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Karayevia clevei* var. *balcanica* (Hustedt) Levkov & Krstic 2007**

(Pl. 19, figs. 18-30)

Ref. Hustedt 1945, p. 908, pl. 39, figs. 34-37; Levkov et al. 2007, p. 125, pl. 22, figs. 13-14.

Status of name: accepted taxonomically.

Synonym: *Achnanthes clevei* var. *balcanica* Hustedt 1945

Diagnosis: Valves are lanceolate to elliptical-lanceolate with subrostrate, acutely rounded apices. Raphe valve has a narrow linear axial area without a central area. The raphe is filiform, straight; the distal raphe endings are deflected to the same side; the proximal raphe endings are slightly expanded externally with small central pores and deflected toward opposite sides internally. Transapical striae are distinctly punctate, radiate throughout the valve, about 12-14 in 10 μm. The rapheless valve has a narrow linear-lanceolate axial area. Central area is absent. Transapical striae are coarsely punctate, weakly radiate in the centre and more radiate towards the apices, about 10-12 in 10 μm. Length of the valve 23-32 μm, and the breadth 7-8 μm.

Ecological preference: It is reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments, associated with the nominate variety. It has the same ecological preference as the nominate species

Occurrence: Recorded as common in Jeziorak Lake, and frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Karayevia clevei* var. *minor* Zalat nov. var.**

(Pl. 20, figs. 1-14)

Diagnosis: Valves are small, elliptic, with bluntly rounded apices. Raphe valve has a very narrow linear axial area. Central area is small, oval to subrounded, and somewhat indistinct. The raphe is filiform, straight; the distal raphe endings are deflected to the same side; the proximal raphe endings are slightly expanded without central pores. Transapical striae are punctate, radiate entire the valve, about 22-24 in 10 μm. The rapheless valve

has a narrow linear axial area. Central area is small and subrounded, somewhat absent. Transapical striae are coarsely punctate, radiate at the valve centre and more radiate towards the apices, about 16-18 in 10 µm. Length of the valve 7-9 µm, and the breadth 4-5 µm.

Remarks: This variety is distinguished from the nominate species by smaller dimensions and the presence of a small central area.

Ecological preference: It is reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments, associated with the nominate variety. It has the same ecological preference as the nominate species

Etymology: The epithet of the new variety refers to its smaller size.

Holotype: the specimens illustrated in plate 20, figures 1-14.

Type locality: Kamionka Lake.

Occurrence: Recorded as common in Kamionka Lake, and frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Karayevia bottnica* (Cleve) Lange-Bertalot 2004**

Ref. Hustedt 1933, p. 392, fig. 841; Bahls et al. 2018, p. 40, pl. 3, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes clevei* var. *bottnica* Cleve 1891
Achnanthes bottnica (Cleve) Cleve 1895
Actinoneis bottnica (Cleve) Cleve 1895
Karayevia clevei var. *bottnica* (Cleve) Bukhtiyarova 1999

Diagnosis: Valves are lanceolate to elliptical-lanceolate with strongly convex margins and apiculate, rostrate, acutely rounded apices. Raphe valve has a narrow linear axial area with indistinct or weakly ovate central area. The raphe is filiform, straight; the proximal raphe endings with small central pores that deflected toward opposite sides. Transapical striae are punctate, strongly radiate, about 17-18 in 10 µm, alternating of long and short striae in the middle part, denser towards the apices. The rapheless valve has a narrow linear-straight axial area without central area. Transapical striae are coarsely punctate, parallel throughout the valve and slightly radiate at the apices, 18-20 in 10 µm. Length of the valve 20-28 µm, and the breadth 6-8 µm.

Ecological preference: oligohalobous halophilous form (Witak & Dunder 2007); Benthic, oligohalobous halophilous, alkaliphilous, mesotraphenthic-eutraphenthic, β-mesosaprobous (Witak & Jankowska 2014).

Occurrence: Recorded infrequently in the Eemian palaeolake deposits of central Poland and Jeziorak Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); as *Karayevia clevei* var. *bottnica* (Cleve) from the Holocene sediments of the SW Gulf of Gdańsk, Southern Baltic Sea, north Poland (Witak & Dunder 2007); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Karayevia jeziorakensis* Zalat nov. sp.**

(Pl. 20, figs. 15-20)

Diagnosis: Valves are elliptical with obtusely rounded ends. Raphe valve with a narrow linear axial area without a central area. Raphe is filiform and straight; the proximal raphe endings are slightly expanded without central pores; Transapical striae are punctate, radiate throughout the valve, about 17-19 in 10 µm. Rapheless valve has a very narrow, linear axial area and no central area. Transapical striae on rapheless valves are coarsely punctate, slightly radiate or almost parallel in the valve centre, becoming radiate toward apices, about 15-16 in 10 µm. Length of the valve 6-8 in 10 µm, and breadth 4-5.5 µm

Remarks: This species is distinguished from other related taxa by the shape of the outline, smaller sizes, coarsely punctate striae and no central area.

Etymology: The epithet of the new variety refers to Jeziorak Lake.

Holotype: the specimens illustrated in plate 20, figures 15-20.

Type locality: Jeziorak Lake.

Ecological preference: Reported from shallow**,** benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Karayevia kolbei* (Hustedt) Bukhtiyarova 1999**

(Pl. 20, figs. 21-22)

Ref. Hustedt 1930, p. 204, fig. 279; Hustedt 1933, p. 397, fig. 846; Kaczmarska 1977, p. 41, pl. 10, fig. 5; Hartley et al. 1996, p. 24, pl. 4, fig. 15; Delgado et al. 2013, p. 95, figs. 32-38; Kulikovskiy et al. 2016, p. 232, pl. 34, figs. 28-30; Kryvosheia & Kapustin 2019, p. 557, figs. l, k.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes kolbei* Hustedt 1930

Kolbesia kolbei (Hustedt) Round & Bukhtiyarova ex Fourtanier & Kociolek 1999

Diagnosis: Valves are elliptical-lanceolate with apiculate, short, rostrate, bluntly rounded apices. In the raphe valve, the raphe is straight, filiform; the proximal raphe endings with distinct small pores; the distal raphe endings are indistinct. Axial area is lanceolate without a distinct central area, narrowing towards the ends. Transapical striae are radiate, distinctly punctate, about 11-13 in 10 μm. In the rapheless valve, the axial area is lanceolate and narrows markedly at the apices; central area is lacking. Transapical striae are punctate, short, slightly radiate throughout, and interrupted by a marginal longitudinal line, about 12-14 in 10 μm. Length of the valve 10-25 μm, and the breadth 5.5-7 μm.

Ecological preference: Alkaliphilous **(**Kaczmarska 1976); it occurs in alkaline, β-mesosaprobic rivers (Lange-Bertalot et al. 2011); alkaline mesotrophic and eutrophic water bodies (Kulikovskiy et al. 2016).

Occurrence: Recorded frequently in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); in springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011).

***Karayevia laterostrata* (Hustedt) Bukhtiyarova 1999**

Ref. Hustedt 1933, p. 392. fig. 840; Simonsen 1987. p. 134, pl. 220, f. 18-26; Krammer & Lange-Bertalot 1991b, p. 36, pl. 21, fig. 18; Hartley et al. 1996, p. 26, pl. 5, fig. 5; Joh 2012, p. 78, figs. 77, 78; Noga et al. 2013 c, p. 137, fig. 2:19; Kulikovskiy et al. 2016, p. 232, pl. 34, figs. 31-35; Rybak et al. 2019, fig. 2: 13.

Status of name: accepted taxonomically.

Synonym: *Achnanthes laterostrata* Hustedt 1933

Diagnosis: Valves are elliptical to elliptical-lanceolate with protracted, narrowly capitate to subcapitate apices. The raphe valve has a linear to linear-lanceolate axial area and no distinct central area. Raphe is filiform, straight, without distinct terminal fissures. The proximal raphe endings are simple externally and curve toward opposite sides internally. Transapical striae are punctate, radiate, alternating long and short striae in the valve centre, about 14-18 in 10 μm. The rapheless valve has a narrow linear axial area and lacking a central area. Transapical striae are punctate, parallel in the centre and slightly radiate towards the apices, about 16-18 in 10 μm. Length of the valve 10-30 μm, and the breadth 6-9 μm.

Ecological preference: *Achnanthes laterostrata* reported from more alkaline lakes in forested watersheds in Canada (Pienitz & Smol 1993); freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg^{-1} (Noga et al. 2013 c).

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: In springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Gołębiówka, Świerkowiec, Stobnica

streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Karayevia ploenensis* (Hustedt) Bukhtiyarova 1999**

(Pl. 20, figs. 23-25)

Ref. Hustedt 1930, p. 199, fig. 280; Kaczmarska 1977, p. 42, pl. 9, figs. 3, 5, 9.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes ploenensis* Hustedt 1930

Kolbesia ploenensis (Hustedt) Round & Bukhtiyarova ex Round 1998

Diagnosis: Valves are elliptical-lanceolate with short rostrate, capitate, bluntly rounded apices. The raphe valve has a very narrow linear axial area that expanded slightly towards the valve centre. Central area is not differentiated. Raphe is filiform, straight, and the proximal raphe endings are simple externally with small central pores that are curved toward opposite sides. Transapical striae are radiate, most marked in the narrowing part of the valve, almost parallel in the extended ends, about 16-19 in 10 μm. Rapheless valve has a lanceolate axial area that passes gradually into a broad central area, reaching about 1/3 of the width at the middle valve. Transapical striae are parallel at the valve centre, or very slightly radiate through the entire length, about 19-22 in 10 μm. Length of the valve 15-20 μm, and the breadth 4-5 μm.

Occurrence: Recorded infrequently from the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976, 1977); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011).

***Karayevia rostrata* (Hustedt) Kulikovskiy & Genkal 2013**

(Pl. 20, figs. 26-36)

Ref. Hustedt 1930, p. 204, fig. 295; Hartley et al. 1996, p. 20, pl. 2, fig. 4; Levkov et al. 2007, p. 125, pl. 22, figs. 15-19; Kulikovskiy et al. 2016, p. 233, pl. 34, figs. 16-19.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes clevei* var. *rostrata* Hustedt 1930

Achnanthidium clevei var. *rostratum* (Hustedt) M.B.Edlund 1995

Karayevia clevei var. *rostrata* (Hustedt) Bukhtiyarova 1999

Karayevia clevei f. *rostrata* (Hustedt) Levkov & Krstic 2007

Diagnosis: Valves are lanceolate to elliptical-lanceolate with apiculate, rostrate apices. Raphe valve has a narrow linear to weakly linear-lanceolate axial area without a distinct central area. Raphe is filiform and straight; the distal raphe endings are deflected to the same side; the proximal raphe endings are slightly expanded externally with small central pores. Transapical striae are punctate, radiate throughout the valve, about 17-18 in 10 μm. Rapheless valve has a very narrow linear axial area and no distinct central area. Transapical striae are coarsely punctate, parallel in the centre and slightly radiate towards the apices, 12-14 in 10 μm. Length of the valve 15-21 μm, and the breadth 6-8 μm.

Ecological preference: alkaline mesotrophic and eutrophic water bodies (Kulikovskiy et al. 2016); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake; common in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Karayevia suchlandtii* (Hustedt) Bukhtiyarova 1999**

Ref. Hustedt 1933, p. 406, fig. 859 B; Hustedt 1954, p. 466, figs. 10, 11; Patrick 1945, p. 168, pl. 1, figs. 2-3; Hartley et al. 1996, p. 32, pl. 8, fig. 9; Kulikovskiy et al. 2016, p. 233, pl. 34, figs. 2025.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes suchlandtii* Hustedt 1933

Achnanthes lewisiana Patrick 1945

Cocconeis utermoehlii Hustedt 1954

Achnanthes suchlandtii var. *robusta* Hustedt 1933

Kolbesia suchlandtii (Hustedt) Kingston 2000

Diagnosis: Valves are elliptical to linear-elliptical, with broadly rounded ends. The raphe valve has a linear-lanceolate axial area and no distinct central area. The raphe is straight without terminal fissures. External proximal and distal raphe endings are slightly expanded. Transapical striae are almost parallel in the middle part of the valve, becoming radiate toward apices, about 18-20 in 10 µm. The rapheless valve has a linear, weakly lanceolate axial area and lacking a central area. Transapical striae are interrupted by a longitudinal line at each side of the valve, slightly radiate or almost parallel in the valve centre, becoming radiate toward apices, about 18-20 in 10 µm. Length of the valve 7-15 µm, and the breadth 3.5-5.5 µm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); prefers alkaline mesotrophic water bodies (Kulikovskiy et al. 2016).

Distribution in Poland: Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

Genus *Kolbesia* Round and Bukhtiyarova ex Round 1996

Diagnosis: Valves are elliptic to elliptic-lanceolate, apices are drawn-out and attenuated to obtusely rounded. Raphe is filiform and straight in an elliptical axial area. Transapical striae are slightly radiate on both valves. Areolae elongate and separated, few in each stria.

Holotype species: *Kolbesia kolbei* (Hustedt) Round & Bukhtiyarova ex Fourtanier & Kociolek 1999

***Kolbesia gessneri* (Hustedt) Aboal 2003**

Ref. Hustedt 1953, p. 148, figs. 14-19; Carter 1964, p. 199, fig. 1; Lange-Bertalot 1989, p. 122, pl. 41, figs. 8-17; pl. 44, figs. 4-5.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes gessneri* Hustedt 1953
Achnanthes wickenensis Carter 1964
Achnanthes ploenensis var. *gessneri* (Hustedt) Lange-Bertalot 1989
Karayevia ploenensis var. *gessneri* (Hustedt) Bukhtiyarova 1999
Kolbesia ploenensis var. *gessneri* (Hustedt) Haworth & Kelly 2002

Diagnosis: Valves are elliptic-lanceolate, with subrostrate to rostrate apices. Both raphe and rapheless valves have a narrow lanceolate axial area and lack a distinct central area. The raphe valve has a straight, filiform raphe. Transapical striae are strongly radiate in the middle part of the valve, about 14-16 in 10 µm, becoming parallel to slightly convergent toward the apices, about 18-20 in 10 µm. In the rapheless, transapical striae are slightly radiate in the centre, about 15-17 in 10 µm, becoming parallel to slightly convergent toward the apices, and reached up to 20 in 10 µm, interrupted by a marginal longitudinal line on each side of the valve. Length of the valve 10-18 µm, and the breadth 5-6 µm.

Ecological preference: reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3), and Water pH varied within 7.25-9.58 (Bąk et al. 2006)

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006)

Genus *Planoplatessa* Kulikovskiy, Glushchenko & Kociolek 2022

Diagnosis: Raphe valves: Valves are broadly elliptical with broadly rounded ends. Raphe is straight and filiform. Distal raphe endings are straight and present on the valve face outside. Proximal raphe endings are straight and tear-shaped outside. Distal and central raphe endings are curved in opposite to another. Central area is small and roundish. Axial area is moderately narrow, almost linear. Transapical striae are uniseriate, radiate at the centre of the valve, very strongly radiate and curved toward the ends, about 17-19 in 10 µm. Rapheless valves: Axial area is narrowly lanceolate with a large central area. Transapical striae are uniseriate, spaced slightly wider than in raphe valves. A visible horseshoe-shaped structure is present. Length of the valve 9-20 µm, and the breadth 5.5-8.5 µm.

Holotype species: *Planoplatessa joursacensis* (Héribaud) Kulikovskiy, Glushchenko & Kociolek 2022

***Planoplatessa joursacensis* (Héribaud) Kulikovskiy, Glushchenko & Kociolek 2022**

(pl. 21, figs. 1-34; pl. 22, figs. 1-10)

Ref. Hartley et al. 1996, p. 24, pl. 4, fig. 14; Bąk et al. 2012, p. 283, pl. 25; Chudaev et al. 2015, p. 112-113, pl. 1, figs. 1-9; pl. 2, figs. 1-2; Kulikovskiy et al. 2016, p. 238, pl. 36, figs. 1-6; Kulikovskiy et al. 2022, p. 4, figs. 1-3.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes joursacensis* Héribaud 1903

Achnantheiopsis joursacensis (Héribaud) Lange-Bertalot 1997

Planothidium joursacense (Héribaud) Lange-Bertalot 1999

Platessa joursacensis (Héribaud) Chudaev 2015

Diagnosis: Valves are broadly elliptic to elliptical-lanceolate, with broadly rounded ends. On the raphe valve, the axial area is moderately narrow, almost linear; the raphe is straight and filiform; the distal raphe endings are straight and present on the valve face outside; proximal raphe endings are straight and tear-shaped outside. Central area is small and roundish; it is bounded by 1-2 short, widely spaced striae. Transapical striae are radiate at the centre of the valve; very strongly radiate and curved toward the ends, about 15-18 in 10 µm. On the rapheless valve, the axial area is narrowly lanceolate to rhombic-lanceolate, which is wider than on the raphid valve; the central area on one side; transapical striae are radiate throughout, spaced slightly wider than in the raphe valve. Length of the valve 10–20 µm, and the breadth 5.5-8.5 µm.

Remarks: This taxon is conspecific with *Achnanthes lanceolata* var. *omissa* (Patrick & Reimer 1966), but Chudaev et al. (2015) showed that this species has no terminal raphe fissures and therefore it was transferred to *Platessa*. The presence of the cavum and predominantly uniseriate striae are however, not characteristic of *Platessa*. Since this species has an unusual combination of characters, its generic position is uncertain (Kulikovskiy et al. 2022).

Ecological preference: Fresh-brackish, alkaliphilous, high oxygen requirements, oligosaprobic, oligo-mesotrophic (Van Dam et al. 1994); this species is widespread and locally abundant in alkaline, meso- to eutrophic lakes and lake outflows in the lowlands (Bąk et al. 2012); benthic, oligohalobous indifferent, alkaliphilous, mesotraphenthic-oligotraphenthic (Witak & Jankowska 2014); it is understood to be indicative of higher quality lake and stream systems (Kelly et al. 2014); it prefers alkaline, meso- to eutrophic lakes and lake outlets (Cantonati, et al. 2017); reported from weakly alkaline (pH = 8.7) with an electrical conductivity of 236 µS.cm1 (Kulikovskiy et al. 2022); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Recorded common in Jeziorak, Kamionka, Radomno, Młynek Lakes, and frequent abundance in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014).

***Planoplatessa joursacensis* var. *elongatum* Zalat nov.var.**

(Pl. 22, figs. 11-27)

Diagnosis: Valves are elongate-elliptical to linear-lanceolate with broad, obtusely rounded ends. Raphe valve with narrow, linear axial area; central area broad, subrectangular, one or two striae at the margins. Raphe filiform, becoming slightly broader toward the proximal endings that expanded with distinct central pores; the distal ends curving in the same direction over the ends. Transapical striae are radiate throughout the valve, about 16-18 in 10 µm; the centre striae are short, marginal, and irregular in number. Rapheless valve has a linear axial area, interrupted centrally on one side by a horseshoe-shaped clear area. Central area is on one side. Transapical striae are weakly radiate at the centre and strongly radiate throughout the valve, about 13-14 in 10 µm. Length of the valve 15-20 µm, and the breadth 5.5-7.5 µm.

Remarks: This variety differs from the nominate species by having elongate, elliptical outline with broadly convex margins.

Etymology. The epithet of the new variety refers to the elongate shape.

Holotype: the specimens illustrated in plate 22, figures 11-27.

Type locality: Jeziorak Lake.

Occurrence: Recorded common in Jeziorak Lake, frequent in Kamionka and Młynek Lakes.

Distribution in Poland: New record.

***Planoplatessa joursacensis* var. *ovatum* Zalat nov.var.**

(Pl. 23, figs. 1-12)

Diagnosis: Valves are distinctly ovate to elliptic-lanceolate, with broadly rounded upper end and relatively narrower, bluntly rounded lower end. The raphe valve has a narrow, linear-lanceolate axial area. Central area is subrounded or expanded laterally and bounded by 1-3 short striae on either side, which are widely spaced. The raphe is filiform and straight; the proximal raphe endings are expanded with small, distinct central pores, and the distal raphe endings are straight. Transapical striae are finely punctate, distinctly radiate throughout the valve, about 21-24 in 10 µm, curved at the ends, except the central striae are almost subparallel. The rapheless valve has a linear axial area that is relatively wider than on the raphid valve. Central area is present on one side, and a cavum extends to the apical axis. Transapical striae are distinctly radiate throughout the valve, about 15-17 in 10 µm. Length of the valve 13-15 µm, and the breadth 6.0-6.5 µm.

Remarks: This variety differs from the nominate species by having an ovate shape and finer striae on the raphe valve.

Etymology: The epithet of the new variety refers to the ovate shape of the valve.

Holotype: the specimens illustrated in plate 23, figures 1-12.

Type locality: Jeziorak Lake.

Occurrence: Common in the Jeziorak and frequently in Młynek Lake, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

Genus *Planothidium* Round and Bukhtiyarova 1996

Diagnosis: Frustules are heterovalvar, isopolar, bilaterally symmetrical, with slightly concave raphe valve and convex rapheless valve. Valves are elliptical, elliptical-lanceolate or lanceolate, with a shallow mantle, and rounded, rostrate, capitate or apiculate apices. Striae bi- or multiseriate, radiate or subparallel, usually interrupted on one side of the centre in the rapheless valve by a horseshoe-shaped plain area. Axial area is narrow and linear in the raphe valve, sometimes wider in the rapheless valve. Central area is indistinguishable from the axial area, rounded or transversely elongate; central area is asymmetrical on the rapheless valve when the horseshoe-shaped area is present. Raphe is straight, external proximal endings are expanded, internal proximal endings are deflected in opposite directions; external distal raphe endings are deflected to one side.

The genus *Planothidium* was separated from *Achnanthes* Bory based on thick bi- to multiseriate striae interrupted on the rapheless sternum valve (SV) unilaterally and marked by a “hoof-mark” depression (Round & Bukhtiyarova 1996).

Holotype species: *Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot 1999

***Planothidium amphibium* Wetzel, Ector & Pfister 2014**

(Pl. 23, figs. 13-36)

Ref. Wetzel et al. 2014, p. 444, figs 3A-AS & 4A-J; Stancheva et al. 2020, p. 7, figs. 14-38.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear, linear-lanceolate to elliptic-lanceolate with convex margins and capitate to subcapitate, protracted apices. Raphe valve has a very narrow, linear axial area. Central area is asymmetrical, rectangular, bordered by 2-3 clearly shortened striae. Raphe is straight with simple expanded proximal raphe endings; distal raphe endings are unilaterally deflected. Transapical striae are radiate throughout the entire valve, becoming more distinctly radiate near the apices, about 14-16 in 10 µm. Rapheless valve has a narrow, linear-lanceolate axial area, gradually widening towards the valve centre. Central area is a large horseshoe-shaped

on one side, showing a clear, hemicircular depression surrounded by a raised ridge. On the other side, striae shortened, forming hence a small hemicircular central area on this side. Transapical striae are slightly radiate throughout the entire valve, becoming distinctly radiate near the apices, about 13-16 in 10 μm. Length of the valve 11-21 μm, and the breadth 5-6 μm.

Remarks: *Planothidium amphibium* is closely related to *Planothidium haynaldii* by general valve outline but differs from it mainly by having smaller cells. The main difference concerns the valve width. *Planothidium amphibium* is also closely related to *Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot but differs by always having a wide protracted subcapitate to capitate end (Van de Vijver et al. 2013).

Ecological preference: The species is considered as fresh-brackish water, alkaliphilous, moderate oxygen requirements, ά-mesoosaprobic, eutraphentic (Van Dam et al. 1994); subaerial alkaliphilous species, occurring at pH > 7 (Wetzel et al. 2014); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland and Jeziorak Lake.

Distribution in Poland: New record.

***Planothidium bagualensis* Wetzel & Ector 2014**

(Pl. 23, figs. 37-51)

Ref. Wetzel & Ector 2014, p. 203, figs. 2-31.

Status of name: accepted taxonomically.

Diagnosis: Valves are elliptic to elliptical-lanceolate, with bluntly rounded apices. Raphe valve has a narrow, linear axial area, widening near the central part. Central area is large, round to rhombic, formed due to shortening of the central striae. Raphe is straight with expanded, drop-like proximal raphe endings. Distal raphe endings are unilaterally deflected. Transapical striae are slightly radiate throughout the entire valve, about 11-13 in 10 μm. Rapheless valve has a very narrow, straight and linear axial area. Central area is a wide elliptic unilateral area reaching the valve margin. Transapical striae are parallel at the valve centre to weakly radiate towards apices., about 11-13 striae in 10 μm. Length of the valve 15.5-32.5 μm, and the breadth 6.7-9.5 μm.

Ecological preference: *Planothidium bagualensis* has been reported from lotic environments, water temperature is about 19.6 ± 4.8°C, pH of 6.9 ± 0.5; phosphates were around 0.142 mg/l^{-1} and a chemical oxygen demand of around 3.9 mg/l^{-1}. These data suggest a circum-neutral taxon, occurring in a relative broad range of trophic conditions based on phosphate measurements, with an optimum at mesotrophic conditions. (Wetzel & Ector 2014); reported from the shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland and Młynek Lake.

Distribution in Poland: New record.

***Planothidium biporomum* (Hohn & Hellerman) Lange-Bertalot 1999**

(Pl. 24, figs. 1-10)

Ref. Hohn & Hellerman 1963, p. 273, pl. 2, figs. 5-6; Ferrari & Ludwig 2007, p. 433, fig. 41, Blanco et al. 2010, p. 54, pl. 43, figs. 50-64; Wetzel et al. 2013, p. 45, figs. 1-18, 37-50; Kulikovskiy et al. 2016, p. 234, pl. 36, figs. 70-75.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes biporoma* Hohn & Hellerman 1963
Achnanthes lanceolata subsp. *biporoma* (Hohn & Hellerman) Lange-Bertalot 1993
Achnanthidium biporomum (Hohn & Hellerman) Czarnecki 1995
Achnantheiopsis biporoma (Hohn & Hellerman) Lange-Bertalot 1997

Diagnosis: Frustules are rectangular and slightly arched in girdle view, producing a concave raphe valve. Valves are lanceolate with capitate to subcapitate apices. Raphe valve is concave with a narrow, linear-lanceolate axial area widening near the valve centre. Central area is moderate, somewhat rounded to elliptic or transapically rectangular, bordered on each side by shortened striae. Raphe is filiform, straight, somewhat sigmoid at terminal pores with expanded, drop-like proximal raphe endings and unilaterally deflected distal raphe endings. Rapheless valve is convex with narrow, straight, and linear-lanceolate axial area, sometimes slightly expanded in the middle

portion of the valve. Central area is asymmetric, with a unilateral large horseshoe-shaped hyaline expansion and containing a cavum on the internal valve surface. Transapical striae are finely punctate, slightly radiate on both valves, about 13-16 in 10 μm at the central part of the valve opposite to the cavum. Length of the valve 12-25 μm, and the breadth 5.0-7.0 μm

Remarks: This taxon resembles several varieties of *Achnanthes lanceolata* (Brébisson) Grunow. It differs only in that the axial area of the raphe valve is distinctly lanceolate rather than linear, and the terminal raphe pores are sigmoid.

Ecological preference: Freshwater, circumneutral, oligotrophic (Van Dam et al. 1994); the species observed from waters with total hardness higher than 80 mg/l^{-1}. (Lowe & Cody 2002); an alkaline taxon (pH 7.8), occurring in medium conductivity level (157.4 μS cm^{-1}) (Wetzel et al. 2013); oligotrophic, alkaline freshwater reaction (pH 7.6–8.1) and low to relatively high conductivity content (Noga et al. 2016a)

Occurrence: Common in the Eemian palaeolake deposits of central Poland

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a, b); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Planothidium capitatum* (O.Müller) Van de Vijver, Kopalová, Wetzel & Ector 2014**

(Pl. 24, figs. 11-19)

Ref. Hustedt 1933, p. 410, fig. 863 g, h; Wetzel et al. 2014, p. 448, fig. 1: F-G, 7: A-Z.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lanceolata* var. *capitata* O.Müller 1909

Achnanthes lanceolata f. *capitata* (O.Müller) Hustedt 1933

Diagnosis: Valves are linear to linear-lanceolate with convex margins and capitate to subcapitate, protracted obtusely rounded apices. Raphe valve has a narrow linear axial area, almost not widening towards the valve centre. Central area is asymmetrical, rectangular to bow-tie shaped, bordered on one side by 2-3 clearly shortened striae, while striae on the other side are usually entirely lacking. Raphe is straight with simple proximal raphe endings and unilaterally deflected distal raphe endings. Rapheless valve has a narrow linear axial area, weakly but gradually widening towards the valve centre. Central area with a large horseshoe-shaped hyaline area on one side, showing a clear, hemicircular depression surrounded by a raised ridge. On the other side, striae are shortened, forming a small hemicircular central area on this side. Transapical striae are similar on both valves, slightly radiate throughout the entire valve, becoming distinctly radiate near the apices, about 14-15 in 10 μm. Length of the valve 15-22 μm, and the breadth 4.3-5.0 μm.

Ecological preference: Epiphytic, alkaliphilous (Kaczmarska 1976); living in the epilithon and epipelon of larger lakes with a slightly to clearly alkaline pH (7.7-8.9) and low to moderate specific conductance levels (75-250 μS cm-1). (Van de Vijver et al. 2014); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Planothidium cavilanceolatum* Wetzel, Kelly & Van de Vijver 2019**

(Pl. 24, figs. 20-23)

Ref. Wetzel et al. 2019, p. 62, figs. 464-521

Status of name: accepted taxonomically.

Diagnosis: Valves are lanceolate with weakly convex margins and slightly protracted, broadly rounded ends. Raphe valve with a narrow linear axial area. Central area is asymmetrical, rather small bordered by several shortened striae. Raphe fissures are straight with expanded, drop-like proximal raphe endings. Internally, proximal raphe endings deflected in opposite directions. The distal raphe endings are bent, continuing shortly onto the valve mantle. Transapical striae are weakly radiate throughout the valve, about

14-16 in 10 μm. Rapheless valve with a narrow and linear axial area, only very weakly widening towards the central area. Central area with a small unilateral horseshoe–shaped hyaline area with a cavum, transapical striae on the opposite side only rarely shortened. Transapical striae are almost parallel throughout the entire valve, becoming weakly radiate near the ends, about 12-16 in 10 μm. Length of the valve 17-20 μm, and the breadth 5.0-6.0 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Młynek Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Planothidium cryptolanceolatum* Jahn & Abarca 2017**

(Pl. 24, figs. 24-32)

Ref. Jahn & Abarca 2017, p. 100, figs. 59-75

Status of name: accepted taxonomically.

Diagnosis: Valves are elliptical to elliptic-lanceolate and slightly asymmetric, with slightly rostrate and rounded apices. Raphe valve with a narrow, linear axial area. The central area forms an asymmetrical rectangular fascia, with 1-3 short striae on each side. Raphe fissures are externally straight with drop-like proximal raphe endings; internally, they are weakly deflected in opposite directions. Distal raphe endings are strongly unilaterally deflected externally. Transapical striae are radiate throughout the valve, about 13-15 in 10 μm. Rapheless valve with a narrow, linear axial area. The central area is a shallow half-moon shaped sinus on one side, which is bounded on the other side by1-3 shorter striae forming a somewhat small and roundish central area. Transapical striae are radiate throughout, more strongly radiate towards the apices, 13-14 in μm. Length of the valve 14-16 μm, and the breadth 4.0-5.0 μm.

Remarks: Differs from *Planothidium lanceolatum* in its more slender and slightly asymmetric outline; the sinus is less pronounced, and it differs from *P. amphibium* Wetzel, Ector & Pfister in its outline.

Occurrence: Eemian palaeolake deposits of central Poland

Distribution in Poland: New record.

***Planothidium daui* (Foged) Lange-Bertalot 1999**

(Pl. 24, fig. 33)

Ref. Foged 1962, p. 14, pl. 1, fig. 10; Krammer & Lange-Bertalot 1991 b, p. 47, pl. 38, figs. 13-24, 30-32; Lange-Bertalot 1997, p. 206, figs. 18-20; Bąk et al. 2012, p. 281, pl. 25; Morales 2002, p. 34, fig. 11; Stancheva et al. 2020, p. 15, figs. 112-115.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes daui* Foged 1962

Achnantheiopsis daui (Foged) Lange-Bertalot 1997

Diagnosis: Valve is elliptical to broadly lanceolate in outline with inflated central region and distinctly produced or broadly capitate to rostrate ends. Raphe valve has a narrow linear axial area. Central area is developed, somewhat rectangular, with 1 or 2 shortened striae in the central part. Raphe is filiform, straight. Transapical striae are strongly radiate throughout the valve, about 14-16 in 10 μm, with the central striae distinctly shorter than the others. The rapheless valve has a narrow lanceolate axial area without an expanded central area. Transapical striae are almost parallel at the valve centre, becoming slightly radiate towards the apices, about 13-15 in 10 μm. Length of the valve 7-12 μm, and the breadth 3.5-6 μm.

Remarks: In the light microscopy, *Planothidium daui* is morphologically very closely related to *Planothidium granum* (Hohn & Hellerman) Lange-Bertalot, Planothidium *lemmermannii* Hustedt and *Karayevia ploenensis* (Hustedt) Bukhtyarova as many authors have proposed (Krammer & Lange-Bertalot 1991 b; Morales 2002).

Ecological preference: The species prefers oligotrophic and neutral conditions. It is known from the northern Hemisphere, the middle, Northern and Western Europe, North America, and Japan (Krammer and Lange-Bertalot 1991 b). It is considered as circumneutral, fresh-brackish and occurs in oligotrophic, oligosaprobous

waters (Van Dam et al. 1994); seems to be widely distributed throughout the U.S. Big Thompson River was characterized by a conductivity of 668 µS/cm, surface water temperature of 13.5°C, pH of 8.2, orthophosphate concentration was 0.100 mg/L, nitrites and nitrates reached a concentration of 0.I mg/L (Morales 2006).

Occurrence: Eemian palaeolake deposits of central Poland

Distribution in Poland: Found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Planothidium delicatulum* (Kützing) Round & Bukhtiyarova 1996**

(Pl. 24, figs. 34-37)

Ref. Hustedt 1930, p. 202, fig. 293; Hustedt 1933, p. 389, fig. 836; Patrick & Reimer 1966, p. 269, pl. 17, figs. 33-34; Foged 1978, p. 24, pl. 15, figs. 11a,b; Germain 1981, p. 114, pl. 42, figs. 10-15; John 1983, p. 70, pl. 30, figs. 3, 4; Holland & Clark 1989, p. 9, pl. 1, figs. 6-8; Lange-Bertalot & Krammer 1989, p. 44, pl. 80, figs.1-23; pl. 87, figs. 14-23'; pl. 90, figs. 1-2; pl. 90, figs. 5-6; Krammer & Lange-Bertalot 1991 b, p. 70, pl 39, figs. 1-19; pl. 40, figs. 1-13; Vyverman et al. 1995, p. 14, pl. 6, fig. 4; pl. 8, fig. 3; pl. 23, figs. 13-14; Witkowski et al. 2000, p. 118, pl. 46, figs.28-29; pl. 48, figs. 1-2; pl. 48, figs. 39-41; Wojtal 2009, p. 286, pl. 5, figs. 45, 46; Bahls et al. 2018, p. 61, pl. 24, figs. 12, 13; Van de Vijver et al. 2018, p. 201, figs. 1-2, 148-161.

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium delicatulum* Kützing 1844
Falcatella delicatula (Kützing) Rabenhorst 1853
Achnanthes delicatula (Kützing) Grunow 1880.
Microneis delicatula (Kützing) Cleve 1895
Achnantheiopsis delicatula (Kützing) Lange-Bertalot 1997

Diagnosis: Valves are almost elliptical-lanceolate with convex margins and protracted, cuneate–rostrate acutely rounded apices. Raphe valve with narrow axial area, weakly widening towards the valve centre. Central area is small, transversely rectangular, never reaching the margins, bordered by 2-3 shortened striae. Raphe is straight, filiform, with a simple, small, rounded central area of proximal raphe endings, and the distal raphe endings are not indistinct. Transapical striae are distinctly punctate, radiate throughout, more radiate towards the apices, about 13-16 in 10 µm. Rapheless valve with narrow, linear axial area, and without a distinct central area, but often unilaterally expanded due to the shortening of a central stria. Transapical striae are parallel in the middle parts to slightly radiate towards the ends, about 17-19 in 10 µm. Length of the valve 10-22 µm, and the breadth 5-8 µm.

Ecological preference: The species is widespread, epipsammic, mesohalobous, euryhaline; pH circumneutral (Foged 1978); occurring in oligotrophic, fresh and brackish waters rich in electrolytes (Krammer & Lange-Bertalot 1991 b); it is classified as brackish epipsammic and occurred in coastal waters, wetlands (Vos & de Wolf 1993); an alkalibiontic and brackish water species (Van Dam et al. 1994); brackish-freshwater, and halophilous, alkaliphilous eutraphentic and ά-mesosaprobic **(** Van Dam et al. 1994; Bąk et al. 2004); *Achnanthes delicatula* is common and cosmopolitan from brackish to freshwaters with high conductivity. It occurred abundantly as plankton in a shallow eutrophic lake in Portugal (Abrantes et al. 2006). It was recorded in salty and brackish environments with neutral or slightly alkaline conditions (Van de Vijver et al. 2018).

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Distributed in the Wyżyna Krakowsko- Częstochowska Upland. Vistula River (Turoboyski 1962); Pilica River (Kadłubowska 1964 b); spring in Dubie (Skalska 1966 a); reported from the saline springs in Pelczyska near OzorkOw in central Poland (Rakowska 2001); dominant in river mouth areas of the Gulf of Gdańsk and in the coastal zone of the Puck Bay, and the northern and western parts of the Szczecin Lagoon (Bąk et al. 2004); Szczecin Lagoon, south western Baltic Sea, north Poland (Witkowski et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Holocene sediments of the south-west Gulf of Gdańsk, Southern Baltic Sea, north Poland (Witak & Dunder 2007); Kobylanka stream, south Poland. in epipelon below Kobylany village (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Wisłok river and Pielnica stream in the territory of the Podkarpacie

Province, south Poland (Noga et al. 2014 a); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015); the Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Planothidium distinctum* (Messikommer) Lange-Bertalot 1999**

(Pl. 24, figs. 38-39)

Ref. Buczkó et al. 2013, p. 4, figs. 5-17; 19-32.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes distincta* Messikommer 1954

Achnantheiopsis distincta (Messikommer) Lange-Bertalot 1997

Diagnosis: Valves are lanceolate with broadly subprotracted, rounded apices. Raphe valve with a narrow, linear axial area. Central area is small, transversely rectangular asymmetrical. In the central area, 1-3 asymmetrically shortened striae are present. Raphe is straight, filiform; the distal raphe endings turned in opposite directions; the proximal raphe endings are straight, slightly expanded, relatively distant from each other. Internally, they are deflected in opposite directions. Transapical striae are radiate throughout the valve, about 15-16 in 10 μm. Rapheless valves with narrow, linear axial area. Central area is narrow, transversely rectangular, asymmetrical, and of variable size, dependent on the length of 2-3 shortened striae. Transapical striae are radiate throughout the valve, about 12-14 in 10 μm. Length of the valve 14 μm, and the breadth 6.5 μm.

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Planothidium dubium* (Grunow) Round & Bukhtiyarova 1996**

(Pl. 24, figs. 40-53)

Ref. Patrick & Reimer, 1966, p. 271, pl. 18, figs. 11-15; Krammer & Lange-Bertalot 1991 b, p.76, pl. 42, figs. 7-26; Witkowski et al. 2000, p. 85, pl. 51, figs. 34-36; Wojtal 2009, p. 288, pl. 5, figs. 47-52; Kulikovskiy et al. 2016, p. 235, pl. 36, figs. 33-36.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lanceolata* var. *dubia* Grunow in Cleve & Grunow 1880

Achnanthidium lanceolatum var. *dubium* (Grunow) Meister 1912

Microneis lanceolata var. *dubia* (Grunow) Frenguelli 1923

Achnanthes lanceolata f. *dubia* (Grunow) Ko-Bayashi 1965

Achnanthes lanceolata subsp. *dubia* (Grunow) Lange-Bertalot 1993

Achnantheiopsis dubia (Grunow) Lange-Bertalot 1997

Diagnosis: Valves are broadly elliptical to linear-elliptic with protracted, narrowly subcapitate to capitate apices. Raphe valve has a linear axial area and a transversely rectangular central area. Raphe is straight with expanded external proximal endings and indistinct distal raphe endings. The rapheless valve has a narrow, linear axial area, with an asymmetric central area that contains a shallow depression on the internal valve surface. Transapical striae are radiate throughout on both valves, about 13-15 in 10 μm on the raphe valve, and 10-12 in 10 μm on the rapheless valve. Length of the valve 9-20 μm, and the breadth 5-8.5 μm.

Ecological preference: Regarded as widespread, requiring calcium-rich waters of moderate or elevated conductivity (Krammer & Lange-Bertalot 1991 b; Werum & Lange-Bertalot 2004); freshwater, low alkaline of some springs (Żelazna-Wieczorek & Ziułkiewicz 2004); occurrence independent of ecoregions with an optimum in alkaline, eu- to polytrophic streams and small rivers; tolerant to organic pollutants up to critical discharge zone (β-α-mesosapous) (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Młynek Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. Kluczwoda stream (Nawrat 1993); in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004; Ziułkiewicz 2005); dominant in limnocrenic spring- Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); in Kobylanka stream, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south eastern Poland (Noga et al. 2013 c); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b).

***Planothidium ellipticum* (Cleve) Edlund 2001**

(Pl. 25, figs. 1-2)

Ref. Hustedt 1930, p. 208, fig. 306 c; Hustedt 1933, p. 410, fig. 863 n-o; Cleve-Euler 1953, p. 16, fig. 509 a-d; Straub 1985, p. 136, pl. 1, figs. 6-9; pl. 3, figs. 30-32; pl. 8, fig. 108; Krammer & Lange-Bertalot 1991 b, p. 76, pl. 41, figs. 9-10; Hartley et al. 1996, p. 26, pl. 5, fig. 1.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lanceolata* var. *elliptica* Cleve 1891
Achnanthidium lanceolatum var. *ellipticum* (Cleve) Meister 1912
Microneis lanceolata var. *elliptica* (Cleve) P.Schulz 1928
Achnanthes elliptica (Cleve) A.Cleve 1932
Achnanthes lanceolata f. *elliptica* (Cleve) Foged 1978
Planothidium lanceolatum var. *ellipticum* (Cleve) Bukhtiyarova 1999

Diagnosis: Valves are elliptic to elliptical-lanceolate with convex margins and not protracted, broadly rounded ends. The Raphe valve has a very narrow axial area, almost not widening near the valve centre. Central area is asymmetrical, wedge-shaped, or variable, bordered on one side by 1-2 shortened striae, whereas on the other side, striae are lacking. Raphe is filiform, straight with expanded, drop-like proximal raphe endings, and the distal endings curved on the valve face at the apices. Transapical striae are radiate throughout the entire valve. Rapheless has a moderate lanceolate axial area, widening asymmetrically towards the valve centre. Central area showing unilateral, more or less horseshoe-shaped hyaline area with a cavum. Transapical striae are slightly radiate throughout the entire valve, becoming strongly radiate towards the valve ends, about 15-17 in 10 μm at the valve centre, 18-20 in 10 μm at the apices. Length of the valve 10-16 μm and the breadth 5-7 μm.

Ecological preference: Epiphytic, alkaliphilous (Kaczmarska 1976); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, relatively high conductivity (416-764 μSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a)

Occurrence: Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south Poland (Noga et al. 2013 a); Wisłok River and the catchment area including rivers and streams (Lubcza, Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b).

***Planothidium engelbrechtii* (Cholnoky) Round & Bukhtiyarova 1996**

Ref. Cholnoky 1955, p. 16, figs. 1-8; Krammer & Lange-Bertalot 1991 b, p. 72, pl. 39, figs. 24-33; Compère & Van de Vijver 2009, p. 187-188, figs. 1-59; Stancheva et al. 2020, p. 15, figs. 116-147.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes engelbrechtii* Cholnoky 1955
Achnanthes delicatula subsp. *engelbrechtii* (Cholnoky) Lange-Bertalot 1991
Achnantheiopsis engelbrechtii (Cholnoky) Lange-Bertalot 1997

Diagnosis: Valves are lanceolate, linear-lanceolate to elliptic-lanceolate and even rhombic–lanceolate with protracted, subrostrate, broadly rounded apices. Raphe valve has a narrow, linear axial area. Central area is

slightly transapically expanded due to the shortening of the middle striae. Central nodule is markedly present. Raphe is filiform, straight, with expanded straight central raphe endings. The distal raphe endings are indistinct, but with unilaterally deflected terminal fissures. Transapical striae are weak to moderately radiate, becoming more radiate towards the valve apices, about 16–18 in 10 μm. Rapheless valve has a very narrow, linear to linear-lanceolate axial area. Central area is absent or very weakly, asymmetrically enlarged due to the shortening of some striae in the valve centre. Transapical striae are almost parallel to subparallel, becoming slightly radiate towards the valve apices, about 16-18 in 10 μm. Length of the valve 8-19 μm, and the breadth 3.5-5.5 μm.

Ecological preference: alkalibiontic, brackish water species (Van Dam et al. 1994); alkaliphilous, preferring eutrophic conditions, ά or β -mesosaprobic (Witkowski 1994, Stachura-Suchoples 1999, Bąk et al. 2004).

Distribution in Poland: Szczecin Lagoon, north Poland **(**Bąk et al. 2004); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015)**;** the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot 1999**

(Pl. 25, figs. 3-28)

Ref. Foged 1978, p. 26, pl. 15, figs. 4, 5, 7, 8; Germain 1981, p. 115, pl. 44, figs. 1-18; John 1983, p. 73, pl. 31, figs. 13-16; Holland & Clark 1989, p. 9, pl. 1, figs. 9, 10; Krammer & Lange-Bertalot 1991 b, p. 75, pl. 41, figs. 1-25; pl. 42, figs. 1-8; pl. 43, figs. 1-40; pl. 44, figs. 1-38; Lange-Bertalot 1993, p. 4, pl. 44, figs. 1-3, 15; pl. 45, fig. 18; Hodgson et al. 1997, p. 28, pl. 4, figs. 6, 7, 15, 16; pl. 6, fig. 28; Wojtal 2009, p. 288, pl 6, figs. 1-7; pl. 61, figs. 1-5; Bahls et al. 2018, p. 114, pl. 77, figs. 8, 9; Wetzel et al. 2019, p. 58, figs 251-282; 344-353.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lanceolata* subsp. *frequentissima* Lange-Bertalot 1993

Achnantheiopsis frequentissima (Lange-Bertalot) Lange-Bertalot 1997

Diagnosis: Valve is broadly elliptical to elliptical-lanceolate or lanceolate with convex margins and rostrate, protracted, broadly rounded, or occasionally rostrate apices. Raphe valve has a narrow linear, axial area that widens near the valve centre. Central area is rectangular to slightly rounded or butterfly-shaped, bordered on each side by usually 2-3 shortened striae. Raphe is filiform, straight with expanded, drop-like proximal raphe endings, and unilaterally deflected the distal raphe endings. Transapical striae are radiate throughout the entire valve and more radiate towards the ends, about 15-17 in 10 μm. Rapheless valve has a narrow, linear-lanceolate axial area. Central area with a unilateral small horseshoe-shaped hyaline area presenting a cavum. On the opposite side, striae are either not shortened or sometimes slightly shortened, forming a small circular area. Transapical striae are weakly radiate throughout the entire valve, more radiate towards the ends, about 14-16 in 10 μm. Length of the valve 9-30 μm, and the breadth 4-7 μm.

Remarks: This taxon was previously included in the broad concept of *Achnanthes lanceolata* and especially its varieties *A. lanceolata* var. *dubia* Grunow. and *A. lanceolata* var. *rostrata* Hustedt.

Ecological preference: The species occurs in heavily contaminated wastewater biotopes (Lange-Bertalot & Krammer 1989); it is a widespread diatom often reported from calcium-rich waters (Krammer & Lange-Bertalot 1991 b); an alkaliphilous, α-mesopolysaprobous, eurytraphentic and fresh brackish water species (Van Dam et al. 1994); as benthic or periphytic diatoms, the species are most dominant and tolerant to polluted waters (Rakowska 2004); it considered to be tolerant and resistant with respect to organic water pollution (Szczepocka & Szulc 2009); freshwater with pH had an alkaline character or close to circumneutral water (pH 6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 17.5-19.5, Nitrate slightly deviated from the standards (Noga et al. 2013 a, c); in acidic water (4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); eutraphentic and mesotraphentic, indicative of nutrient-rich waters (Witak et al. 2017); it is an eurytopic species that occurs globally in a variety of habitat types, from natural springs to rivers in urban areas with high levels of pollution (Olszyński et al. 2019); in water alkaline (pH 7.8-9.4) (Rybak et al. 2019); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 μS cm^{-1} (Pociecha et al. 2020).

Occurrence: Common in Jeziorak, Kamionka and Młynek Lakes; Eemian palaeolake deposits of central Poland;

Distribution in Poland: The species was dominant in sections of the Rawka River and adjacent to other rivers in central Poland (Rakowska 2004); recorded from spring in Warta River valley (Żelazna-Wieczorek & Mamińska 2006); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała central Poland (Szulc 2007); dominant in limnocrenic spring- Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); dominated in the Pilica River and Bzura River, Central Poland (Szczepocka & Szulc 2009); in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004, Żelazna- Wieczorek & Ziułkiewicz 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); in Kobylanka stream, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park; and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al., 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south eastern Poland (Żelazna-Wieczorek & Knysak 2017); Lake Zabinskie in the Masurian Lake District, north-east Poland (Witak et al. 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); outflow of drainage water in urban areas, Stalowa Wola City, south-east Poland; Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Planothidium frequentissimum* var. *minutum* Zalat & Nitychoruk nov. var.**

(Pl. 25, figs. 29-38)

Diagnosis: Valves are consistently elliptical with obtusely rounded ends. Raphe valve with a very narrow, linear axial area. Central area is small, subrounded or irregular in shape due to shortened central striae on both sides, somewhat indistinct. Raphe is filiform, straight. straight; the proximal raphe endings are expanded, drop-like; the distal raphe endings are unilaterally deflected. Transapical striae are radiate throughout the entire valve, about 14-15 in 10 μm. Rapheless valve has a very narrow, linear axial area. Central area with a unilateral small horseshoe-shaped hyaline area presenting a cavum. On the opposite side, striae are either not shortened or sometimes slightly shortened, forming a small area. Transapical striae are strongly radiate throughout the entire valve, about 14-16 in 10 μm. Length of the valve 6-7 μm, and the breadth 3.5-4.5 μm.

Remarks: This variety differs from the nominate variety by its smaller size and more elliptical outline.

Etymology: The epithet of the new variety refers to its small size.

Holotype: the specimens illustrated in plate 25, figures 29-38.

Type locality: Radomno Lake.

Ecological preference: It is reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments and found associated with the nominate variety.

Occurrence: Common in Radomno Lake; Infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Planothidium granum* (Hohn & Hellerman) Lange-Bertalot 1999**

(Pl. 25, figs. 39-41)

Ref. Hohn & Hellerman 1963, p. 274, pl. 2, figs. 9, 10; Krammer & Lange-Bertalot 1991 b, p. 44, pl. 26, figs. 7-23; Lange-Bertalot 1997, p. 207, figs. 16-17; Morales 2002, p. 31, fig. 1; Kulikovskiy et al. 2016, p. 236, pl. 36, figs. 61-63; Stancheva et al. 2020, p. 15, figs. 108-111.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes grana* Hohn & Hellerman 1963

Achnantheiopsis grana (Hohn & Hellerman) Lange-Bertalot 1999

Diagnosis: Valve is elliptical to rhomboidal in outline with blunt, subrostrate, broadly rounded apices. Raphe valve has a narrow, linear, weakly lanceolate axial area. Central area is more or less developed due to the shortening of two striae in the middle of the valve. Raphe is linear and sinuous with expanded small rounded proximal raphe endings and deflected the distal raphe endings on the valve face at the apices. Transapical striae are slightly to strongly radiate and conspicuous, about 15-17 in 10 μm. Rapheless valve has a narrow, linear axial area with a weakly defined central area, and two striae on one side at the valve centre and more distant than the other ones. Transapical striae are weakly to moderately radiate, about 14-16 in 10 μm. Length of the valve 7-9 μm, and the breadth 3.5-4.2 μm.

Ecological preference: Oligotrophic to mesotrophic, circumneutral to slightly acidic waters with moderate conductivity (Krammer & Lange-Bertalot 1991 b); freshwater, acidophilous, high oxygen requirements, oligosaprobous, oligo-mesotrophic (Van Dam et al. 1994); in all alkaline standing and flowing waters in the lowlands with medium and higher trophies (Bąk et al. 2012); alkaline water bodies with medium or high trophic value (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Gulf of Gdańsk, the Baltic Sea, north Poland (Lésniewska & Witak 2011).

***Planothidium grimmei* (Krasske) Bishop & Spaulding 2018**

(Pl. 25, fig. 42)

Ref. Krasske 1925, p. 30, pl.1, fig. 10; Patrick & Reimer 1966, p. 274, pl. 18, figs. 22-23; Wojtal 2013, p. 83; Bishop & Spaulding 2018, p. 272, figs. 128-132, 305.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes grimmei* Krasske 1925

Crenotia grimmei (Krasske) Wojtal 2013

Diagnosis: Valve is linear to elliptical lanceolate with slightly protracted, capitate, obtusely rounded ends. Raphe valve with a narrow lanceolate axial area. Central area is small and rectangular, extending laterally to the margin. Raphe fissures are filiform, straight, and positioned in the middle of the valve; somewhat indistinct. Transapical striae are fine, slightly radiate entire the valve, about 20-22 in 10 μm. Rapheless valve with a narrow lanceolate axial area. Central area is indistinct, sometimes as on the raphe valve. Transapical striae are slightly radiate throughout the valve, about 18-20 in 10 μm at the centre, becoming about 35 in 10 μm at the ends. Length of the valve 13 μm, and the breadth 3.5 μm.

Ecological preference: It is reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Reported from spring waters from various geological formations in southern Poland (Wojtal 2013)

***Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot 1999**

(Pl. 26, figs. 1-19)

Ref. Hustedt 1930, p. 207, fig. 306 a; Patrick & Reimer 1966, p. 269, pl. 18, figs 1-10; Foged 1978, p. 26, pl. 15, figs. 4, 5, 7, 8; Germain 1981, p. 115, pl. 44, figs 1-18; Foged 1981, p. 49, pl. 12, figs. 11-12, 23-24; John 1983, p. 73, pl. 31, figs. 13-16; Laws, 1988, p.153, pl. 17, fig. 20; pl. 25, figs. 8,9; Lange-Bertalot & Krammer, 1989, p. 83, pl. 84, figs. 1-16; Krammer & Lange-Bertalot 1991 b, p. 75, pl 41, figs. 1-25; pl. 42, fig. 1-8; pl. 43, figs. 1-40; pl. 44, figs. 1-38; Hodgson et al. 1997, p. 28, pl. 4, figs. 6, 7, 15, 16; pl. 6, fig. 28; Wojtal 2009, p. 288, pl 6, figs. 8-18; pl. 58, figs. 6-8; pl. 59, figs. 1-6; pl. 60, figs. 1-8; Hofmann et al. 2011, p. 510, pl. 24, figs. 41-47; Stancheva et al. 2020, p. 5, figs. 1, 2, 5, 6, 9, 10.

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium lanceolatum* Brébisson *ex* Kützing 1846
Achnanthes lanceolata (Brébisson *ex* Kützing) Grunow 1880
Microneis lanceolata (Brébisson *in* Kützing) Frenguelli 1923
Achnantheiopsis lanceolata (Brébisson *ex* Kützing) Lange-Bertalot 1997

Diagnosis: Valve is elliptical to elliptical-lanceolate or narrowly rhombic-lanceolate in outline with broadly rounded or subrostrate, somewhat subcapitate apices. Raphe valve has a very narrow, linear to slightly lanceolate axial area, which widens near the valve centre. Central area forming a rectangular to bow-tie shaped fascia, on one side bordered by 1-3 shortened striae. Raphe is filiform, straight with expanded, drop-like proximal raphe endings, and unilaterally deflected the distal raphe endings. Transapical striae are slightly radiate entire the valve, becoming distinctly radiate towards the apices, about 12-15 in 10 μm. Rapheless valve has a narrow-lanceolate axial area, gradually widening from the apices towards the valve centre. Central area with a large horseshoe-shaped hyaline area on one side of the centre and 1-3 slightly shortened striae forming a small circular area on the other side. Transapical striae are almost parallel to weakly radiate in the valve centre, becoming more radiate towards the apices, about 12-14 in 10 μm. Length of the valve 10-34 μm, and the breadth 4.5-8.5 μm.

Remarks: The horseshoe-shaped hyaline marking on the rapheless valve is a distinguishing feature of the species.

Ecological preference: cosmopolitan freshwater, salinity indifferent, pH: alkaliphilous, widely distributed cosmopolitan species, eurytopic, euryzonal and crenophilous (Foged 1957); epipsammic, epiphytic, oligohalobous (indifferent), alkaliphilous (Foged 1978); prefers calcium-rich waters with average to high electrolyte concentration (Krammer & Lange-Bertalot 1991 b); an alkaliphilous, α-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); Tychoplanktonic, mesosaprobous and eutraphentic species (Denys 1991; Hofmann 1994); *Achnanthes lanceolate* prefers well-aerated flowing, neutral to alkaline and hard waters, but not as common in nutrient-rich water. This species is widespread and common all over the world, occurring abundantly as plankton in a shallow eutrophic lake in Portugal (Abrantes et al. 2006); Circumneutral to alkaline water, electrolyte-poor to rich, oligotrophic to eutrophic waters, up to the β-mesosaporobic. However, it does not occur in acidic waters (Bąk et al. 2012); cosmopolitan diatom species, very commonly occurring in Central Europe, preferring waters with a high content of calcium and pH had an alkaline character 7.1-8.3, relatively high conductivity (416-764 μSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a, b); Benthic, oligohalobous indifferent, alkaliphilous, eutraphentic-mesotraphentic, α-mesosaprobous (Witak & Jankowska 2014); in acidic water (pH 4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); freshwater of an alkaline character or close to circumneutral reaction (6.5–8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 a, c); water alkaline (pH 7.8-9.4) (Rybak et al. 2019); It is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 μS cm^{-1} (Pociecha et al. 2020).

Occurrence: Common in the Eemian palaeolake deposits of central Poland; 17-19; frequent in Radomno, Jeziorak, Kamionka and Młynek Lakes.

Distribution in Poland: Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Pilica River (Cabejszek 1951; Kadłubowska 1964a, b); the Wyżyna Krakowskoczęstochowska Upland. Vistula River (Turoboyski 1962; Kyselowa & Kysela 1966); Sanka stream (Kądziołka 1963; Hojda 1971); Prądnik River (Stępień 1963); spring of Szklarka stream (Skalska 1966 a, b); ponds near Krakow (Hanak-Szmagier 1967); springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Biała Przemsza River (Wasylik 1985); Kluczwoda stream (Nawrat 1993); Archeological excavation in the early medieval of Wolin, north-west Poland (Latałowa et al. 1995); Szczecin Lagoon, north Poland (Bąk et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); freshwater, low alkaline of some springs located in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała central Poland (Szulc 2007); Dominant in limnocrenic spring-Piękne Spring vicinity of Łódź in the Moszczenica

River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.); south-east Poland (Noga et al., 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk-Gdynia south-western region, north Poland (Witak & Jankowska 2014); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, and the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Bieszczady National Park, south-east Poland (Noga 2019); outflow of drainage water in urban areas, Stalowa Wola City, south-east Poland (Rybak et al. 2019); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Planothidium lilianeanum* Van de Vijver 2018**

(Pl. 26, figs. 20-23)

Ref. Van de Vijver 2018, p. 203, figs. 29-46

Status of name: accepted taxonomically.

Diagnosis: Valves elliptic to elliptic–lanceolate with cuneately protracted, rostrate apices. Raphe valve has a very narrow, linear axial area, only slightly widening towards the central area. Central area is rounded to rectangular, bordered by several irregularly shortened striae. Raphe fissures are straight, filiform. Proximal raphe endings are simple to weakly enlarged; the distal raphe endings are not discernible in LM. Transapical striae radiate throughout the entire valve, more radiate near the apices, about 16-18 in 10 µm. Rapheless valve with a moderately broad axial area, distinctly lanceolate, widening near the central area. Central area is absent to asymmetrical, and weakly widened. Transapical striae are slightly radiate to almost parallel, equidistant, about 16-18 in 10 µm. Length of the valve 14-16 µm, and the breadth 5.0-6.0 µm.

Ecological preference: The largest populations were found living on wet mosses on the shore of the lake. PH of the water dripping through and over the mosses varied around 7.3 with a conductivity of 230 $\mu S.cm^{-1}$ (Van de Vijver 2018); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake

Distribution in Poland: New record.

***Planothidium pericavum* (Carter) Lange-Bertalot 1999**

Ref. Carter 1966, p. 447, pl. 1, figs. 5-8; Lange-Bertalot & Krammer 1989, p. 162, pl. 79, figs. 40-44'; Krammer & Lange-Bertalot 1991 b, p. 73, pl. 40, figs. 14-20; Żelazna-Wieczorek et al. 2015, p. 55, fig. 9 F1-F6.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes pericava* Carter 1966

Achnantheiopsis pericava (Carter) Lange-Bertalot 1997

Diagnosis: Valves are lanceolate to elliptic–lanceolate with broadly protracted to slightly rostrate apices. Raphe valve has a narrow linear axial area, widening abruptly at the valve centre. Central area is large, slightly unilaterally expanded due to the shortening of 1-3 central striae. Raphe is straight, filiform, with expanded, drop-like proximal raphe endings, and unilaterally deflected the distal raphe endings on the valve face at the apices. Transapical striae are subparallel to slightly radiate entire the valve, becoming more radiate towards the apices, about 12-15 in 10 μm. Rapheless valve has a narrow linear to linear-lanceolate axial area. Central area is weakly enlarged, subrounded, or unilaterally expanded due to the shortening of a central stria. Transapical striae are slightly radiate to almost parallel entire the valve, about 13-15 in 10 μm. Length of the valve 12-20 μm, and the breadth 3-4 μm.

Ecological preference: *Planothidium pericavum* forms important populations on several islands in the southern hemisphere, but it also seems present in the northern hemisphere. It is reported from saline brackish water habitats of alkaline character with pH 6.4-7.99 (Żelazna-Wieczorek et al. 2015).

Distribution in Poland: found in Górki Zachodnie – Vistula River estuary in North Poland (Majewska et al. 2012); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015).

***Planothidium reichardtii* Lange-Bertalot & Werum 2004**

(Pl. 26, figs. 24-27)

Ref. Werum & Lange-Bertalot 2004 p. 172, pl 15, figs. 9-18; pl. 16, figs. 1-5; Wojtal 2009, p. 290, pl. 5, figs. 53-59; pl. 61, figs. 6-9; pl. 62, figs. 1, 2; Kulikovskiy et al. 2016, p. 237, pl. 36, figs. 47-51.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-elliptic to elliptic-lanceolate with protracted rostrate to narrow subcapitate or capitate apices. Raphe valve has a narrow, linear axial area, widening slightly towards the valve centre. Central area is asymmetric, transversely rectangular and forms an acute-angled fascia on one side, a rounded area bordered by 2-3 shortened striae on the opposite side. Raphe is filiform, straight, with expanded external proximal endings and indistinct distal endings. Rapheless valve has a narrow, linear axial area. Central area is asymmetric with a sinus and contains a shallow depression on the internal valve surface. Transapical striae are radiate throughout both valves, about 13-15 in 10 μm. Length of the valve 9-20 μm, and the breadth 4-8.5 μm.

Ecological preference: Cosmopolitan, known from calcium-rich waters of a broad trophic range (Werum & Lange-Bertalot 2004); in eutrophic and mesotrophic alkaline water bodies (Kulikovskiy et al. 2016); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland, common in springs (Wojtal 2006); Kobylanka stream, south Poland (Wojtal 2009).

***Planothidium rostratum* (Østrup) Lange-Bertalot 1999**

(Pl. 26, figs. 28-47; pl. 27, figs. 1-10)

Ref. Hustedt 1930, p. 208, fig. 306 b; Hustedt, 1933, p. 410, fig. 863 i-m; Patrick & Reimer 1966, p. 269, pl. 17, figs. 33-34; Germain 1981, p. 116, pl. 44, figs. 11-16; John 1983, p. 71, pl. 30, figs. 7-10; Simonsen 1987, p. 20, pl. 4, figs. 6-7; Laws 1988, p. 153, pl. 17, figs. 11-13, 15; Krammer & Lange-Bertalot 1991 b, p. 77, pl. 43, figs. 1-14; Ehrlich 1995, p. 53, pl. 9, figs. 11-13; Bąk et al. 2012, p. 286, pl. 25; Wetzel et al. 2019, p. 51, figs. 11-61, 109-119.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes rostrata* Østrup 1902
Achnanthes lanceolata var. *rostrata* Schulz 1926
Microneis lanceolata var. *rostrata* (Østrup) Schulz 1928
Achnanthidium rostrata (Østrup) Mills 1933
Achnanthes lanceolata f. *rostrata* (Østrup) Hustedt 1957
Achnanthes lanceolata ssp. *rostrata* (Østrup) Lange-Bertalot 1991
Achnantheiopsis rostrata (Østrup) Lange-Bertalot 1997

Diagnosis: Valves are broadly elliptical with protracted, distinct rostrate apices. Raphe valve has a narrow, linear axial area, widening slightly towards the valve centre. Central area is rectangular to slightly rounded, bordered on each side by usually two shortened striae. Fascia absent. Raphe is filiform, straight with expanded, drop–like proximal raphe endings, and unilaterally deflected distal raphe endings. Transapical striae are radiate throughout the entire valve, about 10-14 in 10 µm. Rapheless valves have a narrow, straight, linear axial area. Central area is a unilateral, large horseshoe-horseshoe-shaped hyaline area with a visible cavum. On the opposite side, striae never shortened, always reaching the axial area. Transapical striae are slightly radiate throughout the entire valve, about 12-14 in 10 µm at the central part of the valve opposite to the cavum. Length of the valve 6.0-15.0 µm, and the breadth 4.0-7.0 µm.

Remarks: *Planothidium rostratum* or *Achnanthes lanceolata* var. *rostrata* have a very similar morphology and look similar to the variety *dubia*. However, variety *dubia* is easily distinguished as it lacks a hooded cavity and double horseshoe print (Lowe & Cody 2002).

Ecological preference: Cosmopolitan, salinity indifferent, pH: alkaliphilous (Foged 1957); Fresh-brackish water, alkaliphilous, moderate oxygen requirements, ά-mesoosaprobic, eutraphentic (Van Dam et al. 1994); it considered to be tolerant and resistant concerning organic water pollution (Szczepocka & Szulc 2009); in all alkaline flowing waters and lakes, the optimum occurrence is found in lowland waters, in which the species occurs in mesotrophic to eutrophic conditions (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Eemian palaeolake deposits of central Poland; frequent in Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Dominant in limnocrenic spring- Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała central Poland (Szulc 2007); Dominated in the Bzura River- Central Poland (Szczepocka & Szulc 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); in springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Swibno-Vistula River estuary in North Poland (Majewska et al. 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Stobnica, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village in south-eastern Poland (Szczepocka & Rakowska 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-eastern Poland (Noga et al. 2016 a); Gulf of Gdánsk and surrounding waters (the southern Baltic Sea) (Plinski & Witkowski 2020).

***Planothidium septentrionalis* (Østrup) Round & Bukhtiyarova 1996**

Ref. Østrup 1910, p. 215, figs. 13-21; Lange-Bertalot & Krammer 1989, p. 46, pl. 80, figs. 24-31; pl. 82, figs. 1-24; pl. 90, figs. 3-4; Krammer & Lange-Bertalot 1991 b, p. 71, pl. 39, figs. 15-19; Lange-Bertalot & Metzeltin 1996, p. 150, pl. 16, figs. 25-30; Witkowski et al. 2000, p. 124, pl. 46, figs. 20-22; Kobayasi et al. 2006, p. 133, pl. 168, figs. 1-12.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes septentrionalis* Østrup 1910
Achnanthes schwabei Krasske 1939
Achnantheiopsis septentrionalis (Østrup) Lange-Bertalot 1997

Diagnosis: Valves are broadly lanceolate, broadly elliptical to rhombic-lanceolate with wedge-shaped and not protracted or drawn-out, subrostrate, acutely rounded apices. Raphe valve with narrow, linear axial area. Central area is small, transversely rectangular, never reaching the margins, bordered by 2-3 shortened

striae. Raphe is straight, filiform with simple, small rounded proximal raphe endings, and the distal raphe endings are indistinct. Transapical striae are distinctly punctate, radiate throughout, more radiate towards the apices, about 12-16 in 10 μm. Rapheless valve with narrow, linear axial area, and without a distinct central area, but often unilaterally expanded due to the shortening of a central stria. Transapical striae are very coarse, parallel in the middle parts to slightly radiate towards the ends, about 10-13 in 10 μm. Length of the valve 6-19 μm, and the breadth 4-7 μm.

Ecological preference: *Achnanthes delicatula* ssp. *septentrionalis* is cosmopolitan in brackish waters and coastal areas (Krammer & Lange-Bertalot 1991 b); alkalibiontic, brackish (Van Dam et al. 1994); cosmopolitan, marine and brackish water species, epipsammic, found in the fine sand (Ribeiro 2010).

Distribution in Poland: Recorded from Górki Zachodnie – Vistula River estuary, north Poland (Majewska et al. 2012)**;** Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Planothidium taeansa* Jahn & Abarca 2017**

(Pl. 27, figs. 11-17)

Ref. Jahn et al. 2017, p. 100, figs. 172-191.

Status of name: accepted taxonomically.

Diagnosis: Valves are broad, elliptic to elliptic-lanceolate with rostrate, narrowly rounded apices. Raphe valve has a narrow and linear axial area. Central area forms a roundish to rectangular fascia, with 2–3 more or less shorter, irregularly spaced striae on each side. The raphe fissures are externally straight with drop-like proximal raphe endings; internally, they are weakly deflected to opposite sides. The distal raphe endings are strongly unilaterally deflected externally, internally terminating in small helictoglossae. Transapical striae are multiseriate, slightly radiate at the valve centre, and more radiate towards the apices, about 12-13 in 10 μm. Rapheless valve has a narrow and linear axial area. Central area has a slightly rimmed, more or less half-moon-shaped sinus on one side, which is bordered by 1-2 (3) slightly shortened striae on the other side to form a roundish area. Transapical striae are multiseriate striae, composed of several rows of small, round areolae. Striae about 13-14 in 10 μm. Length of the valve 18-19 μm, and the breadth 6-7 μm.

Remarks: This taxon differs from *Planothidium lanceolatum* (Van de Vijver et al. 2013) and *Planothidium cryptolanceolatum* by its broad elliptic outline with rostrate, narrowly rounded apices.

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Planothidium victori* Novis, Braidwood & Kilroy 2012**

(Pl. 27, figs. 18-25)

Ref. Straub 1985, p. 139, pl. 10, fig. 142; pl. 11, fig. 142b; Novis et al. 2012, p. 22, figs. 26-41, 161; Jahn et al. 2017, p. 101; Wetzel et al. 2019, p. 59, figs. 283–343; 354-361.

Status of name: accepted taxonomically

Synonym: *Achnanthes rostrata* var. *magna* Straub in Straub 1985

Planothidium caputium Zimmermann & Jahn 2014

Diagnosis: Valves are lanceolate to weakly elliptic-lanceolate with convex margins and rostrate, protracted apices. Raphe valve has a narrow, linear axial area that widens near the central area. Central area rectangular to slightly rounded, usually bordered on each side by two, occasionally three, shortened striae. Raphe fissures are straight with expanded, drop-like proximal raphe endings. The distal raphe endings are unilaterally deflected and continue shortly onto the valve mantle. Transapical striae radiate throughout the entire valve, 14-16 in 10 μm. Rapheless valve has a narrow, linear axial area. Central area with a unilateral small horseshoe-shaped hyaline area with a cavum. On the opposite side, striae are either not shortened or sometimes slightly shortened, forming a small circular central area. Transapical striae are weakly radiate throughout the entire valve, about 14-16 in 10 μm. Length of the valve 8-10 μm, and the breadth 4.0-4.5 μm.

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

Genus *Platessa* Lange-Bertalot 2004

Diagnosis: Frustules are heterovalvar; one valve possesses a raphe, and the other valve lacks a raphe. Valves are elliptic, linear-elliptic or elliptic-lanceolate. Both of the valve faces are nearly flat, in contrast to other monoraphids that have convex and concave valve faces. Transapical striae are mostly biseriate, but in some species, the raphe valve face may be uniseriate. Terminal raphe fissures are absent. Instead, the raphe ends with distinct terminal pores. Platessa lacks terminal deflections or hooks.

Holot**ype species**: *Platessa bavarica* Lange-Bertalot & Hofmann 2004

***Platessa conspicua* (A. Mayer) Lange-Bertalot 2004**

(Pl. 27, figs. 26-55; pl. 28, figs. 1-7)

Ref. Hustedt 1930, p. 202, fig. 291; Hustedt 1933, p. 387, fig. 833 a-d; Germain 1981, p. 112; pl. 42, figs. 1-2; Krammer & Lange-Bertalot 1991 b, p. 28, pl. 16, figs. 22-33; Ehrlich 1995, p. 50, pl. 9, fig. 22; Hartley et al., 1996, p. 20, pl.2, fig. 11; Morales 2006, p. 327, figs 1-25, 67-72; Wojtal 2009, p. 286, pl. 5, figs. 34, 35; Bahls et al. 2018, p. 40, pl. 3, figs. 8-9.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes conspicua* A. Mayer 1919

Planothidium conspicuum (A. Mayer) Aboal 2003

Diagnosis: Valves are isopolar, bilaterally symmetrical, elliptic to linear-elliptical with not protracted, broadly rounded apices. Raphe valve has a narrow, linear axial area and a transversely rectangular central area that reaches both valve margins. Raphe is filiform, straight, with slightly expanded proximal and distal endings, without terminal fissures. Internally, proximal raphe endings are deflected in opposite directions. Rapheless valve has a narrow or moderately wide lanceolate axial area. Central area is inconspicuous or lacking. Transapical striae of both valves are almost parallel in the valve centre, but become strongly radiate towards the apices, biseriate, about 12-16 in 10 µm. Length of the valve 7-18 µm, and the breadth 3.5-6 µm.

Ecological preference: salinity indifferent (halophilous), pH: alkaliphilous, littoral form in lakes, Europe (Foged 1957); wide range of trophic states, preferring waters with moderate and higher conductivity (Krammer & Lange-Bertalot 1991 b), tychoplanktonic (Denys 1991); a neutrophilous, oligosaprobous, eutraphentic and freshwater species (Van Dam et al. 1994); freshwater, reported from low alkaline of some springs (Żelazna- Wieczorek & Ziułkiewicz 2004); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c).

Occurrence: Common in the Eemian palaeolake deposits of central Poland; frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: the Wyżyna Krakowsko- Częstochowska Upland. Sanka stream (Kądziołka 1963); Prądnik River (Stępień 1963; Dratnal 1977); spring of Szklarka stream (Skalska 1966 a); springs of Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna- Wieczorek & Ziułkiewicz 2004); Kobylanka stream, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); in springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.) , south-east Poland (Noga et al. 2013 c); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Różanka, Pielnica, Stobnica, Mleczka, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a).

***Platessa conspicua* var. *minuta* Zalat & Nitychoruk nov. var.**

(Pl. 28, figs. 8-14)

Diagnosis: Valves are isopolar, elliptic, with not protracted, bluntly rounded apices. Raphe valve has a narrow, linear axial area. Central area is a narrow, transversely rectangular area that reaches both valve margins. Raphe is filiform, straight. The proximal raphe endings are slightly expanded, and the distal raphe endings are without terminal fissures. Transapical striae are almost parallel at the valve centre, and slightly radiate towards the ends, about 17-20 in 10 μm. Rapheless valve has a moderately wide lanceolate axial area. Central area is indistinct. Transapical striae are biseriate, almost parallel in the valve centre, but become radiate towards the apices, about 16-18 in 10 μm. Length of the valve 7-9 μm, and the breadth 3.5-4 μm.

Remarks: This variety differs from the nominate species by its smaller size and elliptical shape.

Etymology. The epithet of the new variety refers to its smaller size.

Holotype: the specimens illustrated in plate 28, figures 8-14.

Type locality: Młynek Lake.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: New record.

***Platessa guianensis* Le Cohu, Tudesque & Wetzel 2016**

(Pl. 28, figs. 15-23)

Ref. Tudesque et al. 2016, p. 240, figs. 2-71.

Status of name: accepted taxonomically.

Diagnosis: Valves are elliptic with broadly rounded apices. Raphe valve has a very narrow axial area, almost non-discernible. Central area is transapically expanded and bordered by several alternately longer and shorter striae. Transapical striae are more irregularly spaced in the central area, radiate throughout the valve, about 15-17 in 10 μm. Raphe is filiform, straight; the proximal raphe endings are expanded with small central pores that internally deflected in the opposite direction; the distal raphe endings are located in a cone-shaped depression bordered by a shallow groove and slightly curved to opposite sides. Rapheless valve has a wide rhomboidal to elliptical axial area with numerous dots. Transapical striae are short, parallel in the centre and becoming radiate to the apices, about 11-13 in 10 μm. On both valves, striae biseriate are composed of offset areolae relative to each other. Length of the valve 9.0-16 μm, and the breadth 6.5-9 μm.

Ecological preference: oligotrophic and oligosaprobic (Tudesque et al. 2016).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Platessa holsatica* (Hustedt) Lange-Bertalot 2004**

Ref. Hustedt 1936, p. 407, figs. 67-72; Hustedt 1950, p. 344, pl. 35, figs. 1-6; Simonsen 1987, p. 204, pl. 315, figs. 13-22.

Status of name: accepted taxonomically.

Synonym: *Achnanthes holsatica* Hustedt 1936

Diagnosis: Valves are broadly elliptical to elliptic-lanceolate with broadly rounded ends. Raphe valve has a narrow axial area, gradually widening towards the valve centre. Central area is a transversely small elliptical or unilateral rectangular due to shortening of two central striae. The raphe is filiform, straight, with slightly expanded proximal and distal endings, and lacks terminal fissures. Transapical striae are strongly radiate throughout the valve, about 18-20 in 10 μm. Rapheless valve has a very wide elliptical to lanceolate axial area and no distinct central area. Transapical striae are radiate, short and marginal, about 16-18 in 10 μm. Length of the valve 8.5-9 μm, and the breadth 5-5.5 μm.

Ecological preference: meso- to eutraphentic (Van Dam et al. 1994); oligotrophic, alkaline freshwater reaction (pH 7.6-8.1) and low to relatively high conductivity content (Noga et al. 2016a)

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a).

***Platessa lutheri* (Hustedt) Potapova 2012**

Ref. Hustedt 1933, p. 405, fig. 858; Hartley et al. 1996, p. 26, pl. 5, fig.13; Potapova 2012, p. 33, figs. 45-58.

Status of name: accepted taxonomically.

Synonym: *Achnanthes lutheri* Hustedt 1933

Diagnosis: Valves are elliptic, with broadly rounded apices. Raphe valve has a narrow linear axial area and a wide, bow-tie-shaped central area. The raphe is straight, filiform, without terminal fissures, and with external distal endings slightly expanded into drop-like pores. The external proximal raphe endings are straight and sited within a shallow groove. There are helictoglossae at the internal distal raphe ends. Transapical striae are uniseriate, and strongly radiate, about 26-29 in10µm. Rapheless valve has a very wide lanceolate axial area. Transapical striae are biseriate, short and distant, about 12-16 in 10 µm. Length of the valve 8-17 µm, and the breadth 4.5-7 µm.

Ecological preference: freshwater species, acidophilous, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); oligotrophic circumneutral waters and aerial habitats of Europe and North America (Krammer & Lange-Bertalot 2004); rarely in stagnant waters in the lowlands, an aerophilic species, numerous occurs in sites with variable humidity (Bąk et al. 2012).

Distribution in Poland: the species is rarely reported from Poland (Bąk et al. 2012)

***Platessa montana* (Krasske) Lange-Bertalot 2004**

Ref. Krasske 1929, p. 350, fig. 8a-b; Hustedt 1930, p. 204, fig. 303; Hustedt 1933, p. 398, fig. 847; Lange-Bertalot & Krammer 1989, pl. 29, figs. 10-21; pl. 30, fig. 6; pl. 31, fig. 2; Krammer & Lange-Bertalot 1991 b, p. 31, pl. 17, figs. 22-34; Hartley et al. 1996, p. 28, pl. 6, fig. 7; Lange-Bertalot & Metzeltin 1996, p. 34, pl. 5, figs. 22-30; Buczkó 2016, p. 25, pl. 85, figs. 18-19; Noga et al. 2016 b, tab. 2 , fig. 2s; Rybak et al. 2017, p. 349, pl. 2,figs. 23-28; pl. 3, figs. H-I.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes montana* Krasske 1929

Psammothidium montanum (Krasske) Mayama 2002

Diagnosis: Valves are small, broadly elliptical to almost rhombic-elliptical with more or less bluntly rounded apices. Raphe valve with a narrow axial area, widening gradually towards the valve centre. Central area is transversely expanded, rounded-rectangular, reaching close to the valve margins. Raphe is straight, filiform, with slightly expanded proximal and distal endings, and lacks terminal fissures. Transapical striae are markedly radiate throughout the valve, about 18-20 in 10 µm. Rapheless valve with broad lanceolate axial area, without a distinct central area. Transapical striae are short, marginal, radiating markedly throughout the valve, about 15-17 in 10 µm. Length of the valve 9-14 µm, and the breadth 5-7 µm.

Ecological preference: a relatively rare species in Central Europe, optimum occurrence in oligotrophic habitats with variable humidity, on the bedrock, also on limestone and peat bogs (Krammer & Lange-Bertalot 1991 b); Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); in slightly acidic and oxygen-rich waters, low content of electrolytes, calcium and nitrates (Wojtal 2013); recorded from alkaline, most frequently close to a pH level of 8, and in water was highly saturated in oxygen and was characterized by low or average values of electrolytic conductivity (Noga et al. 2016 b).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Rarely reported from Polish, from the Słonka stream near Rabki (Tarnowska 1970); from the Suwałki Lake District (Zakryś 1980); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al., 2016); in the Wołosatka stream and its tributary and in the Wołosaty stream, recorded in material collected from stones, mosses and silt in the Bieszczady Mountains streams, south Poland (Rybak et al. 2017); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Platessa oblongella* (Østrup) Wetzel, Lange-Bertalot & Ector 2017**

Ref. Foged 1978, p. 29, pl. 14, figs. 13-17; John 1983, p. 74, pl. 32, figs. 5-8; Holland & Clark 1989, p. 9, pl. 1, fig. 12; Lange-Bertalot & Krammer 1989, p. 111, pl. 33, figs. 1-26; pl. 34, figs.1-7; Krammer & Lange-Bertalot 1991 b, p. 29, pl. 16, figs. 1-14; Vyverman et al. 1995, p. 18, pl. 22, fig. 7; Hodgson et al. 1997, p. 31, pl. 4, fig. 1; Wetzel et al. 2017, p. 213, figs. 2-20, 33-71, 97-102, 109, 111-119.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes oblongella* Østrup 1902
Psammothidium oblongellum (Østrup) Van de Vijver 2002
Karayevia oblongella (Østrup) Aboal 2003
Cocconeis kerguelenensis Manguin 1955

Diagnosis: Valve is elliptical-lanceolate to linear-elliptical in outline with broadly rounded ends. The raphe valve has a narrow linear axial area and a transversely rectangular or bow tie-shaped central area with a few short striae at the margin. Raphe is straight, filiform, without terminal fissures. The proximal and distal raphe ends are slightly expanded. The proximal raphe ends curve toward opposite sides internally. Transapical striae are slightly radiate in the valve centre and strongly radiate and curved at apices, 24-30 in 10 µm. Rapheless valve has a linear to broadly linear or lanceolate axial area. The central area is usually not differentiated from the axial area, but sometimes two middle striae on one side of the valve are more distant from each other than other striae. Transapical striae are broader than those on the raphe valve, punctate, parallel in the centre and radiate at apices, about 10-14 in 10 µm. Shortened marginal striae are often present. Length of the valve 6-18 µm, and the breadth 4-7 µm.

Ecological preference: *Achnanthes oblongella* is commonly distributed in the mountain and alpine streams worldwide, and prefers oligotrophic, circumneutral and low conductivity waters (Krammer & Lange-Bertalot 1991 b); Fresh-brackish water, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); this species preferred relatively low conductivity and more acidic conditions than periphyton in small lowland rivers in the northern central region of Portugal (De Almeida & Gil 2001).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: found in Górki Zachodnie and Swibno-Vistula River estuary, North Poland (Majewska et al. 2012); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); as *Psammothidium oblongellum* from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011), the Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Platessa stewartii* (Patrick) Potapova 2012**

(Pl. 28, figs. 24-29)

Ref. Patrick 1945, p. 169, pl. 2, figs. 1-3; Krammer & Lange-Bertalot 2004, p. 437; Potapova 2012, p. 38, figs. 72-83.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes stewartii* Patrick 1945
Planothidium stewartii (Patrick) Lange-Bertalot 2004

Diagnosis: Valves are elliptic with bluntly rounded apices. Raphe valve has a linear axial area. Central area is transapically narrow and rectangular, often reaching the valve margin. The raphe is straight, filiform and lacks terminal fissures. Proximal external raphe endings are expanded and sharply turned to one side. Distal external raphe endings are slightly expanded and straight. Rapheless valve has a narrow axial area. Central area is small and often asymmetric. On both valves, the transapical striae are biseriate and slightly radiate, about 14-16 in 10 µm. Length of the valve 10-13 µm, and the breadth 5.0-6.5 µm.

Ecological preference: *Platessa stewartii* was shown to have a preference for a low calcium content and a low conductivity optimum of 134 µS/cm (Potapova and Charles 2003).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland;

Distribution in Poland: New record.

***Platessa ziegleri* (Lange-Bertalot) Lange-Bertalot 2004**

(Pl. 28, figs. 30-39)

Ref. Krammer & Lange-Bertalot 1991 b, p. 39, pl. 23, figs. 33-38; Lange-Bertalot 1993, p. 8, pl. 35, figs. 4-7; Bąk et al. 2012, p. 287, pl. 24; Kulikovskiy et al. 2016, p. 238, pl. 36, figs. 13-18; Silva et al. 2017, p. 209, figs. 70-71.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes ziegleri* Lange-Bertalot 1993

Diagnosis: Valve is linear-elliptical to elliptical, sometimes appearing rectangular, with rostrate to subcapitate rounded ends. Raphe valve has a narrow axial area, widening towards the valve centre. Central area is transverse, forming a fascia that reaches the valve margins. Raphe is filiform, without terminal fissures. The proximal and distal raphe ends are slightly expanded. Transapical striae are radiate throughout, becoming denser and tending to subparallel at the ends, about 26-30 in 10 μm. Rapheless valve has a narrow-lanceolate axial area, widening towards the valve centre. Central area is absent or unilateral, rectangular, expanding to the valve margin due to the absence of central striae. Transapical striae are almost parallel in the centre, becoming radiate towards the ends, about 22-25 in 10 μm. Length of the valve 12.5-20 μm, and the breadth 6-8 μm.

Ecological preference: the species characteristic of alkaline, oligo- to mesotrophic lakes and rivers flowing from lakes, with optimal distribution in high mountains and lowlands. In stagnant waters in the mountains, as well as in waters flowing very rarely (Bąk et al. 2012); mesotrophic and eutrophic alkaline water bodies (Kulikovskiy et al. 2016); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak, Kamionka and Młynek Lakes; the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the reservoir Mylof on the Brda River in the Tuchola Forests, north Poland (Sekulska-Nale Wajko 1999); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

Genus *Psammothidium* Bukhtiyarova and Round 1996

Diagnosis: Frustule with concavo-convex apical and transapical axes, raphe valve is convex, rapheless valve is concave. Valves are small, elliptical, lanceolate-elliptical or linear-elliptical. Apices are always rounded. Axial area of the raphe valve is variable, narrowly linear to narrowly triangular. Central area is variable. Raphe slit is straight; central pores and terminal fissures are variably developed. Internally, the raphe is situated in a rib, the central pores slightly bent towards opposite sides, and the helictoglossae slightly raised. Axial area of the rapheless valve and the raphe valve is alike or dissimilar. Areolae of both valves are similarly arranged. Transapical striae are radiate, around 30 in 10 μm.

Holotype species: *Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round 1996

***Psammothidium acidoclinatum* (Lange-Bertalot) Lange-Bertalot 1999**

Ref. Lange-Bertalot & Metzeltin 1996, p. 22, pl. 21, figs. 22-24c; pl. 113, figs. 1-7; Lange-Bertalot 1999, p. 279, pl. 21, figs. 22-24c; pl. 113, figs. 1-7.

Status of name: accepted taxonomically.

Synonym: *Achnanthes acidoclinata* Lange-Bertalot 1996

Diagnosis: Valves are broadly elliptic, elliptic-lanceolate to linear-elliptic, with broadly rounded apices. Raphe valve has a linear axial area, which widens toward the valve centre. Central area is large, transversely elliptic to rectangular due to shortening of the middle striae. Raphe is straight, filiform, without terminal fissures. The proximal and distal raphe endings are simple. The proximal raphe endings curve in opposite directions internally. Rapheless valve has a wide rhomboid-lanceolate axial area. The central area is usually not differentiated from the axial area. Transapical striae are radiate throughout on both valves, about 23-27 in 10 μm. Length of the valve 8-16 μm, and the breadth 4.5-5.8 μm.

Ecological preference: Common in soft acidic waters. It is recorded from oligotrophic lakes with acidic water (Sienkiewicz et al. 2006); in acidic mid-altitude lakes and streams in Central Europe (Lange-Bertalot and Metzeltin, 1996)

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Lakes Mały and Wielki Staw in the northeastern part of Karkonosze Massif (western Poland) (Sienkiewicz et al., 2006); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Psammothidium altaicum* (Poretzky) Bukhtiyarova 1996**

Ref. Cleve-Euler 1953, p. 48, fig. 592; Flower & Jones 1989, p. 233, figs. 10-14, 70-74; Lange-Bertalot & Krammer 1989, p.21, pl. 48, figs. 34-40; pl. 49, figs. 1, 2, 4, 5; pl. 96, figs. 15-16; Krammer & Lange-Bertalot

1991 b, p. 34, pl. 7, fig. 2; pl.20, figs. 24-32; Bukhtiyarova & Round 1996, p. 5, figs. 12-15; Lange-Bertalot & Metzeltin 1996, 160, pl. 21, figs. 35-40; Bąk et al. 2012, p. 290, pl. 26.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes recurvata* Hustedt 1937

Achnanthes altaica (Poretz.) A.Cleve 1953

Achnanthes altaica var. *minor* Flower & Jones 1989

Diagnosis: Valve is bilaterally symmetrical, elliptic to elliptical-lanceolate, with not protracted, broadly rounded apices. Raphe valve has a narrow, linear axial area; central area is transapically ovate or subrectangular, occupying half the breadth of the valve, bounded by 3-5 shortened striae. Raphe is straight, without terminal fissures. The proximal and distal raphe endings are simple. The proximal raphe endings curve toward opposite directions and are accompanied by ridges; the distal raphe endings are curved in opposite directions on the apical part of the valve face. Rapheless valve has a broad lanceolate axial area, slightly triangular at apices, widening to the valve centre, occupying about half the breadth of the valve in the centre. Transapical striae are punctate, radiate throughout on both valves, about 28-34 in 10 µm. Length of the valve 8-20 µm, and the breadth 4.5-7 µm.

Ecological preference: The species is strictly limited to oligotrophic soft waters in the mountains, rarely in silicate streams in the lowlands; it is an indicator species of very good ecological quality (Bąk et al. 2012).

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Psammothidium bioretii* (Germain) Bukhtiyarova & Round 1996**

(Pl. 28, figs. 40-42)

Ref. Germain 1981, p. 112, pl. 42, figs. 6-7; Lange-Bertalot & Krammer 1989, p. 30, pl. 21, figs. 23-35; pl. 95, figs. 14, 14'; pl. 96, figs. 1–2'; Krammer & Lange-Bertalot 1991 a, p. 19, pl. 12, figs. 1-9; Bukhtiyarova & Round 1996, p. 9, figs. 26-31; Lange-Bertalot & Metzeltin 1996, p. 274, pl. 76, fig. 6; pl. 103, figs. 19-20; Wojtal, 2004, p. 218, figs. 11-15, 40, 41; Bąk et al. 2012, p. 290, pl. 26; Kulikovskiy et al. 2016, p. 239, pl. 35, figs. 35-39.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes bioretii* Germain 1957

Achnanthes alaskana Patrick & Freese 1961

Achnanthidium bioretii (H.Germain) Monnier, Lange-Bertalot & Ector 2007

Diagnosis: Valve is elliptic to linear-elliptical, with broadly rounded apices. Raphe valve with narrow linear axial area. Central area is rectangular, formed by irregularly shortened striae. Raphe is straight or slightly sigmoid near the apices without terminal raphe fissures and slightly expanded terminal ends. The proximal raphe endings are simple or slightly expanded externally and curved toward opposite sides internally. Rapheless valve with narrow linear axial, expanding in the valve centre. Central area is transversely elliptical or rectangular, bordered by 4-6 shortened striae of variable length. Transapical striae are radiate throughout the raphe and rapheless valves and continue to the valve mantle, about 22-25 in 10 µm in the middle and up to 30 in 10 µm at the apices. Length of the valve 12-22 µm, and the breadth 5-8 µm.

Ecological preference: the species is often occurs in oligotrophic waters with a moderate concentration of electrolytes and a very wide range of pH (Krammer & Lange-Bertalot 1991 b); circumneutral, fresh-brackish, high oxygen requirements, oligosaprobous, mesotrophic (Van Dam et al. 1994); It has an optimum occurrence in silicate lakes and in small flowing waters, both in mountainous areas and in the Lowlands, it usually occurs in small numbers in waters well alkaline, with an average content of electrolytes and nitrates, and with a high level of medium to high calcium concentrations (Krammer & Lange-Bertalot 1991 b; Hofmann et al. 2011; Bąk et al. 2012); often found in moderately high numbers in the auk of numerous flowing waters and standing state, while being largely tolerant of the trophic state (oligotrophic to eutrophic) (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015)

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: The species was first recorded from springs in north Poland (Wołoszyńska 1922); from Wigry Lake, north-east Poland (Wołoszyńska 1924); from the Baltic Sea (Snoeijs & Potapova 1995); the Mylof reservoir dam north Poland (Sekulska-Nalewajko 1999); springs and other water bodies in central and north Poland (Rakowska 2001); in calcium-rich waters of the Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2004); from sources in the Warta Valley, central Poland (Żelazna-Wieczorek & Mamińska 2006); springs in the northern part of the Wyżyna Krakowsko-Częstochowska upland, Duszatyńskie springs of Lódz Hills, central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Known also from the area of the Western Tatras, the Kraków-Częstochowa Upland (Wojtal 2004; 2013); Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); In the Podkarpackie Voivodeship, the species has occurred in the following rivers and streams: Wisłok, Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Stobnica, Żołynianka, Przyrwa and Jeziorki Duszatyński (Tambor & Noga 2011; Noga 2012, 2013a,b, 2014 a; Peszek et al. 2015); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); found in the tributary of the Rzeczyca stream, the Wołosatka stream together with a tributary and in the Wołosaty stream southern Poland (Rybak et al. 2017); *As Achnanthidium bioretii* from Roztocze National Park, the Magura National Park, peat bogs and small streams and rivers in the Bieszczady National Park in south-east Poland (Noga 2019); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, southern Poland (Rybak et al. 2019).

***Psammothidium daonense* (Lange-Bertalot) Lange-Bertalot 1999**

Ref. Lange-Bertalot 1989, p. 43, pl. 19, figs. 27-32; pl. 25, figs. 1-6; pl. 95, figs. 1-13; Krammer & Lange-Bertalot 1991 b, p. 20, pl. 12, figs. 10-20; Bukhtiyarova & Round 1996, p. 12, figs. 38-39; Lange-Bertalot & Metzeltin 1996, p. 156, pl. 19, fig. 9; Bąk et al. 2012, p. 291, pl. 26; Rybak et al. 2017, p. 346, pl. 2, figs. 4-7; pl. 3, figs. C-D.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes daonensis* Lange-Bertalot 1989

Psammothidium grischunum f. *daonensis* (Lange-Bertalot) Bukhtiyarova & Round 1996

Achnanthidium daonense (Lange-Bertalot) Lange-Bertalot, Monnier & Ector 2007

Diagnosis: Valve is elliptical to linear-elliptical in outline with broadly rounded, not protracted ends. Raphe valve has a narrow straight axial area, which widens gradually towards the valve centre. Central area is transapically elliptical, rectangular, or diamond-shaped, extending towards the margin to show a variable outline with irregularly shortened striae in the margin. Raphe is straight, filiform without terminal fissures, and the proximal raphe endings are distant in the central area and curved toward opposite sides internally. The proximal and distal raphe ends are slightly expanded externally. Transapical striae are finely punctate, radiate throughout the valve, about 27-32 in 10 µm, and puncta about 36-45 in 10 µm. Rapheless valve has a large, more lanceolate to rhomboid axial area, which has an irregular border. Central area is usually not differentiated from the axial area, somewhat rhombic. Transapical striae are finely punctate, radiate, about 24-30 in 10 µm, puncta about 36-45 in 10 µm. Length of the valve 10-22 µm and the breadth 4.8-7.5 µm.

Ecological preference: *Achnanthes daonensis* prefers oligotrophic, oligosaprobous, low conductivity and circumneutral waters; it occurs in the benthic diatom assemblages (Van Dam et al. 2007). The ecological optimum of this species is oligo- to dystrophic, neutral waters (Krammer, Lange-Bertalot 1991; Van Dam et al. 1994; Hofmann et al. 2011; Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6–7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c).

Occurrence: Infrequent in Jeziorak and Kamionka Lakes.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); from stones, mosses and silt in the Bieszczady Mountains streams, south Poland (Rybak et al. 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Psammothidium grischunum* (Wuthrich) Bukhtiyarova & Round 1996**

Ref. Wuthrich 1975, p. 303, pl. 7, figs. 7-20; Lange-Bertalot & Krammer 1989, p. 62, pl. 26, figs. 22-36; pl. 62, figs. 1-3; pl. 96, figs. 17-20; Krammer & Lange-Bertalot 1991 b, p. 24, pl. 13, figs. 24-40; Bukhtiyarova & Round 1996, p. 12, figs. 32-37; Wojtal 2009, p. 290, pl. 5, figs. 15-18; Bąk et al. 2012, p. 291, pl. 26; Noga et al. 2013 c, p. 137, fig. 2: 20; fig. 4: 7; Kulikovskiy et al. 2016, p. 240, pl. 35, figs. 70-74.

Status of name: Uncertain.

Synonym: *Achnanthes grischuna* Wuthrich 1975

Diagnosis: Valves are elliptical or linear-elliptical, with broadly rounded apices. Raphe valve with very narrow, linear axial area. Central area is transversely expanded, irregular, occupying from 1/2 to 2/3 of the valve breadth and bounded by 4-8 striae slightly wider placed. Raphe is straight, without terminal fissures. The proximal and distal raphe endings are simple. The proximal raphe endings curve, accompanied by ridges and grooves; the distal raphe endings are drop-type, curved on opposite sides on the apical part of the valve face. Rapheless valve with an axial area narrow towards the apices, becoming broader or rhombic at the centre. Transapical striae are slightly radiate throughout the raphe and rapheless valves, about 20-24 in 10 μm. Length of the valve 6-18 μm, and the breadth 4-5.5 μm.

Ecological preference: Cosmopolitan, oligosaprobic species known from circumneutral spring and stream waters with low or moderate conductivity (Krammer & Lange-Bertalot 1991 b); fresh water species, in waters with very low Cl- concentration (below 100 mg/l^{-1}) (Van Dam et al. 1994); freshwater of an alkaline character or close to circumneutral reaction (6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 b, c).

Occurrence: Infrequent in Jeziorak and Radomno Lakes.

Distribution in Poland: It was recorded in material collected from submerged stones, *Vaucheria* sp. filaments and mud from springs and from Kobylanka stream, south Poland (Wojtal 2004 a; 2009); from calcium-rich waters of the Wyżyna Krakowsko-Częstochowska upland in Poland (Wojtal 2004 b); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b, c); Wisłok river and Morwawa, Baryczka, Stobnica, Mleczka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wisłoka River, the Magura National Park and the Wołosaty River, the Bieszczady National Park, south Poland (Noga et al. 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Psammothidium helveticum* (Hustedt) Bukhtiyarova & Round 1996**

Ref. Hustedt 1933, p. 385, fig. 831 g-k; Flower & Jones 1989, p. 235, figs. 26-30, 65-69; Lange-Bertalot & Krammer 1989, p. 63, pl. 19, figs. 1-20, 26; pl. 20, figs. 1-6; pl. 96, figs. 6-11; Krammer & Lange-Bertalot 1991 b, p. 18, pl. 10, figs. 12-27; Bukhtiyarova & Round 1996, p. 8, figs. 20-25; Lange-Bertalot & Metzeltin 1996, p. 158, pl. 20, figs. 12-16; Manoylov 2007, p. 320, figs. 11-21, 49-51; Bąk et al. 2012, p. 292, pl. 26.

Status of name: accepted taxonomically.

Synonyms: *Psammothidium helveticum* (Hustedt) Bukhtiyarova & Round 1996
Achnanthidium helveticum (Hustedt) Monnier, Lange-Bertalot & Ector 2007
Achnanthes kenyae Cholnoky 1960
Achnanthes helvetica f. *minor* Flower & Jones 1989
Achnanthes helvetica var. *alpina* Flower & Jones 1989
Achnanthes helvetica (Hustedt) Lange-Bertalot 1989
Achnanthes austriaca var. *helvetica* Hustedt 1933

Diagnosis: Valves are elliptical to linear-elliptical in outline with obtusely rounded apices. Raphe valve has a narrow linear axial area. Central area is a bow-tie-shaped or rectangular, extends to the margin with a few short striae on the margin. Raphe is straight, has long terminal fissures curved to opposite sides. The proximal raphe endings are slightly expanded externally and distantly apart, curved toward opposite directions internally. Transapical striae are radiate, about 23-28 in 10 μm. Rapheless valve has a narrow linear axial area. Central area is a large, rounded, hexagonal or diamond-shaped. Transapical striae are radiate, about 26-30 in 10 μm, interrupted at the valve margin. Length of the valve 12-26 μm, and the breadth 5-8 μm.

Ecological preference: *Achnanthes helvetica* occurs in oligotrophic to dystrophic, low conductivity, circumneutral to slightly acidic environments in mountain streams (Krammer & Lange-Bertalot 1991b); the species is aquatic to aerophilic, tolerant N-autotrophic, alkaliphilous, oxybiontic, halophobous, high oxygen requirements, ά-mesosaprobous and mesotrophic (Van Dam et al. 1994); it occurred in ultra-oligotrophic Lake El'gygytgyn, in northeastern Siberia (Cremer & Wagner 2003); the species was classified as oligotrophic and low conductivity species in Finland (Soininen et al. 2004); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a); found in strongly acidified streams and still waters of the siliceous central highlands and in weakly acid to circumneutral running waters of the lowland (Lange-Bertalot et al. 2017).

Distribution in Poland: In the high mountain lakes under the stress of acidification (Tatra Mts, Poland) as *Achnanthes helvetica* (Kawecka & Galas 2003); in springs of Lódz Hills, central Poland (Zelazna-Wieczorek 2011); Wisłok River in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Psammothidium helveticum* var. *minus* (Flower & Jones) Buczkó 2016**

Ref. Flower & Jones 1989, p. 235, figs. 19-25, 76-79; Buczkó 2016, p. 146, pl. 60, figs. 1-19.

Status of name: accepted taxonomically.

Synonym: *Achnanthes helvetica* var. *minor* Flower & Jones 1989

Diagnosis: Valve is elliptical to elliptic-lanceolate, with broadly rounded apices. Raphe valve has a narrow, linear axial area. Raphe is straight, filiform, with proximal endings distinct by central pores that are accompanied by ridges and grooves. The distal raphe endings are simple, long, and curved in opposite directions. Rapheless valve has a narrow, linear axial area. Central area is rounded, occupying half the valve breadth and bounded by 4-7 striae. Transapical striae are punctate, radiate throughout both valves, about 22-26 in 10 μm on the raphe valves and 14-16 in 10 μm on the rapheless valve. Length of the valve 8-11 μm, and the breadth 5-6 μm.

Ecological preference: acidophilous (Kawecka & Galas, 2003); it has the same ecological preference as the nominate variety.

Distribution in Poland: In the high mountain lakes under the stress of acidification (Tatra Mts, Poland) as *Achnanthes helvetica* var. *minor* (Kawecka & Galas 2003)

***Psammothidium kryophilum* (Petersen) Reichardt 2004**

Ref. Petersen 1924, p. 316, fig. 6; Hustedt 1933, p. 403, fig. 854; Hartley et al. 1996, p. 24, pl. 4, fig. 17; Reichardt 2004, p. 441, pl. 1, figs. 1-9; pl. 2, figs. 1-4; Wetzel et al. 2015, p. 218, figs. 302-307; Pinseel et al. 2016, p. 10, figs. 24. 25.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes kryophila* Petersen 1924
Achnanthidium kryophilum (Petersen) Bukhtiyarova 1995

Diagnosis: Valves are elliptic to elliptical-lanceolate with broadly rounded not protracted apices. Raphe valve has a narrow linear axial area. Central area is transapically expanded, elliptical to rectangular, does not reach the valve margin and is delineated by 4-6 shortened striae. Raphe is vestiges, straight, filiform; proximal raphe endings are simple, slightly expanded without pronounced central pores; the distal raphe endings are deflected in the same direction on the valve face at the apices. Rapheless valve has a narrow, linear axial area that expands at the valve centre. Central area is variably shaped, though usually more or less rhombic, somewhat unilateral due to shortened central striae on one side. Transapical striae are finely punctate, uniseriate, radiate throughout the valve on both valves, about 25-28 in 10 μm on the raphe valve, and 23-27 in 10 μm on the rapheless valve. Length of the valve 11-19 μm, and the breadth 4-5.5 μm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); reported from the benthic habitats of slightly acidic, oligotrophic, freshwater environments.

Occurrence: Infrequent in Zielone Lake.

Distribution in Poland: Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts (Kwandrans 1993).

***Psammothidium lauenburgianum* (Hustedt) Bukhtiyarova & Round 1996**

(Pl. 28, figs. 43-46)

Ref. Hustedt 1950, p. 394, fig. 36: 3-9; Lange-Bertalot & Krammer 1989, p. 94, pl 28, figs. 3-7; pl. 35, figs. 1-10; Krammer & Lange-Bertalot 1991 b, p. 26, pl. 14, figs. 27-34; Bukhtiyarova & Round 1996, p. 17, figs. 62-65; Wojtal 2004, p. 219, figs. 30-39; Wojtal 2009, p. 292, pl. 5, figs. 19-21; Noga et al. 2014 a, p. 22, pl. 1, fig. 31; Kulikovskiy et al. 2016, p. 240, pl. 35, figs. 46-52; Rybak et al. 2017, p. 347, pl. 2, figs. 16-21; pl. 3, fig. G.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lauenburgiana* Hustedt 1950

Achnanthidium lauenburgianum (Hustedt) Monnier, Lange-Bertalot & Ector 2007

Diagnosis: Valves are elliptic, linear elliptical to elliptic-lanceolate, with broadly rounded apices. Raphe valve has a linear axial area. Central area is transversely rectangular reaching the valve margins, forming bow-tie shaped, which is slightly asymmetric or symmetric. Raphe is straight without terminal raphe fissures. The proximal and distal raphe endings are simple. Internally, the proximal raphe endings curved toward opposite directions. Rapheless valve has a lanceolate axial area. Central area is large, transverse, asymmetric with a rimmed depression on the internal valve surface. The transapical striae are radiate throughout on both valves. One row of areolae is present on the mantle of both valves, about 24-27 in 10 μm. Striae on both valves interrupted near mantle. Length of the valve 8-15 μm, and the breadth 3.5-5.0 μm.

Ecological preference: *Psammothidium lauenburgianum* is known from the Northern Hemisphere, found in flowing waters in the highlands and in alkaline lakes in the lowlands, in waters with a wide range of conditions, oligo- and mesotrophic waters with pH above 7 and with low to medium electrolyte concentrations (Krammer & Lange-Bertalot 1991 b); euplanktonic (Denys 1991); it is an oligo-mesotraphentic species, a neutrophilous, belonging to the group of diatoms typical for circumneutral waters with Cl concentration below 500 mg/l $^{-1}$ and fresh brackish water species (Van Dam et al. 1994); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, (Noga et al. 2013 b); it prefers well-oxygenated waters with moderate to elevated levels of nitrate and calcium content (Hofmann et al. 2011; Bąk et al. 2012; Wojtal 2013); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a)

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Recorded in calcium-rich waters of the Wyżyna Krakowsko-Częstochowska upland in Poland (Wojtal 2004 b, 2009); from the Szczecin Lagoon (Bąk et al. 2006); sources in the Warta valley (Żelazna-Wieczorek, Mamińska 2006); Zalew Szczeciński (Bąk et al. 2006); spring in Warta River valley (Żelazna-Wieczorek & Mamińska 2006); in Kobylanka stream, south Poland, in upper and lower part of the stream (Wojtal 2009); in springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b); in many rivers and streams: Wisłok,Gmina Ołynianka contains the villages and settlements of Morwawa, Baryczka, Pielnica,

Stobnica, Strug, Ryjak, Żołynianka, Przyrwa and San (Noga 2012; Noga et al. 2013c, 2014 a, b, 2016 a; Pajączek et al. 2012; Peszek et al. 2015); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); species recorded in material collected from stones, mosses and silt in the Bieszczady Mountains streams, south Poland (Rybak et al. 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Psammothidium levanderi* (Hustedt) Bukhtyiarova & Round 1996**

Ref. Hustedt 1933, p. 404, fig. 856; Patrick & Reimer 1966, p. 262, pl. 17, figs. 3-4; Lange-Bertalot & Krammer 1989, p. 96, pl. 27, figs. 6-13; pl. 28, figs. 1-2; pl. 96, fig. 3, 3'; Krammer & Lange-Bertalot 1991 b, p. 23, pl. 15, figs. 11-18; Bukhtiyarova & Round 1996, p. 18, figs. 66, 67; Hartley et al. 1996, p. 26, pl. 5, fig. 8; Bąk et al. 2012, p. 293, pl. 26; Kulikovskiy et al. 2016, p. 240, pl. 35, figs. 40-45; Blanco et al. 2017, p. 22, figs. 42-45.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes levanderi* Hustedt 1933

Achnanthes levanderi var. *helvetica* Hustedt 1933

Achnanthidium levanderi (Hustedt) Czarnecki *in* Czarnecki & Edlund 1995

Diagnosis: Valves are elliptical, broadly elliptic to linear-elliptical, with broadly rounded apices. Raphe valve has a linear axial area that widens into a small, irregular, clearly asymmetric central area. Raphe is vestigial, straight, filiform without terminal fissures. Internally, the proximal raphe endings are curved toward opposite sides. Rapheless valve has a rhomboid axial area, which often has an irregular border. Central area is usually not differentiated from the axial area, transapically expanded near the centre, and surrounded by more or less regularly shortened striae. Transapical striae are areolate, slightly radiate in the centre and strongly radiate at the apices of both valves, about 21-23 in 10 µm on raphe valve, and 25-30 in 10 µm on rapheless valve. Central striae slightly wider spaced. One row of areolae is present on the mantle of both valves. Areolae are often visible in LM. Length of the valve 7-11 µm, and the breadth 4.5-5.0 µm.

Remarks: *Psammothidium levanderi* (Hustedt) Bukhtyiarova is similar to *Psammothidium sacculum* in size and striation pattern (Heudre et al. 2017). It has, however, elliptic valves and a very wide lanceolate to elliptic axial area on rapheless valve.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); this taxon inhabits pristine freshwaters, occurring in mountainous rivers with oligotrophic, oligosaprobic waters and low electrolyte contents, circumneutral or slightly acidophilic, good quality indicator for waters (Bąk et al. 2012; Blanco et al. 2017).

Distribution in Poland: The Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round 1996**

Ref. Hustedt 1930, p. 205, fig. 299; Hustedt 1933, p. 404, fig. 855; Patrick & Reimer 1966, p. 261, pl. 17, figs. 1, 2; Flower & Jones 1989, p. 233, figs. 31-38, 54-59; Krammer & Lange-Bertalot 1991 b, p. 23, pl. 13, figs. 1-20; Bukhtiyarova & Round1996, p. 5, figs. 2-11; Hartley et al. 1996, p. 26, pl. 5, fig. 14; Lange-Bertalot & Metzeltin 1996, p. 344, pl. 113, figs. 8-15; Bąk et al. 2012, p. 293, pl. 26; Buczkó 2016, p. 152, pl. 63, figs. 1-13; Bahls et al. 2018, p. 114, pl. 77, figs. 10, 11; p. 147, pl. 110, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes marginulata* Grunow 1880

Achnanthes marginulata f. *major* Flower & Jones 1989

Diagnosis: Valves are bilaterally symmetrical, elliptical to elliptical lanceolate with broadly rounded ends. Raphe valve has a narrow, linear-lanceolate axial area, widening gradually towards the valve centre. Central area is broadly rhombic to almost rectangular, bordered by several shorter striae. Raphe is straight, filiform; proximal raphe endings are simple, widely spaced, situated slightly within the central area; distal raphe endings are straight, very slightly expanded on the valve face and slightly bent to opposite sides. Rapheless valve

has a large lanceolate axial area. Central area is undistinguished from the axial area. Transapical striae are punctate, uniseriate, radiate throughout on both valves, about 24-26 in 10 µm at the valve centre, becoming about 28-30 in 10 µm at the ends. Length of the valve 10-21 µm, and the breadth 4-8 µm.

Ecological preference: Acidophilic diatom of boreo-alpine distribution, more commonly in relatively soft, slightly acid to circumneutral waters (Patrick & Reimer 1966); the species occurred in slightly acidified lakes, acidophilous (Kawecka & Galas 2003).

Occurrence: Infrequent in Zielone Lake.

Distribution in Poland: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); as *Achnanthes marginulata* from the high mountain lakes under the stress of acidification, Tatra Mts, south Poland (Kawecka & Galas 2003).

***Psammothidium microscopicum* (Cholnoky) Blanco 2016**

Ref. Cholnoky 1959, p. 17, pl. 2, figs. 105, 106; Carter 1963, p. 200, pl. 1, fig. 3; Lange-Bertalot & Krammer 1989, p. 99, pl. 67, figs. 7-9; Krammer & Lange-Bertalot 1991 b, p. 21, pl. 11, figs. 1-8; Wojtal 2009, p.133, pl. 5, figs. 22, 23.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis microscopica* Cholnoky 1959
Achnanthes microscopica (Cholnoky) Lange-Bertalot & Krammer 1989
Psammothidium curtissimum (Carter) Aboal 2003
Achnanthes curtissima Carter 1963

Diagnosis: Valves are symmetrical, elliptic to linear-elliptic with broadly rounded apices. Raphe valve has a relatively narrow, linear axial area. Central area is small, transversely elongated or narrow rectangular formed by one to three shortened striae on each side. Raphe is straight, without terminal fissures. The proximal and distal raphe endings are slightly expanded externally. Internally, the proximal raphe endings curve toward opposite directions. Rapheless valve has a linear-lanceolate or narrowly rhomboid axial area. Central area is small slightly asymmetric and transversely expanded. Transapical striae are uniseriate, areolate, radiate on both valves, about 27-30 in 10 µm. Striae are interrupted at the valve margin. External openings of the areolae are usually small and circular to silt-like. Internal openings of the areolae on the faces of both valves are square. Valves are small, less than 10 µm. Length of the valve 6-8.5 µm, and the breadth 3.5-4 µm.

Ecological preference: It is recorded from oligotrophic lakes with acidic water ((Sienkiewicz et al. 2006); *Achnanthes curtissima* is known in Europe from scattered, oligotrophic, circumneutral and slightly acidic waters with low conductivity (Krammer & Lange-Bertalot 1991 b).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: *Achnanthes curtissima* was reported from lakes in Tatra Mts, south Poland (Kawecka & Galas 2003); Sudety Mts., south Poland (Sienkiewicz 2006); soft-water lakes in Lasy Tucholskie (Milecka & Bogaczewicz- Adamczak 2006); Lakes Mały and Wielki Staw in the northeastern part of Karkonosze Massif, west Poland (Sienkiewicz et al. 2006); Kobylanka stream, Kobylany village, south Poland (Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011).

***Psammothidium placentuloides* (Guslakov) Witkowski, Kulikovskiy & Pliński 2011**

Ref. Guslakov et al. 1992, p. 59, pl. 80, figs. 1-3; Witkowski et al. 2000: p. 93, pl. 50, figs. 13-19.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis placentuloides* Guslakov 1992
Achnanthes placentuloides (Guslakov) Witkowski & Lange-Bertalot 2000

Diagnosis: Valves are elliptic to linear-elliptic with broadly rounded apices. Raphe valve has a narrow, linear axial area. Central area is small, transversely expanded. Raphe is straight, filiform, external proximal endings are distant, the distal endings terminate in a polar position and deflected on one side. Rapheless valve has a narrowly lanceolate axial area that is slightly expanded in the middle. Central area is unilateral in the form of a transverse fascia reaching the valve margin. Transapical striae are radiate throughout on both valves, about 22-26 in 10 µm. Length of the valve 7-12 µm, and the breadth 3-5 µm.

Ecological preference: the species reported from pristine waters that characterized by very low content of trace metals, low organic pollutants, low concentrations of pollutants, high conductivity (Nevrova & Petrov 2019).

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005)**;** the Gulf of Gdánsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Psammothidium punctulatum* (Simonsen) Bukhtiyarova et Round 1996**

Ref. Simonsen 1959, p. 75, pl. 10, figs. 14-17; Patrick & Freese 1961, p. 167, pl. 1, fig. 7a-b; Lange-Bertalot & Krammer 1989, p. 127, pl. 43, figs. 13-20; pl. 75, fig. 7; Krammer & Lange-Bertalot 1991 b, p. 51, pl. 29, figs. 17-22; Bukhtiyarova & Round 1996, p. 14, figs. 52-57.

Status of name: Uncertain.

Synonym: *Achnanthes punctulata* Simonsen, 1959

Diagnosis: Valves are elliptic to elliptical-lanceolate with obtusely rounded, not protracted apices. Raphe valve has a very narrow, linear axial area. Central area is oval, asymmetrically expanded on one side, almost to the valve margin, and bounded by 3-4 striae. Raphe is straight, filiform. Proximal raphe endings with central pores accompanied by ridges and grooves; the distal endings are drop-type, curved on the valve face at the apices. Rapheless valve has a very narrow, linear axial area. Central area is transversely rectangular, unilateral, reaches almost to the valve margin. Transapical striae are finely punctate, radiate throughout on both valves, about 24-28 in 10 μm. Striae clear, interrupted near the mantle on both valves. Length of the valve 8-12 μm, and the breadth 4-6 μm.

Ecological preference: Occasionally recorded from rivers and streams (Patrick & Freese, 1961; Bukhtiyarova & Round, 1996); mostly reported from brackish waters (Snoejis & Kasperovičiené 1996; Hay et al. 2003).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: found in Górki Zachodnie – Vistula River estuary in Northern Poland (Majewska et al., 2012)**;** the Gulf of Gdánsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Psammothidium rechtense* (Leclercq) Lange-Bertalot 1999**

Ref. Leclercq 1983, p. 501, pl. 5, figs. 1-17; Bąk et al. 2012, p. 293, pl. 26; Kulikovskiy et al. 2016, p. 241, pl. 35, figs. 75-79; Rybak et al. 2017, p. 348, pl. 2, figs. 29-34; pl. 3, J, K.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes rechtensis* Leclercq 1983

Diagnosis: Valves are elliptic to elliptic-lanceolate with subprotracted to subrostrate, bluntly rounded apices. Raphe valve has a narrow, linear axial area. Central area is moderate, irregular and transversely oblong or lanceolate, bordered by shortened striae. Raphe is straight, filiform; the proximal and distal raphe endings are slightly expanded. Rapheless valve has a narrow, linear axial area. Central area is moderately wide, rhombic to lanceolate. Transapical striae are fine punctate, radiate throughout on both valves, and slightly curved in opposite directions at the apices, about 25-30 in 10 μm. Length of the valve 11-25 μm, and the breadth 5.5-6.5 μm.

Ecological preference: Neutrophilic, polyoxybiontic, freshwater, oligosaprobic and oligotraphentic (Van Dam et al. 1994); found in mountains and lowlands in waters poor in nutrients and electrolytes, but not acidic, indicator of waters of very good quality (Hofmann et al. 2011, Bąk et al. 2012); in nutrient- and electrolyte-poor, not acidified freshwater habitats, indicator of very good ecological quality (Lange-Bertalot et al. 2017); in good oxygenated and slightly acidic waters, with very low conductivity and low calcium and nitrate content. (Rybak et al. 2017).

Distribution in Poland: sources in the Warta Valley (Żelazna-Wieczorek & Mamińska 2006); reported from the spring waters from various geological formations in south Poland (Wojtal 2013). In the Bieszczady National Park, on the tributary of the Wołosatka stream, and found in material derived from both stones and mosses (Rybak et al. 2017); Roztocze National Park, the Magura National Park, peat bogs and small streams and rivers in the Bieszczady National Park in south-east Poland (Noga 2019).

***Psammothidium rossii* (Hustedt) Bukhtiyarova et Round 1996**

Ref. Hustedt 1954, p. 467, figs. 12-20; Simonsen 1987, p. 396, pl. 595, figs. 22-30; Lange Bertalot & Krammer 1989, p. 133, pl. 48, figs. 1-8; Bukhtiyarova & Round 1996, p. 12, figs. 40-47; Hartley et al. 1996, p. 30, pl. 7, fig. 15; Lange-Bertalot & Metzeltin 1996, p. 160, pl. 21, figs. 41-42 a; Kulikovskiy et al. 2016, p. 241, pl. 35, figs. 64-69.

Status of name: accepted taxonomically.

Diagnosis: Valves are elliptic to elliptic-lanceolate with broadly rounded and somewhat slightly protracted, subrostrate, bluntly rounded apices. The valve is distinctively flexed, placing the central area and the apices in separate planes of focus. Raphe valve has a narrow, linear axial area, slightly eccentric at the apices. Central area is narrow, irregular, and transversely rectangular, bordered by 3-4 shortened striae. Raphe is filiform; proximal raphe endings with simple central pores, raphe fissures in some individual valves revealing very slight ridging but without grooves; distal raphe endings are simple, short, turning to opposite sides. Rapheless valve has a linear axial area that expands at the valve centre. Central area is moderately wide, rhombic to lanceolate, occupying 1/2 of the valve width in the centre. Transapical striae are similar on both valves, areolate, slightly radiate throughout and slightly curved in opposite directions at the apices, about 28-32 in 10 μm. Striae are interrupted near the mantle. Length of the valve 9-12 μm, and the breadth 4.5-6 μm.

Ecological preference: Fresh water, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); prefers low nutrient, low conductivity, but not acidic waters (Cantonati et al. 2017).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012).

***Psammothidium semiapertum* (Hustedt) Aboal 2003**

(Pl. 28, figs. 47-48)

Ref. Hustedt 1945, p. 905, pl. 39, figs. 1-3; p. 910, pl. 39, figs. 4-7; Hartley et al. 1996, p. 32, pl. 8, fig. 3; Aboal et al. 2003, p. 175; Potapova 2012, p. 35, figs. 36-44.

Status of name: accepted taxonomically.

Synonym: *Cocconeis semiaperta* Hustedt 1945
Achnanthes semiaperta Hustedt 1945
Achnanthes hintzii Lange-Bertalot & Krammer 1989

Diagnosis: Valves are elliptic with broadly rounded ends. Raphe valve has a narrow linear axial area and a transversely rectangular central area. The raphe is filiform and straight with slightly expanded, almost straight or very slightly deflected external distal and proximal ends. Internal proximal raphe ends are deflected to opposite sides. Internal distal ends terminate in small helictoglossae. The rapheless valve has a narrow linear axial area and a transversely rectangular central area that may be symmetric or slightly asymmetric. Transapical striae are uniseriate, punctate on both valves, about 22-24 in 10 μmon the rapheless valve. Areolae are about 25 in 10 μm, and 5-7 areolae in each central stria. Length of the valve 12 μm, and the breadth 5.0 μm.

Ecological preference: It is reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: New record.

***Psammothidium subatomoides (*Hustedt) Bukhtiyarova & Round 1996**

(Pl. 28, figs. 49-51)

Ref. Cleve-Euler 1953, p. 180, fig. 879 b; Lange-Bertalot & Krammer 1989, p.145, pl. 21, figs. 11-14, 17, 18, 22; pl. 95, figs. 22-23; Krammer & Lange-Bertalot 1991 b, p. 24, pl. 14, figs. 1-10; Bukhtiyarova & Round 1996, p. 13, figs. 48-51; Lange-Bertalot 1996, p. 162, pl. 22, figs. 41-43; Manoylov 2007, p. 323, figs. 33-45, 55-57; Bąk et al. 2012, p. 294, pl. 26; Noga et al. 2014 a, p. 22, pl. 1, fig. 32; Kulikovskiy et al. 2016, p. 242, pl. 35, figs. 80-83; Rybak et al. 2017, p. 347, pl. 2, figs. 35-38; pl. 3, figs. L-M.

Status of name: accepted taxonomically.

Synonyms: *Navicula subatomoides* Hustedt 1936
Navicula utermoehli var. *subatomoides* (Hustedt) Cleve-Euler 1953
Achnanthes subatomoides (Hustedt) Lange-Bertalot *et* Archibald 1985
Achnanthidium subatomoides (Hustedt) Monnier, Lange-Bertalot *et* Ector 2007

Diagnosis: Valve is elliptical with broadly rounded apices. Raphe valve has a narrow linear axial area. Central area is transversely rectangular with short striae on the margin. Raphe is straight and filiform; the proximal raphe endings are expanded, accompanied by ridges and grooves; the distal raphe endings are indistinct. Transapical striae are fine, slightly radiate throughout the valve, about 33-40 in 10 μm. Rapheless valve has a narrow linear axial area with an expanded rectangular central area that occupies 1/4 of the valve in the centre. Transapical striae are radiate throughout the valve, about 28-34 in 10 μm. Length of the valve 7-15 μm and the breadth 4-6.5 μm.

Ecological preference: *Achnanthes subatomoide*sis is widespread species, occurs in aquatic freshwater, sensitive N-autotrophic, acidophilic, polyoxybiontic, oligosaprobic and oligo-mesotrophic (Van Dam et al. 1994); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 3.0-17.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 b, c); oligotrophic and dystrophic waters, poor in electrolytes with very good ecological quality (Szczepocka & Rakowska 2015); Oligotrophic, circumneutral to naturally weakly acid streams and standing freshwater habitats on siliceous substrata, with low calcium content and low or very low concentrations of Nitrate, indicator of very good ecological quality (Lange-Bertalot et al. 2017).

Occurrence: Infrequent in Radomno and Młynek Lakes; the Eemian palaeolake deposits of central Poland.

Distribution in Poland: In rivers and lakes with low pH from the Carpathians, Sudetes and Świętokrzyskie Mountains, south Poland (Kwandrans 2007); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.); south-east Poland (Noga et al., 2013 b, c); Wisłok River and the catchment area including rivers and streams (Gołębiówka, Szuwarka, Morwawa, Baryczka, Mleczka, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Drogowle village in south-east Poland (Szczepocka & Rakowska 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); in the Bieszczady Mountains streams, south Poland (Rybak et al. 2017); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Roztocze National Park, the Magura National Park, peat bogs and small streams and rivers in the Bieszczady National Park in south-east Poland (Noga 2019); from the Subcarpathian region its occurrence was recorded in the following rivers: Wisłok, Gołębiówka, Szuwarka, Morwawa, Baryczka, Mleczka, Żołynianka, Biała Tarnowska, San and in Duszatyńskie Lakes (Noga 2012; Noga et al. 2013 a, c, 2014 a, b, 2015; Pajączek et al. 2012; Peszek et al. 2015).

***Psammothidium ventrale* (Krasske) Bukhtiyarova & Round 1996**

(Pl. 27, figs. 52-55)

Ref. Hustedt 1937, p. 180, figs. 15-16; Patrick & Reimer 1966, p. 262, pl. 17, figs. 5-6; Simonsen 1987, p. 205, pl. 317, figs. 19-26; Lange-Bertalot & Krammer 1989, p. 155, pl. 46, fig. 7; pl. 47, figs. 1-4; pl. 79, figs. 22-33; Krammer & Lange-Bertalot 1991 b, p. 40, pl. 24, figs. 8-22; Bukhtiyarova & Round 1996, p. 7, figs. 16-19; Lange-Bertalot & Metzeltin 1996, p. 162, pl. 28, figs. 20-23; Bąk et al. 2012, p. 294, pl. 26; Kulikovskiy et al. 2016, p. 242, pl. 35, figs. 53-58.

Status of name: Uncertain.

Synonyms: *Navicula ventralis* Krasske 1923
Achnanthes sublaevis Hustedt 1937
Achnanthes ventralis (Krasske) Lange-Bertalot 1989
Achnanthidium ventrale (Krasske) Haworth & Kelly 2002

Diagnosis: Valves are elliptical with broad capitate, rounded apices. Raphe valve has a narrow, linear axial area. Central area is wide, irregular and transversely rectangular, occupying 2/3 of the breadth and bounded by 6-7 shortened striae on the margins. Raphe is straight, filiform, the proximal and distal raphe endings are simple, and slightly expanded. Rapheless valve has a broadly lanceolate axial area, gradually widening towards the valve centre. Central area is wide, rhombic to lanceolate. Transapical striae are fine punctate, radiate throughout on both valves, about 27-32 in 10 μm. Length of the valve 8-16 μm, and the breadth 4.5-6 μm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligo-mesotrophic (Van Dam et al. 1994); oligotrophic and dystrophic waters, poor in electrolytes, rich in calcium and silicon with very good ecological quality (Szczepocka & Rakowska 2015); circum-neutral or weakly acidic oligotrophic (Kulikovskiy et al. 2016); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka Lake.

Distribution in Poland: Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015); as *Achnanthes ventralis* from Roztocze National Park, the Magura National Park, peat bogs and small streams and rivers in the Bieszczady National Park in south-east Poland (Noga 2019).

Genus *Skabitschewskia* Kuliskovskiy & Lange-Bertalot, 2015

Diagnosis: The genus includes all taxa possessing uniseriate striae on the raphe valve and biseriate striae and a cavum on the rapheless valve. The frustules are almost flat or have very slightly concave raphe valves and convex rapheless valves. In girdle view, the frustules may be linear or slightly bent. The valve outline is elliptic-lanceolate to lanceolate. Valve apices vary from rounded to capitate.

Holotype species: *Skabitschewskia dispersipunctata* Kuliskovskiy & Lange-Bertalot 2015

***Skabitschewskia oestrupii* (A.Cleve) Kuliskovskiy & Lange-Bertalot 2015**

Ref. Cleve-Euler 1922, p. 53, pl. 1, fig. 1; Hustedt 1930, p. 207, fig. 301; Hustedt 1933, p. 411, fig. 864; Krammer & Lange-Bertalot 1991 b, p. 81, pl. 48, figs. 1-18; Lange-Bertalot 1997, p. 207; Hartley et al. 1996, p. 30, pl. 7, fig. 2; Bąk et al. 2012, p. 285, pl. 25.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes lanceolata* var. *oestrupii* A.Cleve 1922
Achnanthes oestrupii (A.Cleve) Hustedt 1930
Achnantheiopsis oestrupii (A.Cleve) Lange-Bertalot 1997
Planothidium oestrupii (A.Cleve) Edlund 2001

Diagnosis: Valves are broadly elliptical to elliptic-lanceolate, with convex valve margins and slightly apiculate, wide to cuneate-shaped rounded apices. Raphe valve has a narrow linear axial area, slightly widening at the valve centre. Central area is bow-tie-shaped, bounded by several shortened striae. Raphe is straight and filiform. The external proximal raphe endings are straight; the distal raphe endings are indistinct. Transapical striae are uniseriate, radiate throughout the valve, about 26-30 in 10 μm in the centre, becoming strongly radiate and denser at the ends, about 35 in 10 μm, short and long striae alternate around the central area. Rapheless valve has a variable axial area, from narrow to wide and lanceolate in shape. Central area is unilateral and contains a wide cavum. Transapical striae are biseriate, slightly radiate throughout the valve, about 14-20 in 10 μm. Length of the valve 7.5-40 μm, and the breadth 4-15 μm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligo-mesotrophic (Van Dam et al. 1994); benthic, oligohalobous indifferent, pH- pH-indifferent, mesotraphentic, oligosaprobous (Witak & Jankowska 2014); eutrophic, rich in calcium, but they are also known to occur in lakes poor in calcium (Bąk et al. 2012); indicates oligo-mesotrophic conditions (Slobodníková et al. 2023).

Distribution in Poland: Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014).

***Skabitschewskia peragalloi* (Brun & Héribaud) Kuliskovskiy & Lange-Bertalot 2015**

Ref. Hustedt 1930, p. 207, fig. 300; Hustedt 1933, p. 412, fig. 865; Patrick & Reimer 1966, p. 274, pl. 19, figs. 1-2; Germain 1981, p. 116, pl. 44, figs. 19-20; Krammer & Lange-Bertalot 1991 b, p. 82, pl. 48, figs. 19-26; Hartley et al. 1996, p. 30, pl. 7, fig. 4; Lange-Bertalot & Metzeltin 1996, p. 160, pl. 21, figs. 50-51; Lange-Bertalot 1997, p. 207, fig. 24; Bąk et al. 2012, p. 285, pl. 25; Rivera-Rondón & Catalan 2017, p. 216, figs. 36-37; Wetzel et al. 2019, p. 69, pl.1, figs.5, 6.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes peragalli* Brun & Hèribaud 1893

Achnanthes peragalli var. *fossilis* Tempére & Peragallo 1909.

Planothidium peragallii (Brun & Héribaud) Round & Bukhtiyarova 1996

Achnantheiopsis peragalli (Brun & Héribaud) Lange-Bertalot 1997

Diagnosis: Valves are broadly elliptical with protracted, rostrate to capitate ends. Raphe valve has a narrow, linear axial area, expanding slightly at the valve centre. Central area is an expanding rectangle, bow-tie shaped, bounded by short marginal striae. Raphe is filiform, straight, the proximal raphe endings are close, and the distal ends are indistinct. Transapical striae are strongly radiate, slightly curved, short in the central part of the valve and varied in length, about 20-23 in 10 μm at the centre, becoming about 27 in 10 μm toward the ends. Rapheless valve has a lanceolate axial area that narrows sharply at either end. Central area is indistinct from the axial area, somewhat elliptical with variable expansion, and unilateral with a wide cavum. Transapical striae are slightly radiate, more distinct than on the raphe valve, interrupted on one side by a double horseshoe-shaped thickening, about 16-18 in 10 μm at the centre, up to 20 in 10 μm near the ends. Length of the valve 8-18 μm, and the breadth 6-9 μm.

Ecological preference: *Achnanthes peragalli* is reported mostly from lakes and smaller streams, pH indifferent (Patrick & Reimer 1966); freshwater, circumneutral, high oxygen requirements, β-mesosaprobic, oligotrophic (Van Dam et al. 1994); it has an ecological optimum in oligotrophic waters poor in electrolytes, in the mountains and lowlands; it often inhabits streams; in alkaline waters and indicator of very good ecological quality (Bąk et al. 2012); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon, very good water quality (Szczepocka & Rakowska 2015)

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Czarna Staszowska River near the Smyków and Drogowle villages in south-east Poland (Szczepocka & Rakowska 2015).

Genus *Eucocconeis* Cleve ex Meister 1912

Diagnosis: Frustules are lanceolate or rhombic and broad in valve view, with bluntly rounded ends; twisted; bent in girdle view. Valves are heterovalvar and isopolar, one valve with a raphe, the other without a raphe. Raphe valve is convex, and the rapheless valve is concave in the transapical section. Axial area is narrow in both the raphe and rapheless valves. Central area is expanded and elliptical or rhombic in the raphe valve; very strongly expanded into a large plain area in the rapheless valve. Raphe in the midline of the valve towards the centre of the valve, sigmoid overall, because of an opposite curvature at the two poles; expanded externally at the centre to form raindrop-like endings; central internal endings offset, turned in opposite directions; no terminal fissures. Transapical striae are uniseriate, strongly radiate with long and short striae alternating at the centre, can be interrupted at the junction of valve face and mantle; areolae are very small, circular to quadrangular.

Type species: ***Eucocconeis flexella*** (Kützing) Meister 1912

***Eucocconeis alpestris* (Brun) Lange-Bertalot 1999**

Ref. Hustedt 1930, p. 193, fig. 271; Hustedt 1933, p. 416, fig. 867 d; Germain 1981, p. 109, pl. 40, figs. 8-9; Krammer & Lange-Bertalot 1991 b, p. 17, pl. 9, figs. 7-10; Lange-Bertalot & Metzeltin 1996, p. 24, pl. 20, figs. 4-8; pl. 112, fig. 6. Wojtal 2009, p. 204, pl 6, fig. 24; Enache & Potapova 2012, p. 79, figs. 19-25; Bahls et al. 2018, p. 147, pl. 110, fig. 26.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes flexella* var. *alpestris* Brun 1880
Cocconeis minuta var. *alpestris* (Brun) Cleve 1895
Eucocconeis minuta var. *alpestris* (Brun) Meister 1912
Eucocconeis flexella var. *alpestris* (Brun) Hustedt 1930
Achnanthes alpestris (Brun) Lange-Bertalot & Metzeltin 1996

Diagnosis: Valves are rectangular-elliptical with twisted ends or in the shape of a parallelogram. The raphe valve has an oblique narrow linear or slightly sigmoid axial area and a transversely rectangular central area. The raphe is slightly sigmoid with terminal raphe fissures curved in opposite directions. The rapheless valve has a narrow linear or slightly sigmoid axial area, which is also often oblique. Central area is large, hexagonal to diamond-shaped or rounded. Transapical striae are punctate, slightly radiate, or radiate on one side of the valve, but parallel to slightly convergent on the other side, about 22-26 in 10 μm. Length of the valve 12-25 μm, and the breadth 6-8 μm.

Ecological preference: salinity (halophobous), pH: acidophilous, Boreal species, which especially occurs in localities with cold water in Europe and North America (Foged 1957); Cosmopolitan, occurring in oligotrophic waters of a wide range of pH and conductivity; the species is not rare in circumneutral and slightly acidic waters (Krammer & Lange-Bertalot 1991 b); A neutrophilous, oligosaprobous, oligotraphentic and freshwater species (Van Dam et al. 1994); in water with calcium content, oligo- to weakly mesotrophic lakes in upland and lowland areas, an indicator of very good water quality (Bąk et al. 2012).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland, Biała Przemsza River (Cabejszekowna 1935); peat bog in Modlniczka, south Poland (Piątek 2007); recorded rare in Kobylanka stream, south Poland (Wojtal 2009).

***Eucocconeis austriaca* (Hustedt) Lange-Bertalot 1999**

Ref. Hustedt 1922, p. 233, pl. 3, figs. 6, 7; Hustedt 1930, p. 201, fig. 285; Hustedt 1933, p. 384, fig. 831 a-c; Simonsen 1987, p. 69, pl. 93, figs. 1-11; Lange-Bertalot & Krammer 1989, p. 82, pl. 18, figs. 7-12.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes austriaca* Hustedt 1922
Achnanthes laevis var. *austriaca* (Hustedt) Lange-Bertalot 1989

Diagnosis: Valves are elliptical to linear elliptical with broadly rounded ends. The raphe valve has a linear axial area and a bow-tie-shaped central area. The distal raphe endings are curved to opposite sides. The proximal raphe ends are slightly expanded externally. The rapheless valve has a narrow linear axial area and a large subrounded, or diamond-shaped central area. Transapical striae are radiate throughout on both valves, about 24-30 in 10 μm. Length of the valve 15-25 μm, and the breadth 6-8 μm.

Ecological preference: Freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013a; 2014a).

Distribution in Poland: Matysówka stream, a right-bank tributary of Strug River, district of Tyczyn, Podkarpackie province, southern Poland (Noga et al. 2013a; 2014a).

***Eucocconeis flexella* (Kützing) Meister 1912**

(Pl. 29, figs. 1-10)

Ref. Hustedt 1930, p. 193, fig. 270; Hustedt 1933, p. 415, fig. 869 a-c; Patrick & Reimer 1966, p. 260, pl. 16, figs. 31-32; Enache & Potapova 2012, p. 79, figs. 9-12; Noga et al. 2013 c, p. 137, fig. 2: 26; Kulikovskiy et al. 2016, p. 229, pl. 34, figs. 1-5; Bahls et al. 2018, p. 61, pl. 24, figs. 16, 17; p. 93, pl. 56, figs. 31, 32; p. 114, pl. 77, figs. 22, 23; p. 147, pl. 110, figs. 19-22.

Status of name: accepted taxonomically.

Synonyms: *Cymbella flexella* Kützing 1844
Achnanthidium flexellum (Kützing) Brébisson ex Kützing 1849
Achnanthes flexella (Kützing) Brun 1880
Cocconeis flexella (Kützing) Cleve 1895

Diagnosis: Frustules are strongly curved in girdle view with concave raphe valve and convex rapheless valve. Valves are highly arched and somewhat twisted, elliptical-lanceolate with obtusely rounded to broadly rostrate ends. Valve face has depressions along the margins. The raphe valve has a narrow axial area and a lanceolate-rhomboid central area. The raphe is straight or slightly sigmoid with terminal ends sharply turned in opposite directions. Rapheless valve has a narrow linear or slightly sigmoid axial area and a large rectangular or hexagonal central area. Transapical striae are punctate, strongly radiate on the raphe valve and slightly radiate on the rapheless valve, about 20-24 in 10 μm. Length of the valve 18-40 μm, and the breadth 9-20 μm.

Ecological preference: Salinity (halophobous), pH: acidophilous, Boreal species, which especially occurs in localities with cold water in Europe and North America (Foged 1957); more commonly found in lakes, ponds and bogs or in water courses draining such areas; pH indifferent or acidophilous (Patrick & Reimer 1966); freshwater, alkaliphilous, high oxygen requirements, oligosaprobous, oligotrophic (Van Dam et al. 1994); widely distributed in oligotrophic, calcium-rich lakes mountain forests, in mesotrophic conditions, it is considered an indicator of very good water quality (Bąk et al. 2012); Circumneutral mainly occurring at pH about 7 (Szulc & Szulc 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Jeziorak Lake; frequent in Kamionka Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok River of the podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Gulf of Gdansk and surrounding waters, southern Baltic sea (Plinski & Witkowski 2020).

***Eucocconeis laevis* (Østrup) Lange-Bertalot 1999**

(Pl. 29, figs. 11-14)

Ref. Krammer & Lange-Bertalot 1991b, p. 17, pl. 9, figs. 14-22; pl. 10, figs. 1-11; pl. 4, fig. 4; Lange-Bertalot & Metzeltin 1996, p. 158, pl. 20, figs. 20-21; pl. 78, figs. 1-3; Bąk et al. 2012, p. 126, pl. 22; Enache & Potapova 2012, p. 76, figs. 13-18; Kulikovskiy et al. 2016, p. 230, pl. 34, figs. 6-11; Bahls et al. 2018, p. 93, pl. 56, figs. 29, 30; p. 147, pl. 110, figs. 27-28.

Status of name: accepted taxonomically.

Synonym: *Achnanthes laevis* Østrup 1910

Diagnosis: Frustules are strongly bent in the girdle view with concave raphe valve and convex rapheless valve. Valves are elliptical, linear-elliptical to elliptical-lanceolate with broadly rounded ends. The raphe valve has a narrow axial area and an asymmetrical, lanceolate-rhomboid central area, which is usually expanded to the valve margin on one side. The raphe is straight or slightly sigmoid with terminal ends sharply turned in opposite directions. Rapheless valve has a narrow linear or slightly sigmoid axial area and a large rectangular or hexagonal central area, often asymmetrical and expanded to one or both valve margins. Transapical striae are punctate, strongly radiate on the raphe valve and slightly radiate on the rapheless valve, about 23-28 in 10 μm. Length of the valve 10-25 μm, and the breadth 5-8 μm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotrophic (Van Dam et al. 1994); alkaliphilous mainly occurring at pH > 7 (Szulc & Szulc 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Duszatyńskie Lakes (Western Bieszczady Mts.) , south-east Poland (Noga et al. 2013 c); Wisłok river, and Zalew Rzeszowski, Morwawa, Pielnica, Stobnica, Mleczka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Biała

Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the Gulf of Gdansk and surrounding waters, southern Baltic sea (Plinski & Witkowski 2020).

***Eucocconeis quadratarea* (Østrup) Lange-Bertalot 1999**

(Pl. 29, figs. 15-16)

Ref. Hustedt 1924, p. 549, pl. 17, figs. 8, 9; Hustedt 1933, p. 414, fig. 868; Cleve-Euler 1953, p. 23, fig. 520 a, b; Germain 1981, p. 109, pl. 41, figs. 10-11; Hartley et al. 1996, p. 30, pl. 7, fig. 19; Lange-Bertalot & Genkal 1999, p. 48.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis quadratarea* Østrup 1910
Achnanthes quadratarea (Østrup) R.Ross 1986
Achnanthes laevis var. *quadratarea* (Østrup) Lange-Bertalot 1989
Eucocconeis lapponica Hustedt 1924
Achnanthes lapponica (Hustedt) Hustedt 1933
Cocconeis lapponica (Hustetd) A.Cleve 1934
Achnanthes lapponica var. *genuina* A.Cleve 1953

Diagnosis: Valve weakly curved, elliptical-lanceolate with subrostrate, broadly rounded apices not set off from the valve body. Raphe valve with narrow linear axial area. Central area expands to form fascia with slightly broader striae, which are irregular or alternately longer and shorter. Raphe is filiform; the proximal raphe endings are only slightly expanded; the distal raphe endings are curved in opposite directions. Transapical striae are radiate throughout, broader at the valve centre, becoming narrower and denser toward the ends. Rapheless valve with narrow, linear axial area. Central area large, oval or rounded, quadrangular, extending close to the margin. Transapical striae are radiate throughout, wider and shorter at the centre, becoming narrow and denser toward the ends; about 24-27 in 10 μm at the valve centre, becoming 30-32 in 10 μm toward the ends on both valves. Length of the valve 10-20 μm, and the breadth 6-9 μm.

Ecological preference: as *Achnanthes lapponica* (Hustedt) Hustedt, distributed in streams and small lakes from Nordic-alpine, oligotrophic, acidophilous (Picińska-Fałtynowicz 1988).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Eucocconeis quadratarea* var. *ninckei* (Guermeur & Manguin) Zalat comb. nov.**

Ref. Manguin 1953, p. 541, pl. 1, figs. 10-11; Patrick & Reimer 1966, p. 259, pl. 16, figs. 29, 30; Kaczmarska 1977, p. 41, pl. 10, figs. 6-8; Lange-Bertalot & Krammer 1989, p. 82, pl. 18, figs. 19-20.

Synonyms: *Achnanthes ninckei* Guermeur & Manguin 1953
Achnanthes lapponica var. *ninckei* (Guermeur & Manguin) Reimer 1966
Achnanthes laevis var. *ninckei* (Guermeur & Manguin) Lange-Bertalot 1989
Eucocconeis lapponica var. *ninckei* (Guermeur & Manguin) Edlund 1994

Diagnosis: Valve is moderately arched, short-lanceolate to elliptical with produced rostrate apices in longer forms and obtusely rounded apices not set off from the valve body. Raphe valve with narrow linear axial area expanding slightly near the central area, deflecting in opposite directions quite near the ends, forming a sigma. Central area is a more or less unilateral expanding fascia; the opposite side with slightly broader striae, which are irregular or alternately longer and shorter. Raphe is filiform, proximal raphe endings are only slightly broadened; distal raphe endings are curved in opposite directions. Transapical striae are radiate throughout, broader at the middle portion of the valve, becoming narrower and more numerous toward the ends. Rapheless valve with narrow, linear axial area. Central area is large, oval or quadrangular with unilateral fascia extending to the margin on one side only. Transapical striae are radiate throughout, broader and shorter at the centre, becoming narrow and more numerous toward the ends; striae about 20-24 in 10 μm at the centre, becoming 28-32 in 10 μm toward the ends. Length of the valve 9-24 μm, breadth 5-7 μm.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976, 1977).

Genus *Lemnicola* Round & Basson, 1997

Diagnosis: Frustules are heterovalvar. Valves are linear-elliptic, elliptic, or linear-lanceolate, with wedge-shaped to broadly rounded or slightly protracted apices. Raphe valve is concave with a narrow linear axial area. Central area is expanded into an asymmetric, thickened stauros, extending up to the valve margin. Raphe is straight with expanded teardrop-shaped central ends, internally slightly deflected in opposite directions; terminal raphe fissures are deflected in opposite directions. Rapheless valve is convex with a linear axial area. Mantle with a row of pores, with convex occlusions internally. Transapical striae are biseriate, areolate; areolae are round. The structure of the rapheless valve is similar to the raphe valve, but the central stauros is reduced or absent.

Holotype species: *Lemnicola hungarica* (Grunow) Round & Basson 1997

***Lemnicola hungarica* (Grunow) Round & Basson 1997**

(Pl. 29, figs. 17-18)

Ref. Hustedt 1930, p. 201, fig. 283; Hustedt 1933, p. 383, fig. 829; Patrick & Reimer 1966, p. 259. pl. 16. figs. 27-28; Foged 1978, p. 26, pl. 14, figs. 18, 19; Germain 1981, p. 112, pl. 41, figs. 38-45; John 1983, p. 71, pl. 30, figs. 11-14; Holland & Clark 1989, p. 9, pl. 1, fig. 5; Krammer & Lange-Bertalot 1991 b, p. 33. pl. 19. fig. 1-15; Vyverman et al. 1995, p. 15, pl. 5, fig. 9; Round & Basson 1997, p. 77, figs. 4-7, 26-31; Wojtal 2009, p. 232, pl. 6, figs. 19-23; pl. 58, figs. 3-5; Kulikovskiy et al. 2016, p. 233, pl. 35, figs. 90-93.

Status of name: accepted taxonomically.

Synonyms: *Achnanthidium hungaricum* Grunow 1863
Microneis hungarica (Grunow) Meister 1912
Achnanthes hungarica (Grunow) Grunow 1880
Cocconeis hungarica (Grunow) Schönfeldt 1907

Diagnosis: Valves are linear-elliptical to linear-lanceolate with obtuse-rounded to subcuneate acutely-rounded or subrostrate apices, sometimes slightly protracted by a subtle constriction of the valve margins. The raphe valve has a narrow, linear axial area, sometimes slightly widened at the valve centre. Central area is a broad, transverse fascia, almost reaching margins, often appearing wider on one side. Raphe is filiform, proximal raphe endings are rather close, rounded, distal raphe endings are short, slightly expanded, and turned in opposite directions. Transapical striae are subparallel in the middle part and slightly radiate towards the ends, about 20-23 in 10 µm. Rapheless valve has a narrow linear axial area; Central area is absent or very small, often asymmetric, irregularly shaped, formed by a few slightly shortened central striae. Transapical striae are slightly radiate in the valve centre, becoming strongly radiate at the apices, about 18-22 in 10 µm. Length of the valve 18-40 µm, and the breadth 6-8 µm.

Ecological preference: Cosmopolitan, salinity indifferent, pH: alkaliphilous (Foged 1957); in waters with moderate or elevated conductivity (Krammer & Lange-Bertalot 1991b); an alkaliphilous, α-mesosaprobous, hypereutraphentic and fresh brackish water species (Van Dam et al. 1994); *Achnanthes hungarica* is a common, widespread diatom, occurring all over the world. This species is alkaliphilous and saprobic when present in large numbers. It occurs in lakes and ponds, and occasionally in flowing waters, and some floating plants in freshwaters were dominated by *Achnanthes hungarica* (Garcia & Souza 2006; Buczkó 2007); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); freshwater of an alkaline character or close to circumneutral with pH (6.5-8.4), electrolytic conductivity ranged from 128 µS/cm to 528 µS/cm, temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 b, c); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); peat bog in Modlniczka, southern Poland (Piątek 2007); Kobylanka stream, south Poland (Wojtal 2009); Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

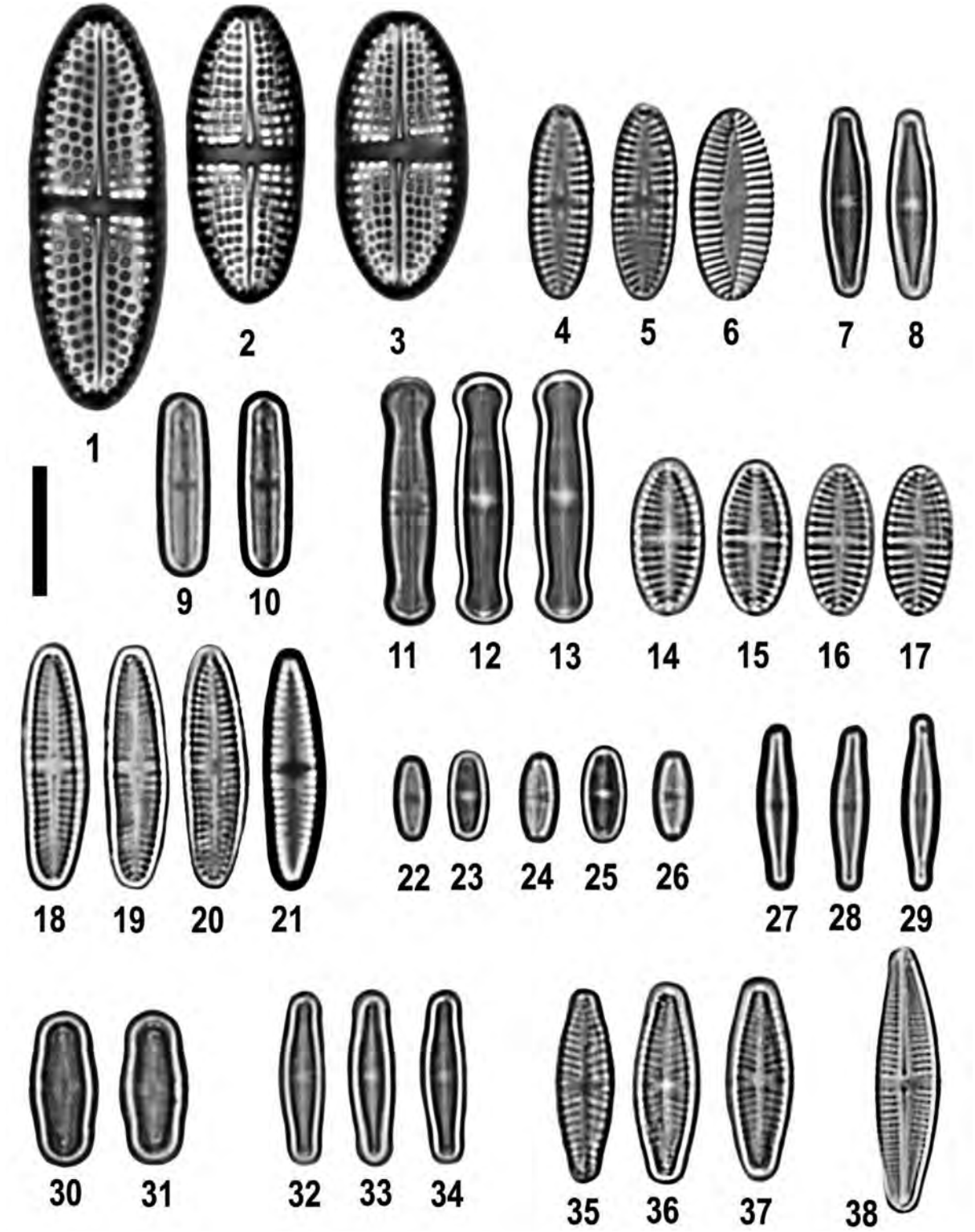


Plate 15: 1-3. *Achnanthes intermedia* Kützing 1833, Jeziorak Lake; 4-6. *Achnanthes rupestoides* Hohn 1961, Eemian deposits; 7-8. *Achnanthidium affine* (Grunow) Czarnecki 1994, Eemian deposits; 9-10. *Achnanthidium anastasiae* (Kaczmarska) Chaudev & Gololobova 2016, Jeziorak Lake; 11-13. *Achnanthidium caledonicum* (Lange-Bertalot) Lange-Bertalot 1999, Eemian deposits; 14-21. *Achnanthidium delmontii* Pérès, Le Cohu & Barthès 2012, Eemian deposits; 22-26. *Achnanthidium duriense* Novais & Ector 2015, 22-23. Eemian deposits; 24-26. Jeziorak Lake; 27-29. *Achnanthidium indistinctum* Van de Vijver & Kopalová 2014, Jeziorak Lake; 30-31. *Achnanthidium microcephalum* Kützing 1844, Eemian deposits; 32-34. *Achnanthidium minutissimum* (Kützing) Czarnecki 1994, Jeziorak Lake; 35-37. *Achnanthidium minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot 1989 , Jeziorak Lake; 38. *Achnanthidium pyrenaicum* (Hustedt) Kobayasi 1997, Młynek Lake. Scale bar = 10 μm.

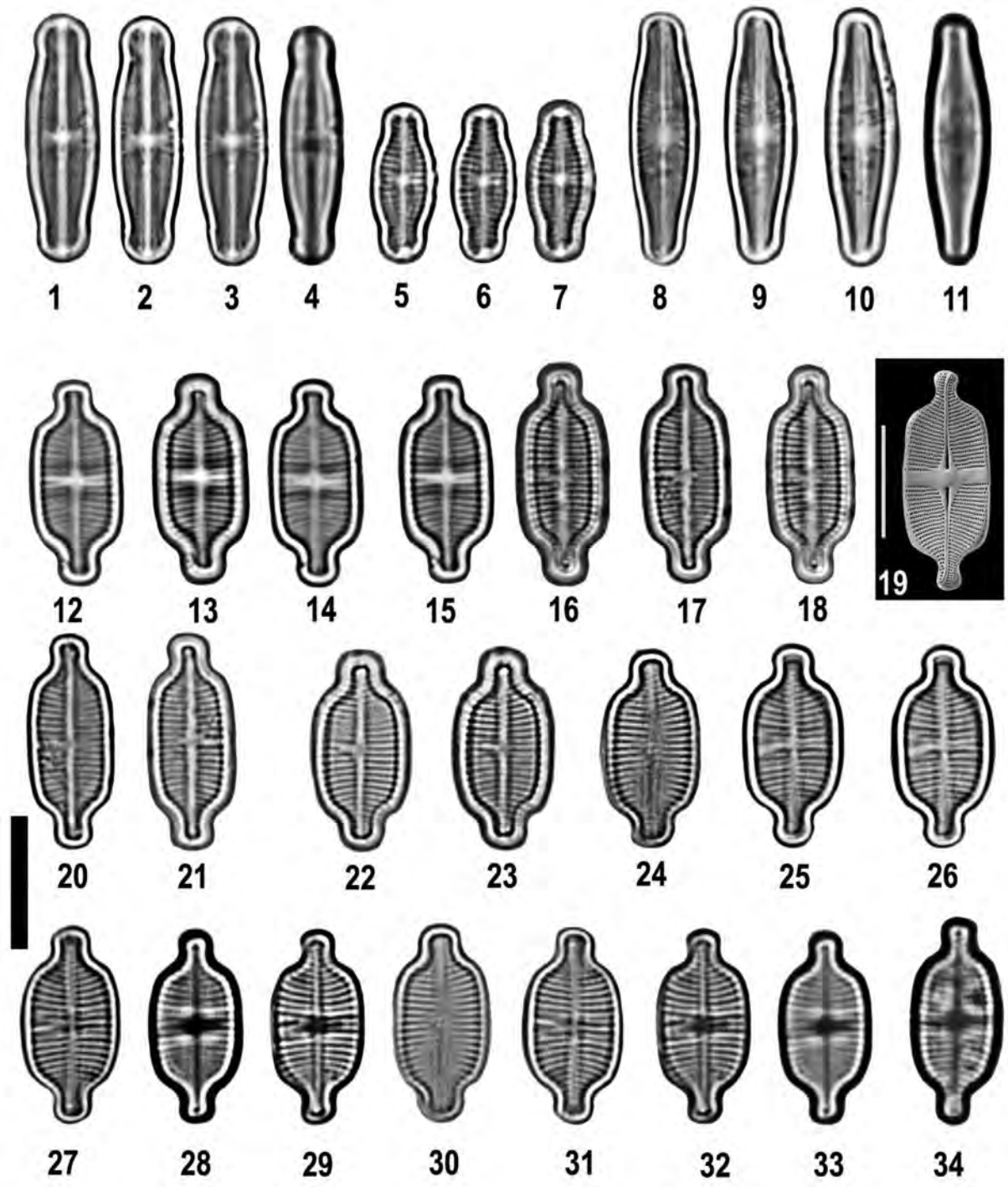


Plate 16: 1-4. *Achnanthidium reimeri* (Camburn) Ponader & Potapova 2007, Eemian deposits; 5-7. *Achnanthidium rosenstockii* (Lange-Bertalot) Lange-Bertalot 2004, Kamionka Lake; 8-11. *Achnanthidium saprophilum* (Kobayashi & Mayama) Round & Bukhtiyarova 1996, Eemian deposits; 12-21. *Gogorevia australexigua* (Van de Vijver) Kulikovskiy & Kociolek 2020, Jeziorak Lake; 22-34. *Gogorevia exilis* (Kützing) Kulikovskiy & Kociolek 2020, Młynek Lake. Scale bar = 10 µm.

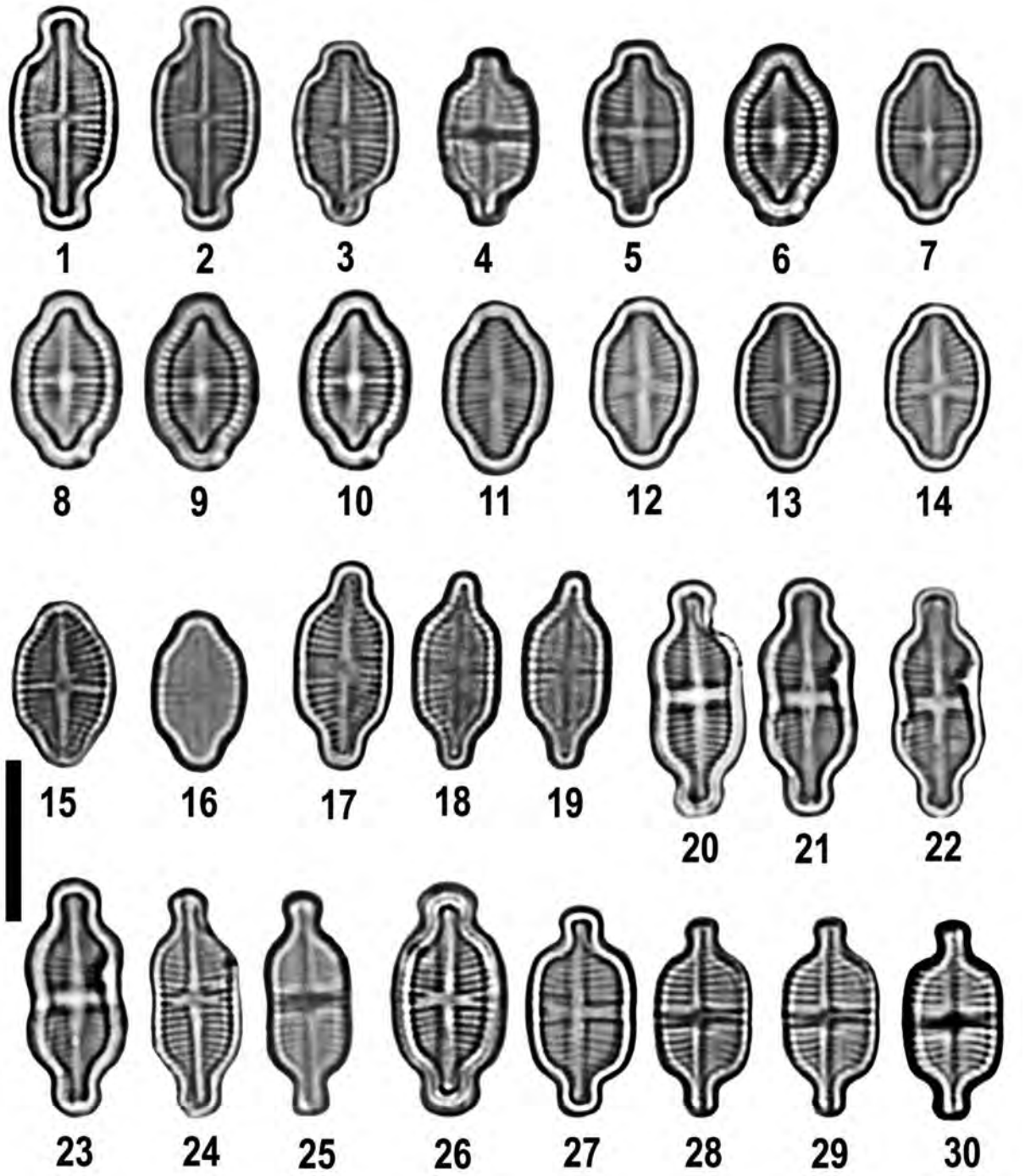


Plate 17: 1-16. *Gogorevia exilis* (Kützing) Kulikovskiy & Kociolek 2020, 1-12. Kamionka Lake; 13-16. Eemian deposits; 17-19. *Gogorevia exilis* var. *angustirostrata* Zalat comb. nov., Jeziorak Lake; 20-25. *Gogorevia exilis* var. *constricta* Zalat & Pidek comb. nov., Eemian deposits; 26-30. *Gogorevia heterovalva* (Krasske) Tseplik & Chudaev 2023, Kamionka Lake. Scale bar = 10 µm.

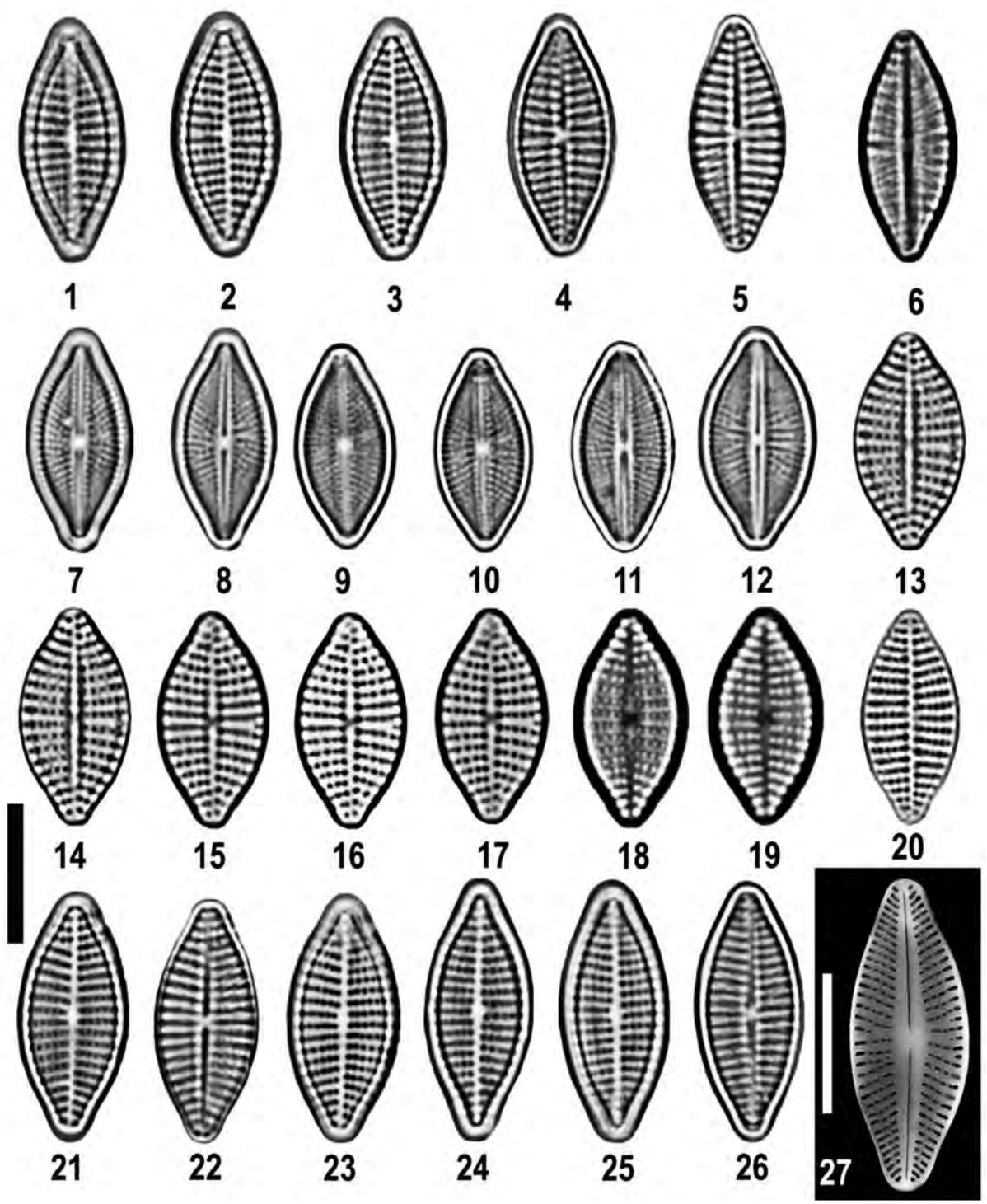


Plate 18: 1-27. *Karayevia clevei* (Grunow) Bukhtiyarova 1999, 1-6. Radomno Lake; 7-27. Eemian deposits. Scale bar = 10 µm.

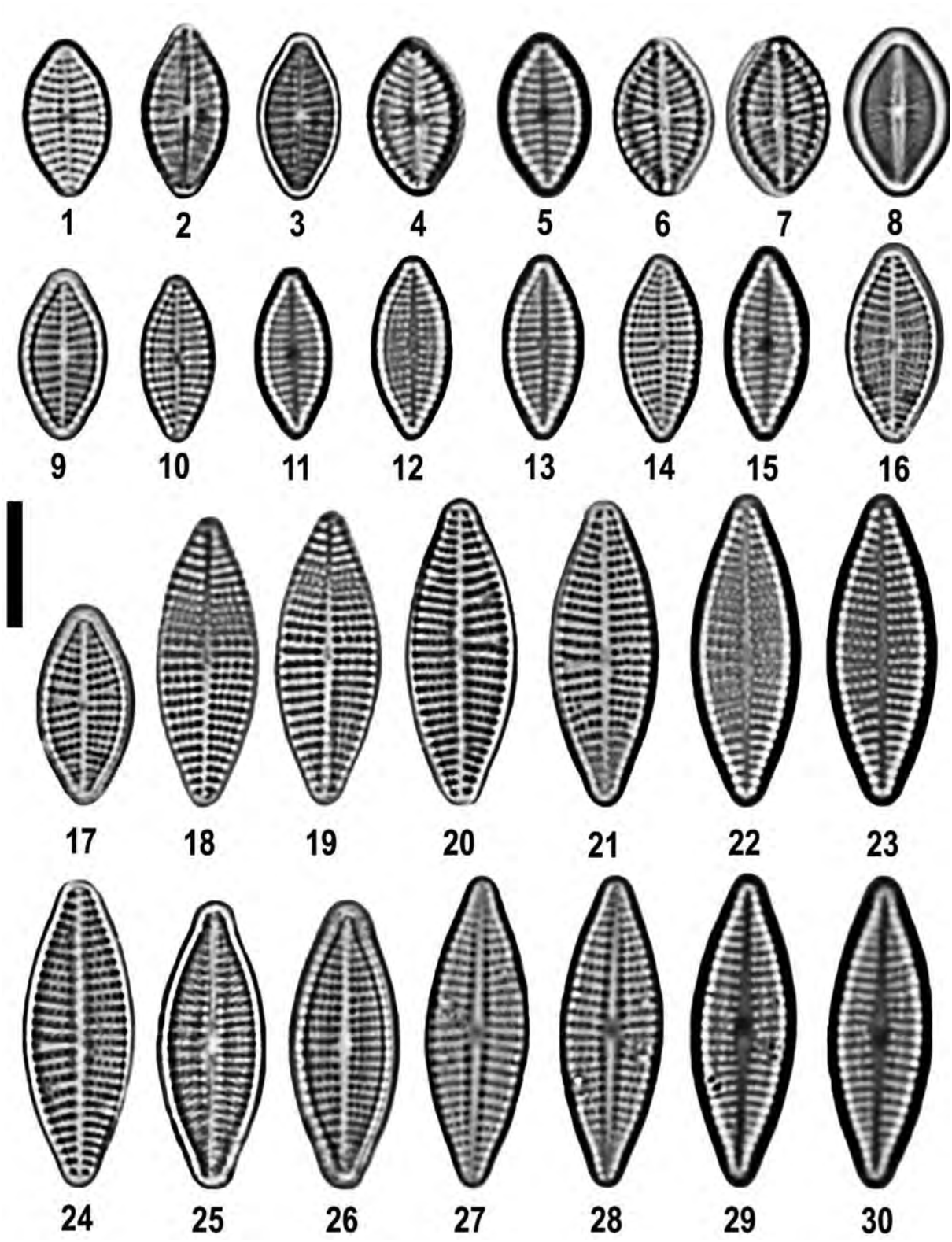


Plate 19: 1-17. *Karayevia clevei* (Grunow) Bukhtiyarova 1999, 1-3. Eemian deposits; 4-14. Jeziorak Lake; 15-17. Radomno Lake; 18-30. *Karayevia clevei* var. *balcanica* (Hustedt) Levkov & Krstic 2007, 18-24. Eemian deposits; 25-30. Jeziorak Lake. Scale bar = 10 µm.

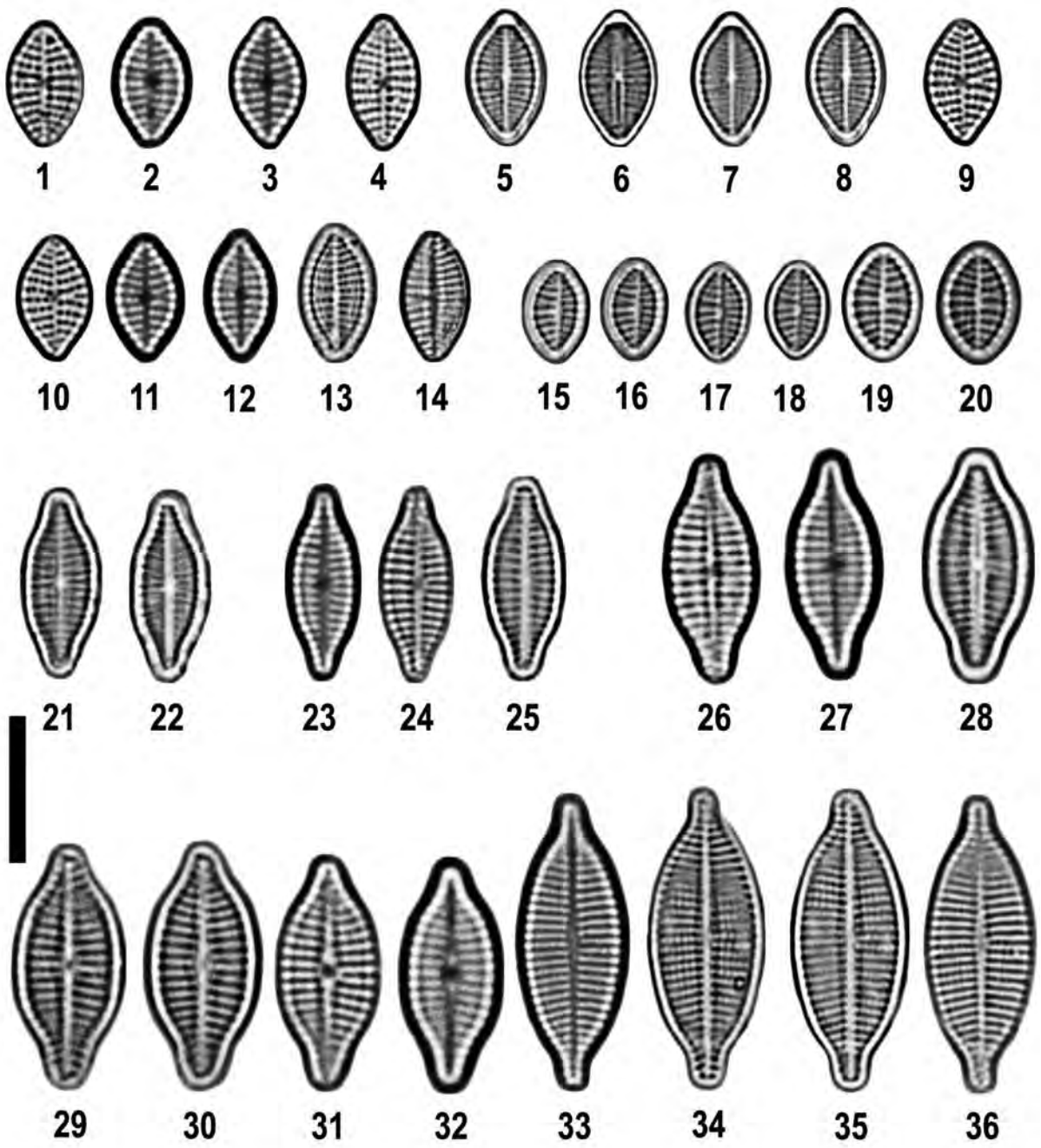


Plate 20: 1-14. *Karayevia clevei* var. *minor* Zalat, nov. var., 1-12. Eemian deposits; 13-14. Kamionka Lake; 15-20. *Karayevia jeziorakensis* Zalat nov. sp. Jeziorak Lake; 21-22. *Karayevia kolbei* (Hustedt) Bukhtiyarova 1999, Eemian deposits; 23-25. *Karayevia ploenensis* (Hustedt) Bukhtiyarova 1999, Eemian deposits; 26-36. *Karayevia rostrata*, 26-27. Jeziorak Lake; 28-36. Eemian deposits. Scale bar = 10 μm.

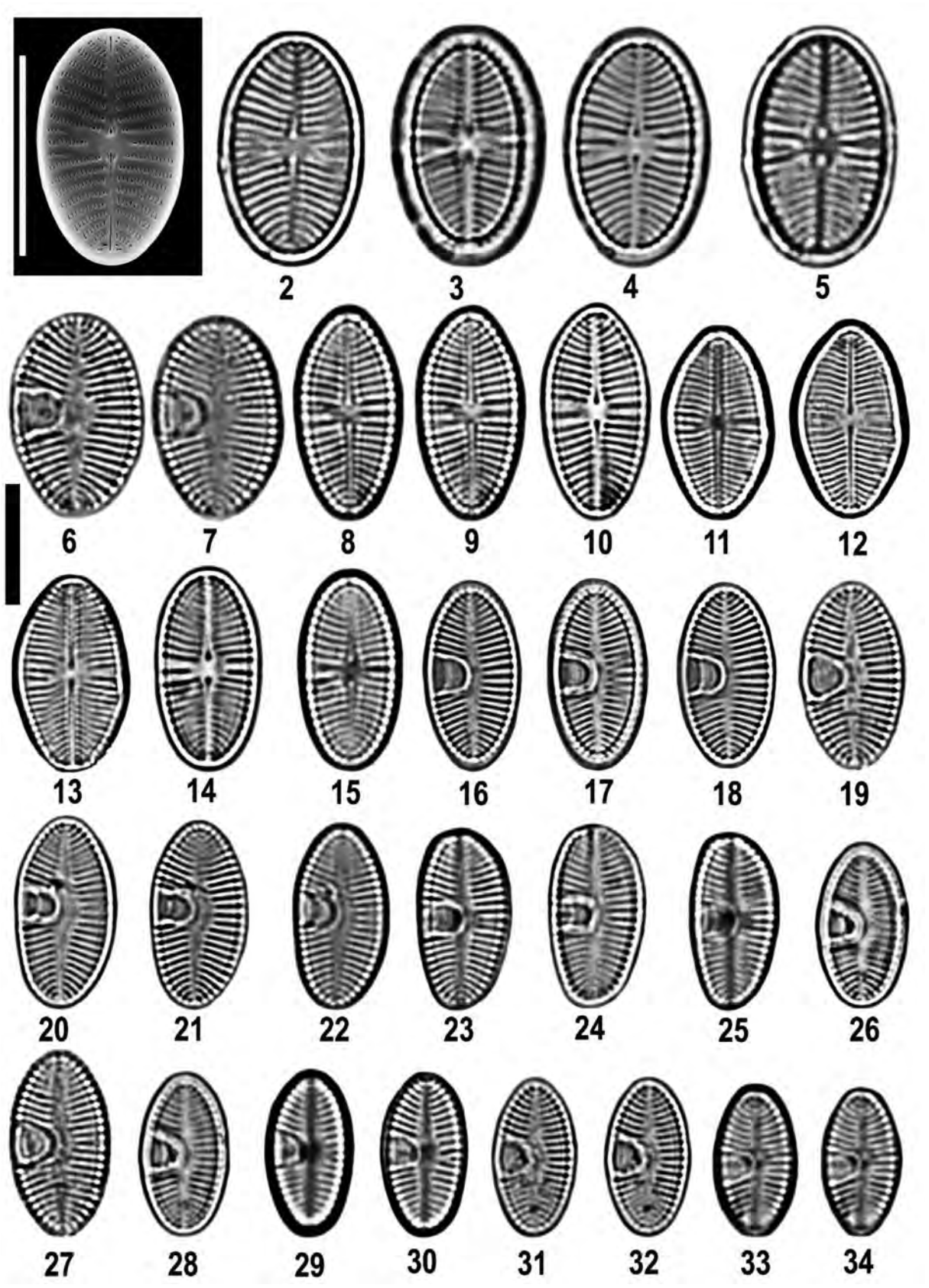


Plate 21: 1-34. *Planoplatessa joursacensis* (Héribaud) Kulikovskiy, Glushchenko & Kociolek 2022, 1-19. Kamionka Lake; 20-34. Jeziorak Lake. Scale bar = 10 µm.

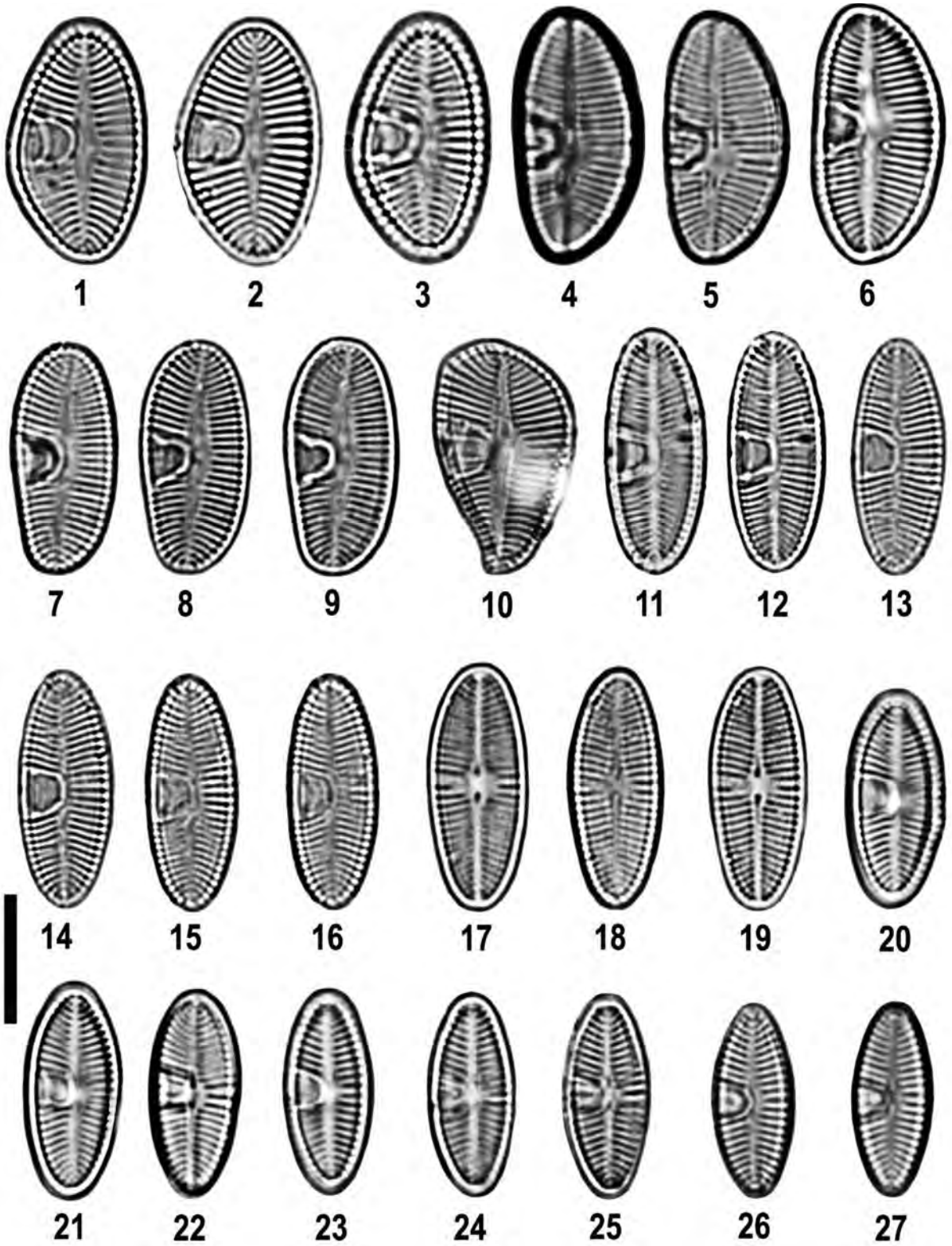


Plate 22: 1-10. *Planoplatessa joursacensis* (Héribaud) Kulikovskiy, Glushchenko & Kociolek 2022, 1-3. Kamionka Lake; 4-10. Jeziorak Lake; 11-27. *Planoplatessa joursacensis* var. *elongatum* Zalat nov.var. 11-16. Kamionka Lake; 17-19, 23-27. Jeziorak Lake; 20-22. Młynek Lake. Scale bar = 10 μm.

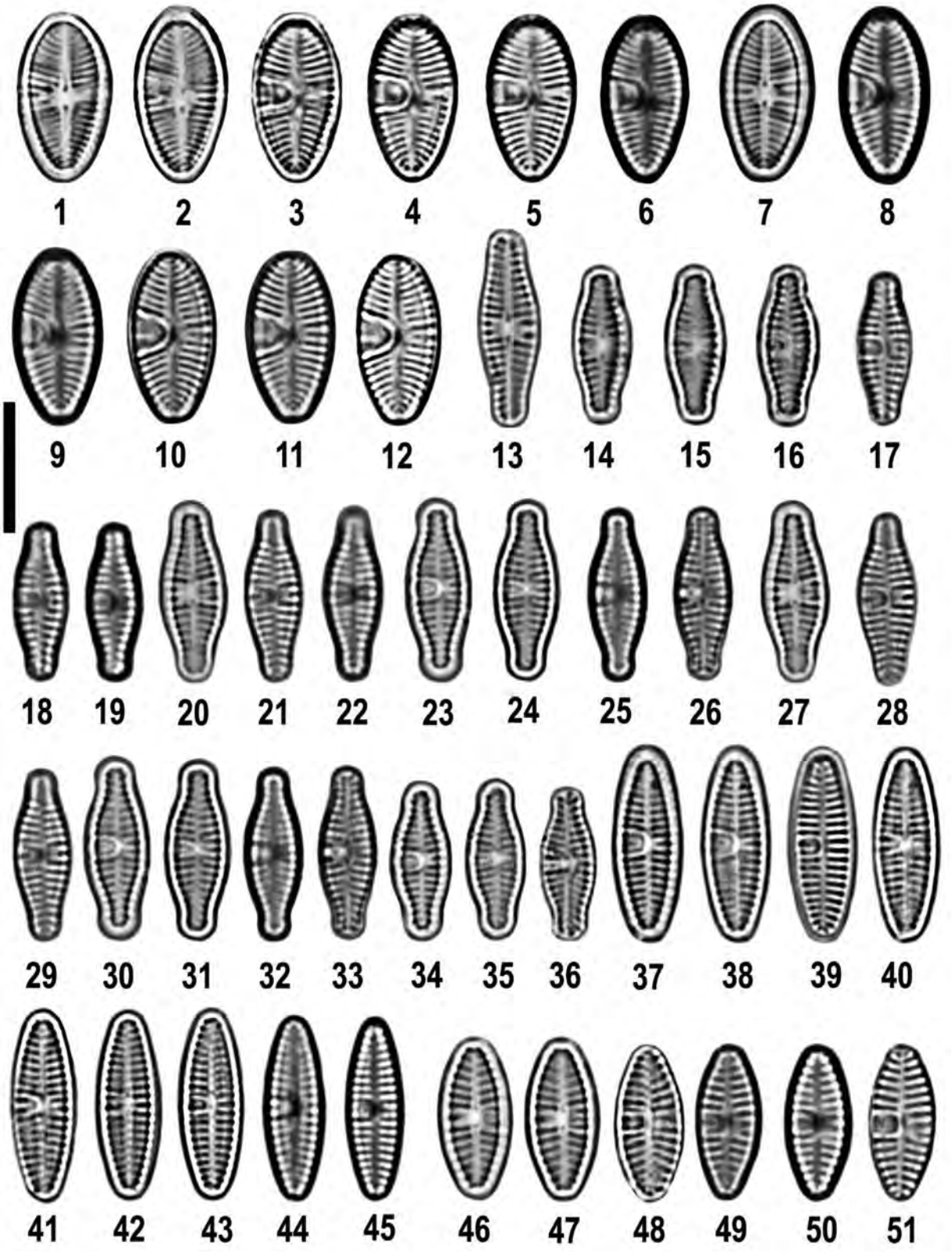


Plate 23: 1-12. *Planoplatessa joursacensis* var. *ovatum* Zalat nov.var. 1-6. Eemian deposits; 7-12. Jeziorak Lake; 13-36. *Planothidium amphibium* Wetzel, Ector & Pfister 2014, 13-19. Eemian deposits; 20-36. Jeziorak Lake; 37-51. *Planothidium bagualensis* Wetzel & Ector 2014, 37-45. Młynek Lake; 46-51. Eemian deposits. Scale bar = 10 µm.

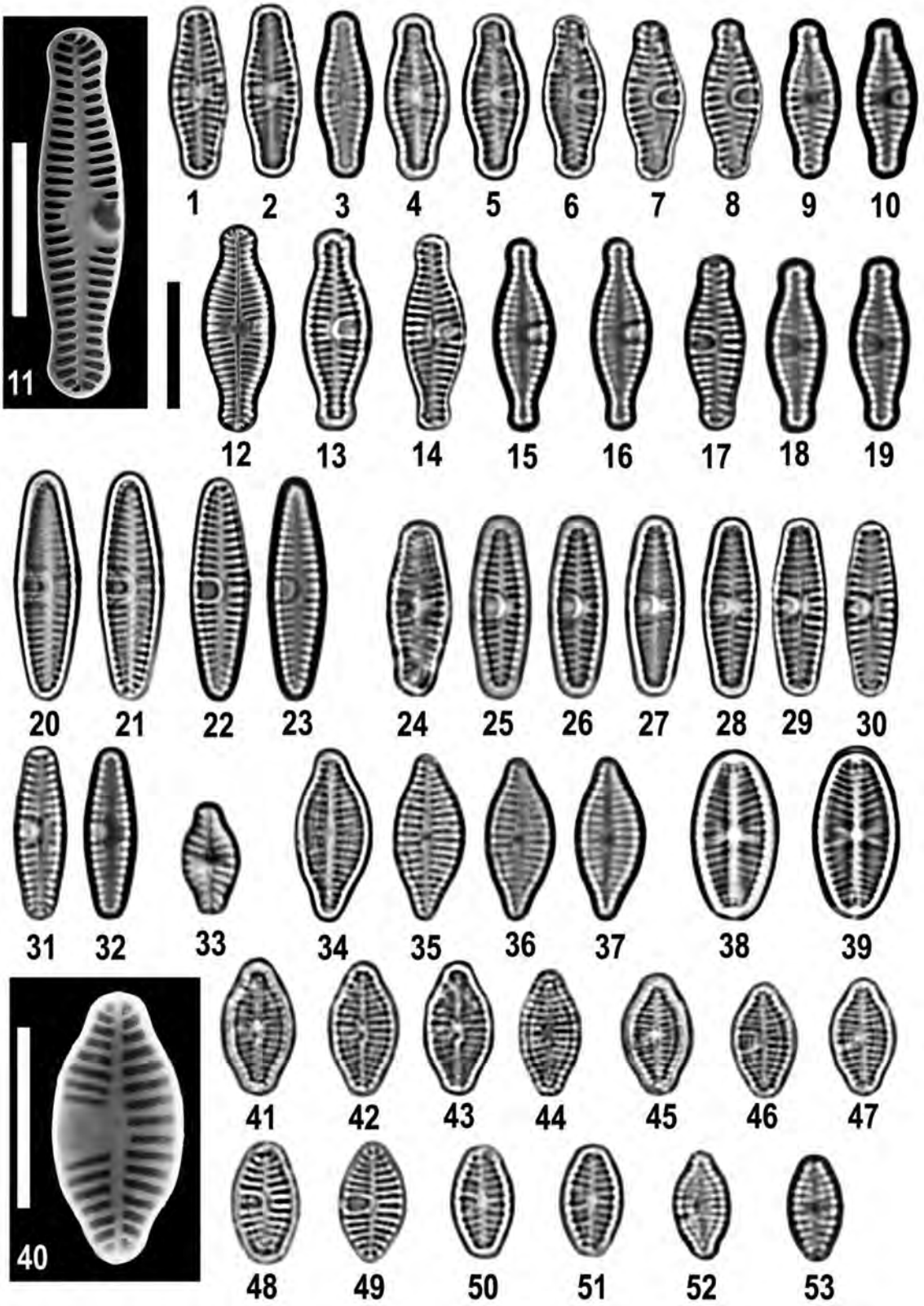


Plate 24: 1-10. *Planothidium biporomum* (Hohn & Hellerman) Lange-Bertalot 1999, Eemian deposits; 11-19. *Planothidium capitatum* (O.Müller) Van de Vijver, Kopalová, Wetzel & Ector 2014, 11-12. Eemian deposits; 13-19-Jeziorak Lake; 20-23. *Planothidium cavilanceolatum* Wetzel, Kelly & Van de Vijver 2019, Eemian deposits; 24-32. *Planothidium cryptolanceolatum* Jahn & Abarca 2017, Eemian deposits; 33. *Planothidium daui* (Foged) Lange-Bertalot 1999, Eemian deposits; 34-37. *Planothidium delicatulum* (Kützing) Round & Bukhtiyarova 1996, Jeziorak Lake; 38-39. *Planothidium distinctum* (Messikommer) Lange-Bertalot 1999, Eemian deposits; 40-53. *Planothidium dubium* (Grunow) Round & Bukhtiyarova 1996, 40-47. Kamionka Lake; 48-53. Młynek Lake. Scale bar = 10 µm.

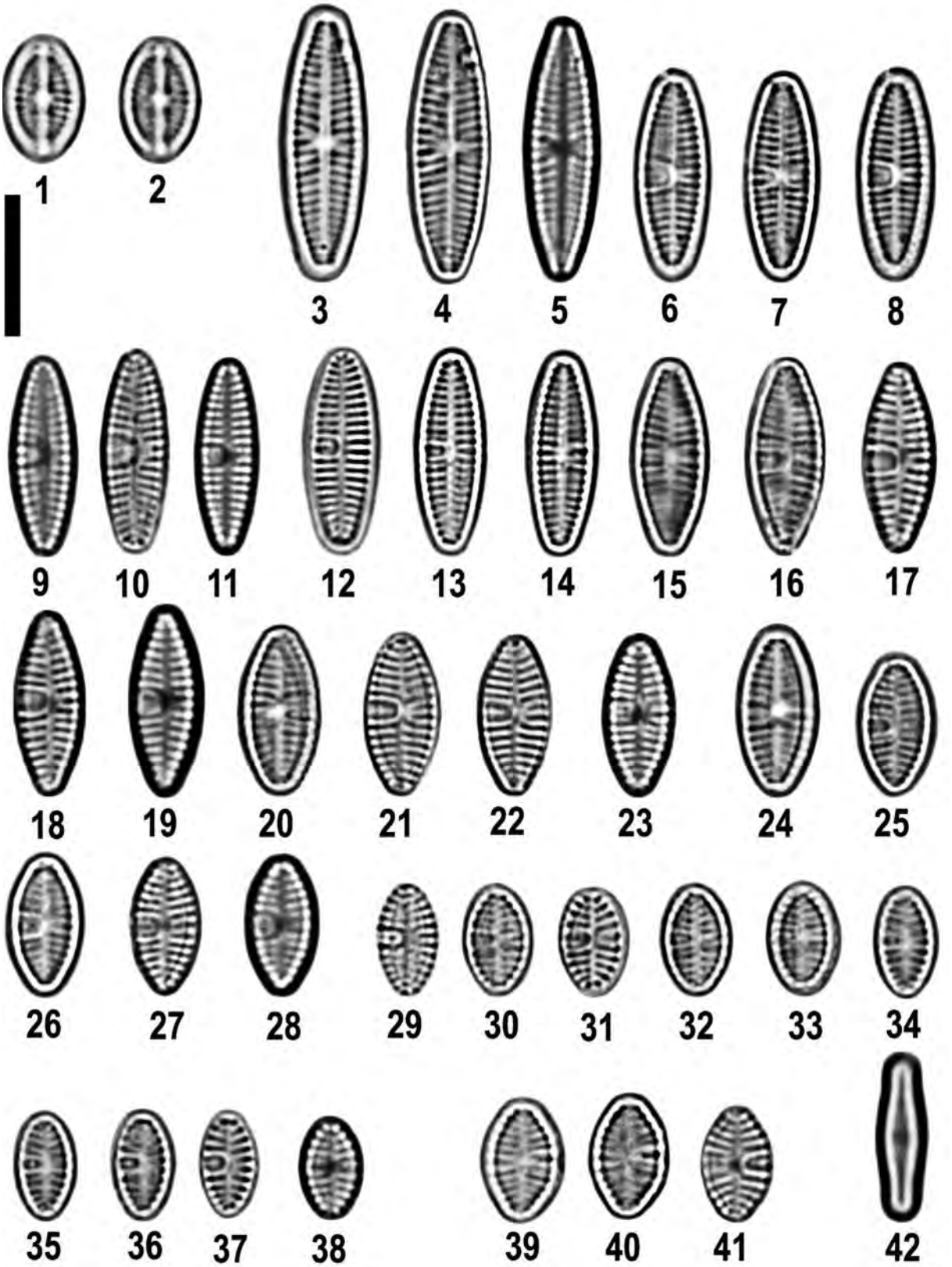


Plate 25: 1-2. *Planothidium ellipticum* (Cleve) Edlund 2001, Eemian deposits; 3-28. *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot 1999, 3-5, 25-28. Jeziorak Lake; 6-14. Młynek Lake; 15-19. Eemian deposits; 20-24. Kamionka lake; 29-38. *Planothidium frequentissimum* var. *minutum* Zalat & Nitychoruk nov. var. 29. Radomno Lake; 30-38. Eemian deposits; 39-41. *Planothidium granum* (Hohn & Hellerman) Lange-Bertalot 1999, Młynek Lake; 42. *Planothidium grimmei* (Krasske) Bishop & Spaulding 2018, Jeziorak Lake. Scale bar = 10 μm.

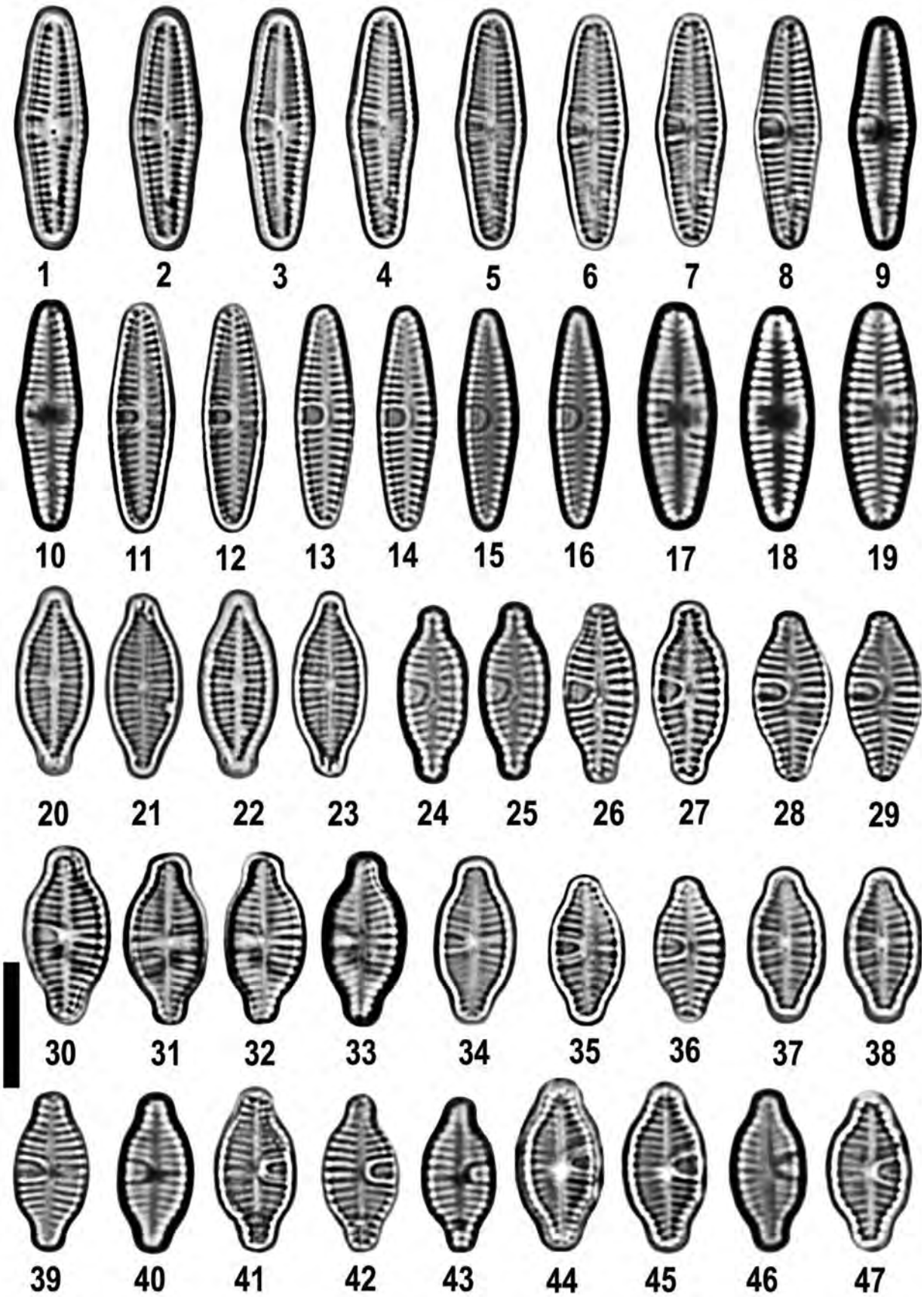


Plate 26: 1-19. *Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot 1999, 1-16. Eemian deposits; 17-19. Radomno Lake; 20-23. *Planothidium lilianeanum* Van de Vijver 2018, Jeziorak Lake; 24-27. *Planothidium reichardtii* Lange-Bertalot & Werum 2004, Jeziorak Lake; 28-47. *Planothidium rostratum* (Østrup) Lange-Bertalot 1999, Eemian deposits. Scale bar = 10 µm.

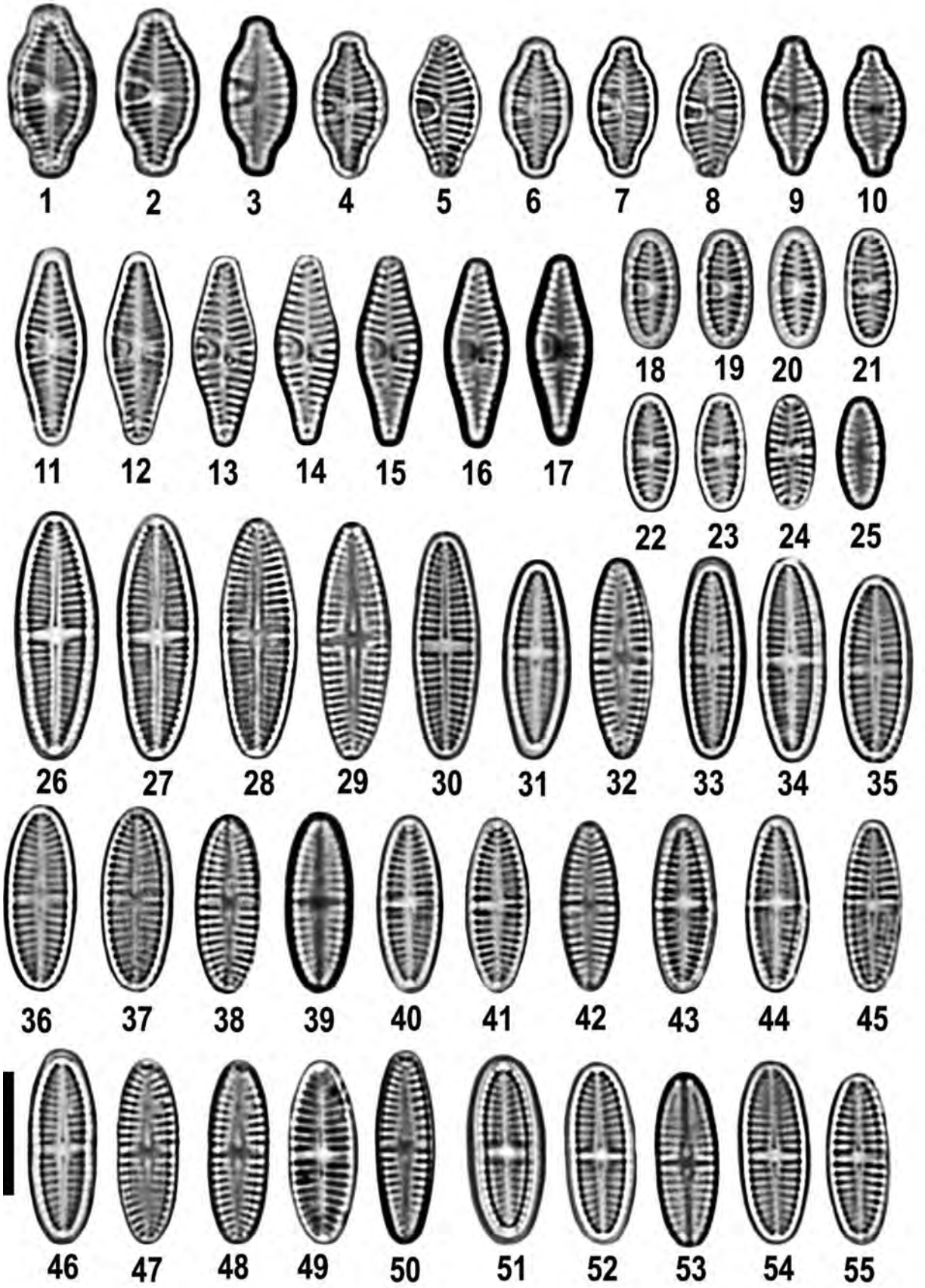


Plate 27: 1-10. *Planothidium rostratum* (Østrup) Lange-Bertalot 1999, 1-3. Eemian deposits; 4-10. Młynek Lake; 11-17. *Planothidium taeansa* Jahn & Abarca 2017, Eemian deposits; 18-25. *Planothidium victori* Novis, Braidwood & Kilroy 2012, Eemian deposits; 26-55. *Platessa conspicua* (A. Mayer) Lange-Bertalot 2004, 26- 50. Eemian deposits; 51-55. Radomno Lake. Scale bar = 10 μm.

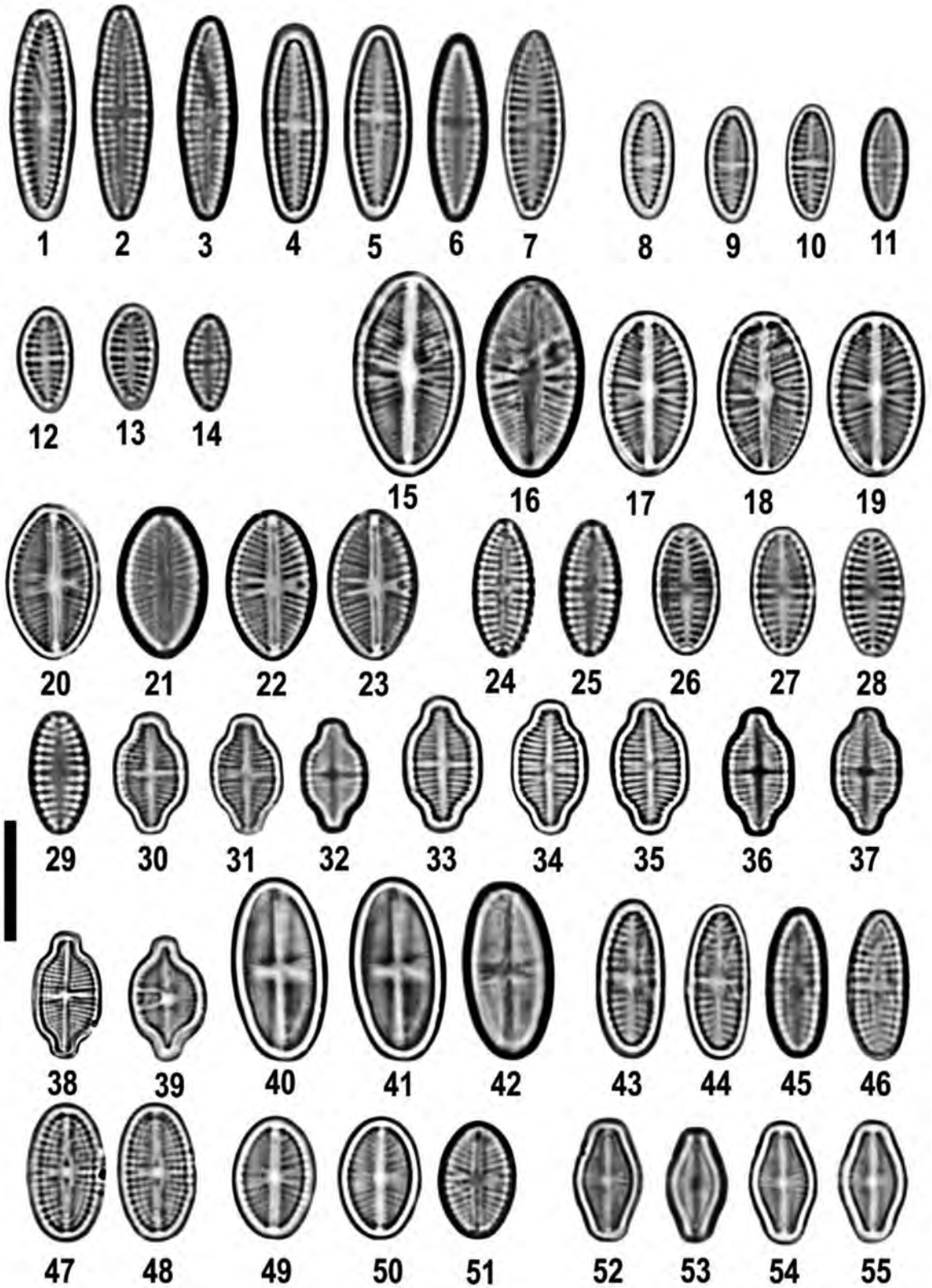


Plate 28: 1-7. *Platessa conspicua* (A.Mayer) Lange-Bertalot 2004, Eemian deposits; 8-14. *Platessa conspicua* var. *minuta* Zalat & Welc nov. var., Młynek Lake; 15-23. *Platessa guianensis* Le Cohu, Tudesque & Wetzel 2016, Eemian deposits; 24-29. *Platessa stewartii* (Patrick) Potapova 2012, Eemian deposits; 30-39. *Platessa ziegleri* (Lange-Bertalot) Lange-Bertalot 2004, 30-33. Eemian deposits; 34-37. Jeziorak Lake; 38. Kamionka Lake; 39. Młynek Lake; 40-42. *Psammothidium bioretii* (Germain) Bukhtiyarova & Round 1996, Jeziorak Lake; 43-46. *Psammothidium lauenburgianum* (Hustedt) Bukhtiyarova & Round 1996, Jeziorak Lake; 47-48. *Psammothidium semiapertum* (Hustedt) Aboal 2003, Kamionka Lake; 49-51. *Psammothidium subatomoides (*Hustedt) Bukhtiyarova & Round 1996, Eemian deposits; 52-55. *Psammothidium ventrale* (Krasske) Bukhtiyarova & Round 1996, Kamionka Lake. Scale bar = 10 μm.

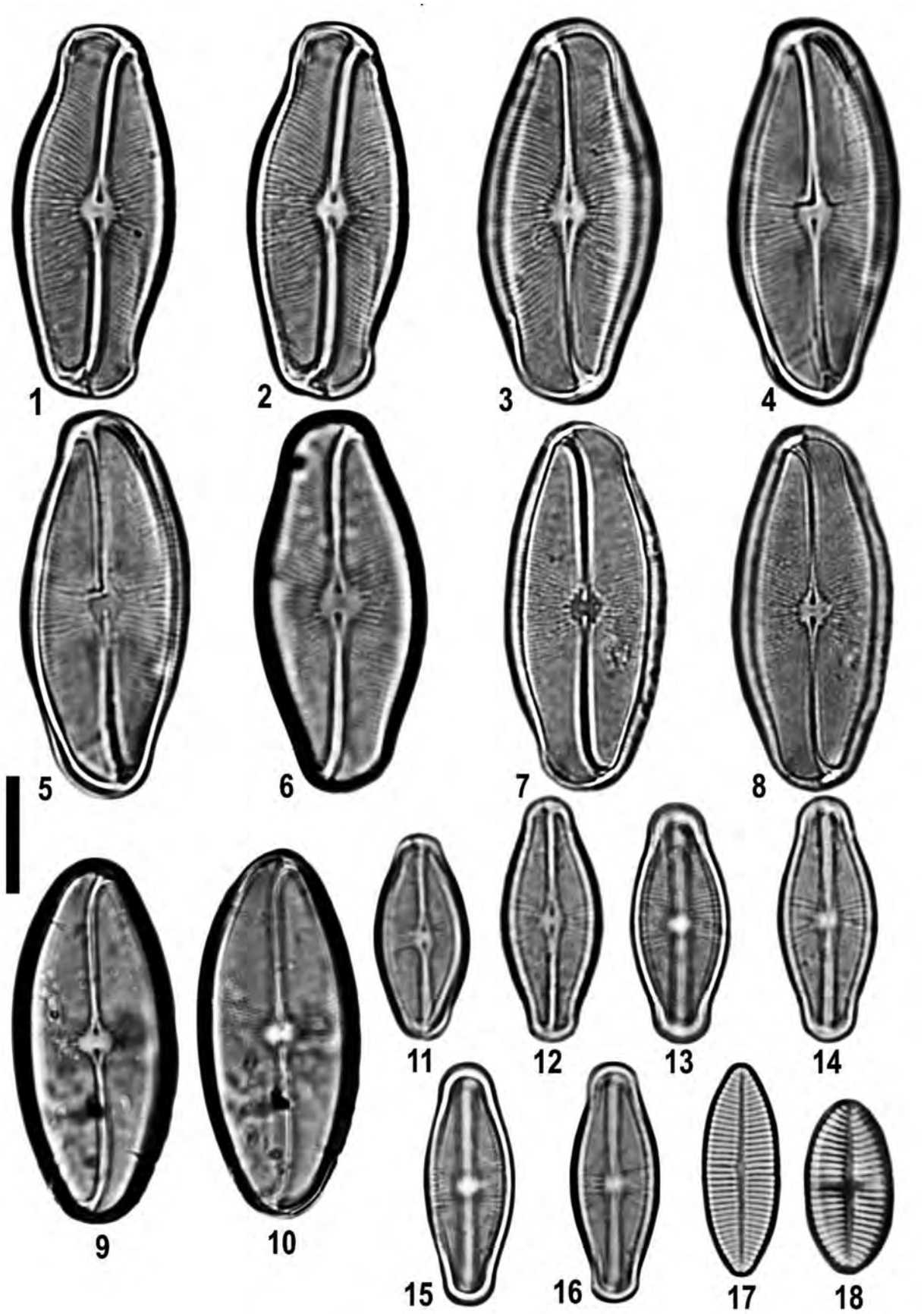


Plate 29: 1-10. *Eucocconeis flexella* (Kützing) Cleve 1885, 1-6. Jeziorak Lake; 7-8. Kamionka Lake; 9-10. Eemian deposits; 11-14. *Eucocconeis laevis* (Østrup) Lange-Bertalot 1999, Jeziorak Lake; 15-16. *Eucocconeis quadratarea* (Østrup) Lange-Bertalot 1999; Jeziorak Lake; 17-18. *Lemnicola hungarica* (Grunow) Round & Basson 1997, Radomno Lake. Scale bar = 10 µm.

Family Cocconeidaceae Kützing 1844

Genus *Anorthoneis* Grunow 1868

Diagnosis: Frustules are heterovalvar. Valves are elliptical, often almost circular. Valves are very shallow with no true mantle, and the valve face is undulate. Raphe sternum and araphid sternum are short, not reaching the ends, eccentric. Raphe without terminal fissures. Internal proximal raphe endings are non-coaxial, being curved in opposite directions. External proximal raphe endings are straight, slightly expanded. Transposal striae are uniseriate, comprising grounded or oval poroids.

Anorthoneis is a small benthic marine genus (Round et al. 1990) whose members live with their raphe valve attached to the substratum (e.g., rocks, sand grains, plants or animals) and the rapheless valve exposed to the surrounding environment (Round *et al*. 1990)

Holotype species: *Anorthoneis excentrica* (Donkin) Grunow 1868

***Anorthoneis vortex* Sterrenburg 1987**

Ref. Sterrenburg 1987, p. 15, figs. 1-4; Sterrenburg 1988, p. 375, pl. 1, figs. 5, 7; pl.2, figs. 8-15; pl. 5, figs. 30-35; Witkowski et al. 2000, p. 98, pl. 42, fig 23-25; Riaux-Gobin et al. 2011a, pl. 1, figs. 4, 5; pl. 26, figs. 1-6; Lobban et al. 2012, p. 286, pl. 39, fig. 5; Pennesi et al. 2018, p. 227, figs. 112-129; Kaleli et al. 2020, p. 208, fig. 3. F.

Status of name: accepted taxonomically.

Diagnosis: Valves are heterovalvar, broadly elliptical to almost circular in outline. Raphe valve has a flat to convex valve face, with a concave mantle. Axial area is asymmetric, developed within the valve face. Central area is strongly asymmetric. Proximal raphe endings are expanded, pore-like, and deflected in opposite directions. Distal raphe endings are similar in shape to the central ones, terminate in roundish terminal areas, distant from the valve margin. Transapical striae are uniseriate, radiate throughout the valve, about 22-24 in 10 μm, becoming biseriate on the mantle. Internally, both the axial area and the central nodule are thickened and prominent. Rapheless valve has a flat valve face, becoming convex near the mantle. Axial area is eccentric, very narrow, not well evident, and lacking terminal areas. Central area is asymmetric, irregular. Transapical striae are areolate, uniseriate, radiate throughout the valve, about 20-22 in 10μm, areolae about 16-19 in 10 μm. Length of the valve 14–16 μm, and the breadth 10-12 μm.

Remarks: This species is distinguished from *Anorthoneis excentrica* (Donkin) Grunow and *Anorthoneis pulex* Sterrenburg by the size and the striae count.

Ecological preference: This taxon is part of the adnate, epipsammic fraction of estuarine-marine sandy sediments; observed both in epilithic and epiphytic samples. A marine, euryhaline species (Hendey 1964; Lobban et al. 2012; Witkowski et al. 2000).

Distribution in Poland: found in Górki Zachodnie – Vistula River estuary in North Poland (Majewska et al. 2012)**;** Gulf of Gdánsk and surrounding waters, southern Baltic Sea. (Plinski & Witkowski 2020).

Genus *Cocconeis* Ehrenberg 1837

Diagnosis: Frustules are heterovalvar with a concave raphe valve and a convex rapheless valve, often very strongly so. Girdle is shallow, and the frustules are almost always lying in valve view. Valves are varied from almost circular in outline to elliptical with rounded, or slightly pointed, ends. The raphe valve with fine, radiate striae, a narrow, linear axial area and a small central area. Often, a hyaline area is at or close to the margin of the valve. The rapheless valve with a linear or lanceolate axial area and no central area. Transapical striae are coarsely punctate. The convex curvature of the rapheless valve is often apparent under the light microscope.

Holotype species: *Cocconeis scutellum* Ehrenberg 1838

***Cocconeis czarneckii* Stancheva, Mora & Jahn 2021**

(Pl. 30, figs. 1-10)

Ref. Mora & Jahn 2021, p. 61, 64, 65, figs. 1-76.

Status of name: accepted taxonomically

Diagnosis: Valves are elliptic to round-elliptic with obtusely rounded apices. Raphe valve has a narrow, linear axial area. Central area is a very small elliptical. Raphe is a filiform and straight to slightly deflected. Transapical striae are slightly radiate at the centre to strongly radiate and curved toward the apices, about 20-24 in 10 µm. Areolae are distinguishable with LM, about 18-25 in 10 µm. Rapheless valve has a narrow, linear, somewhat slightly deflected axial area. Central area is absent or indistinct. Transapical striae are slightly radiate at the centre to strongly radiate and curved toward the apices, about 20-26 in 10 µm. Areolae are short and dash-like, about 13-20 in 10 µm, and form undulating longitudinal lines. Length of the valve 22-34 µm, and the breadth 16-26 µm.

Remarks: According to Mora & Jahn (2021), *Cocconeis czarneckii* belongs to *C. placentula* species complex. The fine striation pattern of the rapheless valve of *C. czarneckii* is very similar to the illustrations of *C. placentula* (Patrick & Reimer 1966, pl 15, fig. 7) and *C. placentula* s.l. (Lange-Bertalot et al. 2017, pl 20, figs. 1, 2).

Occurrence: Frequent in Młynek Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record.

***Cocconeis disculus* (Schumann) Cleve 1895**

(Pl. 31, figs. 1-7)

Ref. Hustedt 1930, p. 191, fig. 266; Cleve-Euler 1953, p. 10, figs. 495 a-b; Hustedt 1933, p. 345, fig. 799; Hendey 1964, p. 178, pl. 28, fig. 19; Patrick & Reimer 1966, p.239, pl. 15, figs. 1, 2; Germain 1981, p. 104, pl. 39, figs. 11-13; John 1983, p. 77, pl. 33, figs. 10-11; Jensen 1985, p. 305, fig. 799; Krammer & Lange-Bertalot 1988, p. 89, pl. 56, figs. 1-13; Zalat 1991, p. 72, pl. 11, fig. 8; Ehrlich 1995, p. 55, pl. 12, fig. 8; Hartley et al.1996, p. 118, pl. 51, fig. 9; Bąk et al. 2012, p. 66, pl. 21; Kulikovskiy et al. 2016, p. 246, pl. 32, figs. 10-13.

Status of name: accepted taxonomically.

Synonyms: *Navicula disculus* Schumann 1862
Cocconeis thomasiana Brun 1895
Navicula scutelloides var. *disculus* (Schumann) Torka 1906

Diagnosis: Valves are relatively flat, elliptical or very slightly elongate elliptical. Raphe valve with rim evident at valve margin. Axial area is narrow and linear. Central area is very small or lacking; Raphe is filiform and straight. Transapical striae are curved, radiate, distinctly punctate, about 22-23 in 10 µm. Rapheless valve with very coarse structure. Axial area is linear to linear-lanceolate. Transapical striae are thick, coarsely punctate, slightly radiate in the centre, radiate at the ends, about 8-9 in 10 µm, each composed of three punctae. Length of the valve 15-20 µm, and the breadth 10-12 µm.

Ecological preference: Epipsammic; epipelic, mesohalobous; benthic, in brackish waters on all European coasts (Hendey 1964); epiphytic, freshwater, alkaliphilous with pH values 7.5-8.0 (Ehrlich 1973); brackish-freshwater species, oligosaprobic (Van Dam et al. 1994); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013c).

Occurrence: Frequent in Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Archeological excavation in the early medieval of Wolin, north-west Poland (Latałowa et al. 1995); Szczecin Lagoon, south western Baltic Sea, north Poland (Witkowski et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); found in Górki Zachodnie – Vistula River estuary in north Poland (Majewska et al. 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok river in the Podkarpacie Province, south Poland (Noga et al. 2014 a); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cocconeis disculus* var. *minor* Fontell 1922**

Ref. Kaczmarska 1977, p. 40, pl. 9, fig. 7; Hartley et al. 1996, p. 118, pl. 51, fig. 10.

Status of name: accepted taxonomically.

Diagnosis: Valve is elliptical with obtusely rounded ends. Raphe valve with a narrow, linear axial area. Central area is very small. Raphe is filiform. Transapical striae are curved, radiate, distinctly punctate, about 14-15 in 10 µm. Rapheless valve with a very linear to slightly lanceolate axial area. Transapical striae are thick, coarsely punctate, lineate, slightly radiate in the centre, more radiate at the ends, about 9-10 in 10 µm, each composed of three punctae. Length of the valve 14-17 µm, and the breadth 8-10 µm.

Ecological preference: Alkaliphilous, epiphytic (Kaczmarska 1976);

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Cocconeis euglypta* Ehrenberg 1854**

(Pl. 31, figs. 8-20)

Ref. Hustedt 1930, p. 190, fig. 261; Hustedt 1933, p. 349, fig. 802c; Patrick & Reimer 1966, p. 241, pl. 15, fig. 8; Foged 1978, p. 42, pl. 13, fig. 9; Germain 1981, p. 104, pl. 39, figs. 4-5; John 1983, p. 79, pl. 35, figs. 2-3; Jensen 1985, p. 306, fig. 802c; Krammer & Lange-Bertalot 1991 b, p. 87, pl. 49, fig. 3; pl 50, figs. 1; pl. 53, figs. 1-19; Zalat 1991, p. 75, pl. 11, figs. 4-5; Ehrlich 1995, p. 56, pl. 11, figs. 9-10; pl. 12, figs. 1-2; Wojtal 2009, p. 168, pl. 7, figs. 17-20; Al-Yamani & Saburova 2019, p. 226, pl. 118, figs. a-d; Costa et al. 2019, p. 6, figs. 13-24, 31-36.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis lineata* var. *euglypta* (Ehrenberg) Grunow 1880
Cocconeis rouxii var. *euglypta* (Ehrenberg) Héribaud 1893
Cocconeis placentula var. *euglypta* (Ehrenberg) Cleve 1895
Cocconeis placentula f. *euglypta* (Ehrenberg) Hustedt 1957

Diagnosis: Valves are isopolar, bilaterally symmetrical, elliptic with slightly cuneate, obtusely rounded apices. Raphe valve is concave, has a very narrow and linear axial area. Central area is small, hardly wider than the axial area, and somewhat elliptical or rounded. Raphe is filiform and straight; proximal raphe endings are expanded and close, internally bent to opposite sides, and externally straight and slightly expanded; distal raphe endings terminate at inner hyaline area, externally drop-like expanded. Transapical striae are uniseriate, finely punctate and radiate towards the apices, about 19-24 in 10 µm. Submarginal striae formed by 1-2 round areolae, becoming smaller near the axial area. Rapheless valve is convex, has a narrow, linear axial area. Central area is lacking. Valve margins are strongly silicified, centrally divided by a medium depressed area. Transapical striae are uniseriate, radiate and strongly curved at the apices, about 22-24 in 10 µm. Striae apically arranged in 4–6 undulated rows. Length of the valve 10-50 µm, and the breadth 7.5-38 µm.

Ecological preference: The species was recorded as epiphytic, epipsammic, oligohalobous (indifferent), alkaliphilous (Foged 1981); observed in sandy oligohalobous and mesohalobous intertidal deposits, cosmopolitan, present in periphyton and epilithon (Krammer & Lange-Bertalot 1991 b); an alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); occurred abundantly and dominantly as epilithic diatoms, in the influence of sewage effluent (Kelly 2002); dominant in eutrophic, slightly alkaline, and slightly brackish waters of northern Egyptian lakes (Zalat & Servant-Vildary 2005); freshwater with pH had an alkaline character or close to circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al., 2013 a, b, c); Benthic, oligohalobous indifferent;, alkaliphilous, mesotraphentic to eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Common in Radomno, Jeziorak, Kamionka and Młynek lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: The species was reported from the Wyżyna Krakowskoczęstochowska Upland. Fish pond in Mydlniki (Starmach 1939); Młynowka stream (Gumiński 1947); Vistula River (Turoboyski 1962; Pudo1977); Sanka stream (Kądziołka 1963; Hojda1971); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b); spring of Szklarka stream(Skalska 1966 a, b); springs of Kobylanka stream(Skalna

1969); Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Biała Przemsza River (Wasylik 1985), Kluczwodastream (Nawrat 1993); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); in the periphyton in Kobylanka stream, south Poland. (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Świerkowiec, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park; Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al., 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, southern Poland (Pociecha et al. 2020).

***Cocconeis hauniensis* Witkowski 1993**

Ref. Hohn & Hellerman 1966, p. 121, pl. I, figs. 15, 16; Witkowski 1993, p. 468, pl. 42, figs. 1-7; pl. 55, fig. 1; Riaux-Gobin et al. 2011b, p.10, figs. 46-49; Desianti et al. 2015, p. 16, figs. 113-126; Siqueiros Beltrones et al. 2023, tab A1, fig. A3i.

Status of name: accepted taxonomically.

Synonym: *Cocconeis nugalas* Hohn & Hellerman 1966

Diagnosis: Valve is broadly elliptical with more or less broadly rounded ends. Raphe valve has a narrow, slightly lanceolate axial area. Central area is small, elliptical. Raphe is filiform, straight to slightly sigmoid; proximal raphe endings are linear and opposed, distal raphe endings are simple, close to the valve margin. Transapical striae are uniseriate, radiate throughout the valve, more radiate towards the ends and interrupted by a longitudinal hyaline band, about 24-28 in 10 μ m. Rapheless valve has an irregularly widened lanceolate axial area, expanded in the middle. Central area is indistinct. Transapical striae are uniseriate, equidistant, seem to be more robust, with almost distinct punctae, radiate throughout the valve, about 18-23 in 10 μ m. length of the valve 7.5–16 μm and the breadth 4.5-7 μm.

Ecological preference: Marine shallow water (Witkowski 1993)

Distribution in Poland: Bottom deposits of Puck Bay, a shallow water embayment in the southern part of the Baltic Sea (Witkowski 1993); Holocene sediments of Szczecin Lagoon, south western Baltic Sea, north-west Poland (Witkowski et al. 2004); Holocene sediments of Vistula Lagoon, northern Poland (Witak et al. 2005); found in Górki Zachodnie – Vistula River estuary in north Poland (Majewska et al. 2012); Puck Lagoon, which is enclosed by the Hel Peninsula, Gulf of Gdansk (Witak 2013); Gulf of Gdansk and surrounding waters, the southern Baltic Sea.(Plinski & Witkowski 2020).

***Cocconeis lineata* Ehrenberg 1849**

(Pl. 32, figs. 1-4)

Ref. Hustedt 1930, p. 190, fig. 262; Hustedt 1933, p. 348, fig. 802d; Patrick & Reimer 1966, p. 242, pl. 15, figs. 5-6; Germain 1981, p. 104, pl. 39, figs. 6-8; Krammer & Lange-Bertalot 1991b, p. 87, pl. 49, fig. 1; pl. 50, fig. 2; pl. 52, figs.1-13; Zalat 1991, p. 77, pl. 11, fig. 6; Ehrlich 1995, p. 56, pl. 12, figs. 3-4; Wojtal 2009, p. 168, pl. 7, figs. 9-16; Kulikovskiy et al. 2016, p. 246, pl. 31, figs. 1-9.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis placentula* var. *lineata* (Ehrenberg) Van Heurck 1885
Cyclotella lineata (Ehrenberg) Raciborski 1894
Cocconeis placentula f. *lineata* (Ehrenberg) Hustedt 1957

Diagnosis: Valves are elliptic, with broadly rounded apices. Raphe valve has a very narrow and linear axial area. Central area is small and rounded. Raphe is filiform and straight. Proximal raphe endings are close. Transapical striae are uniseriate, finely punctate and radiate towards the apices, about 22-25 in 10 μm. Rapheless valve has a linear and very marked axial area, slightly widening towards the valve centre. Central area is not differentiated. Transapical striae are uniseriate, coarsely punctate, radiate and strongly curved at the apices, about 18-20 in 10 μm. Puncta that are either rounded or form short 'dashes'. The gaps between the punctae are relatively large, forming 3 to 10 longitudinal undulating lines running along the length of the valve. Narrow inner hyaline ring interrupting the striae all along the valve and forming a submarginal area. Length of the valve 12-68 μm, and the breadth 8-32 μm.

Ecological preference: Cosmopolitan, Tychoplanktonic, an alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Denys 1991; Van Dam et al. 1994); freshwater, low alkaline of some springs (Żelazna-Wieczorek & Ziułkiewicz 2004); dominant in eutrophic, slightly alkaline, and slightly brackish waters of northern Egyptian lakes (Zalat & Servant-Vildary 2005); it considered to be tolerant and resistant with respect to organic water pollution (Szczepocka & Szulc 2009); alkaliphilous mainly occurring at pH > 7 (Szulc & Szulc 2012); freshwater with pH had an alkaline character or close to circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); benthic, oligohalobous indifferent, alkaliphilous, mesotraphenthic to eutraphenthic, β-mesosaprobous (Witak & Jankowska 2014); the species occur mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Frequent in Jeziorak, Młynek and Radomno Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowsko- Częstochowska Upland. Spring in Dubie (Skalska 1966 a, b); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); springs located in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna-Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); Holocene sediments of Vistula Lagoon, northern Poland (Witak et al. 2005); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała central Poland (Szulc 2007); Dominated in the Pilica River- the Bzura River- Central Poland, (Szczepocka & Szulc 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); dominant in the Wisłok River, Duszatyńskie Lakes (Western Bieszczady Mts.), Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b, c, d); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Late-glacial and Holocene deposits from Lake Łebsko, southern coast of the Baltic Sea, north Poland (Staszak-Piekarska & Rzodkiewicz 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie south Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); northern part of the Stalowa Wola city, south-

east Poland (Rybak et al., 2018); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cocconeis neodiminuta* Krammer 1990**

(Pl. 32, figs. 5-11)

Ref. Hustedt 1930, p. 190, fig. 265; Hustedt 1933, p. 346, fig. 800; Foged 1981, p. 61, pl. 13, fig. 11; Jensen, 1985, p. 306, fig. 800; Laws 1988, p. 156, pl. 18, figs. 10-12; Krammer 1990, p.151, pl. 1, figs. 1-2, pl. 3, figs. 40-45; Pankow, 1990, p. 166, pl. 34, figs. 20-21; Krammer & Lange-Bertalot 1991 b, p. 90, pl 55, figs. 1-4; pl. 56, figs. 18-32; Zalat 1991, p. 72, pl. 11, fig. 7; pl. 12, figs. 5-6; Ehrlich 1995, p. 54, pl. 12, fig. 7; Sims1996, p. 118, pl. 51, fig. 11; Wojtal 2009, p. 164, pl. 8, figs. 1-3; Kulikovskiy et al. 2016, p. 246, pl. 32, fig. 14.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis diminuta* Pantocsek 1902

Cocconeis disculus var. *diminuta* (Pantocsek) Scheshukova 1950

Diagnosis: Valves are broadly elliptical in outline, relatively flat with broadly rounded apices. Raphe valve has a distinct valvocopula and a hyaline band developed around the margin. Axial area is linear, very narrow. Central area is small and rounded. Raphe is straight and filiform; the proximal raphe endings are very close. Transapical striae are uniseriate, delicate, and radiate towards the ends, about 24-32 in 10 μm. Rapheless valve has a linear to somewhat lanceolate axial area. Central area is indistinct. Transapical striae are uniseriate, punctate or areolate with elongated areolae, radiate towards the apices about 11-14 striae in 10 μm, and 2-4 elongated areolae along the transapical axis. Length of the valve 9-19 μm and the breadth 6-9 μm.

Ecological preference: Epipsammic, oligohalobous (indifferent); alkaliphilous (Foged 1981); mesohalobous benthic, it is reported from the water of ponds was from circumneutral to slightly alkaline (pH 6.7-7.9) (Whiting 1983). a fresh brackish water species (Van Dam et al. 1994); alkaliphilous, preferring eutrophic conditions, ά orβ -mesosaprobic (Stachura-Suchoples 1999, Bąk et al. 2000, Bąk et al. 2004); the species occurs as epiphyte in freshwaters, benthic diatoms on sediments (Szulc 2007); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); benthic, oligohalobous indifferent;, alkaliphilous, dystraphentic-eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); it considered to be tolerant and resistant concerning organic water pollution (Szczepocka & Szulc 2009); Conductivity ranged between 412 and 892 μS cm−1 (Pociecha et al. 2020).

Occurrence: Common in the Eemian palaeolake deposits of central Poland and frequently distributed in Radomno and Młynek lakes.

Distribution in Poland: The species reported from Vistula River (Starmach 1938); the Wyżyna Krakowsko-częstochowska Upland. Młynowka stream (Gumiński 1947); spring of Szklarka stream (Skalska 1966 a); springs of Kobylanka stream (Skalna 1969), Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, north-west Poland **(**Bąk et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir, Central Poland (Szulc 2007); found mainly in epilithon and periphyton in Kobylanka stream above Kobylany village. (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland souther Poland (Żelazna-Wieczorek & Bik 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok river and Pielnica stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River, south Poland (Pociecha et al. 2020); from the Gulf of Gdánsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cocconeis neothumensis* Krammer 1991**

(Pl. 32, figs. 12-15)

Ref. Hustedt 1930, p. 191, fig. 264; Hustedt 1933, p. 346, fig. 801; Krammer 1990, p. 151, pl. 1, figs. 1-2, pl. 2, figs. 32-39, pl. 3, figs. 40-45; Krammer & Lange-Bertalot 1991 b, p. 91, pl. 57, figs. 8-31; Bąk et al. 2012, p. 67, pl. 21; Kulikovskiy et al. 2016, p. 247, pl. 32, figs. 19-32; Costa et al. 2019, p. 11, figs. 85-88.

Status of name: accepted taxonomically.

Synonym: *Cocconeis thumensis* A. Mayer 1919

Diagnosis: Frustule is small, valves are broadly elliptical, elliptical-lanceolate and rhombic-elliptic with almost circular in outline, relatively flat. Raphe valve has a very narrow, linear axial area. Central area is small and rounded. Raphe is straight and filiform, and the proximal raphe endings are closely located. Transapical striae are coarse punctate, radiate throughout the valve, about 28-36 in 10 μm. Rapheless valve has a linear to somewhat slightly narrow lanceolate axial area without a central area. Transapical striae are coarse punctate, radiate throughout of the valve, strongly radiate towards the ends, about 16-25 in 10 μm, and 3-4 elongated areolae along a transapical axis. Length of the valve 7.5-18 μm and the breadth 4-9 μm.

Ecological preference: Freshwater form (Cleve-Euler 1953); it is considered as being halophobous and alkalibiontic (Hustedt 1957); its pH-optimum is about 8 (Cholnoky 1968); epipelic or epiphytic in slowly running or stagnant waters, it was recorded in water of rather low pH (6.5-6.9), and low alkalinity and it may be oligo-mesothermal (Gasse 1986); freshwater, alkalibiontic, oligosaprobic (Van Dam et al. 1994); widely distributed in alkaline lowland lakes, it is also found in calcium-rich mountain lakes, in flowing waters, and it prefers medium to higher trophic degrees (Bąk et al. 2012); Benthic, oligohalobous indifferent;, alkaliphilous, mesotraphentic to eutraphentic, oligosaprobous (Witak & Jankowska 2014).

Occurrence: Infrequent in Jeziorak and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); found in Górki Zachodnie – Vistula River estuary in North Poland (Majewska et al. 2012); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia, north Poland (Witak & Jankowska 2014); the Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cocconeis pediculus* Ehrenberg 1838**

(Pl. 32, figs. 16-23)

Ref. Hustedt 1930, p. 188, fig. 259; Hustedt 1933, p. 350, fig. 804; Patrick & Reimer 1966, p. 240, pl. 15, figs. 3-4; Germain 1981, p. 104, pl. 38, figs. 7-9; Ricard 1987, p. 284, figs. 1160-1164; Krammer & Lange-Bertalot 1991 b, p. 89, pl. 55, figs. 1-8; pl. 57, figs. 1-4; Foged 1993, p. 238, fig. 49; Ehrlich 1995, p. 55, pl. 11, figs. 1-7; Lange-Bertalot & Metzeltin 1996, p. 274, pl. 78, fig. 39; Moreno et al. 1996, p. 52, pl. 16, figs. 8-9; Wojtal 2009, p. 164, pl. 6, figs. 25-27; pl. 7, figs. 1, 2; pl. 63, figs. 1-4, 6; Kulikovskiy et al. 2016, p. 247, pl. 32, figs. 6-9; Rybak et al. 2019, fig. 2: 11; Siqueiros Beltrones et al. 2023, tab A1, fig. A4m, n.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis communis* var. *pediculus* (Ehrenberg) O.Kirchner 1878
Cocconeis communis f. *pediculus* (Ehrenberg) Chmielevski 1885
Encyonema cespitosum var. *pediculus* (Ehrenberg) De Toni 1891

Diagnosis: Valves are broadly elliptical to rhombic-elliptical or almost circular in outline. Raphe valve has a narrow linear axial area. Central area is small, rounded or oval. Raphe is filiform, straight. Transapical striae are punctate, radiate throughout the valve, about 16-24 in 10 μm, and punctae 18-23 in 10 μm. Rapheless valve is strongly convex, has a narrow axial area often indented within a longitudinal furrow. Transapical striae are coarse and almost parallel at the valve centre, becoming transversely radiate towards the apices, about 17-20 in 10 μm and arranged in longitudinally undulating rows. Length of the valve 18-50 μm, and the breadth 9-28 μm.

Ecological preference: Cosmopolitan periphytic diatom reported from waters of moderate and high conductivity, including brackish waters (Krammer & Lange-Bertalot 1991 b); Tychoplanktonic, mesosaprobous and eutraphentic species (Denys 1991; Hofmann 1994); an alkaliphilous, β-mesosaprobous, eutraphentic,

strictly aquatic and brackish fresh water species (Van Dam et al. 1994); it was found as an epiphyte on many aquatic plants (Vilbaste 2001); Reported from Szczecin Lagoon with alkaline (pH 7.25-9.58), slightly saline, shallow water which is strongly mixed and usually well oxygenate and high organic phosphorus contents (Bąk et al. 2004); occurred in large numbers in samples scraped from stones and sediment in the river (Szulc 2007); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b).

Occurrence: Common in Młynek, Jeziorak and Radomno Lakes, and infrequently abundant in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Vistula River (Turoboyski 1962; Pudo 1977); Prądnik River (Stępień 1963); Sanka stream (Kądziołka 1963; Hojda 1971); Pilica River (Kadłubowska 1964 a, b); spring of Szklarka stream (Skalska 1966 a, b); Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kluczwoda stream (Nawrat 1993); Rivers in Kraków province, the Vistula, Raba and their affluents, south Poland (Kwandrans et al. 1998); Szczecin Lagoon, southern Baltic Sea, north-west Poland **(** Bąk et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała, central Poland (Szulc 2007); Holocene lacustrine-fluvial-swamp deposits at Domuraty, north-east Poland (Winter et al. 2008); Kobylanka stream in Kobylany village, south Poland. (Wojtal 2009); Lake Żółwia Błoć in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); dominant in the Wisłok River; Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b, d); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), Wielopolka, Trzcianka, Żołynianka, Matysówka) in of the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Rzeczyca stream and its tributary Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cocconeis peltoides* Hustedt 1939**

Ref. Hustedt 1939, p.606, figs. 23-27; Simonsen 1987, p. 253, pl. 376, figs. 1–10; Witkowski et al. 2000, p. 112, pl. 38, figs. 1-9; Sar et al. 2003, p. 91, figs. 34–41; Riaux-Gobin et al. 2011b, p. 2, figs. 7-22; López-Fuerte et al. 2020, p. 17, fig. 25m,n; Siqueiros Beltrones et al. 2021, tab. 1, fig. 14q, r.

Status of name: accepted taxonomically.

Diagnosis: Valves are broadly elliptical or orbicular in outline with rounded apices. Raphe valve has a narrow, linear-lanceolate axial area. Central area is lanceolate. Raphe is filiform, straight. Proximal raphe endings are simple, not expanded; the distal raphe endings are small, rounded. Transapical striae are punctate, uniseriate, radiate throughout the valve, more radiate towards the ends, about 20-23 in 10 µm, punctae on the valve face about 45-70 in 10 µm, irregularly shaped and the striae interrupted by a longitudinal hyaline band. Rapheless valve has a narrow, straight axial area, delineated by two longitudinal costae not reaching the apices, and several areolae are less regularly arranged, in varied sizes, with some warts present near the axial area. Central area is elliptic-lanceolate. Transapical striae are robust, coarse punctate, uniseriate, radiate throughout the valve, about 14-16 in 10 µm, punctae 22-27 in 10 µm, and striae are crossed by one hyaline

longitudinal rib on either side of the axial area. In the marginal areas, monoseriate radiate and equidistant striae with rounded areolae. Length of the valve 8-20 µm, and the breadth 6-14 µm.

Ecological preference: *Cocconeis peltoides* is a cosmopolitan epipsammic, adnate species found in sandy sediments of estuaries and coastal areas (Hustedt 1955); it is brackish or coastal form in the coastal environment (Hendey 1964); occurs in brackish area of the Gulf of Riga on the eastern side of the Baltic Sea (Vilbaste et al. 2000); this species has significant abundance as epipelic diatoms in the intertidal mudflats of both the eutrophic Westerschelde Estuary and the oligotrophic Oosterschelde Estuary in the Netherlands (Hagerthey et al. 2002); Epipsammic on coral sand grains, marine environment (Riaux-Gobin et al. 2011b).

Distribution in Poland: Bottom sediments of Dolgie Wielkie Lake located on the Gardno-Leba Coastal Plain, southern Baltic, north Poland (Lutynska 2008); found in Górki Zachodnie – Vistula River estuary, north Poland (Majewska et al. 2012); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Zgrundo et al. 2008; Plinski & Witkowski 2020).

***Cocconeis placentula* Ehrenberg 1838**

(Pl. 33, figs. 1-7; pl. 34, figs. 1-4)

Ref. Hustedt 1930, p. 189, fig. 260; Hustedt 1933, p. 347, fig. 802 a, b; Patrick & Reimer 1966, p. 240, pl. 15, fig. 7; Foged 1978, p. 42, pl. 13, figs. 7-9; Foged 1981, p. 61, pl. 13, figs. 13,14; John 1983, p. 79, pl. 34, figs. 11,12; pl. 35, fig. 1; Gasse 1986, p. 33, pl. 7, fig. 6; Krammer & Lange-Bertalot 1991 b, p. 86, pl. 49, figs. 1-4; pl. 50, figs. 5; pl. 51, figs. 1–5; Ehrlich 1995, p. 56, pl. 11, fig. 8; Lange-Bertalot & Metzeltin 1996, p. 274, pl. 78, figs. 40-43; Hein et al. 2008, p. 38, pl. 17, fig. 8; Al-Handal 2009, p. 18, figs. 70-77; Wojtal 2009, p. 168, pl. 7, figs. 3-5; pl. 63, figs. 5, 7, 8; pl. 64, figs. 1, 2; Kulikovskiy et al. 2016, p. 247, pl. 31, figs. 10-17.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis pediculus* var. *placentula* (Ehrenberg) Grunow 1867
Cocconeis communis var. *placentula* (Ehrenberg) O.Kirchner 1878
Cocconeis communis f. *placentula* (Ehrenberg) Chmielevski 1885

Diagnosis: Valves are isopolar, bilaterally symmetrical, elliptic to linear-elliptic and relatively flat. Raphe valve has a narrow linear axial area. Central area is small, circular or oval. Raphe is straight and filiform. The distal raphe endings are straight and expanded externally. The proximal raphe endings are straight externally, close, and slightly expanded. Internally, the proximal raphe ends are deflected to opposite sides. Transapical striae are finely areolate, almost parallel at the centre, becoming radiate towards the apices, about 20-24 in 10 µm and interrupted by a hyaline ring positioned close to the valve margin. Areolae are usually well distinguished. The valvocopula attached to the raphe valve has conspicuous fimbriae. Rapheless valve has a linear to linear-lanceolate axial area. Central area is lacking. Transapical striae are coarser than for the raphe valve, forming more or less isodiametric puncta. Transapical striae are almost parallel at the centre, becoming radiate towards the apices, about 15-22 in 10 µm. Punctae are arranged in longitudinal and undulating rows. Length of the valve 13-60 µm, and the breadth 8-30 µm.

Ecological preference: *Cocconeis placentula* is the most common in freshwater bodies and are to be cosmopolitan in lotic waters as rivers and streams, lentic ones of lakes, reservoir and ponds in both freshwaters and estuarine waters. Their life forms are varied, as epiphyte on aquatic plants (Blindow 1987; Buczkó 2007) and other algae, as epilithon in small softwater stream (Jones 1978) and as benthic diatoms on sediments (Zalat 1991; Szulc 2007). Cosmopolitan diatom, epiphytic, occurs in periphyton and epilithon (Krammer & Lange-Bertalot1991 b), tychoplanktonic (Denys 1991); this species is more commonly found in circumneutral to alkaline waters and are apparently salt indifferent to extends into brackish water but not observed in great numbers in brackish waters (Patrick & Reimer 1966); Epiphytic; epipsammic; oligohalobous (indifferent), alkaliphilous, (Foged 1981); an alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water diatom (Van Dam et al. 1994); it is tolerant of moderate, but not severe, organic pollution and is occasionally abundant in the disposal of nutrient-rich sewage effluents (Kelly 2002); dominant in alkaline, eutrophic, moderately polluted, slightly brackish water habitat (Zalat & Servant-Vildary 2005); epiphytic diatoms in shallow water body, in very slightly alkaline, meso-eutrophic and oxygen-saturated (Toporowska et al. 2008); Benthic, oligohalobous indifferent,

alkaliphilous, mesotraphentic to eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm-1 (Pociecha et al. 2020).

Occurrence: Common in Młynek, Jeziorak and Radomno Lakes, and frequently abundant in Kamionka and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: This species was recorded from the Wyżyna Krakowskoczęstochowska Upland, Vistula River (Starmach1938; Turoboyski 1956, 1962; Kyselowa & Kysela 1966); fish ponds in Mydlniki (Siemińska 1947); Młynowka stream (Gumiński 1947); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964a, b); spring of Szklarka stream (Skalska 1966 a, b); ponds near Krakow, without exact localities (Hanak-Szmagier 1967); springs of Kobylanka stream (Skalna 1969); Będkowka stream (Kubik 1970); Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Biała PrzemszaRiver (Wasylik 1985); Archeological excavation in the early medieval of Wolin, north-west Poland (Latałowa et al. 1995); Szczecin Lagoon, south western Baltic Sea, north Poland (Bąk et al. 2004; Witkowski et al. 2004); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Holocene sediments of the southwest Gulf of Gdańsk, Southern Baltic Sea, north Poland (Witak & Dunder 2007); Holocene lacustrine-fluvial-swamp deposits at Domuraty, north-east Poland (Winter et al. 2008); Pilica River at the village of Przedbórz and downstream from the Sulejów Reservoir in the town of Spała, central Poland (Szulc 2007; Szczepocka & Szulc 2009); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Lake Skomielno in Łęczyńsko-Włodawskie Lakeland, east Poland (Toporowska et al. 2008); in Kobylanka stream, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Skaliska Lake (northern part of Mazury Lake District, north-east Poland (Sienkiewicz 2013); abundant in the lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Morwawa, Pielnica, Stobnica, Mleczka, Ryjak, Wielopolka, Żołynianka) in the territory of the Podkarpacie Province, southern Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Lake Zabinskie in the Masurian Lake District, north-east Poland (Witak et al. 2017); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020); the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Zgrundo et al. 2008; Plinski & Witkowski 2020).

***Cocconeis placentula* var. *intermedia* (Peragallo & Héribaud) Cleve 1895**

Ref. Hustedt 1933, p. 348; Kaczmarska 1977, p. 40, pl. 9, fig. 4.

Status of name: accepted taxonomically.

Synonyms: *Cocconeis intermedia* Héribaud & Peragallo 1893

Cocconeis rouxii var. *intermedia* (Peragallo & Héribaud) Frenguelli 1936

Cocconeis rouxii Héribaud & Brun 1893

Diagnosis: Valves are elliptic, with broadly rounded apices. Raphe valve has a very narrow and linear axial area. Central area is small, rounded or ovate. Raphe is filiform and straight. Proximal raphe endings are expanded and deflected to opposite sides. Transapical striae are finely punctate and radiate throughout the valve, about 16-18 in 10 µm. Rapheless valve has a linear and marked axial area. Central area is not differentiated.

Transapical striae are uniseriate, coarsely punctate, radiate and curved at the apices, about 11-13 in 10 μm. Puncta that are either rounded or form short "dashes. Narrow inner hyaline ring interrupting the striae all along the valve and forming a submarginal area. Length of the valve 20-25 μm, and the breadth 10-15 μm.

Ecological preference: This variety has the same ecological preference as the species.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

Cocconeis placentula* var. *klinoraphis Geitler 1927

(Pl. 34, figs. 5-6)

Ref. Hustedt 1930, p. 190, fig. 263; Hustedt 1933, p. 348, fig. 803. Krammer & Lange-Bertalot 1991 b, p. 87, pl. 51, figs. 6-9; Joh 2012, p. 105, figs. 108, 109.

Status of name: accepted taxonomically.

Diagnosis: Valve is elliptic to linear-elliptic and relatively flat. Raphe valve has a very narrow linear axial area that is inclined at 5 degrees from the apical axis. Central area is small, rounded or oval. Raphe is straight and filiform and inclined with the axial area. The distal raphe endings are straight and slightly expanded externally. The proximal raphe endings are close, distinct by central rounded pores. Internally, the proximal raphe ends are deflected to opposite sides. Transapical striae are punctate, almost parallel at the centre, becoming radiate towards the apices, about 22-26 in 10 μm, always crossed by longitudinal striations. Areolae are usually well distinguished, elongated. The valvocopula attached to the raphe valve has conspicuous fimbriae. Rapheless valve has an inclined narrow, linear axial area with a lacking central area. Transapical striae are coarser than for the raphe valve forming more or less isodiametric elongated puncta. Transapical striae are almost parallel at the centre, becoming radiate towards the apices, about 14-18 in 10 μm. Punctae are arranged in longitudinal and undulating rows. Length of the valve 18-57 μm, and the breadth 9-28 μm.

Remarks: Valve easily differentiated from the type and its varieties by inclining the axial area and the raphe that is diagonal to the apical axis.

Ecological preference: *Cocconeis placentula* var. *klinoraphis* was abundant as epiphyte on the leaves of willow moss (*Fontinalis antipyretica*) (Geitler 1977); Fresh-brackish water, alkaliphilous, moderate oxygen requirements, β-mesoosaprobic, eutraphentic (Van Dam et al. 1994); as epiphyte, slightly alkaline in slightly brackish water of Egyptian lakes (Zalat 2002); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska, 2014).

***Cocconeis pseudolineata* (Geitler) Lange-Bertalot 2004**

(Pl. 34, figs. 7-15)

Ref. Hustedt 1933, p. 349; Krammer & Lange-Bertalot 1991 b, p. 356, pl. 54, figs. 3-11; Metzeltin et al. 2005, p. 322, pl. 39, fig. 7RL; Wojtal 2009, p. 171, pl. 7, figs. 6-8; Heinrich et al. 2019, p. 17, fig. 9b; Kulikovskiy et al. 2016, p. 248, pl. 32, figs. 15-18; Rybak et al. 2019, fig. 2: 12.

Status of name: accepted taxonomically.

Synonym: *Cocconeis placentula* var. *pseudolineata* Geitler 1927

Diagnosis: Valves are isopolar, bilaterally symmetrical, elliptic with slightly pointed to broadly rounded apices. Raphe valve is concave, has a straight, narrow linear axial area that extends to the marginal ridge. Central area is small and circular. Raphe is straight, with slightly expanded, closely positioned proximal endings; distal raphe endings are straight, ending on the marginal ridge. Transapical striae are punctate, dot-like areolae, slightly radiate at the centre, becoming more radiate towards the apices, about 22-25 in 10 μm, interrupted near the margin by a siliceous ridge. Rapheless valve is convex, slightly flexed in girdle view, and has a slightly wider linear axial area that ends just before the apices. Central area is lacking. Transapical striae are formed by larger round to transapically elongate areolae, slightly radiate at the valve centre, becoming more radiate towards the apices, about 12-15 in 10 μm. Length of the valve 15-28 μm, and the breadth 10-18 μm.

Ecological preference: Tychoplanktonic diatom (Denys 1991); an alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); freshwater slightly alkaline or close to neutral (6.5-8.4), low to high conductivity (416-764 µSx cm $^{-1}$), temperature 3.0-17.5; Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ ((Noga et al. 2013 b, c); benthic, oligohalobous indifferent, alkaliphilous, mesotraphentic to eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); found in water with pH 5.3-6.9 and conductivity 43-427 µS cm^{-1} (Rybak et al. 2018); the species occur mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Frequent in Młynek and Radomno Lakes.

Distribution in Poland: Reported from Zalew Wiślany, north Poland (Jankowska et al. 2005); Zalew Szczeciński, north-west Poland (Bąk et al. 2006); Lake Raduń, west Poland (Kowalska & Luścińska 2006); spring in Warta River valley, west central Poland (Żelazna-Wieczorek & Mamińska 2006); Kobylanka stream, south Poland (Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013b,c); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Ryjak, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); in the northern part of the Stalowa Wola city, and Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cocconeis pseudothumensis* Reichardt 1982**

(Pl. 34, figs. 16-19)

Ref. Reichardt 1982, p. 99, pl. 1, figs. 1-5; Bąk et al. 2012, p. 69, pl. 21; Kulikovskiy et al. 2016, p. 248, pl. 32, figs. 24-29; Bahls et al. 2018, p. 40, pl. 3, fig. 12.

Status of name: accepted taxonomically.

Diagnosis: Valves are isopolar, bilaterally symmetrical, elliptic with broadly rounded ends. Raphe valve has a narrow axial area. Central area is very small, oval or rounded. Raphe is straight, filiform; proximal raphe endings are represented by pores located close to each other; the distal raphe endings are indistinct. Transapical striae are very fine, radiate throughout the valve, about 27-30 in 10 µm near the valve margin, and up to 40 in 10 µm near the axial area, which may not be visible. Rapheless valve has a broad, lanceolate axial area that covers 1/3 to 1/2 the width of the valve. Central area is absent. Transapical striae are coarsely areolate and distinctly radiate throughout the valve, about 10-12 in 10 µm. Areolae square to elliptical range from 3 to 5 in 10 µm. length of the valve 10-15 µm, and the breadth 7.5-11 µm.

Ecological preference: Freshwater, low alkaline of some springs (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); in alkaline streams, small rivers, and lakes on the lowlands, rarely observed in the flowing waters of upland areas; it lives in oligo- to eutrophic habitats, but in terms of saprobian it does not tolerate even a slight pollution (Bąk et al. 2012).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Freshwater, in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny, central Poland (Żelazna- Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland, south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Gulf of Gdansk and surrounding waters, southern Baltic Sea, north-west Poland (Plinski & Witkowski 2020).

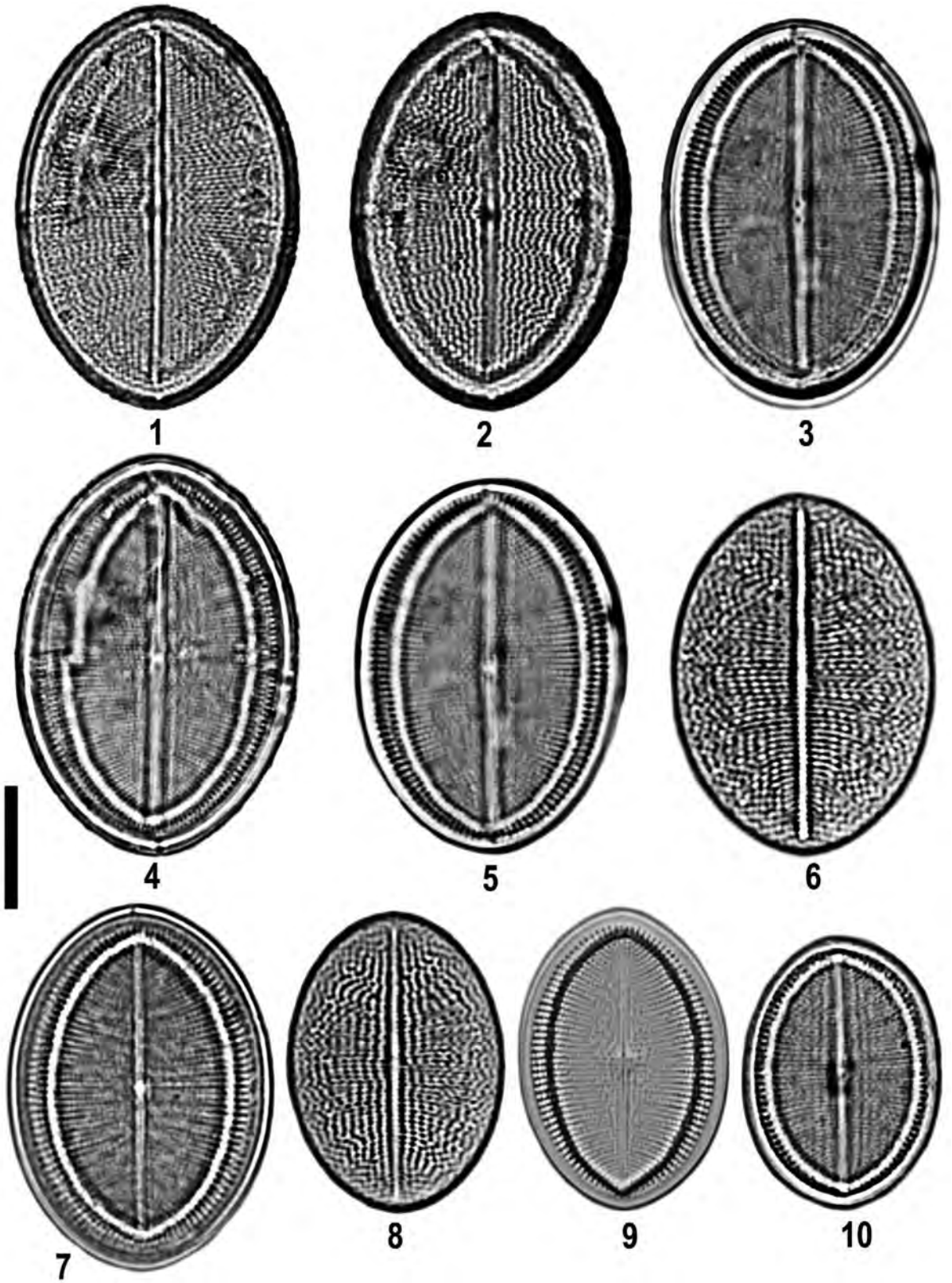


Plate 30: 1-10. *Cocconeis czarneckii* Stancheva, Mora & Jahn 2021, 1-8. Młynek Lake; 9-10. Eemian deposits. Scale bar = 10 µm.

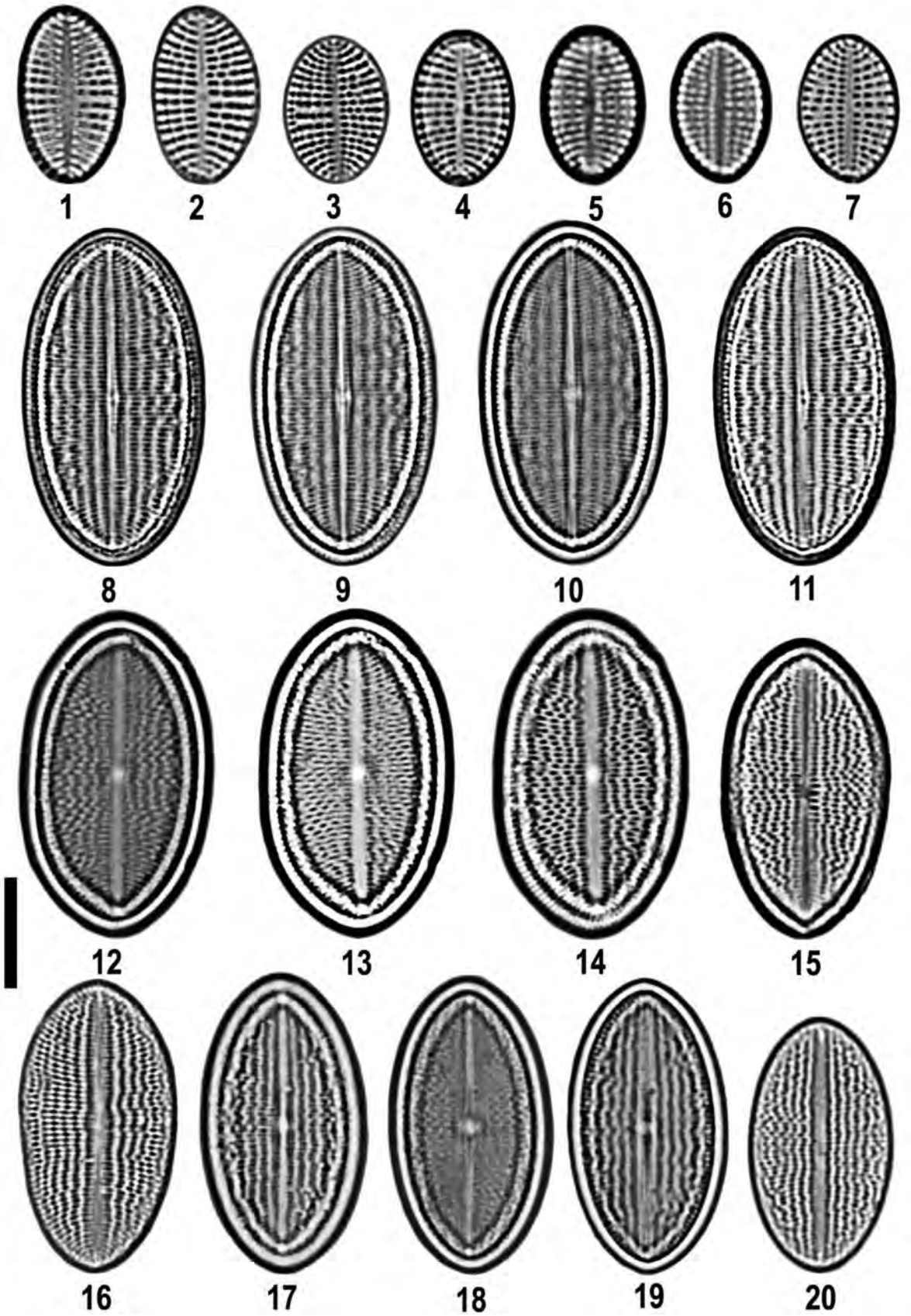


Plate 31: 1-7. *Cocconeis disculus* (Schumann) Cleve 1895, 1-5. Jeziorak Lake ; 6-7. Eemian deposits; 8-20. *Cocconeis euglypta* Ehrenberg 1854, 8-11. Radomno Lake; 12. Eemian deposits; 13-16. Jeziorak Lake; 17-20. Młynek Lake. Scale bar = 10 µm.

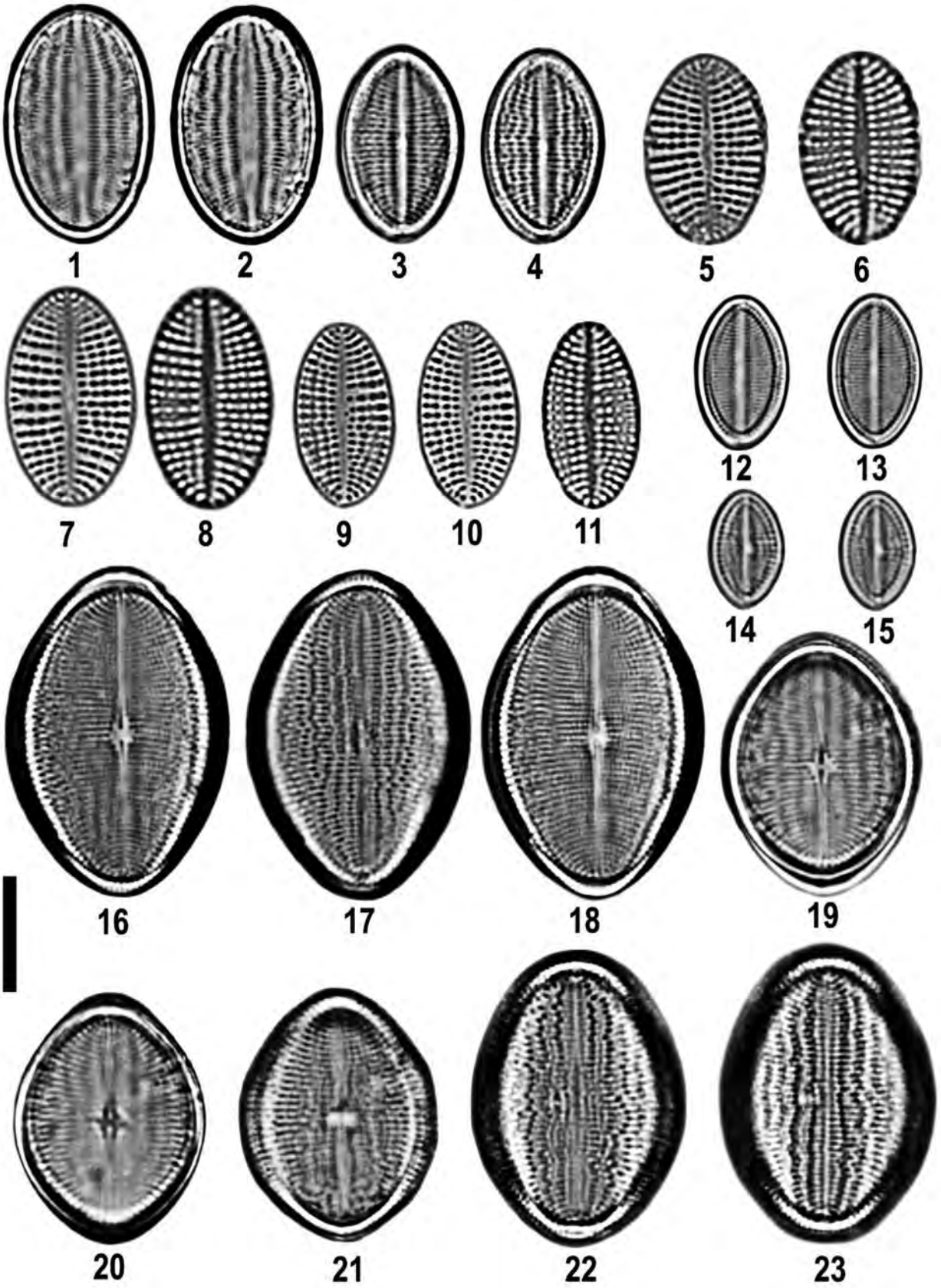


Plate 32: 1-4. *Cocconeis lineata* Ehrenberg 1849, 1-2. Jeziorak Lake, 3-4. Eemian deposits; 5-11. *Cocconeis neodiminuta* Krammer 1990, 5-6. Eemian deposits; 7-11. Radomno Lake; 12-15. *Cocconeis neuthumensis*, Jeziorak Lake; 16-23. *Cocconeis pediculus* Ehrenberg 1838, 16-17. Młynek Lake; 18-21. Jeziorak Lake, 22-23. Radomno Lake. Scale bar = 10 μm.

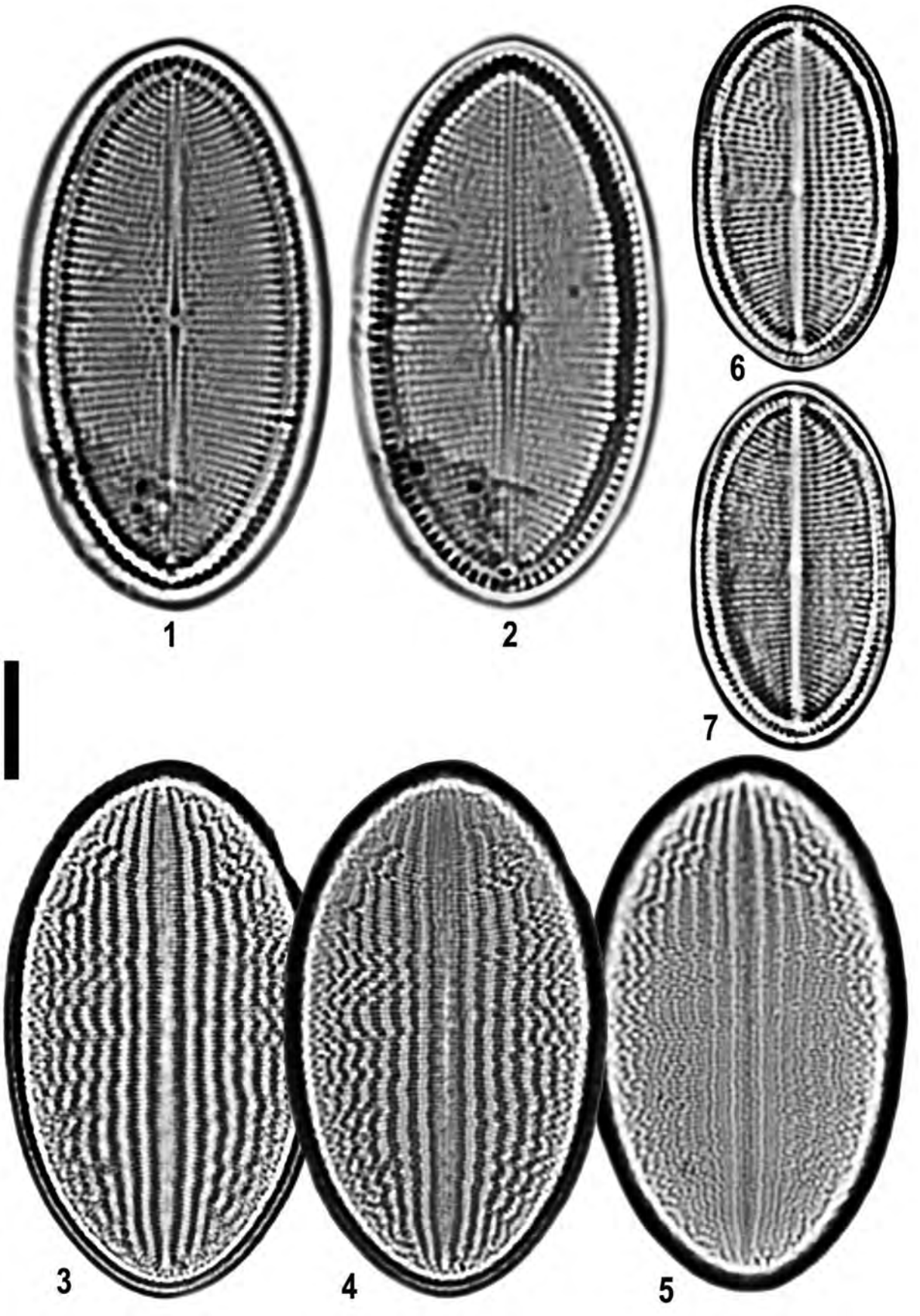


Plate 33: 1-7. *Cocconeis placentula* Ehrenberg 1838, 1-5. Radomno Lake; 6-7. Jeziorak Lake. Scale bar = 10 μm.

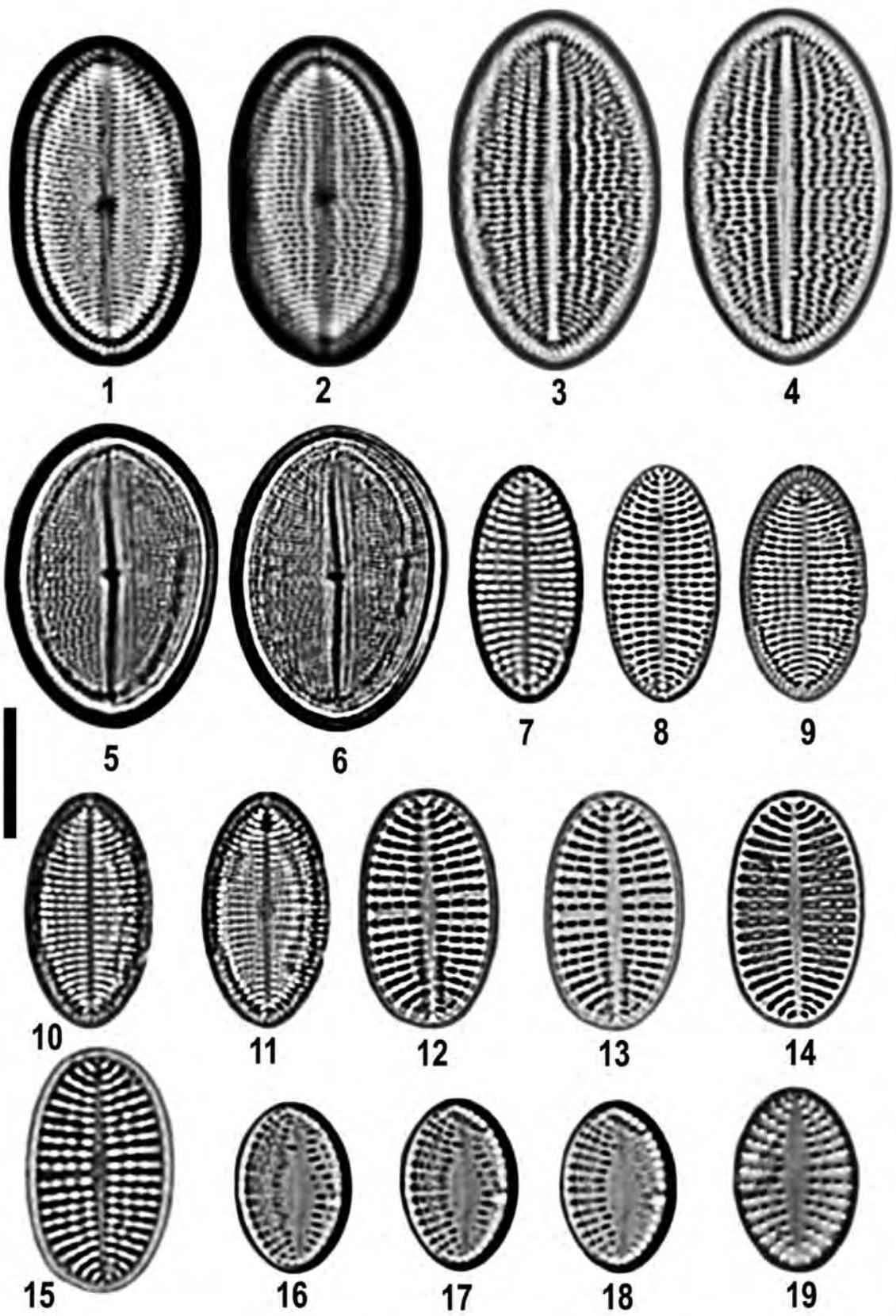


Plate 34: 1-4. *Cocconeis placentula* Ehrenberg 1838, 1-2. Młynek Lake; 3-4. Radomno Lake; 5-6. *Cocconeis placentula* var. *klinoraphis*, Kamionka Lake; 7-15. *Cocconeis pseudolineata* (Geitler) Lange-Bertalot 2004, 7-8. Młynek Lake; 9-15. Radomno Lake; 16-19. *Cocconeis pseudothumensis*, Eemian deposits. Scale bar = 10 μm.

3.3. Order *Cymbellales* Mann 1990

Family *Rhoicospheniaceae* Chen & Zhu 1983

Genus *Rhoicosphenia* Grunow 1860

Frustules are clavate in valve view and heterovalvar with a dissimilar raphe system on both valves. In a girdle view, valves are flexed and curved. As a result of the asymmetry to the transverse axis, the valve face is curved. The concave valve (R-valve) has a complete raphe with two separate branches, while the convex valve (D-valve) has a very small raphe branch on the footpole. Pseudosepta are present and distinct at both poles. The internal proximal raphe fissures on the R-valve are hook-shaped and curved in the same direction as the external distal raphe fissures. The D-valve is characterised by a strongly reduced raphe system. Internally, the raphe fissures are dissimilar: the proximal fissures can be crooked-shaped or hook-shaped, while the distal raphe fissure can be crooked-shaped or slightly bent to linear and not bent. Each stria is composed of a single row of areolae.

Holotype species: *Gomphonema curvatum* Kützing 1833 (= *Rhoicosphenia curvata* (Kützing) Grunow 1867)

***Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot 1980**

(Pl. 35, figs. 1-14)

Ref. Hustedt 1930, p. 211, fig. 311; Hustedt 1933, p. 430, fig. 879; Patrick & Reimer 1966, p. 282, pl. 20, figs. 1-5; Germain 1981, p. 118, pl. 44, figs. 21-25; pl. 168, fig. 13; Krammer & Lange-Bertalot 1986, p. 381, pl. 91, figs. 20-28; Ehrlich 1995, p. 58, pl. 12, figs. 11-20; Metzeltin & Witkowski 1996, p. 56, pl. 12, figs. 8-9; Witkowski et al. 2000, p. 345, pl. 58, figs. 4-7; Wojtal 2009, p. 294, pl. 8, figs. 4-9; pl. 64, figs. 3-6; Hofmann et al. 2011, p. 527, pl. 18, figs. 42-48.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema abbreviatum* C.Agardh 1831
Gomphonema curvatum Kützing 1833
Rhoicosphenia curvata (Kützing) Grunow 1860
Rhoicosphenia curvata var. *major* Cleve 1895
Rhoicosphenia curvata var. *subacuta* M.Schmidt 1899
Gomphonema augur var. *rotundatum* (Ehrenberg) Playfair 1914
Rhoicosphenia curvata var. *genuina* A.Cleve 1953

Diagnosis: Valve is heteropolar, linear-lanceolate to clavate, or club-shaped with broadly to narrowly rounded ends. Raphe valve is concave in girdle view, and in valve view, it has a narrowly lanceolate axial area. Central area is absent to slightly transverse or oval to elliptic. Raphe is filiform with distinct proximal ends. Transapical striae are uniseriate, radiate marginally at the valve centre and more widely spaced, becoming almost parallel towards the ends, about 12-16 in 10 μm. Rapheless valve is convex in girdle view, and in valve view it has a narrowly linear axial area, with a very short raphe at either end that is often difficult to distinguish. Central area is absent. A distinct pseudoseptum is present at the valve ends on the valve margins. Length of the valve 22-55 μm, and the breadth 3.5-8 μm.

Ecological preference: Fresh and brackish water form, in eutrophic lakes (Cleve-Euler 1953); halophile, euryhaline, rheophilous, alkaliphilous, oligosaprobic (Hustedt 1957); tolerant to salinity, 0.0-20 g/l (Simonsen 1962); epiphytic, periphytic, oligohalobous (indifferent), alkaliphilous (Foged 1981); Cosmopolitan diatom, mesosaprobous and eutraphentic species (Krammer & Lange-Bertalot 1986); tychoplanktonic (Denys 1991); an alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); brackish-freshwater, and halophilous, alkaliphilous eutraphentic and ά-mesosaprobic **(**Bąk et al. 2004); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); it considered to be tolerant and resistant with respect to organic water pollution (Szczepocka & Szulc 2009); freshwater of an alkaline character

or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 3.0-17.5 (Noga et al. 2013 b); water alkaline (pH 7.8-9.4) (Rybak et al. 2019); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Jeziorak Lake, frequent in Młynek and Radomno Lakes, infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: The species was recorded from the Wyżyna Krakowskoczęstochowska Upland, Vistula River (Starmach 1938; Turoboyski 1956, 1962; Kyselowa & Kysela 1966); Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Pilica River (Kadłubowska 1964 b); spring of Szklarka stream (Skalska 1966 a); Sanka stream (Hojda 1971); Kluczwoda stream (Nawrat 1993); reported from the saline springs in Pelczyska near OzorkOw in central Poland (Rakowska 2001); dominant in river mouth areas of the Gulf of Gdansk and in the coastal zone of the Puck Bay, and the northern and western parts of the Szczecin Lagoon **(** Bąk et al. 2004); Szczecin Lagoon, south western Baltic Sea, north-west Poland (Witkowski et al. 2004; Bąk et al. 2006); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Dominated in the Pilica River – Central Poland (Szczepocka & Szulc 2009); abundant, with the largest populations observed in periphytic material collected Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); found in Górki Zachodnie and Swibno-Vistula River estuary in North Poland (Majewska et al. 2012); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); abundant on the periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San; Duszatyńskie Lakes (Western Bieszczady Mts.); dominant in the Wisłok River, south-east Poland (Noga et al. 2013 a, b, c, d); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al., 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Kłopotnica River, Magura National Park, south-east Poland (Noga 2019); outflow of drainage water in urban areas, Stalowa Wola City, and Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

Genus *Gomphosphenia* Lange-Bertalot 1995

Diagnosis: Genus *Gomphosphenia* Lange-Bertalot (1995) was separated from *Gomphonema* Ehrenberg (1832) by several ultrastructural features, including transapically elongated areolae and T-shaped internal central raphe fissures, while lacking an apical pore field, isolated stigma, and the deflected terminal raphe fissures found in *Gomphonema*.

Holotype species *Gomphosphenia lingulatiformis* (Lange-Bertalot & Reichardt) Lange-Bertalot 1993

***Gomphosphenia lingulatiformis* (Lange-Bertalot & Reichardt) Lange-Bertalot 1995**

Ref. Patrick & Reimer 1975, p. 143, pl. 15, figs. 15-17; Lange-Bertalot 1993, p. 60, pl. 83, figs. 1-11; Lange-Bertalot 1995, p. 242, pl. 4, figs. 1-4; Bąk et al. 2012, p. 185, pl. 69.

Status of name: Uncertain.

Synonyms: *Gomphonema lingulatiforme* Lange-Bertalot & Reichardt 1995
Gomphonema brasilense Patrick & Reimer 1975
Gomphonema grovei var. *lingulatum* (Hustedt) Lange-Bertalot & Krammer 1985

Diagnosis: Valves are linear-clavate or wedge-shaped with undulate margins in large specimens, while clavate with smooth margins in smaller valves. The headpole is narrowly rounded to nearly acute, and the footpole is narrowly rounded. The axial area is lanceolate, narrow at the poles, and expanded towards the valve centre. Stigmata are absent. The raphe is straight, filiform, and the external proximal raphe ends are dilated. The central nodule is distinct and round. Transapical striae are radiate in the middle part, becoming

parallel near the footpoles, about 14-18 in 10 μm. Striae formed by a single areola, with an additional 1-2 isolated areolae towards the axial area. Length of the valve 11-60 μm, and the breadth 3.5-9 μm.

Ecological preference: *Gomphosphenia lingulatiformis* might occur quite common in alkaline, eutrophic to eu-polytrophic rivers, canals, and lakes (Krammer & Lange-Bertalot 1986, Lange-Bertalot et al. 2017); it occurs in alkaline flowing waters and lakes in the mountains and on the lowlands; optimum spread in eutrophic to polytrophic waters of rivers and canals (Bąk et al. 2012).

Occurrence: Rare in Jeziorak Lake.

Distribution in Poland: Poland (Bąk et al. 2012)

***Gomphosphenia tackei* (Hustedt) Lange-Bertalot 1995**

Ref. Hustedt 1942, p. 205, figs. 16-18; Bąk et al. 2012, p. 185, pl. 69; Rybak et al. 2021, p. 259, figs. 1A-K, 2 A-R

Status of name: accepted taxonomically.

Synonym: *Gomphonema tackei* Hustedt 1942

Diagnosis: Frustules in girdle view are cuneate. Valves are typically clavate to linear-clavate with bluntly rounded apices. The footpole is slightly narrower than the headpole. Axial area is very narrow and linear. The central area is small, rounded, and somewhat transversally dilated because of the shortened striae at the valve centre. There is no stigma. Raphe is straight, filiform. The external raphe endings are small, tear-drop shaped, and internally, proximal raphe endings are T-shaped. Distal raphe endings terminate on large, elongated helictoglossae. Transapical striae are finely areolate, slightly radiate throughout, parallel at the valve apices, about 24–28 in 10 μm. Striae are composed of 2-4 elongated to rounded areolae along the valve, and a single areola at the apices. Length of the valve 10-26 μm, and the breadth 3-4 μm.

Ecological preference: Aerophilic form, known for its waterlogged meadows from various regions of Germany and Hungary (Bąk et al. 2012); oligotrophy and low pH; prefers standing to slow-moving waters, with a eutrophic muddy substratum (Rybak et al. 2021).

Distribution in Poland: The waterbody located in the territory of the city of Rzeszów, south Poland (Rybak et al. 2021); Poland (Bąk et al. 2012).

Family *Anomoeoneidaceae* Mann 1990

Genus *Anomoeoneis* E. Pfitzer 1871

Diagnosis: Valves are lanceolate to elliptical-lanceolate in outline, with broadly round to capitate ends. Axial area is narrow and linear. Central area is asymmetrical, unilateral, or merged with large or small lateral spaces, thereby presenting a lyriform appearance, somewhat symmetrical. Raphe is straight, the external fissures of the proximal raphe endings are slightly bent in the same direction, the internal fissures are hooked; the distal raphe fissures are slightly or strongly curved in the same direction, the central pores are large. Transapical striae are uniseriate, with oval poroids, the poroids on a stria line distantly spaced and arranged in irregular longitudinal lines.

Holotype species: *Anomoeoneis sphaerophora* (Ehrenberg) Pfitzer 1871

(=*Navicula sphaerophora* Kützing 1844).

Distribution: The genus is distributed in high-conductivity freshwater and brackish water, including estuaries, mostly as benthic diatoms. It is especially common in saline inland waters of the mid-western United States and western Canada (Spaulding et al. 2009).

***Anomoeoneis sphaerophora* (Ehrenberg) Pfitzer 1871**

(Pl. 36, figs. 1-5)

Ref. Hustedt 1930, p. 262, fig. 422; Hustedt 1959, p. 740, fig. 108: a; Patrick & Reimer 1966, p. 374, pl. 32, fig. 1; Foged 1980, p. 635, pl. 5, figs. 2, 4; Germain 1981, p. 162, fig. 61; Krammer & Lange-Bertalot 1986, p. 252, pl. 92, figs. 1-6; pl. 93, figs. 1-3; Schoeman & Archibald 1988, p. 226, figs. 23-28; Metzeltin & Witkowski 1996, p. 50, pl. 9, fig. 1; Wojtal 2009, p. 148, pl 18, fig. 19; Bąk et al. 2012, p. 47, pl. 45.

Status of name: accepted taxonomically.

Synonyms: *Schizonema sphaerophorum* (Pfitzer) Kuntze 1898
Navicula sphaerophora Kützing 1844
Navicula amphisbaena var. *sphaerophora* (Kützing) Rabenhorst 1846

Diagnosis: Valves are elliptic to elliptical-lanceolate, with subrostrate to capitate apices. The axial area is narrow and bordered on each side by a single row of areolae. Lateral spacing of areolae is variable, except near the valve margin. The central area is asymmetric and lyrate, reaching the valve margin on one side and broadly rounded on the opposite side and has faint ghost striae. The raphe is lateral and straight. Proximal raphe ends with central pores are slightly inflated and bent to one side. Distal raphe endings are sickle-shaped and deflected sharply in the same direction. Transapical striae are punctuate, radiate throughout, about 15-17 in 10 μm at the valve centre, becoming parallel or slightly convergent at the apices, about 18-20 in 10 μm; puncta in striae are distantly spaced and arranged in irregular longitudinal lines. Length of the valve 30-158 μm, and the breadth 13-43 μm.

Ecological preference: Fresh and slightly brackish water, eutrophic lakes (Cleve-Euler 1953); it is regarded as being halophilous, alkaliphilous (Hustedt 1957); benthic, alkaliphilous to indifferent, with pH values 7-8 (Ehrlich 1973); mesohalobous, alkaliphilous (Baudrimont 1974); it is considered as a good indicator of medium to high alkalinity in East African shallow lakes (Richardson et al. 1978); oligohalobous "halophilous", alkalibiontic (Foged 1980); it exhibited a clear preference for waters of high pH and alkalinity and it can be regarded as being a good indicator of medium high to high mineral content, it is eurythermal (Gasse 1986); important as an indicator for high pH and alkalinity in diatom communities of 63 saline lakes in western North America (Blinn 1993); an alkalibiontic, α-mesosaprobous, eutraphentic and brackish freshwater species (Van Dam et al. 1994); occur commonly in wetlands and hot springs around saline-alkaline Lakes in a semi-arid area of the Kenya Rift Valley (Owen et al. 2004).

Occurrence: Recorded frequently from the Eemian palaeolake deposits of central Poland; Radomno, Kamionka, Młynek and Jeziorak Lakes.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. Pilica River (Kadłubowska 1964 b), Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); in epipelon and periphyton of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a).

***Anomoeoneis sculpta* (Ehrenberg) Cleve 1895**

Ref. Hustedt 1930, p.262, fig. 423; Hustedt 1959, p. 741, fig. 1109; Patrick & Reimer 1966, p. 375, pl. 32, fig. 2; Krammer & Lange-Bertalot 1986, p. 253, pl. 92, figs. 3, 4; Schoeman & Archibald, 1988, p. 230, figs. 50-52.

Status of name: accepted taxonomically.

Synonyms: *Navicula sculpta* Ehrenberg 1854
Frustulia sculpta (Ehrenberg) Rabenhorst 1864
Anomoeoneis sculpta var. *major* Cleve 1895
Navicula sculpta var. *major* (Cleve) Peragallo & Peragallo 1897
Schizonema sculptum (Ehrenberg) Kuntze 1898
Anomoeoneis sphaerophora var. *sculpta* (Ehrenberg) O.Müller 1900
Navicula sphaerophora f. *rostrata* (Ehrenberg) Mills 1934
Anomoeoneis sphaerophora f. *sculpta* (Ehrenberg) Krammer 1985

Diagnosis: Valves are elliptical-lanceolate to broadly elliptic, with protracted subrostrate to rostrate-apiculate apices. Axial area is narrow and bordered on each side by a single row of areolae. The central area is large, symmetric, united with elongate lateral areas forming a lyrate area, sometimes with median expansion on one side, which extends to the margin. The central nodule is transversely elliptic. Raphe fissures are lateral, becoming filiform near the terminal fissures, which are deflected to one side. Proximal raphe endings are curved gently to the same side and terminate in large, bulbous pores. Transapical striae are slightly radiate at the valve centre, becoming more radiate near the apices, then parallel at the apices, about 12-15 striae in 10 μm. Length of the valve 70-165 μm, width 30-45 μm.

Ecological preference: Brackish water species (Van Dam et al. 1994); it has the same ecological preferences as *Anomoeoneis sphaerophora*.

Distribution in Poland: Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015).

Genus *Pauliella* Round & Basson, 1997

Diagnosis: Valves are linear to linear elliptic with rounded apices. Raphe valve has a very narrow axial area, expanded slightly at the centre. Raphe is filiform, straight, the proximal raphe endings are simple, and the distal raphe endings on the valve surface are turned slightly to one side. Transapical striae are uniseriate, finely areolate, parallel throughout the valve, about 35 striae in 10 µm. Rapheless valve with a very broad axial area and marginal single rows of irregular areolae separated from single or double rows of mantle areolae. Transapical striae are difficult to observe with the LM.

Holotype species (holotype) : *Pauliella taeniata* (Grunow) Round & Basson 1997

***Pauliella taeniata* (Grunow) Round & Basson 1997**

Ref. Round & Basson 1997, p. 77, figs 8-12, 32-39; Hartley et al. 1996, p. 32, pl. 8, fig. 10.

Status of name: accepted taxonomically.

Synonyms: *Achnanthes taeniata* Grunow 1880

Achnanthes hyperborea Grunow 1884

Diagnosis: Valves are linear to linear elliptic with relatively parallel or slightly convex margins and cuneate to bluntly rounded apices. Raphe valve has a very narrow axial area, prolonged slightly at the valve centre. The central area is small, oval. Raphe is filiform, straight; proximal raphe endings are simple and deflected in the opposite direction; the distal raphe endings are curved on the valve face apically and turned slightly to one side. Transapical striae are uniseriate, finely punctate, parallel throughout the valve, very slightly radiate at the apices, about 32- 35 in 10 µm. Rapheless valve with a very broad lanceolate axial area without a central area and a marginal single row of irregular areolae separated from single or double rows of mantle areolae. Transapical striae are difficult to observe with the LM. Length of the valve 6-40 µm, and the breadth 3-6 µm.

Ecological preference: as *Achnanthes taeniata* from the Northern cold-water region and the Baltic Sea (Hasle & Syvertsen 1996).

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005).

Genus *Staurophora* Mereschkowsky, 1903

Diagnosis: Valves are linear-lanceolate, or elliptic-lanceolate, often with protracted subcapitate rounded ends. Valve face is strongly curved onto the mantle, which is relatively deep. The central area is represented by fascia and is interrupted at the margins by several short striae. Raphe is straight, external proximal raphe endings lie in spathulate grooves and are deflected slightly to one side. Distal raphe endings are hooked toward the secondary side of the valve. Transapical striae are uniseriate, composed of small round poroids, and radiate throughout the valve.

Holotype species: *Staurophora amphioxys* (Gregory) Mann 1990

***Staurophora salina* (W. Smith) Mereschkowsky 1903**

Ref. Mereschkowsky 1903, p. 20, pl. 1, figs. 9, 10, 18, 19; Hustedt 1930, p. 258, fig. 414; Hustedt 1959, p. 786, fig. 1133; Hendey 1964, p. 218, pl. 37, figs. 13-14; Germain 1981, p. 157, pl. 60, fig. 23; Krammer & Lange-Bertalot 1986, p. 250, pl. 91, figs. 14-15; Round et al. 1990, p. 482, figs. a-I; Witkowski et al. 2000, p. 353, pl. 149, fig.13; López-Fuerte et al. 2010, p. 51, pl.31, fig.7; Żelazna-Wieczorek et al. 2015, p. 59, fig. 6 F1-F3.

Status of name: accepted taxonomically.

Synonyms: *Stauroneis salina* W.Smith 1853

Navicula salina (W.Smith) Schütt 1896

Schizonema salinum (W.Smith) Kuntze 1898

Diagnosis: Valve is lanceolate, with smoothly convex margins and rostrate, extremely acutely rounded apices. Valve face is convex. Axial area is narrow and linear, somewhat slightly lanceolate. The central area is a transverse fascia reaching the valve margins. Raphe is filiform, straight. Proximal raphe endings are simple and close to each other, distal raphe endings are curved on the valve face at the apices. Transapical striae are relatively coarsely punctate, slightly radiate throughout the valve, about 18-22 in 10 µm. Punctae about 37-40 in 10 µm. Length of the valve 25-65 µm, and the breadth 9-11 µm.

Ecological preference: *Staurophora salina* found in brackish-marine sediments worldwide (Hustedt 1930, 1959, Witkowski et al. 2000); restricted to streams with high conductivity, mostly recorded in epipelic and epilithic assemblages (Sonneman et al. 2000), and a common littoral species widely spread on all North Sea coasts (López-Fuerte et al. 2010); reported from Saline waters (Żelazna-Wieczorek et al. 2015).

Distribution in Poland: Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015).

Family *Cymbellaceae* Greville 1833

Genus *Brebissonia* Grunow 1860

Diagnosis: Valves are slightly isopolar, rhombic-lanceolate or lanceolate with attenuate, acutely rounded apices. The valve face is flat, and the mantle is shallow. Raphe is straight, filiform; the proximal raphe endings are expanded and internally deflected to the primary side of the valve; the distal raphe fissures are long and bent on the valve face. Internally, a prominent helictoglossa is present. Transapical striae are biseriate. Robust transapical ribs are present.

Holotype species: *Brebissonia boeckii* (Ehrenberg) Grunow 1860

***Brebissonia lanceolata* (Agardh) Mahoney & Reimer 1986**

(Pl. 37, figs. 1-3)

Ref. Hustedt 1930, p. 364, fig. 679; Germain 1981, p. 278, pl. 101, figs. 1, 2; pl. 168, fig. 9; Krammer & Lage-Bertalot 1986, p. 319, pl. 131, fig. 2; Mahoney & Reimer 1986, p. 184, figs. 1-18; Ehrlich 1995, p. 97, pl. 31, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 298, pl. 90, figs. 3-3'; Metzeltin & Witkowski 1996, p. 62, fig. 115: 2-2A; Krammer 2002, p. 125, pl. 144, figs. 1-3; pl. 146, figs.1-4; Hofmann et al. 2011, p. 153, pl. 82, figs. 3-5; Bąk et al. 2012, p.83, pl.57.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema lanceolatum* C.Agardh 1831
Cymbella lanceolata (C.Agardh) Kirchner 1878
Cocconema boeckii Ehrenberg 1834
Doryphora boeckii (Ehrenberg) W.Smith 1853
Brebissonia boeckii (Ehrenberg) Grunow 1860
Cymbella lanceolata var. *boeckii* (Ehrenberg) Rabenhorst 1864
Vanheurckia boeckii (Ehrenberg) F.Schütt 1896

Diagnosis: Valves are lanceolate, lanceolate-elliptic to slightly rhombic-lanceolate with slightly protracted, broadly rounded to attenuate apices. The valve face is flat, and the mantle is shallow. Axial area is narrow, barely widened in the middle. Central area is not differentiated from the axial area. Raphe fissures are straight, filiform, and the proximal raphe endings are expanded with conspicuous central pores. The distal raphe endings are long and bent. The elongate central nodule results in a large gap between the proximal raphe ends. Transapical striae are parallel in the centre, becoming radiate toward the apices, about 11-14 in 10 µm. Internally, helictoglossae are present at the raphe ends. Apical pore fields are present. Length of the valve 55-185 µm, and the breadth 15-32 µm.

Ecological preference: Cosmopolitan, Halobien indifferent, pH: alkaliphilous (Foged 1959); Fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, eutraphentic (Van Dam et al. 1994); the species is reported from streams have pH value ranges from 6.9 to 7.9 and specific conductance ranges from 19 to 86 µS/cm (Potapova 1996); reported from eutrophicated and β-mesosaprobic waters of the Szczecin

Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); distributed in a variety of calcium-containing, oligo- to moderately eutrophic waters, with an average electrolyte content (Bąk et al. 2012); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); alkaliphilous, fresh, oligo- to eutraphentic (Malinowska-Gniewosz et al. 2018).

Occurrence: Distributed frequently in Radomno and Młynek Lakes.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Zalew Rzeszowski, San (near Jarosław), Lubcza, Wielopolka, and Żołynianka streams of the territory of the Podkarpacie Province, and San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 a, b); found in the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); as *Cymbella lanceolata* from the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

Genus *Cymbella* Agardh 1830

Diagnosis: Valves are more or less asymmetrical along the apical axis, symmetrical on the transapical axis; cymbiform to strongly arcuate; linear or linear-lanceolate and somewhat naviculoid shape, with rounded, rostrate or capitate ends. Dorsal margin is convex; ventral margin is either concave, slightly convex or straight, and sometimes slightly swollen in the middle part. Raphe fissures, proximal and distal raphe endings, and the axial area are distinct. The external proximal raphe fissures are often sinuous, ending centrally in expanded pores or a hooked pointing towards the ventral margin; the distal fissures are turned towards the dorsal margin. Central area is sometimes developed by a distinct stigma. Valve surface with transverse punctate striae, uniseriate, radiate or parallel; shorter on the ventrum and longer on the dorsum.

Holotype species: *Cymbella cymbiformis* Agardh 1830

***Cymbella affiniformis* Krammer 2002**

(Pl. 38, figs. 1-2)

Ref. Krammer 2002, p. 45, pl. 25, figs. 1-8; Wojtal 2009, p. 180, pl. 10, figs. 1-2; Kulikovskiy et al. 2016, p. 166, pl. 97, figs. 8-10.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, with a markedly convex dorsal margin and straight to weakly convex ventral margin. Apices are narrow, rostrate to subrostrate. Axial area is relatively narrow and linear. Central area is small, somewhat undistinguished from the axial area. Two, rarely three, stigmata are present at the valve centre close to the middle ventral striae. Raphe is lateral, becoming filiform near the indistinct terminal fissures. Proximal raphe endings are reverse-lateral and deflected to the ventral side. Transapical striae are areolate, slightly radiate, becoming more radiate near the apices, about 10-12 in 10 µm; Areolae about 26-30 in 10 µm. Length of the valve 25-38 µm, and the breadth 7-10 µm.

Ecological preference: The species ecology remains very poorly known. It has been described by Krammer (2002) from material collected from pond (Germany); Low to moderate water conductivity range between

292 to 569 µS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: in the periphyton of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009).

***Cymbella affinis* Kützing 1844**

(Pl. 38, figs. 3-5)

Ref. Hustedt 1930, p. 362, fig. 671; Foged 1959, p. 68, pl. 9, figs. 1-3; Patrick & Reimer 1975, p. 57, pl. 10, fig. 7; Germain 1981, p. 282, pl. 104, figs. 1-11; Gasse 1986, p. 40, pl. 27, fig. 20; Krammer & Lange-Bertalot 1986, p. 314, pl. 125, figs. 1-22; Hartley et al. 1996, p. 142, pl. 63, fig. 2; Lange-Bertalot & Metzeltin 1996, p. 300, pl. 91, figs. 6-9; pl. 107, figs. 7-8; Metzeltin & Witkowski 1996, p. 58, pl. 13, fig. 18; Delgado et al. 2013, p. 96, figs. 73-75; Noga et al. 2013 c, p. 139, fig. 3: 5; p. 141, fig. 4: 8; da Silva et al. 2015, p. 7, figs. 1-7; Kulikovskiy et al. 2016, p. 166, pl. 95, figs. 5-10.

Status of name: accepted taxonomically.

Synonyms: *Cocconema affine* (Kützing) West & West 1905
Cocconema nanum Hantzsch 1862
Cymbella nana (Hantzsch) Gutwinski 1903
Cymbella nanum (Hantzsch) Mills 1934

Diagnosis: Valve is asymmetric, slightly to strongly dorsiventral, half-lanceolate to half-elliptic, with a strongly convex dorsal margin, straight to very slightly concave ventral margin and slight swelling in the middle portion of the ventrum. Apices are subprotracted, subrostrate to rostrate, and acutely rounded. Axial area is narrow and linear. Central area is indistinct or slightly oval. Raphe is eccentric, becoming filiform near the distal end, shifted slightly or moderately to the ventral side; reverse-lateral; distal fissures deflected toward the dorsum; proximal raphe endings sinuate, terminating with central pores. One stigma is present at the end of the middle striae. Transapical striae are fine areolate, slightly radiate in the middle, about 10-12 in 10 µm; distinctly radiate at the ends, about 1213 in 10 µm. Areolae are about 25-30 in 10 µm. Length of the valve 31-48 µm, and the breadth 8-12 µm.

Ecological preference: Freshwater with optimal development in warmer regions (Hustedt 1930); fresh to slightly brackish water (Cleve-Euler 1955); cosmopolitan, halobien indifferent (halophilous), pH: alkaliphilous (Foged 1959); its pH-optimum lies around 8 (Cholnoky 1968); alkaliphilous with pH value 7.5-8 (Ehrlich 1973); oligohalobous "indifferent", alkaliphilous (Foged 1980); it was best developed in circumneutral to slightly acidic waters of low alkalinity (Gasse 1986); cosmopolitan, littoral, epilithic and epiphytic in stagnant and running water (Krammer & Lange-Bertalot 1986); fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, eutraphentic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15–3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); occurs in calcium-rich, oligotrophic lakes and waters flowing in the mountains, indicator of very good ecological quality (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Młynek, Jeziorak and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Rivers in Kraków province, the Vistula, Raba and their affluents, south Poland (Kwandrans et al. 1998); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok River and the catchment area

including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Lubcza, Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), Trzcianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbella affinis* var. *neoprocera* Silva 2015**

(Pl. 38, figs. 6-9)

Ref. Krammer 2002, p. 159, pl. 9, figs.1-7; pl.10, figs.10-13; pl.12, fig.7; Li et al. 2007, p. 2019, fig. 34; Silva et al. 2015, p. 10, figs. 22-28.

Status of name: accepted taxonomically.

Synonym: *Cymbella excisa* var. *procera* Krammer 2002

Diagnosis: Valve is dorsiventral, with broadly convex dorsal margin and straight ventral margin; Apices are not protracted, rounded, or subrostrate to rostrate. Axial area is narrow, linear-arched. Central area is indistinct; Raphe is eccentric, reverse-lateral; deflected to the ventral side; distal raphe endings are reflected toward the dorsum; proximal raphe endings are sinuate, ending with central pores. Transapical striae are finely areolate, slightly radiate throughout the valve, 8-10 in 10 μm at the valve centre, becoming 12-14 toward the ends, punctae about 22-27 in 10 μm. One isolated stigma is found at the end of the central striae on the ventral side. Length of the valve 26-34 μm, and the breadth 8-10 μm.

Ecological preference: The species recorded from freshwater with pH 8.0, air temperature 16-17°C, water temperature 7-20°C (Li et al. 2007); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Distributed frequently in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbella affinis* var. *subcapitata* (Krammer) Silva 2015**

(Pl. 38, figs. 10-14)

Ref. Krammer 2002, p. 159, pl. 10, figs. 1-9, 14-18; Silva et al. 2015, p. 11, figs. 36-42.

Status of name: accepted taxonomically.

Synonym: *Cymbella excisa* var. *subcapitata* Krammer 2002

Diagnosis: Valve is dorsiventral, with broadly convex dorsal margin, and straight, with slight excision in the middle portion of ventral margin. Apices are barely protracted, acutely rounded, to broadly protracted, subcapitate. Axial area is narrow, linear-arched, with an indistinct central area. Raphe as in the nominate species. Transapical striae are slightly radiate throughout the valve, about 8-12 in 10 μm, becoming 11-15 towards the ends. One isolated stigma is located at the end of the central striae of the ventral side. Length of the valve 21-31.5 μm, and the breadth 7.0-9.0 μm.

Ecological preference: The species recorded with the nominate type; it has the same ecological preference.

Occurrence: Frequent in Radomno Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: New record

***Cymbella asiatica* Metzeltin, Lange-Bertalot & Li 2009**

(Pl. 38, figs. 15-18)

Ref. Metzeltin et al. 2009, p. 686, pl. 118, figs. 1-3; pl. 119, figs. 1-4; pl. 120, figs. 1-6; pl. 121, fig. 7; Kulikovskiy et al. 2016, p. 167, pl. 94, figs. 1-4.

Status of name: accepted taxonomically.

Diagnosis: Valve is strongly dorsiventral, half-lanceolate with a strongly convex dorsal margin and slightly to moderately concave ventral margin with slight tumid in the middle portion. Apices are not or very slightly protracted, broadly rounded. Axial area is moderately wide. The central area is orbicular to broadly elliptical, about half of the valve width. Raphe is distinctly lateral, becoming abruptly reverse-lateral near central pores; proximal raphe endings are distinct, widely spaced; distal fissures abruptly reverse-lateral. About 4-6 stigmata

on the ventral side, closer to the median shortened striae. Transapical striae are coarsely areolate, slightly radiate, about 6-7 in 10 µm. Areolae at the dorsal side are about 16-18 in 10 µm, at the ventral side about 18-22 in 10 µm. Length of the valve 50-105 µm, and the breadth 14-18 µm.

Ecological preference: Frequent in oligotrophic waters **(**Metzeltin et al. 2009); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: New record.

***Cymbella aspera* (Ehrenberg) Cleve 1894**

(Pl. 38, fig. 19; pl. 39, figs. 1-4)

Ref. Hustedt 1930, p. 365, fig. 680; Patrick & Reimer 1975, p. 53, pl.10, fig.8; Foged 1978, p. 46, pl. 38, fig. 8; Jensen 1985, p. 818, fig. 680; Krammer & Lange-Bertalot 1986, p. 319, pl. 131, fig. 1; pl. 7, fig. 1; pl. 8, fig. 2; pl. 11, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 236, pl. 59, fig. 26; pl. 90, fig. 1; Metzeltin & Witkowski 1996, p. 62, pl. 15, fig. 1-1A; Krammer 2002 p. 114, pl. 62, fig. 5; pl. 124, figs. 1-8; pl. 125, figs. 1-4; pl. 126, figs. 1-5; pl. 127, fig. 7; pl. 142, fig. 7; Wojtal 2009, p. 180, pl. 9, figs. 1-3; pl. 70, figs. 1-7; Bąk et al. 2012, p. 79, pl. 57; Bahls et al. 2018, p. 80, pl. 43, figs. 1, 2; p. 155, pl. 118, fig. 13.

Status of name: accepted taxonomically.

Synonyms: *Cocconema asperum* Ehrenberg 1840
Cymbella lanceolata var. *aspera* (Ehrenberg) Brun 1880
Cymbella gastroides (Kützing) Brébisson & Godey 1835
Cymbophora gastroides (Kützing) Brébisson 1838
Cocconema gastroides (Kützing) Pelletan 1888

Diagnosis: Valve is moderately dorsiventral, half-lanceolate; dorsal margin is strongly convex; ventral margin is slightly convex to nearly straight, slightly tumid in the middle portion. Apices are broadly rounded. Axial area is linear, moderately wide. Central area is small, asymmetric, ovate to nearly indistinct. The ventral side of the central area is bordered by irregularly spaced areolae. Raphe is eccentric, moderately lateral; distal raphe fissures are sickle-shaped, curved dorsally; proximal raphe endings are slightly hooked, with distinct rounded central pores. Several stigmata are found near the central nodule toward the ventrum. Transapical striae are uniseriate, distinctly punctate, radiate in the middle of the valve, slightly radiate to parallel at the ends, about 8-10 in 10 µm in the middle of the dorsum, 11-12 in 10 µm at the ends; areolae about 9-11 in 10 µm. length of the valve 110-220 µm, and the breadth 22-36 µm.

Ecological preference: Epipelic, cosmopolitan, halobien indifferent (halophilous), pH: alkaliphilous (Foged 1959); oligohatobous, alkaliphilous, often reported from seeps and springs, but also found in streams and lakes in shallower water (Patrick & Reimer 1975); oligohatobous (indifferent); alkaliphitous (Foged 1981); tychoplanktonic (Denys 1991); an alkaliphilous, oligosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); preferring oligotrophic waters with moderate conductivity (Krammer 2002); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); widespread in alkaline, meso- to eutrophic waters, flowing waters and lakes in the lowlands (Bąk et al. 2012); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); freshwater with pH had an alkaline character 7.1-8.3, low to high conductivity (100-764 µSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013a, 2014a); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Młynek Lake, and frequent in Radomno, Jeziorak, and Kamionka Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Distributed in the Wyżyna Krakowsko- Częstochowska Upland; Vistula River (Turoboyski 1962); Pilica River (Kadłubowska 1964 b); spring in Dubie (Skalska 1966 a, b); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream situated *ca* 30 km northwest of Krakow and

its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south Poland (Noga et al. 2013 a); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Gołębiówka, Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Strug, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbella aspera* var. *elongata* Skvortzov 1928**

(Pl. 40, figs. 1-3; pl. 41, figs. 1-4)

Ref. Skvortzov 1928, p. 46, pl. 4, fig. 4.

Status of name: accepted taxonomically.

Synonym: *Cymbella lanceolata* var. *elongata* (Skvortzov) Skvortzov 1946

Diagnosis: Valve is moderately dorsi-ventral, with evenly arched dorsal margin and nearly straight ventral margin with slightly gibbous central portion. Apices are slightly tapered, broad and rounded. The axial area is linear, widening slightly at the valve centre to form a shallow elliptical central area. The raphe is lateral, tapering near the proximal and distal ends, becoming slightly reverse-lateral near the distal ends; ventrally deflected. The proximal raphe ends are rounded. The distal raphe ends are distinctly forked, curved dorsally. Transapical striae are punctate, slightly radiate at the valve centre to somewhat parallel, about 8-10 in 10µm at the centre, becoming 11-12 in 10µm near the ends. Length of the valve 70-200µm, and the breadth 20-30µm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Młynek and Radomno Lakes.

Distribution in Poland: New record.

***Cymbella baicalaspera* Glushchenko, Kulikovskiy and Kociolek 2022**

(Pl. 42, figs. 1-4)

Ref. Glushchenko et al. 2022, p. 6, figs. 5-8.

Status of name: accepted taxonomically

Diagnosis: Valves are dorsiventral, moderately arched with a convex dorsal margin and slightly convex ventral margin at the valve centre. Apices are broadly rounded, not protracted. Axial area is moderately wide and linear. The central area is shallow, about 1/3 of the valve width. Raphe is filiform, lateral; the proximal raphe endings are slightly expanded, weakly deflected ventrally, terminating as inflated drop-shaped pores. Distal raphe ends are deflected to the dorsal margin. Stigmata are present on the ventral side of the central margin, about 8-13, which are round to slit-like

in shape. Transapical striae are uniseriate, radiate, becoming subparallel at the central part and condensed towards the ends, 8-9 in 8 µm at the central part, 11-12 in 10 µm near the ends. Areolae are coarse, 10-11 in 10 µm. Length of the valve 140-155 µm, breadth 30-32 µm.

Remarks: According to Glushchenko et al. 2022, *Cymbella baicalaspera* differs from *C. peraspera* in valve breadth and from *C. aspera* in a smaller variety of areola opening types.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, eutrophic freshwater environments.

Occurrence: Frequent in the Radomno Lake.

Distribution in Poland: New record.

***Cymbella cistula* (Ehrenberg) Kirchner 1878**

(Pl. 43, figs. 1-10; pl. 44, figs. 1-12)

Ref. Hustedt 1930, p.363, fig. 676 a; Andrews 1970, p. l9, pl. 3, fig. 9; Patrick & Reimer 1975, p. 62, pl. 11, fig. 34; Gasse 1986, p. 42, pl. 28, figs. 1, 3; Krammer & Lange-Bertalot 1986, p. 316, pl. 127, figs. 8-11; pl. 128, figs. 1-6; pl. 10, fig. 5; Ehrlich 1995, p. 94, pl. 30, fig. 12; Le Cohu 1996, p.82, figs. 12-13; Lange-Bertalot & Metzeltin 1996, p. 300, pl. 91, fig. 5.

Status of name: accepted taxonomically.

Synonyms: *Bacillaria cistula* Ehrenberg 1828
Cocconema cistula (Ehrenberg) Ehrenberg 1831
Cymbella cistula var. *crassa* Tempere & Peragallo 1909
Cymbella cistula var. *typica* Meister 1912

Diagnosis: Valve is asymmetric, dorsiventral with a convex dorsal margin and slightly concave ventral margin that often shows a slight tumid in the centre. Apices are bluntly rounded to slightly subprotracted. Axial area is narrow, linear, and expanded to the valve centre. The central area is rounded or elliptical. Raphe is eccentric, lateral or reverse-lateral; distal raphe endings are deflected dorsally, proximal raphe endings are sinuate, slightly hooked and with distinct rounded central pores. A row of coarse isolated stigma, about 15 found near the central nodule toward the ventrum. Transapical striae are coarsely punctate, radiate throughout the valve, about 89 in 10 µm at the valve centre, and 11-12 in 10 µm near the ends; punctae 2022 in 10 µm. Length of the valve 68-80 µm, and the breadth 14-16 µm.

Ecological preference: Fresh and slight brackish water (Cleve-Euler 1955); oligohalobous "indifferent", alkaliphilous (Foged 1959, 1970); Alkaliphilous, "indifferent" oligohalobous; eurytopic, epiphytic (Patrick & Reimer 1975); epiphytic, freshwater form, pH "indifferent" around value 7 (Ehrlich 1973); it is regarded as being oligohalobous-indifferent or salt-indifferent, and alkaliphilous (Schoeman 1973); cosmopolitan, epiphytic in stagnant and running, oligo- to eutrophic waters (Krammer & Lange-Bertalot 1986); fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, eutraphentic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Radomno Lake, frequent in the Jeziorak, Młynek and Kamionka Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

***Cymbella cistula* var. *siamense* Hirano 1967**

(Pl. 45, figs. 1-2)

Ref. Hirano 1967, p. 29, pl. 7, fig. 5.

Status of name: accepted taxonomically.

Diagnosis: This variety differs from the typical form of the species in the non-inflated ventral margin of the valve, the attenuation towards the apices is gradual, while in the type species it is rapid. Transapical striae are markedly punctate, radiate throughout the valve, about 79 in 10 µm at the valve centre, and 10-11 in 10 µm towards the ends; Length of the valve 46-55 µm, and the breadth 14-15 µm.

Ecological preference: This variety is accompanied by the nominate species, and it has the same ecological preferences; reported from the benthic habitats of slightly alkaline, eutrophic freshwater environments.

Occurrence: Infrequent in the Radomno Lake.

Distribution in Poland: New record.

***Cymbella cistuloides* var. *angulata* Skvortzov 1971**

(Pl. 45, figs. 3-7)

Ref. Skvortzov 1971, p. 87, pl. 14, fig. 6.

Status of name: accepted taxonomically.

Diagnosis: Valve is dorsiventral, asymmetric, with a convex dorsal margin and nearly straight ventral margin with a slight tumid in the centre. Apices are rounded and not protracted. Axial area is narrow, linear, and expanded to the valve centre. The central area is relatively elliptical. Raphe is eccentric, lateral or reverse-lateral; distal raphe endings are deflected dorsally, proximal raphe endings are sinuate, slightly hooked and with distinct rounded central pores. Stigmata absent. Transapical striae are coarsely punctate, radiate throughout the valve, about 67 in 10 µm at the valve centre, and 9-10 in 10 µm towards the ends; punctae 2024 in 10 µm. Length of the valve 58-65 µm, and the breadth 16-18 µm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, eutrophic freshwater environments.

Occurrence: Frequent in the Radomno Lake.

Distribution in Poland: New record.

***Cymbella cistuliformis* Krammer 2002**

(Pl. 45, figs. 8-11)

Ref. Krammer 2002, p. 170, pl.101, figs.1-4; pl.102, figs. 1-5.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately dorsiventral, dorsal margin strongly convex, ventral margin slightly concave with a slightly tumid at the valve centre. Apices are not protracted and broadly rounded. Axial area moderately wide, nearly linear, expanded to the valve centre. Central area rounded, about 1⁄4 to 1/3 the breadth of the valve. Raphe nearly eccentric, moderately to distinctly lateral, becoming filiform near the distal and proximal ends; distal raphe endings scythe-like dorsally deflected, proximal raphe endings distinct with rounded central pores. A row of coarse isolated stigma, about 6⁄10 present near the central nodule toward the ventral side, and sometimes distant from the middle ventral striae. Transapical striae are coarsely punctate-lineolate, radiate throughout the valve, more radiate towards the ends, about 67 in 10 µm on both dorsal and ventral margins; becoming about 8 in 10 µm towards the ends; punctae 1315 in 10 µm. Length of the valve 80-140 µm, and the breadth 24-31 µm.

Ecological preference: alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a); reported from the benthic habitats of slightly alkaline, eutrophic freshwater environments.

Occurrence: Frequent in the Radomno Lake.

Distribution in Poland: Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015).

***Cymbella compacta* Østrup 1910**

(Pl. 46, figs. 1-2)

Ref. Hustedt 1955, p. 47, figs. 1-5; Foged 1959, p.72, pl. 9, fig. 7; Bąk et al. 2012, p. 80, pl. 55; Rybak et al. 2019, fig. 2: 32; Kulikovskiy et al. 2016, p. 167, pl. 101, figs. 3-6.

Status of name: accepted taxonomically.

Synonyms: *Cymbella turgidula* Grunow sensu Cleve & Möller 1878
Cymbella helvetica var. *abbreviata* Grunow 1885
Cymbella javorkae Krenner 1926
Cymbella filarszkyi Halász 1937
Cymbella helvetica var. *compacta* (Østrup) Hustedt 1955

Diagnosis: Valves are moderately dorsiventral, lanceolate-elliptical with a convex dorsal margin and a slightly convex to nearly flat ventral margin. Apices are rounded and may become weakly protracted in larger specimens. Axial area is very narrow and curved, just like the raphe fissures. The central area is small and elliptic in shape, somewhat indistinct. Raphe is located almost in the middle, lateral, becoming filiform near the proximal and terminal ends. Proximal raphe endings are small central pores, more or less bent towards the ventral margin. Distal raphe endings are deflected dorsally at a 45-degree angle. Stigmata are elongated, about 4-8 present at the proximal ends close to the median ventral striae. Transapical striae are coarsely areolate, slightly radiate throughout the valve, becoming parallel, and then convergent near the apices, about 10-12 in 10 µm. Areolae are about 22-25 in 10 µm. Length of the valve 35-78, and the breadth 11-15.

Ecological preference: The species reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); it occurs in large numbers in oligo- to β-mesosaprobic waters, eutrophic, rich in calcium, with an average content of electrolytes, optimum occurrence in large rivers throughout Central Europe (Bąk et al. 2012); freshwater with pH had an alkaline character or close to neutral 6.6-8.3, low to high conductivity (128-764 µSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a, c); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016b); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, c); San (near Jarosław) and Matysówka streams in the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016); Rzeczyca stream and its tributaries, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cymbella cursiformis* Hufford & Collins 1972**

Ref. Hustedt, 1955, p. 62, figs 39-40; Hufford & Collins 1972, p. 186, figs. 4-6, 8, 10; Foged 1979, p. 37, pl 35, fig. 12; Krammer 2002, p. 86, pl. 74, figs. 1-4, 7, 8.

Status of name: unresolved and requires further investigation

Synonyms: *Cymbella cistula* var. *gracilis* Hustedt 1955

Cymbella crassistigmata Krammer 2002

Diagnosis: Valve is asymmetric, strongly dorsiventral, with a convex dorsal margin and slightly concave ventral margin, inflated in the middle. Apices are bluntly rounded to subprotracted. Axial area is relatively broad, linear. The central area is small. Raphe eccentric, reverse-lateral; distal endings curved dorsally, while the proximal ends sinuate. Transapical striae are punctate-lineate, radiate throughout the valve, about 6-9 in 10 µm at the centre of the dorsal margin, up to 10-14 in 10 µm at the ends. Striae on the ventral margin terminate in a row of coarse isolated stigma, about 35 along the margin of the central area. Length of the valve 78-95 µm, and the breadth 13-17 µm

Ecological preference: Recorded as an epiphyte on aquatic plants in slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbella cymbiformis* Agardh 1830**

(Pl. 46, figs. 3-10)

Ref. Hustedt 1930, p. 362, fig. 672; Foged 1959, p.69, pl. 9, fig. 9; Ehrlich 1973, p. 21, pl. 3, fig. 14; Patrick & Reimer 1975, p. 54, pl. 10, figs. 3-4; Germain 1981, p. 282, pl. 103, figs. 12-14; Krammer & Lange-Bertalot 1986, p. 317, pl. l29, figs. 2-9; pl. 5, fig. 5; pl. 12, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 236, pl. 59, fig. 25; pl. 90, fig. 6; Hofmann et al. 2011, p. 148, pl. 80, figs.1-11; Bąk et al. 2012, p. 80, pl. 55; Noga et al. 2013 c, p. 139, fig. 3: 6; Kulikovskiy et al. 2016, p. 169, pl. 90, figs. 6-11.

Status of name: accepted taxonomically.

Synonyms: *Cymbella fulva* (Kützing) C.Agardh 1830
Frustulia fulva Kützing 1833
Cymbophora fulva (Kützing) Brébisson 1838

Diagnosis: Valve is cymbiform, dorsiventral, linear-lanceolate to half-lanceolate; the dorsal margin is convex; the ventral margin is nearly straight to very slightly concave with slight swelling in the middle portion. Apices are bluntly rounded. Axial area is linear, narrow at the ends, and slightly wide at the centre. Central area is small, and elliptic, somewhat wider on the ventral side. Raphe is weakly eccentric, distinctly lateral, becoming reverse-lateral near the proximal ends; distal raphe endings are deflected toward the dorsum in the form of a question mark; proximal raphe endings are curved ventrally and terminate with inflated central pores. An isolated stigma is present in the central area on the ventral side. Transapical striae are punctate, widely spaced, nearly parallel or slightly radiate at the valve centre, distinctly radiate at the ends, about 8-9 in 10 µm on the dorsum and 9-10 on the ventrum at the centre, while 12-14 in 10 µm at the ends. Areolae are distinct and widely spaced, about 14-17 in 10µm. Length of the valve 72-110 µm, and the breadth 15-19 µm.

Ecological preference: Freshwater form, Cosmopolitan, oligohalobous 'indifferent', alkaliphilous (Foged 1959, 1970); epiphytic, pH 'indifferent', around 7 (Ehrlich 1973); it inhabited dilute waters with circumneutral to slightly alkaline pH (Gasse 1986); oligotrophic to mesotrophic waters (Krammer & Lange--Bertalot 1986); widespread, euplanktonic, oligosaprobous, oligo-mesotraphentic, circumneutral or alkaliphilous species (Denys 1991; Van Dam et al. 1994; Krammer 2002); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); circumneutral, fresh, oligo-mesotrophic (Malinowska-Gniewosz et al. 2018); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Radomno Lake, frequent in the Jeziorak and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Żołynianka stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020); Lakes Łazduny and Rzésniki in the Masurian Lake District in north-east Poland (Szczerba et al. 2023).

***Cymbella cymbiformis* var. *nonpunctata* Fontell 1917**

(Pl. 46, figs. 11-14)

Ref. Fontell 1917, p. 24, pl. 2, fig. 42; Cleve-Euler 1955, p. l60, fig. 1246 ef; Patrick & Reimer 1975, p. 55, pl. 10, fig. 5; Krammer & Lange-Bertalot 1986, p. 317, pl. 129, figs. 78; Metzeltin & Witkowski 1996, p. 58, pl. 13, figs. 19-20; Li et al. 2007, p. 218, figs. 30-31.

Status of name: accepted taxonomically.

Diagnosis: This variety differs from the type species by the absence of an isolated stigma at the central striae of the ventral margin, and by having a linearlanceolate axial area and straight ventral margin, with a very slight swelling in the median part. Transapical striae are radiate throughout the valve, 10-11 in 10 µm at the centre to 1314 in 10 µm at the ends. Length of the valve 34-50 µm, and the breadth 8-10 µm.

Ecological preference: Similar to that of the type species; recorded from circumneutral fresh-brackish water oligosaprobous, high oxygen requirements, oligo-mesotraphentic (Van Dam et al. 1994); freshwater with pH 8.5, air temperature 13.5°C, water temperature 14°C (Li et al. 2007); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Radomno and Młynek Lakes.

Distribution in Poland: Lubcza stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

***Cymbella cymbiformis* var. *unipunctata* A. Cleve 1955**

(Pl. 47, figs. 1-7)

Ref. Cleve-Euler 1955, p. 160, fig. 1246 a, b; Navatha & Reddy 2020, p. 1515, pl.1, fig. 4a.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, sickle-shaped, asymmetrical, with a convex dorsal margin, almost straight or concave ventral margin and slightly swollen in the middle. Apices are broadly rounded. The axial area is fairly wide, linear. Central area is slightly enlarged with an isolated stigma on the ventral side at the end of the central striae. Raphe is arcuate and thick; proximal raphe endings with central pores that bend ventrally; distal raphe endings are dorsally deflected. Transapical striae are lineate, strongly radiate throughout the valve, about 8-10 in 10 µm at the centre to 1013 in 10 µm towards the ends. Length 46-65 µm, and the breadth 11-13µm.

Ecological preference: Freshwater with low nutrient levels, found in unpolluted water, and is considered an indicator of good water quality (Navatha & Reddy 2020); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Kamionka Lakes.

Distribution in Poland: New record.

***Cymbella diversiformis* Krammer 2002**

(Pl. 47, figs. 8-13; pl. 48, figs. 1-4)

Ref. Krammer 2002, p. 80, p. 167, pl. 67, fig. 1-2.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately dorsiventral, lanceolate with a strongly convex dorsal margin, slightly concave ventral margin with a slight tumid in the middle portion of the ventrum. Apices are bluntly rounded. Axial area is moderately wide, narrowing towards the ends. Central area is absent or not well defined. Raphe is strongly lateral, becoming filiform near the terminals and distinctly reverse-lateral near the central ends. Proximal raphe endings with distinct central pores, bulbous; distal raphe endings are dorsally deflected. About 3-4 distinct stigmata are on the ventral side of the central nodule. Transapical striae are lineolate, slightly radiate at the valve centre, more radiate towards the ends, about 8-9 in 10 µm on the dorsal side, and 9-10 in 10 µm on the ventral side, becoming up to 12 in 10 µm near the ends; puncta 14-17 in 10 µm. Length of the valve 70-82 µm, and the breadth 16.8-18 µm.

Remarks: This species is similar to *Cymbella cymbiformis* Agardh, but it is distinguished by the coarsely lineolate striae and the number of stigmata.

Ecological preference: It is reported from freshwater of oligotrophic lakes, in low Biological Oxygen Demand, clean, unpolluted aquatic systems (Jackson 2022); recorded as a benthic and epiphytic taxon that often attaches to submerged surfaces like plants and sediment in slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in the Radomno and Młynek Lakes.

Distribution in Poland: New record

***Cymbella diversistigmata* Krammer 2002**

(Pl. 48, figs. 5-8)

Ref. Krammer 2002, p. 165, pl.40, figs.1-11; Naseri et al. 2022, p. 8, fig. 63.

Status of name: accepted taxonomically.

Diagnosis: Valve is asymmetrical, dorsiventral, elliptical-lanceolate with a strongly convex dorsal margin, straight to moderately concave ventral margin with slight tumid in the middle portion. Apices are not protracted, but bluntly rounded. Axial area is narrow, somewhat curved. Central area is small and well defined. Raphe is slightly ventrally displaced, strongly lateral, becoming filiform near the distal and filiform to slightly reverse-lateral near the proximal endings. 1-4 distinct stigmata on the ventral side of the central nodule, and sometimes also on the dorsal side. Transapical striae are punctate, slightly radiate at the valve centre, more radiate towards the ends, about 9-10 in 10 µm on both dorsal and ventral sides, becoming up to 12-13 in 10 µm near the ends; puncta 21-24 in 10 µm. Length of the valve 32-67 µm, and the breadth 10-12.7 µm.

Ecological preference: Found in benthic habitats attached to substrates like plants and sediment in an alkaline freshwater environment with pH value ranges 7.22-9.7, low conductivity and TDS ((mg/l) ranges 105-421, oligosaprobic to β-mesosaprobic (Naseri et al. 2022); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Radomno Lake.

Distribution in Poland: New record.

***Cymbella dorsenotata* Østrup 1910**

(Pl. 48, figs. 9-13)

Ref. Le Cohu & Tudesque 2008, p. 8, figs. 47, 48, 68; Bąk et al. 2012, pl. 56; Reavie 2023, p. 17, figs. 9P-Q.

Status of name: accepted taxonomically.

Diagnosis: Valves are asymmetrical, dorsiventral with a marked convex dorsal margin and slightly concave ventral margin with a slight tumid at mid-valve. Apices are broadly rounded, but not protracted. Axial area is narrow, linear, and expanding towards the valve centre. Central area is distinct, enlarged dorsally and ventrally, and somewhat rounded. Raphe is centrally located within the axial area, reverse lateral; the proximal raphe endings are expanded and oriented towards the ventral side. About 3-5 isolated stigmata are present on the ventral side of the central area. Transapical striae are punctate, slightly radiate at the centre, more radiate towards the ends, about 7-8 in 10 µm at the valve centre, up to 11-12 in 10 µm near the ends. Length of the valve 45-115 µm, and the breadth 14-18 µm.

Remarks: This species is similar to *Cymbella neocistula* var. *islandica*, but differs by having a more lunate shape and the presence of multiple stigmata at the central area and a higher striae density.

Ecological preference: This taxon is reported as an epiphyte in an alkaline, mesotrophic freshwater environment

Occurrence: Frequent in the Kamionka Lake.

Distribution in Poland: New record.

***Cymbella excisa* Kützing 1844**

(Pl. 49, figs. 1-4)

Ref. Obukhova 1961, p. 151, pl. 6, figs. 4-7; Krammer 2002, p.26, pl. 8, figs. 1-26; Li et al. 2007, p. 219, fig. 33; Hofmann et al. 2011, p.150, pl.77, figs. 23-28; Bąk et al. 2012, p. 81, pl. 54; Solak et al. 2016, p. 954, pl. 2, figs. 1-4; Rybak et al. 2019, pl. 2, fig. 30.

Status of name: accepted taxonomically.

Synonyms: *Cocconema excisum* (Kützing) H.L.Smith 1876
Cymbella affinis var. *excisa* (Kützing) Grunow 1882
Cymbella affinis f. *excisa* (Kützing) Grunow 1882
Encyonema ventricosum var. *excisum* (Kützing) Mayer 1947
Cymbella affinis var. *ventriconcava* Obukhova 1961

Diagnosis: Valves are strongly dorsiventral, widely lanceolate with a strongly convex dorsal margin and slightly convex or more rarely straight ventral margin, sometimes there is a characteristic indentation or excised in the central area. Apices are subrostrate to rostrate, bluntly rounded. Axial area is narrow, linear, and slightly curved. Central area is very small or not defined. One stigma is present at the end of the middle striae. The raphe is lateral, becoming filiform near the distal end, shifted towards the ventral margin. The proximal raphe endings

have central pores that deflect towards the ventral side. Transapical striae are finely punctate, slightly radiate throughout the valve, about 10-13 in 10 μm on the dorsal side; puncta about 25-30 in 10 μm. Length of the valve 22-37 μm, and the breadth 7-10 μm.

Remarks: The main difference between *Cymbella excisa* and *Cymbella affinis* is the presence of an excision in the middle portion of the ventral side of the valve, a characteristic common to populations of *Cymbella excisa* around the world (Krammer 2002).

Ecological preference: A widely spread species, it prefers mesotrophic waters with a medium electrolyte content. It was reported from freshwater with pH 7.0-8.0, air temperature 14-17°C, water temperature 3-20°C (Li et al. 2007); an epilithic and primarily epiphytic species found in flowing and stagnant waters, often mesotrophic to slightly eutrophic, with a medium content of electrolytes (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b, c); in acidic water with lowest pH values (Stanek-Tarkowska et al. 2015); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 μS cm-**1**) and low temperature 5.6-9.3°C (Noga et al. 2016b); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Radomno and Jeziorak Lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Dominant in the Wisłok River, Duszatyńskie Lakes (Western Bieszczady Mts.), Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Baryczka stream left bank tributary of the River San south-east Poland (Noga et al., 2013 a, b, c, d); the Wisłoka, Ropa, Bielcza and San rivers, the Podkarpacie Province, south Poland (Noga et al. 2014 a); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park; Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al., 2016a,b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, south-east Poland (Peszek et al. 2021).

***Cymbella hantzschiana* Krammer 2002**

(Pl. 49, figs. 5-6)

Ref. Krammer 2002, p. 47, pl. 27, figs. 8-14; pl. 28, figs. 1-19; pl. 29, figs. 1-12; pl. 30, figs. 9-14; Li et al. 2007, p. 220, fig. 38; Jüttner et al. 2010, p. 87, pl. 10, figs. 1-10; Kulikovskiy et al. 2016, p. 169, pl. 89, figs. 5-11; Bahls et al. 2018, p. 42, pl. 5, figs. 20, 21; p. 80, pl. 43, figs. 8-11; p. 155, pl. 118, fig. 2.

Status of name: accepted taxonomically.

Synonyms: *Cocconema pachycephalum* Rabenhorst 1861
Cocconema tumidum var. *pachycephalum* (Rabenhorst) Rabenhorst 1864
Frustulia cymbiformis Kützing 1833
Cocconema cymbiforme (Kützing) Ehrenberg 1838
Cocconema robustum Rabenhorst 1863
Cymbella parva sensu Hustedt 1955,
Cymbella parva sensu Cleve-Euler 1955

Diagnosis: Valves are dorsiventral with a convex dorsal and weakly concave to almost straight ventral margin, sometimes with slightly tumid at the valve centre, becoming nearly flat in smaller specimens. Apices are not or very slightly protracted, bluntly rounded. Axial area is narrow, linear to linear-lanceolate. Central area is either not defined from the axial area or small, oval-shaped, sometimes irregular and asymmetric. Raphe is lateral, becoming filiform near the ends and reverse-lateral towards the valve centre. Proximal raphe endings are deflected ventrally and terminate in weakly inflated pores. Distal raphe endings are curved dorsally at

a 45-degree angle. Stigmata are absent. Transapical striae are finely punctate, parallel to slightly radiate at the valve centre, becoming more strongly radiate near the ends, about 8–10 in 10 μm in the valve centre on both dorsal and ventral sides, and 12-14 in 10 μm near the ends. Areolae are about 25-28 in 10 μm. Length of the valve 25-47 μm, and the breadth 8-11 μm.

Ecological preference: Widespread in temperate regions in oligo- to mesotrophic waters with an average electrolyte content (Krammer 2002); freshwater with pH value 5.5-8.5, air temperature 13.5-24°C, water temperature 10-23°C, (Li et al. 2007); the species was found on submerged and non-submerged bryophytes in springs, on moist soil, and on macrophytes (Jüttner et al. 2010); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016).

***Cymbella helmckei* Krammer 1982**

Ref. Krammer 1982, p. 30, pls. 1071-1073; Bąk et al. 2006, tab. 1, p. 296.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately dorsiventral, lanceolate, with a distinctly convex dorsal margin, slightly concave ventral margin, and a slight tumid in the middle portion. Apices are bluntly rounded and not protracted. Axial area is narrow and linear. Central area is small, oval. Raphe is eccentric. Distal raphe endings are deflected dorsally; the proximal raphe endings are curved slightly toward the ventral margin. Stigmata are absent. Transapical striae are radiate throughout the valve, distinctly punctate, about 9-10 in 10 μm at the valve centre, becoming 12 in 10 μm at the ends. Length of the valve 125-140 μm, and the breadth 26-29 μm.

Ecological preference: The species is reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Cymbella helvetica* Kützing 1844**

(Pl. 49, figs. 7-12; pl. 50, figs. 1-12; pl. 51, figs. 1-11)

Ref. Hustedt 1930, p. 364, fig. 678; Germain 1981, p. 280, pl. 101, figs. 3-11; Krammer & Lange-Bertalot 1986, p. 324, pl. 132, figs. 2-4; pl. 133, figs. 1-8; Foged 1993, p. 240, fig. 147; Ehrlich 1995, p. 96, pl. 31, figs. 1-3; Lange-Bertalot & Metzeltin 1996, p. 43, pl. 89, figs. 1-8; pl. 107, fig. 2; Le Cohu 1996, p. 82, figs. 14-16; Metzeltin & Witkowski 1996, p. 60, pl. 15, figs. 3-4; Krammer 2002, p. 154, pl. 183, figs. 1-3; pl. 184, figs. 1-4; pl. 185, figs. 1-6; pl. 187, figs. 1-5; Hofmann et al. 2011, p. 151, pl. 81, figs. 3-4; Kulikovskiy et al. 2016, p. 169, pl. 96, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Cymbella gastroides* var. *helvetica* (Kützing) Rabenhorst 1864
Cocconema helveticum (Kützing) Cleve & Grunow 1880
Cymbella gallica Héribaud 1908
Cymbella lacroixii Lauby 1910
Cymbella helvetica var. *major* Meister 1912
Cymbella rigida Frenguelli 1942
Cymbella helvetica f. *major* (Meister) A.Cleve 1955
Cymbella cistula var. *lacroixii* (Lauby) VanLandingham 1969

Diagnosis: Valve is moderately dorsiventral, lanceolate to half-lanceolate, with moderately convex dorsal margin, slightly convex to straight ventral margin, which is slightly tumid at the centre. Apices are obtusely to acutely rounded. Axial area is narrow and linear. Central area is indistinct from the axial area. Raphe is nearly eccentric or running near the ventral margin, slightly lateral, becoming filiform near the proximal and distal endings. Distal raphe fissures are bayonet-form, curved toward the dorsal side, and the proximal raphe endings with prominent, small central pores. Stigmata are hardly visible under the light microscope. Transapical striae are finely punctate, parallel to slightly radiate in the middle, parallel to convergent at the ends, about 8-10 in 10 µm. Length of the valve 38-76 µm, and the breadth 9-15 µm.

Ecological preference: Cosmopolitan, it is regarded as being oligohalobous, pH-indifferent, found in water of pH ranging from 6.0 to 9.0 (Hustedt 1957; Haworth 1976); oligohalobous "indifferent", alkaliphilous (Foged 1959, 1993); it is distributed in oligo- to eutrophic water, littoral form (Krammer & Lange-Bertalot 1986). Euplanktonic, alkaliphilous; oligosaprobous, oligo-mesotraphentic or mesotraphentic species (Denys 1991; Hofmann 1994; Van Dam et al. 1994; Krammer 2002); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); oligotrophic, rich in calcium, upland lakes and in flowing waters, indicator very good ecological quality (Bąk et al. 2012); freshwater, oligotrophic with pH had an alkaline character or close to neutral water reactions (pH 6.8-8.2), low to high conductivity (100-764 µSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a, b); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake; frequent in Jeziorak and Młynek Lakes; Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), western Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Swibno-Vistula River estuary, north Poland (Majewska et al. 2012); in Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south-east Poland (Noga et al. 2013 a); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Wisłoka (near Dębica), Matysówka) of the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbella himalaspera* Jüttner & Van de Vijver 2010**

(Pl. 52, figs. 1-4; pl. 53, figs. 1-4)

Ref. Jüttner et al. 2010, p.75, pl. 2, figs. 1-4; pl. 3, figs. 1-8; Kihara et al. 2015, p. 22, fig. 41; Glushchenko et al. 2022, p. 3, figs. 2-4.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral with a moderately convex dorsal margin that gradually tapers towards the ends, and almost straight ventral margin with a slightly tumid valve centre. Apices are broadly rounded. Axial area is linear, moderately wide. Central area is elliptic, about 1/3 of the valve width. Raphe is distinctly lateral, slightly eccentric, and tapering near the proximal and distal ends. Proximal raphe endings are large, drop-like and ventrally deflected; distal raphe endings appear sickle-shaped and are deflected to the dorsal side of the valve. A larger number of small, round to slightly elongate stigmata are present on the ventral side of the central nodule and separated from the shortened ventral striae. Transapical striae are areolate, radiate throughout the valve and sometimes slightly curved at the ends, about 7-9 in 10 µm on both margins. Areolae are about 10-12 in 10 µm. Length of the valve 150-230 µm, and the breadth 35-49 µm.

Ecological preference: Large populations of this species were found in springs on submerged and non-submerged bryophytes and found on moist non-submerged and adjacent to a stream channel (Jüttner et al. 2010).

Occurrence: Common in Radomno Lake.

Distribution in Poland: New record.

***Cymbella hustedtii* Krasske 1923**

(Pl. 54, figs. 1-5)

Ref. Hustedt 1930, p. 363, fig. 674; Patrick & Reimer 1975, p. 27, pl. 4, figs. 2a-3b; Foged 1980, p. 639, pl. 9, fig. 14; Germain 1981, p. 288, pl. 105, fig. 20; Krammer & Lange-Bertalot 1986, p. 333, pl. 140, figs. 9-17; Foged 1993, p. 240, fig. 77; Lange-Bertalot et al. 1996, p. 59, pl. 35, fig. 1, 1 a; Lange-Bertalot & Metzeltin 1996, p. 304, pl. 94, figs. 4-5.

Status of name: accepted taxonomically.

Diagnosis: Valve is dorsiventral and elliptical-lanceolate with a strongly convex dorsal margin, convex to straight ventral margin, sometimes with a slightly tumid at the valve centre. Apices are acutely to bluntly rounded. Axial area is narrow. Central area is indistinct, a somewhat wider continuation of the axial area. Raphe is distinctly lateral, runs near the ventrum; distal raphe endings are bayonet-shaped, curved toward the dorsum; proximal raphe endings terminate in slightly inflated, distinct central pores. Stigma is absent. Transapical striae are finely punctate, radiate throughout the valve, becoming strongly radiate near the apices, about 11-13 in 10 μm in the middle of the dorsal margin, 16-17 in 10 μm at the ends. Areolae are about 24-28 in 10 μm. Length of the valve 15-32 μm, and the breadth 5-8 μm.

Ecological preference: Oligohalobous "indifferent", alkaliphilous (Foged 1980, 1993); cosmopolitan, distributed in oligotrophic water (Krammer & Lange-Bertalot 1986); fresh-brackish water, alkalibiontic, high oxygen requirements, oligosaprobic, oligo-mesotraphentic (Van Dam et al. 1994); it is recorded from oligotrophic lakes with acidic water (Sienkiewicz et al. 2006); freshwater with pH 8.0, air temperature 12°C, water temperature 15°C (Li et al. 2007); abundant in oligotrophic waters, often karst, rich in calcium, with an average content of electrolytes (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm-1) and low temperature 5.6-9.3 °C (Noga et al. 2016b); slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lakes Mały and Wielki Staw in the northeastern part of Karkonosze Massif, west Poland (Sienkiewicz et al. 2006); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014 a; Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbella hustedtii* var. *compacta* Krammer 2002**

(Pl. 54, figs. 6-13)

Ref. Krammer 2002, p. 138,173, pl.160, figs.19, 20.

Status of name: accepted taxonomically.

Diagnosis: This variety has a more compact, shorter, and broader frustule compared to the nominate variety. It has the same range of dimensions and number of striae per 10 μm as the type species

Ecological preference: Reported from the alkaline, meso to eutrophic freshwater environment, attached to substrates like plants and the sediments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella laevis* Nägeli in Kützing 1849**

(Pl. 54, figs. 14-17)

Ref. Hustedt 1930, p. 353, fig. 643; Foged 1959, p.72, pl. 11, fig. 1; Patrick & Reimer 1975, p. 29, pl. 4, fig. 6; Germain 1981, p. 286, pl. 105, fig. 5-5; Krammer & Lange-Bertalot 1986, p. 332, pl. 139, figs. 4-18; Lange-Bertalot & Metzeltin 1996, p. 304, pl. 93, figs. 15-18; pl. 96, figs. 9-12; Bąk et al. 2012, p. 82, pl. 54; Kulikovskiy et al. 2016, p. 170, pl. 99, figs. 5-7.

Status of name: accepted taxonomically.

Synonyms: *Cymbella gracilis* var. *laevis* (Nägeli) Rabenhorst 1864
Cocconema laeve (Nägeli) A.W.F.Schmidt 1875
Cymbella ventricosa var. *laevis* (Nägeli) Mayer 1917

Diagnosis: Valves are strongly dorsiventral, lanceolate with a moderately convex dorsal margin, weakly convex ventral margin. Apices are very narrow, weakly protracted. Axial area is narrow, and gradually widens towards the valve centre. Central area is lacking or indistinctly shaped. Raphe is lateral, becoming reverse-lateral at the proximal ends. Proximal raphe endings are deflected ventrally and terminate with very small central pores. Distal raphe endings are deflected dorsally. Stigmata are lacking. Transapical striae are finely punctate and radiate throughout, more radiate towards the ends, about 12-14 in 10 μm on the ventral side at the centre, up to 17 in 10 μm on the dorsal side. Length of the valve 21-38 μm, and the breadth 5-8 μm.

Ecological preference: Halobien indifferent, pH: alkaliphilous (Foged 1959); acidophilous, aerophilous (Kaczmarska 1976); in waters, oligo- to weakly mesotrophic, rich in calcium, but also slightly anthropogenically disturbed, occurred also in stagnant waters poor in biogenic salts in the highlands and lowlands, indicator of very good ecological quality (Bąk et al. 2012); alkaline or close to neutral water reactions (pH: 7–9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a); benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Kamionka Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015).

***Cymbella lancettula* (Krammer) Krammer 2002**

(Pl. 54, figs. 18-21)

Ref. Krammer 1985, p. 35, pl. 6, figs. 5-8; Krammer 2002, p. 43, pl. 24, figs. 1-15, 20-24; pl. 25, figs. 9-11; pl. 190, figs. 9-21; pl. 191, figs. 21-24.

Status of name: accepted taxonomically.

Synonym: *Cymbella tumidula* var. *lancettula* Krammer 1985

Diagnosis: Valves are moderately dorsiventral, lanceolate to semi-rhomboid with a moderately convex dorsal margin, weakly convex to nearly straight ventral margin with a slight tumid at the valve centre. Apices are narrow, weakly protracted, and acutely rounded. Axial area is relatively broad, linear lanceolate, tapering towards the ends, and gradually widens towards the valve centre. Central area is lacking. Raphe is slightly lateral, becoming reverse-lateral at the proximal ends. Proximal raphe endings are deflected ventrally and terminate with very small central pores. Distal raphe endings are deflected dorsally. An isolated stigma is found at the ends of the middle ventral striae. Transapical striae are punctate and radiate throughout, more radiate towards the ends, about 10-12 in 10 μm on the ventral side at the centre, up to 15 in 10 μm on the dorsal side at the ends. Length of the valve 38-45 μm, and the breadth 7-11 μm.

Ecological preference: Benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in the Radomno Lake.

Distribution in Poland: Poland (Bąk et al. 2012)

***Cymbella lange-bertalotii* Krammer 2002**

(Pl. 54, figs. 22-28; pl. 55, figs. 1-19)

Ref. Krammer 2002, p. 152, pl. 179, figs. 1-6; pl. 180, figs. 1-8; pl. 181, figs. 1-6, 8; pl. 182, figs. 1-9; Wojtal 2009, p. 181, pl. 8, fig. 14; Delgado et al. 2013, p. 97, figs. 99-100, 166-169; Kulikovskiy et al. 2016, p. 170, pl. 99, figs. 8-11.

Status of name: accepted taxonomically.

Synonym: *Cymbella cistula* f. *anormalis* Østrup 1910

Diagnosis: Valve is slightly dorsiventral. lanceolate to half-lanceolate with a moderately convex dorsal margin, slightly convex to flat ventral margin, sometimes with a slightly tumid at the valve centre. Apices are obtusely rounded, not protracted. Axial area is moderate to relatively wide, lanceolate. Central area is large, oval, somewhat wider continuation of the axial area. Raphe is nearly eccentric, distinctly lateral, becoming filiform near the proximal and distal endings; distal raphe endings are bayonet-shaped, curved toward the dorsum at an angle of nearly 45°; proximal endings terminate in slightly orbicular central pores, not deflected. Stigmata are indistinct, somewhat more separated from the median ventral striae. Transapical striae are coarsely punctate, lineolate, radiate in the middle part of the valve, becoming parallel to convergent towards the ends, about 10-12 in 10 µm in the middle of the dorsal margin, 12-14 in 10 µm at the ends. Areolae about 16--20 in 10 µm. Length of the valve 38-100 µm, and the breadth 10-16 µm.

Remarks: This species is very similar to *Cymbella helvetica* Kützing and *C. subhelvetica* Krammer, but its frustules are smaller than in *C. helvetica* and wider than in *C. subhelvetica*.

Ecological preference: Probably cosmopolitan diatom, widespread in temperate zone, especially in calcium-rich oligotrophic to mesotrophic waters with low to moderate conductivity (Krammer 2002); Low to moderate water conductivity range between 292 to 569 µS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg l^{-1} (Wojtal 2009); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016b); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak, Kamionka and Radomno Lakes; infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: in periphyton of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cymbella lange-bertalotii* var. *lanceolata* Zalat nov. var.**

(Pl. 56, figs. 1-4)

Diagnosis: Valves strongly dorsiventral, lanceolate. The dorsal margin is markedly convex, and the ventral margin is weakly concave to nearly straight with very slightly tumid at the valve centre. Apices are weakly protracted and bluntly rounded. Axial area is moderate and linear, widening at the valve centre. Central area is distinct, elliptical. Raphe is slightly lateral, nearly eccentric, becoming filiform near the proximal and distal endings. Proximal raphe endings with small central pores that deflect ventrally, and the distal raphe endings are bayonet-shaped and curved dorsally. Stigmata are indistinct, somewhat more separated from the median ventral striae. Transapical striae are coarsely punctate, lineolate, radiate throughout the valve, becoming parallel to convergent at the ends, about 10-12 in 10 µm in the middle of the dorsal margin, 12-14 in 10 µm at the ends. Areolae are about 16-20 in 10 µm. Length of the valve 110-35 µm, and the breadth 15-18 µm.

Remarks: This variety differs from the nominate species by having an elongate lanceolate shape and a distinct elliptical central area.

Etymology: The epithet of the new variety refers to the lanceolate shape.

Holotype: the specimens illustrated in plate 56, figures 1-4.

Type locality: Radomno Lake.

Ecological preference: The taxon was associated with the nominate variety and reported from the benthic habitats of meso to eutrophic, alkaline freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella leptoceroides* Hustedt 1942**

(Pl. 63, figs. 1-3)

Ref. Hustedt 1942, p. 102, figs. 209-212; Simonsen 1987, p. 283, pl. 418, figs. 7-15.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral with rounded apices. The dorsal margin is moderately convex, and the ventral margin is slightly tumid at the valve centre. The axial area is moderately lanceolate, gradually widening into a broad central area. The raphe is lateral, becoming reverse-lateral towards the valve centre and filiform near the ends. Externally, the raphe is ventrally curved towards the valve centre. The proximal raphe endings are slightly deflected towards the dorsal, and the central pores are dilated and bent ventrally. The distal raphe endings are deflected to the dorsal side. About 2-3 stigmata are present on the ventral side of the valve. Transapical striae are coarsely punctate, lineolate, slightly radiate, becoming strongly radiate near the apices, about 6-8 in 10 μm at the centre; up to 9-10 in 10 μm near the ends. Puncta about 20-25 in 10 μm. Length of the valve 20-50 μm, and the breadth 9-16 μm.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella neocistula* Krammer 2002**

(Pl. 57, figs. 1-11; pl. 58, figs. 1-8)

Ref. Hustedt 1930, p. 363, fig. 676a; Patrick & Reimer 1975, p. 62, pl. 11, figs. 3-4; Krammer & Lange-Bertalot 1986, p. 316, pl. 127, figs. 8-11; pl. 128, figs. 1-6; Krammer 2002, p. 169, pl. 85, figs. 1-4; pl. 86, figs. 1-7; pl. 87, figs. 1-9; pl. 88, figs. 1-8; pl. 89, figs. 1-7; pl. 90, figs. 1-8; pl. 91, figs. 1-6; pl. 92, figs. 1-3; pl. 93, figs. 1-5; Hofmann et al. 2011, p. 155, pl. 79, 11-15; Bahls et al. 2018, p. 42, pl. 5, fig. 18; p. 65, pl. 28, figs. 1-8; p. 98, pl. 61, figs. 1, 2; p. 129, pl. 92, figs. 5, 6.

Status of name: accepted taxonomically.

Synonyms: *Cymbella cistula* f. *recta* Mayer 1913
Cymbella cistula f. *undulata* Mayer 1913
Cymbella cistula f. *minor* A. Mayer 1913
Cymbella cistula f. *truncata* Mayer 1913
Cymbella subcistula Krammer sensu Metzeltin et al. 2009

Diagnosis: Valves are strongly dorsiventral with a broadly convex dorsal margin and flat to slightly concave ventral margin with a swelling at mid-valve. Apices are broadly truncate or rounded, but not protracted or capitate. Axial area is narrow, linear, and expanding slightly towards the valve centre. Central area is small, round. Raphe is centrally located within the axial area, reverse lateral; the proximal raphe endings are curved ventrally and slightly expanded. About 3-5 isolated stigmata are present on the ventral side of the central area. Transapical striae are distinctly punctate, slightly radiate in the middle, more radiate at the ends, about 8-10 in 10 μm at the valve centre, up to 13 in 10 μm near the ends. Areolae are about 16-20 in 10 μm. Length of the valve 32-90 μm, and the breadth 11-16 μm.

Ecological preference: An epiphyte, widespread, tychoplanktonic, alkaliphilous, mesosaprobous and eutraphentic species (Denys 1991; Hofmann 1994; Van Dam et al. 1994; Krammer 2002); freshwater with pH 5.5-10, air temperature 12-27°C, water temperature 3-25°C (Li et al. 2007); a widely distributed species, in meso- to eutrophic waters, with moderate to elevated electrolyte content, weakly alkaline (Bąk et al. 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a); benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno and Kamionka Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al., 2015); Rzeczyca stream and its tributaries, Western Bieszczady**,** Eastern Carpathians, southern Poland (Rybak et al. 2019).

***Cymbella neocistula* var. *lunata* Krammer 2002**

Ref. Krammer 2002, p. 169, pl. 89: figs 1-7; Bahls et al. 2018, p. 129, pl. 92, fig. 4.

Status of name: accepted taxonomically.

Diagnosis: Valve is lunate, strongly dorsiventral with a strongly convex dorsal margin and concave ventral margin with slight swelling at valve centre. Apices are broadly rounded, not protracted. Axial area is relatively moderate, expanding slightly towards the valve centre. Central area is moderate, subrounded to oval. Raphe is reverse lateral; the proximal raphe endings are deflected ventrally and slightly expanded. Distal raphe endings are deflected dorsally. Three stigmata are present on the ventral side of the central area. Transapical striae are distinctly punctate, radiate throughout the valve, about 8-10 in 10 μm. Areolae are about 18-22 in 10 μm. Length of the valve 45-110 μm, and the breadth 13-19 μm.

Remarks: *Cymbella neocistula* var. *lunata* Krammer differs from the nominate in its lunate valve outline.

Ecological preference: It has the same ecological preference as the nominate species; alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Found in Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014; Peszek et al. 2015).

***Cymbella neocistula* var. *radomnoensis* Zalat nov. var.**

(Pl. 59, figs. 1-5)

Diagnosis: Valves are moderately dorsiventral and elongate lanceolate. The dorsal margin is markedly arched, and the ventral margin is slightly concave with a slight gibbous at the valve centre. Apices are subprotracted and broadly rounded. The axial area is moderate and expanding slightly towards the valve centre. The central area is distinct and elliptic. The raphe is lateral, becoming reverse-lateral near the proximal ends. Proximal raphe ends are deflected ventrally and terminate in slightly expanded pores. About 5-7 stigmata are present on the ventral side of the central area close to the middle striae. Transapical striae are distinctly punctate, radiate throughout the valve, about 9-11 in 10 μm. Areolae are about 14-17 in 10 μm. Length of the valve 110-130 μm, and the breadth 18-22 μm.

Remarks: This variety differs from the *Cymbella neocistula* var. *islandica* in the length/width ratio and the position of stigmata in the central area. In *Cymbella neocistula* var. *islandica* the stigmata are separated from the middle striae, but in the new variety, the stigmata are located close to the middle striae. The new variety differs from *Cymbella neocistula* var. *lunata* Krammer 2002 by the nature of the margin curvature.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate variety.

Etymology. The epithet of the new variety refers to Radomno Lake.

Holotype: the specimens illustrated in plate 59, figures 1-5.

Type locality: Radomno Lake.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella neolanceolata* Silva 2013**

(Pl. 60, figs. 1-4)

Ref. Silva et al. 2013, p. 137, figs. 7-11; Kulikovskiy et al. 2016, p. 171, pl. 92, figs. 1-4.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, lanceolate with a broadly convex dorsal margin, and a slightly concave ventral margin that has a slight tumid at the centre. Apices are acutely rounded. Axial area is relatively narrow, linear, and curved with valve curvature. Central area is small and elliptical. Raphe is lateral, becoming reverse lateral on proximal ends, with an external proximal fissure crooked-shaped. The distal raphe endings are deflected dorsally. About 6-8 stigmata on the ventral side of the central area. Transapical striae are distinctly punctate, radiate throughout the valve, about 9-11 in 10 μm, becoming more radiate toward the apices. Areolae are about 14-17 in 10 μm. Length of the valve 96-145 μm, and the breadth 18-24 μm.

Remarks: Compared with the species of the complex *Cymbella aspera* (Ehrenberg) Peragallo, the external proximal raphe endings are hooked in *Cymbella neolanceolata*, while they are punctiform in the complex *Cymbella aspera* (Silva et al. 2013)

Ecological preference: Mesotrophic and eutrophic alkaline freshwater environments

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella neolanceolata* var. *bottnica* (Krammer) Silva 2013**

(Pl. 61, figs. 1-4; pl. 62, figs. 1-4)

Ref. Krammer 2002, p. 126, pl. 148, figs. 1-6; Silva et al. 2013, p. 137, figs. 12-15.

Status of name: accepted taxonomically.

Synonym: *Cymbella lanceolata* var. *bottnica* Krammer 2002

Diagnosis: The valves are long and distinctly dorsiventral. The dorsal margin is markedly arched, and the ventral margin is slightly concave with a slightly gibbous central portion. Apices are broadly rounded, not protracted. The axial area is narrow and linear, widening slightly at mid-valve. The central area is moderate and elliptical, about 1/5 of the valve breadth. The raphe is weakly lateral, becoming filiform near the proximal and distal ends. The proximal raphe endings are recurved toward the ventral side, with moderately rounded central pores. Distal raphe endings are deflected dorsally. Transapical striae are slightly radiate throughout, becoming more radiate near the apices, about 8-9 in 10 μm at the centre, and 11-12 near the apices. Areolae are distinct, more or less rounded, about 10-12 in 10 μm. stigmata are absent. Length of the valve 135-150 μm, and the breadth 24-27 μm.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate variety.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbella neoleptoceros* Krammer 2002**

(Pl. 63, figs. 4-17)

Ref. Hustedt 1930, p. 353, fig. 645; Okuno 1974, p. 28, figs. 893-895; Gasse 1986, p. 43, pl. 28, fig. 4; Krammer & Lange-Bertalot 1986, p. 336, pl. 143, figs. 113; Lange-Bertalot & Metzeltin 1996, p. 304, pl. 93, figs.1-3; Krammer 2002, p.134, pl. 156, figs. 1-8; pl. 157, figs. 1-19; Bahls et al. 2018, p. 42, pl. 5, fig. 9.

Status of name:

Synonyms: *Cocconema leptoceros* Ehrenberg 1843

Cymbella leptoceros (Ehrenberg) Kützing 1844

Diagnosis: Valve is asymmetric, slightly dorsiventral, elliptical to rhombic lanceolate; dorsal margin highly convex; ventral margin slightly convex than the dorsum, with a slight swelling in the middle portion. Apices are subrostrate to narrowly rounded. Axial area is narrow at the ends and expands widely toward the centre to form a lanceolate space. Central area is fused with the axial area or absent. Raphe is moderately to strongly lateral, curved, running in the middle or shifted slightly to the ventral side, becoming filiform, distant from the proximal and narrowing to the distal ends. Distal raphe endings are nearly straight, curved to the dorsum; proximal raphe endings with distinct small central pores. Transapical striae are slightly radiate at the centre, radiate at the ends, coarsely lineolate, 9-11 in 10 μm at the middle of the dorsal. Puncta 17-22 in 10 μm. Length of the valve 25-48 μm, and the breadth 8-12 μm.

Ecological preference: Freshwater, eutrophic and alkaline water (Cleve-Euler 1955); It is regarded as being oligohalobous, alkalibiontic (Hustedt 1957); cosmopolitan, oligohalobous "indifferent", alkaliphilous (Foged 1959, 1970); it seems to prefer dilute water of calcium-magnesium carbonate type, having a medium pH and medium-low alkalinity (Gasse 1986); Freshwater, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); occurring in large numbers in waters oligo- to eutrophic, calcium-rich. Optimum occurrence in mountainous, upland lakes and in the lowlands (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments

Occurrence: Eemian palaeolake deposits of central Poland, Jeziorak Lake and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts), south-east Poland (Noga et al. 2013c).

***Cymbella neoleptoceros* var. *rhombica* Zalat & Chodyka nov. var.**

(Pl. 63, figs. 18-19)

Diagnosis: Valve is moderately dorsiventral, rhombic lanceolate; the dorsal margin is highly convex; ventral margin flat, with a slight tumid in the middle portion. Apices are subrostrate and acutely rounded. Axial area is narrow, linear-lanceolate, narrowing at the ends, and expands slightly toward the centre. Central area is fused with the axial area or absent. Raphe is moderately lateral, eccentric, deflected slightly to the ventral side, filiform, at the proximal and distal ends. The proximal raphe endings with distinct small central pores, slightly deflected towards the ventral side. Transapical striae are slightly radiate at the centre, more radiate at the ends, coarsely punctate, 8-10 in 10 μm at the middle of the dorsal.. Length of the valve 32-40 μm, and the breadth 10-12 μm.

Remarks: This new variety differs from the type species by having a rhomboid shape and relatively narrower axial area.

Ecological preference: Benthic habitats of alkaline, eutrophic freshwater environments. It is recorded as associated with the nominate variety, and it has the same ecological preference.

Etymology. The epithet of the new variety refers to the rhomboid shape of the valve.

Holotype: the specimens illustrated in plate 63, figures 18-19.

Type locality: Kamionka Lake.

Occurrence: Frequent in Kamionka Lake.

Distribution in Poland: New record.

***Cymbella nepalensis* (Jüttner & Van de Vijver) Vishnjakov 2015**

(Pl. 64, figs. 1-12)

Ref. Jüttner & Van de Vijver 2010, p. 82, pl. 6, figs.1-5; pl. 7, figs. 1-4; Vishnjakov et al. 2015, p. 326, figs. 2-4; Metzeltin et al. 2009, p. 382, pl. 125, figs. 1-3; pl. 126, figs. 1-4; pl. 127, figs. 2-9; pl. 128, figs. 1-3; pl. 129, figs. 1-8; Kulikovskiy et al. 2016, p. 171, pl. 89, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Cymbella neocistula* var. *nepalensis* Jüttner & Van de Vijver 2010

Cymbella neocistula Krammer sensu Metzeltin et al. 2009

Diagnosis: Valves are strongly dorsiventral with a convex dorsal margin, gradually narrowing towards the ends and straight to slightly concave ventral margin, sometimes with a slightly tumid at the valve centre. Apices are truncated and broadly rounded, not protracted. Axial area is wide, linear to linear-lanceolate, abruptly broadening at the valve centre. Central area is round, sometimes slightly asymmetrical, about 1/3 of the valve width, clearly set apart from the ventral shortened striae. Raphe is lateral, becoming filiform towards the distal ends and reverse-lateral towards the proximal ends. Proximal raphe endings are expanded and deflected to the ventral side; the distal raphe endings appear sickle-shaped and deflected to the dorsal side. About 4-6 rounded stigmata are present on the ventral side of the central area. Transapical striae are distinctly punctate, parallel to

slightly radiate, becoming more radiate and sometimes curved near the ends; about 8-10 in 10 μm on both dorsal and ventral at the middle, becoming 12-13 in 10 μm near the ends; areolae18-20 in 10 μm. Length of the valve 45-110 μm, and the breadth 14-20 μm.

Ecological preference: Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments. This species was recorded frequently together with *Cymbella neocistula* Krammer, it may have the same ecological preference as this species. Oligotrophic and mesotrophic water bodies and streams, sometimes in brackish-water lakes (Kulikovskiy et al. 2016).

Occurrence: Frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: New record.

***Cymbella parva* (W. Smith) Kirchner 1878**

Ref. Hustedt 1930, p. 363, fig. 675; Cleve-Euler 1955, p. 158, fig. 1244; Patrick & Reimer 1975, p. 57, pl. 10, fig. 7; Germain 1981, p. 282, pl. 104, figs. 1-11; Krammer & Lange-Bertalot 1986, p. 314, pl. 125, figs. 1-22, pl. 10, fig. 1; Krammer 2002, p. 35, pl. 16, figs. 1-19; pl. 17, figs. 1-20; Wojtal 2009, p. 184, pl. 10, figs. 3, 4; Reavie 2023, p. 21, fig. 9: A-K.

Status of name: accepted taxonomically.

Synonyms: *Cocconema parvum* W. Smith 1853
Cocconema cymbiforme var. *parvum* (Smith) Cleve 1880
Cymbella cymbiformis var. *parva* (W.Smith) Van Heurck 1885

Diagnosis: Valves are moderately dorsiventral, lanceolate with moderately convex dorsal margin, slightly convex ventral margin that is slightly tumid in the centre, and somewhat nearly flat in the smallest specimens. Apices are acutely rounded, non-protracted. Axial area is moderately wide, curved, and linear-lanceolate. Central area is small, a slightly wider continuation of the axial area. Raphe is slightly eccentric, distinctly lateral, becoming reverse-lateral near the proximal ends. The proximal raphe endings are deflected ventrally and terminate with inflated central pores. Distal raphe endings are deflected dorsally at about 45 degrees. An isolated stigma is located at the end of the median striae on the ventral side. Transapical striae are distinctly punctate, widely spaced, nearly parallel or slightly radiate at the valve centre, becoming distinctly radiate at the ends, about 9-11 in 10 μm on the dorsal side and at the centre, 12-14 in 10 μm at the ends. Areolae are about 16-20 in 10μm. Length of the valve 22-40 μm, and the breadth 7-10 μm.

Ecological preference: Cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); widespread, especially in the Nordic alpine area, mostly in oligotrophic waters, with low to moderate conductivity (Krammer 2002); Low to moderate water conductivity range between 292 to 569 μS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); freshwater with pH had an alkaline character or close to circumneutral reaction (6.5-8.4), in calcium-rich waters, low to medium electrolytic conductivity ranged from 78 μS/cm to 530 μS/cm, low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a, b; 2018).

Occurrence: Recorded infrequently in the Młynek and Jeziorak Lakes.

Distribution in Poland: in the Wyżyna Krakowsko- Częstochowska Upland. Pond in Krakow (Kukucz 1937); Vistula River (Starmach 1938; Turoboyski 1962); Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b); Baryczka, Żołynianka, Matysówka streams in the territory of the Podkarpacie Province, southPoland (Noga et al. 2014 a); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Bieszczady National Park, south-east Poland (Noga 2019); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cymbella peraspera* Krammer 2002**

(Pl. 65, figs. 1-4)

Ref. Krammer 2002, p. 171, pl. 131, figs. 1-7; pl. 132, figs. 1-6; pl. 133, figs. 1-6; pl.139, figs. 6.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderately to distinctly dorsiventral with an evenly convex dorsal margin, very slightly concave to nearly flat ventral margin that has a slight tumid at the centre. Apices are broadly rounded, not protracted. Axial area is linear, moderately wide, expanding at the valve centre. Central area is indistinct from the axial area, somewhat ovate, about 1/4 to 1/3 of the valve breadth. Raphe is eccentric, slightly lateral, tapering to become filiform near the proximal and distal ends. Proximal raphe endings with distinct large rounded central pores, which are slightly deflected ventrally. Distal raphe fissures are sickle-shaped, curved dorsally. Several stigmata are found near the central nodule toward the ventrum. Transapical striae are uniseriate, coarsely punctate, radiate and commonly distant in the middle of the valve, slightly radiate to parallel at the ends, about 6-8 in 10 µm, becoming up to 10 in 10 µm at the ends; areolae about 7-10 in 10 µm. length of the valve 135-250 µm, and the breadth 40-50 µm.

Ecological preference: It is reported from freshwater streams with pH near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranging from 158 to 369 µS/cm (Peszek et al. 2015); benthic habitats of slightly alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Found in Jagielnia stream, Podkarpackie province, south Poland (Peszek et al. 2015).

***Cymbella perparva* Krammer 2002**

Ref. Krammer 2002, p. 160, pl. 18, figs. 1-15; pl. 53, figs. 1-19; Rybak et al. 2019, pl. 2, fig. 31.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately to strongly dorsiventral, semi-lanceolate, with a distinctly convex dorsal margin, nearly straight ventral margin, somewhat tumid in the centre. Apices are not or indistinctly protracted and rounded. Axial area is narrow, linear. Central area is absent or slightly developed. Raphe is slightly to moderately ventrally displaced, lateral, becoming filiform near the distal end and reverse-lateral near the proximal ends. 1-3 large, isolated stigmata represented on the ventral side. Transapical striae are finely punctate, lineate, slightly radiate in the middle, becoming more radiate near the ends, about 9-12 in 10 µm at the valve centre on both dorsal and ventral margins, becoming 12 in 10 µm at the ends. Puncta 25-29 in 10 µm. Length of the valve 22-46 µm, and the breadth 6.5-8.5 µm.

Remarks: This taxon is distinguished from *Cymbella parva* by its stronger dorsiventrality and from *Cymbella parviformis* by the less dorsiventral valves in addition to the outline and the broader lateral raphe (Krammer 2002).

Ecological preference: Epiphytic and epilithic distribution in oligotrophic water, abundant in areas with moderate electrolyte content, where the water has a large calcium content (Krammer 2002).

Occurrence: Recorded infrequently in the Młynek Lake.

Distribution in Poland: Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cymbella proxima* Reimer 1975**

(Pl. 66, figs. 1-10)

Ref. Patrick & Reimer 1975, p. 61, pl. 11, fig. 1; Krammer & Lange-Bertalot 1986, p. 317, pl. 128, fig. 9; pl. 129, fig. 1; Wojtal 2009, p. 184, pl. 10, fig. 7-9; Bąk et al. 2012, p. 85, pl. 55; Noga et al. 2014 b, p. 17, pl. 2, fig. 11; Bahls et al. 2018, p. 42, pl. 5, fig. 17; p. 65, pl. 28, figs. 11, 12; p. 129, pl. 92, fig. 3; p. 155, pl. 118, fig. 1.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral with a strongly convex dorsal margin, a straight to slightly concave ventral margin that has a slightly tumid central portion. Apices are acuminate, bluntly rounded. Axial area is slightly narrow and almost central, dorsally arched. Central area is orbicular and about one-third of the valve width. Raphe is eccentric, lateral at the valve centre, becoming filiform near the distal and proximal ends.

Proximal and distal raphe endings are very slightly reverse-lateral. Proximal raphe endings have bulbous central pores that curve to the ventral margin. Distal raphe endings are dorsally deflected nearly 90º. About 3-5 stigmata are arranged in a line on the ventral side of the central area. Transapical striae are coarsely punctate, slightly radiate in the middle of the valve, strongly radiate at the ends, about 8-10 in 10 µm in the middle of the dorsum, 12-13 in 10 µm at the ends. Areolae are about 14-16 in 10 µm. Length of the valve 35-76 µm, and the breadth 14-20 µm.

Ecological preference: Widespread in temperate zones, epiphytic or epilithic in oligo- to mesotrophic water with low or moderate conductivity (Krammer & Lange-Bertalot 1986); fresh water species, mesotraphentic (Van Dam et al. 1994); Low to moderate water conductivity range between 292 to 569 µS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); Spread in oligo- to eutrophic, but oligosaprobic waters, with an average content of electrolytes, from the optimum of occurrence in mountainous, upland and lowland lakes (Bąk et al. 2012); oligotrophic, freshwater of circumneutral character or close to neutral (6.6-7.1), low to moderate conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c, 2014 b); oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Common in Jeziorak, Radomno and Młynek Lakes.

Distribution in Poland: Zatoka Gdańska, north-west Poland (Witak 2002); spring in Warta River valley (Żelazna-Wieczorek & Mamińska 2006); Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south eastern Poland (Noga et al. 2013 c); found in Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014 a; Peszek et al. 2015); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); Czarna Staszowska River near the Drogowle village in south-eastern Poland (Szczepocka & Rakowska 2015).

***Cymbella proxima* var. *bottnica* Krammer 2002**

(Pl. 67, figs. 1-6)

Ref. Patrick & Reimer 1975, p. 61, pl. 11, fig. 2; Krammer 2002, p.171, pl.114, figs. 1-7.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, reniform outline, with a strongly convex dorsal margin, straight to slightly concave ventral margin with slightly tumid central portion. Apices are acuminate, bluntly rounded. Axial area is relatively narrow and almost central, curved dorsally. Central area is subrounded and about one-third of the valve width. Raphe is eccentric, lateral at the valve centre, becoming filiform near the distal and proximal ends. Proximal raphe endings have moderately large central pores that are reflected to the ventral margin. Distal raphe endings are dorsally deflected. About 3-5 stigmata on the ventral side of the central area. Transapical striae are coarsely punctate, lineolate, slightly radiate in the middle of the valve, strongly radiate at the ends, about 8-10 in 10 µm in. Areolae are about 15-18 in 10 µm. Length of the valve 36-90 µm, and the breadth 17-25 µm.

Ecological preference: Benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species and shares the same ecological preference.

Occurrence: Frequent in the Młynek and Radomno Lakes.

Distribution in Poland: New record.

***Cymbella radomnoensis* Zalat nov. sp.**

(Pl. 68, figs. 1-4)

Diagnosis: Valves are asymmetric, with a strongly convex dorsal margin, and nearly straight ventral margin with a swelling at the valve centre. Apices are bluntly rounded, not protracted. The axial area is relatively narrow towards the ends, widening gradually towards the valve centre. Central area is subovate or indistinct from the axial area. Raphe slightly lateral, the distal endings deflected towards the dorsal side, and the proximal endings slightly deflected towards the ventral side. Transapical striae radiate throughout the valve, more spaced at the centre, closely spaced near the ends, about 8-9 in 10 µm at the centre, 11-12 at the ends. Length of the valve 57 µm, and the breadth 15 µm.

Remarks: *Cymbella radomnoensis* is relatively similar to *Cymbella subleptoceros*, *C. neoleptoceros*, *C. neoleptoceros* var. *tenuistriata*, and *C. stigmaphora*. The new species can be distinguished from similar taxa by a combination of features: strongly dorsiventral valves, asymmetric rhomboid outline with convex dorsal margin, not protracted, bluntly rounded valve apices, the dorsal deflection of distal raphe fissures, and absence of stigmata.

Etymology: The epithet of the new variety refers to Radomno Lake.

Holotype: the specimens illustrated in plate 68, figures 1-4.

Type locality: Radomno Lake.

Ecological preference: Reported as a periphytic species in benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake

Distribution in Poland: New record.

***Cymbella stigmaphora* Østrup 1910**

(Pl. 68, figs. 5-7)

Ref. Krammer 2002, p. 135, pl. 154, figs. 18-23; Li et al. 2007, p. 222, fig. 49; Kulikovskiy et al. 2016, p. 172, pl. 92, figs. 5-9; Bahls et al. 2018, p. 42, pl. 5, fig. 10.

Status of name: accepted taxonomically.

Diagnosis: Valves slightly dorsiventral, rhombic-lanceolate with a smoothly arched dorsal margin and slightly convex ventral margin with a slight gibbous at mid-valve. Apices are cutely rounded, not protracted. Axial area moderately wide, lanceolate, narrowing towards the ends. Central area absent. Raphe distinctly lateral, becoming slightly reverse-lateral, filiform towards the proximal and distal ends. Proximal raphe endings have small central pores, while the distal raphe endings are dorsally deflected. There is no stigma. Transapical striae slightly radiate in the middle portion, radiate towards the poles, about 10-12 in 10 μm. Length of the valve 55 μm, and the breadth 14 μm.

Ecological preference: pH 7.0, air temperature 20°C, water temperature 15°C (Li et al. 2007), mesotrophic, alkaline freshwater (Kulikovskiy et al. 2016); benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbella stigmaphora* var. *polonica* Zalat nov. var.**

(Pl. 68, figs. 8-10)

Diagnosis: Valves are dorsiventral and nearly rhombic-lanceolate. The dorsal margin is convex; the ventral margin is weakly convex to nearly flat with a tumid centre. The axial is relatively wide, lanceolate, and tapers at the ends. The central area is indistinct, somewhat wider than the axial area. The raphe is lateral, with ventrally deflected proximal raphe ends. The proximal raphe endings with slightly inflated pores. Distal raphe endings are deflected dorsally. Transapical striae are parallel to slightly radiate throughout, about 8-10 in 10 μm. Length of the valve 46 μm, and the breadth 11-12 μm.

Remarks: This variety differs from the nominate species by having obtusely rounded apices, marked tumid mid-valve and relatively coarse striation. It is relatively similar to *Cymbella aubertii* Manguim 1954.

Etymology: The epithet of the new variety refers to Poland.

Holotype: the specimens illustrated in plate 67, figures 8-10.

Type locality: Radomno Lake.

Ecological preference: Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella* sp.1**

(Pl. 67, figs. 11-13)

Diagnosis: Valves are dorsiventral, sublinear. Dorsal margin is slightly arched in the middle portion; ventral margin is weakly concave to almost straight with a tumid centre. Apices are bluntly rounded and protracted. The axial area is moderate, tapering towards the ends. Central area is not distinguished from the axial area, and

somewhat semi-elliptical shape. Raphe is weakly lateral, becoming reverse-lateral near the proximal ends and filiform near the distal ends. Proximal raphe endings are deflected ventrally and bent with weakly inflated small pores. Distal raphe endings are deflected dorsally. Transapical striae are punctate, slightly radiate, becoming subparallel near the valve apices, about 10-11 in 10 µm. An isolated stigma is present on the ventral side. Length of the valve 56 µm, breadth 12-13 µm.

Remarks: *Cymbella* sp.1 is relatively similar to *Cymbella alpestris* Krammer 2002, *Cymbella incurvata* Krammer 2002, and *Cymbella mongolica* var. *subalpina* (Meist.) Cleve-Euler 1955.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record

***Cymbella subaspera* Krammer 2002**

(Pl. 69, figs. 1-3; pl. 70, figs. 1-4)

Ref. Krammer 2002, p. 172, pl.136, figs.1-5; pl.142, figs. 3-6.

Status of name: accepted taxonomically.

Diagnosis: Valve is moderately to strongly dorsiventral. The dorsal margin is strongly convex, and the ventral margin is nearly straight with a slightly tumid middle portion. Apices are broadly rounded, not protracted. Axial area is linear, moderately wide, expanding at the valve centre. Central area is small, circular, to nearly indistinct from the axial area, and ventrally is bordered by irregularly spaced areolae. Raphe is eccentric, distinctly lateral, becoming filiform near the proximal and distal ends. Distal raphe endings are sickle-shaped, curved dorsally; proximal raphe endings with distinct rounded small central pores. Several stigmata are found near the central nodule toward the ventrum. Transapical striae are uniseriate, distinctly punctate, lineolate, radiate throughout the valve, about 8-10 in 10 µm; Puncta about 10-14 in 10 µm. Length of the valve 60-100 µm, and the breadth 23-27 µm.

Ecological preference: It prefers oligotrophic to weakly mesotrophic spring waters on rocks or in the breaker zone of rivers and lakes with low to moderate electrolyte content (Krammer 2002); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Młynek and Radomno Lakes.

Distribution in Poland: New record.

***Cymbella subaspera* var. *fabianii* Zalat nov. var.**

(Pl. 71, figs. 1-4)

Diagnosis: Valve is strongly dorsiventral. The dorsal margin is strongly convex, and the ventral margin is slightly concave with a marked tumid middle portion. Apices are broadly rounded, not protracted. The axial area is linear, moderately wide, and expands slightly at the valve centre. Central area is moderate, elliptical. Raphe is eccentric, distinctly lateral, becoming filiform near the proximal and distal ends. Distal raphe endings are sickle-shaped, curved towards the dorsal margin; the proximal raphe endings with distinct rounded small central pores that are slightly deflected towards the ventral side. Several stigmata are found close to the middle striae. Transapical striae are uniseriate, distinctly punctate, lineolate, radiate throughout the valve, about 8-9 in 10 µm at the centre, becoming 11-12 near the ends. Puncta are about 10-14 in 10 µm. Length of the valve 100-130 µm, and the breadth 23-27 µm.

Remarks: This new variety differs from the nominate species by having a distinct swollen middle portion and an elliptical central area.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecological preference.

Etymology: The epithet of the new variety refers to Prof. Fabian Welc

Holotype: the specimens illustrated in plate 71, figures 1-4.

Type locality: Młynek Lake.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbella subaspera* var. *salina* Krammer 2002**

(Pl. 72, figs. 1-8)

Ref. Krammer 2002, p.172, pl.137, figs. 1-8.

Status of name: accepted taxonomically.

Diagnosis: Coarsely structured taxon. Valves are more strongly dorsiventral, with a convex dorsal margin and a flat ventral margin that has a slightly tumid at the valve centre. Apices are obtusely rounded. The axial area is linear, slightly wide, and expands at the valve centre. Central area is absent or not well expressed. This variety is distinguished from other taxa in the *Cymbella aspera* complex by its smaller size. Length of the valve 32-45 µm, and the breadth 16-21 µm.

Ecological preference: Brackish water species, it prefers oligotrophic to weakly mesotrophic spring waters on rocks or in the breakers zone of rivers and lakes with low to moderate electrolyte content (Krammer 2002); Benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Common in Jeziorak and Młynek Lakes.

Distribution in Poland: New record.

***Cymbella subcistula* Krammer 2002**

Ref. Krammer 2002, p. 169, pl. 83, figs. 1-9; pl. 84, figs. 1-9; pl. 85, figs. 1-8; Li et al. 2007, p. 222, fig. 50; Genkal et al. 2020, p. 134, pl. 1, figs. 7-9.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, with a strongly convex dorsal margin, nearly straight to slightly concave ventral margin that has a slightly tumid at the valve centre. Apices are broadly rounded, sometimes slightly protracted. Axial area is slightly narrow, linear, and curved. Central area is small, round, and about 1/4 to 1/3 of the valve width. Raphe is slightly lateral, becoming filiform near the ends and barely reverse-lateral near the centre. Proximal raphe endings are expanded, drop-shaped, straight or slightly ventrally deflected. Distal raphe endings are dorsally deflected. About 3-4 stigmata are located ventrally at the central nodule. Transapical striae are coarsely punctate, lineolate, slightly radiate in the middle, more radiate at the ends, about 7-10 in 10 µm at the mid-valve, becoming 12 in 10 µm at the ends. Length of the valve 38-74 µm, and the breadth 14-18 µm.

Ecological preference: it prefers mesotrophic waters with an average electrolyte content (Krammer 2002); freshwater with pH 6.5-8.5, air temperature 16-22°C, water temperature 7-20°C (Li et al. 2007); freshwater with pH had an alkaline character or close to circumneutral (pH 6.5–8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013a, b); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Infrequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013a, b); Baryczka, Żołynianka, Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a).

***Cymbella subhelvetica* Krammer 2002**

(Pl. 75, figs. 1-7)

Ref. Krammer 2002, p. 151, 174, pl. 176, figs. 1-13; pl. 177, figs. 8-14; pl. 178, figs. 1-13; pl. 180, fig. 9; Ector & Hlúbiková 2010, p. 39, pl. 75, figs. 8-16; Kulikovskiy et al. 2016, p. 173, pl. 99, fig. 4.

Status of name: accepted taxonomically.

Diagnosis: Valve is dorsiventral, lanceolate to half-lanceolate. The dorsal margin is convex, and the ventral margin is weakly convex to straight. Apices are obtusely to acutely rounded. Axial area is narrow to moderately narrow, linear. Central area is indistinct from the axial area, somewhat slightly expanded on the

ventral side. Raphe is nearly eccentric or running near the ventral margin, slightly lateral, becoming filiform near the proximal and distal endings. Distal raphe fissures are bayonet-form, curved toward the dorsal side, and the proximal raphe endings with prominent, small central pores that are deflected ventrally. Transapical striae are punctate, lineate, parallel to slightly radiate in the middle, parallel to convergent at the ends, about 9-10 in 10 μm. Length of the valve 43-55 μm, and the breadth 8-12 μm.

Ecological preference: Oligotrophic water bodies with an average level of mineralization (Kulikovskiy et al. 2016); benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes

Distribution in Poland: New record.

***Cymbella subhimalaspera* Jüttner & Van de Vijver 2010**

(Pl. 73, figs. 1-3; pl. 74, figs. 1-4)

Ref. Jüttner et al. 2010, p. 80, fig. 4: 1-3, fig. 5: 1-6; Kulikovskiy et al. 2016, p. 173, pl. 91, figs. 1-3.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral with a convex dorsal margin and almost straight to weakly concave ventral margin with a slightly gibbous part in the valve centre. Apices are broadly rounded, not protracted. Axial area is moderately wide, linear, with almost parallel margins. Central area is elliptical and sometimes barely distinguished from the axial area, about 1/4-1/3 of the valve centre width. The raphe is lateral, located nearly in the mid-line of the valve and tapering near the proximal and distal ends. The proximal raphe endings are drop-like, straight or only very slightly ventrally deflected; the distal raphe endings appear sickle-shaped and are deflected to the dorsal side. About 8-10 elongated stigmata are located on the ventral side of the central area and are slightly separated from the shortened central striae. Transapical striae are coarsely areolate, radiate throughout the valve, about 8-10 in 10 μm in the valve centre, becoming 10-12 near the ends. The areolae appear large and round, about 12-15 in 10 μm. Length of the valve 120-130 μm, and the breadth 24-28 μm.

Ecological preference: Oligotrophic water bodies with an average level of mineralization (Kulikovskiy et al. 2016). It is recorded from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Cymbella subleptoceros* Krammer 2002**

(Pl. 75, figs. 8-20)

Ref. Krammer 2002, p. 173, pl. 154, figs. 2-17; pl. 155, figs. 1-7; pl.161, fig.12 a, b; Li et al. 2007, p. 223, figs. 52-53; Kulikovskiy et al. 2016, p. 173, pl. 93, figs. 4-10.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderately dorsiventral, lanceolate with moderately convex dorsal margin, weakly convex to nearly flat ventral margin, somewhat with a slight tumid in the valve centre or semi-rhombic and characterised by a central hump in larger individuals. Apices are bluntly rounded, subprotracted. Axial area is narrow at the ends and gradually widens towards the centre of the valve. Central area is indistinct or lacking, somewhat wider continuation of the axial area; otherwise not distinguished. Raphe is distinctly lateral and bowed, narrowing toward the ends. Proximal raphe endings with small central pores that deflected ventrally. Distal raphe fissures are deflected dorsally at about a 45-degree angle. Stigmata are lacking. Transapical striae are finely punctate, nearly parallel at the valve centre, becoming radiate near the apices, about 9-11 in 10 μm. Puncta about 20-24 in 10 μm. Length of the valve 15-35 μm, and the breadth 6-9 μm.

Ecological preference: Tychoplanktonic, oligo- or mesosaprobous, alkaliphilous and oligotraphentic species (Denys 1991; Hofmann 1994; Van Dam et al. 1994); widespread in the temperate zone, reported from mesotrophic water with an average electrolyte content (Krammer 2002); freshwater with pH 5.0-10, air temperature 13.5-24°C, water temperature 7-23°C (Li et al. 2007).

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella subleptoceros* var. *rostrata* Zalat nov. var.**

(Pl. 75, figs. 21-23)

Diagnosis: Valves are slightly dorsiventral, elliptical-lanceolate. Dorsal margin is convex, and the ventral is weakly convex.e. Apices are rostrate and protracted. The axial area is lanceolate, moderately broad, and narrower near the apices. Central area is indistinguishable from the axial area. Raphe is lateral and becomes filiform towards the proximal and distal ends. Proximal raphe endings are slightly expanded and displaced ventrally. Distal raphe ends are deflected dorsally. Stigmata are absent. Transapical striae are subparallel at the centre, slightly radiate throughout the valve, about 12-14 in 10 µm. Length of the valve 33 µm, and the breadth 6 µm.

Remarks: This variety differs from the nominate species by having acutely rounded, protracted, rostrate apices.

Etymology: The epithet of the new variety refers to the rostrate apices.

Holotype: the specimens illustrated in plate 75, figures 21-23.

Type locality: Jeziorak Lake.

Ecological preference: Benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecological preference.

Occurrence: Jeziorak Lake.

Distribution in Poland: New record.

***Cymbella tumida* (Brébisson) Van Heurck 1880**

(Pl. 76, fig. 7)

Ref. Hustedt 1930, p. 366, fig. 677; Foged 1959, p. 75, pl. 10, fig. 4; Okuno 1974, p. 30, figs. 897-898; Patrick & Reimer 1975, p. 58, pl. 10, fig. 8; Foged 1980, p. 640, pl. 9, figs. 9, 10; Germain 1981, p. 288, pl. 106, figs. 1-2; Jensen 1985, p. 818, fig. 677; Gasse 1986, p. 46, pl. 28, fig. 2; Krammer & Lange-Bertalot 1986, p. 318, pl.130, figs.4-6; Ehrlich 1995, p. 100, pl. 29, fig. 13; Krammer 2002, p.141, pl.162, figs. 1-8; pl. 163, figs.1-6; pl. 164, figs.1-8; Hofmann et al. 2011, p.157, pl.81, figs. 5-6.

Status of name: accepted taxonomically.

Synonyms: *Cocconema tumidum* Brébisson 1849

Cymbella stomatophora Grunow 1875

Diagnosis: Valves are dorsiventral, cymbiform to broadly lanceolate or half-lanceolate to half-elliptic, with a convex dorsal margin and nearly straight or slightly concave or convex ventral margin, which is marked by a broad, slight tumid at the centre. Apices are rounded, subrostrate, sometimes just truncated and protracted. Axial area is linear, narrow near the ends, becoming wider toward the centre. Central area is a moderately large, rounded or rhombic shape with a width equal to a third to half that of the valve. Raphe is nearly in the middle, curved, moderately lateral, becoming filiform near the endings. Distal raphe endings are sickle-shaped, turned toward the dorsal side; proximal raphe endings are expanded, terminate with distinct central pores, which are ventrally deflected. A single coarse stigma is present on the ventral side of the central nodule. Transapical striae are coarsely punctate, radiate in the valve centre, about 8-10 in l0 µm, becoming slightly radiate at almost parallel, even convergent, about 12-13 in l0 µm at the ends. Length of the valve 35-95 µm, and the breadth 18-22 µm.

Ecological preference: Eutrophic lakes, alkalibiontic, pH 7.4 to up 9.0 (Jørgensen 1948); it is placed in the oligosaprobic zone (Hustedt 1957); cosmopolitan, oligohalobous “indifferent”, alkaliphilous to circumneutral (Foged 1959, 1970, 1978); oligohalobous “indifferent”, alkalibiontic, frequently littoral, or benthic and is probably eutrophic (Van Landingham 1970); epiphytic, in mesotrophic to eutrophic water (Krammer & Lange-Bertalot 1986); fresh-brackish water, alkaliphilous, high oxygen requirements, oligosaprobic, meso- to eutraphentic (Van Dam et al. 1994); common in central Europe, in meso- to eutrophic waters, standing and flowing with an average content of electrolytes, optimum occurrence in rivers, flows and lakes in the lowlands (Bąk et al. 2012); freshwater, alkaline or close to circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 100 µS/cm to 528 µS/cm, (Noga et al. 2013; Noga et al. 2014a).

Occurrence: Frequent in the Eemian palaeolake deposits of central Poland and Radomno Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Baryczka stream left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Świerkowiec, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Wisłoka (near Dębica), Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbella tumida* f. *major* Rich 1937**

(Pl. 77, figs. 1-5)

Ref. Rich 1937, p. 216, pl. 10, fig. H; Rivera 1974, p. 67, fig. 104.

Status of name: accepted taxonomically

Diagnosis: Valves are dorsiventral, elongate, broadly lanceolate. The dorsal margin is convex and the ventral margin is nearly straight or weakly concave, which has a broad, slight tumid at the centre. Apices are obtusely rounded and protracted. Axial area is linear, narrow near the ends, and becomes wider toward the mid-valve. Central area is a moderately large, rhombic shape, about 1/3 of the valve breadth. Raphe is nearly eccentric, curved, moderately lateral, becoming filiform near the ends. Distal raphe endings are sickle-shaped, turned toward the dorsal side; proximal raphe endings are expanded, terminate with distinct central pores, which are ventrally deflected. Transapical striae are coarsely punctate, slightly radiate to subparallel throughout the valve, about 9-10 in l0 μm. Length of the valve 110-125 μm, and the breadth 18-24 μm.

Remarks: This form differs from the nominate species (*C. tumida*) primarily in larger valve dimensions.

Ecological preference: Benthic and associated with periphytic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Reported infrequently in Radomno Lake.

Distribution in Poland: New record.

***Cymbella tumida* var. *nitychorukii* Zalat nov. var.**

(Pl. 76, figs. 8-11)

Diagnosis: Valves strongly dorsiventral. The dorsal margin is markedly convex, the ventral margin is slightly concave with a slight tumid at mid-valve. Apices are protracted, broadly rounded. Axial area is relatively narrow, linear, weakly widens towards the valve centre. Central area is large, approximately orbicular to rhombic, about 1/2 the breadth of the valve. Raphe in the mid-line, moderately lateral, becoming filiform near the distal and proximal ends. Proximal raphe endings are slightly deflected towards the ventral with distinct central pores. An isolated stigma is present close to the ventral side of the central nodule. Transapical striae are distinctly punctate, strongly radiate at the middle portion of the valve, convergent towards the apices, about 9-11 in 10 μm, and punctae are about 22-24 in 10 um. Length of the valve 98 μm, and the breadth μm um.

Remarks: This variety differs from the nominate species by having a large orbicular to rhombic central area, larger valve dimensions and protracted, broadly rounded apices.

Etymology: The epithet of the new variety refers to Prof. Jerzy Nitychoruk.

Holotype: the specimens illustrated in plate 76, figures 8-11.

Type locality: Młynek Lake.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species and has the same ecological preference.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbella tumidula* Grunow 1875**

Ref. Hustedt 1930, p. 361, fig. 669; Cleve-Euler 1955, p. 157, fig. 1239 a, b; Patrick & Reimer 1975, p. 56, pl. 10, fig. 6; Kaczmarska 1977, p. 53, pl. 25, figs. 8, 9; Navatha & Reddy 2020, p. 1516, pl. 2, fig. 9.

Status of name: accepted taxonomically.

Synonym: *Cymbella tumidula* var. *genuina* A.Cleve 1955

Diagnosis: Valves are asymmetrical, dorsiventrally lanceolate. The dorsal margin is moderately convex in the large individuals and strongly convex in the small ones, and the ventral margin is slightly convex. Apices are slightly or not stretched, subcapitate and obtusely rounded. Axial area is narrow, linear-lanceolate, straight to arched, and tapering at the ends. Central area is irregular to rounded; somewhat absent, resulting from shortening of some dorsal striae around the central nodule and or their irregular arrangement. Raphe is sometimes slightly displaced ventrally, becoming very slightly reverse oblique to proximal endings. Proximal raphe endings with very small central pores, and the distal raphe endings are curved on the dorsal side. About 2 to 4 stigmata are located at the end of the central striae on the ventral side. Transapical striae are radiate, shorter and unevenly distributed at the valve centre, about 10-14in 10 µm, becoming more radiate toward the ends, about 12-16 in 10 µm, punctae about 26-33 in 10 µm. Length of the valve 28-41 µm, and the breadth 6-8 µm.

Ecological preference: Fresh water, alkaliphilous, epiphytic (Patrick & Reimer 1975; Kaczmarska 1976).

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Cymbella vidarbhensis* Sarode & Kamat 1984**

(Pl. 76, figs. 1-3)

Ref. Sarode & Kamat 1984, p. 247, pl. 21, fig. 480.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, linear, and lanceolate. The dorsal margin is strongly convex and slightly depressed towards both ends; the ventral margin is almost straight and gibbous at the centre; Apices are bluntly rounded, not protracted. Axial area is relatively moderate, linear-lanceolate and narrow at the ends. Central area is small. Stigmata lacking. Raphe is eccentric, straight, with distal fissures ventrally directed and proximal endings with small central pores. Transapical striae are punctate, slightly radiate at the mid-valve, more radiate at the ends, about 9-11 in 10 µm. Length of the valve 45 µm, and the breadth 12 µm.

Ecological preference: Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbella vulgata* Krammer 2002**

(Pl. 76, figs. 4-6)

Ref. Krammer 2002, p.163, pl. 32, figs. 7-13; pl. 36, figs. 1-14; pl. 37, figs. 16-21; pl. 38, figs. 1-18; pl. 39, figs. 1-7; Li et al. 2007, p. 224, figs. 54-55; Bąk et al. 2012, p. 86, pl. 54; Delgado et al. 2013, p. 97, figs. 101-102; p. 99, figs. 151-154; Kulikovskiy et al. 2016, p. 174, pl. 96, figs. 5-12; Reavie 2023, p. 22, fig. 9M.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, semi-lanceolate. The dorsal margin is strongly arched, the ventral margin is slightly convex or concave, appearing somewhat tumid in the middle. Apices are not protracted, broadly rounded in the largest specimens and narrowly rounded in smaller specimens. Axial area is a slightly narrow, broadening gradually towards the valve centre. Central area is a slightly wider continuation of the axial area on the ventral side. Raphe is distinctly lateral, becoming reverse-lateral near the proximal ends, and filiform near the distal ends. Proximal raphe endings are deflected ventrally and terminate in weakly expanded pores. Distal raphe endings are deflected dorsally. A single isolated stigma is located at the proximal end of the median ventral stria. Transapical striae are parallel to slightly radiate near the valve centre, becoming strongly radiate near the apices, about 8-12 in 10 µm in the middle, 13-14 in 10 µm towards the ends. Areolae are coarse, about 20-22 in 10 µm. Length of the valve 30-60 µm, and the breadth 8-11 µm.

Remarks: This taxon is confused with *Cymbella cymbiformis* (Patrick & Reimer 1975).

Ecological preference: epiphytic and epilithic habitats in oligotrophic waters with low to average electrolyte content (Krammer 2002). Habitat: pH 6.0-8.5, air temperature 16-20°C, water temperature 7-23°C (Li et al. 2007); predominantly in mesotrophic alkaline water bodies (Kulikovskiy et al. 2016); benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Poland (Bąk et al. 2012)

Genus *Cymbellafalsa* Lange-Bertalot & Metzeltin, 2009

Diagnosis: Valves are symmetric to weakly asymmetric to one or both of the transapical and/or apical axis, lanceolate, with rounded to rostrate apices. The raphe is filiform and straight. Proximal raphe endings are externally hooked and deflect to the primary side; the distal endings deflect in the opposite direction of the proximal ends. Transapical striae are uniseriate, somewhat irregularly spaced, and composed of small areolae. Both valve ends exhibit an apical porefield which may be visible in LM.

Holotype species: *Cymbellafalsa diluviana* (Krasske) Lange-Bertalot & Metzeltin 2009

***Cymbellafalsa diluviana* (Krasske) Lange-Bertalot & Metzeltin 2009**

Ref. Krammer & Lange-Bertalot 1986, p. 144, pl. 49, figs. 10-13; Lange-Bertalot & Metzeltin 1996, p. 282, pl. 82, figs. 8-10; Lange-Bertalot et al. 1996, p. 105, pl. 10, fig. 27; Lange-Bertalot & Metzeltin 2009, p. 28; Bahls 2019, p. 5, pl.51, figs. 1-12.

Status of name: accepted taxonomically.

Synonyms: *Navicula diluviana* Krasske 1933
Cymbella diluviana (Krasske) Florin 1971
Cymbella similis Patrick 1943
Cymbella couleensis Sovereign 1963
Cymbella expecta VanLandingham 1968

Diagnosis: Valves are elliptic-lanceolate, scarcely dorsiventral. Apices are subrostrate or rostrate, bluntly rounded. Axial area is narrow to moderately wide. Central area is irregular, formed by somewhat shorter and more widely spaced striae. Raphe is filiform; proximal raphe endings with tiny barbs pointed to the same side; distal raphe endings are deflected in the opposite direction of the proximal ends. Transapical striae are radiate throughout the valve, parallel near the apices, somewhat irregularly spaced at the valve centre, about 8-10 in 10 μm, more dense near the valve apices, up to 15 in 10 μm. Length of the valve 12-25 μm, and the breadth 5-7 μm.

Ecological preference: Freshwater, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); benthic, oligohalobous indifferent, oligotraphentic (Witak & Jankowska 2014); Mountain lakes and streams with cold, alkaline and oligotrophic water, low to moderate conductivity, in sediment deposits of lakes with alkaline pH (8.0-8.8) (Bahls 2019).

Occurrence: Common in the Eemian palaeolake deposits, frequent in Kamionka, Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014).

Genus *Cymbopleura* (Krammer) Krammer, 1999

Diagnosis: Frustules are relatively broad in valve outline, asymmetric to the apical axis, typically with a convex ventral margin and an even broader convex dorsal margin. The proximal raphe endings are expanded, while the distal raphe endings are hooked and dorsally deflected. Transapical striae are composed of rounded areolae. Species within *Cymbopleura* lack apical pore fields and stigmata.

Holotype species: *Cymbopleura inaequalis* (Ehrenberg) Krammer 2003

***Cymbopleura acuta* (Schmidt) Krammer 2003**

(Pl. 78, figs. 1-7)

Ref. Krammer 2003, p. 36, pl. 52, figs. 1-8; pl. 53, figs. 1-10; pl. 54, figs. 1-9; pl. 56, fig. 6; Reavie 2023, p. 22, fig. 12H.

Status of name: accepted taxonomically.

Synonyms: *Cymbella americana* var. *acuta* Schmidt 1881
Cymbella acuta (Schmidt) Cleve 1894

Diagnosis: Valves are very slightly dorsiventral, broadly lanceolate. The dorsal and ventral margins are strongly arched, with pointed, very slightly protracted and acutely rounded apices. Axial area is narrow, linear, almost in the median line of the valve, sometimes slightly broader near the valve centre. Central area is about1/4 or 1/3 the valve breadth, rhomboid-orbicular, sometimes asymmetrical. Raphe is slightly lateral, tapering to filiform towards the proximal and distal ends. The proximal raphe endings are expanded, terminated with distinct central pores that deflected ventrally; the distal raphe endings are hooked and dorsally deflected. Transapical striae are distinctly punctate-lineate, radiate throughout the valve, sometimes slightly curved, about 8-10 in the middle portion of the dorsal margin, becoming about 14-15 towards the ends. Length of the valve 40-80 µm, and the breadth 16-20 µm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Kamionka Lake, frequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Cymbopleura amphicephala* (Nägeli) Krammer 2003**

(Pl. 79, figs. 1-10)

Ref. Hustedt 1930, p. 355, fig. 651; Foged 1959, p. 69, pl. 9, figs. 4, 5; Patrick & Reimer 1975, p. 33, pl. 4, fig. 11; Gasse 1986, p. 41, pl. 28, fig. 10; Krammer & Lange-Bertalot 1986, p. 335, pl. 142, figs. 3-14, 21; Krammer 2003, p. 70, pl. 91, figs. 1-18; pl. 93, figs. 2-8; Hofmann et al. 2011, p. 160, pl. 83, figs. 11-15; Bąk et al. 2012, p. 87, pl. 58; Noga et al. 2013 c, p. 139, pl. 3, fig. 2; Bahls et al. 2018, p. 44, pl. 7, figs. 10, 11; p. 99, pl. 62, fig. 31.

Status of name: accepted taxonomically.

Synonym: *Cymbella amphicephala* Naegeli *ex* Kützing 1849

Diagnosis: Valves are slightly dorsiventral, broadly elliptical, with dorsal and ventral margins convex in a similar manner. Apices are capitate to subcapitate and weakly bent towards the ventral margin. Axial area is narrow and located near the midline of the valve. Central area is very small and asymmetric, formed by 1-3 short striae on one or both sides, sometimes absent. Raphe is filiform to weakly lateral with proximal endings not expanded and deflected slightly towards the ventral margin. Distal raphe endings are deflected dorsally. Transapical striae are finely punctate, slightly radiate throughout and more closely spaced towards the apices, about 13-15 in 10 µm at the centre up to 18 in 10 µm at the ends. Length of the valve 20-34 µm, and the breadth 6.5 -9.0 µm.

Ecological preference: Cosmopolitan, halobien indifferent (halophilous), pH: indifferent (Foged 1959); frequently under conditions of high oxygen content and at a pH above 7 (Patrick & Reimer 1975); widespread, tychoplanktonic, fresh-brackish, oligo-mesotrophic, oligo-mesosaprobous, circumneutral species (Denys 1991; Hofmann 1994; Van Dam et al. 1994); widely distributed in the temperate zone in oligo- to mesotrophic habitat with low to a moderate electrolyte content (Krammer 2003); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 128 µS/cm to 528 µS/cm, temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 a, c); Well-oxygenated and alkaline (calcium-bicarbonate) waters with moderate electric conductance. (Bahls 2019).

Occurrence: Common in Jeziorak, Kamionka and Radomno Lakes.

Distribution in Poland: Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream

left bank tributary of the River San and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013a,b,c); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Ryjak, Wielopolka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbopleura anglica* (Lagerstedt) Krammer 2003**

(Pl. 79, figs. 15-21; pl. 80, figs. 1-8; pl. 81, figs. 1-8)

Ref. Krammer 2003, p. 10, pl. 4, figs. 1-12; pl. 5, figs. 1-11; pl. 6, figs. 1-4; pl. 7, figs. 1-6; pl.8, figs.1-9; Van de Vijver et al. 2011, p. 257, figs. 56-60; Kulikovskiy et al. 2016, p. 176, pl. 104, figs. 4-7; Bahls et al. 2018, p. 44, pl. 7, fig. 18; p. 131, pl. 94, fig. 9; Bahls 2019, p. 6, pl. 58, 59.

Status of name: accepted taxonomically.

Synonyms: *Cymbella anglica* Lagerstedt 1873
Cymbella amphicephala var. *anglica* (Lagerstedt) van Heurck 1896
Cymbella cuspidata var. *anglica* (Lagerstedt) Mayer 1947
Cymbella cuspidata var. *anglica* (Lagerstedt) A.Cleve 1955

Diagnosis: Valves are slightly dorsiventral, broadly elliptic to elliptical-lanceolate with strongly convex dorsal and convex ventral margins. Apices are rostrate to subcapitate and bluntly rounded. Axial area is narrow, linear and widening gradually towards the valve centre. Central area is large, rounded to rhombic, occupies ca. 1/3 of the valve width and is sometimes slightly asymmetrical. Raphe is lateral and becomes filiform near the proximal endings, which are somewhat inflated and deflected toward the ventral margin. Distal raphe endings are deflected dorsally. Transapical striae are punctate, slightly radiate throughout the valve and more closely spaced on the ventral side and near the apices, about 9-10 in 10 μm on the dorsum, 11-12 in 10 μm on the ventrum, and 15-18 in 10 μm towards the apices. Puncta about 24-28 in 10 μm. Length of the valve 35-52 μm, and the breadth 13.0-18 μm.

Ecological preference: The species is widely distributed in Nordic-alpine and subarctic areas of Europe, where it prefers oligotrophic waters with lower electrolyte content (Krammer 2003); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015); found in Mountain streams, lakes, fens and potholes with cool and somewhat alkaline and oligotrophic water with low conductance (Bahls 2019); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Kamionka Lake, frequent in Radomno, Młynek and Jeziorak Lakes and Eemian paleolake deposits, central Poland.

Distribution in Poland: It is uncommon in Poland, found in Żołynianka stream in the Podkarpacie Province (Noga et al. 2014a), and Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Cymbopleura angustata* (W.Smith) Krammer 2003**

(Pl. 79, figs. 11-14)

Ref. Hustedt 1930, p. 351, fig. 639; Patrick & Reimer 1975, p. 22, pl. 3, figs. 3-5; Germain 1981, p. 276, pl.100, fig. 11; Krammer & Lange-Bertalot 1986, p. 328, pl. 135, figs. 15-18; Metzeltin & Witkowski 1996, p. 64, pl. 16, figs. 13-14; Krammer 2003, p. 82, pl. 102, figs. 1-14; pl. 103, figs. 1-16; pl. 104, figs. 1-6; pl. 105, figs. 9-17b; pl. 106, figs. 11-20; pl .109, figs. 12-16; Bahls et al. 2018, p. 131, pl. 94, fig. 2; p. 156, pl. 119, figs. 13, 14.

Status of name: accepted taxonomically.

Synonyms: *Navicula angustata* W.Smith 1853
Navicula cryptocephala var. *angustata* (W.Smith) Brun 1880
Cymbella angustata (W.Smith) Cleve 1894

Diagnosis: Valves are very slightly dorsiventral, lanceolate to linear-lanceolate, weakly triundulate. Apices are rostrate to subcapitate. Axial area is narrow and slightly arched, with the concave margin towards the ventral margin. Central area is small and asymmetric with irregular borders. Raphe is lateral and follows the curvature of the axial area. Proximal raphe endings are filiform, close, with weakly inflated pores and displaced slightly to the ventral margin. Distal raphe endings are comma-shaped and deflected dorsally. Transapical striae are parallel at the valve centre, becoming radiate and then strongly radiate towards the apices, about 16-18 in 10 μm at the valve centre, 18-20 in 10 μm at the valve ends. Length of the valve 30-45 μm, and the breadth 6-9.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); the species is widely distributed in oligotrophic waters with low to moderate electrolyte content in Nordic, subarctic, and temperate regions, including the Alps (Krammer 2003); Oligotrophic, circumneutral to alkaline (pH 6.98-9.10) and mostly cool to cold standing waters with low to moderate levels of dissolved solids, specific conductance 71-460 μS/cm (Bahls 2019). Found in benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Eemian paleolake deposits of central Poland; infrequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbopleura apiculata* Krammer 2003**

(Pl. 82, figs. 1-4)

Ref. Krammer 2003, p. 152, pl. 7, figs. 8-10; pl. 9, figs. 1-6; pl. 10, figs. 1-4; pl. 11, figs. 1-3 b; Kihara et al. 2015, p. 22, fig. 44; Kulikovskiy et al. 2016, p. 176, pl. 102, figs. 4-6; Bahls et al. 2018, p. 44, pl. 7, fig. 15; p. 81, pl. 44, fig. 2; p. 100, pl. 63, fig. 10; p. 131, pl. 94, fig. 11; p. 157, pl. 120, figs. 3, 7; Bahls 2019, p. 7, pls. 6, 7.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, broadly subelliptic to elliptical-lanceolate with strongly arched dorsal and ventral margins. The ventral margin is narrowing towards the valve centre. Apices are short, apiculate-cuspidate and somewhat ventrally deflected. Axial area is moderately narrow, widening gradually from the apices toward the valve centre. Central area is a large, rounded or slightly elliptical and asymmetric, about one-third to one-half valve width. Raphe is lateral, becoming filiform toward the distal and proximal ends. Proximal raphe endings are curved ventrally. Distal raphe endings are comma-shaped, deflected dorsally. Transapical striae are punctate, radiate throughout and more closely spaced towards the apices, about 8-10 in 10 μm on the dorsal side, 9-11 in 10 μm on the ventral side at the valve centre, and 13-16 in 10 μm at the apices. Puncta are about 18-24 in 10 μm. Length of the valve 70-110 μm, and the breadth 20-25 μm.

Ecological preference: Cosmopolitan, halobien indifferent (halophilous), pH: indifferent (Foged 1959); widely distributed fossil and recent, both in lakes and streams of the Nordic areas, found in the northern area in dystrophic and oligotrophic waters with low conductivity, in middle Europe often occur in mesotrophic waters with moderate conductivity (Krammer 2003); it is reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 μS/cm (Peszek et al. 2015); oligotrophic lakes, ponds and fens (Bahls 2019); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Młynek Lakes.

Distribution in Poland: Found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al., 2015).

***Cymbopleura austriaca* (Grunow) Krammer 2003**

(Pl. 82, figs. 5-8)

Ref. Hustedt 1930, p. 354, fig. 647; Hartley et al. 1996, p. 142, pl. 63, fig. 9; Krammer 2003, p. 50, pl. 69, figs. 1-8; pl. 70, figs. 1-7; pl. 71, figs. 1-3; Bąk et al. 2012, p.87, pl. 59; Bahls et al. 2018, p. 100, pl. 63, figs. 12, 13.

Status of name: accepted taxonomically.

Synonym: *Cymbella austriaca* Grunow 1875

Diagnosis: Valves are dorsiventral and broadly linear-lanceolate, rhomboid-elliptical to elliptic-lanceolate with an arcuate dorsal margin and slightly convex ventral margin. Apices are obtusely rounded. Axial area is moderately wide, slightly ventrally displaced, widening towards the valve centre. Central area is commonly absent or a shallow depression on one or both sides of the mid-valve. Raphe branches are strongly lateral but become filiform near the distal ends and strongly reverse-lateral near the proximal ends. Proximal raphe endings are slightly expanded as central pores and ventrally deflected. Distal raphe endings are comma-shaped and dorsally deflected. Transapical striae are punctate, radiate in the middle and become curved and more radiate towards the apices; in the largest specimens, striae are parallel at the apices. Striae and areolae are more widely spaced on the dorsal side than on the ventral side. Striae about 9-12 in 10 μm at the valve centre, up to 14 in 10 μm at the apices. Puncta about 21-25 in 10 μm. Length of the valve 45-100 μm, and the breadth 14-19 μm.

Ecological preference: This taxon prefers dripping wet moss or wet rock, less widespread on the shores of oligotrophic lakes and water courses in the mountains, common in waters have a moderate electrolyte content (Krammer 2003); a species characteristic of limestone mountains, mainly on sprinkled grasslands and rocks, less often in the littoral zone of oligotrophic lakes and flowing waters, indicator of very good quality waters (Bąk et al. 2012).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Poland (Bąk et al. 2012)

***Cymbopleura budayana* (Pantocsek) Krammer 2003**

(Pl. 83, figs. 1-5)

Ref. Krammer 2003, p. 19, pl.19, figs.1-5; Levkov & Williams 2011, p. 19, figs. 122-125.

Status of name: accepted taxonomically.

Synonym: *Cymbella budayana* Pantocsek 1892

Diagnosis: Valve is slightly dorsiventral, broadly elliptical-lanceolate with convex margins, the dorsal margin is more strongly arched. Apices are slightly protracted and acutely rounded. Axial area is moderately wide, expanding gradually towards the valve centre. Central area is an asymmetrical, elliptical-lanceolate. Raphe broadly lateral, narrowing towards the distal endings, reverse-lateral at the proximal end. Proximal raphe endings are nearly without central pores. Distal raphe endings in the form of a question mark, dorsally deflected. Transapical striae are coarsely punctate, radiate at the valve centre, about 5-7 in 10 μm on the dorsum, becoming slightly denser and strongly radiate at the ends, about 9-10 in 10 μm. Areolae are about 15-20 in 10 μm. Length of the valve 47-65 μm, and the breadth 22-25 μm.

Ecological preference: Periphytic in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Jeziorak Lake, and frequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbopleura citrus* (Carter & Bailey-Watts) Krammer 2003**

(Pl. 83, figs. 6-19)

Ref. Carter & Bailey-Watts 1981, p. 548, figs. 26-29; Krammer & Lange-Bertalot 1986, p. 335, pl. 142, figs. 15-17; Krammer 2003, p. 67, pl. 97, figs. 5-12; Li et al. 2007, p. 213, figs. 2-3.

Status of name: accepted taxonomically.

Synonyms: *Cymbella citrus* J.R.Carter & Bailey-Watts 1981

Cymbella amphicephala var. *citrus* (Carter & Bailey-Watts) Krammer 1985

Diagnosis: Valves are not or very slightly dorsiventral, broadly subelliptic-lanceolate, with strongly arched dorsal and ventral margins. Apices are slightly apiculate to subrostrate, protracted. Axial area is narrow, linear-lanceolate, tapering slightly towards the ends, almost along the median line of the valve. Central area is very small, irregular, asymmetric, and sometimes absent. Raphe is filiform to slightly lateral and then narrows towards the proximal and distal ends. Distal raphe endings are comma-shaped and dorsally deflected; proximal raphe

endings are indistinct. Transapical striae are slightly radiate throughout, irregularly arranged around the central nodule, about 12-15 in 10 μm on the middle of the dorsal margin, up to 17 in 10 μm towards the ends. Puncta 35-38 in 10 μm. Length of the valve 15-26 μm, and the breadth 7-10 μm.

Ecological preference: Freshwater with pH 5.5-8.5, air temperature 12-24°C, water temperature 10-21°C, (Li et al., 2007); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Jeziorak Lake, and frequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Cymbopleura cuspidata* (Kützing) Krammer 2003**

(Pl. 83, figs. 20-23; pl. 84, figs. 1-8)

Ref. Hustedt 1930, p. 357, fig. 650; Foged 1959, p.69, pl. 9, fig. 8; Patrick & Reimer 1975, p. 39, pl. 6, figs. 2-3; Germain 1981, p. 277, pl. 100, fig. 3; Krammer & Lange-Bertalot 1986, p. 338, pl. 140, figs. 1-4; Lange-Bertalot & Metzeltin 1996, p. 328, pl. 105, figs. 10-11; Metzeltin & Witkowski 1996, p. 66, pl. 17, figs. 8-11; Krammer 2003, p. 8, pl. 1, figs. 1-12; pl. 2, figs. 1-11; pl. 6, figs. 5-8; Wang & Wu 2005, p. 42, fig. 1. E-F; Bąk et al. 2012, p. 88, pl. 58.

Status of name: accepted taxonomically.

Synonyms: *Cymbella cuspidata* Kützing 1844
Cocconema cuspidatum (Kützing) G.S.West 1905
Cymbella meniscus Héribaud 1903
Cymbella ovum Héribaud 1908

Diagnosis: Valves are slightly dorsiventral, broadly lanceolate, broadly linear-elliptical to elliptical. The dorsal margin is strongly convex, and the ventral margin is slightly convex. Apices are apiculate, cuspidate, and acutely rounded. Axial area is narrow, linear, and almost in the median line of the valve. Central area is well developed ventrally, rounded to ovate, sometimes asymmetrical, 1/3-1/4 the valve width. Raphe is slightly lateral and narrowing towards the distal ends, appearing filiform or subtly reverse-lateral near the proximal ends. Distal raphe endings are comma-shaped and dorsally deflected; proximal raphe endings are expanded as central pores, and somewhat curved ventrally. The central nodule is large. Transapical striae are uniseriate, distinctly punctate, lineolate, radiate in the middle portion, about 8-11 in 10 μm on the dorsum, becoming more radiate near the ends, about 12-15 in 10 μm. Puncta 20-23 in 10 μm. Length of the valve 28-60 μm, and the breadth 14-18 μm.

Ecological preference: Fresh brackish water, circumneutral, high oxygen requirements, oligosaprobic (Van Dam et al. 1994); it prefers oligotrophic up to mesotrophic waters with a moderate electrolyte content (Krammer 2003); distributed in oligotrophic to eutrophic, oligosaprobic waters, with electrolyte content (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 μSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok river and Żołynianka stream in the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbopleura cuspidata* var. *compacta* Zalat nov.var.**

(Pl. 85, figs. 1-8)

Diagnosis: Valves are slightly dorsiventral, broadly linear-elliptical. The dorsal and ventral margins are convex to weakly convex. Apices are apiculate, rostrate, and acutely rounded. Axial area is relatively moderate, narrow-lanceolate, tapers at the ends and is almost in the median line of the valve. Central area is well developed,

large, rhombic to orbicular, and sometimes asymmetrical. Raphe is slightly lateral and narrowing towards the distal ends, appearing filiform or subtly reverse-lateral near the proximal ends. Distal raphe endings are comma-shaped and dorsally deflected; proximal raphe endings are expanded as small central pores and deflected ventrally. Transapical striae are punctate, lineolate, and slightly radiate at the valve centre, about 8-11 in 10 μm on the dorsum, becoming more radiate near the ends, about 12-15 in 10 μm. Length of the valve 47-50 μm, and the breadth 18-20 μm.

Remarks: This variety differs from the nominate species by having weakly convex, relatively subparallel margins, a larger central area and compacted valves.

rostrate apices.

Ecological preference: Periphytic in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Etymology: The epithet of the new variety refers to the compact valve.

Holotype: the specimens illustrated in plate 84, figures 1-8.

Type locality: Kamionka Lake.

Occurrence: Common in Kamionka Lake, frequent in Radomno and Młynek Lakes

Distribution in Poland: New record.

***Cymbopleura diminuta* (Grunow) Krammer 2003**

Ref. Reichardt 1994, p. 126, pl. 2, figs. 29-30; pl. 5, figs. 3-4; Krammer 2003, p. 106, pl. 127, figs. 1-10.

Status of name: accepted taxonomically.

Synonyms: *Cymbella obtusa* var. *diminuta* Grunow 1885
Cymbella aequalis var. *diminuta* (Grunow) Cleve 1894
Cymbella diminuta (Grunow) Reichardt 1994

Diagnosis: Valves are slightly to distinctly dorsiventral, lanceolate-elliptical, with a more convex dorsal margin than the ventral one, which may be nearly straight. Apices are narrowing, acutely rounded, and not protracted. Axial area is moderately wide, linear-lanceolate, and slightly ventrally displaced. Central area is small or indistinct. Raphe is filiform, curved. Distal raphe endings are dorsally deflected; proximal raphe endings are simple, slightly expanded and ventrally deflected. Transapical striae are finely punctate, slightly radiate in the middle, more radiate towards the ends, about 13-16 in 10 μm in the middle portion, up to 20 in 10 μm towards the ends. Puncta about 28-30 in 10 μm. Length of the valve 15-27 μm, and the breadth 5-6 μm.

Ecological preference: Benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura florentina* (Grunow) Krammer 2003**

(Pl. 86, figs. 1-10)

Ref. Krammer 2003, p. 99, pl. 75, fig. 3; pl. 124, figs. 1-8; pl.125, figs. 1-11, 13-15; pl. 128, figs. 1-3; Bahls et al. 2018, p. 44, pl. 7, fig. 9.

Status of name: accepted taxonomically.

Synonyms: *Cymbella subaequalis* var. *florentina* Grunow 1880
Cymbella aequalis var. *florentina* (Grunow) Cleve 1894
Cymbella florentina (Grunow) F.W.Mills 1934

Diagnosis: Valves are moderately dorsiventral, lanceolate to rhomboid-elliptical with arched dorsal margin and a less strongly arched ventral margin that has a slight humped at the valve centre. Apices are bluntly rounded and not protracted. Axial area is moderately wide, broadening gradually towards the valve centre. Central area is a narrow lanceolate, somewhat slightly dilated towards the ventral margin, or formed by a shallow depression on the dorsal side. Raphe is distinctly lateral, narrowing towards the distal ends. Proximal raphe endings are reverse-lateral, deflected towards the ventral margin, and tipped with slightly

expanded pores. Distal raphe endings are comma-shaped and dorsally deflected. Transapical striae are punctate, radiate throughout, more strongly radiate near the apices, about 10-14 in 10 μm in the middle portion of the dorsum, up to 15 in 10 μm towards the ends. Puncta are about 22-24 in 10 μm at the valve centre, and are closer together towards the apices, about 34 in 10 μm. Length of the valve 28-70 μm, and the breadth 8-12 μm.

Ecological preference: The species reported from oligotrophic lakes in the Alps and from the Balkans with a moderate electrolyte content (Krammer 2003). Alkaline, calcium-rich lakes, ponds and fens; pH 7.3-9.5; specific conductance 140-1500 μS/cm (Bahls 2019); periphytic in benthic habitats of slightly alkaline, eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes, and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Cymbopleura florentina* var. *brevis* Krammer 2003**

(Pl. 86, figs. 11-17)

Ref. Krammer 2003, p. 100, pl. 75, fig. 3; pl. 119, figs. 16-18; pl. 124, figs. 1-8; pl. 125, figs. 8-11; Kulikovskiy et al. 2016, p. 177, pl. 106, figs. 10-13.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, rhombic-elliptic to rhomic-lanceolate. The dorsal and ventral margins are slightly convex. Apices are bluntly rounded, not protracted. Axial area is moderately wide, linear-lanceolate, tapering towards the ends. Central area is weakly expressed, expanded laterally, and somewhat subround. Raphe is distinctly lateral, narrowing towards the distal ends. Proximal raphe endings are reverse-lateral, deflected towards the ventral margin, and terminated with small central pores. Distal raphe endings are dorsally deflected. Transapical striae are punctate, radiate throughout and strongly radiate near the apices, about 10-12 in 10 μm in the middle portion of the dorsum, up to 15 in 10 μm towards the ends. Length of the valve 37-45 μm, and the breadth 8-10 μm.

Remarks: Distinguished from the nominate species by rhomboid-lanceolate shape, obtusely rounded apices and the much coarser valve structure.

Ecological preference: Oligotrophic reservoirs with moderate salinity (Kulikovskiy et al. 2016); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Cymbopleura florentiniformis* Krammer 2003**

(Pl. 86, figs. 18-21; pl. 87, figs. 1-4)

Ref. Krammer 2003, p. 164, pl. 127: figs 13-18; Kulikovskiy et al. 2016, p. 177, pl. 106, figs. 14-18.

Status of name: accepted taxonomically.

Diagnosis: Valve is slightly or not dorsiventral, linear-lanceolate to lanceolate-elliptical with slightly convex dorsal and ventral margins. Apices are rostrate to subcapitate, bluntly rounded, somewhat subprotracted. Axial area is moderately narrow, in the median line of the valve, linear or broadening gradually towards the valve centre. Central area is small, irregularly shaped, sometimes asymmetrical and then more well-developed dorsally. Raphe is filiform to slightly lateral, narrowing towards the proximal and distal ends. Distal raphe endings are comma-shaped and dorsally deflected. Proximal raphe endings are deflected towards the ventral margin and tipped with slightly expanded pores. Transapical striae are slightly radiate throughout, about 14-15 in 10 μm in the middle portion of the dorsal margin, up to 18 in 10 μm towards the ends. Length of the valve 28-36 μm, and the breadth 7-7.5 μm.

Ecological preference: Oligotrophic water bodies (Kulikovskiy et al. 2016); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Młynek and Jeziorak lakes.

Distribution in Poland: New record.

***Cymbopleura frequens* Krammer 2003**

(Pl. 87, figs. 5-7)

Ref. Krammer 2003, p. 158, pl. 91, figs. 19-23; pl. 92, figs. 1-15; pl. 96, figs. 1-5, 10-11; Kulikovskiy et al. 2016, p. 177, pl. 105, figs. 9-12; Bahls 2019, p. 10, pl. 64, fig. 29; pl. 65, figs. 1-14.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, linear-lanceolate, subelliptical-lanceolate with a convex dorsal margin, weakly convex to almost straight ventral margin. Apices are apiculate to rostrate, protracted. Axial area is narrow and linear-lanceolate, narrowing slightly towards the ends and widening gradually to the valve centre. Central area is barely wider than the axial area, or irregular, asymmetric. Raphe is weakly lateral and becomes filiform toward the proximal and distal ends. Proximal raphe endings are weakly expanded and curved towards the ventral margin. Distal raphe endings are comma-shaped and curved dorsally. Transapical striae are very finely punctate, slightly radiate throughout, about 12-14 in 10 µm on the middle part of the dorsal side, up to 15 in 10 µm towards the ends. Puncta about 35-40 in 10 µm. Length of the valve 20-38 µm, and the breadth 7-9 µm.

Ecological preference: This taxon prefers oligotrophic to mesotrophic waters with moderate electrolyte content (Krammer 2003); oligotrophic and mesotrophic water bodies (Kulikovskiy et al. 2016); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b); oligotrophic to mesotrophic, calcium-rich lakes and streams with moderate conductivity (Bahls 2019).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b).

***Cymbopleura hercynica* (A. Schmidt) Krammer 2003**

(Pl. 87, figs. 8-13)

Ref. Krammer & Lange-Bertalot 1986, p. 335, pl. 142, figs. 18-20; Krammer 2003, p. 72, pl. 96, figs. 17, 19-21; pl. 97, figs.1-4; Li et al. 2007, p. 214, fig. 7; Wojtal 2009, p. 184, pl. 10, fig. 5; Bąk et al. 2012, p. 88, pl. 58.

Status of name: accepted taxonomically.

Synonyms: *Cymbella hercynica* A.W.F. Schmidt 1875

Cymbella amphicephala var. *hercynica* (A. Schmidt) Cleve 1894

Diagnosis: Valves are slightly dorsiventral, broadly subelliptical to elliptical-lanceolate. The dorsal margin is strongly convex, and the ventral margin is slightly convex. Apices are apiculate to subrostrate protracted. Axial area is very narrow. The central area is approximately 1/3 to 1/2 the valve width, rounded, sometimes asymmetrical, and then more well-developed dorsally. Raphe is barely lateral, curved, and narrowing towards the distal ends, appearing filiform or subtly reverse lateral near the proximal ends. Proximal raphe ends are expanded and ventrally bent. Distal raphe endings are comma-shaped and dorsally deflected. Transapical striae are finely punctate, radiate throughout, about 12-15 in 10 µm in the middle portion of the dorsal margin, up to 20 in 10 µm towards the ends. Puncta 32-36 in 10 µm. Length of the valve 16-40 µm, and the breadth 7-10 µm.

Ecological preference: Fresh-brackish water, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); it prefers waters with higher conductivity (Krammer 2003; Wojtal 2009). freshwater with pH 6.0, air temperature 23°C, water temperature 13°C (Li et al. 2007); reported from low to moderate water conductivity range between 292 to 569 µS cm–1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009).

***Cymbopleura hybrida* (Grunow) Krammer 2003**

(Pl. 87, figs. 14-16)

Ref. Hustedt 1930, p. 357, fig. 652; Patrick & Reimer 1975, p. 32, pl. 4, fig. 10; Foged 1981, p. 70, pl. 45, fig. 20; pl. 51, fig. 15; Gasse 1986, p. 43, pl. 27, fig. 21; Krammer & Lange-Bertalot 1986, p. 337, pl. 145, figs. 1-5; Krammer 2003, p. 63, pl. 86, figs. 1-14; pl. 87, figs. 1-4; pl. 88, figs. 12-14; Bahls et al. 2018, p. 44, pl. 7, fig. 1; p. 99, pl. 62, figs. 32-34; p. 156, pl. 119, fig. 4; Bahls 2019, p. 11, pl. 35, figs. 1-3; pl. 36, figs. 12-22.

Status of name: accepted taxonomically.

Synonym: *Cymbella hybrida* Grunow ex Cleve 1894

Diagnosis: Valve is very slightly dorsiventral, linear, and nearly symmetric on either side of the apical axis; the dorsal and ventral margins are straight to slightly convex. Apices are subrostrate, rostrate or capitate protracted. Axial area is narrow to moderately wide, following the valve midline. Central area is large, about 1/3 to 1/2 the valve width, oval, rounded or diamond-shaped, sometimes asymmetrical. Raphe is slightly lateral, narrowing towards the distal ends, appearing filiform near the proximal ends. Proximal raphe endings are slightly expanded as central pores and curved slightly toward the ventral side. Distal raphe endings are angle-shaped and dorsally deflected. Transapical striae are slightly radiate throughout, at the central area usually short, curved, more widely spaced, about 11-13 in 10 μm in the middle portion of the dorsal margin, up to 17 in 10 μm towards the ends. Length of the valve 27-60 μm, and the breadth 8-11 μm.

Ecological preference: Alkaline and oligotrophic lakes, ponds and fens in or near the mountains; tundra lakes near the Arctic Circle. In a shallow calcium-rich lake in northwestern Montana, this species was associated with small cyanobacterial stromatolites (Bahls 2019); benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Młynek and Radomno Lakes.

Distribution in Poland: Poland (Bąk et al. 2012),

***Cymbopleura hybrida* var. *capitata* (Grunow) Krammer 2003**

(Pl. 87, figs. 17-20)

Ref. Krammer 2003, p. 63, pl. 87, figs. 5-14

Status of name: accepted taxonomically.

Synonym: *Cymbella hybrida* var. *capitata* Fontell 1917

Diagnosis: Valves are linear-elliptic and slightly dorsiventral, with barely convex dorsal and ventral margins and abruptly constricted capitate apices. Axial area is relatively narrow and linear. Central area is large and transversely oval or rectangular. Raphe is lateral, becoming filiform near the proximal ends. Proximal raphe endings have small hooks deflected towards the ventral margin; the distal raphe endings are deflected dorsally. Transapical striae are parallel at the valve centre, usually short and radiate towards the apices, about 11-12 in 10 μm at the mid-valve, 14-15 in 10 μm at the ends. Length of the valve 38-40 μm, and the breadth 10.5-11 μm.

Remarks: This variety is differentiated from the nominate species by having subcapitate to capitate apices. According to Krammer 2003**,** this variety is distinguished from *C. navicidiforinis* by outline (nearly straight sides) and the course of the proximal raphe branches.

Ecological preference: Reported from benthic habitats of slightly alkaline, meso- to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Cymbopleura inaequaliformis* Krammer 2003**

(Pl. 88, figs. 1-8; pl. 89, figs. 1-8; pl. 90, figs. 1-6)

Ref. Hustedt 1930, p. 356, fig. 656; Krammer 2003, p. 23, pl.25, fig.1-3; pl.26, figs.1-4; pl.27, figs.1-8; Wojtal 2009, p. 184, pl. 11, fig. 1; Bąk et al. 2012, p. 89, pl. 59; Bahls 2019, p. 12, pl. 16, figs. 1-7; pl. 17, figs. 1-3.

Status of name: accepted taxonomically.

Synonyms: *Cymbella ehrenbergii* sensu Hustedt 1930, p. 346

Cymbella inaequalis sensu Reimer in Patrick & Reimer 1975

Diagnosis: Valves are very slightly dorsiventral, broadly lanceolate, elliptical-lanceolate to rhomboid-lanceolate, with strongly arched dorsal and ventral margins. Apices are narrowly bluntly rounded, subrostrate, not protracted. Axial area is moderately wide, somewhat ventrally displaced. Central area is ovoid, widening about 1/4 valve width. Raphe is lateral, narrowing towards the distal ends, appearing filiform or subtly reverse-lateral near the proximal ends. Proximal raphe endings are slightly expanded as central pores; distal raphe endings are quite thin, comma-shaped and dorsally deflected. Transapical striae are coarsely punctate, radiate in the middle portion, becoming more radiate near the ends, about 6-9 in 10 µm in the middle portion of the dorsal margin, and 11-12 in 10 µm towards the ends. Puncta 24-30 in 10 µm. Length of the valve 78-168 µm, and the breadth 25-37 µm.

Ecological preference: as *Cymbella ehrenbergii* is considered as a fresh-brackish water, alkalibiontic, high oxygen requirements, oligosaprobic, mesotraphentic (Van Dam et al. 1994); widespread in larger alpine lakes, rarely recorded in large numbers from lowland lakes (Krammer 2003); reported from low to moderate water conductivity range between 292 to 569 µS cm–1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15 °C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); alkaline waters of moderate conductivity; it has a wider ecological amplitude than most species of *Cymbopleura* **(**Bahls 2019).

Occurrence: Common in Kamionka and Młynek Lakes; frequent in Jeziorak and Radomno Lakes, and Eemian paleolake deposits of central Poland.

Distribution in Poland: as *Cymbella ehrenbergii* from Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-eastern Poland (Noga et al., 2016a).

***Cymbopleura inaequalis* (Ehrenberg) Krammer 2003**

(Pl. 91, figs. 1-7; pl. 92, figs. 1-7)

Ref. Hustedt 1930, p. 356, fig. 656; Germain 1981, p. 278, pl. 100, fig. 1; Krammer & Lange-Bertalot 1986, p. 337, pl. 144, figs. 1-6; Lange-Bertalot & Metzeltin 1996, p. 302, pl. 92, figs. 1-2; Krammer 2003, p. 25, pl. 29, figs. 1-9; pl. 32, figs. 1a, 2-8; pl. 33, figs. 1, 2; pl. 34: figs. 1-3; Kulikovskiy et al. 2016, p. 178, pl. 101, figs. 1-2; Bahls 2019, p. 12, pl 16, figs. 1-7; pl. 17, figs. 1-3.

Status of name: accepted taxonomically.

Synonyms: *Navicula inaequalis* Ehrenberg 1836
Cymbella inaequalis (Ehrenberg) Rabenhorst 1846
Cymbella ehrenbergii Kützing 1844
Pinnularia inaequalis Ehrenberg 1854
Cymbella ehrenbergii var. *minor* Grunow 1880
Cocconema ehrenbergii (Kützing) G.S.West 1905
Cymbella cucumis var. *delicata* Tempère & Peragallo 1909
Cymbella dissimilis M.Peragallo 1909F

Diagnosis: Valves are weakly to moderately dorsiventral, linear to elliptical-lanceolate, rhomboid-lanceolate with convex dorsal and ventral margins. Apices are subprotracted, subrostrate to rostrate and bluntly rounded. Axial area is moderately wide, follows close to the valve midline, sub-linear, narrowest near the apices and widening gradually toward the valve centre. Central area is small, rounded to elliptic, about ¼ of the valve width. Raphe is running near the ventral side, slightly lateral; filiform near proximal and distal ends; proximal raphe endings with prominent, large, rounded central pores; distal raphe endings comma-shaped, curved toward the dorsum. Transapical striae are coarsely punctate, radiate throughout the valve, becoming parallel near the apices about 8-9 in 10 µm in the middle of the dorsum, 11-12 in 10 µm at the ends. Puncta 18-22 in 10 µm. Length of the valve 78-155 µm, and the breadth 25-36 µm.

Remarks: *Cymbopleura inaequalis* is confused with to *Cymbopleura perstechlinensis* Krammer & Metzeltin 2003 and *Cymbopleura inaequaliformis* Krammer 2003, but differs only by the large size of the valves and the number of coarse puncta in 10 μm.

Ecological preference: As *C. ehrehbergii* cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); *Cymbopleura inaequalis* is widely distributed in lakes, ponds, and slow-moving streams across the United States, where it prefers somewhat alkaline waters of moderate conductivity (Patrick & Reimer 1975); it is distributed in oligo- to mesotrophic water (Krammer & Lange-Bertalot 1986); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); observed in freshwater to slightly brackish water habitats, in low to medium alkalinity with pH values 7.2-8.0; it is considered to be oligohalobous "indifferent", alkaliphilous. Alkalibiontic, fresh-, mesotrophic (Malinowska-Gniewosz et al. 2018); alkaline waters of moderate conductivity; has a wider ecological amplitude than most species of *Cymbopleura* (Bahls 2019). Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Kamionka and Radomno; frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); As *C. ehrenbergii* from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Pielnica and Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbopleura inaequalis* var. *ellipticum* Zalat nov. var.**

(Pl. 93, figs. 1-8)

Diagnosis: Valves are dorsiventral, elliptical-lanceolate, with convex dorsal and ventral margins. Apices are subprotracted, rostrate and acutely rounded. Axial area is moderately wide, linear, narrows near the apices and widens gradually toward the valve centre. Central area is moderate, subrounded to elliptic. Raphe is slightly lateral; filiform near proximal and distal ends; proximal raphe endings with large, rounded central pores, deflected slightly towards the ventrum; distal raphe endings are comma-shaped, curved towards the dorsum. Transapical striae are coarsely punctate, strongly radiate throughout the valve, about 6-7 in 10 μm in the middle of the dorsum, 8-9 in 10 μm at the ends. Puncta 16-19 in 10 μm. Length of the valve 100-135 μm, and the breadth 28-35 μm.

Remarks: This new variety differs from the nominate species by the elliptical shape of the valves, coarse and the number of striae in 10 μm.

Ecological preference: Found in shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecological preference.

Etymology: The epithet of the new variety refers to the elliptical shape of the valve.

Holotype: the specimens illustrated in plate 93, figures 1-8.

Type locality: Kamionka Lake.

Occurrence: Common in Kamionka Lake, infrequent in Jeziorak and Radomno Lakes.

Distribution in Poland: New record.

***Cymbopleura inaequalis* var. *rhomboidea* Zalat & Nitychoruk nov. var.**

(Pl. 94, figs. 1-5)

Diagnosis: Valve slightly dorsiventral, broadly rhomboid-lanceolate with strongly convex dorsal and ventral margins that taper to narrowly rounded, subrostrate apices. Axial area is moderately wide and linear. Central area is well defined, slightly large, about ¼ of the valve width, rhomboid-elliptical to ovate to rhomboid shape. Raphe is eccentric, lateral, and narrowing towards the distal and proximal ends, appearing filiform or subtly reverse-

lateral near the proximal ends. Proximal raphe endings are very slightly expanded as central pores. Transapical striae radiate throughout the valve, distinctly punctate, areolate, about 7-8 in 10 µm, and areolae are about 15-17 in 10 µm. Length of the valve 140-155µm, and the breadth 43-48 µm.

Remarks: This new variety differs from the nominate species by the rhomboid shape of the valves, coarse and the number of striae in 10 µm, and the raphe is eccentric.

Ecological preference: Found in shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecological preference.

Etymology: The epithet of the new variety refers to the rhomboid shape of the valve.

Holotype: the specimens illustrated in plate 94, figures 1-5.

Type locality: Kamionka Lake.

Occurrence: Common Kamionka Lake

Distribution in Poland: New record.

***Cymbopleura inaequilatera* (Lagerstedt) Krammer 2003**

(Pl. 95, figs. 1-2)

Ref. Cleve-Euler 1955, p. 135, fig. 1191 b-d; Krammer 2003, p. 84, pl.105, figs.1-4; Genkal & Yarushina 2019, p. 268, fig.1e.

Status of name: accepted taxonomically.

Synonyms: *Navicula inaequilatera* Lagerstedt 1873

Cymbella angustata var. *inaequilatera* (Lagerstedt) A.Cleve 1955

Diagnosis: Valves are weakly dorsiventral, linear-lanceolate to elliptical-lanceolate. The dorsal and ventral margins are slightly convex and triundulate. Apices are produced and moderately broad, rostrate to capitate and acutely rounded. Axial area is moderately wide, linear-lanceolate, slightly arched, and almost in the median line of the valve. Central area is lacking. Raphe is filiform, slightly lateral, and narrows towards the proximal and distal ends. Proximal raphe endings with close, prominent, rounded central pores, deflected slightly to the ventral side. Distal raphe endings are question mark-shaped and dorsally deflected. Transapical striae are radiate throughout the valve, about 12-14 in 10 µm in the middle portion of the dorsal margin, up to 18-20 in 10 µm towards the ends. Length of the valve 36 µm, and the breadth 7-9 µm.

Ecological preference: The species is reported from rivers and shallow lakes with low transparency, water temperature did not exceed 11°C; low mineralized (<100 mg/dm3), of hydrocarbonate class, pH around neutral to slightly alkaline (7.0-7.3) and oligotrophic in respect to the content of nutrients, with low concentrations of nitrogen and phosphorus compounds (Genkal & Yarushina 2019).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record

***Cymbopleura incerta* (Grunow) Krammer 2003**

Ref. Hustedt 1930, p. 360, fig. 665; Foged 1974, p. 40, pl. 24, figs. 13-15; Gasse 1986, p. 43, pl. 27, figs. 12, 13; Krammer & Lange-Bertalot 1986, p. 329, pl. 136, figs. 4-12; Lange-Bertalot & Metzeltin 1996, p. 240, pl. 61, figs. 9-11; pl. 95, fig. 15; Krammer 2003, p. 90, pl. 110, figs. 1-16; pl. 111, figs. 1-14b; pl. 112, figs. 1-18; Bąk et al. 2012, p. 90, pl. 58; Bahls et al. 2018, p. 44, pl. 7, fig. 6; p. 99, pl. 62, figs.10-12; Bahls 2019, p. 12, pl. 38, figs. 1-18; p. 39, figs. 1-10.

Status of name: accepted taxonomically.

Synonyms: *Cymbella incerta* Grunow 1878

Cymbella pisciculus var. *incerta* (Grunow) Grunow 1881

Cymbella subaequalis var. *incerta* (Grunow) Grunow 1885

Cymbella scotica var. *incerta* (Grunow) Ross 1947

Diagnosis: Valve is naviculoid, linearelliptical to lanceolate; slightly dorsiventral. The dorsal and ventral margins are equally slightly convex, somewhat the dorsal margin is much more arched than the ventral margin. Apices are subprotracted to subrostrate, acutely rounded. Axial area is linear, narrow near the apices, widening gradually toward the valve centre. Central area is moderate in size, rounded or elliptical, about 1/3 to 1/2 the

width of the valve. Raphe is central, lateral, straight, becoming reverse-lateral near the valve centre. Distal raphe endings are narrow and hooked toward the dorsal side in the form of a question mark; proximal raphe endings terminate with distinct central pores, which are deflected toward the ventral side. Transapical striae are finely punctate, radiate at the centre, more radiate at the ends, about 13-15 in 10 μm at the valve centre, up to 18 in 10 μm at the ends. Puncta about 28-32 in 10 μm. Length of the valve 36-75 μm, and the breadth 7-10 μm.

Ecological preference: Halophobous, acidophilous, or pH-indifferent (Foged 1970, 1974); freshwater form, oligotrophic (Krammer & Lange-Bertalot 1986); freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); oligotrophic habitats with low to moderate conductivity in northern and alpine regions (Krammer 2003); circumneutral, mainly occurring at pH about 7 (Szulc & Szulc 2012); alkaline, oligotrophic lakes and streams with low conductivity (Bahls 2019).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012).

***Cymbopleura incertiformis* Krammer 2003**

Ref. Krammer 2003, p. 92, pl. 105, figs. 7-8; pl. 113, figs. 8-21; Bahls 2019, p. 13, pl. 41, figs. 1-25; pl. 42, figs. 1-19; Bahls et al. 2018, p. 172, pl. 121, fig.5; Reavie 2023, p. 27, figs. 15 NN.

Status of name: accepted taxonomically.

Diagnosis: Valves are naviculoid, barely dorsiventral, lanceolate, linear sub-elliptical with convex to nearly straight ventral margin and convex dorsal margin; Apices are either not protracted or weakly protracted and subrostrate. Axial area is narrow, linear, and broadens somewhat near the valve centre. Central area is rounded or elliptical and more or less symmetric, formed by shallow depressions on the dorsal and ventral sides. Raphe is lateral, becoming filiform toward the ends. Proximal raphe endings are deflected ventrally and terminate with weakly expanded pores. Distal raphe endings are hooked toward the dorsal side. Transapical striae are radiate throughout and more widely spaced near the valve centre, about 14-16 in 10 μm at the valve centre, 20-22 in 10 μm at the ends on the dorsal side. Puncta 28-32 in 10 μm. Length of the valve 30-60 μm, and the breadth 7-9.5 μm.

Ecological preference: Widely distributed in the subarctic, Nordic, and alpine area in oligotrophic to dystrophic habitats with commonly low electrolyte content (Krammer 2003); freshwater with pH 8.0, air temperature 17°C, water temperature 20°C (Li et al. 2007); lakes with circumneutral pH (6.7-7.8) and low specific conductance (10-53 μS/cm) (Bahls 2019).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbopleura incertiformis* var. *crassipunctata* Krammer 2003**

(Pl. 95, figs. 3-5)

Ref. Krammer 1985, p. 28, pl. 8, figs. 6, 7; Krammer 2003, p. 93, pl. 114, figs. 1, 2.

Status of name: accepted taxonomically.

Synonym: *Cymbella incerta* var. *crassipunctata* Krammer 1985

Diagnosis: Valves are weakly dorsiventral, linear-lanceolate, with a weakly convex dorsal margin and a very slightly arched to nearly flat ventral margin; Apices are weakly protracted and subrostrate. Axial area is very narrow and linear. Central area is small, rounded or asymmetric. Raphe is slightly lateral, becoming filiform toward the ends. Proximal raphe endings are deflected ventrally and terminate with weakly expanded pores. Distal raphe endings are hooked toward the dorsal side. Transapical striae are punctate, radiate throughout the valve, about 16-17 in 10 μm at the valve centre, 19-22 in 10 μm at the ends on the dorsal side. Puncta 28-32 in 10 μm. Length of the valve 37-40 μm, and the breadth 7-9 μm.

Ecological preference: Found in benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura incertiformis* var. *inariensis* Krammer 2003**

(Pl. 95, figs. 6-7)

Ref. Krammer 2003, p. 161, pl.114, figs. 5-12.

Status of name: accepted taxonomically.

Diagnosis: Valves are naviculoid, symmetric, narrow linear lanceolate with broadly convex dorsal and ventral margins. Apices are protracted, rostrate to subcapitate. Axial area is very narrow, linear, and expanding slightly near the valve centre. Central area is small, subrounded and more or less symmetric. Raphe is slightly lateral, becoming filiform toward the ends. Proximal raphe endings with small central pores that deflected ventrally. Distal raphe endings are curved toward the dorsal side. Transapical striae are radiate throughout the valve, about 16-18 in 10 μm at the valve centre, 20-22 in 10 μm at the ends. Puncta 20-33 in 10 μm. Length of the valve 28-30 μm, and the breadth 6-7 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura incertiformis* var. *laterostrata* Krammer 2003**

(Pl. 95, figs. 8-10)

Ref. Krammer 2003, p. 161, pl.109, fig. 2-11.

Status of name: accepted taxonomically.

Diagnosis: Valves are naviculoid, narrow linear lanceolate with broadly convex dorsal and ventral margins. Apices are protracted, subtruncate to subcapitate. Axial area is very narrow, linear. Central area is small, asymmetric, and expanded laterally. Raphe is slightly lateral, becoming filiform toward the ends. Proximal raphe endings with small central pores that deflected ventrally. Distal raphe endings are deflected dorsally. Transapical striae are radiate throughout the valve, about 18-19 in 10 μm at the valve centre, 22-25 in 10 μm at the ends. Length of the valve 35-42 μm, and the breadth 6-8 μm.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura lata* (Grunow) Krammer 2003**

(Pl. 95, figs. 11-20; pl. 96, figs. 1-8)

Ref. Hustedt 1930, p. 355, fig. 649; Patrick & Reimer 1975, p. 37, pl. 5, fig. 4; Germain 1981, p. 277, pl. 100, fig. 2; Krammer & Lange-Bertalot 1986, p. 337, pl. 143, figs. 17-18; Lange-Bertalot & Metzeltin 1996, p. 302, pl. 92, fig. 7; Krammer 2003, p. 20, pl. 20, figs. 1-7; pl. 21, figs. 1-6; pl. 22, figs. 1-8; pl. 23, figs. 1-7; pl. 24, figs. 1-6; Bąk et al. 2012, p. 90, pl. 58; Kulikovskiy et al. 2016, p. 179, pl. 103, figs. 4-7; Bahls et al. 2018, p. 44, pl. 7, fig. 17; p. 100, pl. 63, fig. 11; Bahls 2019, p. 15, pl. 22, figs. 1-7.

Status of name: accepted taxonomically.

Synonym: *Cymbella lata* Grunow ex Cleve 1894

Diagnosis: Valves are slightly dorsiventral, lanceolate to broadly elliptic-lanceolate with a strongly convex dorsal margin and convex, nearly straight ventral margin. Apices are short, broadly truncate, rostrate to apiculate. Axial area is rather narrow to moderately wide, sublinear, broadening gradually towards the valve centre. Central area is subrounded to ovoid. Raphe is slightly lateral, narrowing towards the distal ends, slightly reverse-lateral at the proximal ends. Proximal raphe endings are inflated with distinct central pores; distal raphe endings are comma-shaped and dorsally deflected. Transapical striae are finely punctate, radiate throughout the valve, about 8-11 in 10 μm in the middle portion of the dorsal margin, increasing to 14-17 in 10 μm near the ends. Puncta about 28-32 in 10 μm. Length of the valve 42-85 μm, and the breadth 17-25 μm.

Ecological preference: Halobien indifferent, pH: alkaliphilous (Foged 1959); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); it is

reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); alkaline, oligotrophic lakes and streams with low to moderate conductivity (Bahls 2019); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno, Jeziorak and Kamionka Lakes; infrequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015).

***Cymbopleura lata* var. *americana* Krammer 2003**

(Pl. 97, figs. 1-15)

Ref. Krammer 2003, p.153, pl. 22, figs. 1-7.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, broadly lanceolate with a more convex dorsal margin, and convex to nearly straight ventral margin. Apices are short, broadly truncated, and subrostrate. Axial area is moderate, broadening gradually towards the valve centre. Central area is sometimes indistinct or slightly ovate. Raphe is slightly lateral, narrowing towards the distal ends, slightly reverse-lateral at the proximal end. Proximal raphe endings with distinct central pores, distal raphe endings are comma-shaped, dorsally deflected. Transapical striae are finely punctate, radiate throughout the valve, about 8-9 in 10 µm in the middle portion of the dorsal margin, increasing to 14 in 10 µm near the ends. Punctae about 30-35 in 10 µm. Length of the valve 46-84 µm, and the breadth 18-23 µm.

Ecological preference: Freshwater, known only from the benthic habitat, it has the same ecological preference as the type species.

Occurrence: Common in Radomno Lake and frequent in Kamionka and Jeziorak Lakes.

Distribution in Poland: New record.

***Cymbopleura lata* var. *irrorata* Krammer 2003**

(Pl. 98, figs. 1-5)

Ref. Krammer 2003, p. 153, pl. 24, figs. 1-3; Naseri et al. 2022, p. 9, fig. 82.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, broadly elliptical-lanceolate with a slightly convex ventral margin, and distinctly convex dorsal margin. Apices are short, broadly rounded, and subrostrate. Axial area is moderate, broadening gradually towards the valve centre. Central area is indistinct from the axial area or somewhat broadening toward the ventral margin. Raphe is slightly lateral, narrowing towards the distal ends, slightly reverse-lateral at the proximal end. Proximal raphe endings with distinct central pores, distal raphe endings are comma-shaped, dorsally deflected. Transapical striae are punctate, radiate throughout the valve, about 10-12 in 10 µm in the middle portion of the dorsal margin. Puncta about 27-29 in 10 µm. Length of the valve 40-60 µm, and the breadth 17-19 µm.

Ecological preference: It is reported from fresh, alkaline water with pH 7.22-8.9, low conductivity (Naseri et al. 2022); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: New record.

***Cymbopleura lata* var. *jeziorakensis* Zalat nov. var.**

(Pl. 98, figs. 12-14)

Diagnosis: Valves are distinctly dorsiventral, broadly elliptical with a more convex dorsal margin, and broadly convex ventral margin. Apices are short, broadly apiculate, subprotracted, and bluntly rounded. Axial area is narrow and linear. Central area is indistinct. Raphe is linear to very weakly lateral. Proximal

raphe endings are dilated with distinct central pores, and the distal raphe endings are dorsally deflected. Transapical striae are punctate, radiate throughout, about 9-10 in 10 μm. Length of the valve 35-38 μm, and the breadth 20-22 μm.

Remarks: This variety differs from the nominate species by having a narrow, linear axial area, lacking a central area, and bluntly rounded apices.

Ecological preference: It is reported from the benthic habitats of an alkaline, eutrophic freshwater environment.

Etymology: The epithet of the new variety refers to Jeziorak Lake.

Holotype: the specimens illustrated in plate 98, figures 12-14.

Type locality: Jeziorak Lake.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbopleura lata* var. *lura* Miho & Krammer 2003**

(Pl. 98, figs. 6-11)

Ref. Miho & Krammer 2003, p. 153, pl. 23, fig. 5.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, broadly elliptical-lanceolate with a convex ventral margin and strongly convex dorsal margin. Apices are short, subrostrate to broadly apiculate, protracted, and rounded. Axial area is moderate-lanceolate, broadening gradually towards the valve centre. Central area is distinct, widening towards the dorsal margin, a symmetrical, subovate. Raphe is slightly lateral, narrowing towards the distal ends, slightly reverse-lateral at the proximal end. Proximal raphe endings are dilated with distinct central pores that deflect dorsally, and the distal raphe endings are dorsally deflected. Transapical striae are punctate, subparallel at the valve centre, radiate towards the ends, about 8-10 in 10 μm in the middle portion of the dorsal margin. The central striae with isolated areolae, not stigmata. Puncta about 26-28 in 10 μm. Length of the valve 59-70 μm, and the breadth 25-28 μm.

Ecological preference: known from the benthic habitat of alkaline, meso-to eutrophic freshwater environments associated with the nominate species, and it has the same ecological preference.

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: New record.

***Cymbopleura lata* var. *truncata* Krammer 2003**

(Pl. 99, figs. 1-6)

Ref. Krammer 2003, p. 153, pl. 20, figs. 4-8; pl. 23, figs. 6-7; pl. 24, figs. 4-6; Genkal & Yarushina 2014, p. 552, fig.1:1.

Status of name: accepted taxonomically.

Synonym: *Cymbella ehrenbergii* var. *minor* Grunow 1880

Diagnosis: Valves are moderately dorsiventral, lanceolate to broadly elliptic-lanceolate with a strongly convex dorsal margin and slightly convex, nearly straight ventral margin. Apices are broadly truncated, protracted and bluntly rounded. Axial area is moderately wide, semi-lanceolate, broadening gradually towards the valve centre. Central area is slightly large, rounded to subovate, and somewhat indistinct from the axial area. Raphe is slightly lateral, narrowing towards the distal ends, slightly reverse-lateral at the proximal ends. Proximal raphe endings are inflated with distinct central pores; distal raphe endings are comma-shaped and dorsally deflected. Transapical striae are punctate, radiate throughout the valve, about 7-8 in 10 μm; puncta 22-27 in 10 μm. Length of the valve 35-94 μm, and the breadth 20-23.5 μm.

Ecological preference: Reported from Serbian peat bogs with circumneutral to slightly alkaline freshwater pH 6.5-7.3, low to medium conductivity 30-350 (μS cm-1) and temperature ranges 13-22°C (Vidaković et al. 2016).

Occurrence: Frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: New record.

***Cymbopleura margalefii* Delgado, Novais, Blanco & Ector 2013**

Ref. Delgado et al. 2013, p. 98, figs. 191-204.

Status of name: accepted taxonomically.

Diagnosis: Valve is distinctly dorsiventral, broad, asymmetrically elliptical-lanceolate, with arched dorsal margin and very slightly convex to nearly straight ventral margin, somewhat with very slight tumid in the centre. Apices are obtusely rounded, not protracted. Axial area is narrow, curved, broadening weakly at the valve centre and slightly ventrally displaced. Central area is lacking. Raphe is distinctly lateral, narrowing towards the distal ends, appearing reverse-lateral near the proximal ends. Distal raphe endings are dorsally deflected, proximal raphe endings are slightly expanded with central pores that deflect ventrally. Transapical striae are radiate throughout the valve, in the middle portion of the dorsum about 11-12 in 10 μm, up to 13 towards the ends. Puncta about 40-45 in 10 μm. Length of the valve 19-37 μm, and the breadth 6.5-9.0 μm.

Ecological preference: Reported from alkaline and eutrophic springs in Majorca Island (Spain) (Delgado et al., 2013).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbopleura naviculiformis* (Auerswald) Krammer 2003**

(Pl. 100, figs. 1-6)

Ref. Hustedt 1930, p. 356, fig. 653; Patrick & Reimer 1975, p. 31, pl. 4, fig. 9; Krammer 1982, p. 40, figs. 1127-1132; Krammer & Lange-Bertalot 1986, p. 338, pl. 145, figs. 6-11; pl. 142, fig. 22; Lange-Bertalot & Metzeltin 1996, p. 240, pl. 61, figs. 1-3; pl. 105, fig. 12; Metzeltin & Witkowski 1996, p. 66, pl. 17, figs. 4-7; Krammer 2003, p. 56, pl. 76, figs. 1-13; pl. 77, figs. 1-13; pl. 78, figs. 1-8; pl. 79, figs. 1-14; pl. 80, fig. 12; pl. 82, figs. 1-12; pl. 83, figs. 9-11; Wojtal 2009, p. 185, pl. 11, figs. 5-8; pl. 70, fig. 8; pl. 71, figs. 1-3; Bąk et al. 2012, p. 91, pl. 58; Bahls et al. 2018, p. 81, pl. 44, fig. 9; Bahls 2019, p. 17, pl. 60, figs. 9-22; pl. 61, figs. 1-9.

Status of name: accepted taxonomically.

Synonyms: *Cymbella naviculiformis* Auerswald ex Heiberg 1863
Cymbella cuspidata W.Smith 1853
Cymbella cuspidata var. *naviculiformis* Auerswald 1864
Cymbella cuspidata f. *maxima* Rabenhorst 1868
Cocconema naviculiforme (Auerswald) Kirchner 1885

Diagnosis: Valves are moderately dorsiventral, asymmetrically naviculoid, elliptic-lanceolate, with a moderately convex dorsal margin and a slightly convex to nearly flat ventral margin. Apices are produced, rostrate to capitate, bluntly rounded. Axial area is narrow, linear, or narrowly lanceolate and expands gradually towards the valve centre. Central area is a relatively large, rounded, broad, rhomboid, one-half to two-thirds valve width, sometimes asymmetrical and more well developed dorsally or ventrally. Raphe is lateral and becomes filiform near the ends. Distal raphe endings are somewhat undulate, comma-shaped and deflected dorsally. Proximal raphe endings are not or very slightly expanded as central pores and curved with short hooks, deflected slightly towards the ventral margin. Transapical striae are finely punctate, slightly radiate throughout and somewhat more closely spaced on the ventral side, about 12-14 in 10 μm at the valve centre, becoming 16-18 in 10 μm at the ends. Puncta about 30-35 in 10 μm. Length of the valve 28-45 μm, and the breadth 9-12 μm.

Ecological preference: Cosmopolitan, halobien indifferent, pH: indifferent (Foged 1959); a neutrophilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater with pH 5.5-8.5, air temperature 16-27°C, water temperature 7-25°C (Li et al. 2007); freshwater an alkaline character or close to neutral or close to circumneutral reaction (6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 3.0-17.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 b, c); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from

158 to 435 µS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b); from small lakes and streams in mountains; prefers well-oxygenated, circumneutral and slightly alkaline waters with low concentrations of dissolved solids (Bahls 2019).

Occurrence: Frequent in Młynek, Kamionka and Radomno Lakes.

Distribution in Poland: distributed in the Wyżyna Krakowskoczęstochowska Upland, Vistula River (Starmach1938; Kyselowa & Kysela 1966), fish ponds in Mydlniki (Siemińska 1947); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b); spring of Szklarkastream (Skalska 1966 a); springs of Będkowka stream (Kubik 1970); Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); frequent, in epipelon and periphyton in Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b, c); Wisłok River and the catchment area including rivers and streams ((San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Baryczka, Pielnica, Stobnica, Ryjak, Wisłoka (near Dębica), Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Springs at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Cymbopleura novafundlandica* Krammer 2003**

(Pl. 100, figs. 7-14)

Ref. Krammer 2003, p. 152, pl. 12, fig.1.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, asymmetric, broadly lanceolate to linear-elliptical. The dorsal margin is strongly convex, and the ventral margin is slightly convex. Apices are apiculate, capitate, and acutely rounded. Axial area is narrow, linear, and almost in the median line of the valve. Central area is well developed, asymmetrical to subrounded, about 1/3-1/4 the valve width. Raphe is slightly lateral and narrowing towards the distal ends, appearing filiform or subtly reverse-lateral near the proximal ends. Distal raphe endings are dorsally deflected; proximal raphe endings are expanded as central pores that deflect ventrally. The central nodule is large. Transapical striae are distinctly punctate, slightly radiate in the middle portion, about 8-9 in 10 µm on the dorsum, becoming more radiate near the ends, about 12-13 in 10 µm. Puncta 18-22 in 10 µm. Length of the valve 68-75 µm, and the breadth 22-25 µm.

Ecological preference: Recorded from the benthic habitat of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes.

Distribution in Poland: New record.

***Cymbopleura peranglica* Krammer 2003**

Ref. Krammer 2003, p.158, pl. 84, figs.1-4; Noga et al. 2013 c, p. 139, pl. 3, fig. 3; Kihara et al. 2015, p. 22, fig. 46; Bahls 2019, p. 18, pl. 62, fig. 21.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, broadly subelliptic to elliptical-lanceolate, with a distinct convex dorsal margin and a moderately convex ventral margin. Apices are protracted, rostrate-capitate, and bluntly rounded. Axial area is relatively narrow, almost in the median line of the valve, linear, and expanded

gradually towards the valve centre. Central area is large, about half of the valve width, rounded or rhomboid, sometimes asymmetrical and then more well developed dorsally or ventrally. Raphe is slightly lateral narrowing towards the distal ends, appearing filiform or weakly reverse-lateral near the proximal ends. Distal raphe endings are comma-shaped and dorsally deflected. Proximal raphe endings are slightly expanded with central pores and somewhat ventrally deflected. Transapical striae are finely punctate, radiate throughout the valve, about 9-11 in 10 μm in the middle portion of the dorsal margin, up to 15 in 10 μm towards the ends. Puncta about 20-24 in 10 μm. Length of the valve 35-60 μm, and the breadth 12-14.5 μm.

Ecological preference: It is widely distributed in northern and alpine areas, where it prefers oligotrophic waters with low conductivity (Krammer 2003); freshwater of circumneutral character or close to neutral (6.6–7.1), low conductivity (128-129 μSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013c).

***Cymbopleura percuspidata* Krammer 2003**

(Pl. 101, figs. 1-7)

Ref. Krammer 2003, p. 153, pl. 13, figs. 5-8; Kulikovskiy et al. 2016, p. 180, pl. 102, figs. 1-3.

Status of name: accepted taxonomically.

Diagnosis: Valves are very slightly dorsiventral, broadly lanceolate, to broadly elliptic with more convex dorsal margin, and slightly convex, somewhat nearly straight ventral margin. Apices are narrowly apiculate, subprotracted, and rostrate. Axial area is narrow, linear, and in the median line of the valve. Central area is distinctly set off dorsally and ventrally, large, rectangular, and asymmetrical due to the shortening of the middle striae. Raphe is very slightly lateral, narrowing towards the distal and proximal ends. Proximal raphe endings with distinct central pores; distal raphe endings are dorsally deflected. Transapical striae are finely punctate, distinctly radiate throughout the valve, about 8-9 in 10 μm in the middle portion of the dorsal margin, up to 15 in 10 μm towards the ends. Puncta about 22-24 in 10 μm. Length of the valve 45-67 μm, and the breadth 20-22 μm.

Remarks: This taxon is distinguished from other taxa of the cuspidate group by the combination of size, outline, distinct central pores, and the shape of the large central area.

Ecological preference: Prefers oligotrophic water with low electrolyte content (Krammer 2003); oligotrophic acidified water bodies (Kulikovskiy et al. 2016).

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbopleura procera* (Hustedt) Krammer 2003**

Ref. Foged 1981, p. 74, pl. 49, fig. 2; Krammer 2003, p. 43, pl. 61, figs. 4, 5; Bahls 2019, p. 18, pl. 10, figs. 1-6.

Status of name: accepted taxonomically.

Synonyms: *Cymbella procera* Hustedt 1931

Cymbella neoprocera Van Landingham 1969

Diagnosis: Valves are moderately dorsiventral, broadly lanceolate to half-lanceolate, with a more convex dorsal margin and slightly convex to nearly straight ventral margin. Apices are acuminate, subrostrate, not protracted, and acutely rounded. Axial area is wide-lanceolate, broadening gradually towards the valve centre. Central area is about half the valve breadth, forming a round depression on both sides of the mid-valve. Raphe is lateral, narrowing towards the proximal and distal ends. Proximal raphe endings are not expanded with central pores and are somewhat ventrally curved. Distal raphe endings are bayonet-shaped, more or less straight and dorsally deflected. Transapical striae are finely punctate-lineate radiate throughout the valve, parallel to convergent at the ends, about 8-10 in 10 μm in the middle portion of the dorsal margin, becoming 13-15 in 10 μm towards the ends. Puncta 24-26 in 10 μm. Length of the valve 70-115 μm, and the breadth 18-25 μm.

Ecological preference: The species is recorded from Hoskins Lake, a mountain lake surrounded by conifer forest in northwest Montana, in freshwater with a pH 7.6 and specific conductance measured 67 µS/cm (Bahls 2019).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Cymbopleura subaequalis* (Grunow) Krammer 2003**

(Pl. 102, figs. 1-13)

Ref. Krammer 2003, p. 101, pl. 119, figs. 1-15, 19; pl. 120, figs. 1-8; pl. 121, figs. 1-5; pl. 122, fig. 18; pl. 123, figs. 1-14, 19; pl. 124, figs. 1-19; pl. 126, figs. 9-11; pl. 128, figs. 4-8 ; Wojtal 2009, p. 188, pl. 10, fig. 6; Bąk et al. 2012, p. 91, pl. 58; Kulikovskiy et al. 2016, p. 181, pl. 106, figs. 1-4; Bahls et al. 2018, p. 44, pl. 7, fig. 9; Bahls 2019, p. 20, pl. 54, figs. 1-24.

Status of name: accepted taxonomically.

Synonyms: *Cymbella subaequalis* Grunow 1880

Cymbella aequalis var. *subaequalis* (Grunow) Mayer 1919

Cymbella obtusa var. *subaequalis* (Grunow) A.Cleve 1932

Diagnosis: Valves are slightly or very slightly dorsiventral, lanceolate, linear subelliptic to linear-lanceolate with slightly arched dorsal and ventral margins. Apices are obtusely rounded, subtruncate, truncate or subtly protracted. Axial area is narrow to moderately wide, linear, in the median line of the valve, and widens gradually from the apices toward the valve centre. Central area is absent or small, commonly irregularly shaped, sometimes asymmetrical and then more well-developed dorsally or ventrally. Raphe is slightly to distinctly lateral, narrowing towards the proximal and distal ends or subtly reverse-lateral near the proximal ends and displaced ventrally. Proximal raphe endings are slightly expanded as central pores, deflected ventrally; distal raphe endings are semicircular and dorsally deflected. Transapical striae are indistinctly punctate, radiate throughout the valve, about 12-14 in 10 µm in the middle portion of the dorsal margin, 17-19 in 10 µm towards the ends. Puncta about 35-38 in 10 µm. Length of the valve 20-54 µm, and the breadth 7-9.5 µm.

Ecological preference: Cosmopolitan in temperate and colder regions in both the northern and southern hemispheres, oligo- to mesotrophic waters, with low to moderate conductivity (Krammer 2003); a neutrophilous, oligosaprobous, oligo-mesotraphentic and fresh water species (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); found in low to moderate water conductivity range between 292 to 569 µS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); It is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); it prefers cold, oligotrophic, and somewhat alkaline waters with low to moderate specific conductance (Bahls 2019).

Occurrence: Common in Radomno Lake and frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: Reported from Zatoka Pucka (Witak 2002); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok river and Mleczka, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland

(Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Cymbopleura subaequalis* var. *alpestris* Krammer 2003**

Ref. Krammer 2003, p. 102, pl. 121, figs. 1-4; pl. 122, fig. 18; pl. 126, figs. 9-11; Kulikovskiy et al. 2016, p. 181, pl. 106, figs. 5-9.

Status of name: accepted taxonomically.

Synonym: *Cymbopleura krammeri* var. *alpestris* (Kützing) Reichardt 2011

Diagnosis: Valves are nearly linear with weakly convex dorsal and ventral margins. Apices are truncate to obtusely rounded. Axial area is narrow to moderately wide, linear, and almost in the median line of the valve. Central area is small, irregularly shaped, rounded to subovate, sometimes asymmetrical and well-developed dorsally or ventrally. Raphe is lateral, narrowing towards the proximal and distal ends, somewhat slightly reverse-lateral near the proximal ends. Proximal raphe endings are slightly expanded as central pores, deflected ventrally; distal raphe endings are comma-shaped and deflected dorsally. Transapical striae are radiate throughout the valve, about 13-15 in 10 µm in the middle portion, up to 20 in 10 µm towards the ends. Puncta about 37-40 in 10 µm. Length of the valve 24-43 µm, and the breadth 7-9 µm.

Ecological preference: the species reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Cymbopleura subaequalis* var. *pertruncata* Krammer 2003**

(Pl. 102, figs. 14-15)

Ref. Krammer 2003, p. 163, pl. 124, figs. 13-19; Kulikovskiy et al. 2016, p. 181, pl. 106, figs. 23-27.

Status of name: accepted taxonomically.

Synonym: *Cymbopleura krammeri* var. *pertruncata* (Kützing) Reichardt 2011

Diagnosis: Valve is dorsiventral, linear subelliptic to lanceolate, with a convex dorsal margin, and a weakly convex to straight ventral margin. Apices are broadly rounded, truncate. Axial area is moderately wide, linear-lanceolate, widening gradually towards the valve centre. Central area is indistinct or irregularly shaped, sometimes asymmetrical and then more well-developed dorsally or ventrally. Raphe is slightly to distinctly lateral, narrowing towards the proximal and distal ends or slightly reverse-lateral near the proximal ends. Proximal raphe ends are slightly expanded as small central pores; distal raphe endings are dorsally deflected. Transapical striae are slightly radiate in the middle part of the valve, about 12-14 in 10 µm, more radiate towards the apices, about 14-17 in 10 µm. Puncta about 30-35 in 10 µm. Length of the valve 20-45 µm, and the breadth 6-8 µm.

Ecological preference: As the nominate variety**,** cosmopolitan in temperate and colder regions in both the northern and southern hemispheres, oligo- to mesotrophic waters, with low to moderate conductivity (Krammer 2003); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Cymbopleura subaequalis* var. *truncata* (Grunow) Krammer 2003**

Ref. Krammer 2003, p. 163, pl. 121, fig. 5; pl. 123, figs. 1-12, 19; pl. 124, figs. 1-12; pl. 128, figs. 4-6; Rivera-Rondón & Catalan 2017, p. 342, pl. 101, fig. 3; Żelazna-Wieczorek & Knysak, 2017, p. 329, fig. 7: 27.

Status of name: accepted taxonomically.

Synonym: *Cymbopleura krammeri* var. *truncata* (Kützing) Reichardt 2011.

Diagnosis: Valves are very slightly dorsiventral, linear, and linear-lanceolate. The dorsal and ventral margins are weakly arched to nearly straight and parallel. Apices are set off, broadly wedge-shaped, to truncate. Axial area is relatively narrow, linear and tapers gradually towards the valve ends. Central area is absent or small, irregularly shaped, and sometimes asymmetrical. Raphe is slightly lateral, narrowing towards the proximal and distal ends or slightly reverse-lateral near the proximal ends. Proximal raphe endings are slightly expanded as small central pores; distal raphe endings are dorsally deflected. Transapical striae are radiate throughout the valve, about 12-14 in 10 μm in the middle portion of the dorsal margin, up to 16-18 in 10 μm towards the ends. Puncta about 32-36 in 10 μm. Length of the valve 20-44 μm, and the breadth 7.5-8.2 μm.

Ecological preference: As the nominate variety, cosmopolitan in temperate and colder regions in both the northern and southern hemispheres, oligo- to mesotrophic waters, with low to moderate conductivity (Krammer 2003); it is reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Cymbopleura subaequalis* var. *chodykai* Zalat nov. var.**

(Pl. 102, figs. 16-17)

Diagnosis: Valves are slightly dorsiventral, linear-elliptic to linear-lanceolate with slightly arched dorsal and ventral margins. Apices are obtusely rounded, subprotracted. Axial area is moderately wide, lanceolate, in the median line of the valve, and widens gradually toward the valve centre. Central area is indistinct or irregularly shaped. Raphe is slightly lateral, narrowing towards the proximal and distal ends. Proximal raphe endings are slightly expanded as central pores, deflected ventrally; distal raphe endings are dorsally deflected. Transapical striae are radiate throughout the valve, about 13-14 in 10 μm in the middle portion of the dorsal margin, 16-17 in 10 μm towards the ends. Length of the valve 46 μm, and the breadth 13 μm.

Remarks: This variety differs from the nominate species by the romboid shape of the valve, linear to weakly lateral raphe and the shape of striation.

Etymology: The epithet of the new variety refers to Dr. Marta Chodyka.

Holotype: the specimens illustrated in plate 102, figures 16-17.

Type locality: Kamionka Lake.

Ecological preference: Reported from the benthic habitat of a slightly alkaline, eutrophic freshwater environment.

Occurrence: Frequent in Kamionka Lake.

Distribution in Poland: New record.

***Cymbopleura subapiculata* Krammer 2003**

(Pl. 102, figs. 18-21)

Ref. Krammer 2003, p. 152, pl.7, fig.7; pl.13, figs.1-4.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, broadly elliptical-lanceolate with strongly convex dorsal and ventral margins. Apices are apiculate-cuspidate, protracted and acutely rounded. Axial area is moderate, lanceolate, narrowing at the ends and widening gradually towards the valve centre. Central area is a relatively large, rounded or slightly rectangular and asymmetric, about 1/4 to 1/3 valve width. Raphe is moderately lateral, becoming filiform toward the distal and proximal ends. Proximal raphe endings are curved ventrally with small central pores. Distal raphe endings are comma-shaped and deflected dorsally. Transapical striae are distinctly punctate, radiate throughout, about 8-10 in 10 μm at the valve centre, and 13-15 in 10 μm at the apices. Puncta are about 20-24 in 10 μm. Length of the valve 50-55 μm, and the breadth 20-23 μm.

Ecological preference: Found in benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura subcuspidata* (Krammer) Krammer 2003**

(Pl. 103, figs. 1-8)

Ref. Foged 1981, p. 67, pl. 48, figs. 4-6; Krammer 1982, p. 41, pls. 1133-1138; Krammer & Lange-Bertalot 1986, p. 339, pl. 146, figs. 6, 7; pl. 15, fig. 1; Krammer 2003, p. 15, pl. 14, figs. 1-6; pl. 15, figs. 1-9; pl. 16, figs. 1-6; pl.17, figs.1-5, (?) 6; pl. 18, figs. 1-7; Rivera-Rondón & Catalan 2017, p. 340, pl. 100, fig. 5; Bahls et al. 2018, p. 44, pl. 7, fig. 14; p. 64, pl. 27, fig. 8; p. 81, pl. 44, fig. 3; Bahls 2019, p. 21, pl. 8, figs. 1-5; pl. 9, figs. 1-6.

Status of name: accepted taxonomically.

Synonyms: *Cymbella subcuspidata* Krammer 1982

Cymbella cuspidata var. *obtusiuscula* Grunow 1885

Diagnosis: Valves are slightly dorsiventral, broadly elliptical-lanceolate, with almost equally arched dorsal and ventral margins, sometimes the dorsal margin is more convex than the ventral one. Apices are bluntly rounded, rostrate to capitate. Axial area is moderately narrow, widening gradually from the apices towards the valve centre. Central area is large, transversally rounded or rhomboidal, one-third to one-half valve width, commonly asymmetrical. Raphe is lateral, narrowing towards the distal and proximal ends or weakly reverse-lateral near the proximal ends. Proximal raphe endings are deflected ventrally and shaped like a crochet hook or a crosier. Distal raphe endings are bayonet-shaped and deflected dorsally. Transapical striae are distinctly punctate, radiate throughout the valve and more closely spaced towards the apices, about 9-11 in 10 μm in the middle portion of both dorsal and ventral margins, up to 16 in 10 μm towards the ends. Puncta about 19-22 in 10 μm. Length of the valve 70-115 μm, and the breadth 19-25 μm.

Remarks: This taxon is similar to *Cymbopleura apiculata* Krammer has wider valves and apiculate apices. *Cymbopleura anglica* (Lagerstedt) Krammer and *C. naviculiformis* (Auerswald) Krammer are smaller with higher areolae density. This species distinguished from the similar cuspidate-taxa by the combination of size, outline, crosier-shaped proximal raphe endings and the rostrate-capitate apices (Krammer 2003).

Ecological preference: Freshwater, high oxygen requirements, oligosaprobic (Van Dam et al. 1994); the species prefers oligotrophic water with low electrolyte content (Krammer 2003); oligotrophic water bodies with low salinity (Kulikovskiy et al. 2016); oligotrophic lakes and ponds with circumneutral pH and low conductivity (Bahls 2019).

Occurrence: Frequent in Kamionka Lake and Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Cymbopleura sublanceolata* Krammer 2003**

(Pl. 104, fig. 1)

Ref. Krammer 2003, p. 59, pl. 81, figs. 1-13; pl. 82, figs. 1-12; pl. 85, figs. 3-9; Li et al., 2007, p. 216, fig. 20; Bahls 2019, p. 21, pl. 60, figs. 1-8; pl. 61, figs. 10-25.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly dorsiventral, lanceolate with almost equally arched dorsal and ventral margins, the dorsal side is somewhat more convex than the ventral one. Apices are rostrate to capitate. Axial area is narrow, in the median line of the valve and expands gradually towards the valve centre. Central area is large, rounded, somewhat rhomboid, asymmetric, about one-half valve width. Raphe is lateral and becomes filiform near the distal ends, appearing subtly reverse-lateral near the proximal ends. Proximal raphe endings are weakly expanded with short hooks, deflected slightly towards the ventral margin. Distal raphe endings are in the form question mark and deflected dorsally. Transapical striae are finely punctate-lineate, slightly radiate throughout the valve and somewhat more closely spaced on the ventral side and near the apices, about 12-15 in 10 μm at the valve centre of the dorsal side, up to 18 in 10 μm towards the ends. Puncta 30-35 in 10 μm. Length of the valve 29-50 μm, and the breadth 10-12.5 μm.

Remarks: This species is easily confused with *Cymbopleura naviculiformis* (Auerswald) Krammer, which differs slightly in the shape of the valve and the degree of arch in the ventral margin. *Cymbopleura naviculiformis* has narrower valves with less convex to nearly flat ventral margins. *Cymbopleura anglica* (Lagerstedt) Krammer has larger valves with lower areolae density.

Ecological preference: *Cymbopleura sublanceolata* recorded from the Alps, Nordic and subarctic, freshwater oligotrophic waters with low to moderate electrolyte content (Krammer 2003); freshwater with pH 8.0, air temperature 16°C, water temperature 7°C (Li et al., 2007); oligotrophic lakes and ponds with circumneutral pH and low to moderate conductivity (Bahls 2019).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Cymbopleura sublanceolata* var. *javanica* Krammer 2003**

(Pl. 104, figs. 2-6)

Ref. Krammer 2003, p.157, pl.85, figs. 5-9.

Status of name: accepted taxonomically.

Diagnosis:. Valves are slightly dorsiventral, lanceolate with distinct, broadly convex dorsal and weakly convex to nearly flat ventral margin. Apices are rostrate and acutely rounded. Axial area is narrow, linear and in the median line of the valve. Central area is moderate, subrounded or irregular. Raphe is slightly lateral and becomes filiform near the distal ends. Proximal raphe endings are weakly expanded with short hooks, deflected slightly towards the ventral margin. Distal raphe endings are deflected dorsally. Transapical striae are finely punctate, radiate throughout the valve and somewhat more closely spaced near the apices, about 13-15 in 10 µm at the valve centre, up to 18 in 10 µm towards the ends. Puncta 30-33 in 10 µm. Length of the valve 40-52 µm, and the breadth 11-12 µm.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: New record.

Genus *Encyonema* Kützing 1833

Diagnosis: Valves are isopolar, more or less dorsiventral. Raphe lies along or near the middle part of the valve. Raphe filiform to lateral. Proximal raphe endings are expanded, dorsally bent in species with apical asymmetry or otherwise, practically straight. Distal raphe ends are ventrally curved ("Encyonema"-type raphe sensu Krammer, 1982). Striae uniseriate. Areolae openings of different shapes, from round to slit-like. Internally, areolae are occluded by volae or foricula. One or more stigmoids may be located dorsally, beside the central area. Externally, openings of stigmoids are round or oval, internally, slit-like, inner surface not convoluted or with minute projections.

Holotype species: *Encyonema paradoxum* Kützing 1834

***Encyonema auerswaldii* Rabenhotst 1853**

(Pl. 104, figs. 7-13)

Ref. Cleve-Euler 1955, p. 126, fig.1178a-c; Patrick & Reimer 1975, p. 41, pl. 6, figs. 5-6; Krammer 1997, p. 117, pl.65, figs.1-8; pl. 66, figs. 1-6; pl. 67, figs. 9-14; pl. 68, figs. 6-15; Li et al. 2007, p. 226, fig. 75; Silva et al. 2013, p. 122, figs. 42-45.

Status of name: accepted taxonomically.

Synonyms: *Encyonema cespitosum* var. *auerswaldii* (Rabenhorst) Van Heurck 1885
Cymbella ventricosa var. *auerswaldii* (Rabenhorst) Meister 1912
Cymbella cespitosa var. *auerswaldii* (Rabenhorst) A.Cleve 1955
Cymbella prostrata var. *auerswaldii* (Rabenhorst) Reimer 1975

Diagnosis: Valves are dorsiventral, slightly lanceolate, with a strongly convex dorsal margin, and straight to slightly convex ventral margin, sometimes showing swelling in the middle part of the ventral margin. Apices are rounded, weakly protracted, somewhat subrostrate and slightly displaced to the ventral side. Axial area is straight to linear–lanceolate, narrow near the ends and slightly expanded towards the valve centre. Central area is indistinct to slightly rounded. Raphe is broad lateral; distal raphe endings are deflected

to the ventral side; proximal raphe endings are slightly deflected to the dorsal side. Terminal nodules are positioned on the ventral side, while the central nodule on the dorsal side. Stigmata absent. Transapical striae are coarsely punctate, slightly radiate throughout the valve, about 9-11 in 10 μm at the valve centre, becoming 12-15 in 10 μm near the ends. Puncta about 22-25 in 10 μm. Length of the valve 15-37 μm, and the breadth 8-12 μm.

Ecological preference: Insufficiently known. Freshwater with pH 6.0-8.5, air temperature 13-30°C, water temperature 3-18°C (Li et al., 2007); it reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes and the Eemian paleolake deposits of central Poland.

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b).

***Encyonema caespitosum* Kützing 1849**

(Pl. 104, figs. 14-26)

Ref. Foged 1974, p. 42, pl. 36, figs. 3-6; Foged 1977, p. 40, pl. 36, figs. 4, 5, 9; Krammer & Lange-Bertalot 1986, p. 310, pl. 8, fig. 1; pl. 121, figs. 1216; pl. 122, figs. 15; Lange-Bertalot & Metzeltin 1996, p. 294, pl. 88, figs. 1-3; Metzeltin & Witkowski 1996, p. 58, pl. 13, fig. 7; pl. 70, fig. 22; Krammer 1997, p. 118, pl. 65, figs. 1-17; pl. 66, figs. 7-13; pl. 67, figs. 1-8, 15, 16; pl. 68, figs. 1-5; pl. 69, figs. 1-8; pl. 70, figs. 1-2; Wojtal 2009, p. 198, pl. 10, figs. 10, 11; Bąk et al. 2012, p. 109, pl. 60; Silva et al. 2013, p. 122, figs. 32-41.

Status of name: accepted taxonomically.

Synonyms: *Cymbella caespitosa* (Kützing) Brun 1880
Cocconema cespitosum (Kützing) G.S.West 1905
Cymbella ventricosa var. *caespitosa* (Kützing) Dippel 1905
Cymbella prostrata var. *caespitosa* (Kützing) Foged 1974
Schizonema cespitulum Suhr 1849

Diagnosis: Valves are dorsiventral, halfelliptic to halflanceolate, lunate. The dorsal margin is strongly convex, and the ventral margin is nearly straight to slightly convex, with slight swelling in the middle portion. Apices are subrostrate, acutely rounded, somewhat subprotracted and bent towards the ventrum. Axial area is narrow, linear to linear-lanceolate. Central area is indistinct to slightly rounded. Raphe is lateral, extends in the middle or near the ventral margin; distal raphe endings are deflected to the ventral side, proximal raphe endings with pronounced central fissures, deflected towards the dorsum. Terminal nodules are located on the ventral side, central nodule is on the dorsal side. Stigmata absent. Transapical striae are punctate, radiate throughout the valve, becoming convergent close to the ends, about 9-11 in 10 μm at the valve centre, up to 13 in 10 μm at the ends. Puncta about 15-20 in 10 μm. Length of the valve 24-50 μm, and the breadth 10-13 μm.

Ecological preference: Eutrophic lakes and slightly brackish water (Cleve-Euler 1955); oligohalobous 'indifferent', alkaliphilous (Foged 1980); cosmopolitan, oligotrophic to eutrophic waters, beta- alpha- mesosaprobic (Krammer & Lange-Bertalot 1986); α-mesosaprobous and fresh brackish water species occurring in a broad trophic spectrum (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); low to moderate water conductivity range between 292 to 569 μS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); freshwater with pH had an alkaline character to neutral, pH 6.6-8.3, low to high conductivity (128-764 μSx cm^{-1}), temperature 10.0-19.9, Nitrate slightly deviated from the standards (Noga et al. 2013 a, c); it is reported from freshwater

streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); eutrophic waters with moderate electrolyte content, but tolerant of oligotrophic to eutrophic, lives also in mesotrophic alkaline water bodies, (Hofmann et al. 2011; Kulikovskiy et al. 2016).

Occurrence: Common in Jeziorak Lake; frequent in Kamionka, Młynek and Radomno Lakes.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Lubcza, Różanka, Morwawa, Pielnica, Mleczka, Strug, Ryjak, Wielopolka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, southern Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema cespitosum* var. *comensis* Krammer 1997**

(Pl. 105, figs. 1-6)

Ref. Krammer 1997, p. 173, pl. 66, figs. 7-10; pl. 67, figs. 1-8.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, halfelliptic to lunate. The dorsal margin is strongly convex, and the ventral margin is nearly flat, with a slight tumid in the middle portion. Apices are subrostrate, acutely rounded and bent towards the ventrum. Axial area is moderate, linear-lanceolate and narrow at the ends. Central area is indistinct from the axial area. Raphe is slightly lateral, extends near the ventral margin; distal raphe endings are deflected to the ventral side, proximal raphe endings with pronounced central pores, deflected towards the dorsum. Stigmata absent. Transapical striae are punctate, radiate throughout the valve, becoming parallel close to the ends, about 8-10 in 10 µm at the valve centre, up to 12 in 10 µm at the ends. Puncta about 17-20 in 10 µm. Length of the valve 36-40 µm, and the breadth 11-13 µm.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Jeziorak Lakes, and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Encyonema distinctum* Lange-Bertalot & Krammer 1997**

(Pl. 105, figs. 7-8)

Ref. Krammer 1997, p. 56, pl. 98, figs. 13-16.

Status of name: accepted taxonomically.

Diagnosis: Valve is dorsiventral, semi-lanceolate, and lunate. The dorsal margin is more convex, and the ventral margin is slightly convex to nearly straight, somewhat with a very slight tumid in the middle. Apices are subrostrate, acutely rounded. Axial area is narrow, linear, and offset ventrally. Central area is missing or small and subrounded. Raphe is excentric, filiform; proximal raphe endings with distinct central pores that are curved dorsally, distal raphe endings are deflected ventrally. Stigmata are absent. Transapical striae are distinctly punctate, nearly parallel at the valve centre, becoming slightly radiate towards the ends, about 11–12 in 10 µm. Puncta about 22-25 in 10 µm. Length of the valve 16-23 µm, and the breadth 5-7 µm.

Ecological preference: Benthic habitats of a slightly alkaline, eutrophic freshwater environment.

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: New record.

***Encyonema elginense* (Krammer) Mann 1990**

Ref. Hustedt 1930, p. 358, fig. 660; Foged 1980, p. 640, pl. 9, fig. 13; Gasse 1986, p. 47, pl. 25, fig. 6 (as *Cymbella turgida*); Krammer & Lange-Bertalot 1986, p. 310, pl. 122, figs. 6-9; pl. 18, fig. 7; Bąk et al. 2012, p. 109, pl. 61; Kulikovskiy et al. 2016, p. 183, pl. 109, figs. 6-8; Bahls et al. 2018, p. 159, pl. 122, figs. 10, 11.

Status of name: accepted taxonomically.

Synonyms: *Cymbella elginensis* Krammer 1980
Cymbella turgida (W. Gregory) 1856
Encyonema turgidum (W. Gregory) Grunow 1875
Cocconema turgidum (W. Gregory) G.S.West 1907

Diagnosis: Valve is lunate, half-lanceolate, with a strongly convex dorsal margin, and nearly straight ventral margin with very slight swelling in the middle portion. Apices are subprotracted to subrostrate, acutely rounded. Axial area is linear, or slightly lanceolate, narrowing near the ends, broadening slightly towards the valve centre. Central area is indistinct, sometimes slightly unilateral, ovate to subrounded. Raphe is straight, moderately lateral, running near the ventrum; proximal raphe endings with pronounced central pores which are deflected slightly toward the dorsum; distal raphe endings are elongate, distinct, curved toward the ventrum and ending with small helictoglossa. Stigmata absent. Transapical striae are punctate, shorter in length along the ventral margin than the dorsum; radiate at the valve centre, about 8-9 in 10 µm on the dorsum, while 11-13 in 10 µm on the ventrum and convergent at the ends of the ventral margin. Length of the valve 43-70 µm, and the breadth 10-14 µm.

Ecological preference: Common in the littoral part of alkaline, stagnant waters with pH values up to 8 (Hustedt 1938); freshwater, epiphytic, pH 'indifferent' or neutral, around 7 (Ehrlich 1973); alkaliphilous, epiphytic (Kaczmarska 1976); limnophilous (Haworth 1976); oligohalobous 'indifferent', alkaliphilous, cosmopolitan (Foged 1980).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: as *Cymbella turgida* Gregory from the Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Encyonema gaeumannii* (Meister) Krammer 1997**

Ref. Meister 1934, p. 88, fig. 3; Krammer & Lange-Bertalot 1986, p. 308, pl. 119, figs. 37-43; Krammer 1997, p. 78, pl. 141, figs. 1-22; pl. 142, figs. 22-23; Bąk et al. 2012, p. 110, pl. 61; Noga et al. 2014 b, p. 17, pl. 2, fig. 5; Kulikovskiy et al. 2016, p. 183, pl. 108, figs. 6-9.

Status of name: accepted taxonomically.

Synonyms: *Cymbella gaeumannii* Meister 1934

Diagnosis: Valves are strongly to moderately dorsiventral, lanceolate-elliptical. The dorsal margin is strongly convex, and the ventral margin is slightly convex to straight. Apices are capitate, distinctly acutely rounded. Axial area close to the ventral margin, narrow, linear to slightly lanceolate. Central area is lacking or slightly expanded dorsally. Raphe is filiform, straight; proximal raphe endings are deflected dorsally, distal raphe endings are slightly curved ventrally. Transapical striae are finely punctate, slightly radiate throughout the valve, nearly parallel at the centre of the ventrum, about 15-18 in 10 µm. Puncta about 38-42 in 10 µm. Length of the valve 14-22 µm, and the breadth 4-5 µm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); Oligotrophic, alkaline freshwater reaction (pH 6.8-8.2) and moderate electrolyte content (Noga et al. 2014 b); oligotrophic and dystrophic water bodies with low mineralization (Kulikovskiy et al. 2016); it is reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014b); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b).

***Encyonema hebridicum* Grunow ex Cleve 1891**

Ref. Hustedt 1930, p. 359, fig. 662; Krammer & Lange-Bertalot 1986, p. 309, pl. 121, figs. 1-9; Bąk et al. 2012, p. 110, pl. 60; Potapova 2014, p. 70, fig. 322; Kulikovskiy et al. 2016, p. 183, pl. 110, figs. 1-4; Bahls et al. 2018, p. 43, pl. 6, fig. 9; p. 67, pl. 30, fig. 18; p. 82, pl. 45, fig. 2; p. 101, pl. 64, fig. 17; p. 159, pl. 122, fig. 8.

Status of name: accepted taxonomically.

Synonyms: *Cymbella hebridica* (Grunow ex Cleve) Cleve 1894

Diagnosis: Valves are moderately dorsiventral with moderately arched dorsal margin, slightly convex to nearly flat ventral margin that has slightly tumid at the centre in larger specimens. Apices are subrostrate, cuneate, narrowly rounded. Axial area is narrow, linear, and somewhat broadening slightly towards the valve centre. Central area is rounded in larger specimens and indistinct in small specimens. Raphe is straight, displaced towards the ventral margin, proximal raphe endings are slightly expanded, deflected dorsally, distal raphe fissures are deflected towards the ventral side. Transapical striae are radiate throughout the valve, slightly convergent at the apices, about 9-11 in 10 μm at the valve centre. Length of the valve 22-74 μm, and the breadth 7-13 μm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); found in mountain oligotrophic waters, with low mineral content, on a silicate substrate. Indicator of very good ecological conditions (Bąk et al. 2012); oligotrophic, neutral, and weakly acidic water bodies (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Poland (Bąk et al. 2012).

***Encyonema lacustre* (Agardh) Mills 1934**

Ref. Hustedt 1930, p. 357, fig. 658; Germain 1981, p. 276, pl. 100, fig. 12 y; Krammer & Lange-Bertalot 1986, p. 312, pl. 124, figs. 1-8; Lange-Bertalot & Metzeltin 1996, p. 294, pl. 88, fig. 7; Krammer 1997, p. 36, pl. 113, figs. 1-14; pl. 114, figs. 1-14; Silva et al. 2013, p. 125, figs. 49-59; Silva & Nogueira 2015, p. 335, figs. 6-10.

Status of name: accepted taxonomically.

Synonyms: *Schizonema lacustre* Agardh 1824
Cymbella lacustris (Agardh) Cleve 1894
Navicula lacustris (Agardh) Schütt 1896

Diagnosis: Valves are slightly dorsiventral, rhomboidal, to linear-elliptical or lanceolate, with slightly convex dorsal and ventral margins. Apices are broadly rounded, not protracted. Axial area is narrow, linear–lanceolate. Central area is slightly rounded to indistinct. Raphe is filiform, straight, distal raphe endings are deflected to the ventral side at an angle of about 130°; proximal raphe endings are slightly expanded and deflected to the dorsal side. Terminal nodules are positioned on the ventral side, central nodule is on the dorsal side. Stigmata absent. Transapical striae are distinctly punctate, radiate throughout the valve, converging close to the ends, abou 7-10 in 10 μm; puncta about 20-25 in 10 μm. Length of the valve 30-65 μm, and the breadth 8-12 μm.

Ecological preference: Fresh-brackish water, alkaliphilous, ά-mesosaprobic, meso- to eutraphentic (Van Dam et al. 1994); the species is tolerant in terms of organic pollutants, occurring up to a critical state (β-α-mesososaprobia), preferring higher electrolyte contents, also in brackish waters (Krammer 1997); distributed in the littoral zone of lakes with calcareous waters, oligo- to eutrophic (Bąk et al. 2012); oligotrophic and mesotrophic water bodies with different levels of mineralization (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema lange-bertalotii* Krammer 1997**

Ref. Krammer 1997, p. 96, pl. 5, figs. 1-16; pl. 6, figs. 2-4; pl. 23, figs. 1- 2; pl. 27, figs. 10-16; pl. 29, fig. 14; Wojtal 2009, p. 198, pl. 12, figs. 4, 5; Kheiri et al. 2018, p. 361, figs.108-111; Li et al. 2007, p. 228, figs. 86-88.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, semi-lanceolate-elliptical with a strongly arched dorsal margin, and slightly convex ventral margin. Apices are curved, subprotracted to subrostrate, acutely rounded, oriented ventrally. Axial area is narrow, linear, widening slightly towards the valve centre. Central area is a slightly wider continuation of the axial area. Raphe is filiform, straight; proximal raphe endings are expanded, terminate in inconspicuous central pores which are deflected dorsally; distal raphe endings are deflected ventrally. Transapical striae are finely punctate, radiate throughout the valve, and very short striae on the ventral side are parallel at the valve centre, then radiate, and finally convergent toward the apices, about 10-12 striae in 10 μm. Puncta about 30-35 in 10 μm. Length of the valve 18-37 μm, and the breadth 7-11 μm.

Ecological preference: Widespread periphytic diatom of temperate zone, α-mesosaprobous and fresh brackish water species, occurring in a broad trophic spectrum (Van Dam et al. 1994); freshwater with pH 8.0, air temperature 20°C, water temperature 16°C (Li et al. 2007); reported from low to moderate water conductivity range between 292 to 569 μS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); the species reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b); Rzeczyca stream and its tributary, western Bieszczady**,** eastern Carpathians, south Poland (Rybak et al. 2019).

***Encyonema leibleinii* (Agardh) Silva, Jahn, Ludwig, & Menezes 2013**

(Pl. 105, figs. 20-22; pl. 106, figs. 1-4)

Ref. Hustedt 1930 a, p. 357, fig. 659; Patrick & Reimer 1975, p. 40, pl. 6, fig. 4; Germain 1981, p. 290, pl. 106, figs. 3-4; Krammer & Lange-Bertalot 1986, p. 312, pl. 123, figs. 7-10; Ehrlich 1995, p. 98, pl. 29, figs. 10-11; Krammer 1997, p.38, pl.115, figs.1-3; pl. 116, figs.1-6; pl. 117, figs. 1-6; pl. 118, figs.1-6; pl. 119, figs.1-6; Wojtal 2009, p. 200, pl. 11, figs. 2–4; Hofmann et al. 2011, p.190, pl.86, figs. 1-4 ; Silva et al. 2013, p. 121, figs. 7-17.

Status of name: accepted taxonomically.

Synonyms: *Gloionema leibleinii* C.Agardh 1830
Monema prostratum Berkeley 1832
Schizonema prostratum (Berkeley) Greville 1833
Encyonema prostratum (Berkeley) Kützing 1844
Cymbella prostrata (Berkeley) Cleve 1894

Diagnosis: Valves are dorsiventral, semi–lanceolate to slightly lanceolate. The dorsal margin is strongly convex, and the ventral margin is straight to slightly convex, sometimes showing slight tumid in the middle part. Apices are rounded, somewhat rostrate and slightly displaced to the ventral side. Axial area is straight and moderately narrow. Central area is distinct, small, and rounded. Raphe is lateral, distal raphe endings are deflected to the ventral side, and do not reach the valve margin; proximal raphe endings are slightly deflected to the dorsal side. Terminal nodule is located on the ventral side, central nodule is located on the dorsal side. Stigmata absent. Transapical striae are punctate, radiate throughout the valve, becoming convergent close to the ends, about 7-10 in 10 μm. Puncta about 16-21 in 10 μm. Length of the valve 38-80 μm, and the breadth 16-20 μm.

Ecological preference: as *Encyonema prostratum*, cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); alkaliphilous, indifferent oligohalobous (Pankow 1976); cosmopolitan diatom, occurring in mesotrophic waters of an elevated and high conductivity (Krammer & Lange-Bertalot 1986); found in many freshwater communities and are most common in lentic systems (Round et al. 1990); an alkaliphilous, β-mesosaprobous, eutraphentic, strictly aquatic and fresh brackish water species (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41

to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); observed in low to moderate water conductivity range between 292 to 569 µS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 128 to 528 µS/cm, temperature 10.0-19.9°C (Noga et al. 2013 a, b, c); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); eutrophic reservoirs and freshwater (Kulikovskiy et al. 2016).

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: The species was distributed in the Wyżyna Krakowsko- Częstochowska Upland. Pond in Krakow (Kukucz 1937); Vistula River (Turoboyski 1962; Kyselowa & Kysela 1966); Sanka stream (Kądziołka 1963; Hojda 1971); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); as *Encyonema prostratum* very common in Poland (Siemińska & Wołowski 2003); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); as *Cymbella prostrata* in the pond of the Botanical Garden in Kraków (Wołowski & Kowalska 2009); in epipelon of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Wisłok river , Zalew Rzeszowski, San (near Jarosław), Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, western Bieszczady**,** eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdańsk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema lunatum* (W. Smith) Van Heurck 1880**

Ref. Krammer 1997, p. 150, pl. 83, figs. 8-12; Li et al. 2007, p. 229, figs. 93-94; Żelazna-Wieczorek & Knysak 2017, p. 329, fig. 7: 26; Kulikovskiy et al. 2016, p. 184, pl. 110, figs. 39-42; Bahls et al. 2018, p. 127, pl. 90, figs. 12-18; p. 159, pl. 122, figs. 2-4.

Status of name: accepted taxonomically.

Synonyms: *Cymbella lunata* W.Smith 1855
Cymbella gracilis f. *lunata* (W.Smith) Østrup 1910
Encyonema ventricosum var. *lunatum* (W.Smith) Mayer 1947
Cymbella gracilis var. *lunata* (W.Smith) A.Cleve 1955
Cymbella ventricosa var. *lunata* (W.Smith) Woodhead & Tweed 1960

Diagnosis: Valves are lunate, or crescent-shaped shaped with a moderately arched dorsal margin, and a slightly concave ventral margin. Apices are acutely rounded, not protracted. Axial area is narrow, linear. Central area is small and asymmetric, formed by a slight shortening of the median dorsal stria. Raphe is filiform, straight; proximal raphe endings are deflected to the dorsal side and terminate in inconspicuous central pores; distal raphe fissures are long and curved ventrally. Transapical striae are punctate, radiate on the dorsal side and more widely spaced at the valve centre than near the apices; striae are shorter on the ventral side and more or less parallel throughout, about 8-10 in 10 µm, increasing to 14-16 in 10 µm near the apices. Puncta about 37-40 in 10 µm. Length of the valve 30-48 µm, and the breadth 5-7 µm.

Ecological preference: reported from wetlands have circumneutral pH, low conductivity, and low concentrations of bioavailable nutrients (Krammer 1997); freshwater with pH 8.0, air temperature 20°C,

water temperature 16°C (Li et al. 2007); neutral oligotrophic water bodies with low salinity (Kulikovskiy et al. 2016); it is reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Encyonema mesianum* (Cholnoky) Mann 1990**

(Pl. 105, figs. 9-10)

Ref. Cholnoky 1955, p. 160, figs. 11, 12; Krammer & Lange-Bertalot 1986, p. 304, pl. 118, figs. 1-8; Novelo et al. 2007, p. 62, pl. 14, fig. 2.

Status of name: accepted taxonomically.

Synonyms: *Cymbella mesiana* Cholnoky 1955

Diagnosis: Valves are strongly dorsiventral, half-lanceolate, with a strongly arched dorsal margin, slightly convex ventral margin with a tumid middle portion. Apices are not protracted and acutely rounded. Axial area is narrow, linear, straight or slightly lanceolate. Central area is not distinguishable, or small, subrounded. Raphe is in ventral position, moderately lateral; distal raphe fissures are long and distinct, curved ventrally on the mantle; proximal raphe endings are deflected to the dorsal side and terminate by distinct central pores; A single stigma is sited on the dorsal side, close to the raphe fissures. Transapical striae are punctate, slightly radiate throughout the valve, parallel at the ends, shorter on the ventral side, about 10-11 in 10 µm at the centre of the dorsum, and 10-13 in 10 µm at the centre of the ventrum. Puncta about 18-20 in 10 µm. Length of the valve 35-64 µm, and the breadth 9.5-13 µm.

Ecological preference: This species is reported as *Cymbella mesiana* Cholnoky, that is considered as temperate in Nordic, mountainous regions with some records in Tropical America, alkaliphilous, present in karstic substrata and oligohalobous (Cantoral 1997; Krammer & Lange-Bertalot 1986; Novelo et al. 2007); fresh-brackish water, alkaliphilous species (Van Dam et al. 1994); reported from stream water with specific conductance was generally low (20-250 µS/cm), and water pH was alkaline (7.3-8.4) (Zalat & Al-Wosabi 2011).

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Encyonema minutum* (Hilse) Mann 1990**

(Pl. 105, figs. 11-13)

Ref. Hustedt 1930, p. 359, fig. 661; Patrick & Reimer 1975, p. 47, pl. 8, figs. 1 a- 4 b; Foged 1978, p. 50, pl. 37, figs. 6-8; Germain 1981, p. 292, pl. 107, figs. 11-22; pl. 160, figs. 2-3; John 1983, p. 145, pl. 60, figs. 8-9; Krammer & Lange-Bertalot 1986, p. 305, pl. 119, figs.1-13; pl. 16, fig 4; Laws 1988, p. 159, pl. 27, fig. 14; Lange-Bertalot & Metzeltin 1996, p. 234, pl. 58, fig. 15; pl. 105, fig. 8; Metzeltin & Witkowski 1996, p. 60, pl. 14, figs. 10-11; Krammer 1997, p. 53, pl. 6, figs. 19-27; pl. 24, figs. 5, 6; pl. 25, figs. 1-19; Wojtal 2009, p. 200, pl. 12, figs. 6, 7; pl. 71, figs. 5, 6, 8; Hofmann et al. 2011, p. 188, pl.87, figs. 33-40; Noga et al. 2013 c, p. 139, fig. 3: 4; Bahls et al. 2018, p. 43, pl. 6, fig. 11; p. 82, pl. 45, fig. 4.

Status of name: accepted taxonomically.

Synonyms: *Cymbella minuta* Hilse 1862
Cymbella gracilis var. *minuta* (Hilse) Rabenhorst 1864
Encyonema ventricosum f. *minuta* (Hilse) Grunow 1880
Encyonema ventricosum var. *minuta* (Hilse) Schmidt 1881
Cymbella ventricosa f. *minuta* (Hilse) Mereschkowsky 1906
Cymbella ventricosa f. *minuta* (Hilse) Mayer 1913
Cymbella ventricosa f. *minuta* (Hilse) A.Cleve 1932
Encyonema ventricosum var. *minutum* (Hilse) Mayer 1947
Cymbella ventricosa var. *minuta* (Hilse) A.Cleve 1955

Diagnosis: Valves are dorsiventral, lunate; half-elliptical to half-lanceolate. The dorsal margin is strongly convex, and the ventral margin is slightly concave to flat or slightly convex with slight tumid in the middle portion. Apices are subprotracted to subrostrate, acutely rounded, and shifted toward the ventrum. Axial area is very narrow, linear, becoming slightly wider at the valve centre. Central area is indistinct. Raphe extends near the ventral margin, lateral, distal raphe endings are half-circular shaped, strongly deflected toward the ventrum; proximal raphe endings with distinct central pores, which are deflected toward the dorsum. Transapical striae are slightly parallel at the centre, radiate towards the ends, very much shorter on the ventral side than the dorsum, about 9-11 in 10 μm in the middle portion of the valve, 13-15 in 10 μm at the ends. Length of the valve 7-32 μm, and the breadth 4-7 μm.

Ecological preference: The species occurred in freshwater habitat of low to medium conductivity and alkalinity, with pH values 7.2-7.5, in unpolluted to slightly polluted waters; it is also found in slightly brackish water, epipelic, periphytic (Lowe 1974); cosmopolitan, oligotraphentic, occurring in waters of moderate conductivity, (Krammer & Lange- Bertalot 1986); very common in the temperate zone in oligotrophic waters with moderate conductivity, especially in periphyton (Krammer 1997); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater with pH had an alkaline character or close to circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, c); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 μS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b); occurs in non-disturbed habitats (oligo- to mesotrophic conditions) with a medium electrolyte content (Messyasz & Treska 2019).

Occurrence: Common in Młynek Lake, and frequent in Radomno and Kamionka Lakes.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland, Kluczwoda stream (Nawrat 1993); in the high mountain lakes under the stress of acidification, Tatra Mts, southern Poland (Kawecka & Galas 2003); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); in periphyton of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); as *Cymbella minuta* from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province in south-east Poland (Stanek-Tarkowska & Noga 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Wisłok river , Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, and Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema neogracile* Krammer 1997**

(Pl. 105, figs. 14-15)

Ref. Krammer 1997, p. 177, pl. 82, figs. 1-3; pl. 82, figs. 1-13; pl. 83, figs. 7-10; pl. 86, figs. 9-12; pl. 90, fig. 6; pl. 91, figs. 1, 2; Kihara et al. 2015, p. 22, fig. 60; Kulikovskiy et al. 2016, p. 186, pl. 109, figs. 23-26; Bahls et al. 2018, p. 67, pl. 30, figs. 19-22; p. 82, pl. 45, fig. 1; p. 127, pl. 90, fig. 21.

Status of name: accepted taxonomically.

Synonym: *Encyonopsis neogracile* Krammer 2012

Diagnosis: Valves are dorsiventral, cymbelloid, semi-lanceolate with moderately arched dorsal margin, and weakly convex to nearly flat ventral margin with a slightly tumid at valve centre. Apices are narrowly rounded, rostrate, sometimes slightly protracted. Axial area is narrow, linear. Central area is slightly wider than the axial area, small, rounded, and extended on the dorsal side or indistinct. Raphe is lateral, narrowing near the proximal and distal ends. Proximal raphe endings are expanded, deflected dorsally, and terminate in inconspicuous central pores. Distal raphe endings are long and curved ventrally. Transapical striae are finely punctate, on the dorsal side are radiate and more widely spaced at the valve centre than near the apices. The median dorsal stria has a single isolated areola near the central area. Striae on the ventral side are shorter, parallel to slightly radiate near the valve centre, becoming convergent near the apices, about 12-15 in 10 µm. Puncta about 28-30 in 10 µm. Length of the valve 20-50 µm, and the breadth 5.0-7.0 µm.

Ecological preference: freshwater with pH 5.0-8.5, air temperature 16-30°C, water temperature 11-25°C (Li et al. 2007); locally abundant in oligotrophic waters, with low content of electrolytes, acidic to circumneutral, in streams and lakes in mountainous positions, indicator of very good ecological quality (Bąk et al. 2012); it is reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); an indicator of oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); oligotrophic water bodies with a low level of mineralization (Kulikovskiy et al. 2016).

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: Found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015).

***Encyonema neomesianum* Krammer 1997**

(Pl. 105, figs. 16-17)

Ref. Cholnoky 1958, p. 112, pl. 2, figs. 49, 50; Patrick & Reimer 1975, p. 50, pl. 9, fig. 1a-2b; Krammer 1997, p. 5, pl. 191, figs. 7-9; Lee 2011, p. 34, fig. 9 B, C.

Status of name: uncertain and requires further investigation.

Synonyms: *Cymbella minuta* var. *pseudogracilis* (Cholnoky) Reimer 1975

Encyonema minutum var. *pseudogracilis* (Cholnoky) Czarnecki 1994

Cymbella turgida var. *pseudogracilis* Cholnoky 1958

Diagnosis: Valves are strongly dorsiventral, half-lanceolate with a strongly arched dorsal margin, and weakly convex to slightly flat ventral margin with a tumid valve centre. Apices are narrow, rounded to slightly apiculate. Axial area is narrow near the apices and gradually widens toward the mid-valve. Central area is absent or slightly wider than the axial area. Raphe is lateral, becoming filiform near the proximal and distal ends. Proximal raphe endings are unilaterally deflected toward the dorsal margin, with weakly inflated pores. Distal raphe endings are comma-shaped and ventrally deflected. Terminal nodules are visible. Transapical striae are coarsely punctate, radiate throughout the valve, and convergent near the apices on the ventrum, about 7-10 in 10 µm. Puncta 21-24 in 10 µm. Length of the valve 30-70 µm, and the breadth 9-12 µm.

Ecological preference: Reported from weakly acidic freshwater habitats (Cholnoky 1958).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Encyonema norvegicum* (Grunow) Mayer 1947**

Ref. Hustedt 1930, p. 359, fig. 664; Mayer 1947, p. 231, pl. 3, figs. 8-10; Potapova et al. 2014, p. 108, fig. 57; Hartley et al. 1996, p. 156, pl. 70, fig. 9; Bahls et al. 2018, p. 173, pl. 6, fig. 10; pl. 64, figs. 1-6; pl. 122, fig. 9; Reavie 2023, p. 36, fig. 18: O.

Status of name: accepted taxonomically.

Synonym: *Cymbella norvegica* Grunow 1875

Diagnosis: Valves are moderately dorsiventral, semi-lunate, linear-lanceolate. The dorsal margin is moderately arched, and the ventral margin is sublinear with slightly tumid or slightly concave at the valve centre, giving the margin a slightly triundulate or biundulate appearance. Apices are moderately rounded, not protracted. Axial area is narrow, linear. Central area is asymmetric, slightly or moderately rounded. Raphe is slightly lateral, dorsally displaced. Proximal raphe endings are strongly curved dorsally with dilated small central pores; distal raphe endings are deflected ventrally and terminated in a small helictoglossae. Transapical striae are slightly radiate at valve centre and becoming parallel, to slightly convergent near the apices, striae on the dorsal side about 12-13 in 10 µm at the centre, 14-15 at the ends; on the ventral side striae about 13-15 in 10 µm at the centre, 15-17 at the ends. Length of the valve 25.0-43.0 µm, and the breadth 7.0-8.0 µm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994).

Occurrence: infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Encyonema obscuriforme* Krammer 1997**

(Pl. 105, figs. 18-19)

Ref. Krammer 1997, p. 172, pl. 30, figs. 11-15; pl. 31, figs 1- 2; Kulikovskiy et al. 2016, p. 187, pl. 110, figs. 16-20.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral with a strongly arched dorsal margin, and slightly convex ventral margin, sometimes with a slight swelling at the valve centre. Apices are rostrate to subcapitate, oriented laterally such that the junction between the dorsal margin and the apex is concave. Axial area is narrow, linear. Central area is a slightly wider continuation of the axial area. Raphe is filiform, straight. Proximal raphe endings are deflected dorsally and terminated with slightly inflated central pores. Distal raphe fissures are deflected ventrally. Transapical striae are distinctly punctate on the dorsum, slightly radiate at the centre, and more radiate at the ends. Striae are very short on the ventral side, radiate in the middle part, then parallel, and finally convergent at the apices, about 10-12 in 10 µm. Puncta about 22-26 in 10 µm. Length of the valve 17-37 µm, and the breadth. 8-9.5 µm.

Ecological preference: Oligotrophic water bodies (Kulikovskiy et al. 2016); found in shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Encyonema perpusillum* (Cleve) Mann 1990**

Ref. Hustedt 1930, p. 361, fig. 666; Schoeman 1973, p. 62, pl. 1, fig. 29; Germain 1981, p. 286, pl. 105, fig. 7; Krammer & Lange-Bertalot 1986, p. 306, pl. 119, figs. 22-28; Lange-Bertalot & Metzeltin 1996, p. 236, pl. 59, figs. 22-23; Krammer 1997, p. 29, pl. 110, figs. 1-16; pl. 111, figs. 1-8; Bąk et al. 2012, p. 112, pl. 61; Bahls & Luna 2018, pl. 17, fig. 23; Bahls et al. 2018, p. 67, pl. 30, figs. 1-5.

Status of name: accepted taxonomically.

Synonym: *Cymbella perpusilla* A.Cleve 1895

Diagnosis: Valves are weak to moderately dorsiventral, linear-lanceolate with moderately convex dorsal and slightly convex ventral margins. Apices are subprotracted, rostrate, and acutely rounded. Axial area is narrow, linear. Central area is small, rounded or indistinct. Raphe is straight, filiform; proximal raphe endings are dorsally deflected with small central pores; distal raphe fissures are deflected towards the ventral side. Transapical striae are punctate, parallel to slightly radiate throughout the valve, convergent at the apices, about 10-13 in 10 µm at the valve centre, becoming 14-16 in 10 µm at the ends. Puncta 38-45 in 10 µm. length of the valve 12-30 µm, and the breadth 3-5 µm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); the species characteristic of oligotrophic, often acidic waters, silicate with low electrolyte content, in the mountains and lowlands, indicator of very good ecological quality (Bąk et al. 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et

al. 2014 a); reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm-1 (Pociecha et al. 2020); shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Wisłok river and Pielnica, Stobnica, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al., 2015); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, southern Poland (Pociecha, 2020); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema reichardtii* (Krammer) Mann 1990**

Ref. Krammer 1985, p. 32, pl. 5, figs. 16-25; Krammer & Lange-Bertalot 1986, p. 307, pl. 119, figs. 32-36; Round et al. 1990, p. 667; Krammer 1997, p. 9, pl. 103, figs. 1-24; Hofmann et al. 2011 p.191, pl. 87, figs. 23-29; Bąk et al. 2012, p. 113, pl. 61; Potapova 2014, p. 70, fig. 340; Solak et al. 2016, p. 956, fig. 23; Kulikovskiy et al. 2016, p. 187, pl. 110, figs. 29-34.

Status of name: accepted taxonomically.

Synonym: *Cymbella reichardtii* Krammer 1985

Diagnosis: Valves are small, cymbelloid, moderately dorsiventral. The dorsal margin is semi-elliptic, and the ventral margin varies from slightly concave to flat or convex. Apices are subprotracted and rounded. Axial area is narrow, linear. Central area is asymmetrical, small, rectangular or acute-angled, extending almost to the valve margin on the ventral side. Raphe is straight, filiform. Proximal raphe endings are inflated, dorsally deflected; distal raphe endings are strongly recurved to the ventral margin. Transapical striae are parallel dorsally, parallel or slightly radiate ventrally, convergent at the apices, about 18-20 in 10 µm. Central striae are somewhat irregular, wider spaced, curved and radiate and lower in density, characteristically with a gap between the ventral central striae. Length of the valve 8-13 µm, and the breadth 3-4 µm.

Ecological preference: The species observed in various flowing and stagnant waters, occurring from mountainous areas to lowlands, in numerous localities. Found in waters contain calcium and represent a wide range of fertility, and predominantly in meso- to eutrophic (Bąk et al. 2012); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); found in acidic water (4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); eutrophic and mesotrophic water bodies, with increased calcium content (Kulikovskiy et al. 2016); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b); shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: springs of Lódz Hills, central Poland (Zelazna-Wieczorek 2011); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok river, and Łubienka, Stobnica, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south eastern Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Encyonema silesiacum* (Bleisch) Mann 1990**

(Pl. 106, figs. 5-7)

Ref. Krammer & Lange-Bertalot 1986, p. 304, pl. 117, figs. 1-24; Ehrlich 1995, p. 99, pl. 30, figs. 9-11; Lange-Bertalot & Metzeltin 1996, pl. 70, fig. 21; pl. 88, figs. 11-13; pl. 107, figs. 9-11; Metzeltin & Witkowski 1996, p. 60, pl. 14, figs. 3-6; Krammer 1997, p. 72, pl. 4, figs. 1-18; pl. 7, figs. 1-2, 6-19; pl. 9, figs. 1-8; pl. 13, fig. 13; pl. 16, figs. 1-11; pl. 17, figs. 5-8; pl. 18, figs. 1-4; pl. 24, figs. 1-4; Wojtal 2009, p. 200, pl. 12, figs. 1-3; pl. 71, fig. 4; Hofmann et al. 2011, p.192, pl.87, figs. 11-17; Bahls et al. 2018, p. 66, pl. 29, figs. 1-6; p. 101, pl. 64, fig. 19; p. 159, pl. 122, figs. 15-17.

Status of name: accepted taxonomically.

Synonyms: *Cymbella silesiaca* Bleisch 1864

Cymbella ventricosa var. *silesiaca* (Bleisch) A.Cleve 1955

Cymbella minuta var. *silesiaca* (Bleisch) Reimer 1975

Diagnosis: Valves are dorsiventral, crescent-shaped, halfelliptical to halflanceolate. The dorsal margin is strongly arched, and the ventral margin is straight to very slightly concave and slightly swollen middle portion. Apices are acutely rounded, somewhat subprotracted, inclined toward the ventrum. Axial area is linear, narrow, sometimes slightly lanceolate, and located closer to the ventral side. Central area is absent or indistinct. Raphe is straight, lateral, running near the ventrum; distal raphe endings are curved toward the ventral margin; proximal raphe endings with distinct central pores, which are slightly inflated and deflected dorsally. A single stigma lies at the end of the median dorsal stria. Transapical striae are punctate, radiate throughout the dorsum and middle part of the ventrum, slightly convergent at the ends of the ventral side, about 10-11 in 10 µm on the middle portion of the dorsum and 9 in 10 µm on the ventrum to 1215 in 10 µm at the ends. Puncta 28-32 in 10 µm. Length of the valve 14-45 µm, and the breadth 5.5-10 µm.

Ecological preference: Freshwater, meso to eutrophic lakes (CleveEuler 1955); oligohalobous ʻindifferent', mesoeuryhaline, benthonic (Pankow 1976); Cosmopolitan diatom, occurring in a wide trophic range, and tolerating up to α-mesosaprobic waters, found in standing and flowing, oligo to eutrophic water (Krammer & LangeBertalot 1986); a neutrophilous, α-mesosaprobous, strictly aquatic, fresh brackish water species occurring in a wide trophic range from oligo to eutrophic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); the species was observed commonly in eutrophic freshwater habitat of low to medium conductivity and alkalinity with pH values 6.9-7.5, in unpolluted to moderately polluted waters, also found in slightly brackish water (Zalat & Servant-Vildary 2005); freshwater with pH had an alkaline character or close to circumneutral reaction (6.5-8.4), electrolytic conductivity ranged from 128 µS/c, to 528 µS/cm, temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 a, b, c); freshwater characterized by an acidic reaction (4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); mainly in the mountains, oligotrophic and mesotrophic water bodies with a low or moderate level of mineral (Hofmann et al. 2011; Kulikovskiy et al. 2016); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9); conductivity ranged between 412 and 892 µS cm-1 (Pociecha et al. 2020).

Occurrence: Frequent in Młynek, Radomno, Kamionka and Jeziorak Lakes.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland, Kluczwoda stream (Nawrat 1993); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); dominant in limnocrenic spring- Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); in periphyton of Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake

District, north-east Poland (Zębek et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (San (near Jarosław), Gołębiówka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Ryjak, Wielopolka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, and Terebowiec stream, south-eastern part of the Bieszczady National Park, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River, south Poland (Pociecha, 2020); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonema silesiacum* var. *altense* Krammer 1997**

(Pl. 106, figs. 8-12)

Ref. Krammer 1997, p. 163, pl. 9, figs. 9-19; pl. 17, figs. 1-4; Li et al. 2007, p. 231, figs. 108-109.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, with a strongly convex dorsal margin and weakly convex ventral margin, often with a tumid at the valve centre. Apices are acutely or bluntly rounded, not protracted. Axial area is narrow, linear. Central area is irregular in shape, small, and somewhat subrounded. Raphe is weakly lateral, curved with the axial area. Proximal raphe endings are slightly inflated and deflected dorsally. Distal raphe endings are curved toward the ventral margin. A single stigma lies at the proximal end of the middle dorsal stria. Transapical striae are finely punctate, radiate throughout the valve, becoming convergent toward the apices, about 10-13 in 10 µm. Puncta about 28-32 in 10 µm. Length of the valve 14-35 µm, and the breadth 7-8.5 µm.

Ecological preference: Freshwater with pH 6.5-8.5, air temperature 13.5-27°C, water temperature 7-20°C (Li et al. 2007).

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: New record.

***Encyonema silesiacum* var. *lata* Krammer 1997**

(Pl. 106, figs. 13-14)

Ref. Krammer 1997, p. 164, pl. 12, figs. 6-9, 11-14; pl. 10, figs. 9-13.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, half-lanceolate. The dorsal valve margin is strongly convex, and the ventral valve margin is weakly convex to almost straight with a slight tumid centre. Apices are acutely rounded, subprotracted, and deflected slightly to the ventral side. Axial area is narrow, linear, and slightly expanding towards the valve centre. Central area is slightly expanded toward the dorsum, subrounded to subovate, and somewhat indistinct from the axial area. Raphe is lightly lateral; proximal raphe endings with small central pores that deflected dorsally; distal raphe endings are curved toward the ventral margin. A single stigmata lies at the proximal end of the middle dorsal stria. Transapical striae are punctate, radiate on the dorsal margin, radiate near the valve centre of the ventral margin, becoming convergent toward the apices, about 8-9 in 10 µm. Length of the valve 25-46 µm, and the breadth 7-9 µm.

Ecological preference: Reported from shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Encyonema subelginense* Krammer 1997**

(Pl. 106, figs. 15-18)

Ref. Krammer 1997, p. 173, pl. 62, figs. 2-8; Jacques 2018, p. 169, pl. 11, figs. 9-13.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, Semi-lanceolate, with broadly convex dorsal margin, and straight or weakly convex ventral margin with slightly swollen in the median region. Apices are acutely rounded, subprotracted. Axial area is narrow, linear, and slightly expanded towards the valve centre. Central area is indistinct, somewhat slightly expanded dorsally. Raphe is eccentric, narrow, and filiform. Proximal raphe endings with small central pores that are deflected dorsally. Distal raphe endings are curved as a comma shape toward the ventral margin. Stigmata are present. Transapical striae are distinctly punctate-lineolate, strongly radiate on the dorsal margin, radiate near the valve centre of the ventrum, becoming convergent toward the apices, about 10-13 in 10 μm on the dorsum. Puncta 24-26 in 10 μm. Length of the valve 26-45 μm, and the breadth 9-13 μm.

Ecological preference: Found in shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: New record.

***Encyonema ventricosum* (Agardh) Grunow 1875**

(Pl. 106, figs. 19-20)

Ref. Hustedt 1930, p. 359, fig. 661; Krammer 1997, p. 98, pl 6, figs. 8-18; pl. 7, figs. 3-5; pl. 23, figs. 3-5; pl. 26, figs. 29-31; Wojtal 2009, p. 202, pl. 12, figs. 8, 9, 12; Hofmann et al. 2011, p.192, pl.87, figs.18-22; Bąk et al. 2012, p. 114, pl. 61; Noga et al. 2013 c, p. 25, fig. 25; Solak et al. 2016, p. 956, fig. 26; Bahls & Luna 2018, pl. 17, figs. 1-6; Bahls et al. 2018, p. 43, pl. 6, figs. 12, 22-26; p. 101, pl. 64, fig. 8; p. 127, pl. 90, fig. 11; p. 159, pl. 122, fig. 14.

Status of name: accepted taxonomically.

Synonyms: *Frustulia ventricosa* Agardh 1827
Cymbella ventricosa (Agardh) C.Agardh 1830
Cymbophora ventricosa (Agardh) Brébisson 1838
Cocconema ventricosum (Agardh) Hassall 1845

Diagnosis: Valves are dorsiventral, cymbelloid, semi-lanceolate with a strongly convex dorsal margin, and very slightly convex to nearly flat ventral margin that has slightly tumid in the centre. Apices are acutely rounded, slightly produced, rostrate, and ventrally deflected. Axial area is narrow, straight. Central area is small or not differentiated from the axial area. Raphe appears slightly curved, displaced ventrally. Proximal raphe endings with expanded, central pores that slightly deflected dorsally. Distal raphe endings are short, curved to hook-shaped, deflected ventrally near the apices. Transapical striae are dorsally slightly radiate, ventrally radiate in the valve centre, becoming parallel towards the apices, about 12-14 in 10 μm. Length of the valve 12-28 μm, and the breadth 4.5-6.5 μm.

Ecological preference: Cosmopolitan, halobien indifferent, pH: indifferent (Foged 1959); cosmopolitan diatom of temperate and boreal zones (Krammer 1997); low to moderate water conductivity range between 292 to 569 μS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); one of the most common species dominant in eutrophic waters, also in organically polluted waters to (weakly) α-mesosaprobic with medium electrolyte content (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 a, b, c); reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015); observed in acidic water (4.1-5.3) and the lowest pH values (Stanek--Tarkowska et al., 2015); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 μS cm-1 (Pociecha, 2020).

Occurrence: Common in Radomno and Jeziorak Lake, frequent in Młynek and Kamionka, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. *Cymbella ventricosa* was reported from the fish pond in Mydlniki (Starmach 1939); the Vistula River (Turoboyski 1962; Kyselowa & Kysela 1966; Pudo 1970b; Uherkovich 1970); Młynowka stream (Gumiński1947); Prądnik River (Stępień 1963); Sanka stream (Kądziołka 1963; Hojda1971); Pilica River (Kadłubowska 1964 b); spring of Szklarka stream (Skalska 1966a); springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Biała Przemsza River (Wasylik 1985); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); in periphytic and metaphytic sample from Kobylanka stream 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); dominant in the Wisłok River, Duszatyńskie Lakes (Western Bieszczady Mts.), Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, and Baryczka stream left bank tributary of the River San south-eastern Poland (Noga et al. 2013 a, b, c, d); Baryczka, Żołynianka and Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-eastern Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Encyonema ventricosum* var. *angustum* Krammer 1997**

(Pl. 106, figs. 21-24)

Ref. Krammer 1997, p. 170, pl. 6, figs. 5-7; Bahls & Luna 2018, pl. 17, figs. 7-9; Jacques 2018, p. 168, pl. 10, fig. 56

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, cymbelloid, semi-lanceolate with more convex dorsal margin, and very slightly convex to nearly straight ventral margin. Apices are rostrate, acutely rounded, and ventrally deflected. Axial area is very narrow, linear. Central area is lacking. Raphe is slightly curved, displaced ventrally; proximal raphe endings with small central pores that deflected slightly dorsally; distal raphe endings are short, hook-shaped, and ventrally deflected. Transapical striae are dorsally slightly radiate to subparallel at the centre of the dorsum, slightly radiate towards the ends; ventrally slightly radiate in the middle of the valve, becoming parallel towards the apices, about 13-15 in 10 µm. Length of the valve 16-27 µm and the breadth 4-6 µm.

Ecological preference: Reported from shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka Lake.

Distribution in Poland: New record.

***Encyonema vulgare* Krammer 1997**

Ref. Krammer 1997, p. 167, pl. 36, figs. 4-10; pl. 38, figs. 1-5, 9-10; pl. 39, figs. 1-5; pl. 42, figs. 1-5; pl. 50, figs. 1-8; Vouilloud et al. 2010, p. 52, figs. 21-26; Bąk et al. 2012, p. 115, pl. 60; Kihara et al. 2015, p. 22, fig. 62; Kulikovskiy et al. 2016, p. 188, pl. 108, fig. 10; Bahls et al. 2018, p. 66, pl. 29, fig. 9; p. 127, pl. 90, figs. 22-24.

Status of name: accepted taxonomically.

Diagnosis: Valves are strongly dorsiventral, asymmetric, cymbelloid, semi-lanceolate. The dorsal margin is strongly convex, and the ventral margin is weakly convex to nearly straight with a slight tumid at the centre. Apices are acutely rounded, subrostrate, not protracted. Axial area is narrow, linear, and slightly expanded to

the valve centre. Central area is lacking, continuous with the axial area. Raphe is slightly lateral; proximal raphe ends are inflated, deflected to the dorsal side; distal raphe endings are hooked to the ventral margin. One dorsal stigma is present at the proximal end of the middle dorsal stria. Transapical striae are uniseriate, punctate-lineolate, slightly radiate throughout the valve, and central striae are more distant. Ventral striae are radiate near the valve centre, becoming convergent toward the apices. About 8-11 dorsal striae in 10µm, 9-12 ventral striae in 10 µm. Puncta about 30-35 in 10µm. Length of the valve 28-54µm, and the breadth 7.5-13 µm.

Ecological preference: the species was observed in plankton samples of a lake with pH 6-6.6, conductivity of 84-99µScm-1, Secchi depth of 30-50cm and a temperature of 29.5-32ºC (Vouilloud et al. 2010); from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); in acidic water (pH 4.1-5.3) and the lowest pH values (Stanek-Tarkowska et al. 2015); Reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Baryczka, Żołynianka and Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Fallow soil in Pogórska Wola near Tarnów, south Poland (Stanek-Tarkowska et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019);

Genus *Encyonopsis* Krammer 1997

Diagnosis: Valves are naviculoid and slightly dorsiventral, symmetric to the transapical axis and asymmetric to the apical axis. Valves are linear, lanceolate or elliptic. Apices are acutely rounded or rostrate capitate. Raphe is scarcely eccentric, moderately wide, becoming gradually filiform near the proximal and distal ends. Proximal raphe ends are deflected toward the dorsal margin. Distal raphe fissures are deflected ventrally. Transapical striae are uniseriate, radiate near the valve centre and radiate or parallel near the apices. Areolae in the striae are round or oblong and oriented with their long axes parallel to the transapical axis. Stigmata and apical pore fields are absent.

This genus differs from the morphologically related genus *Encyonema* Kützing mainly by its slightly dorsiventral valve outline and by terminal raphe fissures only slightly bent to the ventral margin (Krammer 1997; Potapova 2014).

Holotype species: *Encyonopsis cesatii* (Rabenhorst) Krammer 1997

***Encyonopsis cesatii* (Rabenh.) Krammer 1997**

(Pl. 106, fig. 25)

Ref. Hustedt 1930, p. 351, fig. 638; Patrick & Reimer 1975, p. 21, pl. 3, fig. 2; Krammer & Lange-Bertalot 1986, p. 325, pl. 134, figs. 4-13; Lange-Bertalot & Metzeltin 1996, p. 242, pl. 62, figs. 1-4; pl. 94, figs. 1-2; Krammer 1997, p. 152, pl. 182, figs. 1-13; pl. 183, figs. 10-12; pl. 185, figs. 1-7, 11-13; Novelo et al. 2007, p. 64, pl. 14, fig. 5; Delgado et al. 2013, p. 97, figs. 103-104; p. 99, figs. 155-158; Noga et al. 2013 c, p. 139, fig. 3: 13; Bahls & Luna 2018, pl. 19, figs. 33-37; Bahls et al. 2018, p. 49, pl. 12, fig. 4; p. 67, pl. 30, figs. 6-11, 13; p. 128, pl. 91, figs. 18-21; p. 160, pl. 123, figs. 25-30.

Status of name: accepted taxonomically.

Synonyms: *Navicula cesatii* Rabenhorst 1853
Cymbella cesatii (Rabenhorst) Grunow 1881
Cymbella cesatii var. *paradoxa* Geitler 1975

Diagnosis: Valves are naviculoid, slightly asymmetric, narrowly lanceolate, dorsal and ventral margins slightly convex. Apices are subrostrate to capitate, acute to bluntly rounded and deflected weakly toward the ventral side. Axial area is narrow, linear, and slightly curved. Central area is small and asymmetric, rounded, sometimes inconspicuous, formed by 1-3 shortened striae on the ventral side. Raphe is weakly lateral. Proximal

raphe endings are slightly expanded central pores that deflect toward the dorsal side. Distal raphe endings are comma-shaped, curved toward the ventral side. Transapical striae are finely punctate, radiate throughout the valve, about 18-22 in 10 μm at the valve centre, 24-26 in 10 μm near the ends. Length of the valve 20-48 μm, and the breadth 4.0-7.0 μm.

Ecological preference: Cosmopolitan, halobien indifferent (halophilous), pH: indifferent (Foged 1959); this species is considered as temperate with some records in America, circumneutral, and oligohalobous indifferent, commonly reported as *Cymbella cesatii* (Rabenhorst) Grunow in neutral to acidic pH (Hustedt 1930; Foged 1984; Patrick & Reimer 1975; Krammer & Lange-Bertalot 1986); freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); optimum distribution in oligotrophic and mesotrophic waters, lakes rich in calcium, less often in flowing waters, in the mountains, rarely observed in silicate waters, an indicator of very good water quality (Bąk et al. 2012); Circumneutral mainly occurring at pH about 7 (Szulc & Szulc 2012); freshwater with pH had an alkaline character to circumneutral 6.6-8.3, low to high conductivity (128-764 μSx cm^{-1}), temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 a, c); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7–7.9), conductivity ranged between 412 and 892 μS cm^{-1} (Pociecha et al. 2020).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, c); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River south Poland (Pociecha et al. 2020); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonopsis descripta* (Hustedt) Krammer 1997**

Ref. Hustedt 1943, p. 170, fig. 25; Krammer & Lange-Bertalot 1986, p. 327, pl. 135, figs. 1-5; Bahls & Luna 2018, pl. 19, figs. 20-22; Kulikovskiy et al. 2016, p. 194, pl. 111, fig. 41; Bahls et al. 2018, p. 160, pl. 123, figs. 10-12.

Status of name: accepted taxonomically.

Synonyms: *Navicula descripta* Hustedt 1943

Cymbella descripta (Hustedt) Krammer et Lange-Bert. 1985

Diagnosis: Valves are slightly dorsiventral, narrow linear-elliptic or linear-lanceolate. Apices are capitate, acutely rounded. Axial area is narrow, linear, and sited along the valve midline. Central area is relatively large, round, and nearly symmetric. Raphe is weakly lateral, becoming filiform near the proximal and distal ends. Proximal raphe endings are weakly expanded and deflected dorsally. Distal raphe endings are curved towards the ventral side. Transapical striae are radiate throughout the valve, about 18-20 in 10 μm at the valve centre, 20-22 in 10 μm near the apices. Length of the valve 15-33 μm, and the breadth 4-6.5 μm.

Ecological preference: Freshwater, circumneutral to slightly alkaline with pH ranges from 7.0 to 8.2 and specific conductance from 64 to 250 μS/cm; oligotrophic, oxygen-rich and cool waters (Krammer & Lange-Bertalot 1986); freshwater, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); oligotrophic water bodies with low mineralization (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Encyonopsis falaisensis* (Grunow) Krammer 1997**

Ref. Krammer & Lange-Bertalot 1986, p. 326, pl. 134, figs. 14-22; Reichardt 1994, p. 125, figs. 18-21; Lange-Bertalot & Metzeltin 1996, p. 242, pl. 62, figs. 9-10; pl. 94, figs. 6-9; Krammer 1997, p. 116, pl. 161, figs. 1-7; pl. 162, figs. 8-24, 27; pl. 163, figs. 1-5; pl. 164, figs. 1-13, 22-23; Bąk et al. 2012, p. 116, pl. 61; Bahls et al. 2018, p. 160, pl. 123, figs. 3-5; Bahls & Luna 2018, pl. 19, figs. 30-32; Rybak et al. 2019, pl. 3, fig. 9.

Status of name: accepted taxonomically.

Synonyms: *Navicula falaisensis* Grunow 1880
Cymbella falaisensis (Grunow) Krammer & Lange-Bertalot 1985
Navicula iniqua Krasske 1932
Cymbella diavola J.R.Carter 1972

Diagnosis: Valves are naviculoid, narrow lanceolate to linear-lanceolate and nearly symmetric concerning the apical axis. The ventral margin is sometimes more convex than the dorsal. Apices are short and subrostrate, bluntly to acutely rounded. Axial area is very narrow, linear. Central area is elliptical to rounded, moderately large, and somewhat asymmetric. Raphe is moderately lateral. Proximal raphe endings with central pores that are deflected toward the dorsal side. Distal raphe endings are hooked toward the ventral side. Transapical striae are radiate throughout the valve, about 16-18 in 10 µm at the valve centre, 19-22 in 10 µm near the apices. Length of the valve 18-36 µm, and the breadth 4.6-6.0 µm.

Ecological preference: freshwaters tend to be cold, somewhat alkaline, and with low to moderate levels of dissolved solids, common in oligotrophic waters of northern Europe and in the mountains of middle Europe (Krammer & Lange-Bertalot 1986); freshwater, high oxygen requirements, oligosaprobic, oligo-mesotraphentic (Van Dam et al. 1994); in oligotrophic waters with low to medium electrolyte content, it is distributed on limestone and silicate substrates, in the littoral zone of mountain lakes, and an indicator of very good water quality (Bąk et al. 2012); it is reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3 °C (Noga et al. 2016 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, Western Bieszczady, eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Encyonopsis krammeri* Reichardt 1997**

Ref. Krammer 1997, p. 99, pl 144, figs. 12-15, 21; pl. 145, figs. 1-14, 16-18; Reichardt 1997, p. 61, figs. 1-20; Delgado et al. 2013, p. 97, figs. 118-123; p. 99, figs. 145, 146, 159, 161; Kulikovskiy et al. 2016, p. 194, pl. 111, figs. 7-14.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderately dorsiventral, narrowly lanceolate to linear-lanceolate. The dorsal margin is arched, and the ventral margin is straight or weakly convex. Apices are rostrate to subcapitate, deflected slightly ventrally. Axial area is very narrow, linear. Central area is very small and continuous with the axial area. Raphe is filiform, located more or less in the centre of the valve, straight to slightly bi-arcuate in the central section of the valve; proximal raphe endings are unexpanded and slightly dorsally deflected; distal raphe fissures are curved toward the ventral margin. Transapical striae are delicate, parallel to slightly radiate, barely visible at the apices, about 25-30 in 10 µm. Length of the valve 13-20 µm, and the breadth 3-4.5 µm.

Ecological preference: It is reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016b).

***Encyonopsis lanceola* (Grunow) Krammer 1997**

Ref. Patric & Reimer 1966, p. 528, pl. 50, fig. 13; Krammer 1997, p. 118, pl. 161, fig. 2; pl. 162, figs. 1-7; pl. 163, figs. 6-8; Reichardt 2011, p. 9, tab.1, figs. 16-19, 64.

Status of name: accepted taxonomically.

Synonyms: *Navicula falaisensis* var. *lanceola* Grunow 1880
Cymbella falaisensis var. *lanceola* (Grunow) Aysel 2005

Diagnosis: Valves are slightly dorsiventral, linear, elliptical-lanceolate with weakly convex dorsal and ventral margins. Apices are narrow, rostrate, subcapitate and acutely rounded, bent weakly towards the ventral. Axial area is very narrow and linear. Central area is small, irregular in shape, somewhat rounded to ovate. Raphe is filiform, slightly lateral; proximal raphe endings are not expanded and deflected dorsally; distal raphe endings are curved ventrally. Transapical striae are very finely punctate, slightly radiate throughout the valve, about 22-26 in 10 µm. Length of the valve 20-32 µm, and the breadth 4-5 µm.

Ecological preference: Reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Encyonopsis microcephala* (Grunow) Krammer 1997**

(Pl. 106, figs. 26-29)

Ref. Hustedt 1930, p. 351, fig. 637; Foged 1959, p.73, pl. 8, figs. 14, 17, 18; Patrick & Reimer 1975, p. 33, pl. 4, figs. 12 a- 13 b; Foged 1980, p. 639, pl. 9, fig. 18; Germain 1981, p. 274, pl. 99, figs. 27-30; Gasse 1986, p. 44, pl. 27, figs. 16, 17; Krammer & Lange-Bertalot 1986, p. 327, pl. 134, figs. 23-32; Lange-Bertalot & Metzeltin 1996, p. 274, pl. 78, fig. 24; pl. 91, figs. 15-16; pl. 107, figs. 16-17; Krammer 1997, p. 91, pl. 143, figs. 1, 4, 5, 8-26; pl. 146, figs. 1-5; pl. 147, figs. 1-3; pl. 148, figs. 4, 7; pl. 149, figs. 1-8; pl. 150, fig. 22; pl. 203, figs. 13-18; Wojtal 2009, p. 202, pl. 8, figs. 15–16; pl. 71, fig. 7; Hofmann et al. 2011, p.197, pl. 89, figs. 35-39; Noga et al. 2013 c, p. 139, pl. 3, fig. 14; p. 141, pl. 4, fig. 2.

Status of name: accepted taxonomically.

Synonyms: *Cymbella microcephala* Grunow 1885
Cocconema microcephalum (Grunow) West 1912
Cymbella microcephala f. *major* Grunow 1880
Cymbella microcephala var. *major* (Grunow) A.Cleve 1932

Diagnosis: Valves are naviculoid, very slightly dorsiventral, slightly asymmetrical to the apical axis; linear to elliptic-lanceolate, with weakly convex margins. Apices are capitate, subprotracted, and acutely rounded. Axial area is very narrow, linear. Central area is indistinct. Raphe is straight to moderately lateral, slightly eccentric; proximal raphe endings with closely spaced central pores; distal raphe endings are short, comma-shaped, and turned toward the ventral side. Transapical striae are delicate, slightly radiate in the middle to parallel at the ends, about 23-25 striae in 10 µm. Length of the valve 13-30 µm, and the breadth 3-4 µm.

Ecological preference: Cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); indifferent to pH or neutral, epiphytic (Ehrlich 1973); it tends to appear more commonly in well-aerated habitats, and tolerant of some chloride (Patrick & Reimer 1975); oligohalobous "indifferent", alkaliphilous (Foged 1980); this species is reported as *Cymbella microcephala* Grunow and it considered as cosmopolitan but frequent in mountainous regions, alkaliphilous, present in karstic substrata, and oligohalobous indifferent (Patrick & Reimer 1975; Foged 1984; Gasse 1986; Krammer & Lange-Bertalot 1986; Cantoral 1997); an alkaliphilous, oligosaprobous, meso-eutraphentic, high oxygen requirements, and fresh brackish water species (Van Dam et al. 1994); in calcium-rich waters with average conductivity, in Central Europe (Krammer 1997); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); epiphytic diatoms in shallow water body, very slightly alkaline, meso-eutrophic and oxygen-saturated (Toporowska et al. 2008); widespread and frequent, optimum in still waters, but also found in flowing waters, from electrolyte-poor, weakly acidic to calcium-rich waters with medium electrolytes when they are oligosaprobic; in addition, it is tolerant of trophies, in oligo- to moderately eutrophic waters (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 128 µS/cm to 528 µS/cm, temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013a, b, c).

Occurrence: Common in Jeziorak and Radomno Lakes and the Eemian paleolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland from Sanka stream as *Cymbella microcephala* (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Skomielno in Łęczyńsko-Włodawskie Lakeland, east Poland (Toporowska et al. 2008); periphytic samples in Kobylanka stream, 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San; Duszatyńskie Lakes (Western Bieszczady Mts.); dominant in the Wisłok River; south-east Poland (Noga et al. 2013 a, b, c, d); Wisłok river , San (near Jarosław), Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wisłoka (near Dębica), and Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters (the southern Baltic Sea) (Plinski & Witkowski 2020).

***Encyonopsis minuta* Krammer & Reichardt 1997**

(Pl. 106, fig. 30)

Ref. Krammer 1997, p. 195, pl. 143, figs. 2, 3, 6, 7; pl. 143a, figs. 1-27; pl. 145, fig. 15; pl. 148, figs. 4-7; pl. 149, fig. 17; Delgado et al. 2013, p. 97, figs. 112-117, 124-129; p. 99, figs. 160, 163-164; Noga et al. 2014 b, p. 16, pl.1, figs. 4-5, 19; Kulikovskiy et al. 2016, p. 195, pl. 111, figs. 29-37; Bahls & Luna 2018, pl. 19, figs. 17-19.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly dorsiventral, lanceolate, with slightly convex dorsal and ventral margins. Apices are acutely rounded, rostrate in smaller specimens, to capitate in larger specimens and deflected slightly ventrally. Axial area is very narrow, linear, scarcely wider than the raphe. Central area is lacking. Raphe is filiform, bent with the convex side of the bow towards the ventral margin. Proximal raphe endings are not or only slightly expanded. Distal raphe endings are hooked ventrally. Transapical striae are slightly radiate throughout, becoming parallel near the apices, about 24-27 in 10 µm. Length of the valve 11-14 µm, and the breadth 3.0-3.7 µm.

Ecological preference: Fresh-brackish water, circumneutral (Van Dam et al. 1994); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm^{-1}), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 $mg/^{-1}$ (Noga et al. 2013 c); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 µS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016b); reported from the benthic habitat of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts.), south east Poland (Noga et al. 2013 c); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Encyonopsis naviculacea* (Grunow) Krammer 1997**

Ref. Hartley et al. 1996, p. 156, pl. 70, fig. 7; Krammer 1997, p. 430, pl. 190, fig. 11; Bahls et al. 2018, p. 80, pl. 43, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Cymbella naviculacea* Grunow 1881

Cymbella incerta var. *naviculacea* (Grunow) Cleve 1894

Cymbella scotica var. *naviculacea* (Grunow ex Cleve) R. Ross 1947

Diagnosis: Valves are naviculoid, lanceolate, with weakly convex margins, symmetric concerning the apical axis. Apices are acutely rounded, not protracted. Axial area is moderately wide, and narrow at the ends, widening abruptly towards the valve centre. Central area is a wider extension of the axial area, subrounded, about one-half valve width; axial and central areas together form a lanceolate space. Raphe is straight and lateral, becoming filiform towards proximal and distal ends; proximal raphe endings are weakly expanded, deflected slightly towards the ventral side; distal raphe endings are comma-shaped, deflected to the dorsal margin. Transapical striae are finely punctate, subparallel to slightly radiate at the centre, more radiate towards the ends, about 14-16 in 10 μm at the valve centre, 18-20 in 10 μm at the apices. Puncta 25-28 in 10 μm. Length of the valve 32-48 μm, and the breadth 8.0-11.5 μm.

Ecological preference: Freshwater, high oxygen requirements, oligosaprobic, tolerating small concentrations of organically bound nitrogen (Van Dam et al. 1994).

Distribution in Poland: as *Cymbella naviculacea* Grunow from Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012).

***Encyonopsis subminuta* Krammer & Reichardt 1997**

(Pl. 106, fig. 31)

Ref. Krammer 1997, p. 195, pl. 143 a, figs. 30-33; pl. 144, figs. 1-11, 16-17; pl. 149, figs. 9-16; pl. 150, figs. 15-21; Delgado et al. 2013, p. 97, fig. 105; p. 99, figs. 142-144; Noga et al. 2014 b, p. 16, pl. 1, figs. 3, 20; Kulikovskiy et al. 2016, p. 195, pl. 111, figs. 21-28; Bahls et al. 2018, p. 43, pl. 6, fig. 20; p. 67, pl. 30, fig. 12; Bahls & Luna 2018, pl. 19, figs. 12-16; Rybak et al. 2019, pl. 3, fig. 11.

Status of name: accepted taxonomically.

Diagnosis: Valves are naviculoid, lanceolate, with slightly convex dorsal and ventral margins, and slightly asymmetrical to the apical axis. Apices are subprotracted, relatively narrow, rounded, subcapitate to rostrate. Axial area is very narrow, linear. Central area is absent. Raphe is slightly arched, filiform; proximal raphe endings with external small central pores dilated slightly; distal raphe endings are deflected dorsally. Transapical striae are parallel to slightly radiate at the centre, more radiate towards the ends, about 23-27 in 10 μm. Length of the valve 10-15 μm, and the breadth 3-4 μm.

Ecological preference: This taxon is regarded as a cosmopolitan taxon, occurring in the temperate and boreal zones. It is most abundant in oligo- to mesotrophic waters with electrolytic conductivity between 190-250 μS L-1 (Krammer 1997; Noga et al. 2014; Novais et al. 2014); common species in oligo- and mesotrophic environments, rare in electrolyte-poor environments (Bertolli et al. 2010, Lange-Bertalot et al. 2017); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); it occurs mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm-1), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018); the species may be sensitive to the concentration of Fe ions; the optimal pH is close to 7 (Olszyński et al. 2019).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 c); Wisłok River in the Podkarpacie Province, south Poland (Noga et al. 2014 a); San River on the San Valley Landscape Park area, and the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2014 b; Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); the Wołosaty and Terebowiec streams, San, Wisłoka rivers, and their tributaries, south-east Poland (Noga et al. 2018)**;** Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, south-east Poland (Peszek et al. 2021).

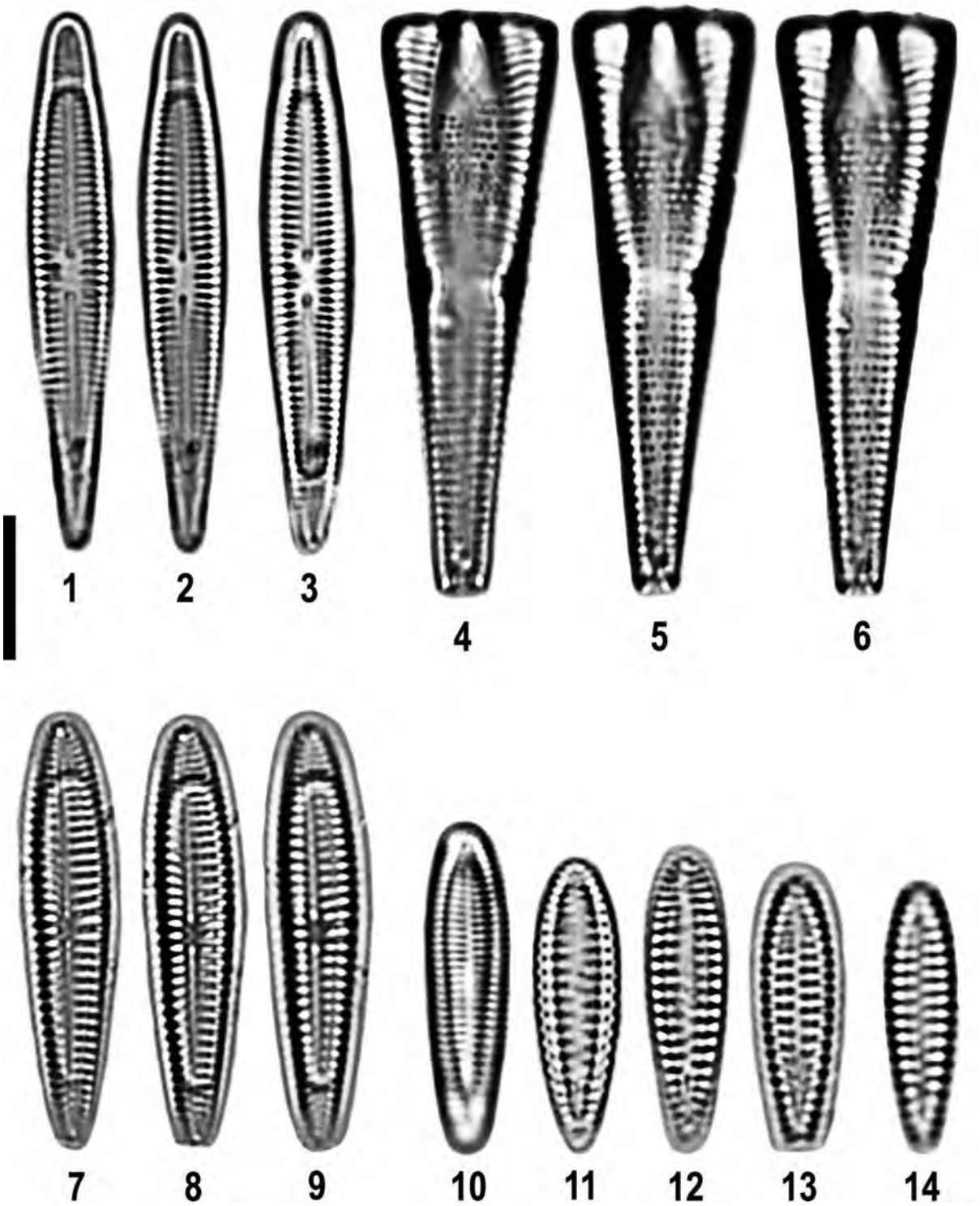


Plate 35: 1-14. *Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot 1980, 1-3. Młynek Lake; 4-14. Radomno Lake. Scale bar = 10 µm.

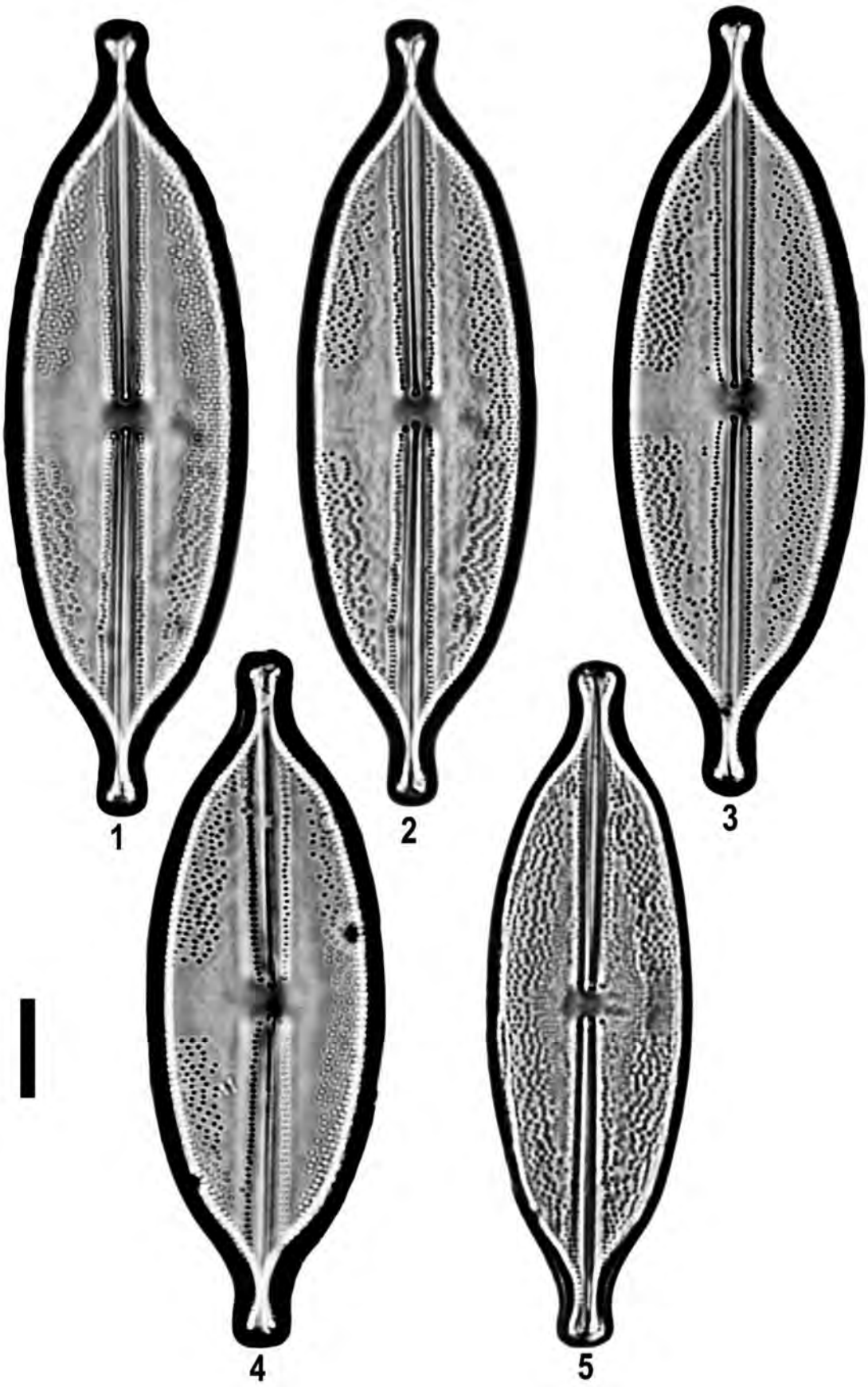


Plate 36: 1-5. *Anomoeoneis sphaerophora* (Ehrenberg) Pfitzer 1871, Radomno Lake. Scale bar = 10 μm.

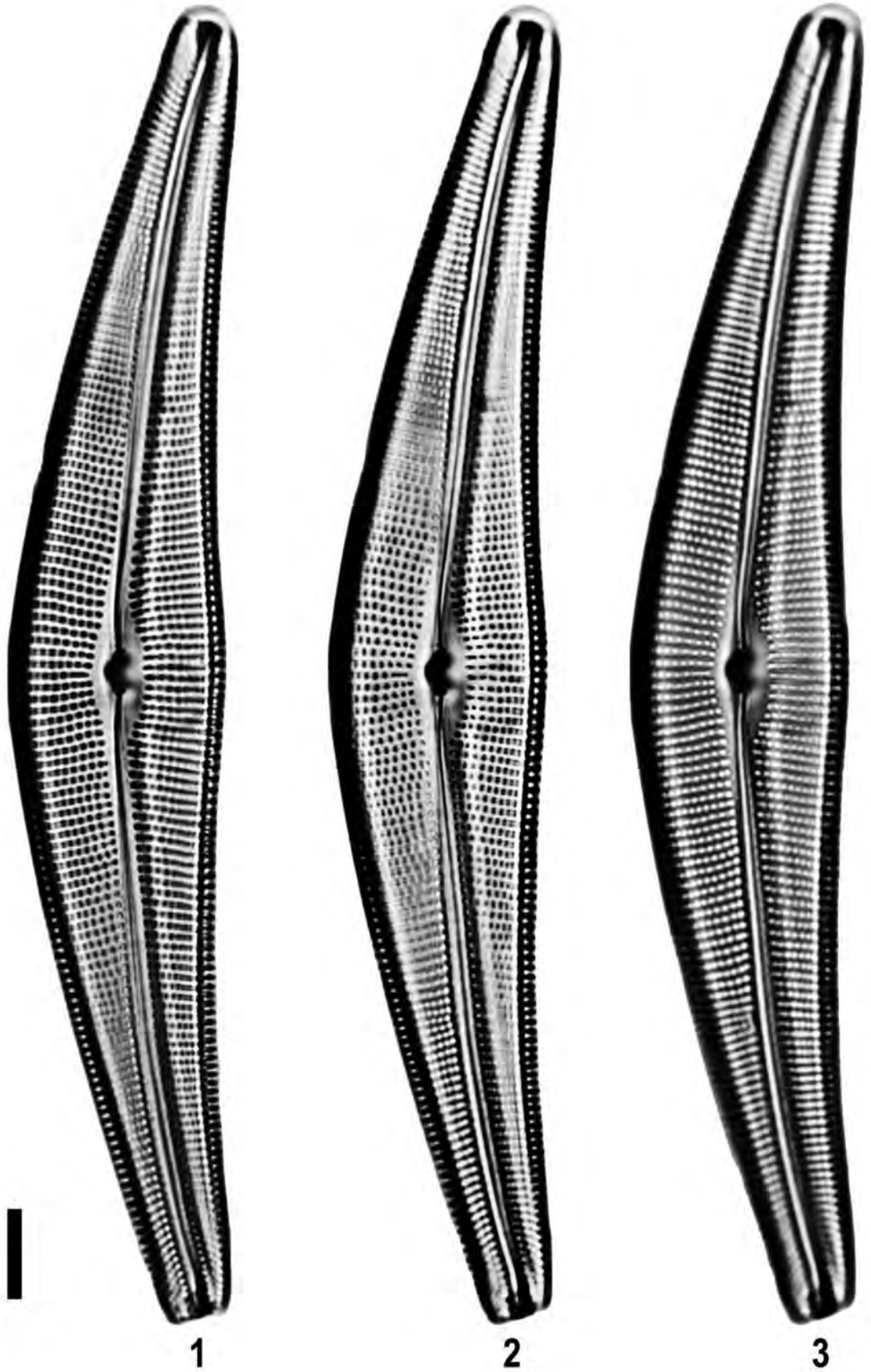


Plate 37: 1-3. *Brebissonia lanceolata* (Agardh) Mahoney & Reimer 1986, Radomno Lake. Scale bar = 10 µm.

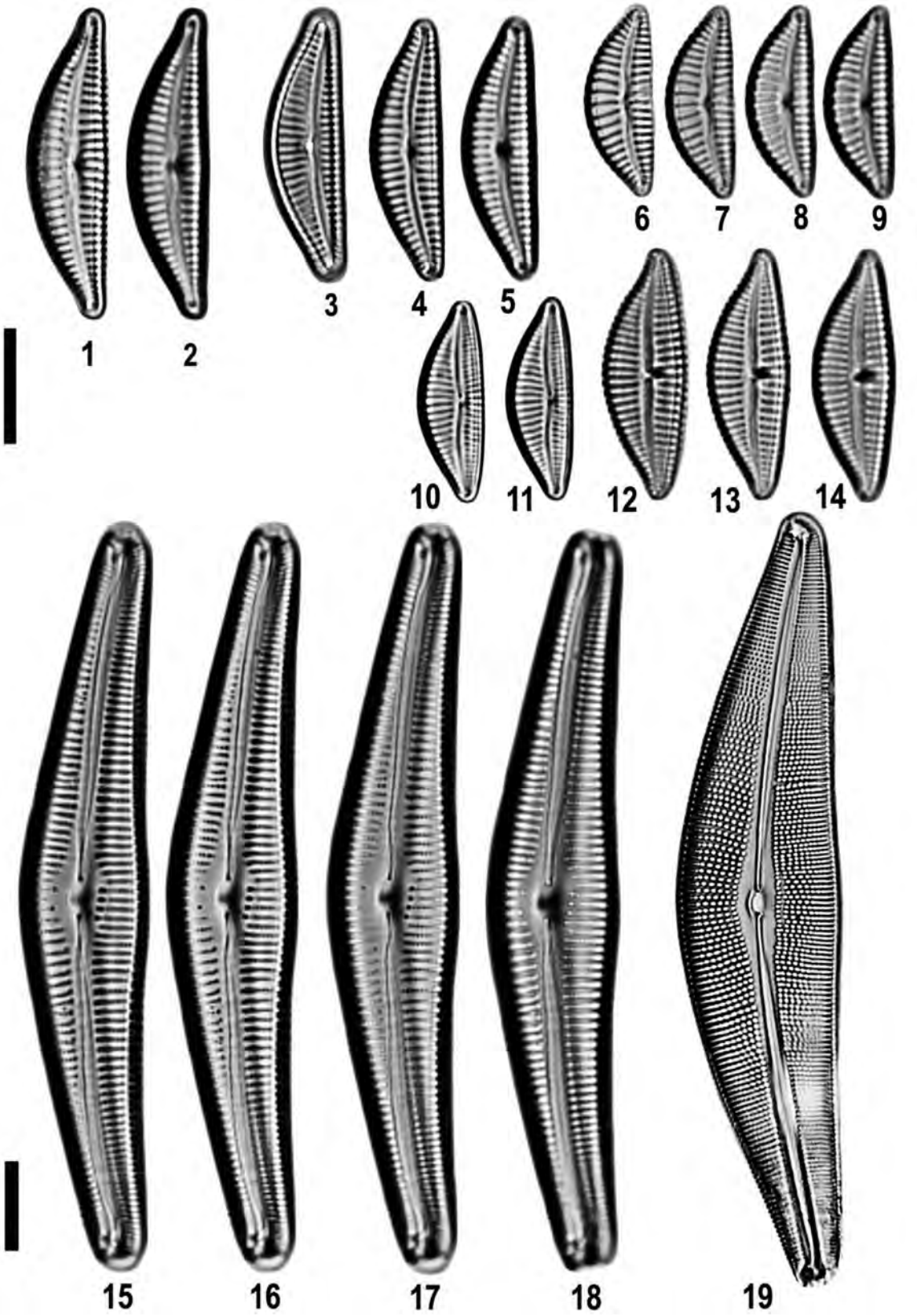


Plate 38: 1-2. *Cymbella affiniformis* Krammer 2002, Jeziorak Lake; 3-5. *Cymbella affinis* Kützing 1844, Radomno Lake; 6-9. *Cymbella affinis* var. *neoprocera* Silva 2015, Jeziorak Lake; 10-14. *Cymbella affinis* var. *subcapitata* (Krammer) Silva 2015, 10-11. Eemian palaeolake deposits of central Poland; 12-14. Radomno Lake; 15-18. *Cymbella asiatica* Metzeltin, Lange-Bertalot & Li 2009, Radomno Lake; 19. *Cymbella aspera* (Ehrenberg) Cleve 1894, Młynek Lake. Scale bar = 10 µm.

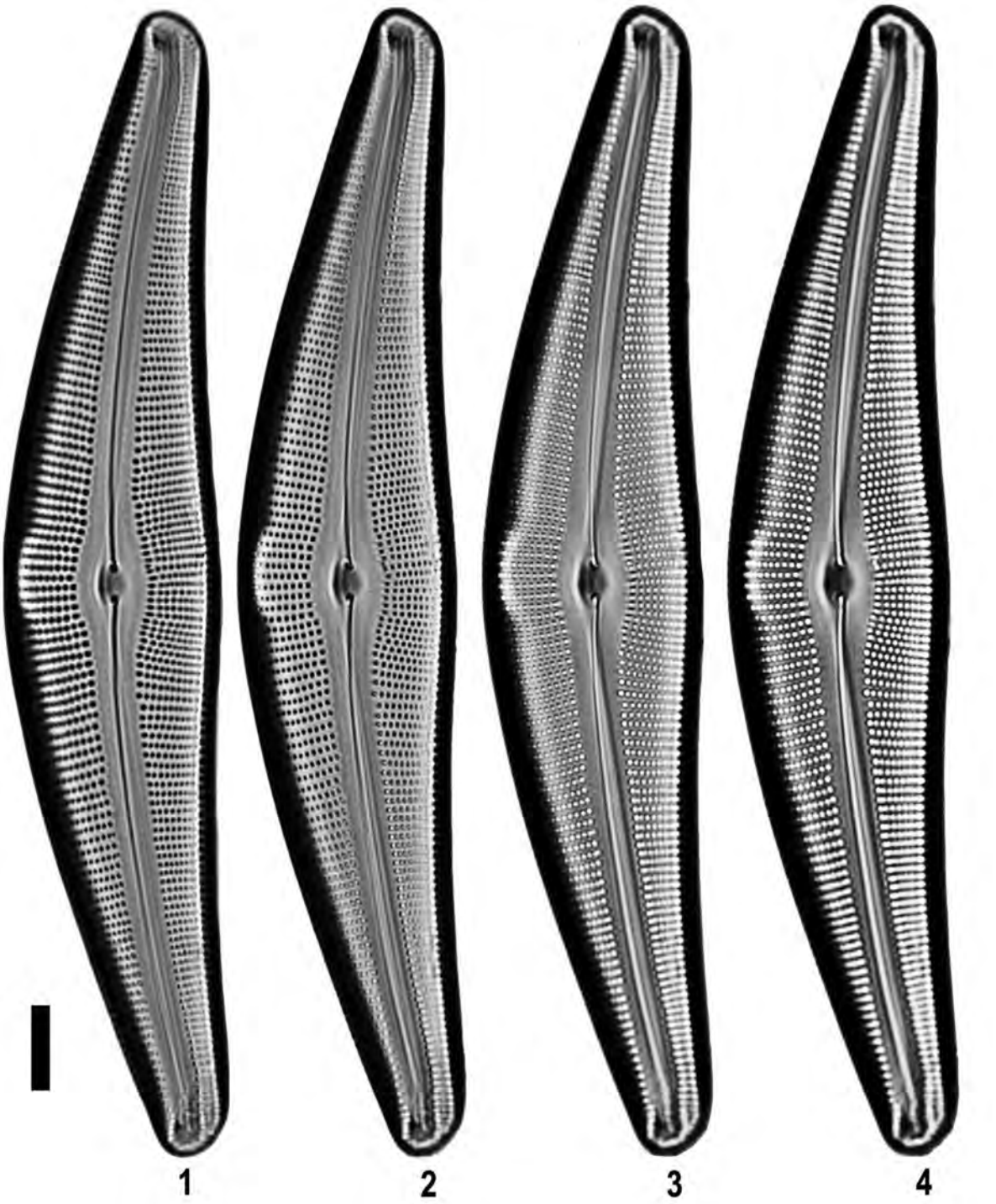


Plate 39: 1-4. *Cymbella aspera* (Ehrenberg) Cleve 1894, Radomno Lake. Scale bar = 10 µm.

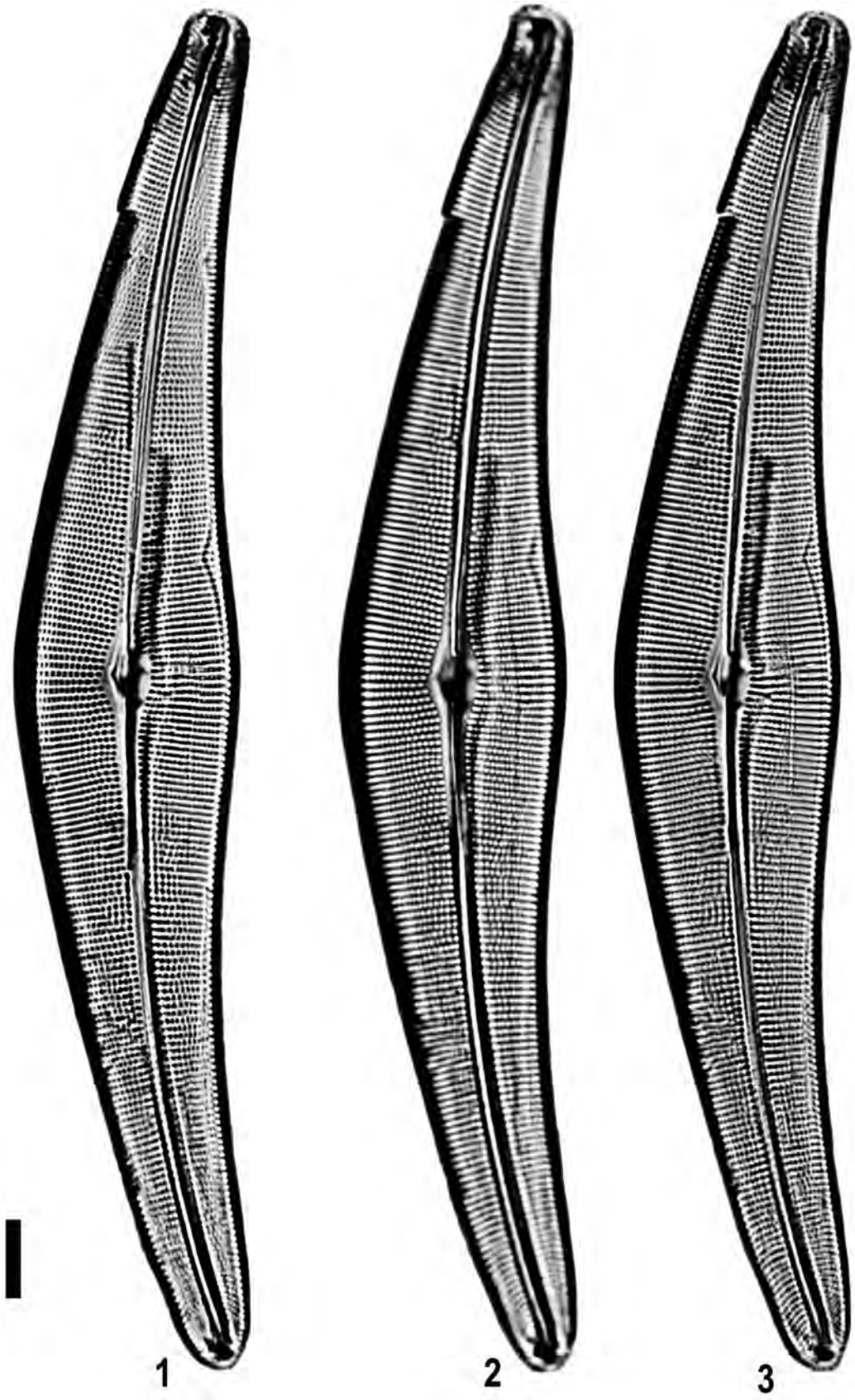


Plate 40: 1-3. *Cymbella aspera* var. *elongata* Skvortzov 1928**,** Młynek Lake. Scale bar = 10 µm.

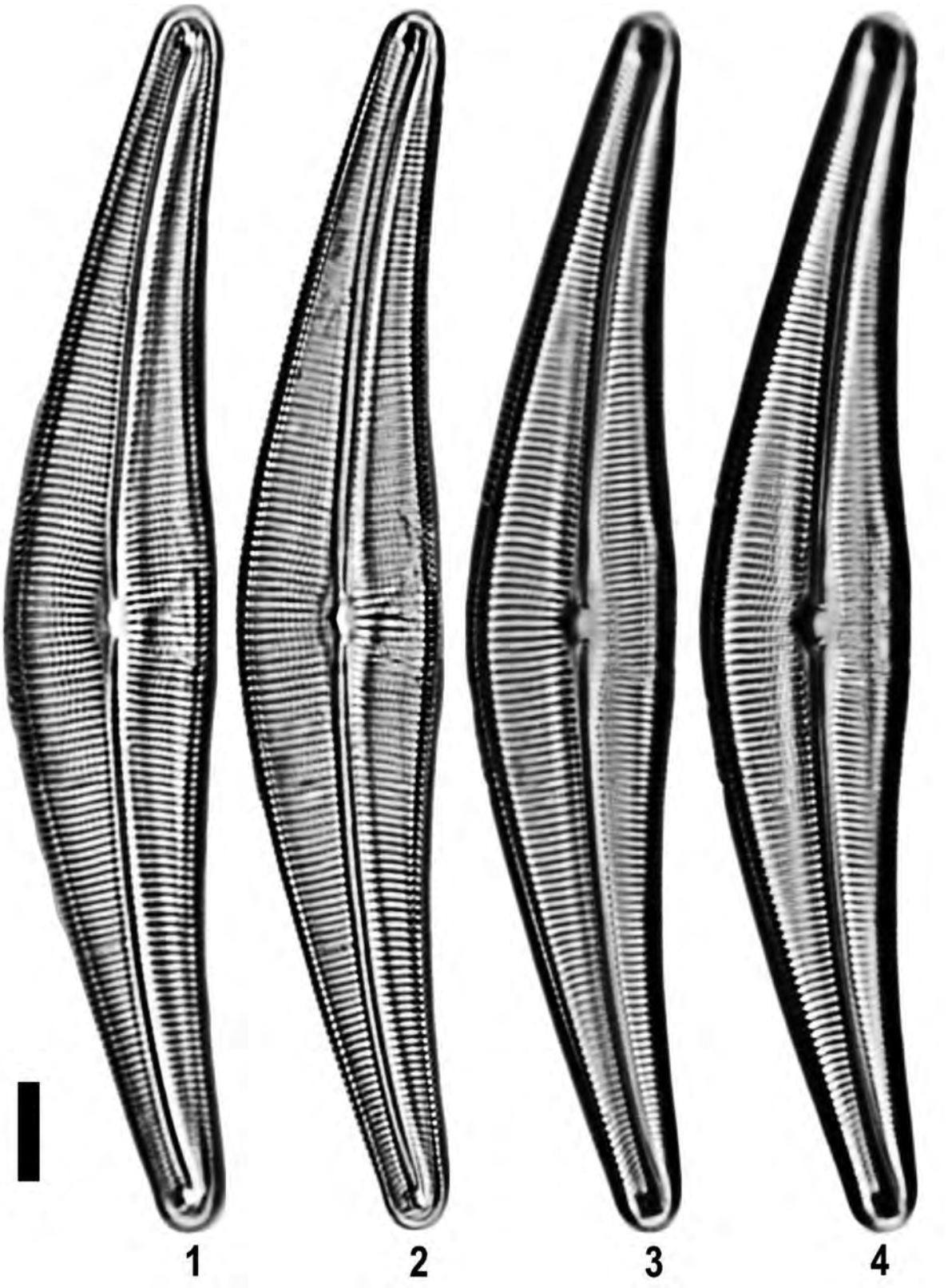


Plate 41: 1-4. *Cymbella aspera* var. *elongata* Skvortzov 1928, Radomno Lake. Scale bar = 10 µm.

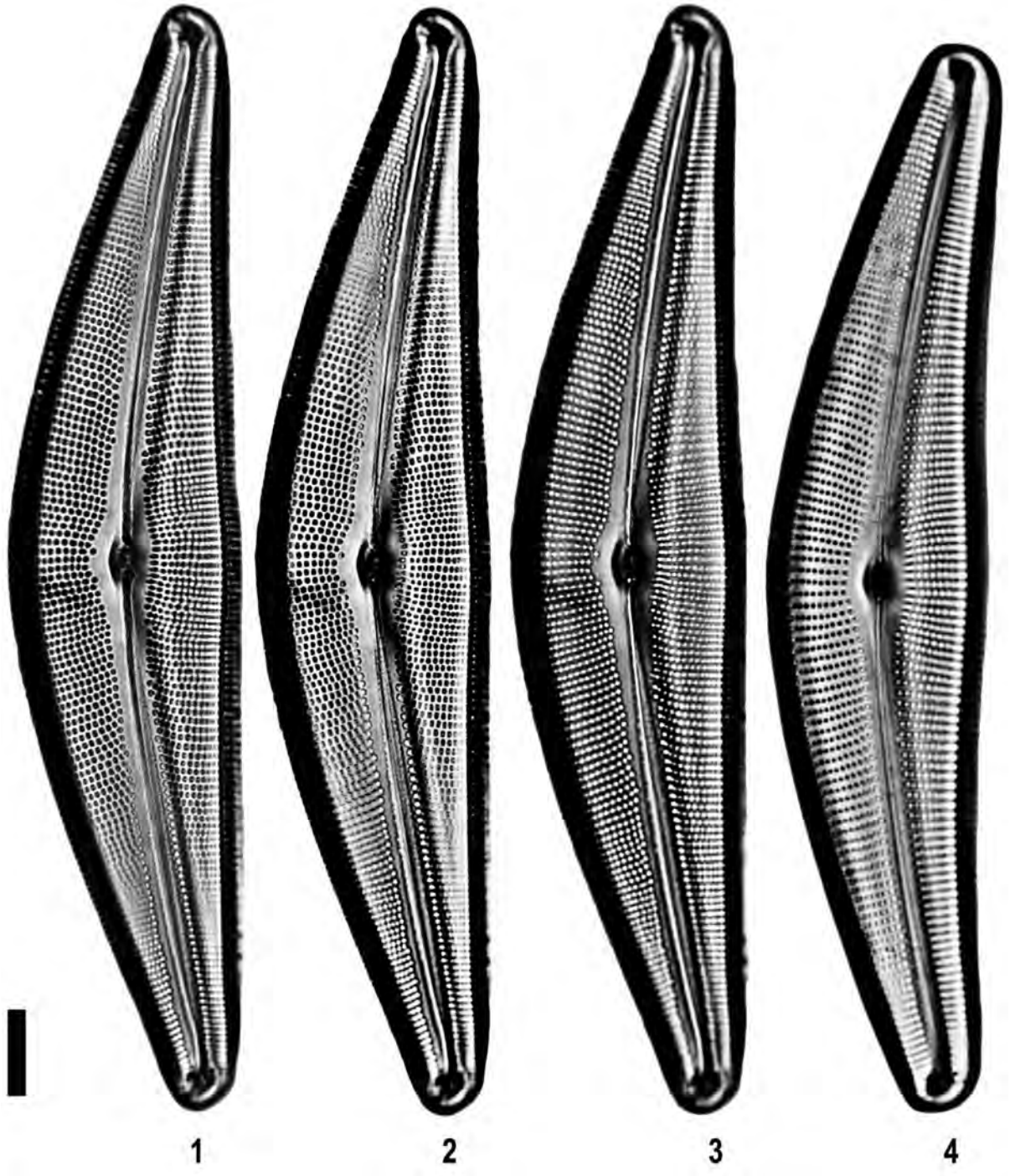


Plate 42: 1-4. *Cymbella baicalaspera* Glushchenko, Kulikovskiy and Kociolek 2022, Radomno Lake. Scale bar = 10 µm.

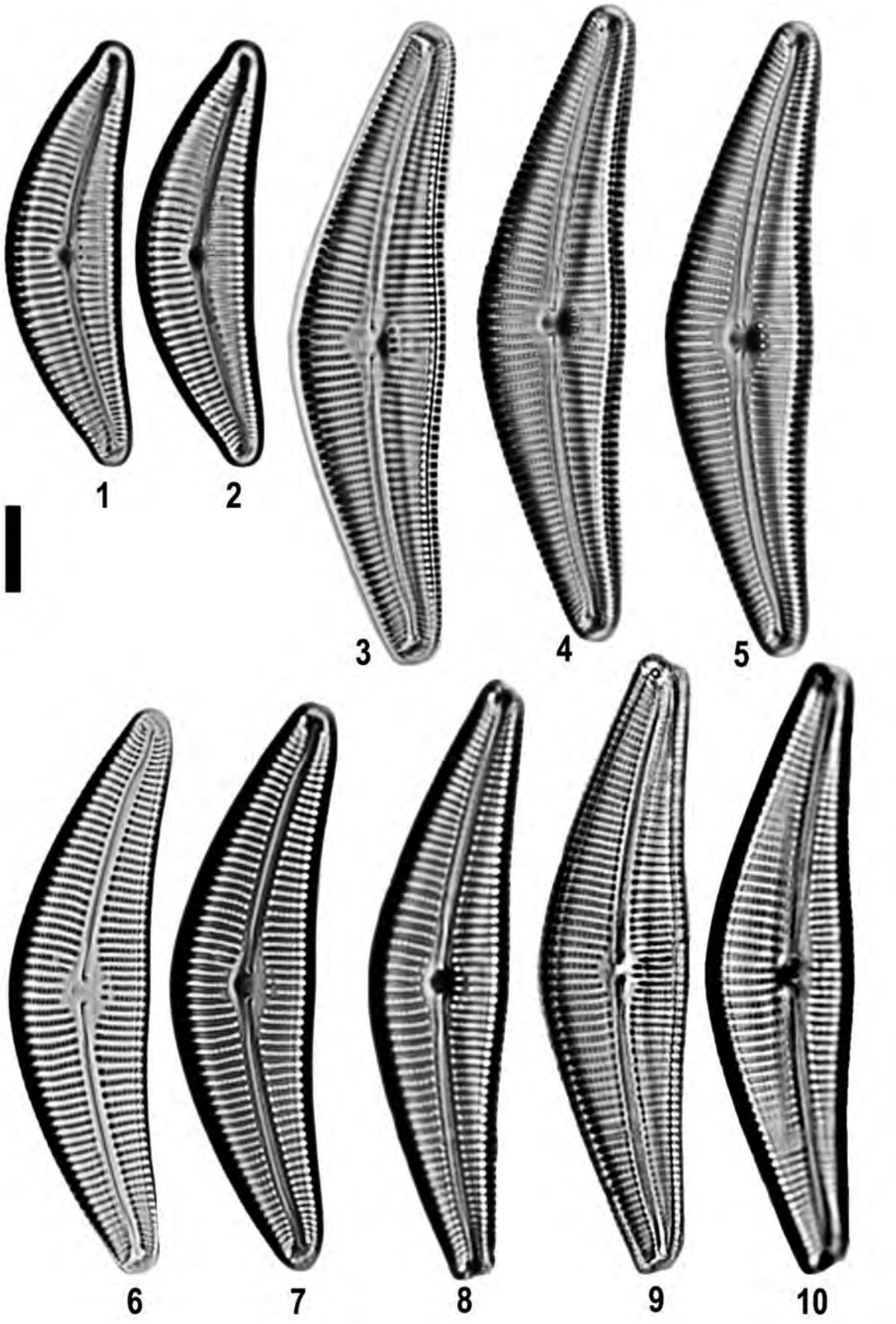


Plate 43: 1-10. *Cymbella cistula* (Ehrenberg) Kirchner 1878, 1-5. Jeziorak Lake; 6-10. Radomno Lake. Scale bar = 10 µm.

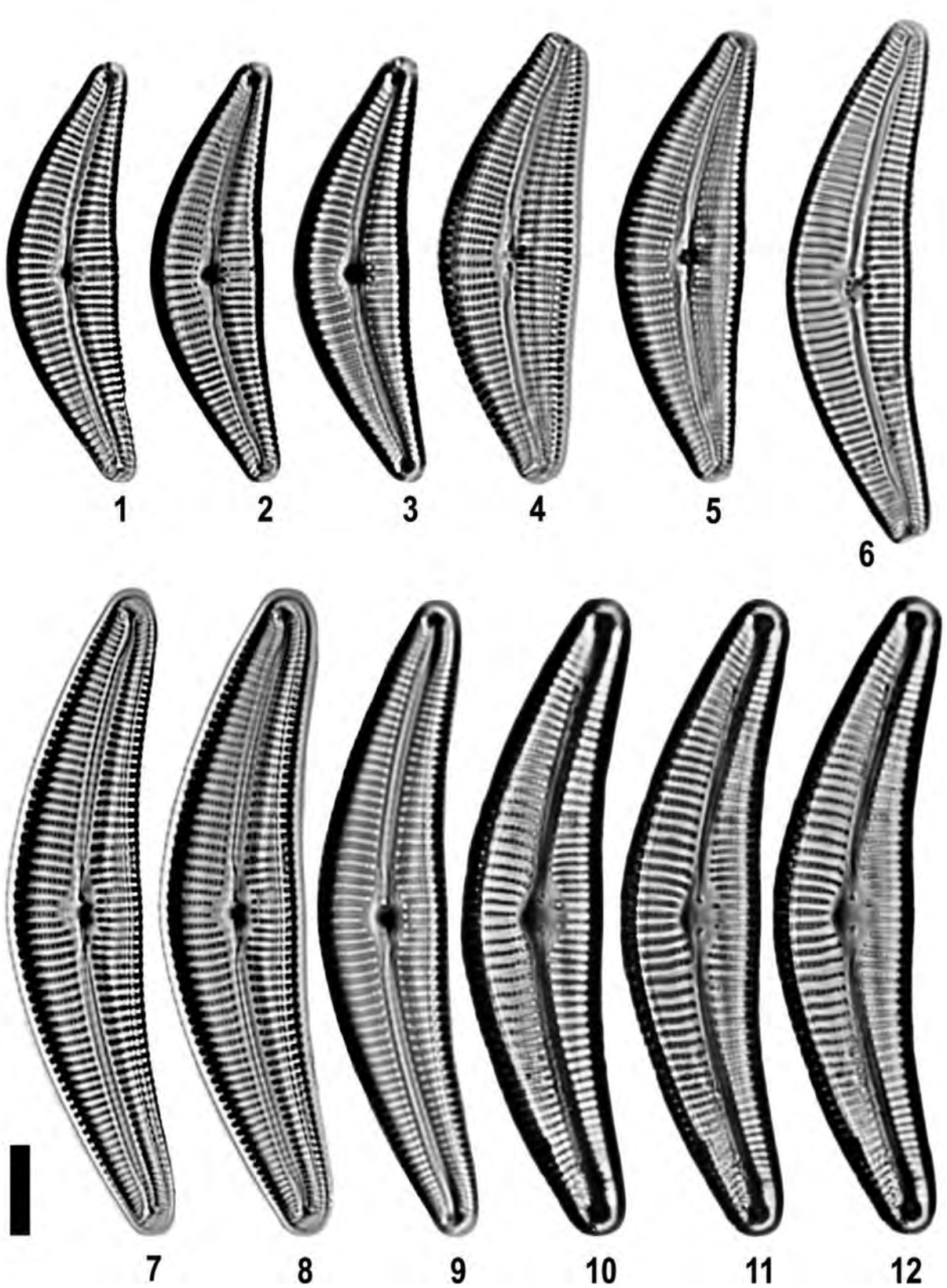


Plate 44: 1-12. *Cymbella cistula* (Ehrenberg) Kirchner 1878, 1-9. Radomno Lake; 10-12. Eemian palaeolake deposits of central Poland. Scale bar = 10 μm.

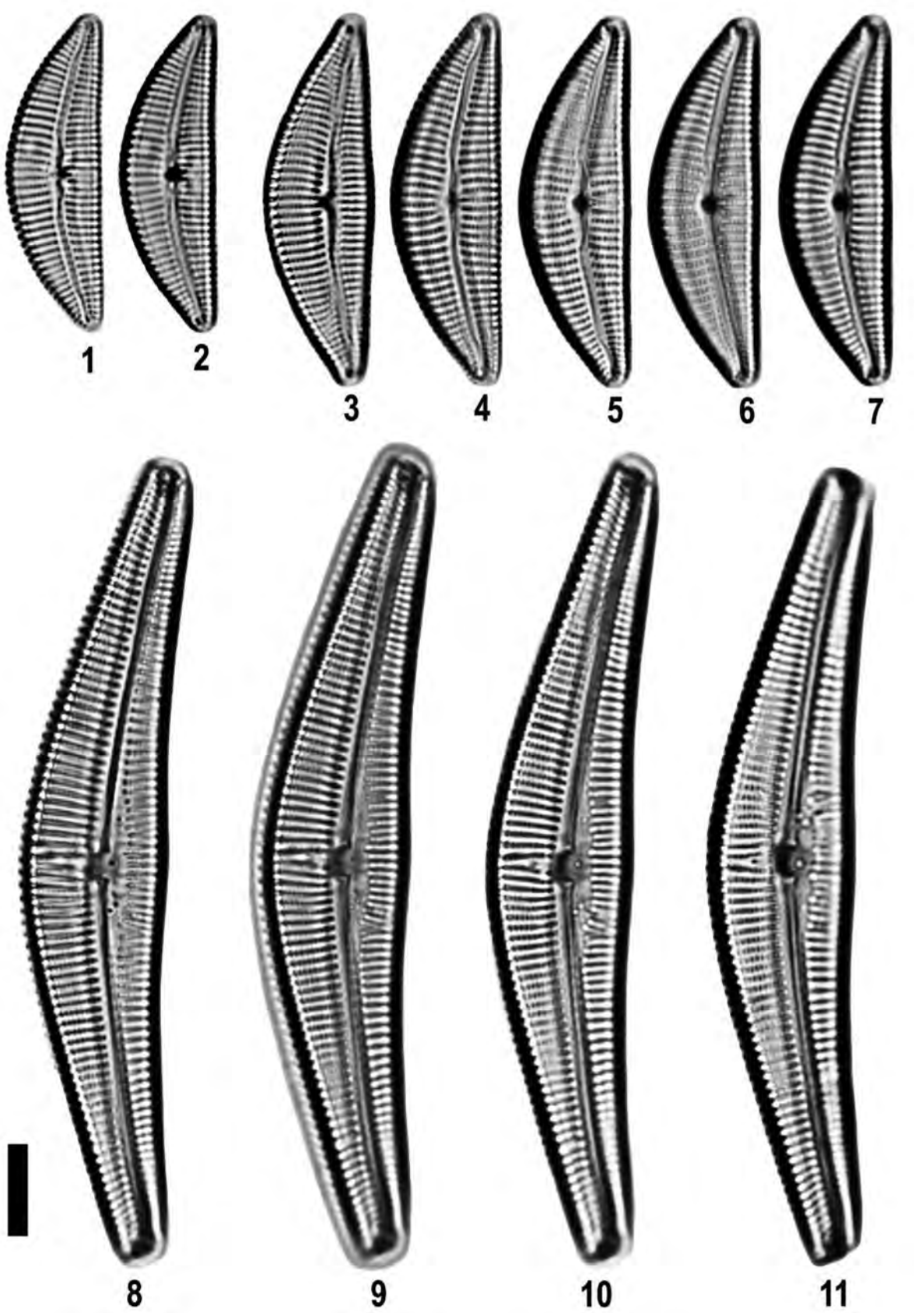


Plate 45: 1-2. *Cymbella cistula* var. *siamense* Hirano 1967, Radomno Lake; 3-7. *Cymbella cistuloides* var. *angulata* Skvortzov 1971, Radomno Lake; 8-11. *Cymbella cistuliformis* Krammer 2002, Radomno Lake. Scale bar = 10 µm.

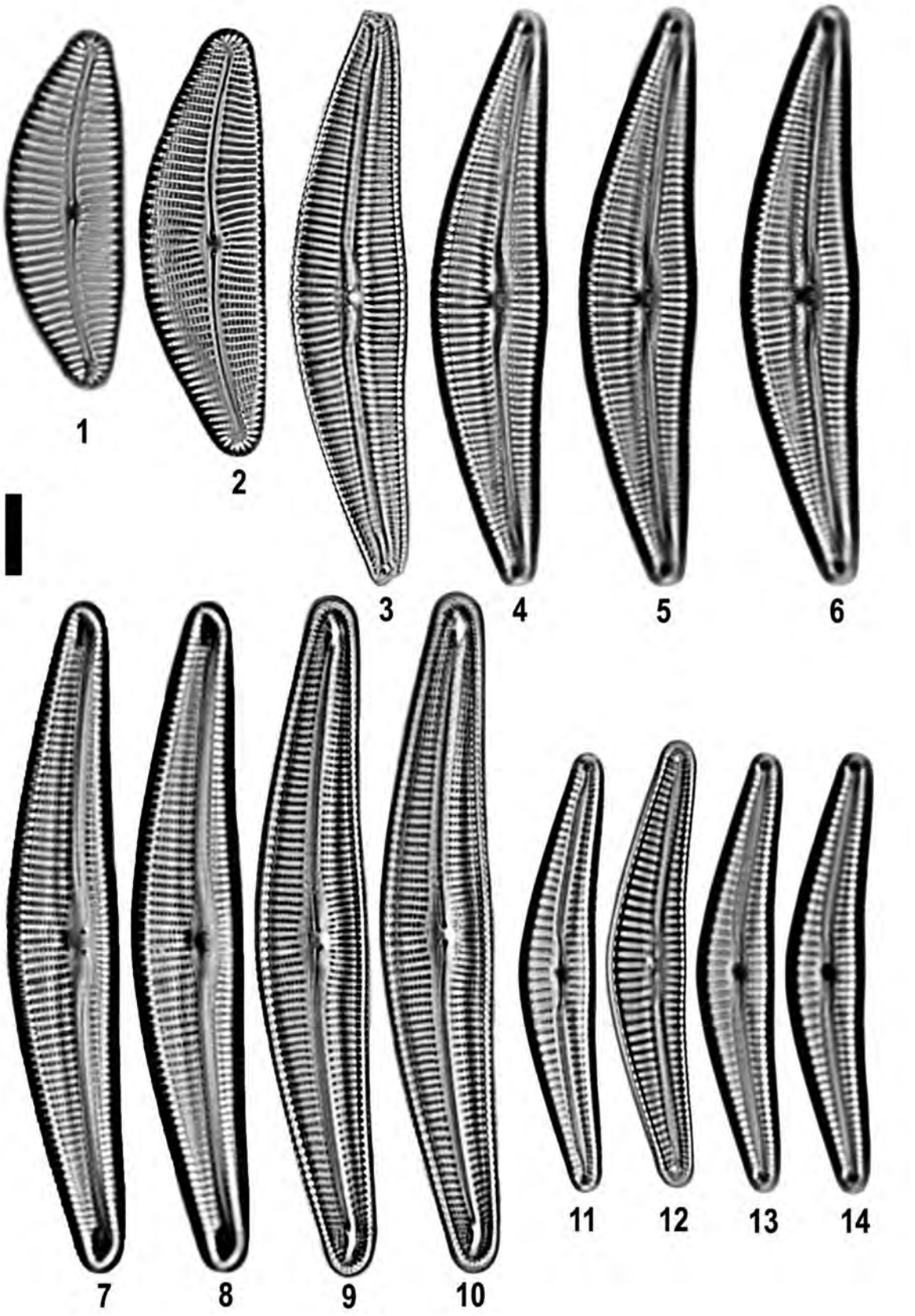


Plate 46: 1-2. *Cymbella compacta* Østrup 1910, Młynek Lake; 3-10. *Cymbella cymbiformis* Agardh 1830, Radomno Lake; 11-14. *Cymbella cymbiformis* var. *nonpunctata* Fontell 1917, Radomno Lake. Scale bar = 10 µm.Radomno Lake; 8-11. *Cymbella cistuliformis* Krammer 2002, Radomno Lake. Scale bar = 10 µm.

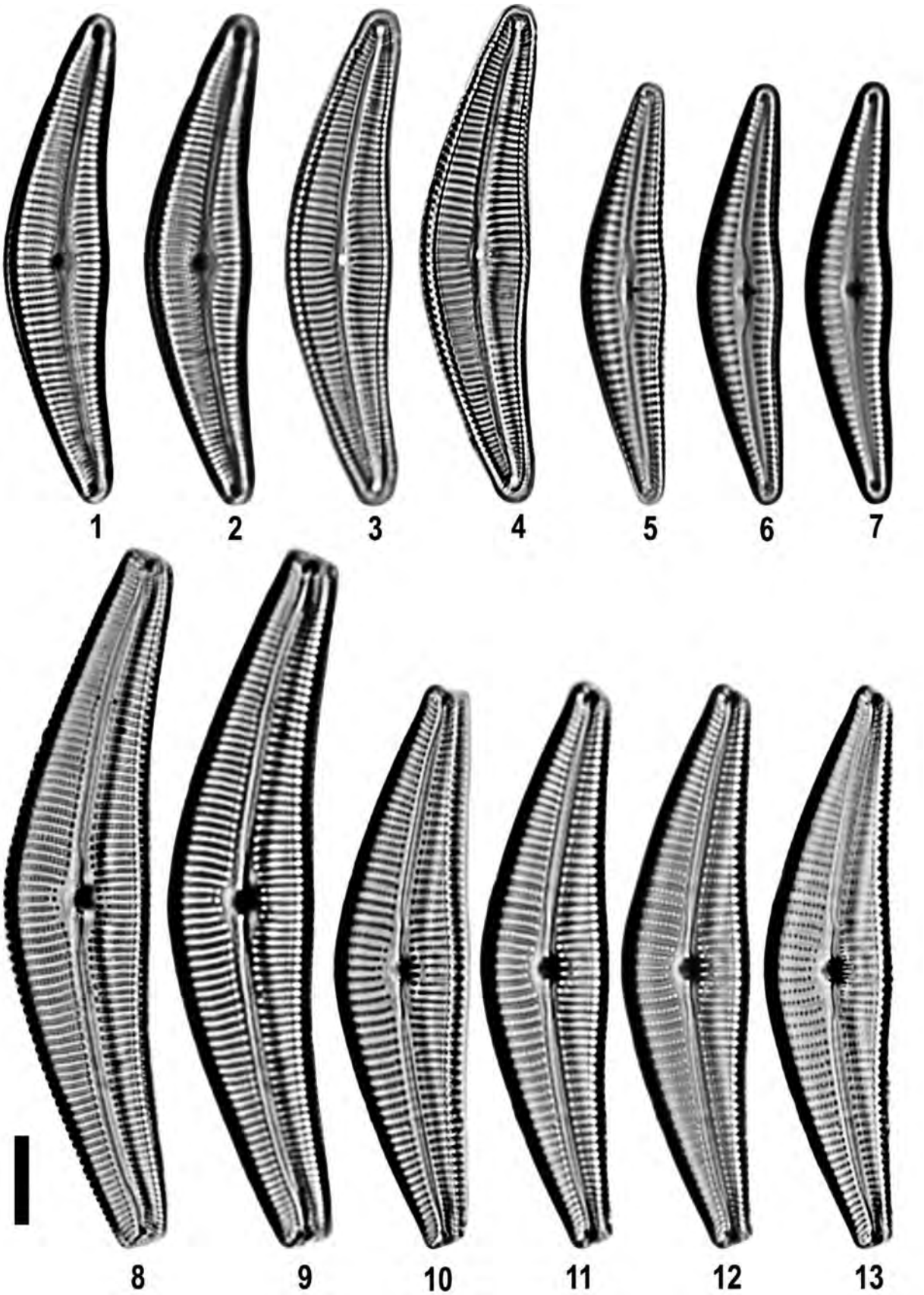


Plate 47: 1-7. *Cymbella cymbiformis var. unipunctata* A. Cleve 1955, 1-3. Jeziorak Lake; 4-7. Kamionka Lake; 8-13. *Cymbella diversiformis* Krammer 2002, Radomno Lake. Scale bar = 10 µm.

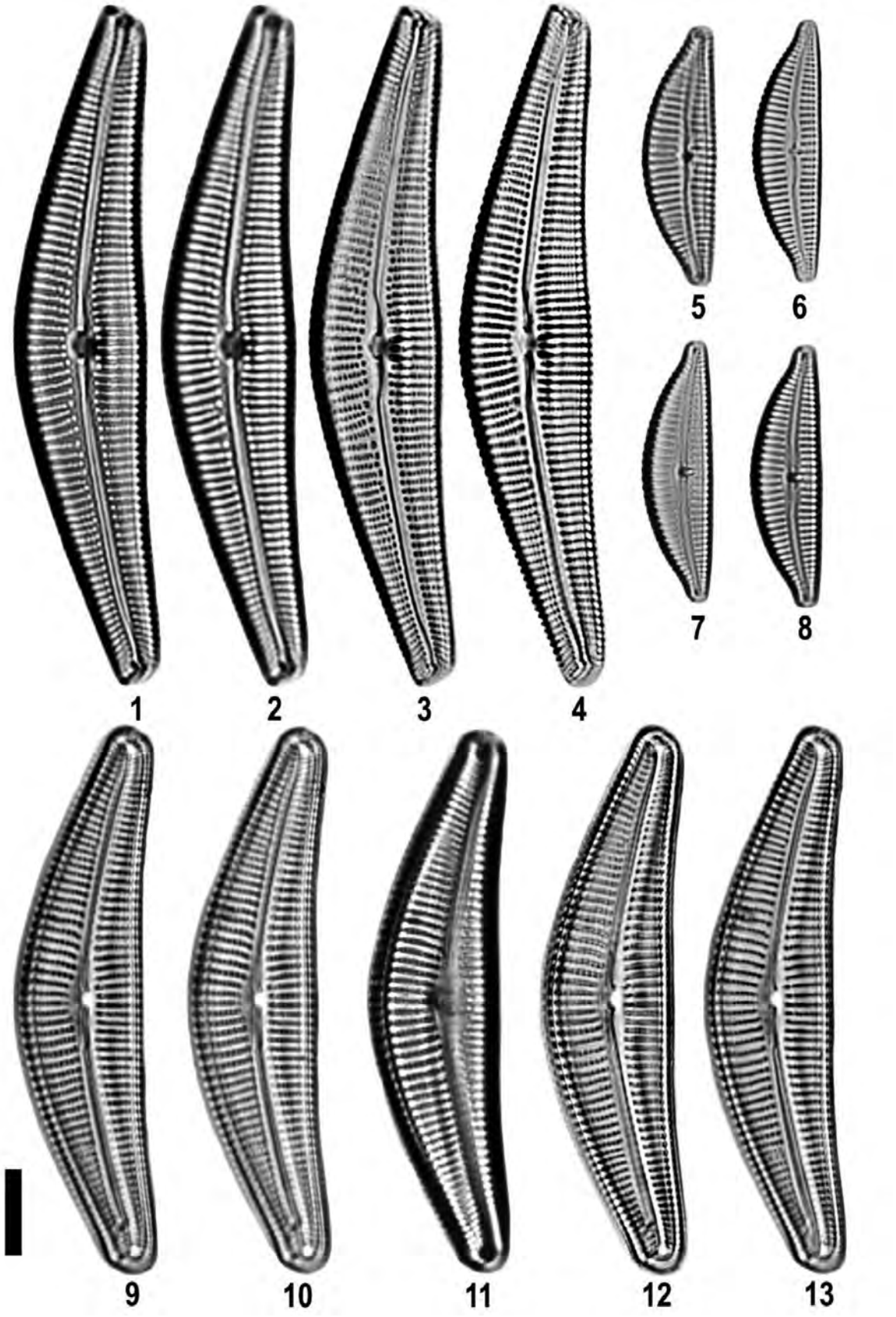


Plate 48: 1-4. *Cymbella diversiformis* Krammer 2002, Radomno Lake; 5-8. *Cymbella diversistigmata* Krammer 2002, Radomno Lake; 9-13. *Cymbella dorsenotata* Østrup 1910, Kamionka Lake. Scale bar = 10 µm.

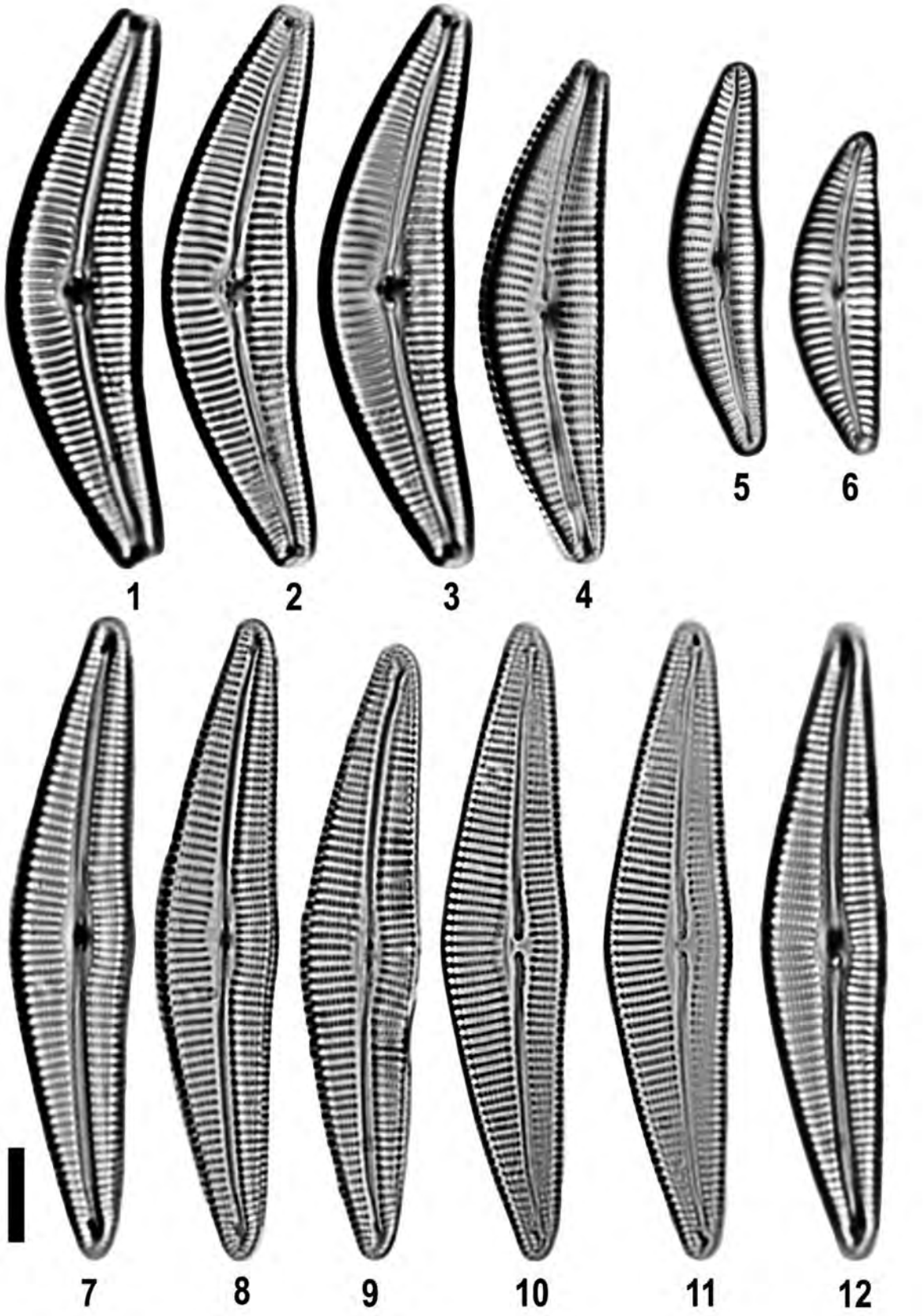


Plate 49: 1-4. *Cymbella excisa* Kützing 1844, 1-3. Radomno Lake;4. Eemian palaeolake deposits of central Poland**;** 5-6. *Cymbella hantzschiana* Krammer 2002, Jeziorak Lake; 7-12. *Cymbella helvetica* Kützing 1844, 7-8. Jeziorak Lake; 9-12. Radomno Lake. Scale bar = 10 μm.

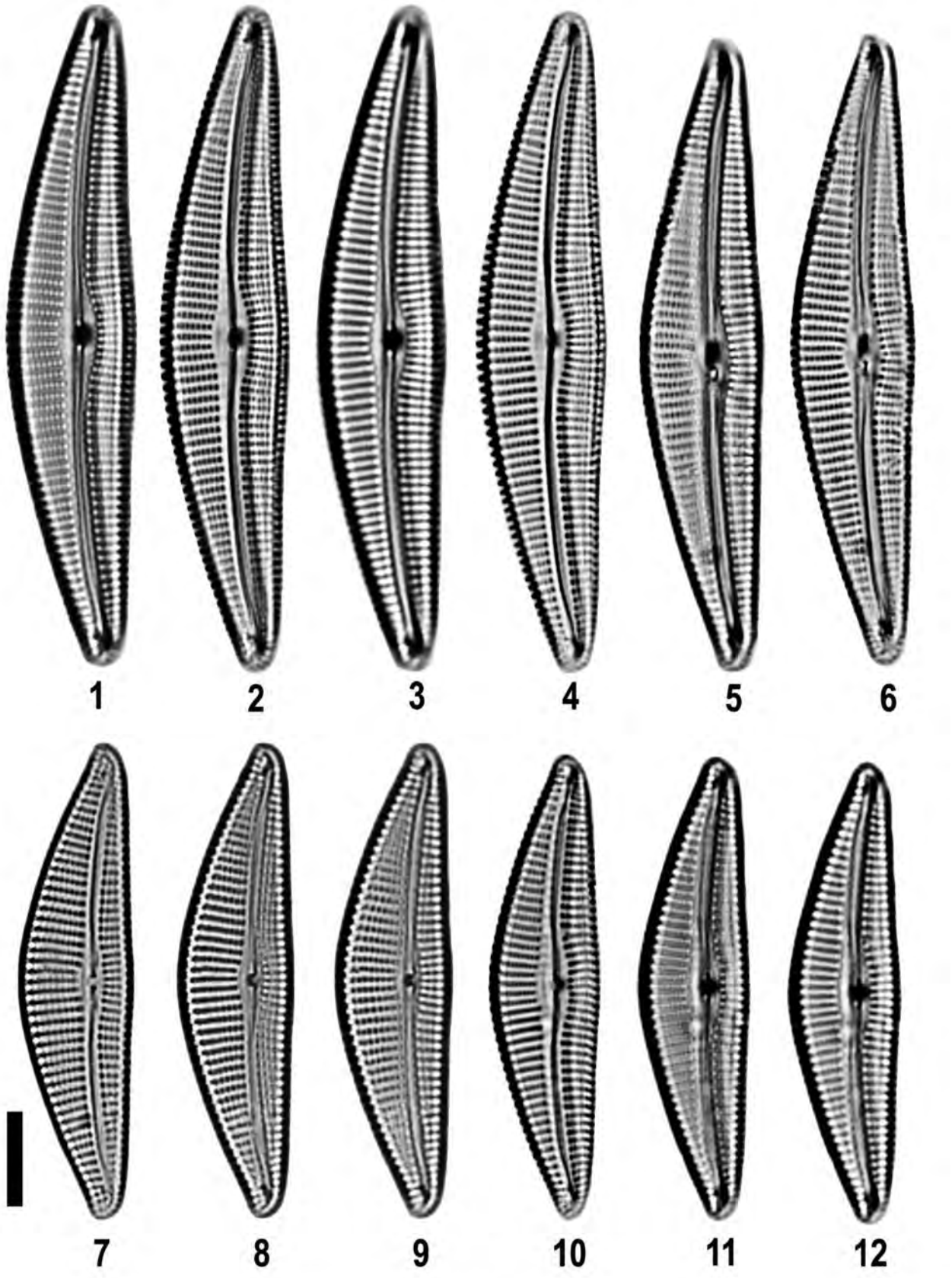


Plate 50: 1-12. *Cymbella helvetica* Kützing 1844, Radomno Lake. Scale bar = 10 µm.

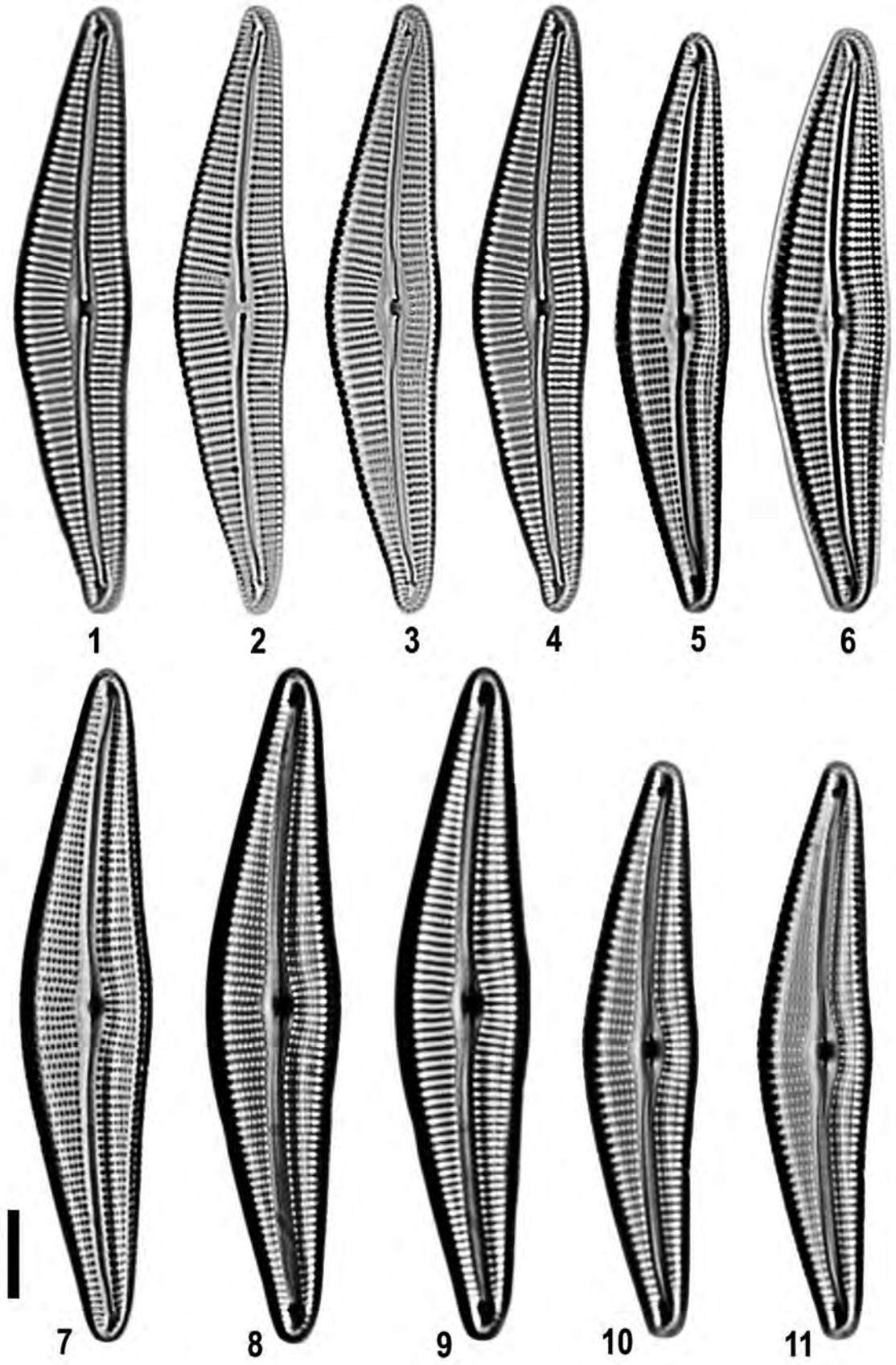


Plate 51: 1-11. *Cymbella helvetica* Kützing 1844, Radomno Lake. Scale bar = 10 µm.

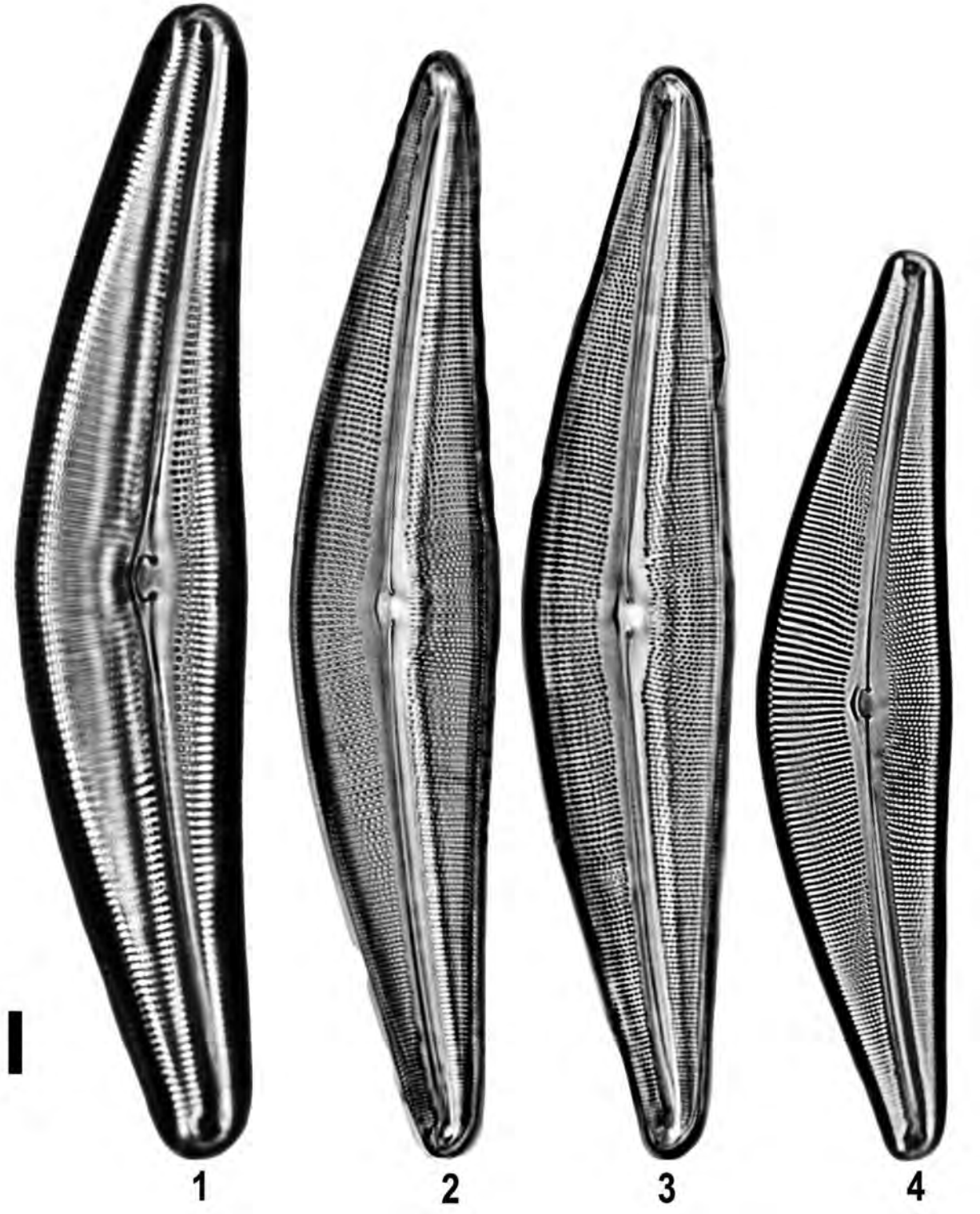


Plate 52: 1-4. *Cymbella himalaspera* Jüttner & Van de Vijver 2010, Radomno Lake. Scale bar = 10 µm.

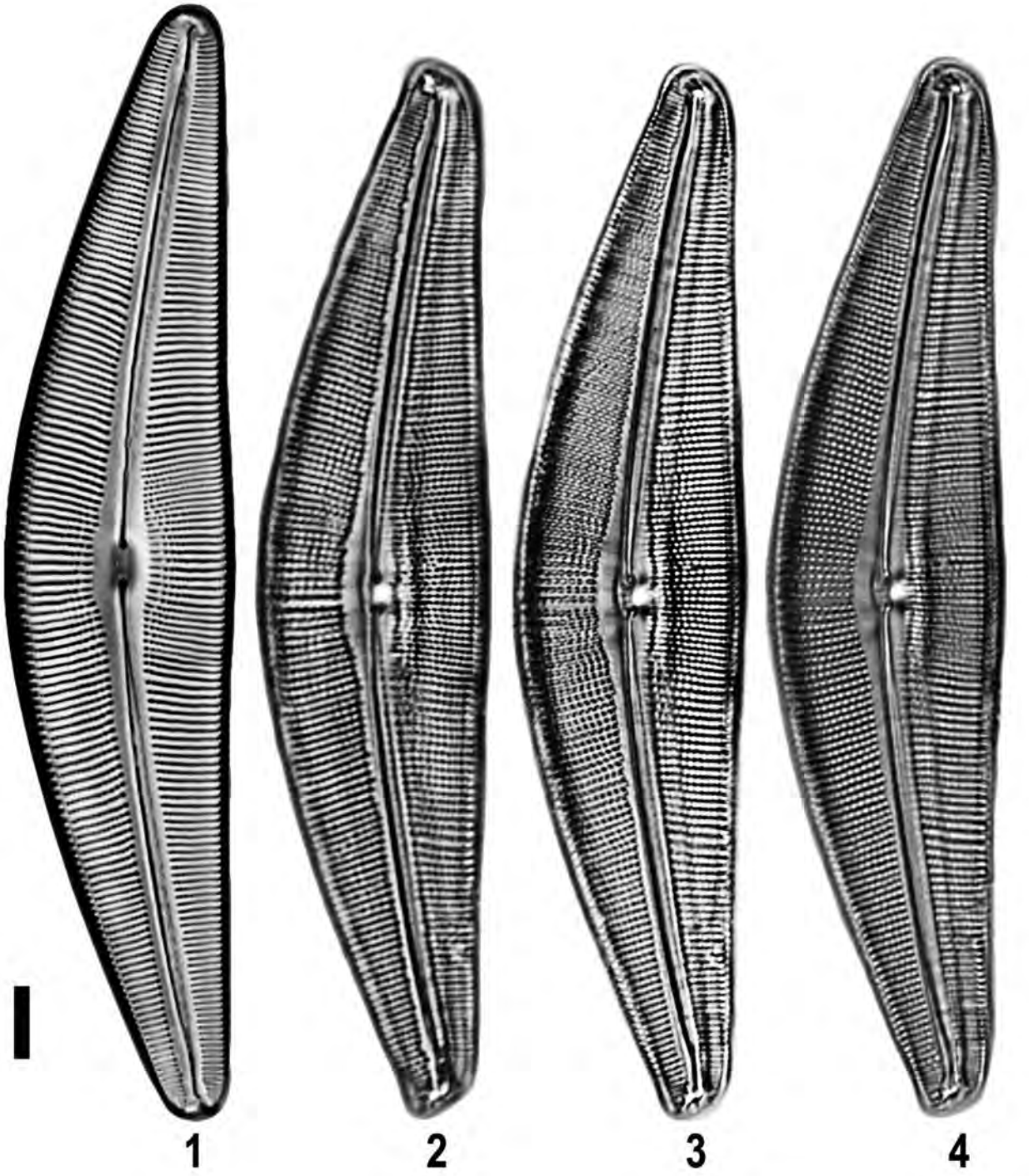


Plate 53: 1-4. *Cymbella himalaspera* Jüttner & Van de Vijver 2010, Radomno Lake. Scale bar = 10 µm.

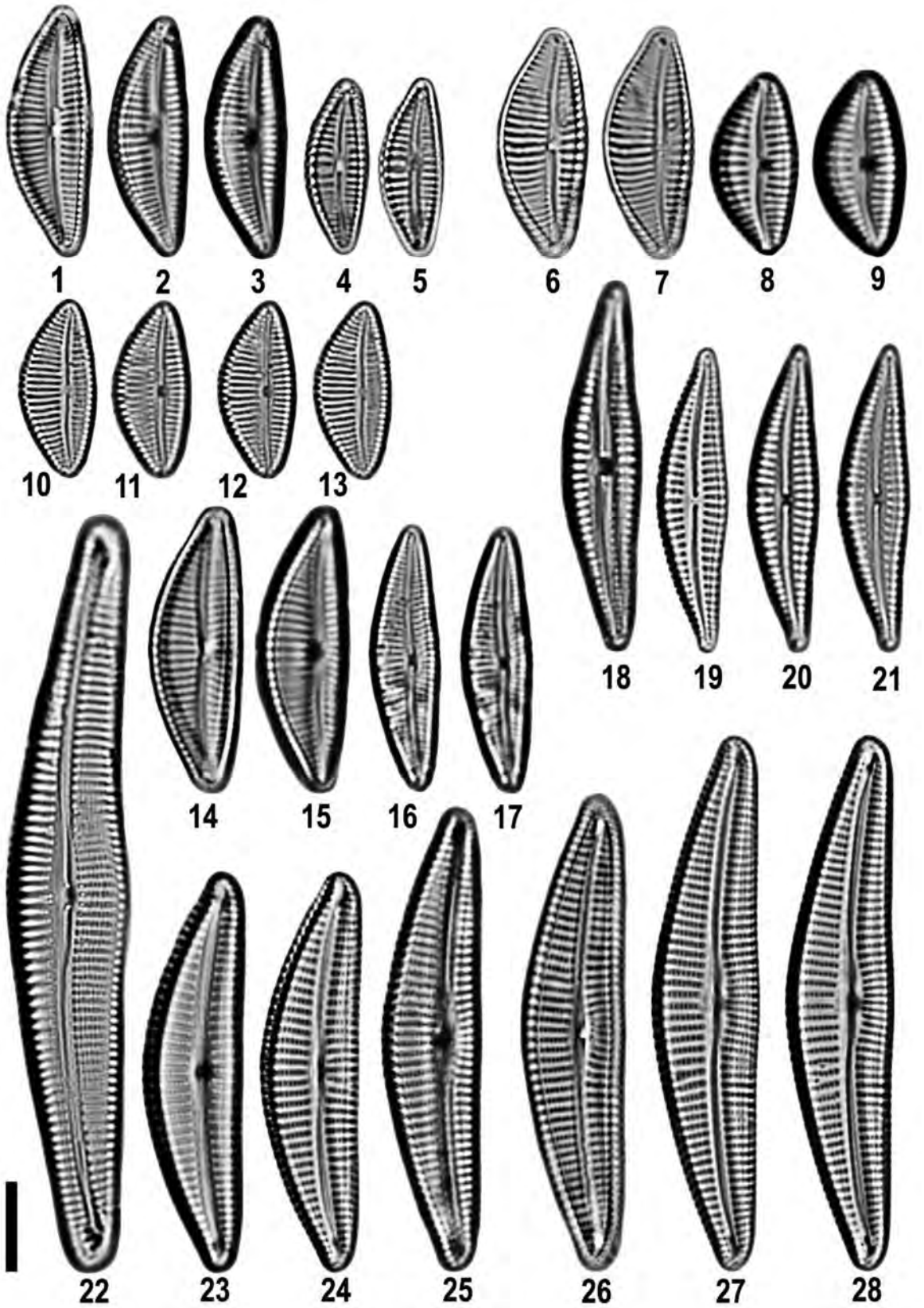


Plate 54: 1-5. *Cymbella hustedtii* Krasske 1923, 1-3. Kamionka Lake; 4. Radomno Lake; 6-13. *Cymbella hustedtii* var. *compacta* Krammer 2002, Radomno Lake; 14-17. *Cymbella laevis* Nägeli in Kützing 1849, 14-15. Kamionka Lake**;** 16-17. Radomno Lake**;** 18-21. *Cymbella lancettula* (Krammer) Krammer 2002, Radomno Lake**;** 22-28. *Cymbella lange-bertalotii* Krammer 2002; 22-23. Jeziorak Lake; 24-25. Kamionka Lake; 21, 26-27. Radomno Lake. Scale bar = 10 µm.

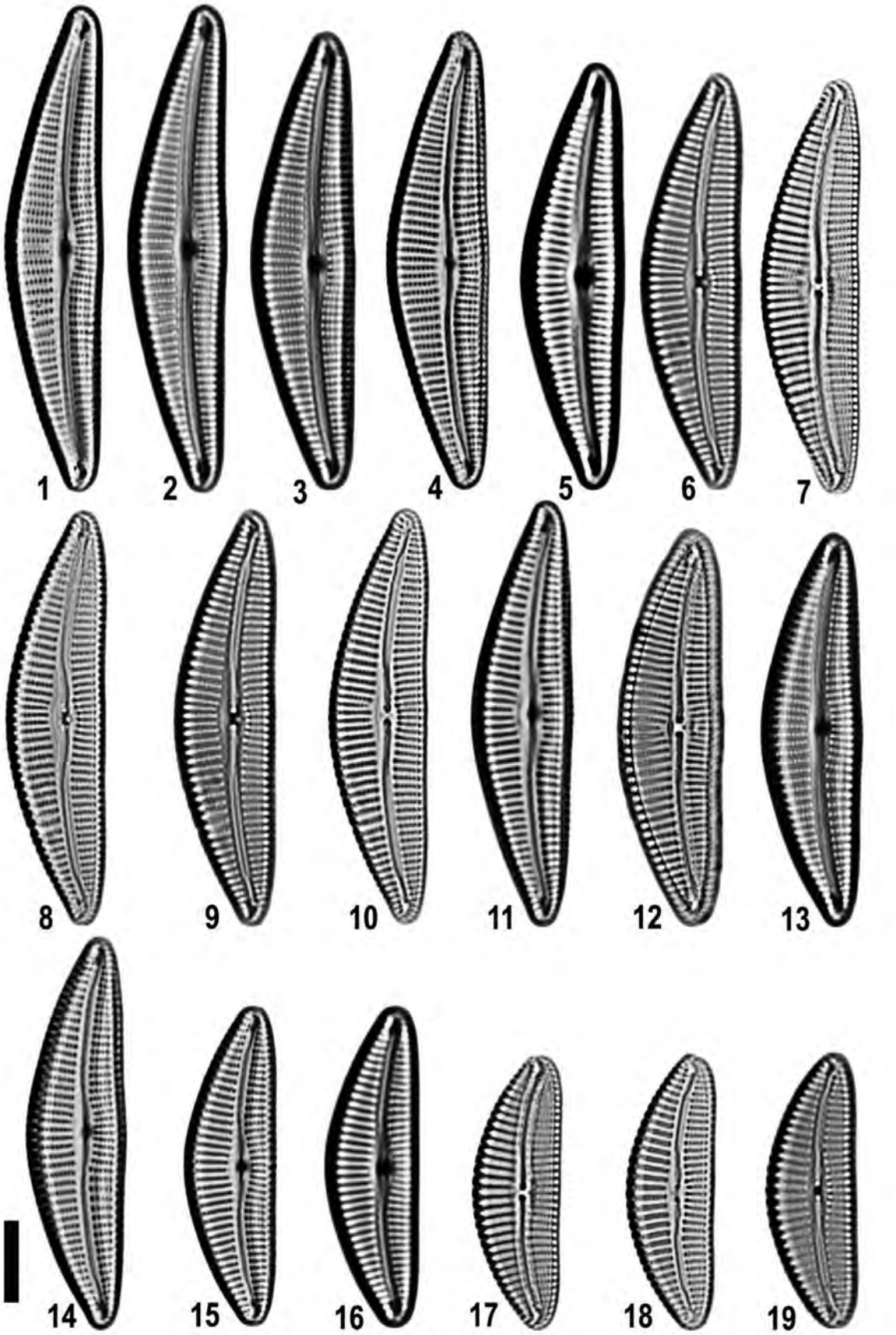


Plate 55: 1-19. *Cymbella lange-bertalotii* Krammer 2002, Radomno Lake. Scale bar = 10 µm.

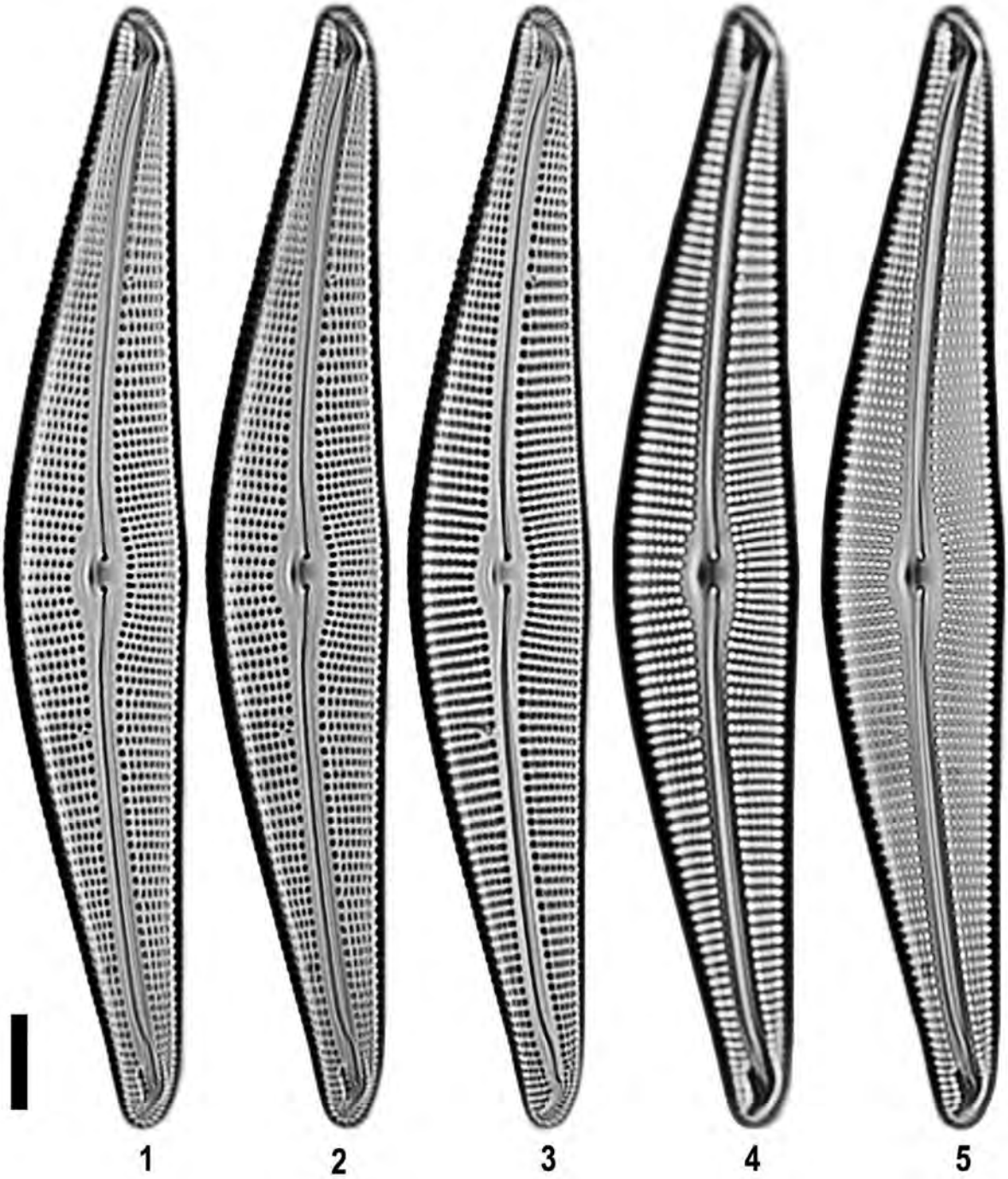


Plate 56: 1-4. *Cymbella lange-bertalotii* var. *lanceolata* Zalat nov. var. Radomno Lake. Scale bar = 10 µm.

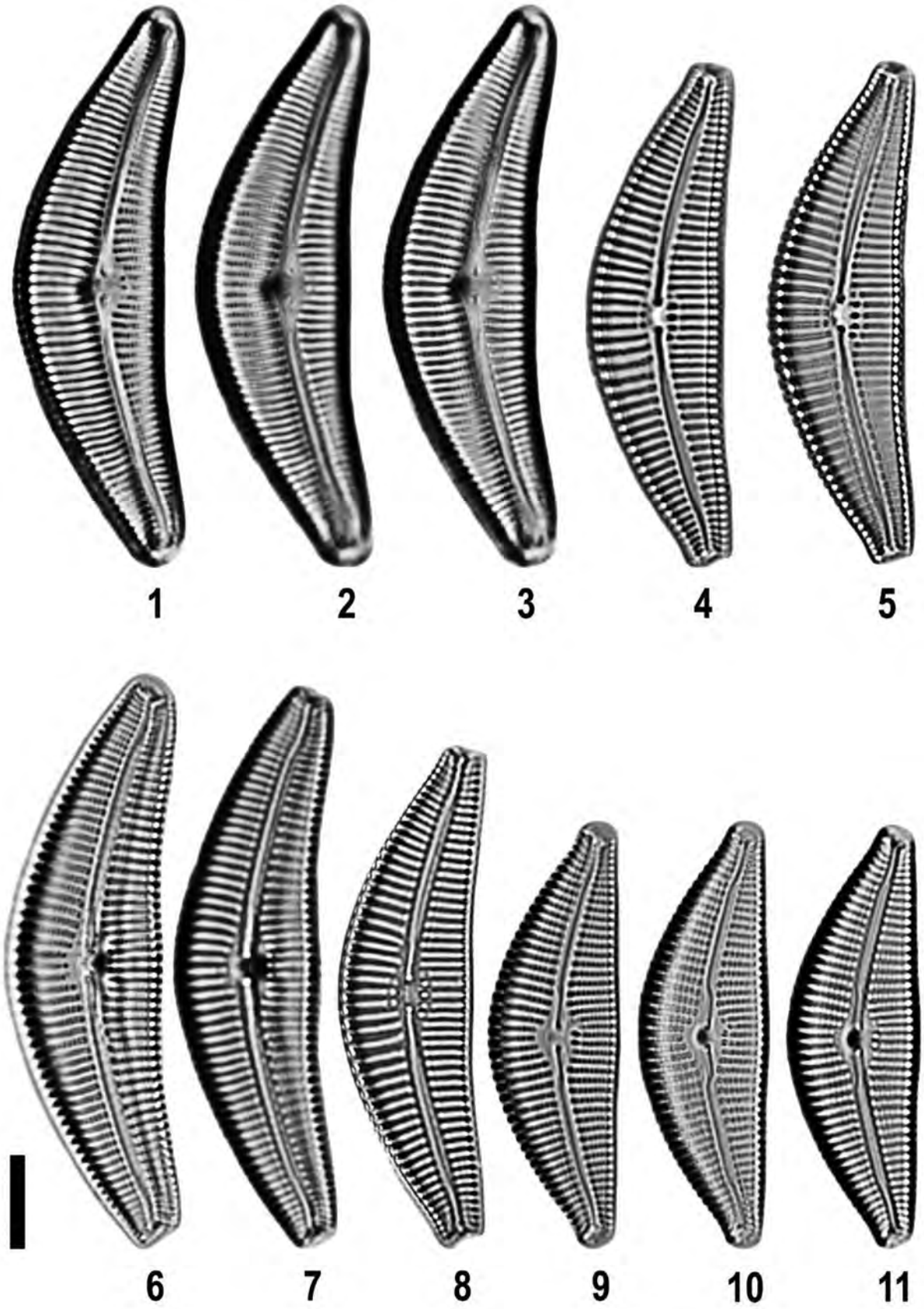


Plate 57: 1-11. *Cymbella neocistula* Krammer 2002, 1-3. Kamionka Lake; 4-11. Radomno Lake. Scale bar = 10 µm.

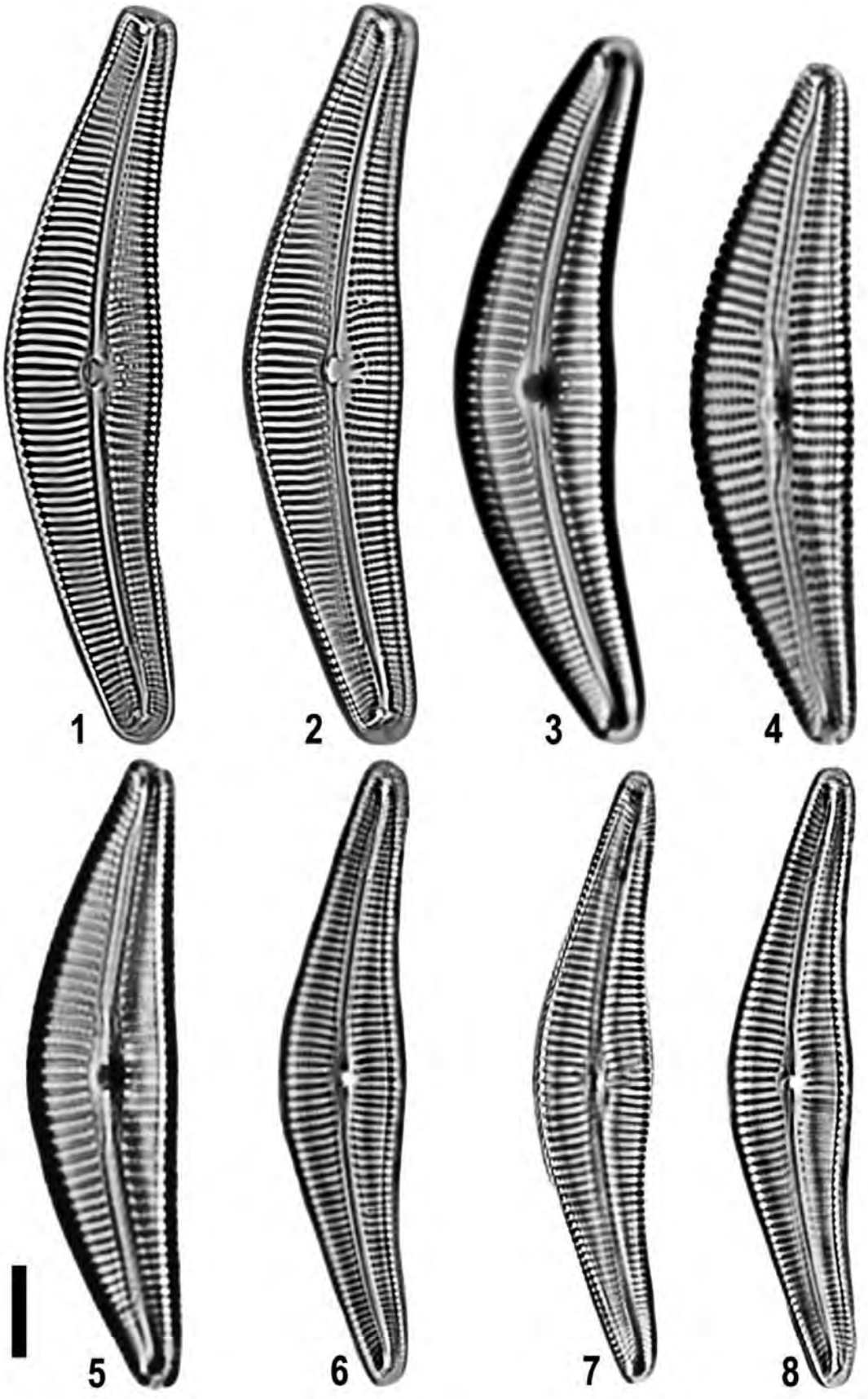


Plate 58: 1-8. *Cymbella neocistula* Krammer 2002, 1-5. Radomno Lake; 6-8. Kamionka Lake. Scale bar = 10 μm.

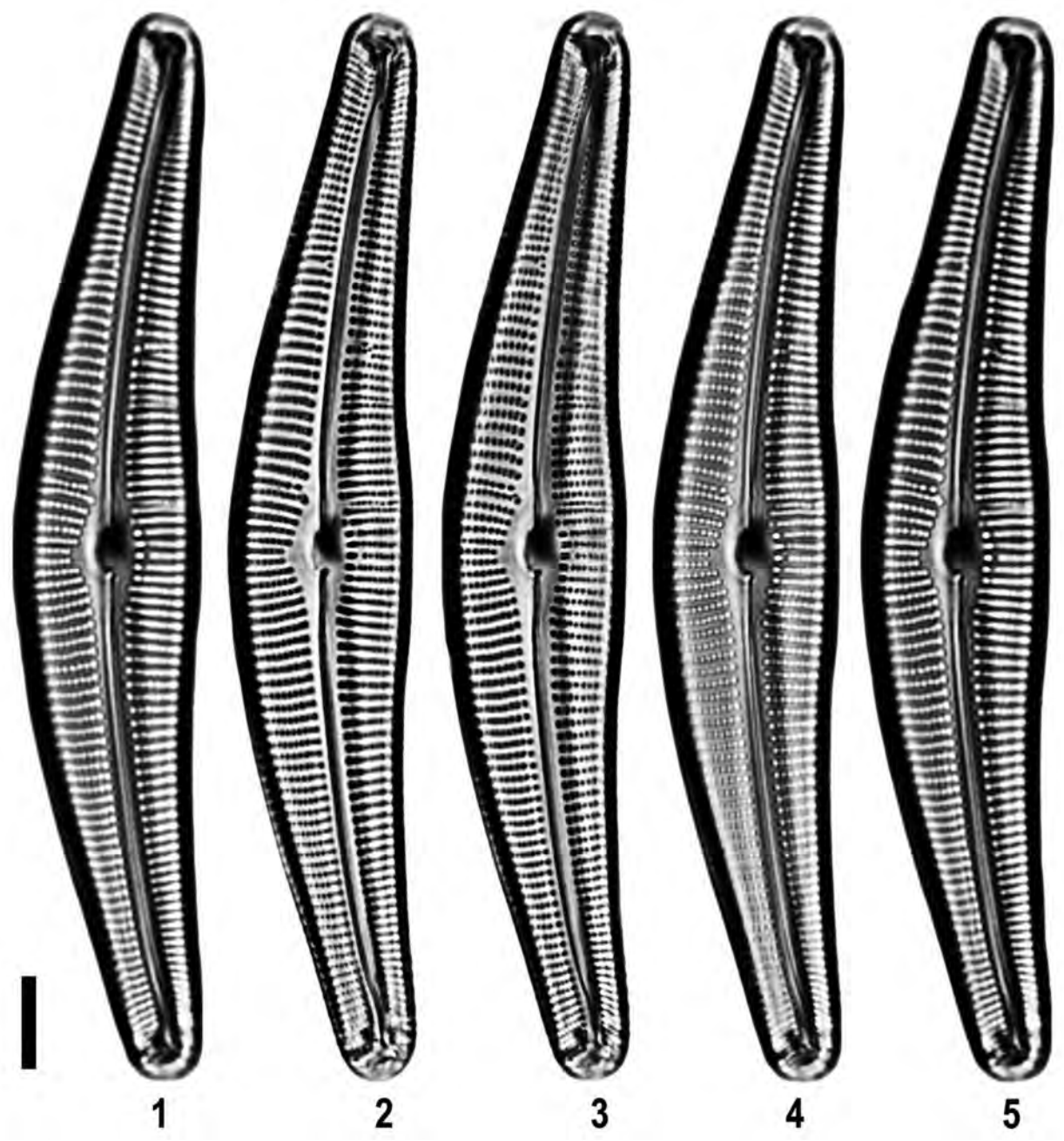


Plate 59: 1-5. *Cymbella neocistula* var. *radomnoensis* Zalat nov var., Radomno Lake. Scale bar = 10 µm.

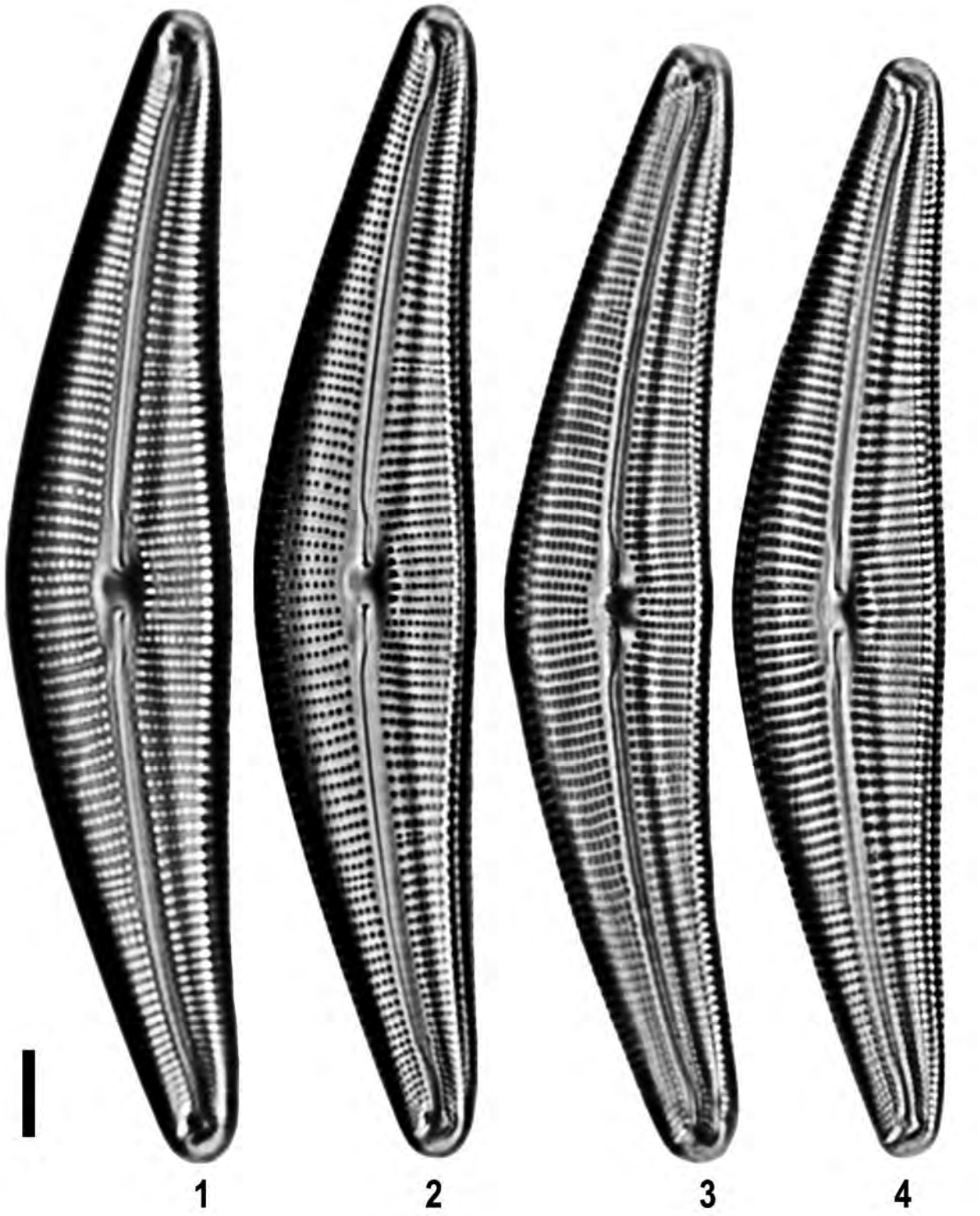


Plate 60: 1-4. *Cymbella neolanceolata* Silva 2013, Radomno Lake. Scale bar = 10 µm.

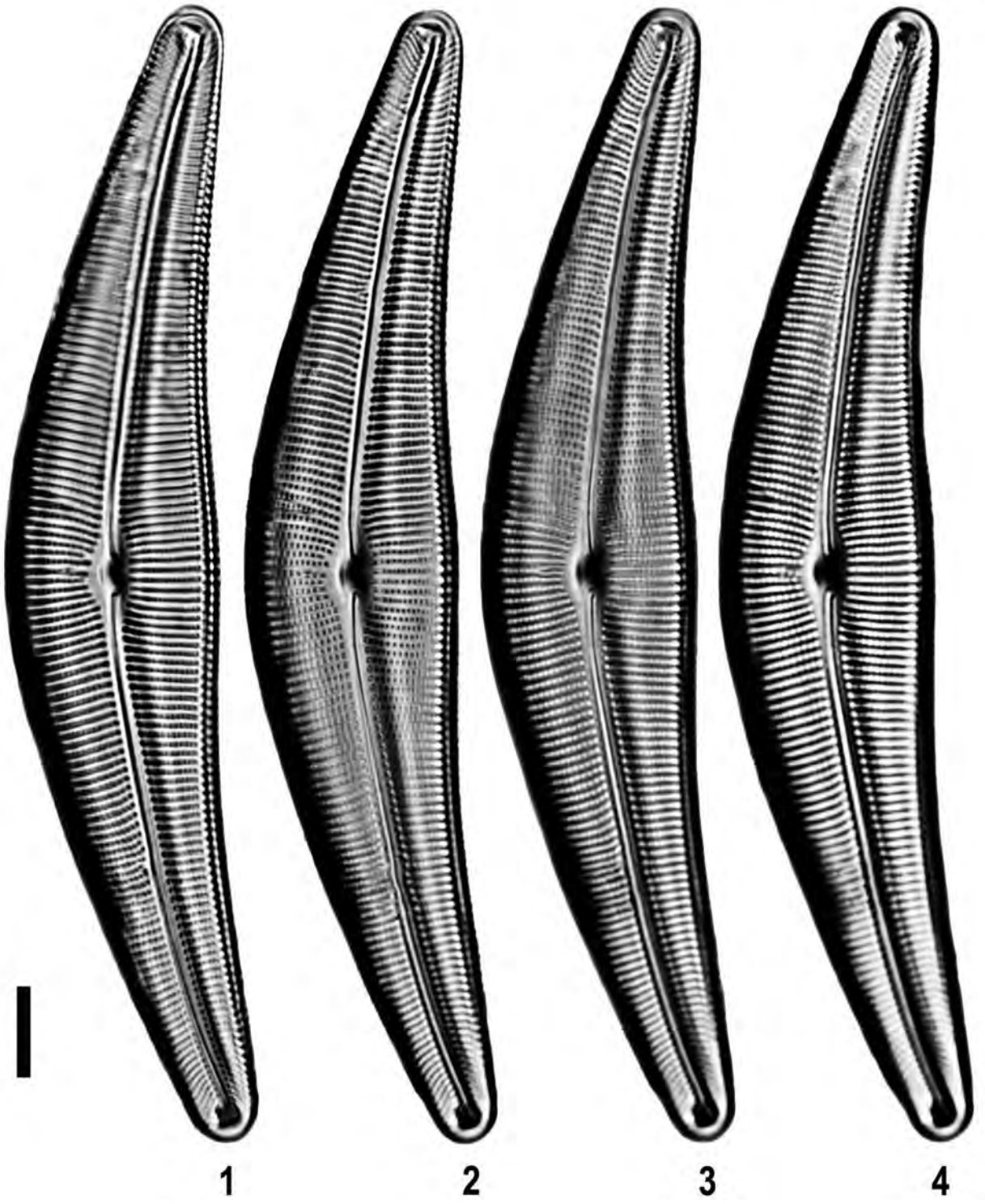


Plate 61: 1-4. *Cymbella neolanceolata* var. *bottnica* (Krammer) Silva 2013, Młynek Lake. Scale bar = 10 µm.

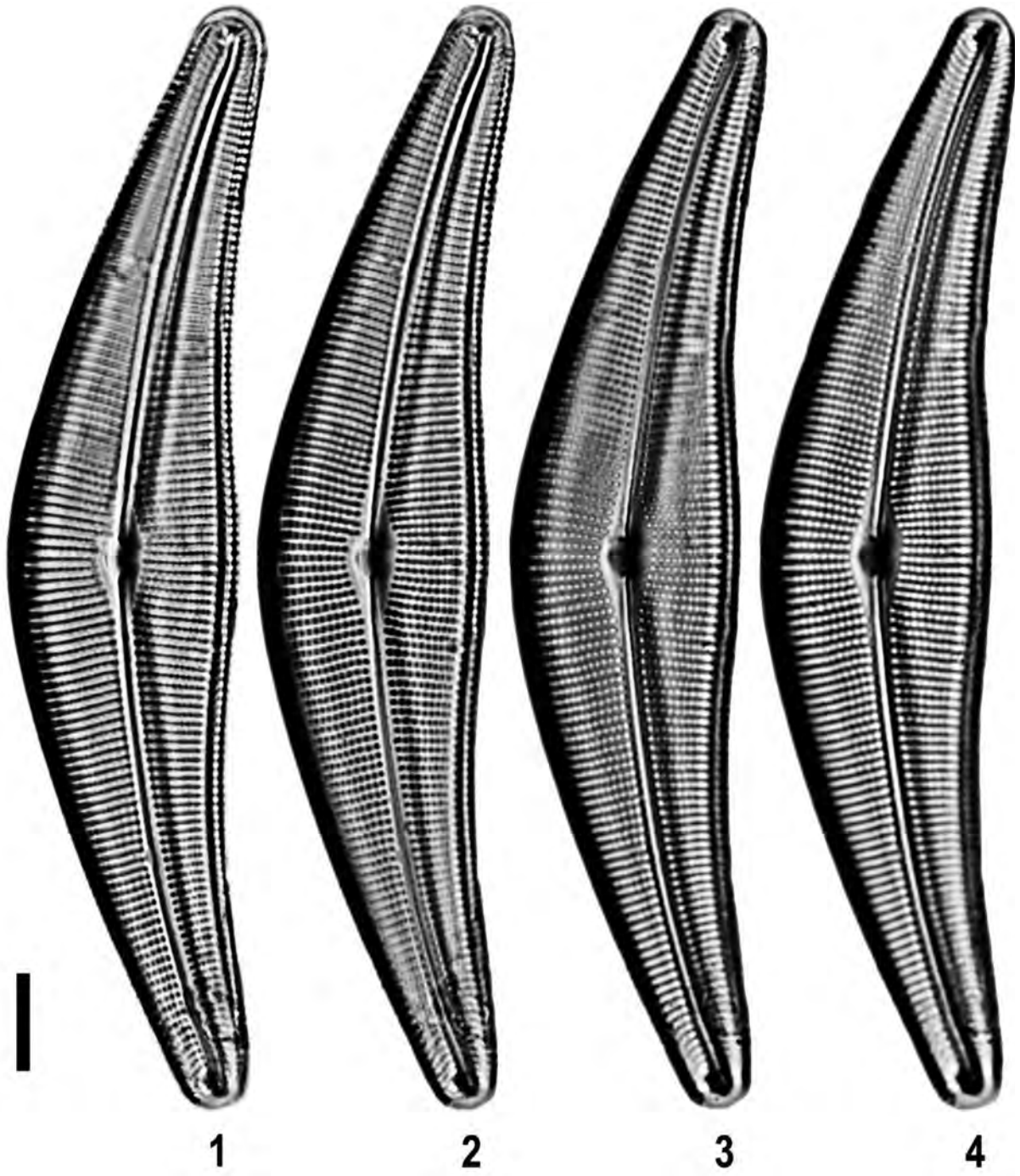


Plate 62: 1-4. *Cymbella neolanceolata* var. *bottnica* (Krammer) Silva 2013, Młynek Lake. Scale bar = 10 µm.

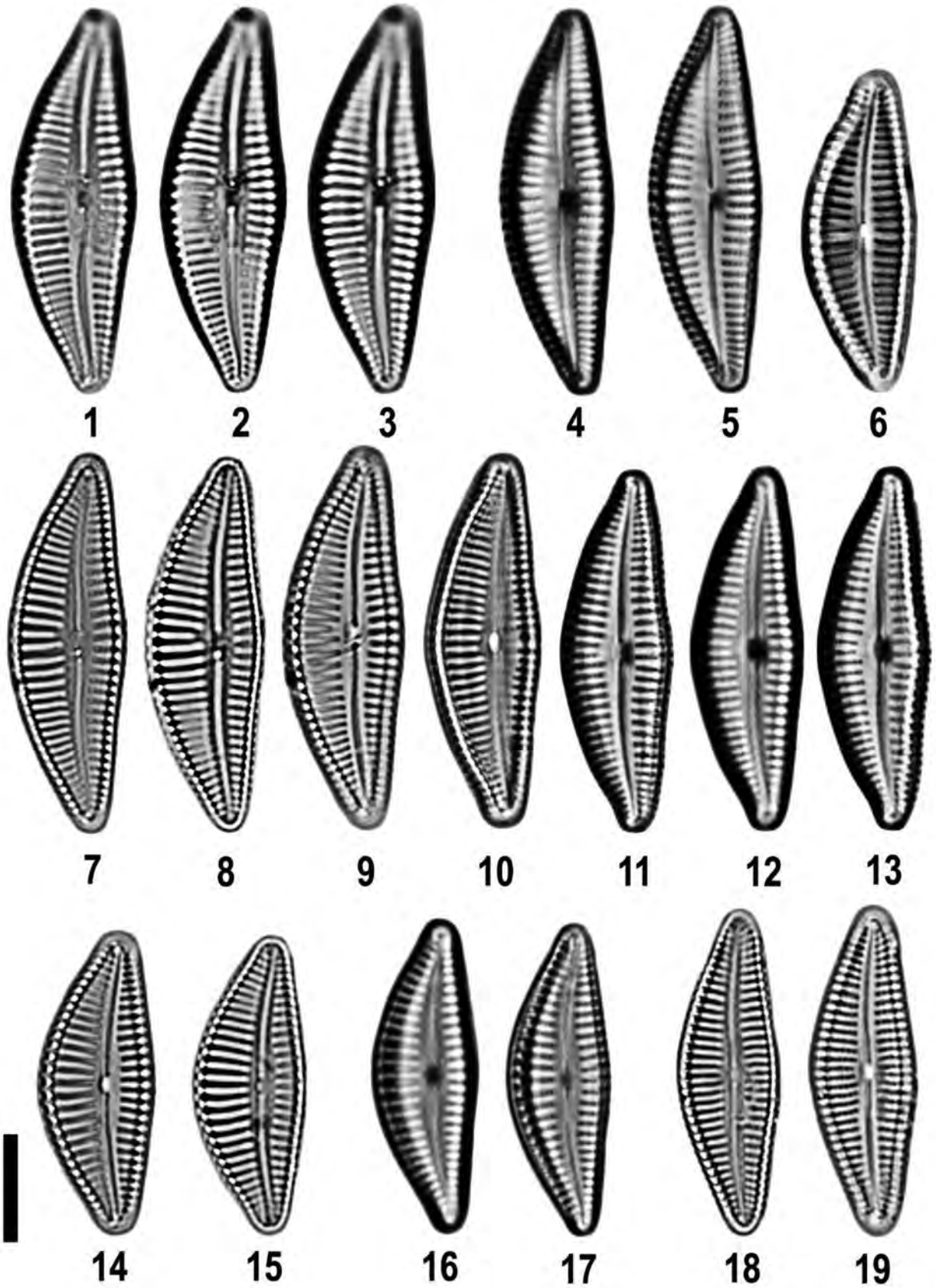


Plate 63: 1-3. *Cymbella leptoceroides* Hustedt 1942, Radomno Lake; 4-17. *Cymbella neoleptoceros* Krammer 2002; 4-6. Eemian palaeolake deposits of central Poland, 7-8. Jeziorak Lake; 9-17. Radomno Lake; 18-19. *Cymbella neoleptoceros* var. *rhombica* Zalat & Chodyka nov. var., Kamionka Lake. Scale bar = 10 μm.

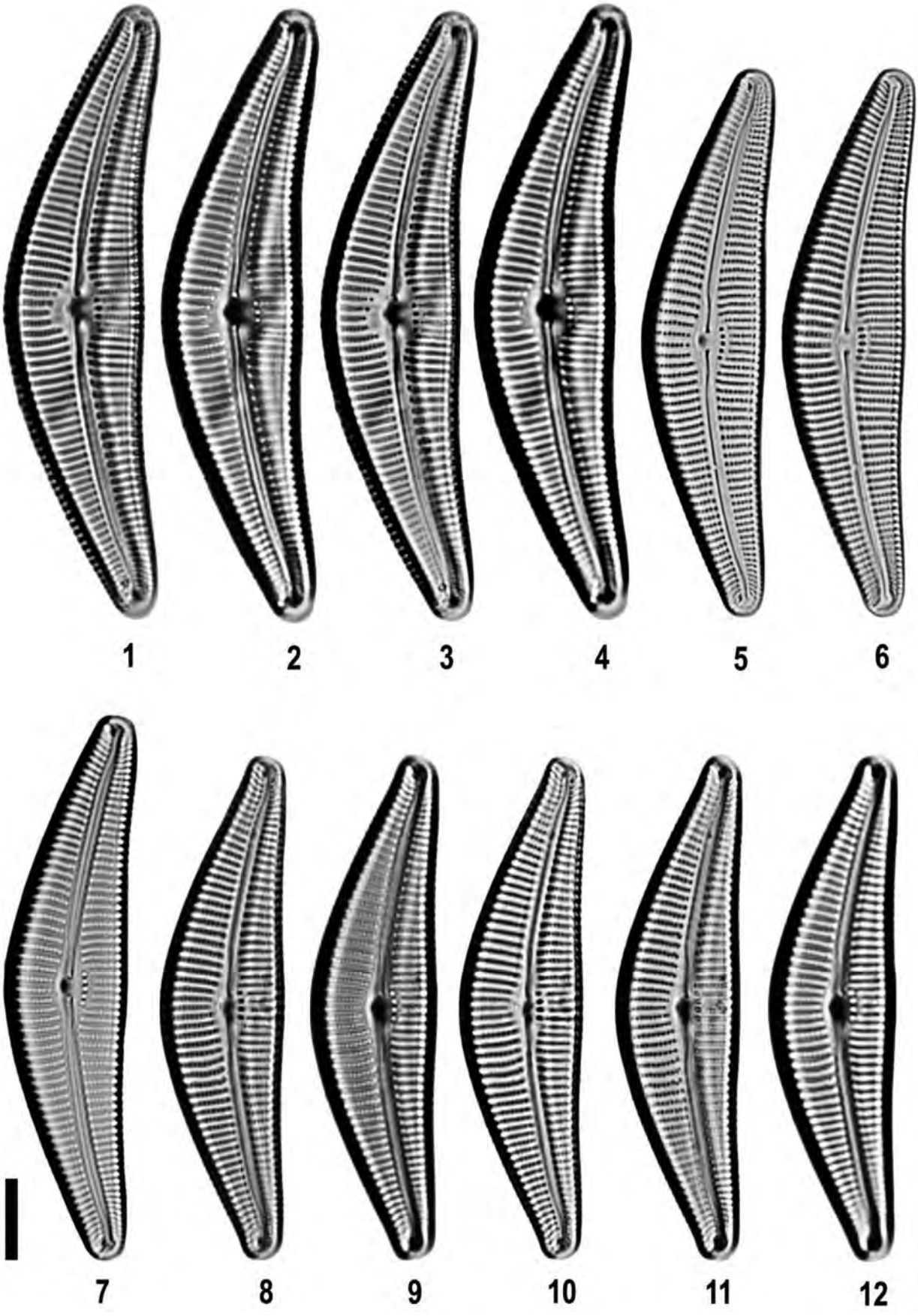


Plate 64: 1-12. *Cymbella nepalensis* (Jüttner & Van de Vijver) Vishnjakov 2015, Radomno Lake. Scale bar = 10 µm.

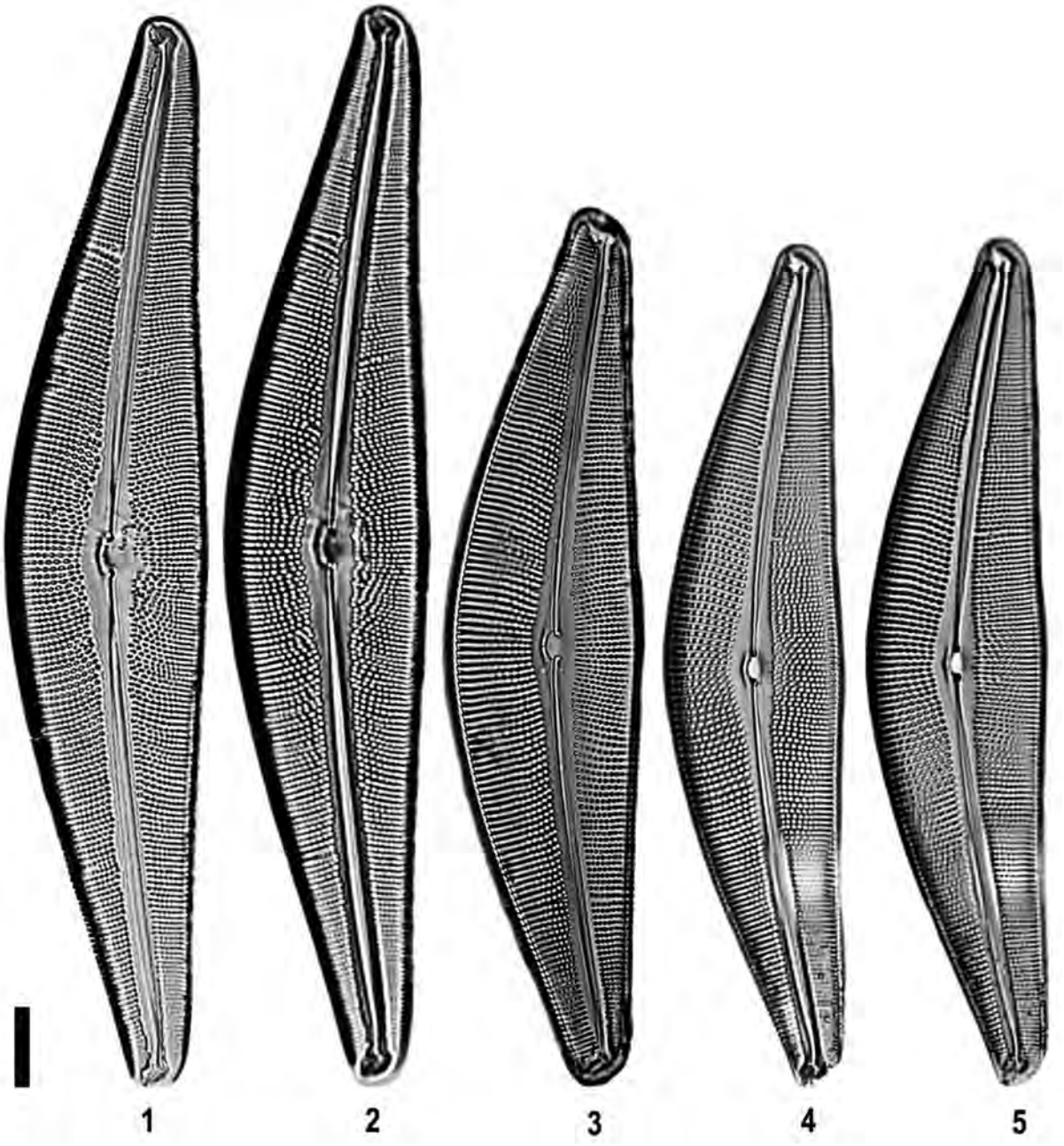


Plate 65: 1-4. *Cymbella peraspera* Krammer 2002, Radomno Lake; 5-6. Młynek Lake. Scale bar = 10 µm.

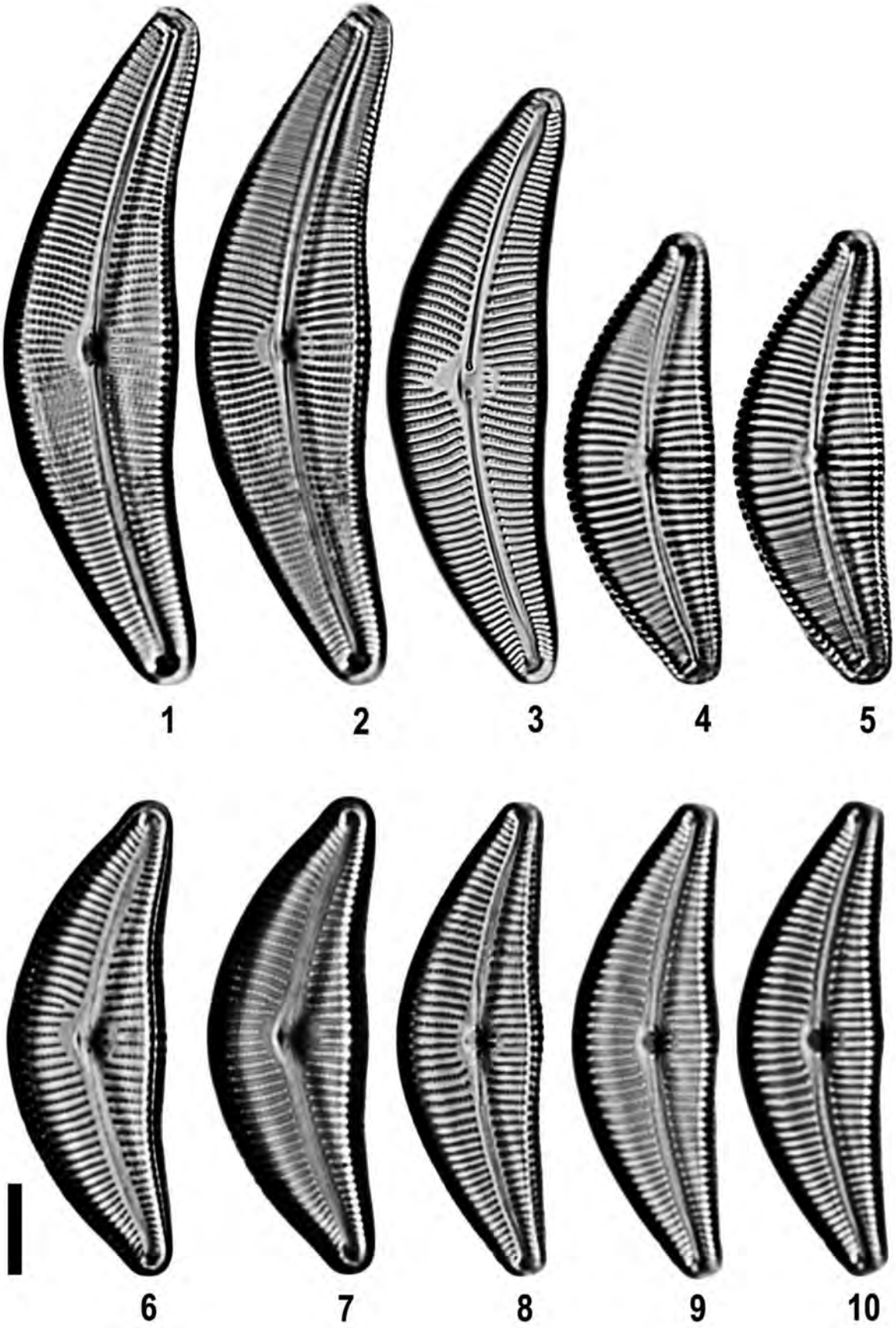


Plate 66: 1-10. *Cymbela proxima* Reimer 1975, 1-6. Jeziorak Lake; 7-10. Młynek Lake. Scale bar = 10 µm.

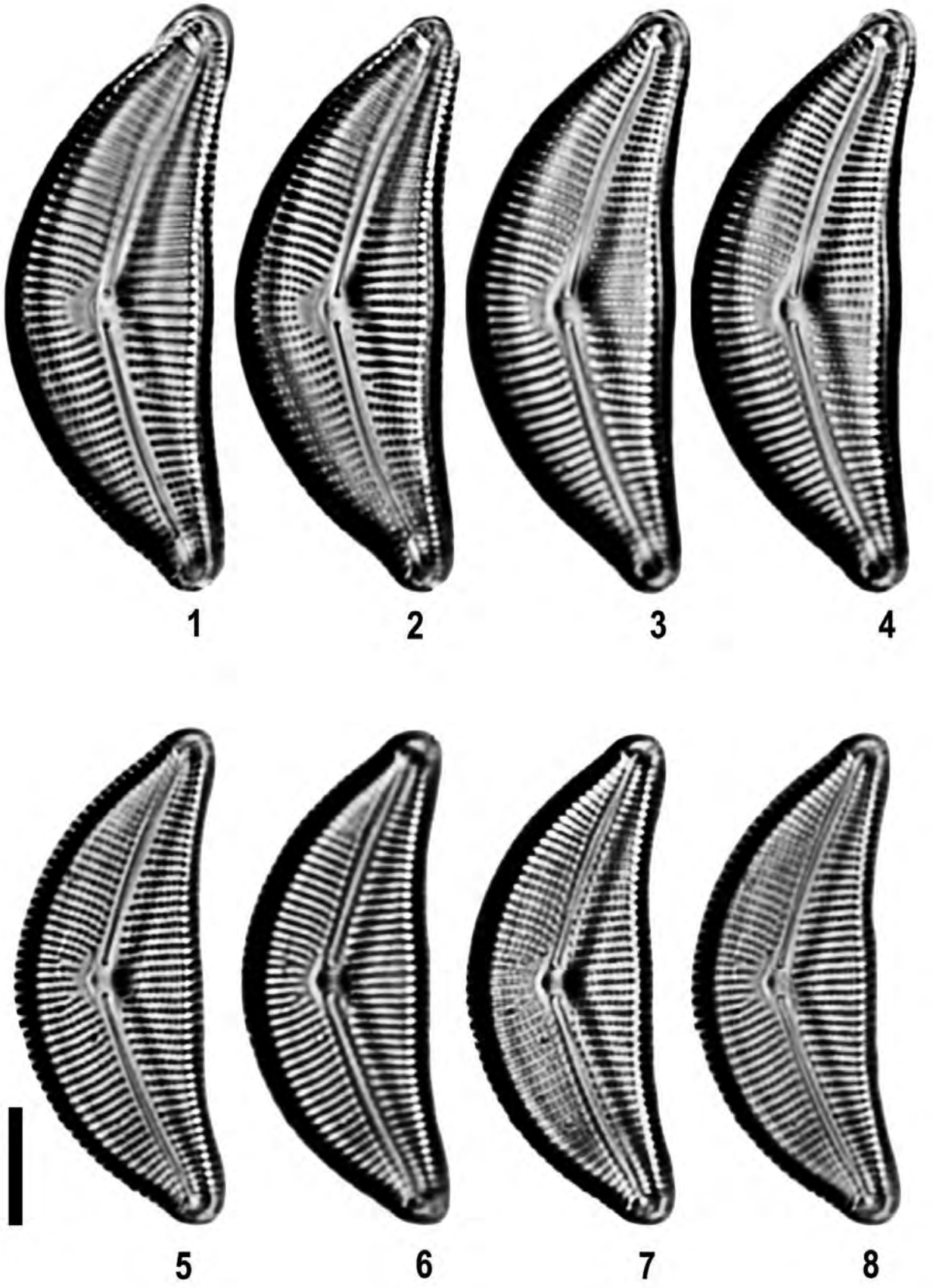


Plate 67: 1-6. *Cymbella proxima* var. *bottnica* Krammer 2002, Młynek Lake. Scale bar = 10 μm.

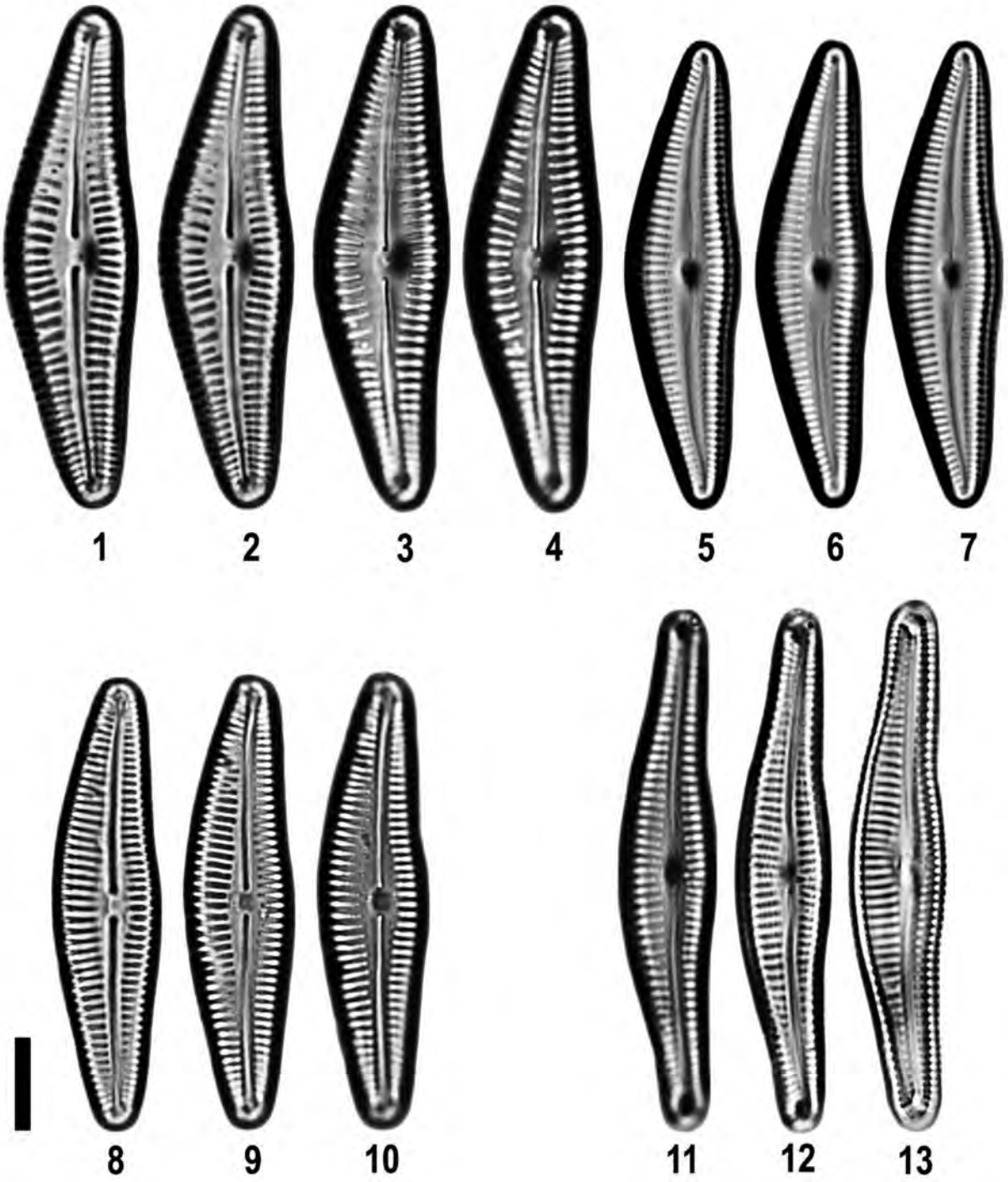


Plate 68: 1-4. *Cymbella radomnoensis* Zalat n. sp., Radomno Lake; 5-7. *Cymbella stigmaphora* Østrup 1910, Jeziorak Lake; 8-10. *Cymbella stigmaphora* var. *polonica* Zalat nov. var. Radomno Lake; 11-13. *Cymbella* sp.1 Radomno Lake.

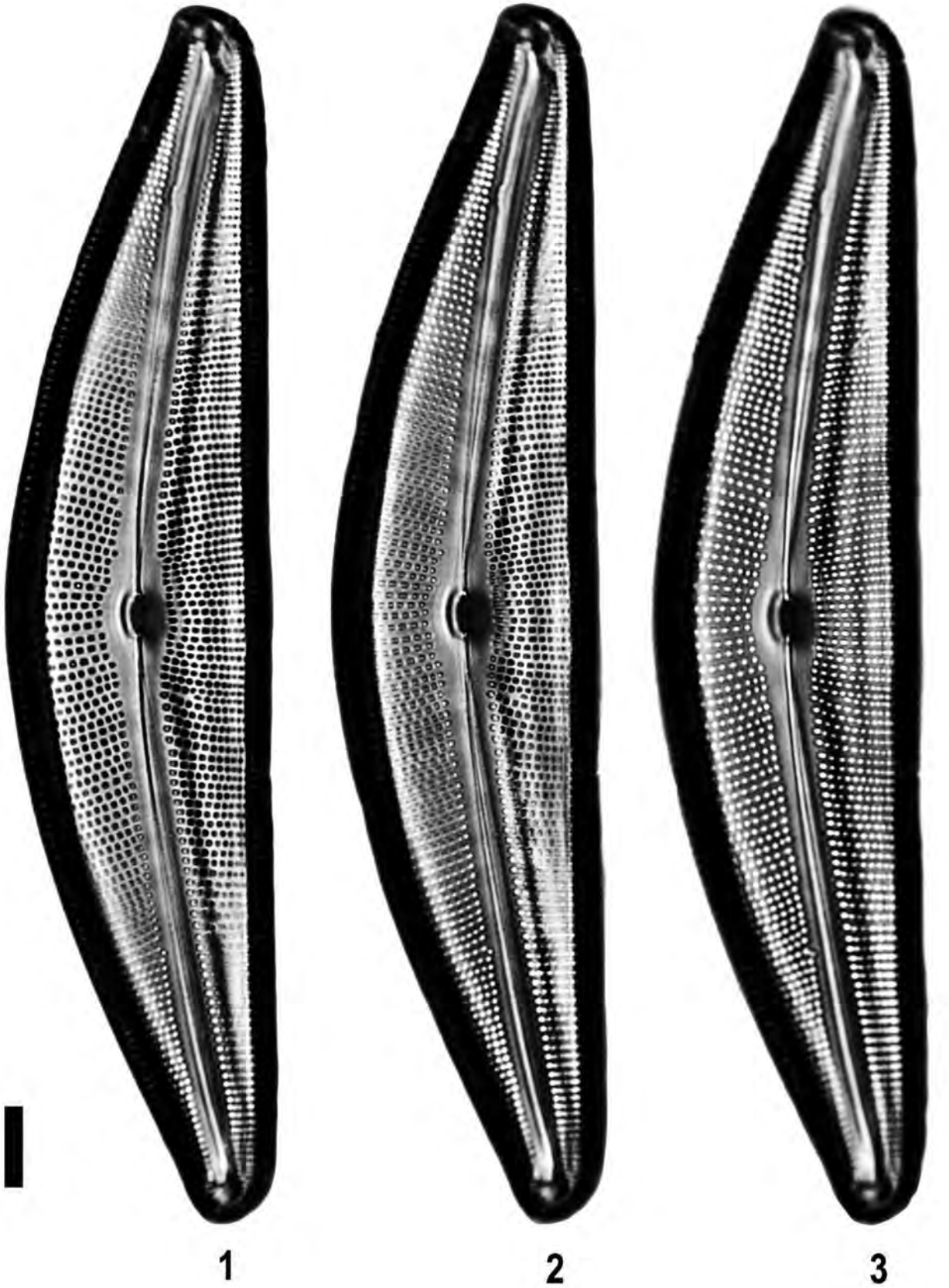


Plate 69: 1-3. *Cymbella subaspera* Krammer 2002, Radomno Lake. Scale bar = 10 µm.

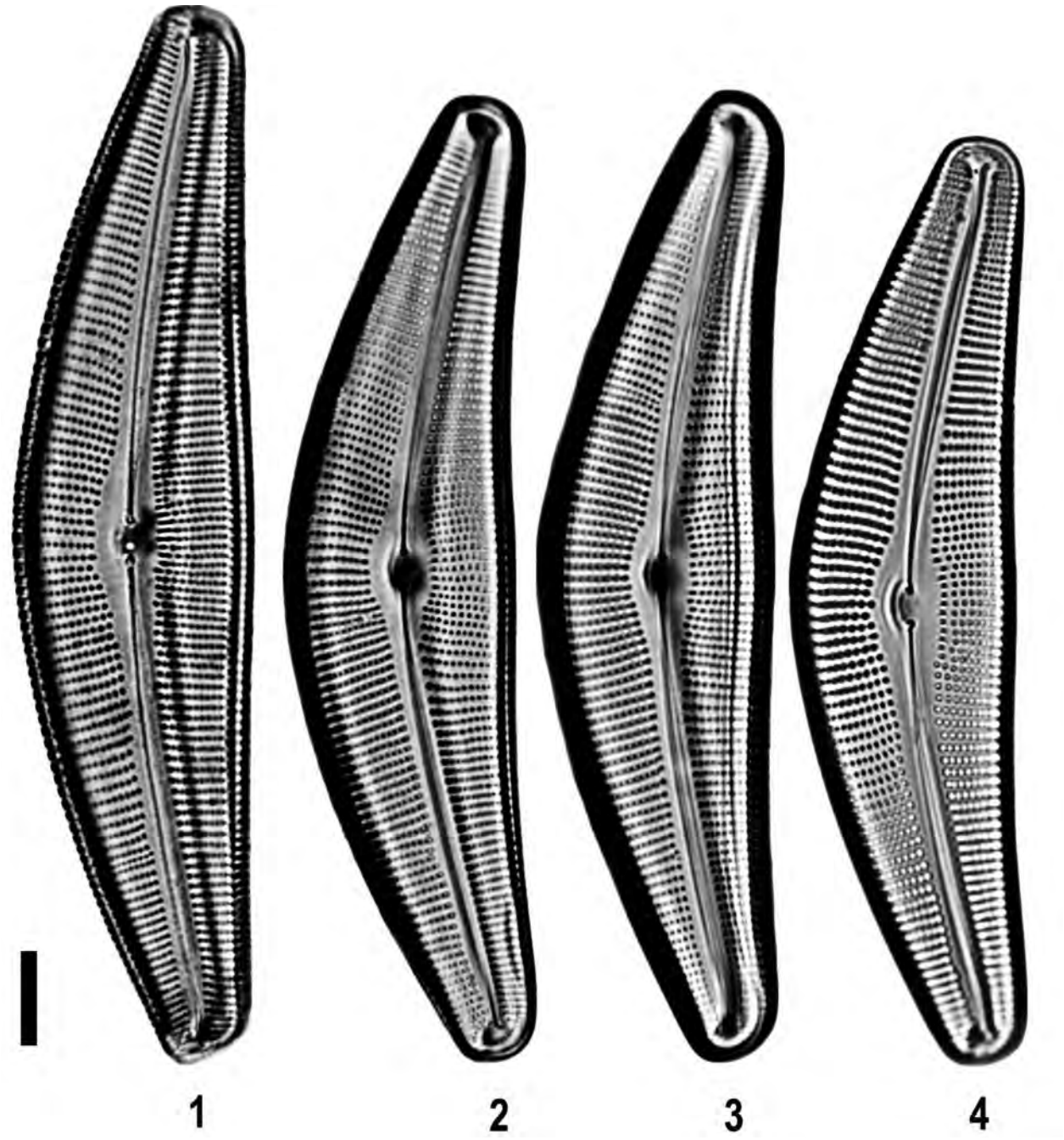


Plate 70: 1-4. *Cymbella subaspera* Krammer 2002, 1-2. Młynek Lake; 3-4. Radomno Lake. Scale bar = 10 µm.

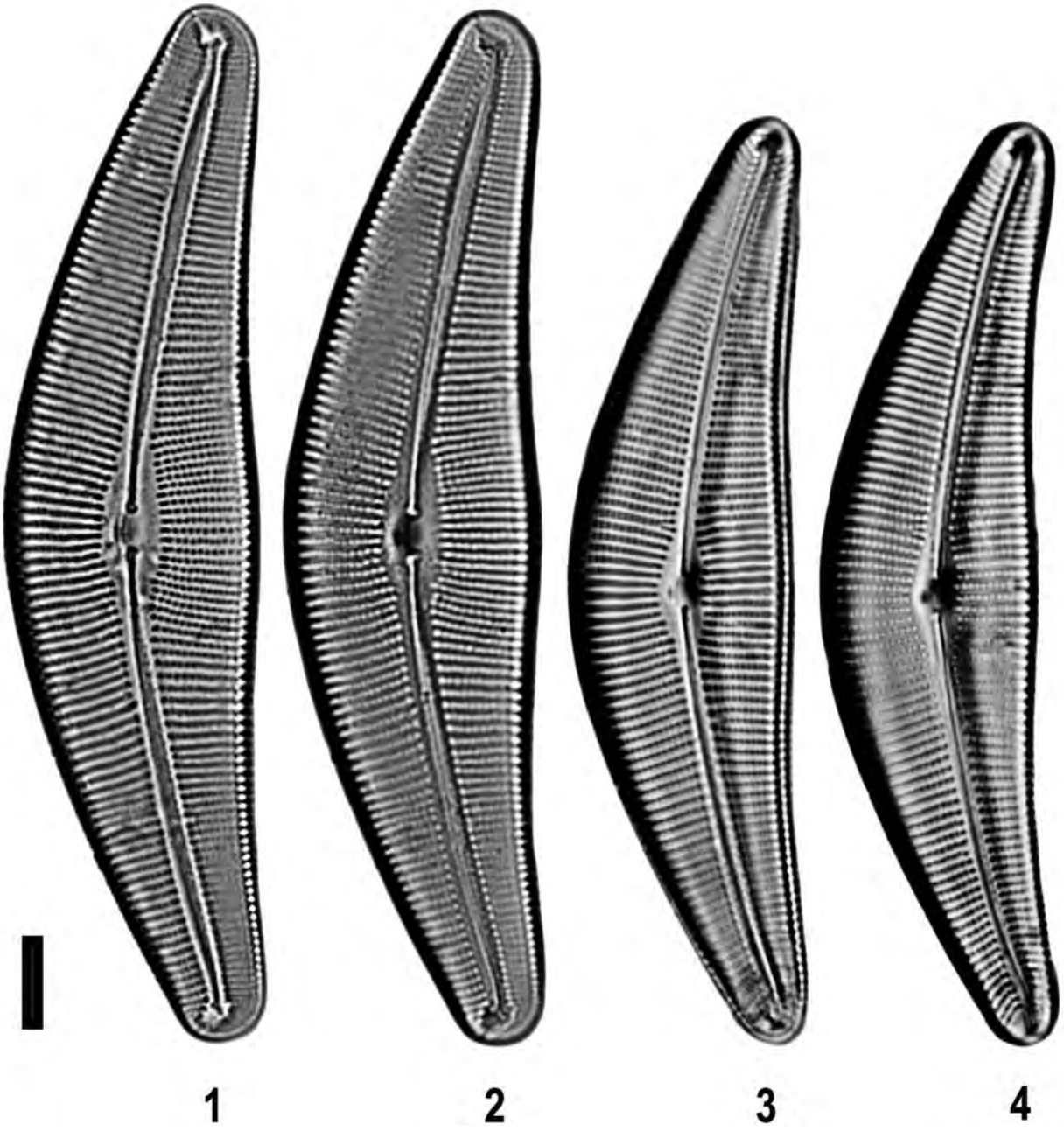


Plate 71: 1-4. *Cymbella subaspera* var. *fabianii* Zalat nov. var., Młynek Lake. Scale bar = 10 µm.

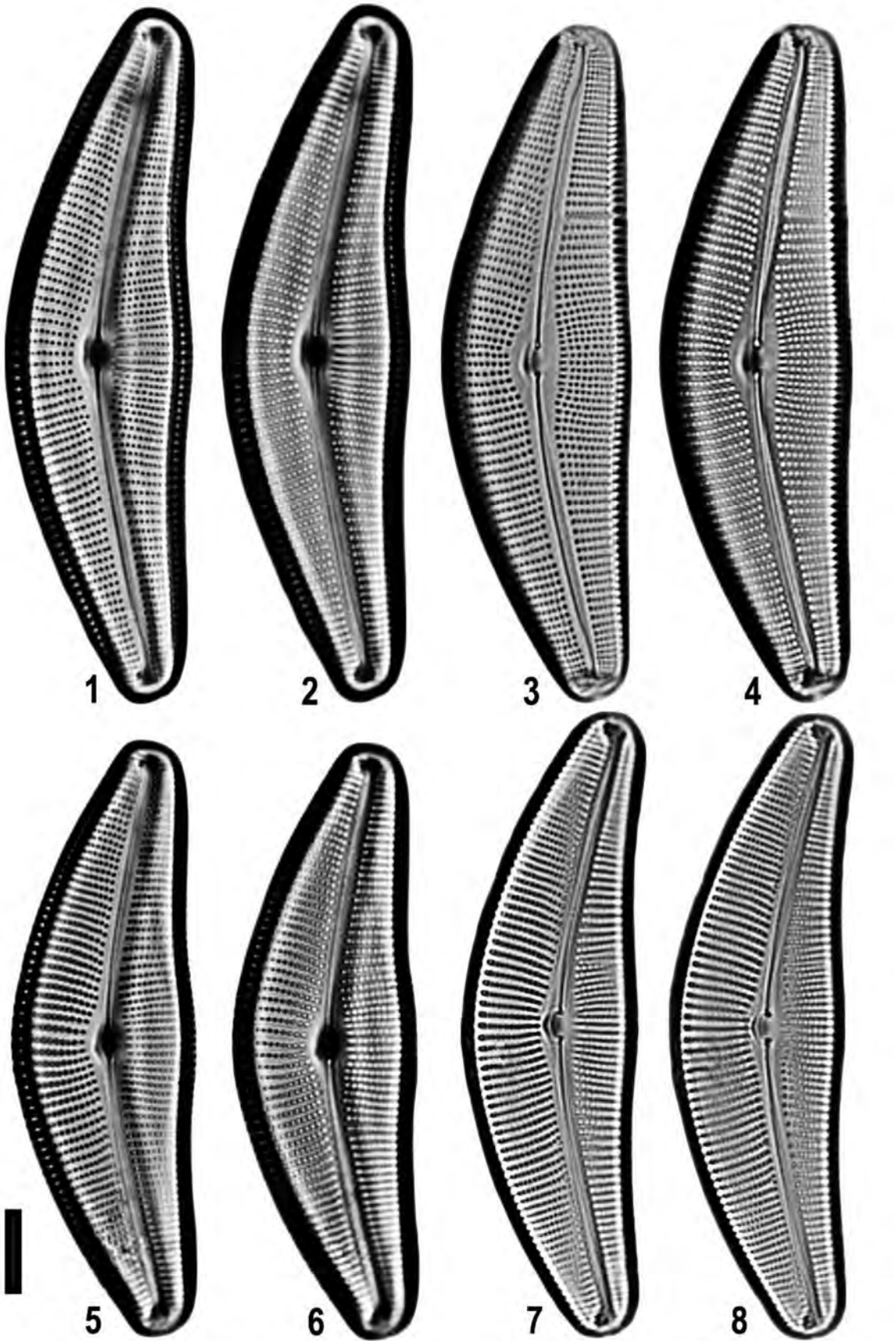


Plate 72: 1-8. *Cymbella subaspera* var. *salina* Krammer 2002, 1-4. Jeziorak Lake; 5-8. Młynek Lake. Scale bar = 10 µm.

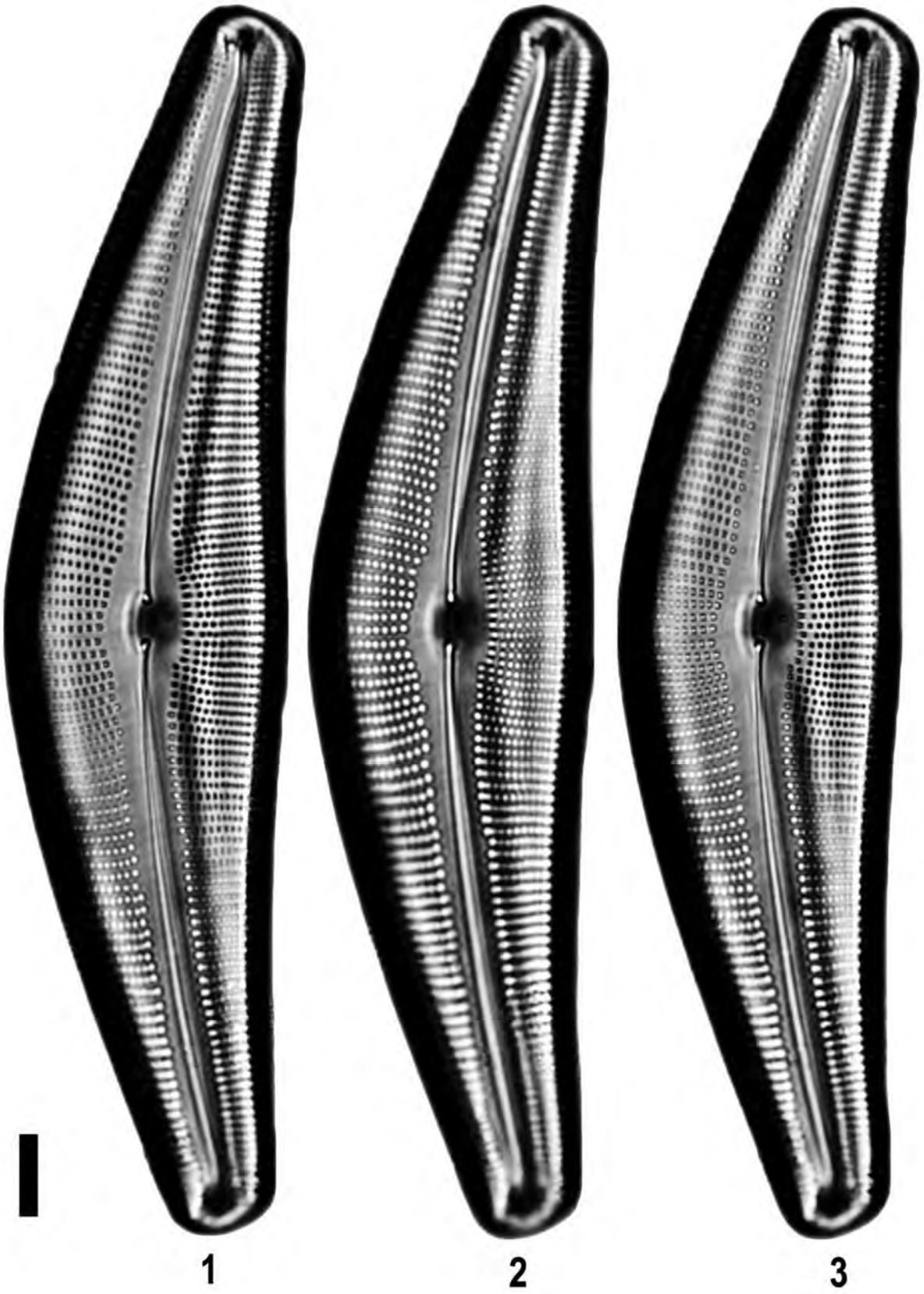


Plate 73: 1-3. *Cymbella subhimalaspera* Jüttner & Van de Vijver 2010, Radomno Lake. Scale bar = 10 µm.

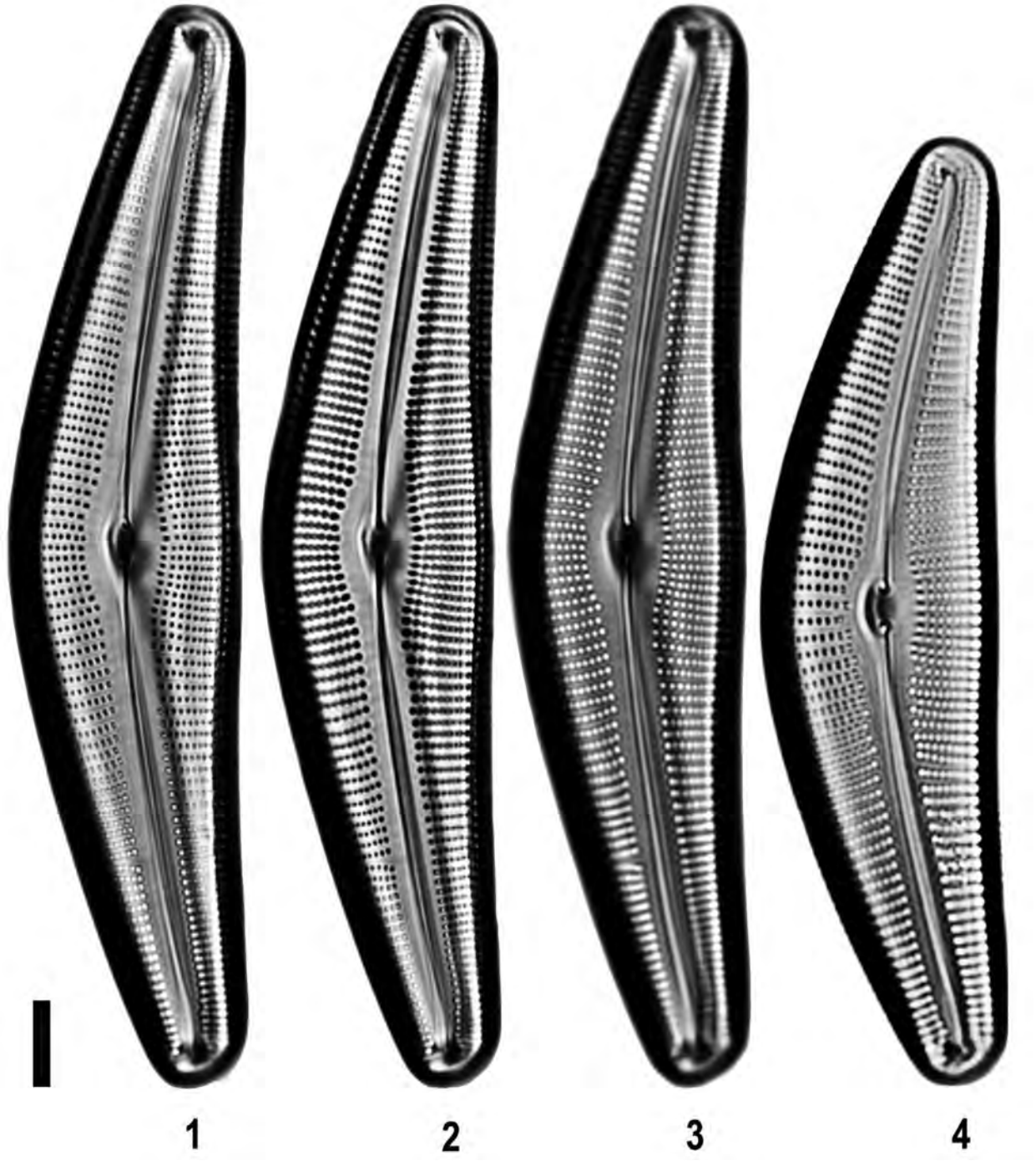


Plate 74: 1-4. *Cymbella subhimalaspera* Jüttner & Van de Vijver 2010, Radomno Lake. Scale bar = 10 µm.

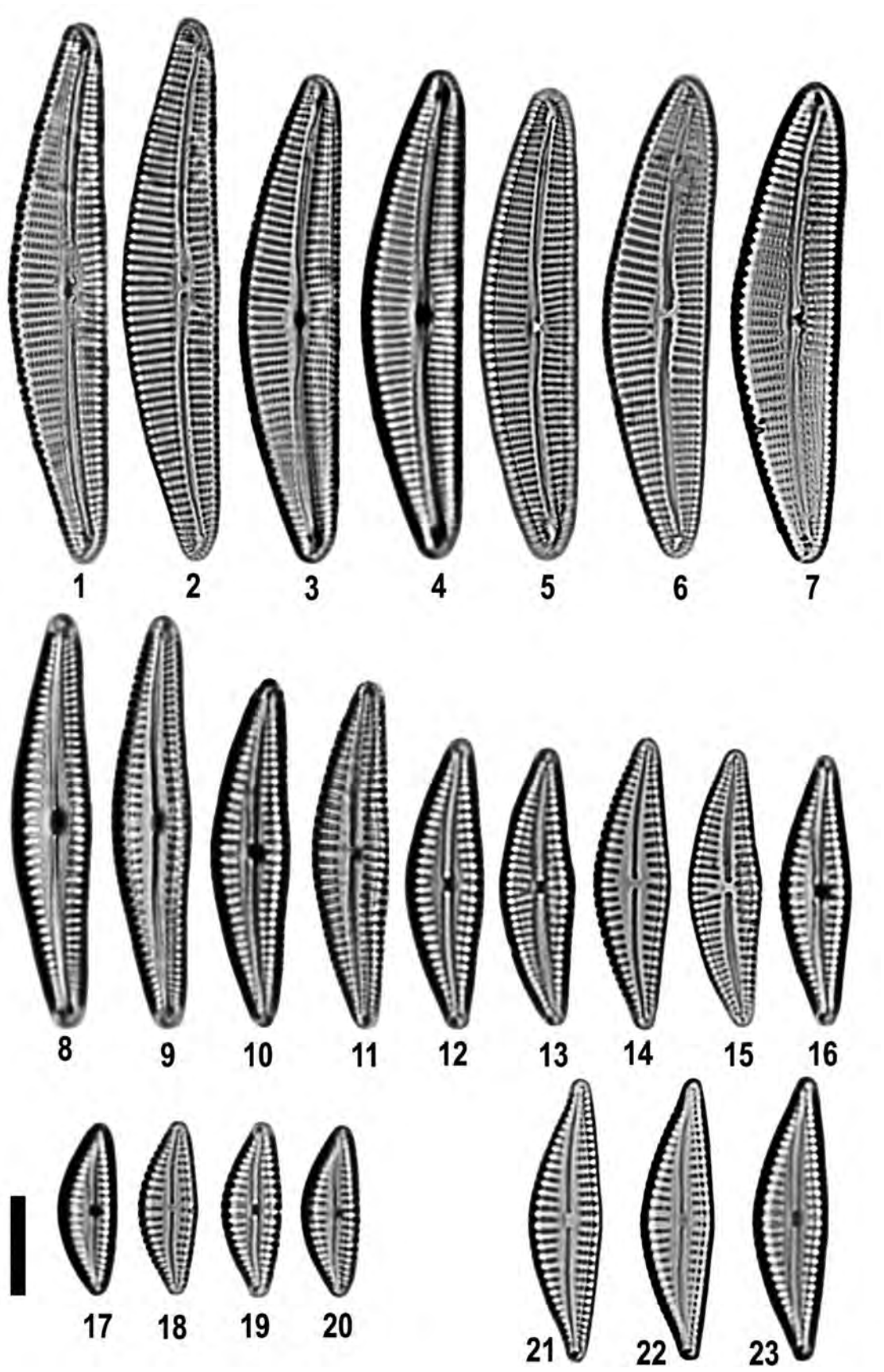


Plate 75: 1-7. *Cymbella subhelvetica* Krammer 2002, 1-5. Kamionka Lake; 6-7. Radomno Lake; 8-20. *Cymbella subleptoceros* Krammer 2002, Radomno Lake; 21-23. *Cymbella subleptoceros* var. *rostrata* Zalat nov. var. Jeziorak Lake. Scale bar = 10 µm.

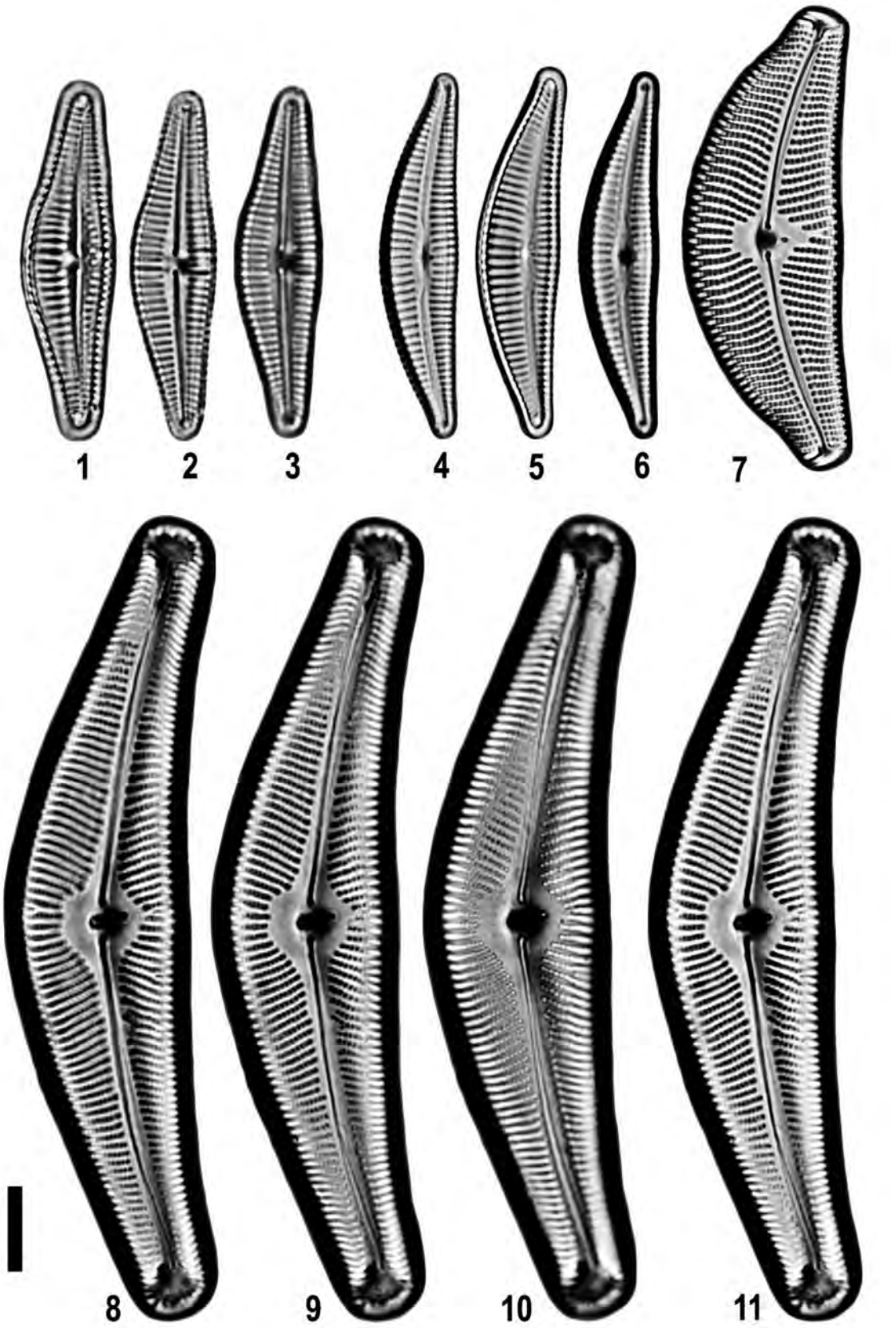


Plate 76: 1-3. *Cymbella vidarbhensis* Sarode & Kamat 1984, Radomno Lake; 4-6. *Cymbella vulgata* Krammer 2002, Radomno Lake; 7. *Cymbella tumida* (Brébisson) Van Heurck 1880, Eemian palaeolake deposits of central Poland; 8-11. *Cymbella tumida* var. *nitychorukii* Zalat nov. var., Młynek Lake. Scale bar = 10 µm.

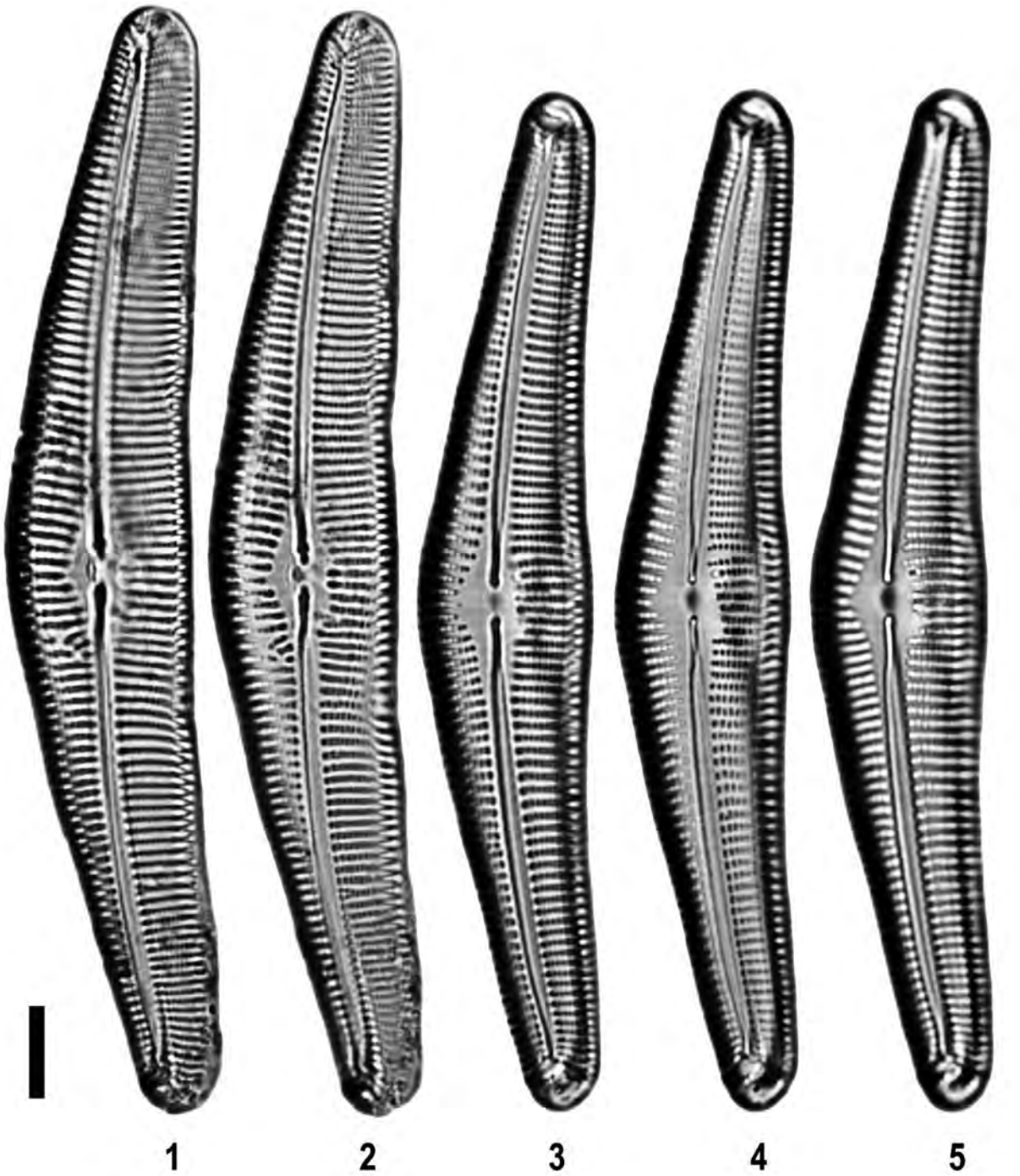


Plate 77: 1-5. *Cymbella tumida* f. *major* Rich 1937, Radomno Lake. Scale bar = 10 µm.

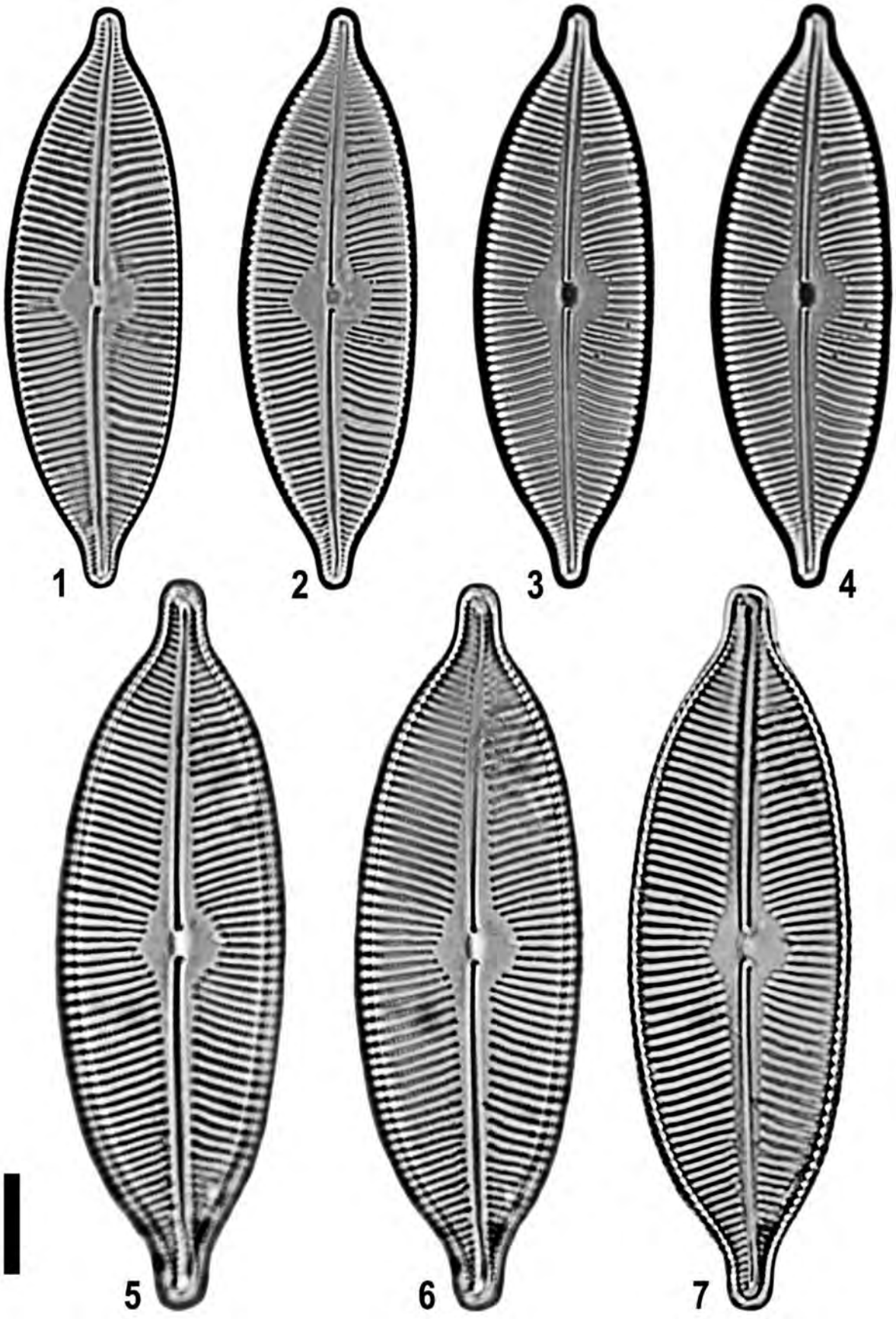


Plate 78: 1-7. *Cymbopleura acuta* (Schmidt) Krammer 2003, Kamionka Lake. Scale bar = 10 µm.

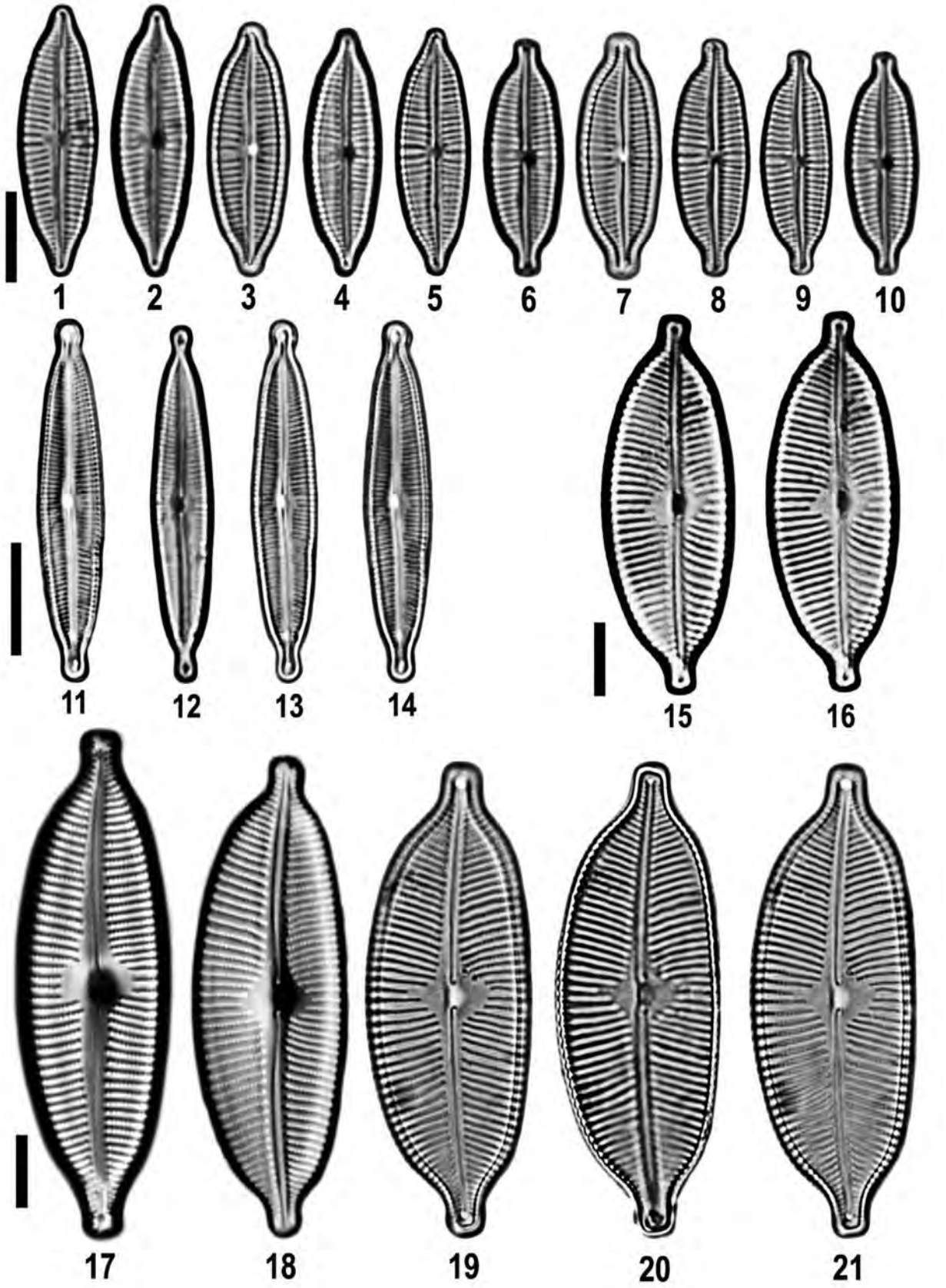


Plate 79: 1-10. *Cymbopleura amphicephala* (Nägeli) Krammer 2003, 1-2. Jeziorak Lake; 3-5. Kamionka Lake; 6-10. Radomno Lake; 11-14. *Cymbopleura angustata* (Smith) Krammer 2003, Eemian paleolake; 15-21. *Cymbopleura anglica* (Lagerstedt) Krammer 2003, 15-16. Eemian palaeolake deposits of central Poland; 17-21. Młynek Lake. Scale bar = 10 µm.

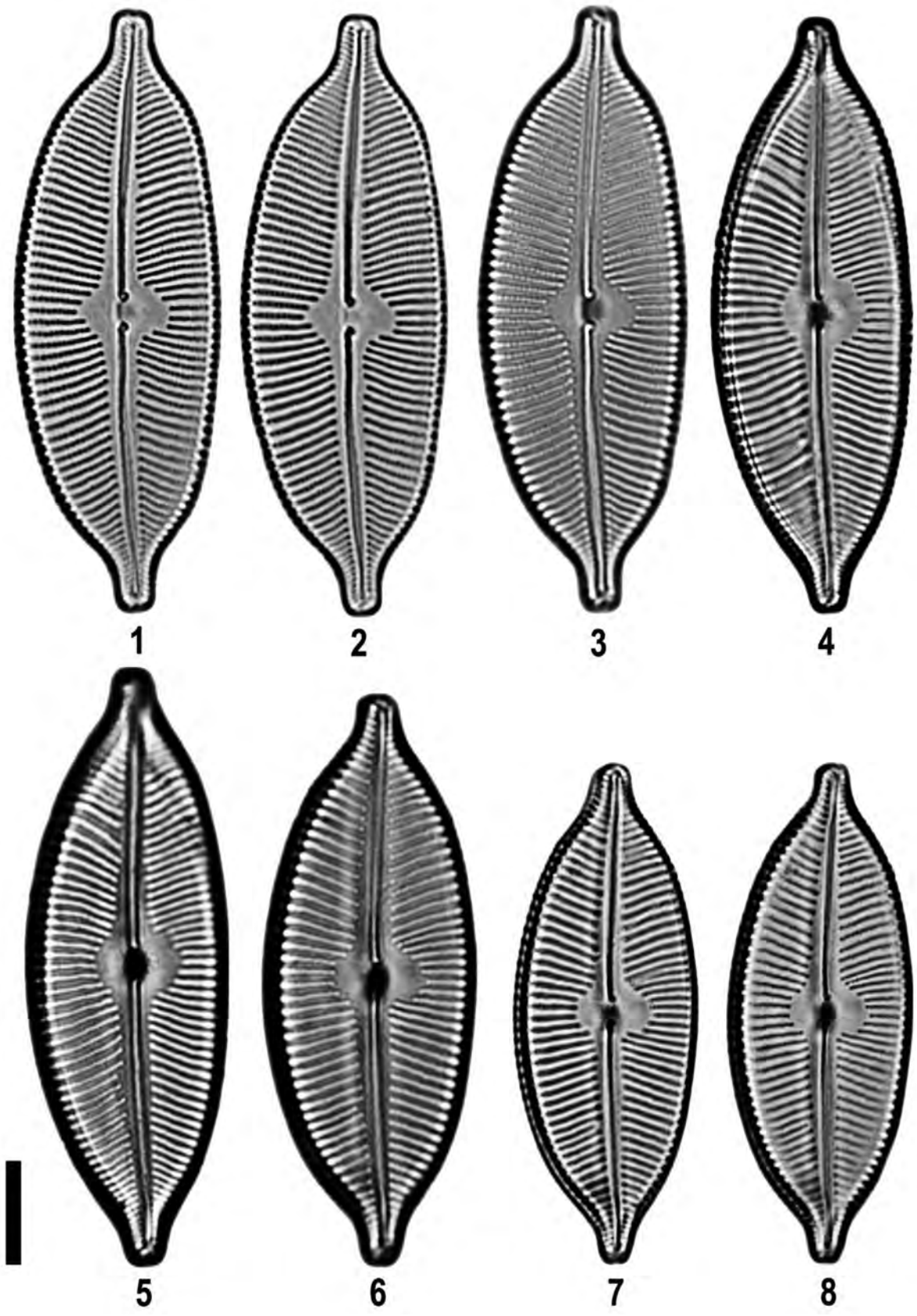


Plate 80: 1-8. *Cymbopleura anglica* (Lagerstedt) Krammer 2003**,** Kamionka Lake. Scale bar = 10 µm.

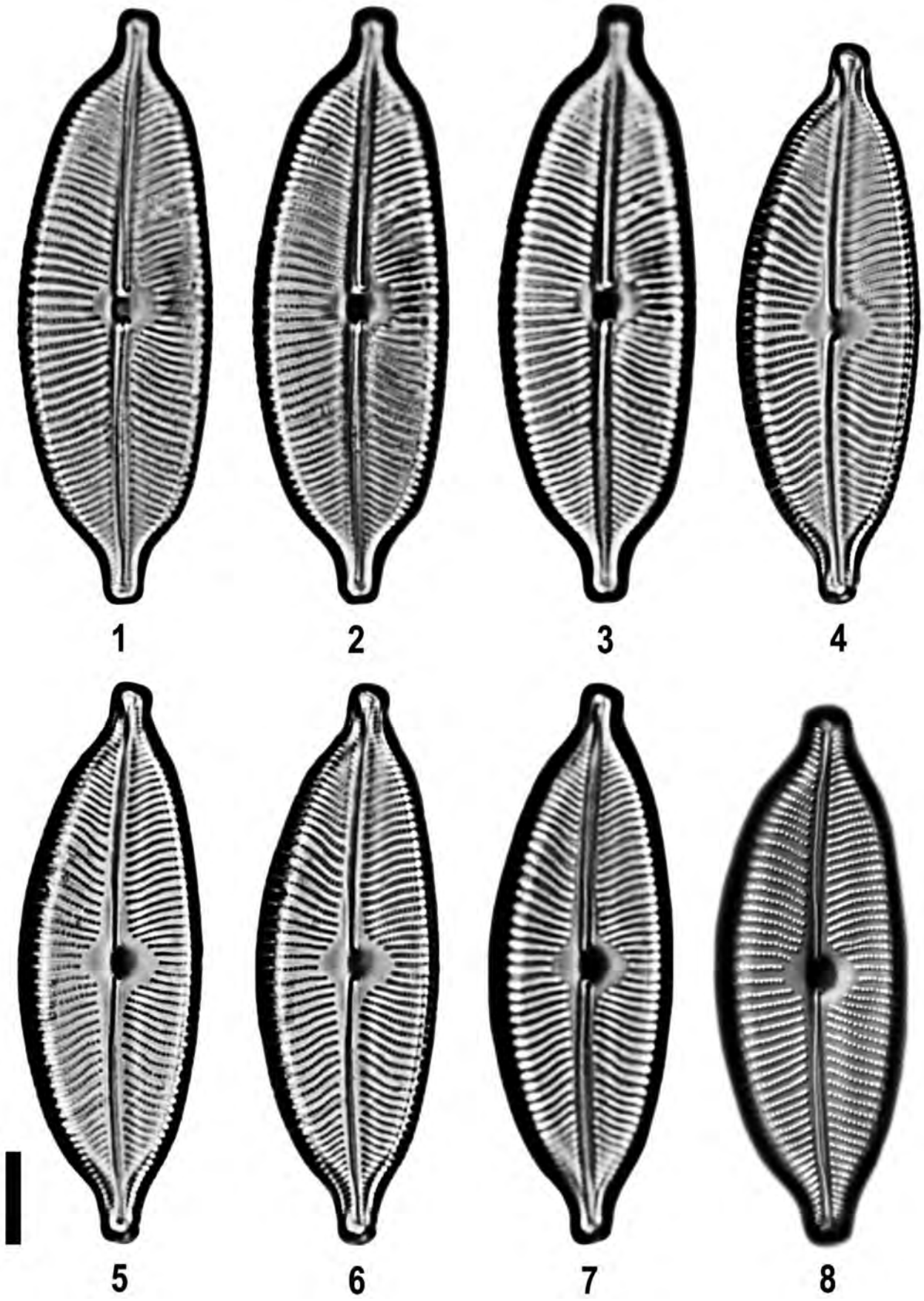


Plate 81: 1-8. *Cymbopleura anglica* (Lagerstedt) Krammer 2003**,** Kamionka Lake. Scale bar = 10 μm.

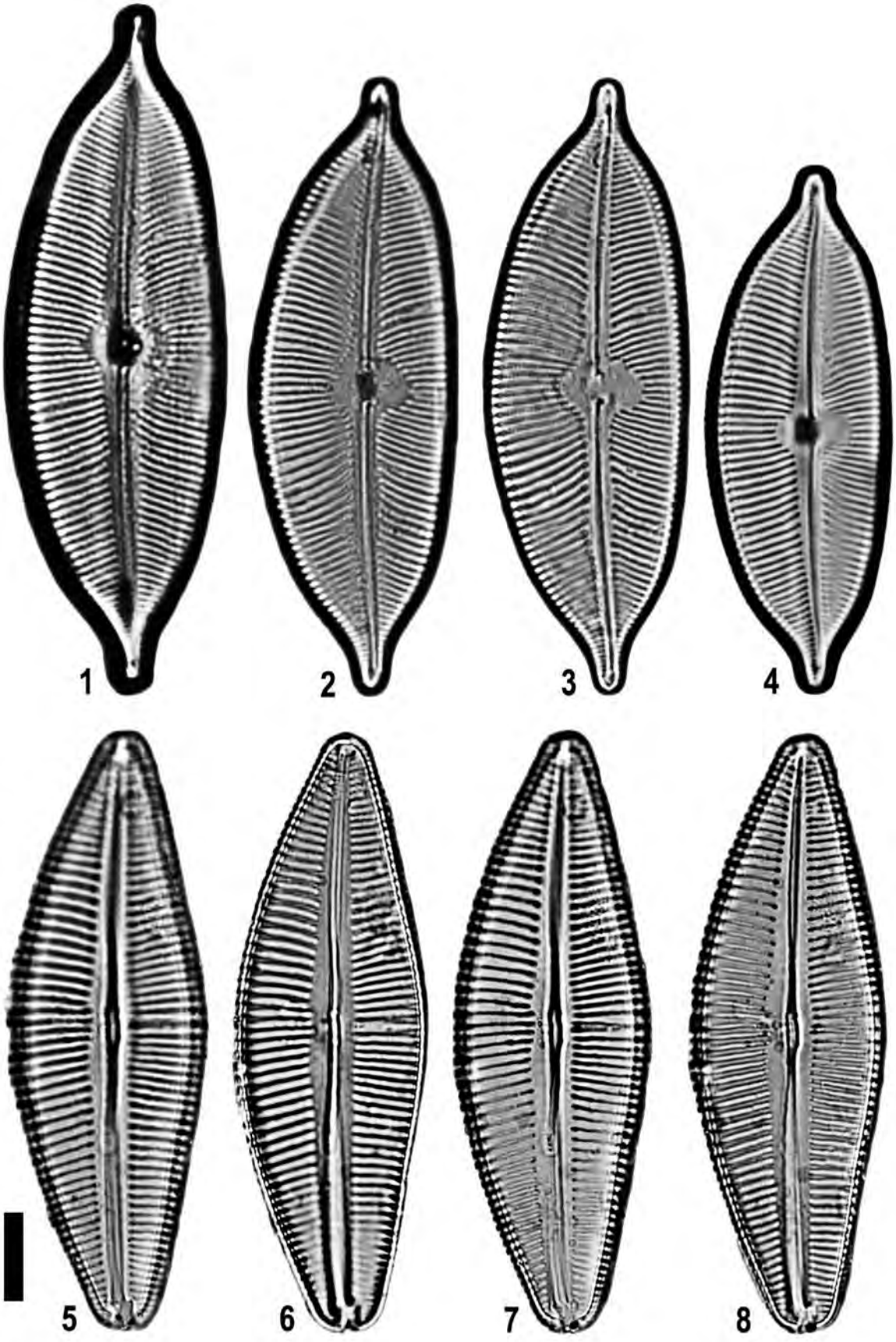


Plate 82: 1-4. *Cymbopleura apiculata* Krammer 2003, Kamionka Lake; 5-8. *Cymbopleura austriaca* (Grunow) Krammer 2003, Kamionka Lake. Scale bar = 10 µm.

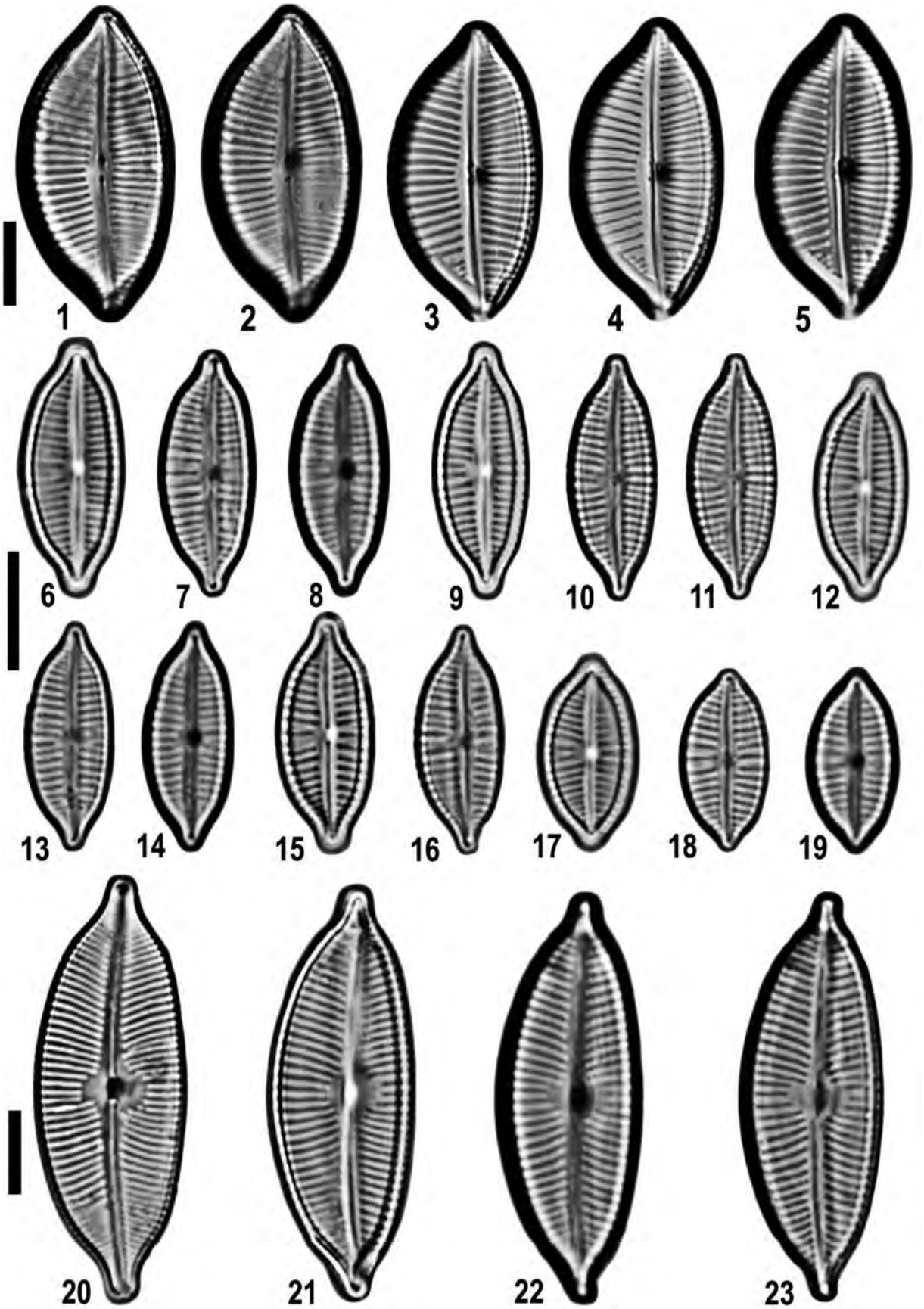


Plate 83: 1-5. *Cymbopleura budayana* (Pantocsek) Krammer 2003, Jeziorak Lake; 6-19. *Cymbopleura citrus* (Carter & Bailey-Watts) Krammer 2003; Jeziorak Lake; 20-23. *Cymbopleura cuspidata* (Kützing) Krammer 2003, 15-18. Jeziorak Lake. Scale bar = 10 µm.

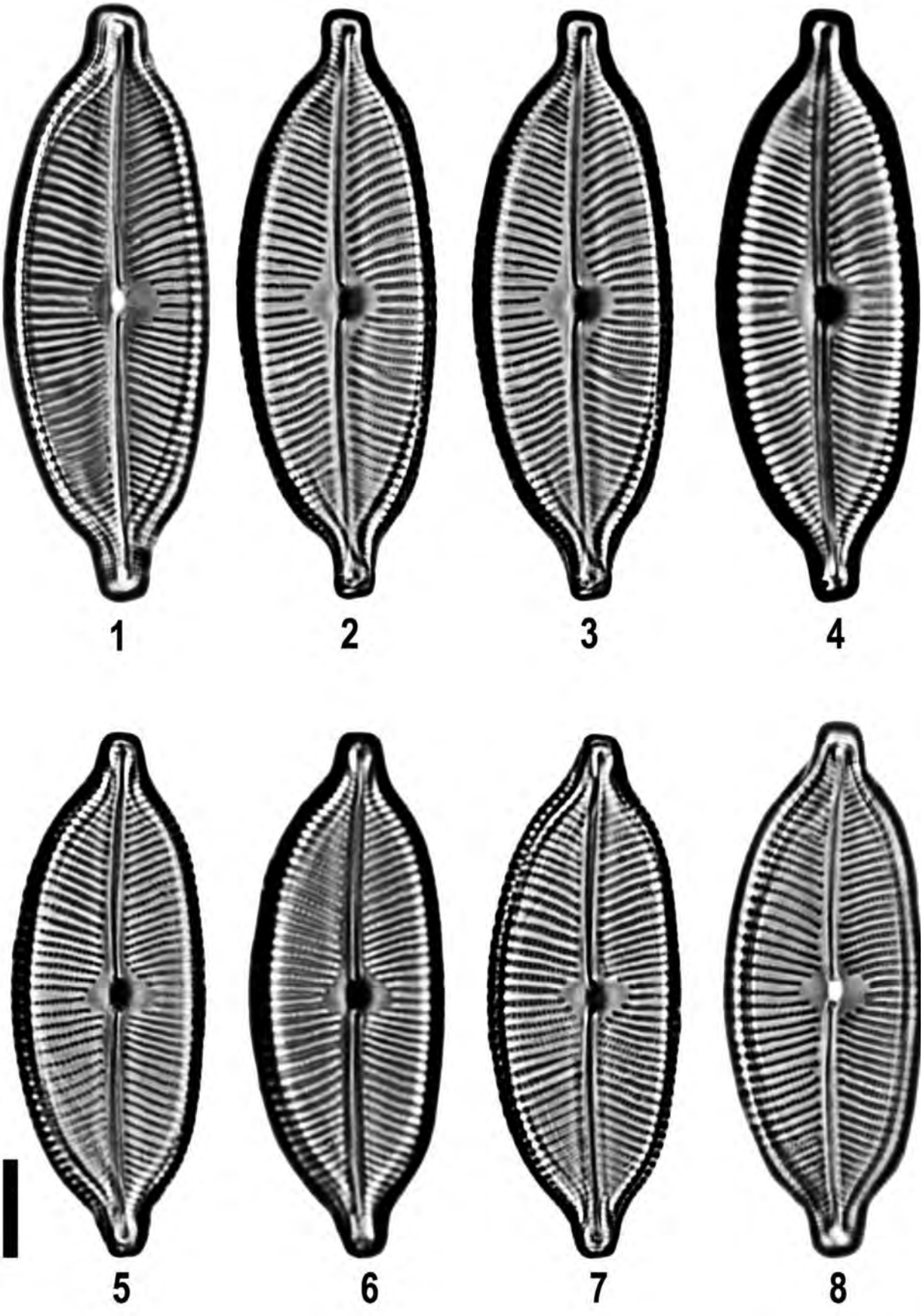


Plate 84: 1-8. *Cymbopleura cuspidata* (Kützing) Krammer 2003, Młynek Lake. Scale bar = 10 µm.

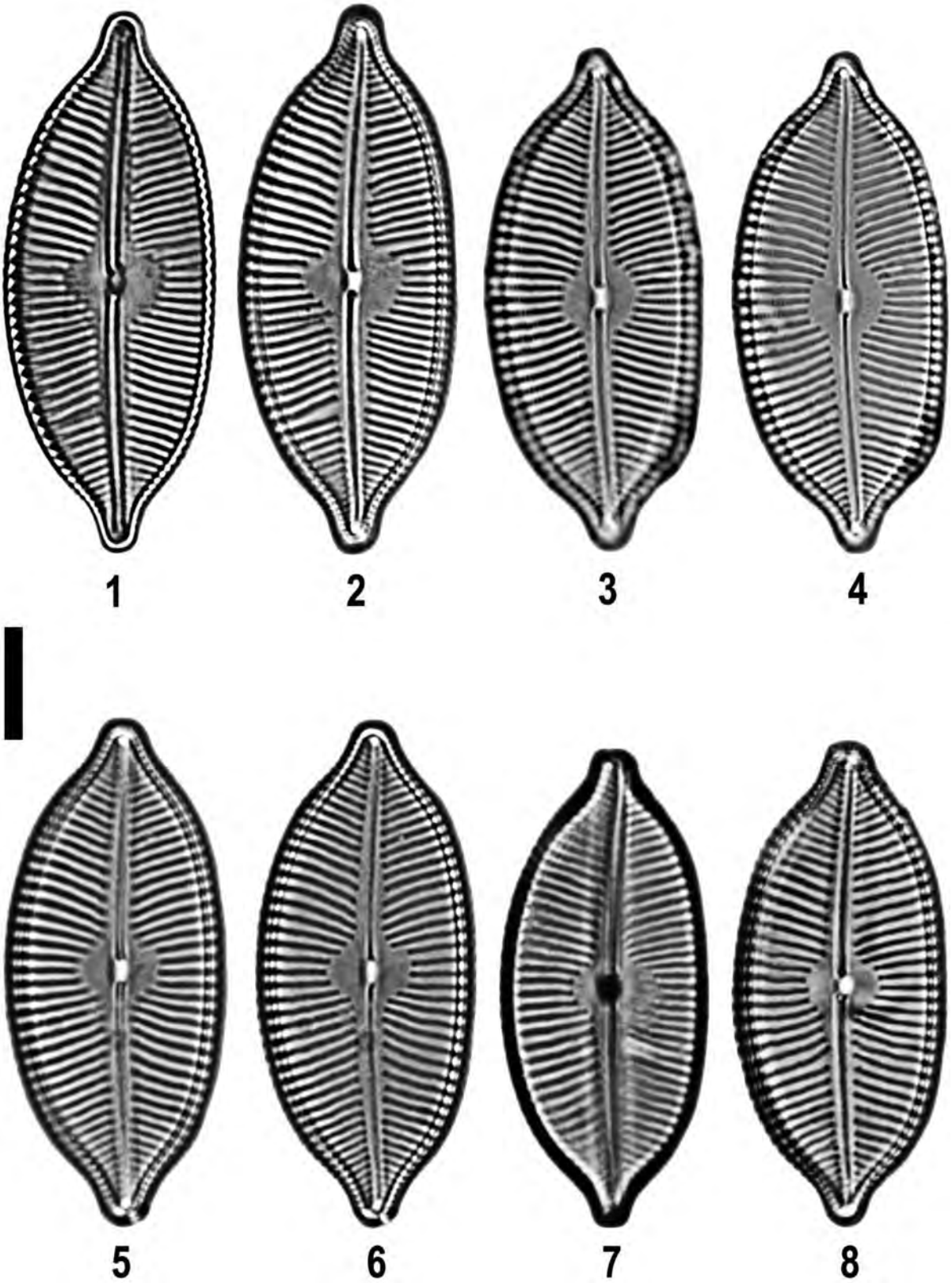


Plate 85: 1-8. *Cymbopleura cuspidata* var. *compacta* Zalat nov. var., 1-8. Kamionka Lake. Scale bar = 10 μm.

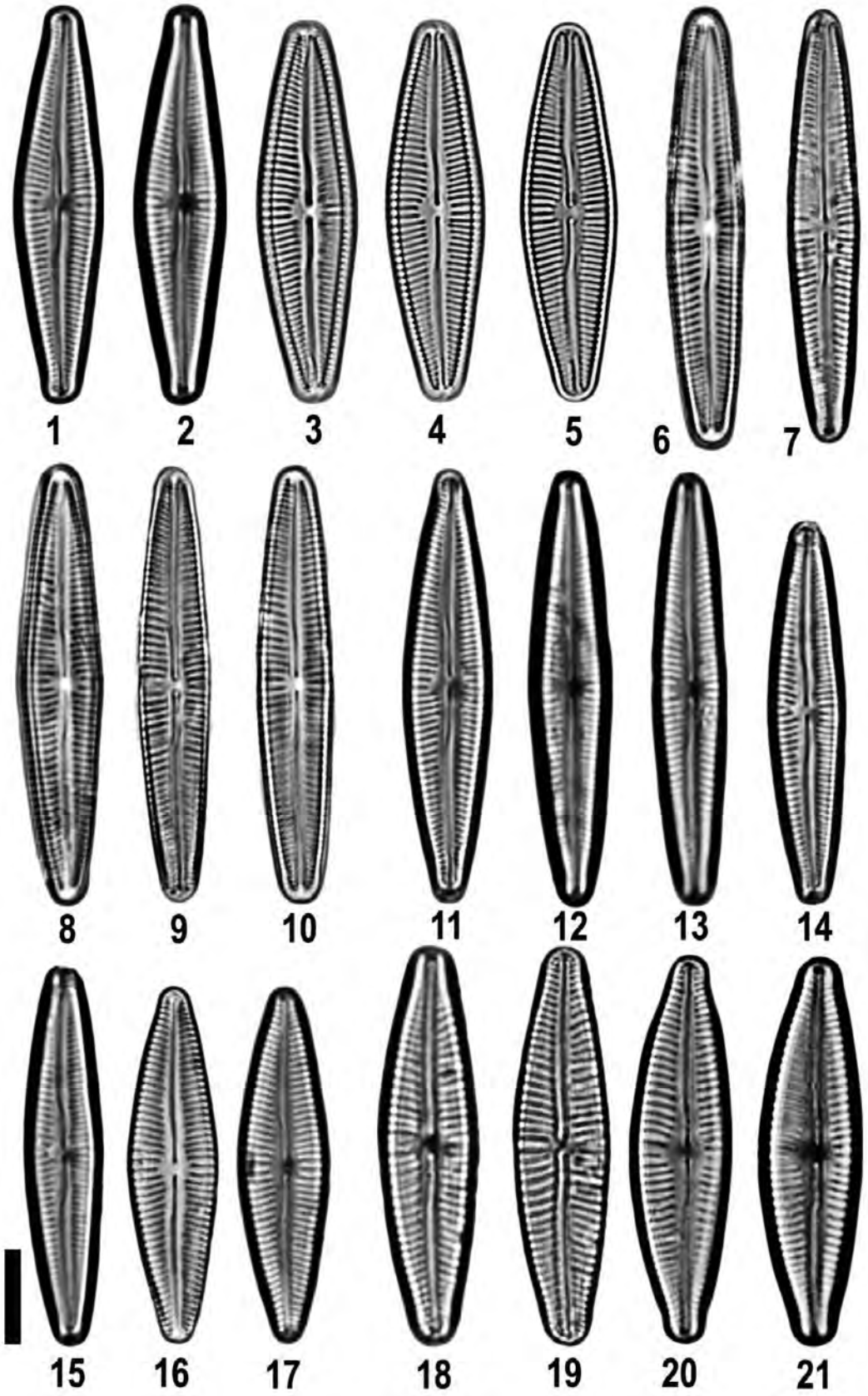


Plate 86: 1-10. *Cymbopleura florentina* (Grunow) Krammer 2003, 1-5.Radomno Lake; 6-10. Eemian paleolake deposits of central Poland; 11-17. *Cymbopleura florentina* var. *brevis* Krammer 2003, 11. Radomno Lake, 12-17. Eemian paleolake deposits of central Poland; 18-21. *Cymbopleura florentiniformis* Krammer 2003, Młynek Lake. Scale bar = 10 µm.

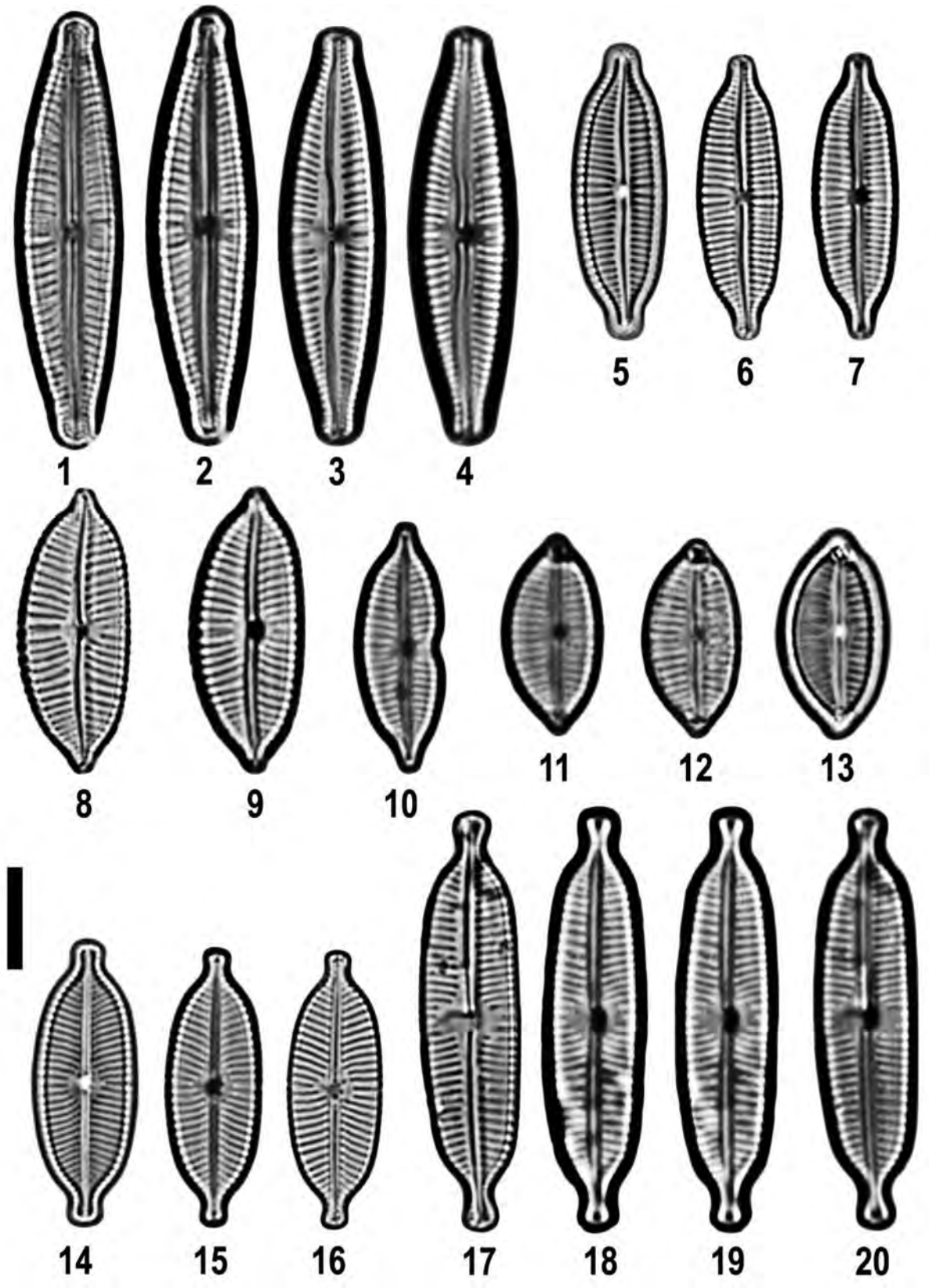


Plate 87: 1-4. *Cymbopleura florentiniformis* Krammer 2003, Młynek Lake; 5-7. *Cymbopleura frequens* Krammer 2003, Radomno Lake; 8-13. *Cymbopleura hercynica* (A. Schmidt) Krammer 2003, 8-9. Radomno Lake; 10-13. Jeziorak Lake; 14-16. *Cymbopleura hybrida* (Grunow) Krammer 2003, Młynek Lake; 17-20. *Cymbopleura hybrida* var. *capitata* (Grunow) Krammer 2003, Eemian paleolake .deposits of central Poland. Scale bar = 10 µm

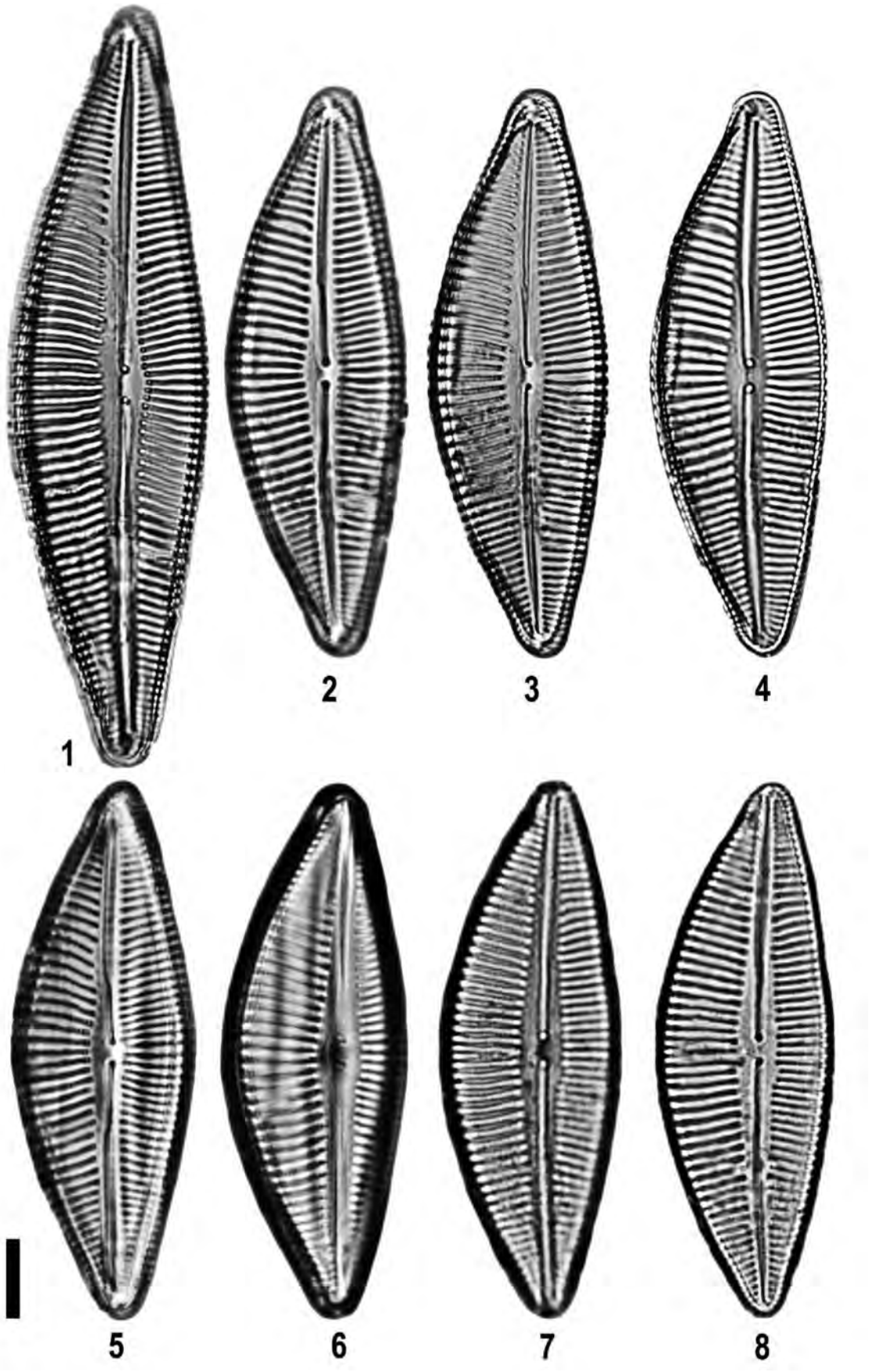


Plate 88: 1-8. *Cymbopleura inaequalformis* Krammer 2003, Kamionka Lake. Scale bar = 10 µm.

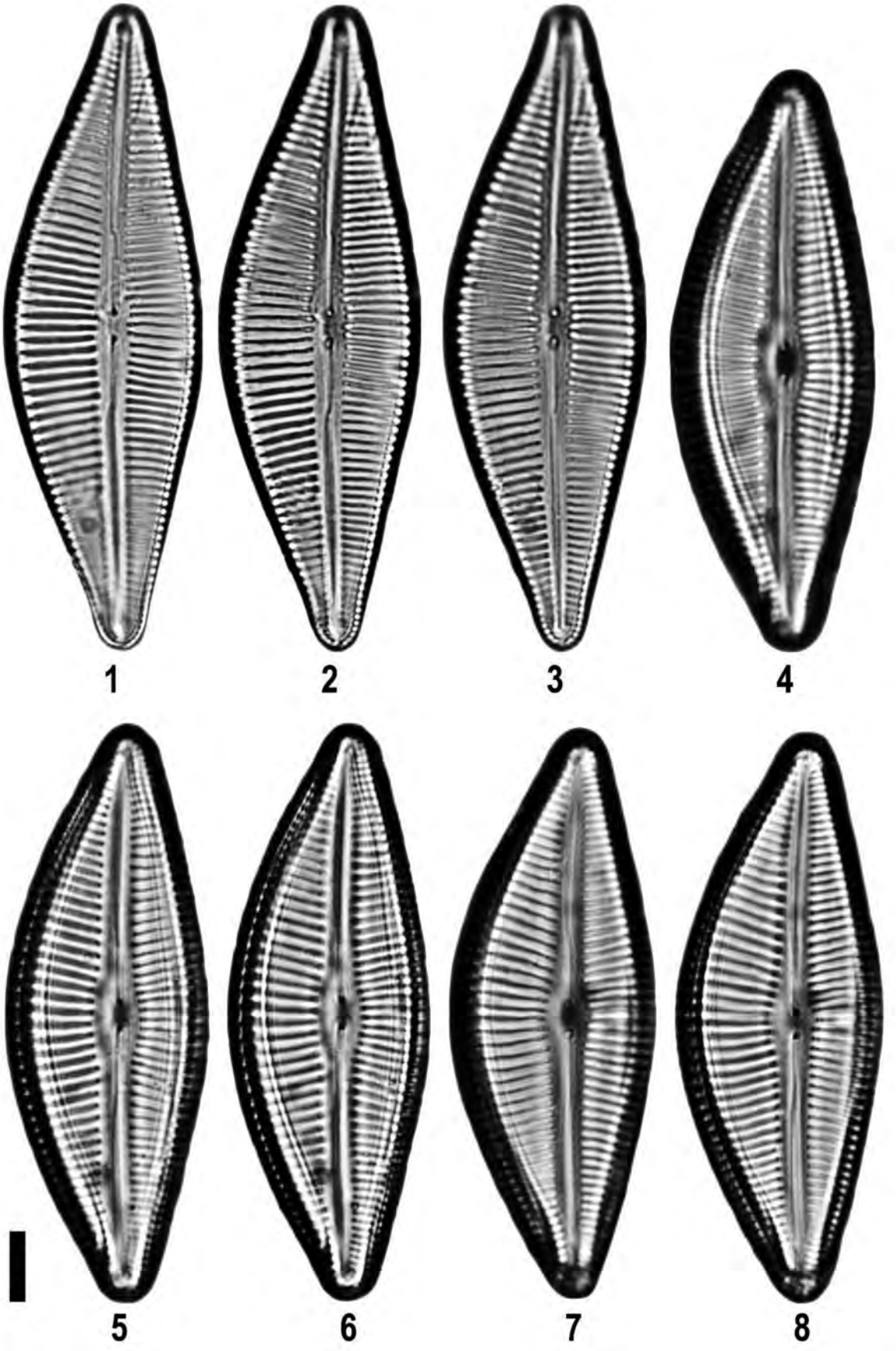


Plate 89: 1-8. *Cymbopleura inaequalformis* Krammer 2003, Kamionka Lake. Scale bar = 10 μm.

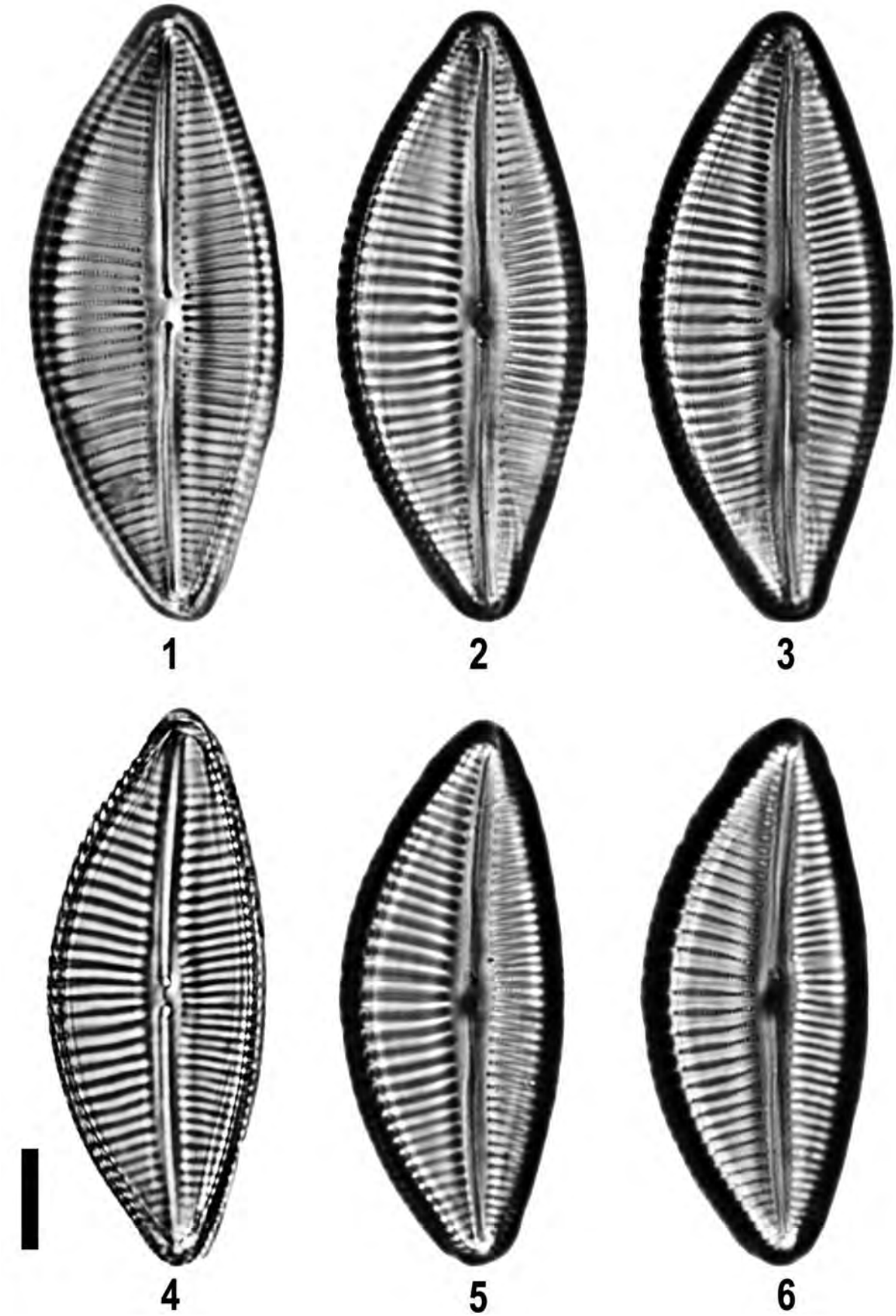


Plate 90: 1-6. *Cymbopleura inaequalformis* Krammer 2003, Kamionka Lake. Scale bar = 10 µm.

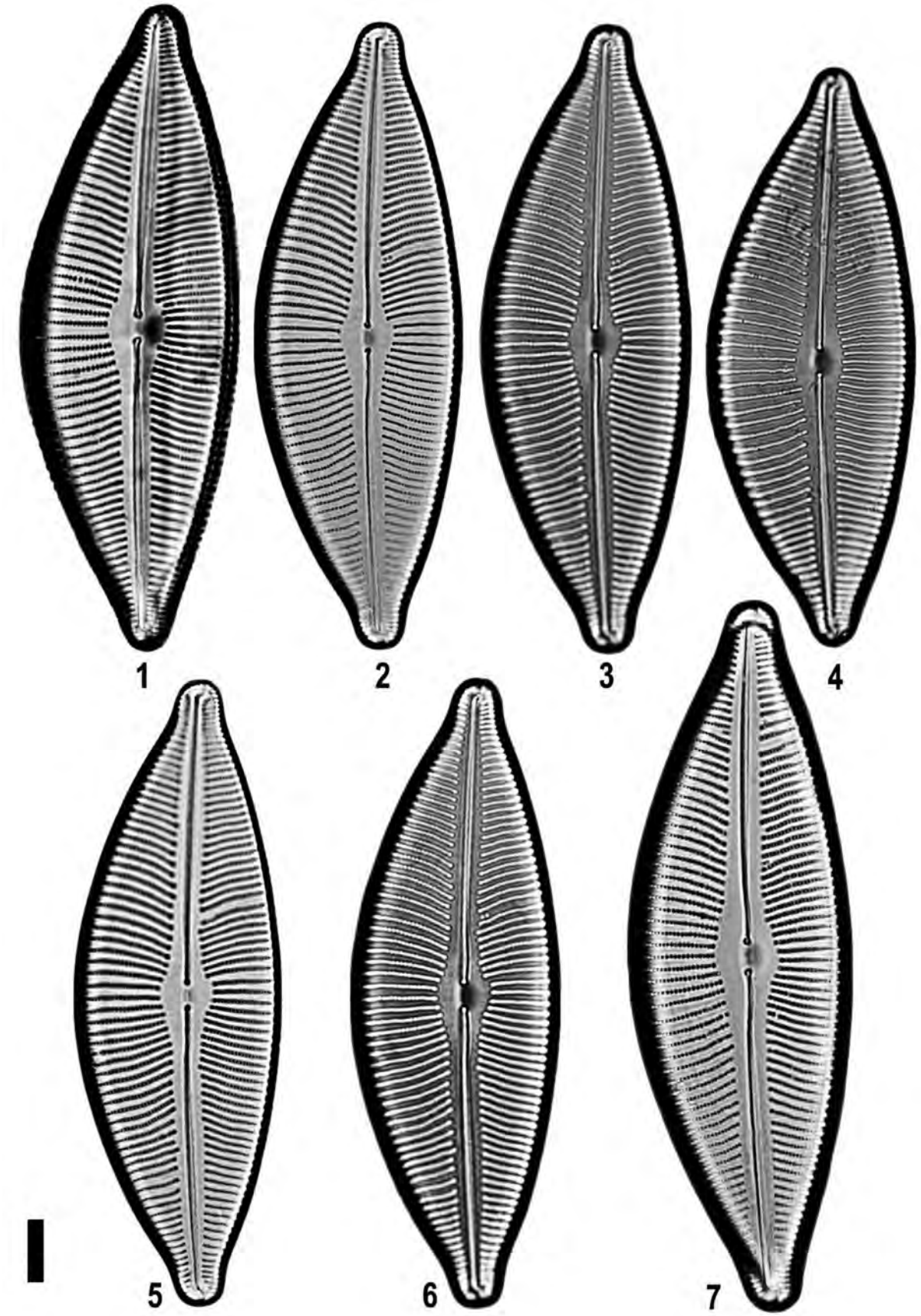


Plate 91: 1-7. *Cymbopleura inaequalis* (Ehrenberg) Krammer 2003, 1-4. Młynek Lake; 5-7. Radomno Lake. Scale bar = 10 µm.

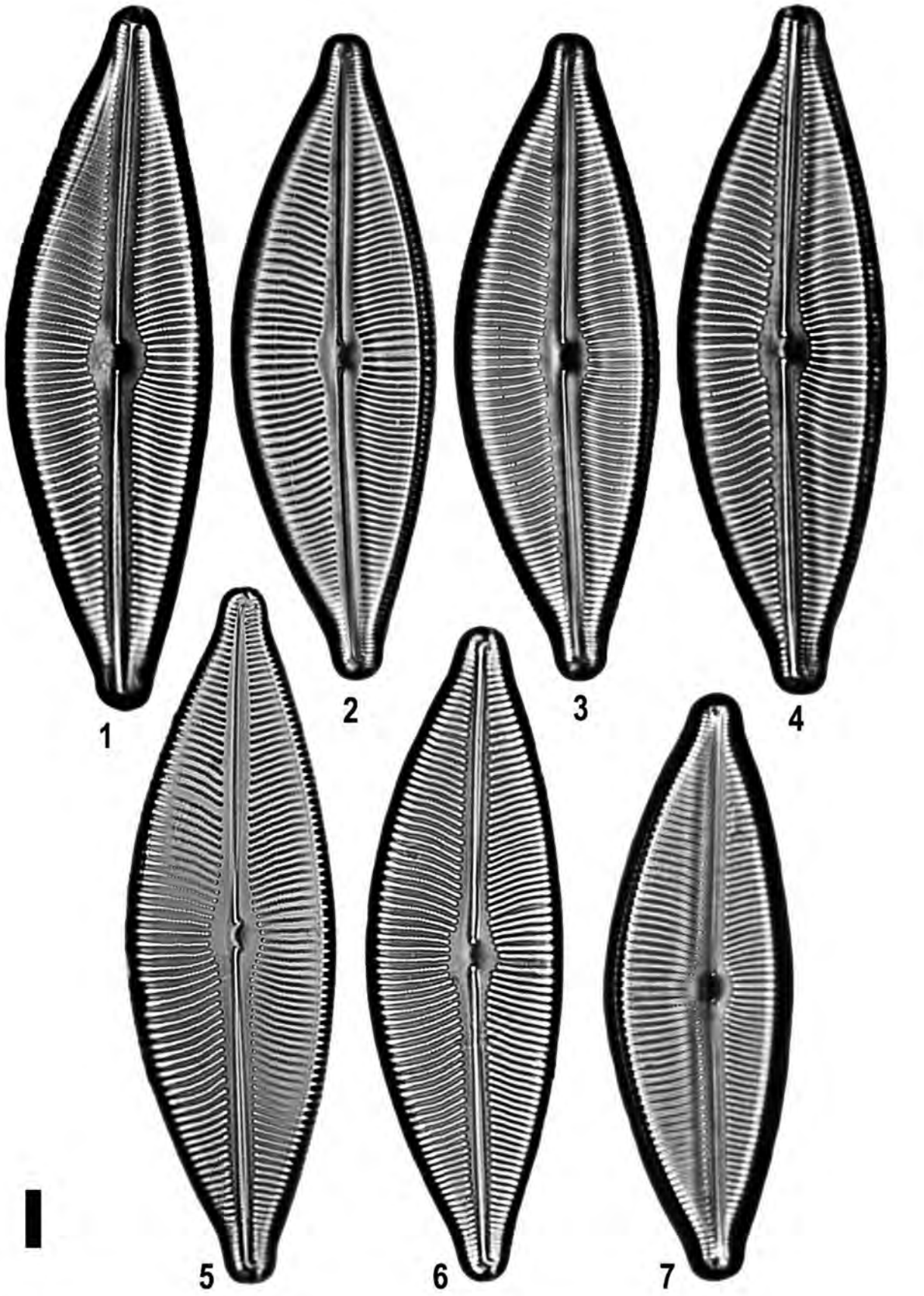


Plate 92: 1-7. *Cymbopleura inaequalis* (Ehrenberg) Krammer 2003, 1-4. Młynek Lake; 5-7. Radomno Lake. Scale bar = 10 µm.

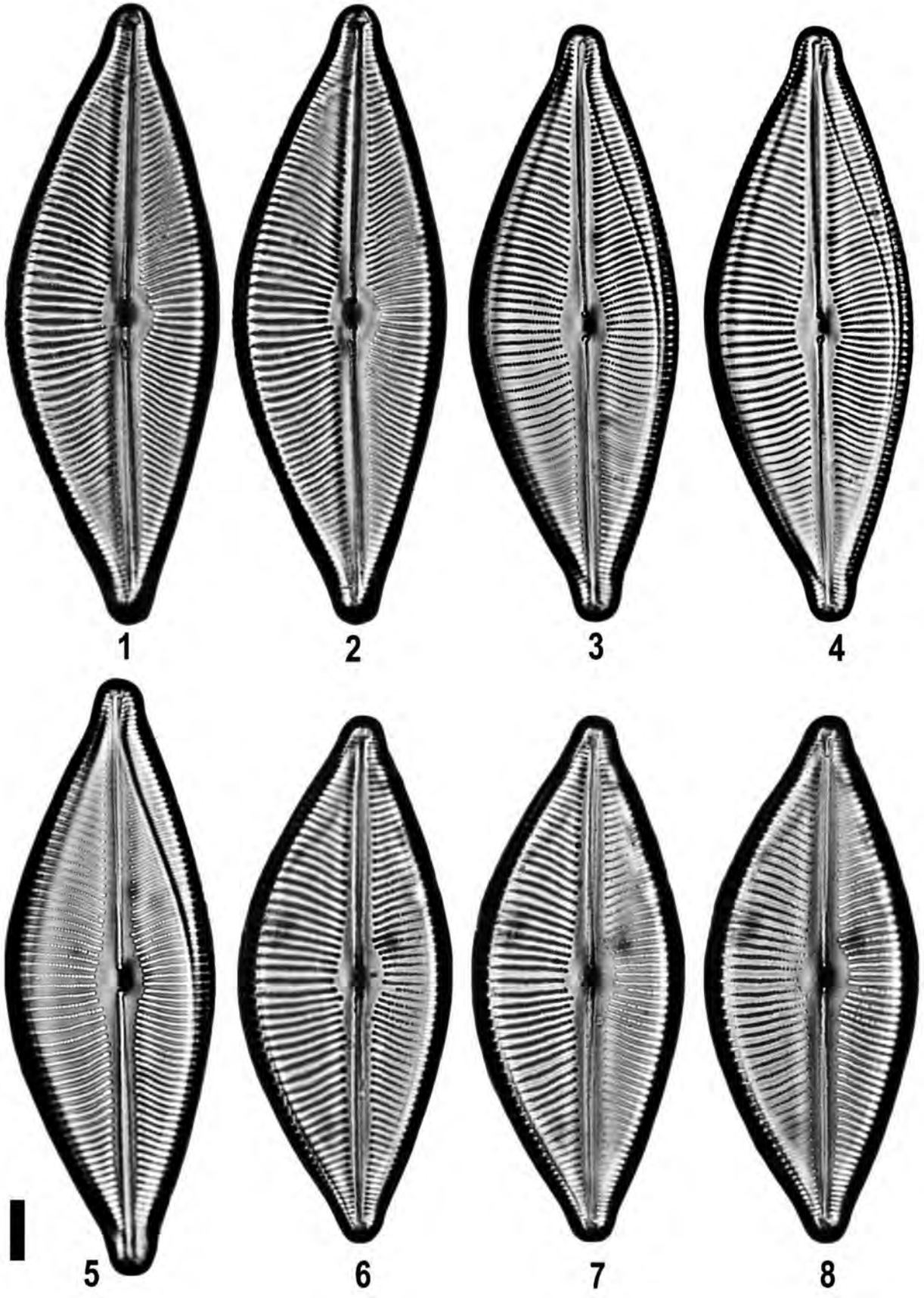


Plate 93: 1-8. *Cymbopleura inaequalis* var. *ellipticum* Zalat nov. var., Kamionka Lake. Scale bar = 10 µm.

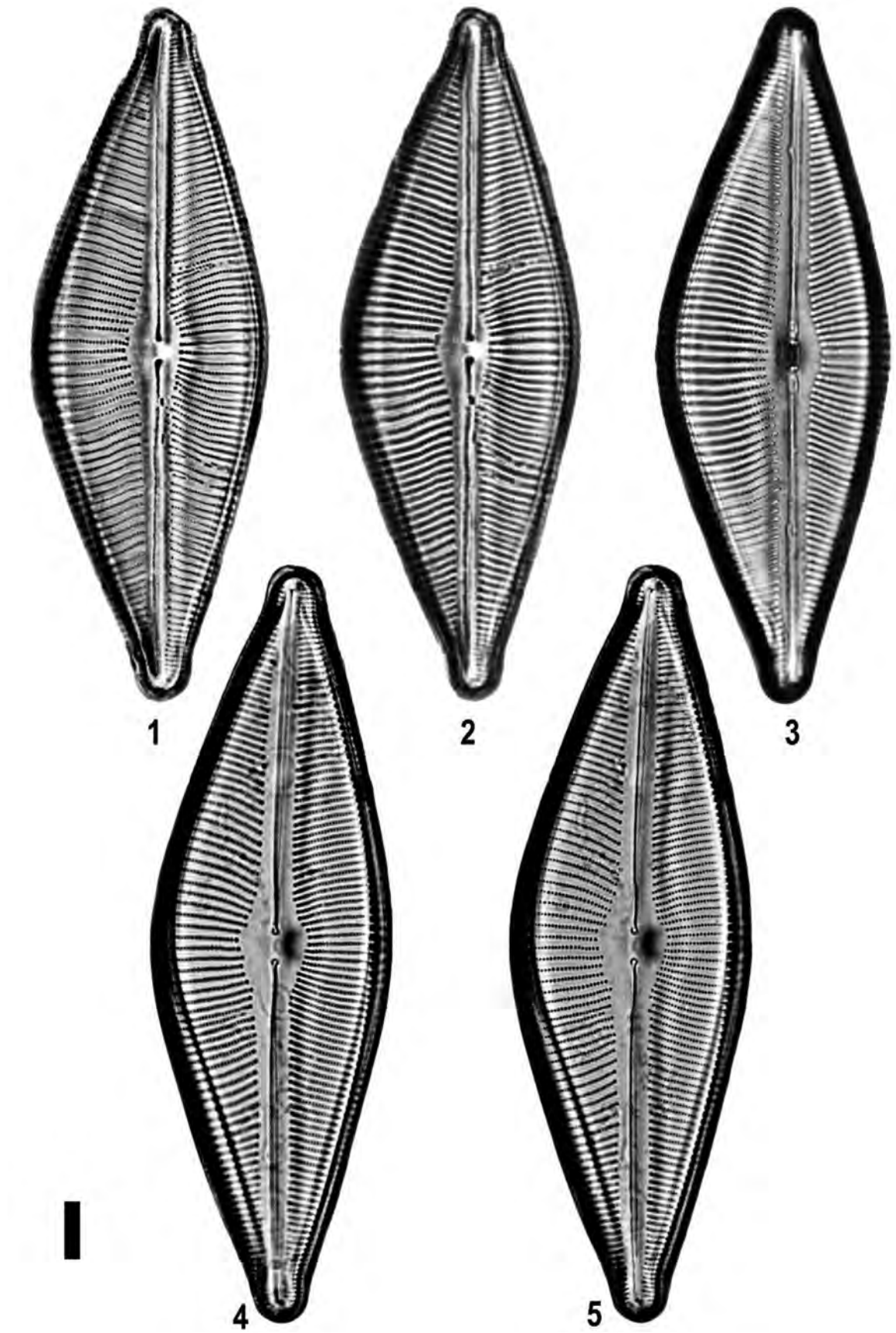


Plate 94: 1-5. *Cymbopleura inaequalis* var *rhomboidea* Zalat & Nitychoruk nov. var., Kamionka Lake. Scale bar = 10 µm.

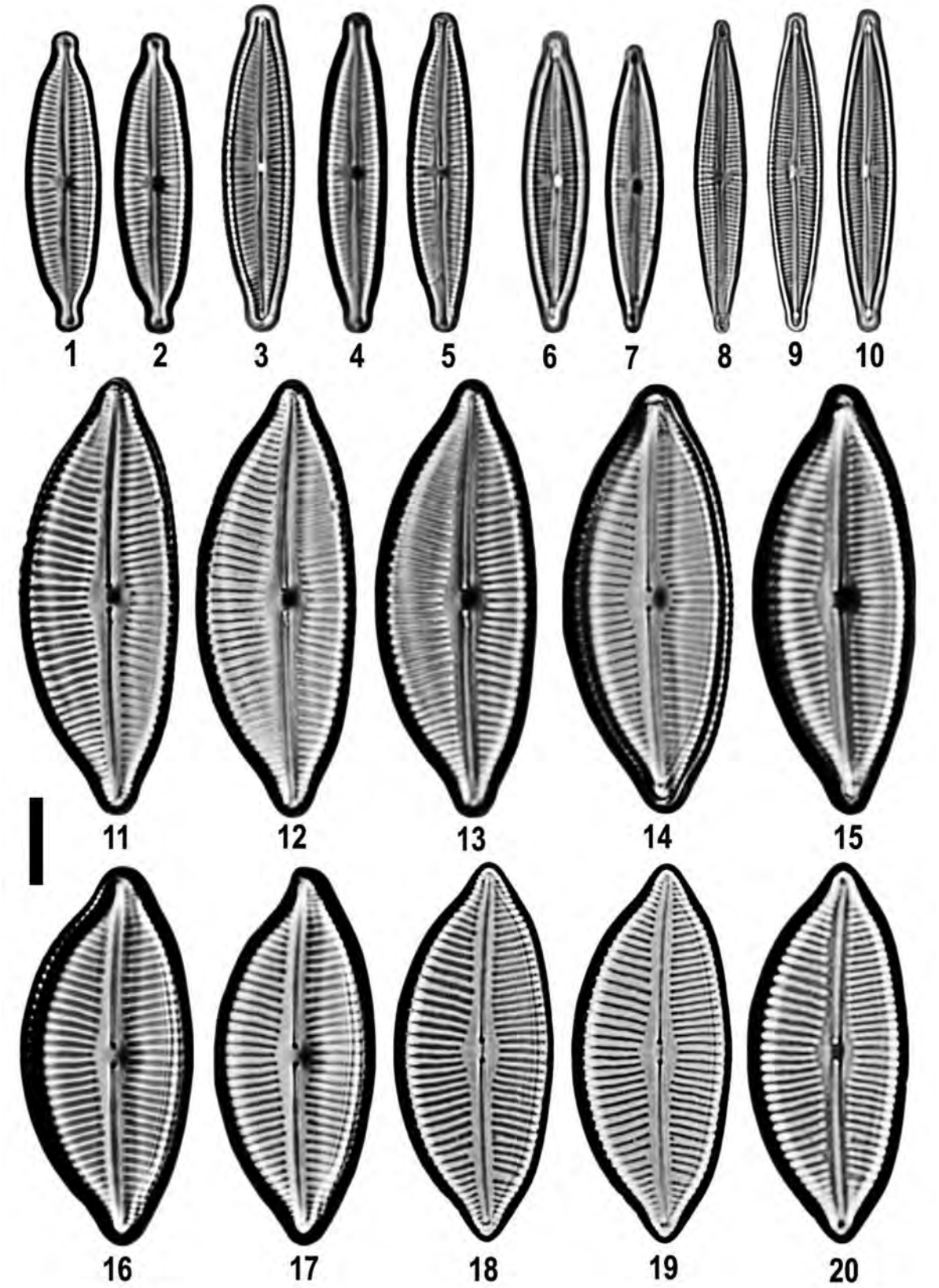


Plate 95: 1-2. *Cymbopleura inaequilatera* (Lagerstedt) Krammer 2003, Radomno Lake; 3-5. *Cymbopleura incertiformis* var. *crassipunctata* Krammer 2003, Radomno Lake; 6-7. *Cymbopleura incertiformis* var. *inariensis* Krammer 2003, Radomno Lake; 8-10. *Cymbopleura incertiformis* var. *laterostrata* Krammer 2003, Radomno Lake; 11-20. *Cymbopleura lata* (Grunow) Krammer 2003, Jeziorak Lake. Scale bar = 10 μm.

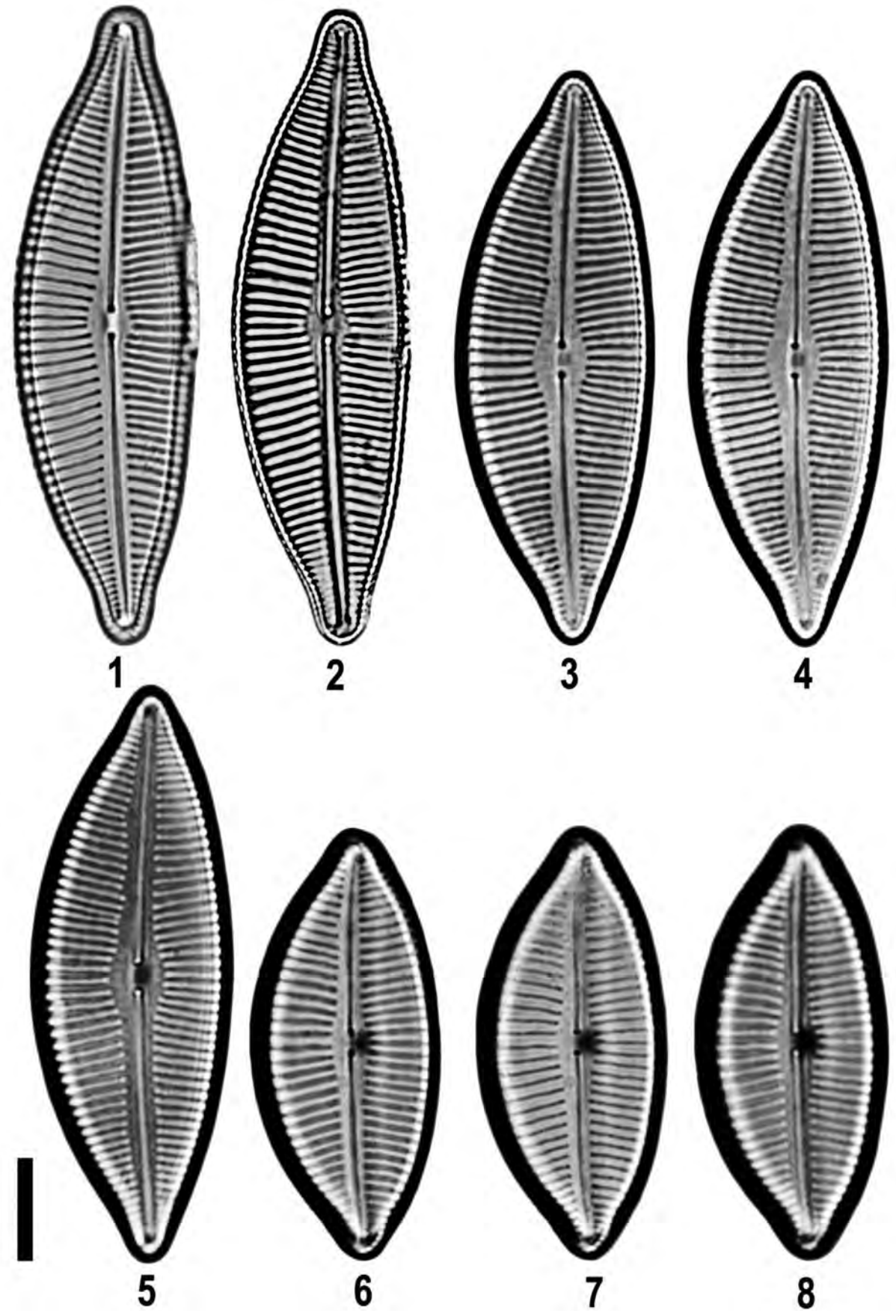


Plate 96: 1-8. *Cymbopleura lata* (Grunow) Krammer 2003, 1-2. Radomno Lake; 3-5. Jeziorak Lake; 6-8. Kamionka Lake. Scale bar = 10 µm.

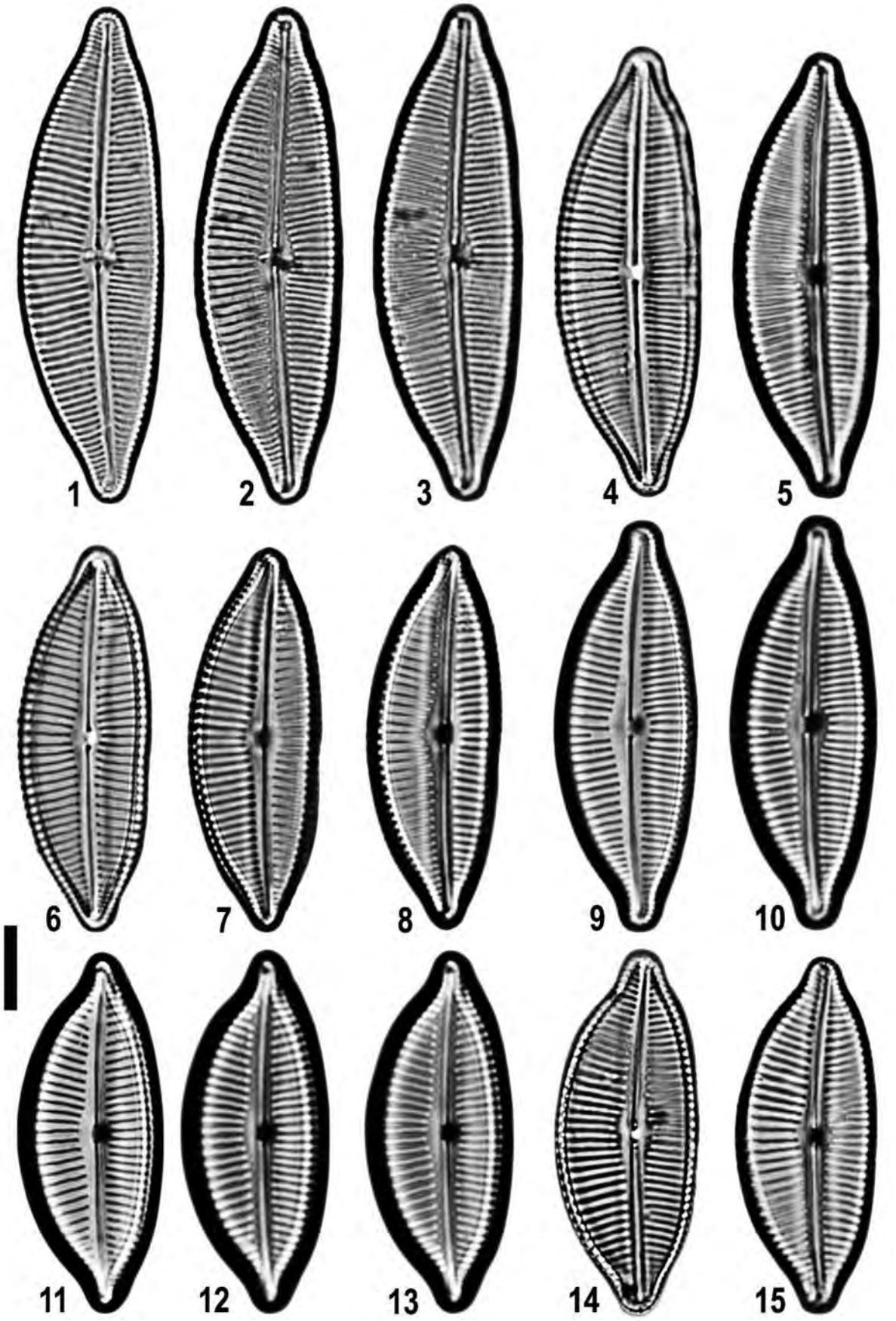


Plate 97: 1-15. *Cymbopleura lata* var. *americana* Krammer 2003, 1-8. Kamionka; 9-15. Radomno Lake. Scale bar = 10 µm.

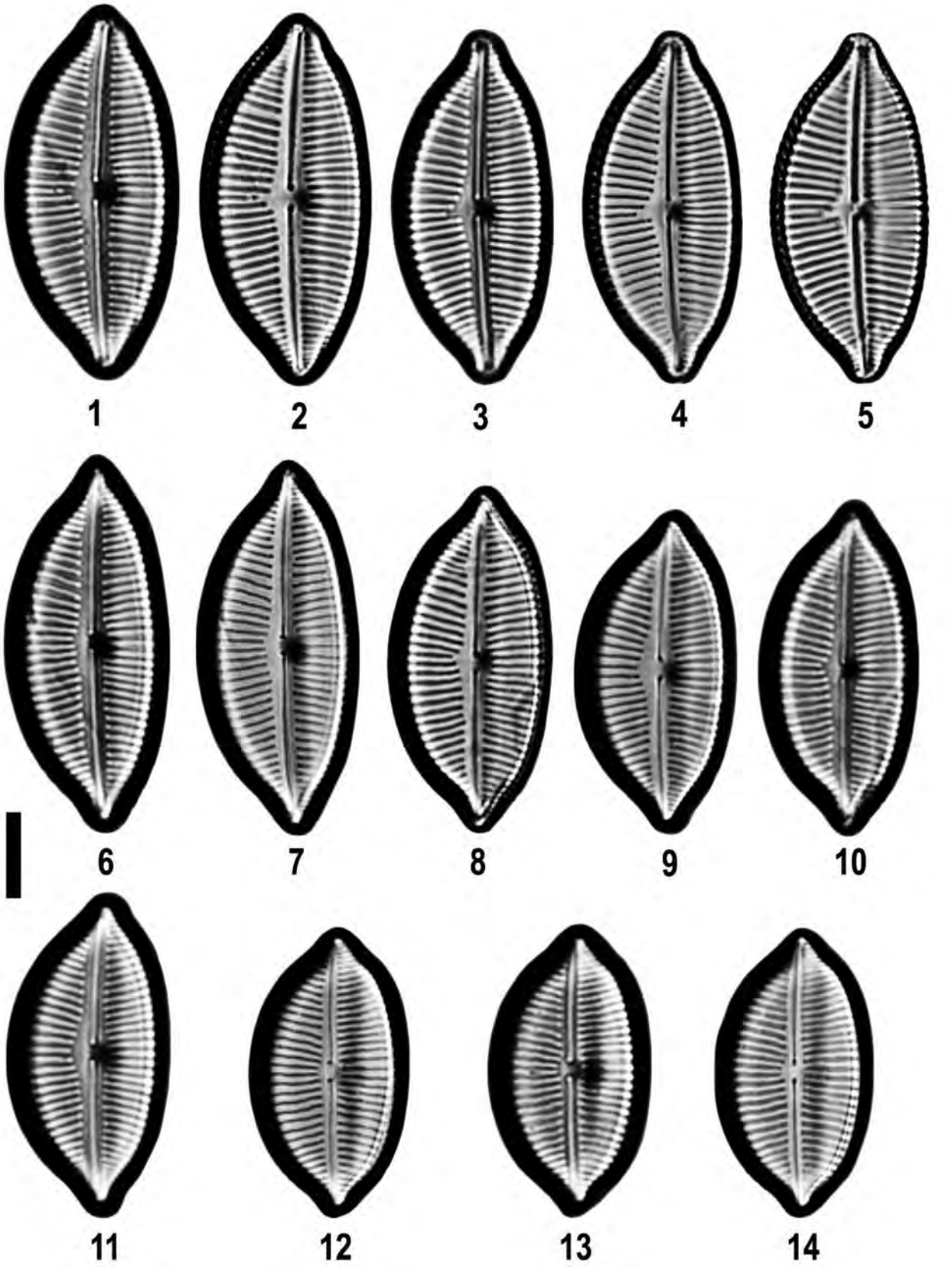


Plate 98: 1-5. *Cymbopleura lata* var. *irrorata* Krammer 2003, Jeziorak Lake; 6-11. *Cymbopleura lata* var. *lura* Miho & Krammer 2003, Jeziorak Lake; 12-14. *Cymbopleura lata* var. *jeziorakensis* Zalat nov. var., Jeziorak Lake. Scale bar = 10 µm.

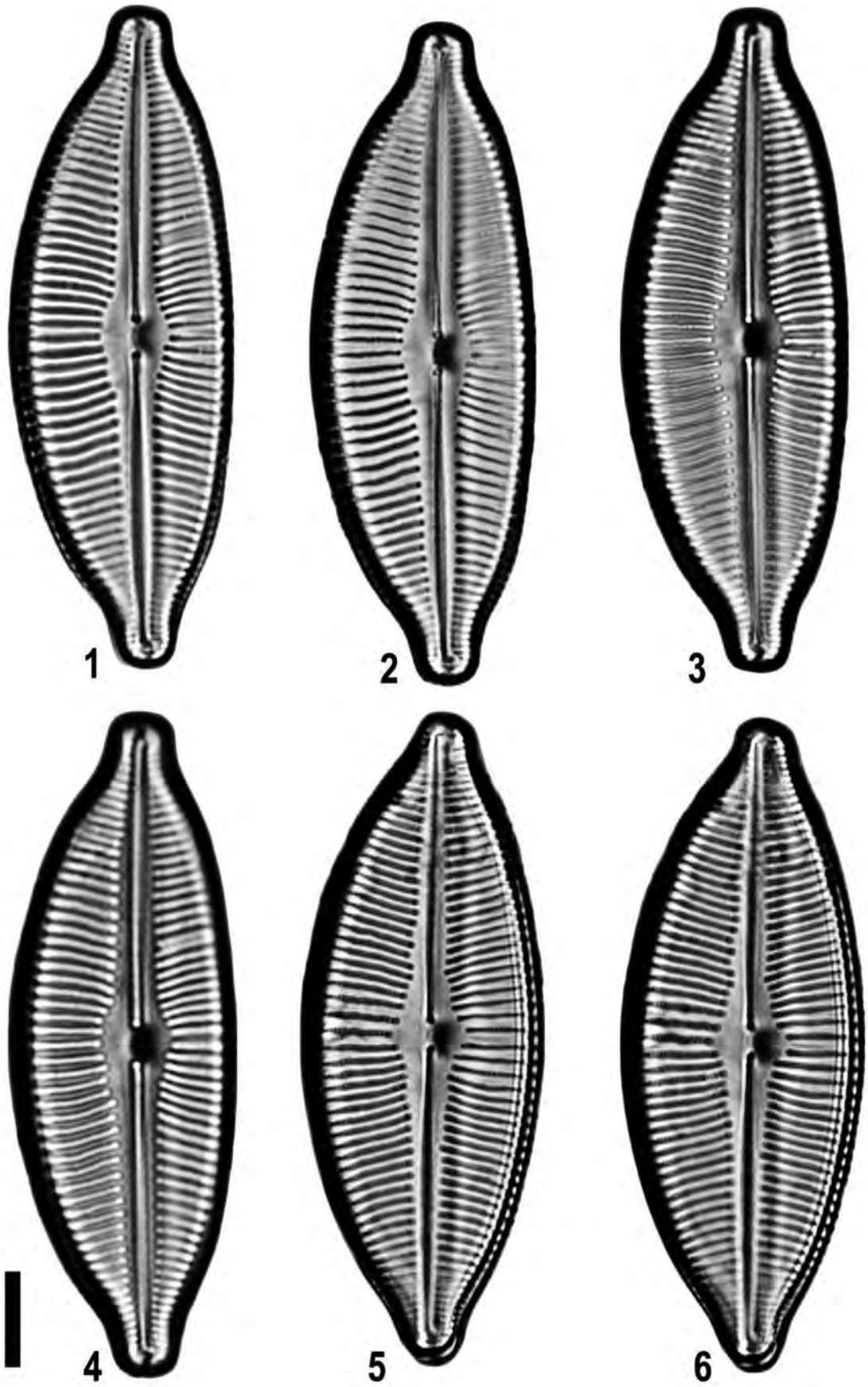


Plate 99: 1-6. *Cymbopleura lata* var. *truncata* Krammer 2003, 1-4. Radomno Lake; 5-6. Jeziorak Lake. Scale bar = 10 µm.

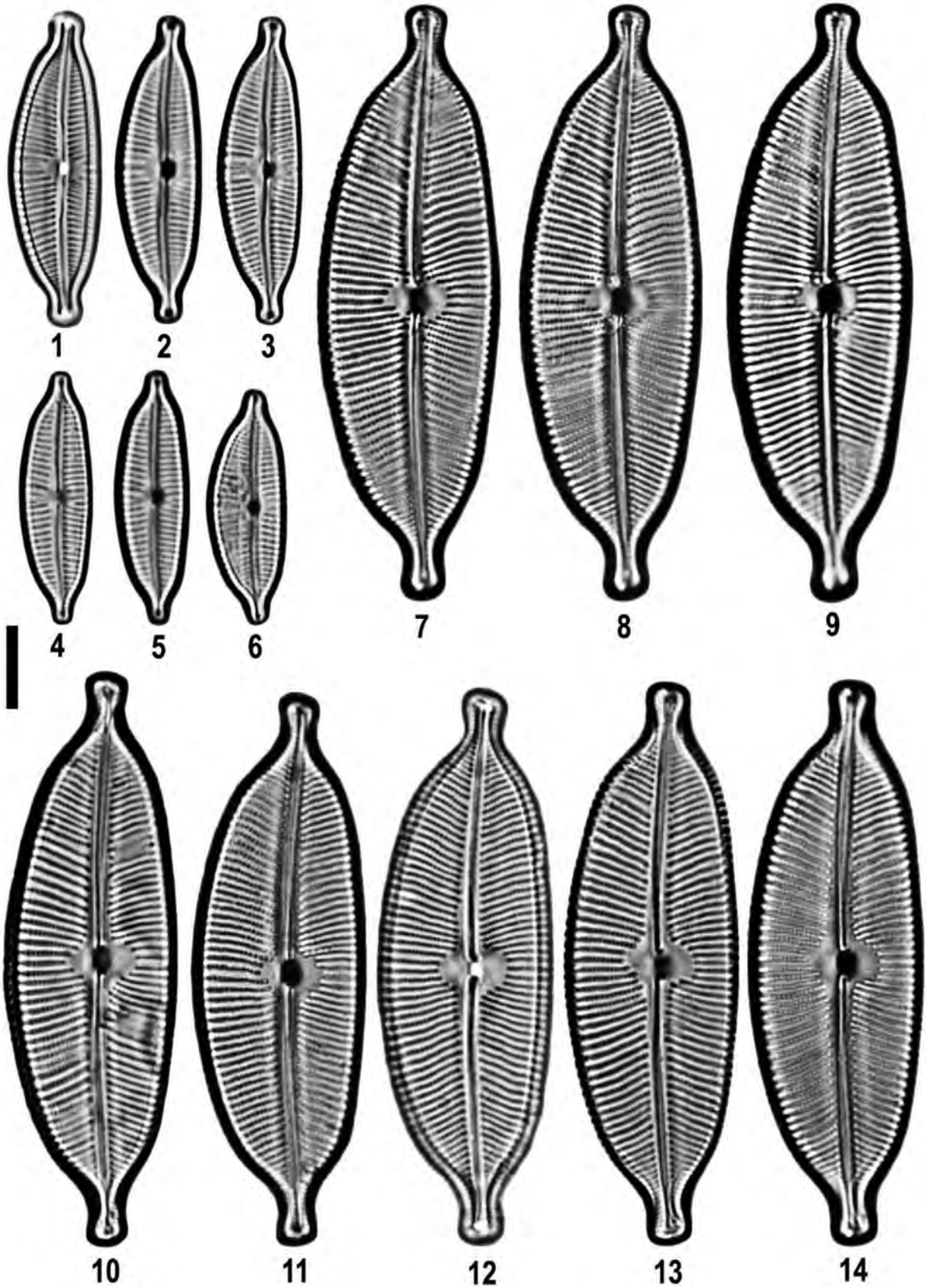


Plate 100: 1-6. *Cymbopleura naviculiformis* (Auerswald) Krammer 2003, 1. Młynek Lake; 2-6. Radomno Lake; 7-14. *Cymbopleura novafundlandica* Krammer 2003, Kamionka Lake. Scale bar = 10 µm.

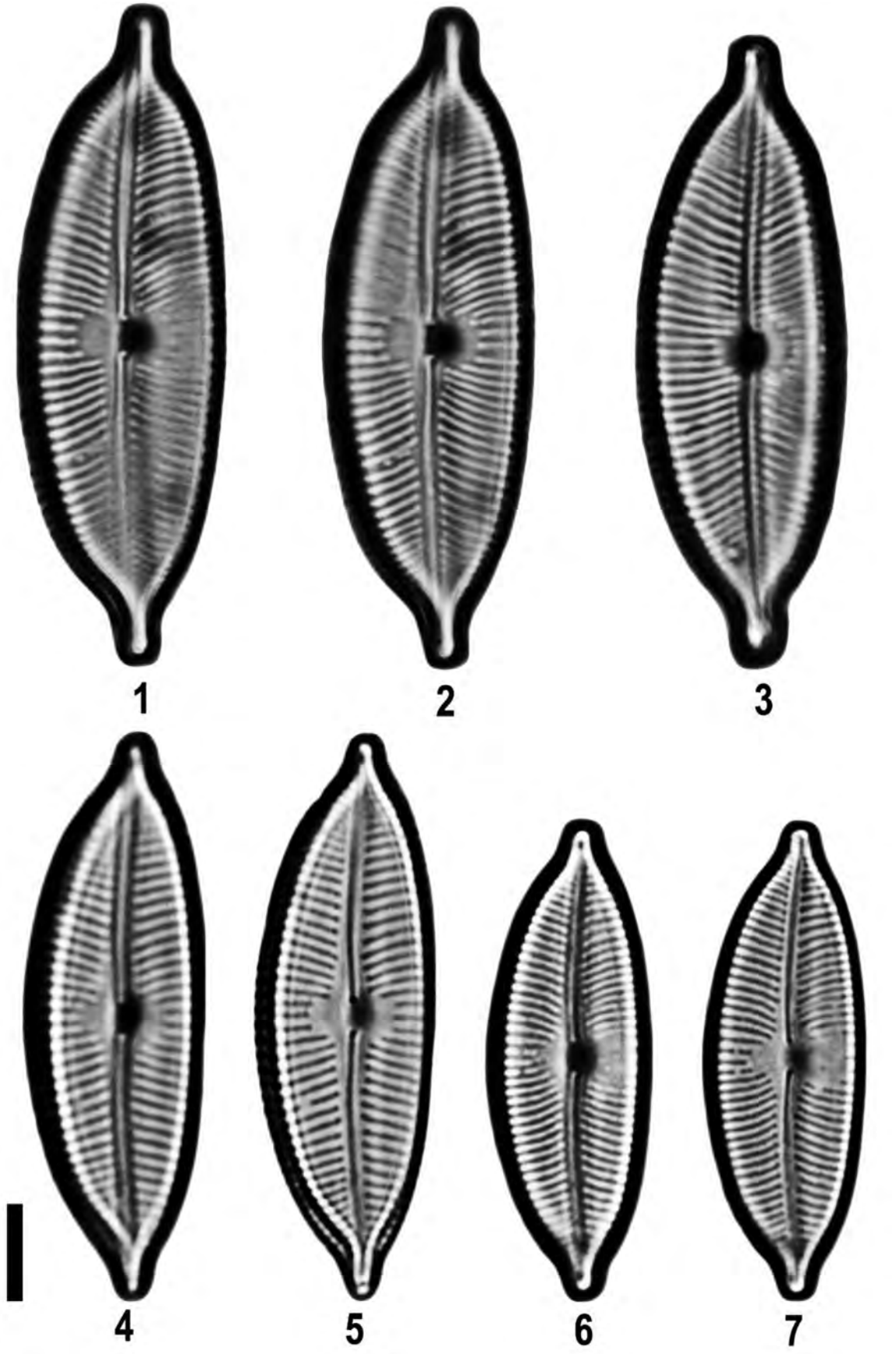


Plate 101: 1-7. *Cymbopleura percuspidata* Krammer 2003, Jeziorak Lake. Scale bar = 10 μm.

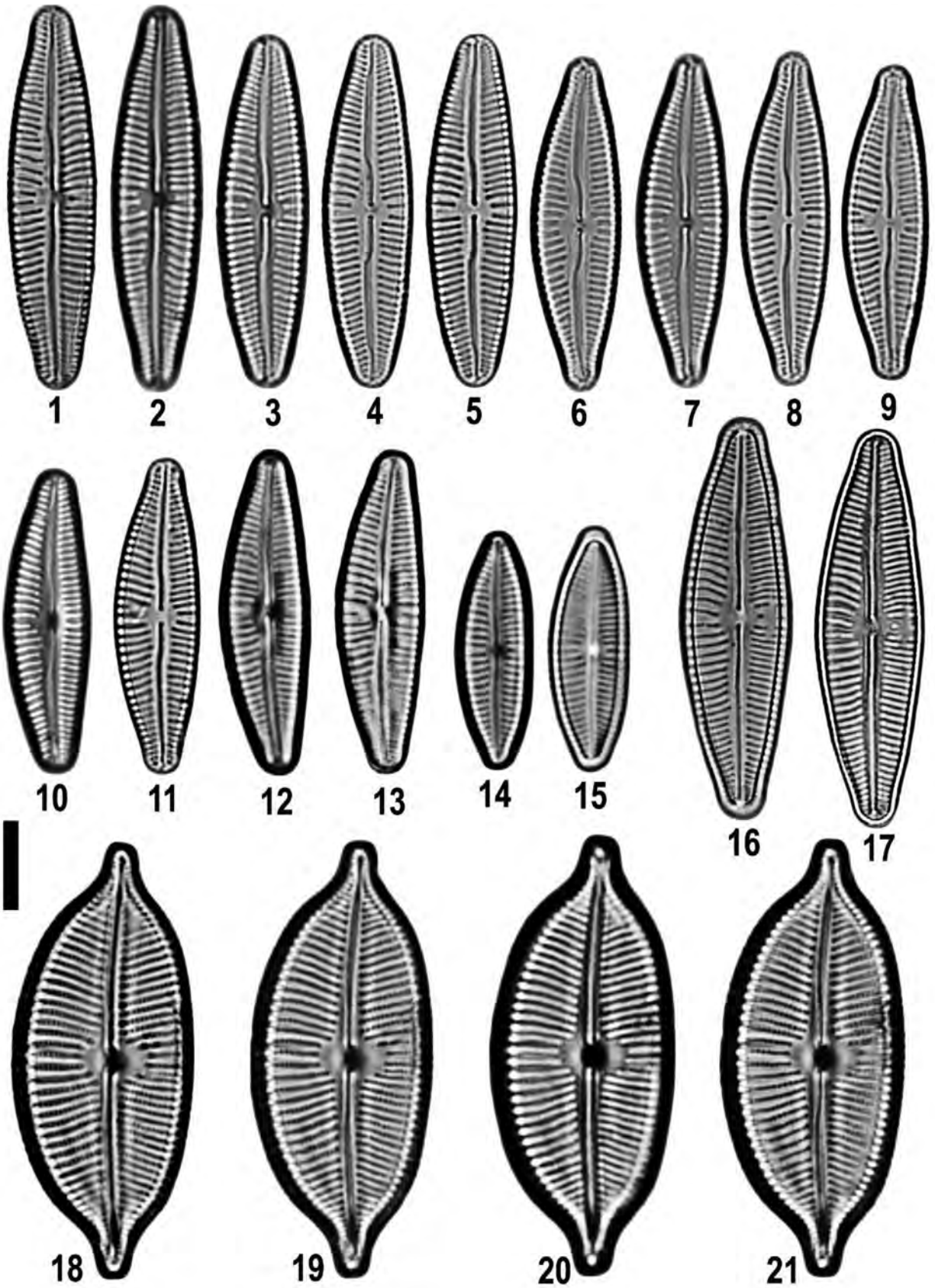


Plate 102: 1-13. *Cymbopleura subaequalis* (Grunow) Krammer 2003, 1-11. Radomno Lake; 12-13. Młynek Lake; 14-15. *Cymbopleura subaequalis* var. *pertruncata* Krammer 2003, Jeziorak Lake; 16-17. *Cymbopleura subaequalis* var. *chodykai* Zalat nov. var., Kamionka lake; 18-21. *Cymbopleura subapiculata* Krammer 2003, Radomno lake. Scale bar = 10 μm.

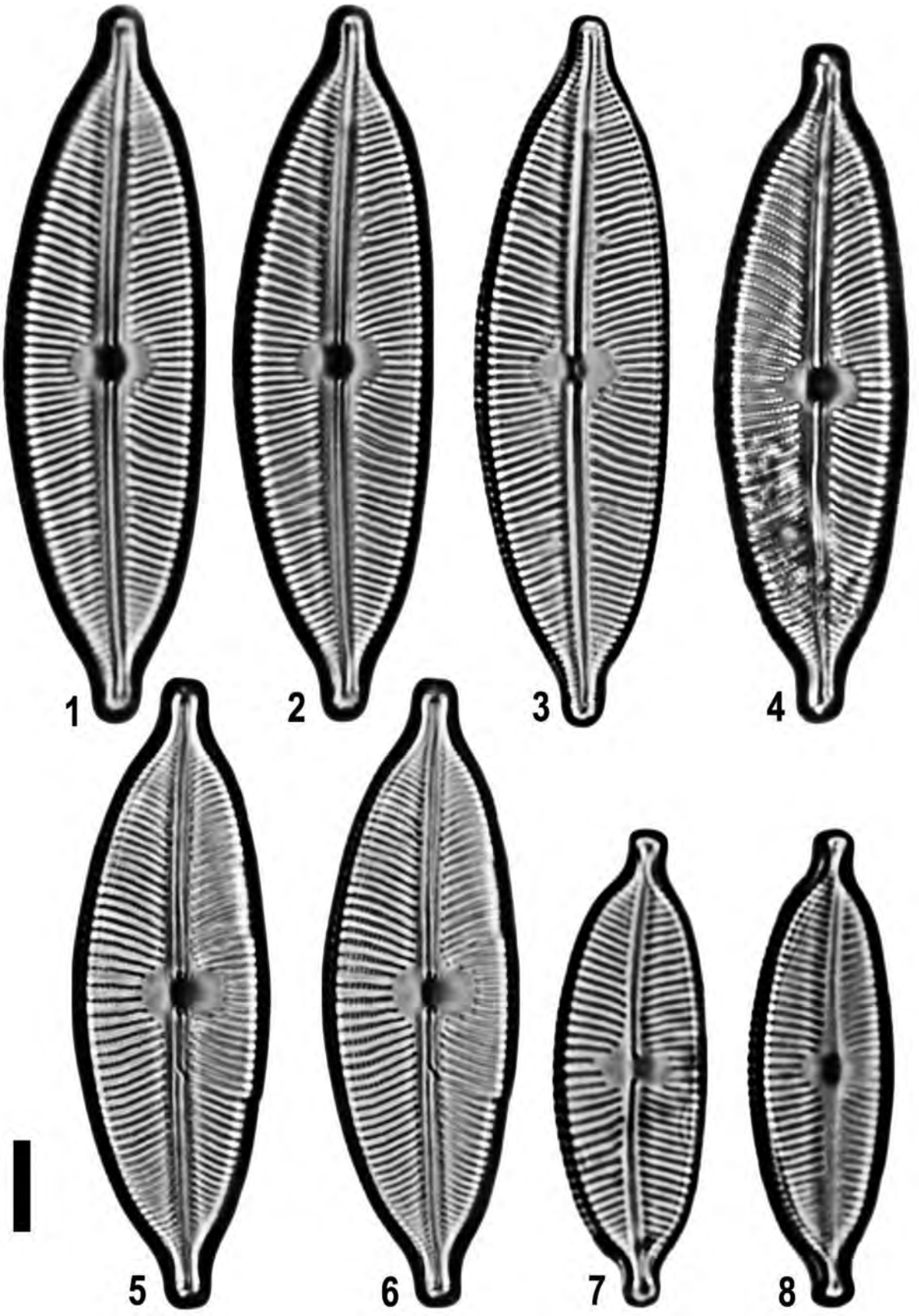


Plate 103: 1-8. *Cymbopleura subcuspidata* (Krammer) Krammer 2003, 1-6. Kamionka Lake; 7-8. Eemian paleolake deposits of central Poland. Scale bar = 10 μm.

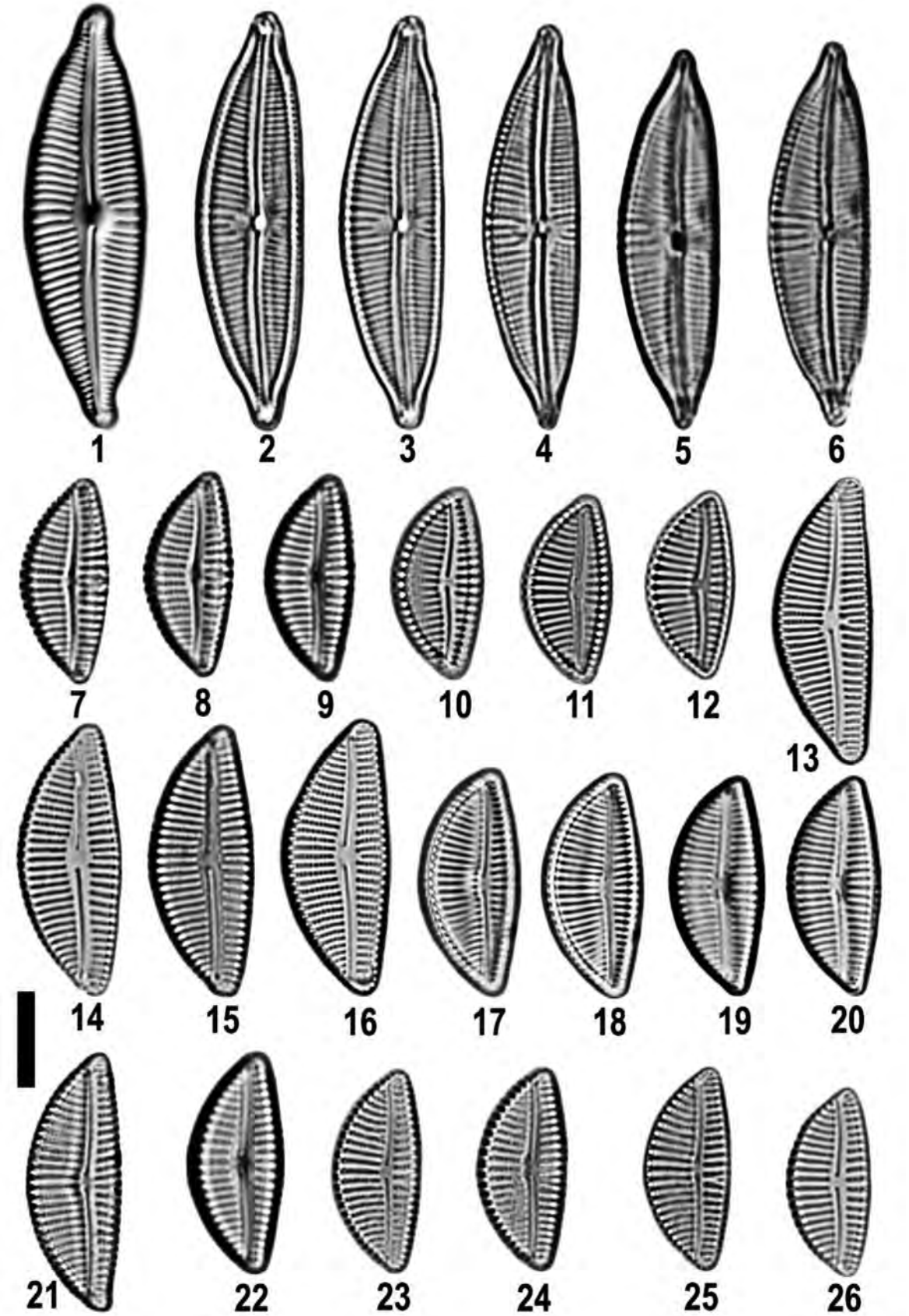


Plate 104: 1. *Cymbopleura sublanceolata* Krammer 2003, Radomno Lake; 2-6. *Cymbopleura sublanceolata* var. *javanica* Krammer 2003, Kamionka lake; 7-13. *Encyonema auerswaldii* Rabenhotst 1853, 7-12. Radomno Lake; 13. Eemian paleolake deposits of central Poland; 14-26. *Encyonema caespitosum* Kützing 1849, 14-20. Jeziorak Lake; 21, 23-25. Kamionka Lake; 22, 26. Radomno Lake. Scale bar = 10 μm.

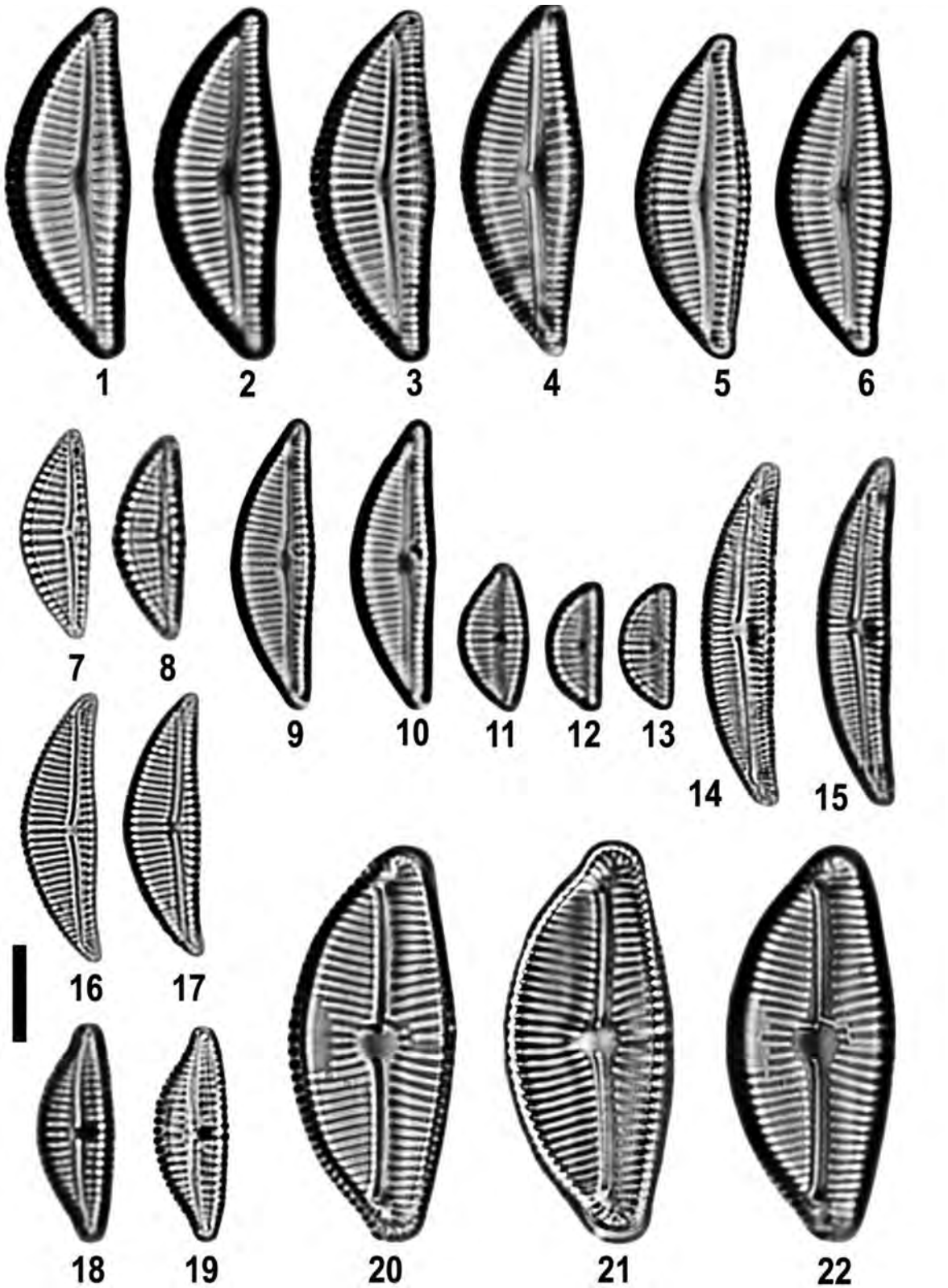


Plate 105: 1-6. *Encyonema cespitosum* var. *comensis* Krammer 1997, 1-3. Eemian paleolake deposits of central Poland; 4. Radomno Lake, 5-6. Jeziorak Lake; 7-8. *Encyonema distinctum* Lange-Bertalot & Krammer 1997, Kamionka Lake; 9-10. *Encyonema mesianum* (Cholnoky) Mann 1990, Jeziorak Lake; 11-13. *Encyonema minutum* (Hilse) Mann 1990, 3. Młynek Lake; 4-5. Kamionka Lake; 14-15. *Encyonema neogracile* Krammer 1997, Radomno Lake; 16-17. *Encyonema neomesianum* Krammer 1997, Radomno Lake; 18-19. *Encyonema obscuriforme* Krammer 1997, Radomno Lake; 20-22. *Encyonema leibleinii* (Agardh) Silva, Jahn, Ludwig & Menezes 2013, Jeziorak Lake. Scale bar = 10 µm.

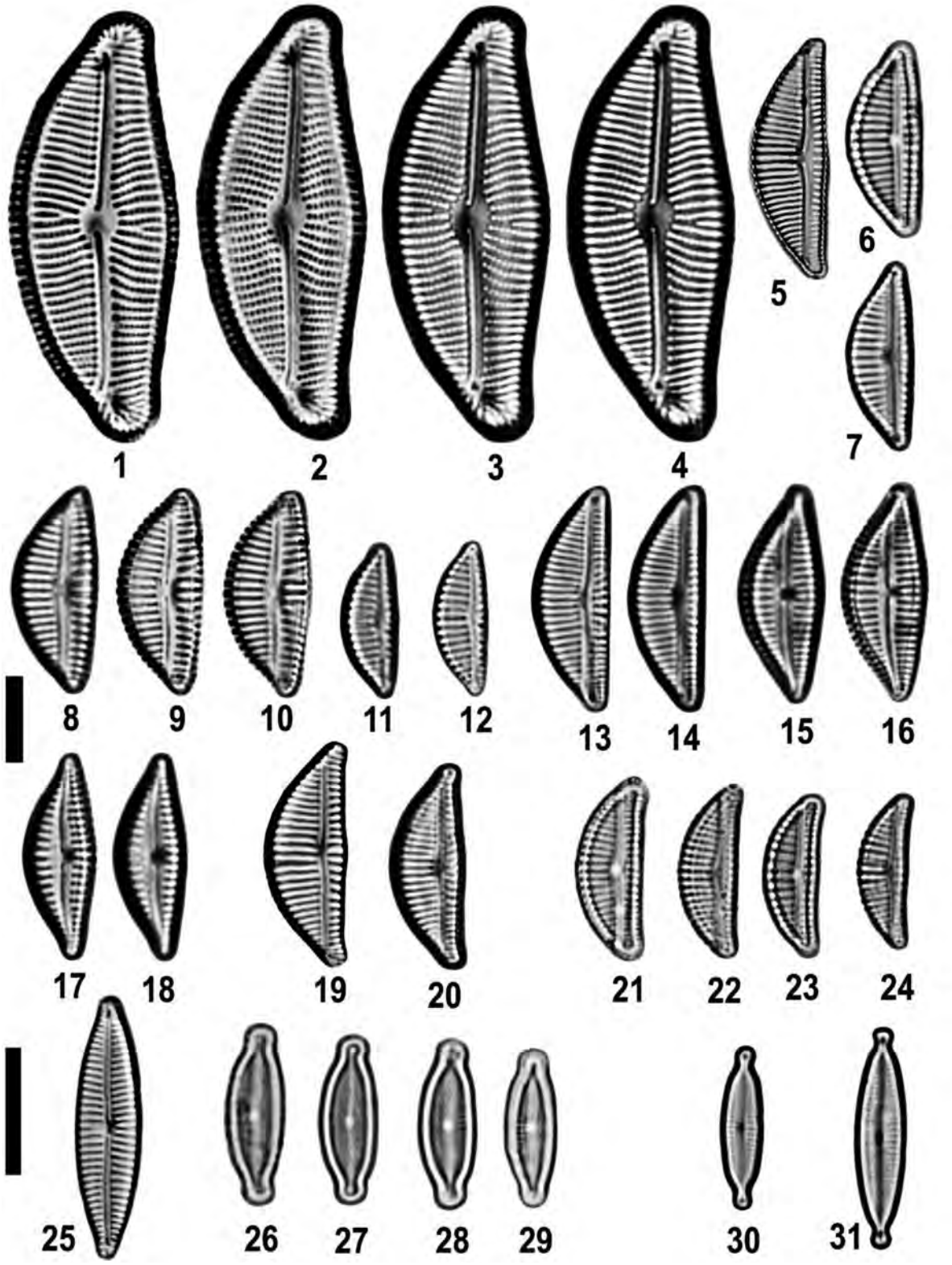


Plate 106: 1-4. *Encyonema leibleinii* (Agardh) Silva, Jahn, Ludwig & Menezes 2013, Młynek Lake; 5-7. *Encyonema silesiacum* (Bleisch) Mann 1990, Kamionka Lake; 8-12. *Encyonema silesiacum* var. *altensis* Krammer 1997, Jeziorak Lake; 13-14. *Encyonema silesiacum* var. *lata* Krammer 1997, Jeziorak Lake; 15-18. *Encyonema subelginense* Krammer 1997, 15-16. Jeziorak Lake; 17-18. Radomno Lake; 19-20. *Encyonema ventricosum* (Agardh) Grunow 1875**,** Radomno Lake; 21-24. *Encyonema ventricosum* var. *angustum* Krammer 1997, Kamionka Lake; 25. *Encyonopsis cesatii* (Rabenh.) Krammer 1997, Radomno Lake; 26-29. *Encyonopsis microcephala* (Grunow) Krammer 1997, 26-28. Jeziorak Lake; 29. Eemian paleolake deposits of central Poland; 30. *Encyonopsis minuta* Krammer & Reichardt 1997, Młynek Lake; 31. *Encyonopsis subminuta* Krammer & Reichardt 1997, Radomno Lake. Scale bar = 10 µm.

Genus *Gomphocymbellopsis* Krammer 2003

Diagnosis: Valves are heteropolar, slightly dorsiventral, lanceolate, and asymmetrical concerning the apical axis. Apices are acutely rounded to capitate. Axial area is narrow. Central area is not well developed. Raphe fissures are slightly lateral, becoming filiform near the ends. Proximal raphe endings are ventrally deflected, while the distal endings are dorsally deflected. Striae are uniseriate or partly biseriate and separated by robust transapical ribs. A distinct isolated stigma is present.

Holotype species: *Gomphocymbellopsis ancyli* (Cleve) Krammer 2003

***Gomphocymbellopsis ancyli* (Cleve) Krammer 2003**

Ref. Hustedt 1930, p. 366, fig. 681; Krammer & Lange-Bertalot 1986, p. 341, pl. 148, figs. 18-20; Lange-Bertalot & Metzeltin 1996, p. 300, pl. 91, fig. 13; Krammer 2003, p. 128, pl. 143, figs. 1-20; pl. 144, figs. 10-19; pl. 145, figs. 1-3; Wojtal 2009, p. 216, pl. 8, fig. 13.

Status of name: accepted taxonomically.

Synonyms: *Cymbella ancyli* Cleve 1902
Gomphocymbella ancyli (Cleve) Hustedt 1930
Gomphocymbella ruttneri Hustedt 1914
Gomphonema ruttneri (Hustedt) Mills 1934

Diagnosis: Valves are moderately dorsiventral and heteropolar, lanceolate. The dorsal margin is distinctly convex, and the ventral margin is slightly convex. Apices are not protracted and narrowly rounded. Axial area is narrow, somewhat curved. Central area is absent or not well developed. Raphe is slightly ventrally displaced, slightly lateral, becoming filiform near the distal and proximal ends. Proximal raphe endings are slightly expanded as central pores and ventrally deflected; distal raphe endings are comma-shaped and dorsally deflected. A distinct isolated stigma is visible just at the end of the central stria on the ventral side. Transapical striae are finely punctate, slightly radiate throughout the valve, becoming more radiate near the ends, bout 7-9 in 10 µm at the centre, becoming 11-12 in 10 µm near the ends. Puncta about 24-28 in 10 µm. Length of the valve 24-55 µm, and the breadth 7-9 µm.

Ecological preference: it is described from oligotrophic aquatic environments with a carbonate substratum (Lange-Bertalot 1 997); widespread, known from oligotrophic lakes of the Alps and the Balkan region however also in similar lakes of the north Germain plain (Krammer 2003); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); low to moderate water conductivity range between 292 to 569 µS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009).

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); found in Kobylanka stream situated *ca* 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009).

Genus *Delicata* Krammer 2003

Valves are dorsiventral, narrow, lanceolate, slightly asymmetric to the apical axis and symmetric to the transapical axis. Apices are rounded, not or slightly protracted. Axial area is narrow or moderately wide. Central area is absent or small, and a slightly wider extension of the axial area. Raphe is distinctly lateral and becomes reverse-lateral at the centre of the valve. The proximal raphe endings are thin. The terminal raphe fissures are deflected toward the dorsal side. Transapical striae are fine, radiate throughout the valve. Stigmata and apical pore fields are absent.

Genus *Delicata* was segregated from *Cymbella sensu lato* (Krammer 2003). Species are distributed broadly from the tropics to the subarctic.

Holotype species: *Delicata delicatula* (Kützing) Krammer 2003

***Delicata delicatula* (Kützing) Krammer 2003**

Ref. Hustedt 1930, p. 352, fig. 642; Foged 1959, p.70, pl. 9, fig. 10; Patrick & Reimer 1975, p. 28, pl. 4, figs. 4 a- 5 b; Germain 1981, p. 274, pl. 99, figs. 22-25; Krammer & Lange-Bertalot 1986, p. 330, pl. 137, figs. 1-11; Reichardt 1991, p. 192, pl. 1, figs. 16-19; Cumming et al. 1995 p. 45, pl. 45, fig. 4; Lange-Bertalot & Metzeltin 1996, p. 308, pl. 95, figs. 18-22; Krammer 2003, p. 113, pl. 129, figs. 1-30; Li et al. 2007, p. 233, figs. 134-135; Bahls et al. 2018, p. 42, pl. 5, figs. 1, 2; p. 155, pl. 118, figs. 11, 12; Bahls 2019, p. 24, pl. 67, figs. 1-34; pl. 68, figs. 1-36; pl. 69, figs. 1-24; Rybak et al. 2019, pl. 2, fig. 28.

Status of name: accepted taxonomically.

Synonyms: *Cymbella delicatula* Kützing 1849

Delicatophycus delicatulus (Kützing) Wynne 2019

Diagnosis: Valves are lanceolate, moderately dorsiventral with a shallow-convex dorsal margin and slightly convex or nearly straight ventral margin. Apices are acutely rounded, sometimes apiculate, and curved dorsally. Axial area is relatively wide. Central area is wide and undifferentiated, a continuation of the axial area. Raphe is lateral, becoming filiform at the distal end; proximal raphe endings are reverse-lateral and deflected ventrally; distal raphe endings are comma-shaped and deflected dorsally. Transapical striae are radiate throughout and more widely spaced near the valve centre, about 15-20 in 10 μm on the dorsal, 19-23 in 10 μm on the ventral. Length of the valve 20-50, and the breadth 5-8.

Ecological preference: Cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); freshwater, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); alkaline lakes on the southern interior plateau of British Columbia (Cumming et al. 1995); oligotrophic, alkaline lakes, streams and wetlands with moderate conductivity (Krammer 2003); freshwater, circumneutral to alkaline with pH 6.5-10, air temperature 13.5-27°C, water temperature 3-17°C (Li et al. 2007); the species characteristic of the waters of mountain lakes, strictly oligotrophic, rich in calcium, an indicator of very good water quality (Bąk et al. 2012); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributaries, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

Genus *Kurtkrammeria* Bahls 2015

Diagnosis: Valves are naviculoid and scarcely dorsiventral, lanceolate to linear-lanceolate, symmetric to the transapical axis and asymmetric to the apical axis. Apices are rostrate, subrostrate, capitate, subcapitate, or acutely to broadly rounded, sometimes slightly bent towards the ventral margin. Axial and central areas are variable. Raphe is lateral and somewhat sinuous, becoming filiform near the proximal and distal ends. Central pores are inconspicuous and deflected slightly towards the dorsal side. Terminal fissures are hooked towards the ventral margin. Transapical striae are radiate near the valve centre, becoming parallel, then convergent near the apices. Middle striae are more widely spaced than striae near the apices. Areolae in the striae are slit-like or crescent-shaped and oriented with their long axes parallel to the apical axis. A more or less well-developed apical pore field may be present at both ends of the valve, or pore fields may be absent.

Holotype species: *Kurtkrammeria weilandii* (Bahls) Bahls 2015

***Kurtkrammeria neoamphioxys* (Krammer) Bahls 2015**

Ref. Hustedt 1930, p. 354, fig. 648; Krammer & Lange-Bertalot 1986, p. 328, pl. 135, figs.11-13; Hartley et al. 1996, p. 142, pl. 63, fig. 6; Krammer 1997, p. 141, pl. 168, figs. 1-7, 11-13; Shi 2013, p. 45, pl. 12, figs. 1, 2; pl. 40, figs. 10, 11; Bahls 2015, p. 176, figs. 50-62; Bahls et al. 2018, p. 179, pl. 91, figs. 30-35; pl. 123, fig. 24.

Status of name: accepted taxonomically.

Synonyms: *Navicula amphioxys* Kützing 1844
Cymbella amphioxys (Kützing) Cleve 1894
Cymbella navicula var. *amphioxys* Grunow in Cleve & Möller 1879
Encyonopsis amphioxys (Kützing) Liu & Shi 2013
Encyonopsis neoamphioxys Krammer 1997

Diagnosis: Valves are weakly dorsiventral, linear-lanceolate to lanceolate elliptic, sometimes slightly tumid in the middle. Apices are subrostrate, weakly protracted, and bent ventrally. Axial area is narrow, linear. Central area is small and rounded. A single stigma lies at the end of a short median stria on the dorsal side of the central area. Raphe is lateral. Proximal raphe endings with central pores, which are weakly expanded and deflected slightly towards the dorsal side. Distal raphe endings are hooked towards the ventral side and terminate in helictoglossae. Transapical striae are radiate near the middle part of the valve and then become parallel and finally convergent at the apices, about 13-15 in 10 μm at the valve centre, 15-18 in 10 μm at the ends on the dorsal side. Length of the valve 34-60 μm, and the breadth 5.0-7.5 μm.

Ecological preference: *Cymbella amphioxys* is reported as a freshwater species, acidophilous, oligosaprobic, oligotraphentic (Van Dam et al. 1994); *Encyonopsis neoamphioxys* has a Nordic-alpine distribution and prefers oligotrophic waters (Krammer 1997); freshwater with air temperature 16.5°C, water temperature 13.5°C, (Li et al. 2007).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

Genus *Paraplaconeis* Kulikovskiy, Lange-Bertalot & Metzeltin, 2012

Diagnosis: Valves are broadly elliptic to elliptical lanceolate, with acutely rounded, protracted rostrate or subrostrate apices. Axial area is usually narrow, expanded towards the valve centre. Central area is variable in shape. Raphe often filiform, proximal raphe endings are expanded and curved to the same or opposite sides. Distal raphe ends are curved to the same side. Transapical striae are uniseriate, radiate, sometimes shortened and more widely spaced in the central valve region.

Holotype species: *Paraplaconeis kornevae* Kulikovskiy, Gusev & Lange-Bertalot 2012

***Paraplaconeis cracoviensis* Lange-Bertalot & Wojtal 2014**

Ref. Lange-Bertalot & Wojtal 2014, p. 410, figs. 49–60, 65–67, 80, 81; Czerwik-Marcinkowska et al. 2018, p. 137, figs. 4, a-e.

Status of name: accepted taxonomically.

Diagnosis: Valves are broadly elliptical, with distinctly convex margins. Apices are narrow, cuneate, protracted, rostrate or subrostrate. Axial area is very narrow at the ends, and becomes expanded lanceolate towards the valve centre. Central area is large, about half of the valve breadth, more or less rhombic or sub-rectangular, defined laterally by 3-4 irregularly shortened striae. Raphe is filiform, slightly lateral, weakly sinuous at the apices; proximal raphe endings are expanded towards distinctly marked central pores that are widely spaced; distal raphe endings are short, curved to one side. Transapical striae are radiate throughout the valve, more strongly radiate and denser spaced at the ends, about 8-11 in 10 μm. Length of the valve 30-45 μm, and the breadth 12-16 μm.

Remarks: *Paraplaconeis cracoviensis is* morphologically closely related to *Placoneis placentula* and related taxa, which are distinguished from each one by a narrow, linear axial area. On the contrary, *P. cracoviensis* possesses a lanceolate axial area (Lange-Bertalot & Wojtal 2014).

Ecological preference: The species is characteristic of alkaline springs and streams, mesotrophic, oligo- β-mesosaprobic, calcium-rich waters with moderate-high conductivity, it is also occurs in karst water streams in the Silická Plateau (Slovak Karst) (Lange-Bertalot & Wojtal 2014; Czerwik-Marcinkowska et al. 2018).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Kobylanka stream, about 30 km northwest of Kraków, south Poland (Lange-Bertalot & Wojtal 2014).

***Paraplaconeis macedonica* (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012**
(Pl. 107, figs. 1-3)

Ref. Levkov & Metzeltin 2007, p. 110, pl. 98, figs. 1-8; pl. 99, figs. 20-23.

Status of name: accepted taxonomically.

Synonyms: *Placoneis macedonica* Levkov & Metzeltin, 2007

Witkowskia macedonica (Levkov & Metzeltin) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are lanceolate to broadly lanceolate or lanceolate-elliptic, gradually tapering towards the ends. Apices are not protracted to subprotracted, subrostrate, and acutely rounded. Axial area is moderately narrow, broadening slightly towards the valve centre. Central area is small, rhombic or moderately transversally widened. Raphe is filiform, straight. Proximal raphe endings are large, tear-drop-shaped central pores, not deflected. Distal raphe endings are unilaterally deflected to one side. Transapical striae are finely punctate, radiate throughout the valve, about 9-11 in 10 μm. Puncta about 36-40 in 10 μm. Length of the valve 20-50 μm, and the breadth 11-14.5 μm.

Ecological preference: The species found in the periphyton of Lake Ohrid, in the Albanian part tolerant to a wide range, from oligotrophic to eutrophic waters (Kupe et al. 2020); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: New record.

***Paraplaconeis minor* (Grunow) Lange-Bertalot 2017**
(Pl. 107, figs. 4-5)

Ref. Miho & Lange-Bertalot 2006, p. 308, figs. 41-45; Lange-Bertalot et al. 2017, p. 471, pl. 47, figs. 47-51.

Status of name: accepted taxonomically.

Synonyms: *Navicula placentula* f. *minor* Grunow 1880

Placoneis minor (Grunow) Lange-Bertalot 2005

Diagnosis: Valve is lanceolate to elliptical-lanceolate with more convex margins. Apices are obtuse, subprotracted to rostrate. Axial area is very narrow, weakly widened towards the valve centre. Central area is irregular in shape, somewhat subrounded to slightly rectangular, expanded toward one side due to the shorter of some central striae. Raphe is straight, filiform; proximal raphe endings with pronounced central pores deflected unilaterally; distal raphe endings are indistinct. Transapical striae are strongly radiate throughout the valve, irregular in length at the central area, about 11-12 in l0 μm. Length of the valve 25-35 μm, and the breadth 10-15 μm.

Ecological preference: Shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Paraplaconeis ohridana* (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012**
(Pl. 107, figs. 6-12)

Ref. Levkov et al. 2007. p. 111, pl. 97, figs. 1-7.

Status of name: accepted taxonomically.

Synonyms: *Placoneis ohridana* Levkov & Metzeltin, 2007

Witkowskia ohridana (Levkov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear-lanceolate to broadly elliptical. Apices are abruptly rostrate. Axial area is moderate, narrowing at the ends, gradually broadening slightly towards the valve centre. Central area is well developed, large, and transversally widened to a subcircular or elliptical shape. Raphe is weakly lateral. Proximal raphe ends are large central pores, slightly deflected; distal raphe ends are oppositely deflected. Transapical striae are finely punctate, radiate throughout, biseriate, 10-11 in 10 μm. Length of the valve 38-61 μm, and the breadth 19-22 μm.

Remarks: This taxon is similar to *P. placentula*; it differs only by valve breadth and the shape of the outline.

Ecological preference: Shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Młynek and Kamionka Lakes.

Distribution in Poland: New record.

***Paraplaconeis ohridana* var. *lanceolatum* Zalat nov.var.**

(Pl. 107, figs. 13-17; pl. 108, figs. 1-7)

Diagnosis: Valves are lanceolate to broadly elliptical. Apices are rostrate, subprotracted, and acutely rounded. Axial area is narrow and linear. Central area is well developed, moderate and subrounded. Raphe is very weakly lateral. Proximal raphe ends are distinct central pores that are slightly deflected; distal raphe ends are oppositely deflected. Transapical striae are punctate, strongly radiate throughout the valve, about 10-11 in 10 μm. Length of the valve 42-60 μm, and the breadth 18-22 μm.

Remarks: This variety differs from the nominate species by having lanceolate-elliptical shape, a smaller central area and a narrow, linear axial area.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Etymology. The epithet of the new variety refers to the lanceolate shape.

Holotype: the specimens illustrated in plate 108, figs. 1-7.

Type locality: Młynek lake.

Occurrence: Common in Młynek Lake and frequent in Kamionka Lake; Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Paraplaconeis ohridana* var. *rostrata* Zalat nov.var.**

(Pl. 108, figs. 8-15)

Diagnosis: Valves are linear-lanceolate to elliptical-lanceolate with broadly and weakly arched margins. Apices are rostrate, subprotracted, and acutely rounded. Axial area is narrow and linear. Central area is well developed, relatively large and rectangular. Raphe is filiform, linear. Proximal raphe ends with distinct central pores, which are not or slightly deflected; distal raphe ends are oppositely deflected. Transapical striae are punctate, strongly radiate throughout the valve, about 9-10 in 10 μm. Length of the valve 46-52 μm, and the breadth 16-19 μm.

Remarks: This variety differs from the nominate species and other taxa by having a linear-lanceolate shape, a relatively large rectangular central area, narrow, filiform raphe fissures and a narrow, linear axial area.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Etymology. The epithet of the new variety refers to the rostrate apices.

Holotype: the specimens illustrated in plate 108, figs. 8-15.

Type locality: Młynek lake.

Occurrence: Common in Młynek Lake, and infrequent in Radomno Lake.

Distribution in Poland: New record.

***Paraplaconeis placentula* (Ehrenberg) Kulikovskiy & Lange-Bertalot 2012**

(Pl. 109, figs. 1-21)

Ref. Patrick & Reimer 1966, p. 523, pl. 50, fig. 1; Krammer & Lange-Bertalot 1986, p. 145, pl. 50, figs. 1-4; Ehrlich 1995, p. 80, pl. 22, fig. 5; Lange-Bertalot & Metzeltin 1996, p. 284, pl. 83, fig. 3; Cox 2003, p. 62, figs. 47-55; Wojtal 2009, p. 284, pl. 16, figs. 1-4; Bąk et al. 2012, p. 279, pl. 36; Lange-Bertalot & Wojtal 2014, p. 410, figs. 45-48; Kulikovskiy et al. 2016, p. 160, pl. 116, figs. 1-5.

Status of name: accepted taxonomically.

Synonyms: *Pinnularia placentula* Ehrenberg 1843

Navicula placentula (Ehrenberg) Kützing 1844

Placoneis placentula (Ehrenberg) Mereschkowsky 1903

Diagnosis: Valves are broadly lanceolate to linear-lanceolate and elliptical-lanceolate, narrowing abruptly to the ends. Apices are apiculate or protracted subrostrate. Axial area is narrow and linear. Central area is distinct, appearing more or less rounded to diamond-shaped. Raphe is filiform, more or less straight. Distal raphe endings are oppositely deflected; proximal raphe endings are expanded towards distinctly marked central pores. Transapical striae are biseriate, radiate throughout the valve, strongly radiate near the ends, about 7-9 in 10 μm, but without markedly longer and shorter alternate striae at the centre. Length of the valve 30-50 μm, and the breadth 14-22 μm.

Ecological preference: Cosmopolitan, in oligosaprobic waters of a broad range of electrolyte content (Krammer & Lange-Bertalot 1986); euplanktonic (Denys 1991); an alkaliphilous, β-mesosaprobous, eurytraphentic, strictly aquatic and fresh brackish water species (Van Dam et al. 1994); a circumneutral, mesotraphentic or eutraphentic diatom, occurring also in slightly brackish waters (Cox 2003); low to moderate water conductivity range between 292 to 569 µS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); optimum distribution in alkaline, flowing and stagnant waters in lowlands with a wide range of mesotrophic (Bąk et al. 2012); reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Common in Radomno, Jeziorak Lake and Młynek Lakes; frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Wyżyna Krakowsko- Częstochowska Upland. Pilica River (Kadłubowska 1964 a, b); springs of Kobylanka stream (Skalna 1969); Sanka stream (Hojda 1971); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); in epipelon of Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in Swibno-Vistula River estuary in North Poland (Majewska et al. 2012); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Paraplaconeis placentula* var. *cuneatum* Zalat nov. var.**

(Pl. 110, figs. 1-9)

Diagnosis: Valves are broadly lanceolate to linear-lanceolate. Apices are cuneate, apiculate, and acutely rounded. Axial area is narrow and linear. Central area is distinct, rectangular, to irregularly shaped. Raphe is filiform, more or less straight. Distal raphe endings are oppositely deflected; proximal raphe endings are expanded with distinct central pores. Transapical striae are slightly radiate at the mid-valve, more radiate throughout towards the ends, about 9-10 in 10 µm. Length of the valve 34-42 µm, and the breadth 16–18 µm.

Remarks: This variety differs from the nominate species and other taxa by having a cuneate, subapiculate apices and a relatively moderate rectangular central area.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Etymology. The epithet of the new variety refers to the cuneate shape of the apices.

Holotype: the specimens illustrated in plate 110, figs. 1-9.

Type locality: Radomno Lake.

Occurrence: Common in Radomno Lake.

Distribution in Poland: New record.

***Paraplaconeis placentula* var. *jenisseyensis* (Bukhtiyarova) Zalat comb. nov.**

(Pl. 110, figs. 10-13)

Ref. Hustedt 1930, p. 304, fig. 536; Bukhtiyarova 1995, p. 419;

Synonyms: *Navicula gastrum* var. *jenisseyensis* Grunow 1880

Placoneis gastrum var. *jenisseyensis* (Grunow) Mereschkowsky 1903

Navicula placentula f. *jenisseyensis* (Grunow) Hustedt 1930

Placoneis placentula var. *jenisseyensis* (Grunow) Bukhtiyarova 1995

Diagnosis: Valves are linear-lanceolate. Apices are cuneate, subprotracted, apiculate, and acutely rounded. Axial area is narrow and linear. Central area is distinct, large, rhomboid, to irregularly shaped, about 1/3 to ½ of the valve width. Raphe is filiform, straight. Distal raphe endings are slightly deflected; proximal raphe endings terminate with distinct central pores. Transapical striae are radiate throughout the valve, about 9-10 in 10 µm. Length of the valve 48-50 µm, and the breadth 16 µm.

Remarks: This variety differs from the nominate species by having a linear-lanceolate outline and a relatively large rhomboid central area.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake

Distribution in Poland: New record.

***Paraplaconeis prespanensis* (Levkov, Krstic & Nakov) Kulikovskiy & Lange-Bertalot 2012**

(Pl. 116, figs. 22-28)

Ref. Levkov et al. 2007, p. 113, pl. 99, figs. 1-17; pl. 100, figs. 1-7; Li et al. 2010, p. 68, figs. 35-40. 42-43; Kulikovskiy et al. 2016, p. 160, pl. 116, figs. 6-10;

Status of name: accepted taxonomically.

Synonym: *Placoneis prespanensis* Levkov, Krstic & Nakov 2007

Diagnosis: Valves are elliptical-lanceolate with shortly protracted, subrostrate ends. Axial area is narrow, linear and widening towards the valve centre. Central area is small, elliptic or subrounded to transversally wide, formed by shortening of 1-2 median striae. Raphe is filiform to weakly arched, sometimes not apparent in small specimens; the proximal raphe endings terminate with distinct central pores that are curving to one side. Transapical striae are radiate throughout the valve, about 9-11 in 10 μm. Length of the valve 18-27 μm, and the breadth 9-12 μm.

Remarks: This species closely resembles Placoneis macedonica, but it can be distinguished by the valve outline, shape of the central area, and striae density (Levkov et al., 2007).

Ecological preference: Oligotrophic to mesotrophic water body (Kulikovskiy et al. 2016); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Kamionka Lakes.

Distribution in Poland: New record.

***Paraplaconeis subplacentula* (Hustedt) Kulikovskiy & Lange-Bertalot 2012**

(Pl. 110, figs. 14-19; pl. 111, figs. 1-28; pl. 116, figs. 1-7)

Ref. Hustedt 1930, pl. 370, fig. 7; Krammer & Lange-Bertalot 1986, p. 145, pl. 50, figs. 5-8; Simonsen, 1987, p. 124, pl. 199, figs. 3-4; pl. 200, figs 1-3; Cox 2003, p. 73.

Status of name: accepted taxonomically.

Synonyms: *Navicula subplacentula* Hustedt 1930

Placoneis subplacentula (Hustedt) Cox, 2003

Diagnosis: Valves are broadly elliptical to elliptical lanceolate, tapering abruptly to the ends. Apices are subapiculate to subrostrate or bluntly rounded. Axial area is narrow at the ends, gradually broadening towards the valve centre, forming a moderate lanceolate area. Central area is distinct, appearing more or less rounded or irregular in shape. Raphe is filiform, markedly sinuate rather than straight. Distal raphe endings are oppositely deflected at the apices; proximal raphe endings are expanded with hooked central pores turning in opposite directions. Transapical striae are biseriate, radiate throughout the valve, strongly radiate near the ends, about 8-9 in 10 μm. Length of the valve 55-65 μm, and the breadth 23-28 μm.

Ecological preference: reported from freshwater rivers and streams of alkaline nature or close to neutral with pH 7-9, low to medium electrolytic conductivity ranged from 100 to 700 μS/cm (Noga et al. 2014a); reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Common in Młynek, Radomno, and Jeziorak Lakes, frequent in Kamionka Lake, and Eemian paleolake deposits of central Poland.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Rivers and streams in the valley of the Wisłok River and on cultivated soils of the Podkarpacie region, south Poland (Noga et al. 2014a).

Genus *Placoneis* Mereschkowsky 1903

Diagnosis: Valves are linear-elliptic to lanceolate, with acutely or broadly rounded, subcapitate, subrostrate, capitate or rostrate apices. Axial area is usually narrow, central area is variable. Raphe is often filiform, proximal raphe ends are expanded and curved to the same or opposite sides. Distal raphe ends are curved to the same side. Isolated pores (stigmata) may be present. Transapical striae are uniseriate, sometimes shortened and more widely spaced in the central valve region. Areolae are round externally and usually square internally.

Holotype species: *Placoneis gastrum* (Ehrenberg) Mereschkowsky 1903

***Placoneis amphibola* (Cleve) Cox 2003**

(Pl. 112, figs. 1-10)

Ref. Krammer & Lange- Bertalot 1986, p. 146, pl. 51, fig. 1; Cox 2003, p. 72, figs. 103, 104; Bahls et al. 2018, p. 48, pl. 11, fig. 22; p. 96, pl. 59, fig. 18.

Status of name: accepted taxonomically.

Synonym: *Navicula amphibola* Cleve 1891

Diagnosis: Valves are linear-elliptic to linear-lanceolate and curved so that they are slightly asymmetric to the apical axis. Apices are rostrate to broadly subapiculate, rounded apices. Axial area is narrow. Central area is large, transverse, bowtie-shaped and bounded by 3-4 short striae of variable length. Raphe is undulate and lateral. Proximal raphe endings are expanded; distal raphe endings are deflected toward the primary side of the valve. Transapical striae are distinctly punctate, radiate and curved toward the valve centre throughout the valve, about 6-8 in 10 µm. The areolae density is approximately 12-16 in 10 µm. Length of the valve 39-75 µm, and the breadth 23-27 µm.

Ecological preference: the species has a Nordic-alpine distribution in Europe, and also occurs in freshwater fossil deposits (Krammer & Lange-Bertalot 1986); reported from the benthic habitats of slightly alkaline, meso- to eutrophic freshwater environments.

Occurrence: Common in Jeziorak and Młynek Lakes; frequent in the Eemian paleolake deposits, central Poland.

Distribution in Poland: New record.

***Placoneis clementioides* (Hustedt) Cox 1988**

(Pl. 113, figs. 1-6)

Ref. Hustedt 1944, p. 285, pl. 8, figs. 19, 20; Krammer & Lange-Bertalot 1986, p 140, pl. 48, figs. 3-8; Cox 1988, p. 155, figs. 13-16, 39, 41, 43, 44; Miho & Lange-Bertalot 2006, p. 311, fig. 63; Kulikovskiy et al. 2016, p. p. 150, pl. 114, figs. 17-19.

Status of name: accepted taxonomically.

Synonym: *Navicula clementioides* Hustedt 1944

Diagnosis: Valve is elliptical, linear elliptical to elliptical-lanceolate. Apices are narrow to rostrate, acutely rounded. Axial area is narrow and linear. Central area is distinct, small to moderately wide, transverse, and somewhat irregular in shape due to the uneven length of the striae. Two isolated punctae are present on one side of the central nodule. Raphe is narrow, linear, and filiform. Proximal raphe ends with small central pores that are slightly expanded externally; distal raphe endings are deflected toward one side of the valve. Transapical striae are finely punctate, strongly radiate throughout the valve; alternately longer and shorter in the middle portion, about 13-14 in 10 µm. Length of the valve 20-32 µm, and the breadth 8-12 µm.

Ecological preference: distributed in middle and north Europe and prefers moderate electrolytic content and oligotrophic waters (Krammer & Lange-Bertalot 1986). It is reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Placoneis clementis* (Grunow) Cox 1987**

(Pl. 113, figs. 7-9)

Ref. Patrick & Reimer 1966, p. 521, pl. 49, fig. 22; Germain 1981, p.198, pl. 76, figs. 7-9; Krammer & Lange-Bertalot 1986, p. 139, pl. 47, figs. 1-9; pl. 53, fig. 3; Cox 1988, p. 155, figs. 28-33; Campeau et al. 1999, p. 131, figs 21: 7-9; Miho & Lange-Bertalot 2006, p. 311, fig. 64; Wojtal 2009, p. 284, pl. 15, figs. 21, 22; Lange-Bertalot & Wojtal 2014, p. 405, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Navicula clementis* Grunow 1882

Schizonema clementis (Grunow) Kuntze 1898

Diagnosis: Valves are elliptical-lanceolate, linear-lanceolate to rhombic-lanceolate and slightly asymmetrical. Apices are moderately protracted, narrowed to rostrate, and bluntly rounded. Axial area is relatively narrow and linear. Central area is irregular in shape due to the uneven length of the striae, somewhat transverse or rounded. Two isolated punctae are present on one side of the central nodule. Raphe is almost straight, filiform to weakly lateral. Proximal raphe endings with expanded and slightly deflected central pores; distal raphe endings are deflected to the opposite side. Transapical striae are finely punctate, distinctly lineate, strongly radiate and curved throughout the valve, about 8-10 in 10 μm at the valve centre to 14-16 in 10 μm at the ends, alternately longer and shorter striae in the middle portion. Puncta density about 28 in 10 μm. Length of the valve 18-50 μm, and the breadth 8-15 μm.

Ecological preference: This taxon is a oligohalobous, littoral, often an aerophile, prefers circumneutral to slightly alkaline waters (Patrick & Reimer 1966); Tychoplanktonic (Denys 1991); an alkaliphilous, β-mesosaprobous, meso-eutraphentic and brackish fresh water species (Van Dam et al. 1994); it occurs in electrolyte rich to brackish waters (Taylor et al. 2007); Low to moderate water conductivity range between 292 to 569 μS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); optimal occurrence in streams and rivers, and lakes in the lowlands, with a medium to high electrolyte content. It is also widespread in estuaries, as well as in brackish waters in general; the habitats are mesotrophic to eu- polytrophic (Bąk et al. 2012); freshwater of an alkaline or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 17.5-19.5, Nitrate slightly deviated from the standards (Noga et al. 2013 b, c); Benthic, oligohalobous indifferent, alkaliphilous, mesotraphentic-eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); found in Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); in Górki Zachodnie – Vistula River estuary in North Poland (Majewska et al. 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b, c); Wisłok River and the catchment area including rivers and streams (Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Placoneis clementispronina* Lange-Bertalot & Wojtal 2014**

(Pl. 113, figs. 10-14)

Ref. Krammer & Lange-Bertalot 1986, p. 139, pl. 47, figs. 1-5; Lange-Bertalot & Wojtal 2014, p. 405, figs. 5-13, 77-79.

Status of name: accepted taxonomically.

Synonyms: *Navicula clementis* Grunow in Van Heurck, 1880

Witkowskia clementispronina (Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broad-elliptical to elliptical-lanceolate, or rhombic-elliptical to rhombic lanceolate. Apices are more or less rostrate or subrostrate, subprotracted to bluntly rounded. Axial area is narrow at the ends, and becomes moderately widened towards the valve centre. Central area is variable in size, rounded, subrounded or transapically expanded up to ½ of the valve width. At the central nodule, unilaterally with two apically orientated stigmoids set off from the adjacent striae, which are alternately shorter and longer. Raphe

is almost straight, filiform to very weakly lateral. Proximal raphe endings are expanded, slightly deflected central pores, which lie in approximately circular depressions; distal raphe endings are heteromorphous, weakly sinuous, turning to opposite sides. Transapical striae are finely punctate, radiate throughout, becoming gradually more strongly radiate towards the ends, about 11-14 in 10 μm. Length of the valve 20-40 μm, and the breadth 10-14 μm.

Ecological preference: Predominantly in alkaline, eutrophic, often mesosaprobic rivers and in more or less brackish water of river estuaries **(**Lange-Bertalot & Wojtal 2014); it is reported from shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Radomno Lakes.

Distribution in Poland: from two localities near Kraków in Kobylanka stream and reservoir in Kryspinów, south Poland (Lange-Bertalot & Wojtal 2014)

***Placoneis constans* (Hustedt) Cox 2003**

Ref. Hustedt 1944, p. 284, pl. 8, fig. 13; Joh 2013, p. 14, pl. 3, fig. 9; Krammer & Lange-Bertalot 1986, p 140, pl. 48, figs. 10-14; Simonsen 1987, pl. 476, figs. 1-5; Cox 2003, p. 73; Bąk et al. 2012, p. 278, pl. 37; Kulikovskiy et al. 2016, p. 151, pl. 113, figs. 20-22.

Status of name: accepted taxonomically.

Synonyms: *Navicula constans* Hustedt 1944

Witkowskia constans (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broad-elliptical to elliptical-lanceolate. Apices are short, narrow, rostrate, subprotracted to bluntly rounded. Axial area is linear, narrow at the ends, and gradually expanding towards the valve centre. Central area is variable in size, rounded, or transapically expanded up to ½ of the valve width. At the central nodule, an isolated stigma may be present, and striae are alternately shorter and longer. Raphe is straight, filiform. Proximal raphe endings are slightly expanded with deflected central pores; distal raphe endings turn to opposite sides. Transapical striae are finely punctate, radiate throughout, strongly radiate towards the ends, about 10-14 in 10 μm. Length of the valve 25-44 μm, and the breadth 10-14 μm.

Ecological preference: Freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, (Noga et al. 2013 b); It is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Baryczka stream, left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Placoneis dicephala* (Ehrenberg) Mereschkowsky 1903**

Ref. Hustedt 1930, p. 302, fig. 526; Hohn 1951, p. 36, fig. 137; Andrews 1966, p. A15, pl. 2, fig. 5; Germain 1981, p. 195, pl. 74, figs. 11-14.

Status of name: accepted taxonomically.

Synonyms: *Navicula dicephala* Ehrenberg 1838

Pinnularia dicephala (Ehrenberg) Ehrenberg 1843

Schizonema dicephalum (Ehrenberg) Kuntze 1898

Cymbella dicephala (Ehrenberg) Holmboe 1901

Witkowskia dicephala (Ehrenberg) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broadly linear to linear lanceolate or linear elliptical, sometimes the valve margin is slightly triundulate. Apices are rostrate and subcapitate, bluntly rounded. Axial area is narrow and linear. Central area is fairly large, somewhat round, transversely expanded, surrounded by alternate long and short, curved striae. Raphe is filiform and straight or slightly curved. Proximal raphe endings are slightly expanded with small central pores; distal raphe endings are deflected toward one side of the valve. Transapical striae are radiate throughout the valve, and curved, closely set at the ends, about 10-12 in 10 μm, slightly wider apart at the valve centre and shorter opposite the central area. Length of the valve 24-30 μm, and the breadth 7-8 μm.

Ecological preference: Benthic, alkaliphilous (Kaczmarska 1976); cosmopolitan species found on sediments in a range of waters, tolerant of moderate pollution. It is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Placoneis elginensis* (Gregory) Cox 1987**

(Pl. 113, figs. 15-27)

Ref. Hustedt 1930, p. 303, figs. 530-531; Cox 1988, p. 155, figs. 20-27, 34, 35, 45, 46, 51; Patrick & Reimer 1966, p. 524. pl. 50, fig. 3; Germain 1981, p. 195, pl. 73, figs. 7-8; Krammer & Lange-Bertalot 1986, p. 136, pl. 46, figs. 1-12. Lange-Bertalot 2001, p. 123, pl. 95, figs. 1-17; pl. 96, fig. 1; Cox 2003, p. 64, figs 59-62; Wojtal 2009, p. 284, pl. 15, figs. 23, 24; Bahls et al. 2018, p. 83, pl. 46, figs. 18, 19.

Status of name: accepted taxonomically.

Synonyms: *Pinnularia elginensis* W. Gregory 1856
Navicula elginensis (Gregory) Ralfs 1861
Navicula dicephala var. *elginensis* (Gregory) Cleve 1895
Placoneis dicephala var. *elginensis* (Gregory) Mereschkowsky 1903
Navicula tumida W.Smith 1853
Navicula anglica Ralfs 1861
Navicula dicephala f. *minor* Grunow 1880
Navicula placentula var. *anglica* (Ralfs) Grunow 1880
Navicula tumida var. *anglica* (Ralfs) Gutwinski 1891
Navicula anglica f. *major* A.Cleve 1932
Placoneis anglica (Ralfs) Cox 2003

Diagnosis: Valves are linear, elliptical-lanceolate to broad elliptical. Apices are subprotracted, rostrate to capitate. Axial area is narrow and linear. Central area is transverse, may be somewhat rounded or rectangular, occupying about half the valve width and bounded by 3-4 short striae of variable length. Raphe is lateral. Proximal raphe endings are slightly expanded with small central pores; distal raphe endings are deflected toward the primary side of the valve. Transapical striae are punctate, strongly radiate throughout and curved toward the valve centre, about 10-11 in 10 µm. Puncta about 27-29 in 10 µm. Length of the valve 20-34 µm, and the breadth 8-12 µm.

Ecological preference: Tolerant of a wide range of conditions in fresh to slightly brackish water (Patrick & Reimer 1966); it is reported as *Placoneis anglica* (Ralfs) Cox in circumneutral, mesotrophic and slightly eutrophic freshwaters (Cox 2003); cosmopolitan, found in unpolluted to slightly polluted dystrophic waters (Taylor et al. 2007); low to moderate water conductivity range between 292 to 569 µS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); freshwater of circumneutral character or close to neutral (6.6-7.1), low conductivity (128-129 µSx cm $^{-1}$), temperature 17.5-19.5, Nitrate slightly deviated from the standards (4.10-4.68 mg/$^{-1}$ (Noga et al. 2013 c); benthic, oligohalobous indifferent, alkaliphilous, dystraphentic-eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Common in Młynek Lake; frequent in Radomno and Kamionka Lakes.

Distribution in Poland: the species was recorded as *Placoneis anglica* (Ralfs) Cox from Wyżyna Krakowskoczęstochowska Upland, Fish ponds in Mydlniki (Siemińska 1947); Vistula River (Turoboyski 1962); Sanka stream (Kądziołka 1963); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b); springs of Będkowka stream (Kubik 1970); Kluczwoda stream (Nawrat 1993); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland, as *Navicula anglica* (Kaczmarska 1976); Holocene

sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); in epipelon and metaphyton in Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Duszatyńskie Lakes (Western Bieszczady Mts.), and Baryczka stream left bank tributary of the River San south-east Poland (Noga et al. 2013 a, b, c); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Placoneis elginensis* var. *elliptica* Zalat nov. var.**

(Pl. 113, figs. 28-30)

Diagnosis: Valves are elliptical-lanceolate. Apices are subprotracted, subcapitate and acutely rounded. Axial area is very narrow and linear. Central area is transversely expanded, rectangular, occupying about half the valve width and bounded by short striae of variable length. Raphe is filiform, straight. Proximal raphe endings are drop-shaped, slightly deflected to one side; distal raphe endings are deflected toward one side of the valve. Transapical striae are finely punctate, distinctly radiate throughout, about 13-14 in 10 µm. Puncta about 30-33 in 10 µm. Length of the valve 18-22 µm, and the breadth 8-10 µm.

Remarks: This variety differs from the nominate species by small size, having an elliptical outline and number of striae per 10 µm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species.

Etymology. The epithet of the new variety refers to the elliptical shape.

Holotype: the specimens illustrated in plate 113, figures 28-30.

Type locality: Młynek Lake.

Occurrence: Common in Młynek Lake, and infrequent in Kamionka and Radomno Lakes.

Distribution in Poland: New record.

***Placoneis densa* (Hustedt) Lange-Bertalot 2005**

(Pl. 114, figs. 1-2)

Ref. Hustedt 1944, p. 284, fig. 28; Foged 1966, p. 84, pl. 1. 3; Metzeltin et al. 2005, pl. 73, figs. 20-24; pl. 76, fig. 6.

Status of name: accepted taxonomically.

Synonym: *Navicula densa* Hustedt 1944

Diagnosis: Valves are broadly elliptical to broadly lanceolate, narrowing abruptly to the ends. Apices are apiculate or protracted subrostrate. Axial area is relatively narrow and linear-lanceolate, narrowing at the ends, and gradually broadening slightly towards the valve centre. Central area is distinct, appearing more or less subrounded or irregularly shaped. Raphe is filiform, more or less straight. Proximal raphe endings are expanded towards distinctly marked central pores. Distal raphe endings are oppositely deflected. Transapical striae are strongly radiate throughout the valve, about 9-10 in 10 µm, with markedly longer and shorter alternate striae at the centre. Length of the valve 38-40 µm, and the breadth 14-16 µm.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Placoneis exigua* (Gregory) Mereschkovsky 1903**

(Pl. 114, figs. 3-8)

Ref. Hustedt 1930, p. 305, fig. 538; Patrick & Reimer 1966, p. 522, pl. 49, fig. 23; Okuno 1974, p. 21, figs. 873-874; Krammer & Lange-Bertalot 1986, p. 138, pl. 46, figs. 16-18; Bartozek et al. 2018, p. 83, figs. 59-61.

Status of name: accepted taxonomically.

Synonyms: *Pinnularia exigua* Gregory 1854
Navicula gastrum var. *exigua* (Gregory) Grunow 1880
Navicula exigua (W.Gregory) Grunow 1880
Placoneis gastrum var. *exigua* (Gregory) Mereschkowsky 1903
Placoneis elginensis f. *exigua* (Gregory) Bukhtiyarova 1995
Witkowskia exigua (Gregory) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear, linear-elliptical, broadly elliptical to elliptical-lanceolate. Apices are subprotracted, rostrate, and acutely rounded. Axial area is narrow and linear. Central area is small to moderately large, transverse, more or less rectangular, occupying about half the valve width and bounded by 3-4 short striae of variable length. Raphe is filiform. Proximal raphe endings are slightly expanded with small central pores; distal raphe endings are deflected toward one side of the valve. Transapical striae are radiate throughout the valve and curved toward the valve centre, irregular in length and more or less alternately longer and shorter, about the central area. Striae about 12-14 in 10 μm. Puncta density of about 29-30 in 10 μm. Length of the valve 17-40 μm, and the breadth 8-15 μm.

Remarks: This taxon resembles *Placoneis constans* (Hustedt) Cox var. *symmetrica* (Hustedt) Kobayasi due to their lanceolate valves and rostrate ends. However, the second species is smaller than *P. exigua* and shows a central area with longer striae surrounded by shorter striae (Marquardt & Bicudo 2014)

Ecological preference: Freshwater, circumneutral pH, with moderate hardness (Patrick & Reimer 1966); benthic, alkaliphilous (Kaczmarska 1976); it is reported as an indicator of eutrophic conditions (Van Dam et al. 1994); occurred in sediment of eu- and hypereutrophic reservoirs (Bartozek et al. 2018).

Occurrence: Frequent in Jeziorak Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland, as *Navicula exigua* (Kaczmarska 1976); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Placoneis explanata* (Hustedt) Lange-Bertalot in Rumrich et al. 2000**

(Pl. 114, figs. 9-17)

Ref. Hustedt 1948, p. 202, 207, figs. 7-8; Patrick & Reimer 1966, p. 526, pl. 50, fig. 7; Krammer & Lange-Bertalot 1986, p. 143, pl. 49, figs. 1-3; Simonsen 1987, p. 338, pl. 517, figs. 1-5; Kulikovskiy et al. 2016, p. 151, pl. 113, figs. 16-19; Rivera-Rondón & Catalan 2017, p. 268, pl. 64, figs. 5-7, 9; Bahls et al. 2018, p. 83, pl. 46, fig. 17.

Status of name: accepted taxonomically.

Synonym: *Navicula explanata* Hustedt 1948

Diagnosis: Valves are lanceolate to linear-lanceolate, with weakly convex margins. Apices are protracted, rostrate and broadly rounded. Axial area is linear and narrow. Central area is variable, transverse, from bow-tie to rectangular. Raphe is straight to weakly lateral. Proximal raphe endings are weakly inflated; distal raphe endings are deflected in opposite directions. Transapical striae are punctate, lineate, radiate and weakly curved at the valve centre, becoming parallel and denser at the apices, about 10-11 in 10 μm at the valve centre, up to 16-18 in 10 μm at the ends. Puncta about 24-26 in 10 μm. Length of the valve 24-40 μm, and the breadth 8.5-12 μm.

Ecological preference: Oligotrophic-mesotrophic water body (Kulikovskiy et al. 2016); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Kamionka and Młynek Lakes; frequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: as *Navicula explanata* from Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Placoneis gastriformis* (Hustedt) Lange-Bertalot 2005**

(Pl. 114, figs. 18-22)

Ref. Schmidt 1934, pl. 398, figs. 17-19; Hustedt 1935, p. 157, pl. 1, fig. 8; Metzeltin et al. 2005, p. 178; Mironov et al. 2024, p. 31.

Status of name: accepted taxonomically.

Synonyms: *Navicula gastrum* var. *gastriforme* (Hustedt) Lange-Bertalot
Navicula gastriformis Hustedt in Schmidt 1934
Witkowskia gastriformis (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are elliptical to elliptical-lanceolate with slightly cymbelloid symmetry. Apices are broadly rounded and shortly protracted. Axial area is narrow and linear. Central area is variable, small, slightly transverse to subrounded in shape, and somewhat indistinct. A single stigma is present. Raphe is straight to weakly lateral. Proximal raphe endings with small, inflated central pores; distal raphe endings are deflected on opposite sides. Transapical striae are punctate, radiate and weakly curved at the valve centre, becoming radiate at the apices, about 10-12 in 10 µm. Striae at the valve centre are alternately long and short, Puncta about 29-30 in 10 µm. Length of the valve 24-50 µm, and the breadth 8.5-15 µm.

Ecological preference: The species was reported from acidic to neutral (pH = 6.51 ± 0.71), with low conductivities (108.23 ± 60.70 µS cm^{-1}), low alkalinity (127 ± 82.64 mg/l^{-1}), moderate dissolved oxygen (5.84 ± 1.22 mg/l^{-1}), high temperature (24.75 ± 1.13°C), and the concentration of silica was relatively high (12.00 ± 6.90 mg/l^{-1}) (N'Guessan et al. 2018); shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Placoneis gastrum* (Ehrenberg) Mereschkowsky 1903**

(Pl. 115, figs. 1-15)

Ref. Hustedt 1930, p. 305, fig. 537; Patrick & Reimer 1966, p. 518, pl. 49, fig. 14; Germain 1981, p. 198. pl. 76, figs. 2-4; Krammer & Lange-Bertalot 1986, p. 143, pl. 49, figs. 4-9; Ehrlich 1995, p. 76, pl. 22, figs. 3-4; Cox 2003, p. 57, figs. 27-32; Bąk et al. 2012, p. 278, pl. 37; Kulikovskiy et al. 2016, p. 151, pl. 113, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Pinnularia gastrum* Ehrenberg 1843
Navicula gastrum (Ehrenberg) Kützing 1844
Schizonema gastrum (Ehrenberg) Kuntze 1898
Navicula gastrum f. *maxima* Tempère & Peragallo 1910

Diagnosis: Valves are lanceolate to elliptical-lanceolate. Apices are obtuse, slightly protracted, and bluntly rounded. Axial area is narrow, linear, and slightly widened towards the valve centre. Central area is small to moderate, irregular in shape, and transverse. Raphe is filiform, weakly lateral and slightly curved near the ends; the proximal raphe endings are slightly expanded by small central pores; the distal raphe endings are unilaterally deflected close to the ends. Transapical striae are distinctly punctate, radiate throughout the valve, about 8-10 in l0 µm at the valve centre up to 12 in 10 µm at the ends, irregular in length and alternately longer and shorter at the central area. Length of the valve 26-60, and the breadth 12-18 µm.

Ecological preference: The taxon occurs in fresh to slightly brackish waters (Patrick & Reimer 1966); its pH optimum lies around 8 (Cholnoky 1968); freshwater, benthic, alkaliphilous with pH values 7.58.0 (Ehrlich 1973); oligohalobous 'indifferent', pH circumneutral (Foged 1980); epipelic in standing water, oligosaprobic (Krammer & Lange-Bertalot 1986); freshwater, mesotrophic to eutrophic (to slightly brackish) lakes (Cox 2003); the species was observed commonly in freshwater habitats of low conductivity and slightly alkaline (Zalat & Servant-Vildary 2005); distributed in lakes, streams and rivers in the lowlands at medium to a high electrolyte content, meso- to eutrophic and oligosaprobic (Bąk et al. 2012); it is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Common in Kamionka, Jeziorak Lake, Młynek Lake and Radomno Lakes, and frequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Placoneis hambergii* (Hustedt) Bruder 2007**

Ref. Hustedt 1934, pl. 400, figs. 12-14; Cleve-Euler 1953, p. 148, fig. 801k; Krammer & Lange-Bertalot 1986, p. 146, pl. 50, figs. 9-13; pl. 53, figs. 4-5; Simonsen 1987, p. 86, pl. 123, figs. 13-18; Ohtsuka 2002, p. 39, fig. 153; Bruder & Medlin 2007, p. 343-347, figs. 13-19; Kulikovskiy et al. 2016, p. 151, pl. 114, figs. 14-16.

Status of name: accepted taxonomically.

Synonyms: *Navicula hambergii* Hustedt 1924

Navicula gastrum var. *hambergii* (Hustedt) A.Cleve 1953

Navicula quadripartita Hustedt 1934

Diagnosis: Valves are broadly elliptical to elliptic-lanceolate. Apices subprotracted, bluntly rounded. Axial area is narrow at the ends, expanded slightly towards the valve centre, and slightly lanceolate. Central area is lacking or very small, formed by reduced striae at the centre. Raphe is filiform, straight; proximal raphe endings with slightly expanded external central pores and the distal raphe endings are straight and hook-like, curved to the same side. Helictoglossae is present at the end. Transapical striae are radiate throughout, irregularly shortened or alternately longer and shorter at the valve centre, about 13-17 in 10 μm. length of the valve 12-24 μm, and the breadth 5-8 μm.

Ecological preference: Cosmopolitan, common in oligotrophic water (Krammer & Lange-Bertalot 1986); It is reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village, in south-east Poland (Szczepocka & Rakowska 2015).

***Placoneis humilis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005**

(Pl. 116, figs. 8-11)

Ref. Metzeltin et al. 2005, p. 182, pl. 74, figs. 11-19; pl. 76, fig. 4.

Status of name: accepted taxonomically.

Diagnosis: Valves are broadly elliptic with cuneate ends, but in longer specimens, very slightly protracted to almost subrostrate. Axial area is narrow at the ends, and very slightly expanded towards the valve centre. Central area is small, subrounded, and sometimes indistinct from the axial area, or irregular due to shortened central striae. Raphe is filiform, almost straight. Proximal raphe endings are distinctly expanded with central pores, not clearly deflected to any side. Stigmata are absent. Transapical striae are distinctly radiate throughout the valve, about 10-11 in 10 μm. Length of the valve 16-17 μm, and the breadth 9-11 μm.

Ecological preference: Benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes.

Distribution in Poland: New record.

***Placoneis ignorata* (Schimanski) Lange-Bertalot 2000**

Ref. Schimanski 1978, p. 585, pl. 6, figs. 1-9; Krammer & Lange-Bertalot 1986, p. 136, pl. 46, figs. 10-12; Rumrich et al. 2000, p. 208, pl. 60, figs 11,12; Cox 2003, p. 73; Miho & Lange-Bertalot 2006, p. 311, figs. 66, 70; Kulikovskiy et al. 2016, p. 153, pl. 114, figs. 20-24.

Status of name: accepted taxonomically.

Synonyms: *Navicula ignorata* Schimanski 1978

Navicula elginensis var. *cuneata* (Møller ex Foged) Lange-Bertalot 1985

Witkowskia ignorata (Schimanski) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear-elliptical to elliptical-lanceolate. Apices are subcapitate, subprotracted, bluntly rounded to rostrate. Axial area is narrow and linear. Central area is transversely expanded, about half of the valve breadth, may be somewhat rounded or rectangular, confined by two shortened striae. Raphe is straight, weakly

lateral. Proximal raphe endings are slightly expanded with small central pores; distal raphe endings are deflected toward one side of the valve. Transapical striae are uniseriate, radiate throughout the valve, about 11-13 in 10 μm. Length of the valve 20-35 μm, and the breadth 7-10 μm.

Ecological preference: It is reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 μS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm-1) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b).

***Placoneis nanoclementis* Lange-Bertalot & Wojtal 2014**

(Pl. 116, fig. 12)

Ref. Lange-Bertalot & Wojtal 2014, p. 407, figs. 14-28, 71-73; Kulikovskiy et al. 2016, p. 154, pl. 114, figs. 29-33; Genkal & Yarushina 2022, p. 165, pl. 3, figs. 9-13.

Status of name: accepted taxonomically.

Synonym: *Witkowskia nanoclementis* (Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broadly elliptical-lanceolate to elliptical. Apices abruptly protracted, broadly subrostrate to rostrate. Axial area is narrow, very slightly expanded towards the valve centre. Central area is more or less extended transapically, about half of the valve width, variable in shape due to 3-4 irregularly shortened striae on either side. Raphe is filiform, almost straight. Proximal raphe endings are distinctly expanded with central pores, not deflected to any side. Distal raphe endings are shortly curved to apparently opposite sides. Two stigmata are present close to the central nodule. Transapical striae are uniseriate, radiate throughout, about 12-13 in 10 μm, becoming more strongly radiate, about 14-16 in 10 μm close to the ends. Length of the valve 14-23 μm, and the breadth 8.0-8.5 μm.

Ecological preference: observed in comparable alkaline, eutrophic, β-mesosaprobic waters with moderately high conductivity (Lange-Bertalot & Wojtal 2014).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Placoneis neoexigua* Lange-Bertalot & Miho 2006**

(Pl. 116, figs. 13-15)

Ref. Miho & Lange-Bertalot 2006, p. 302, figs. 1-11, 20-26.

Status of name: accepted taxonomically.

Diagnosis: Valves are broadly elliptical to linear-elliptical with shortly rostrate to slightly subcapitate apices. Axial area is narrow and linear. Central area is variable in shape due to several striae alternating shorter and longer, moderately expanded transversally, almost circular with at most a single shortened stria on either side. Stigmata are lacking. Raphe is filiform and straight; the proximal raphe endings are expanded with small central pores; the distal raphe endings are heteromorphous, one is simply deflected or curved, the other one is forming a double-curve, first turning to the opposite side, but finally both terminal fissures curve to the same side of the valve mantle. Transapical striae are uniseriate, finely punctate, and radiate throughout the valve, about 10-12 in 10 μm. length of the valve 14-40 μm, and the breadth 7-11 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: New record.

***Placoneis paraelginensis* Lange-Bertalot 2000**

(Pl. 116, figs. 16-19)

Ref. Rumrich et al. 2000, p. 208, pl. 60, figs. 17-20; Cox 2003, p. 67, figs. 63-65; Miho & Lange-Bertalot 2006, p. 311, figs. 67-69; Wojtal 2009, p. 284, pl. 15, figs. 25-31; pl. 66, figs. 5-8; pl. 67, figs. 1-5; Bąk et al. 2012, p. 279, pl. 37; Kulikovskiy et al. 2016, p. 154, pl. 114, figs. 39-42; Genkal & Yarushina 2022, p. 168, pl. 4, figs. 2-3.

Status of name: accepted taxonomically.

Synonyms: *Navicula elginensis* (Gregory) Ralfs 1861

Witkowskia paraelginensis (Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear with parallel margins to elliptical-lanceolate with weakly convex or concave margins. Apices are subprotracted, broadly rostrate to subcapitate. Axial area is narrow and linear. Central area is a transverse, rectangular, occupying about half the valve width and bounded by 4-5 short striae of variable length. Raphe is slightly lateral. Proximal raphe endings are more distant, slightly expanded with small central pores; distal raphe endings are deflected toward the primary side of the valve. Transapical striae are punctate, strongly radiate throughout, about 11-12 in 10 µm, slightly wider apart at the valve centre. Puncta about 27-29 in 10 µm. Length of the valve 20-35 µm, and the breadth 7-9 µm.

Remarks: This taxon is sometimes mistaken with *Pinnularia dicephala* Ehrenberg.

Ecological preference: Optimum occurrence in streams, rivers and lakes in the lowlands with medium to high electrolyte content, oligo- to most often eutrophic, oligosaprobic and in the calcium-rich waters of upland streams (Bąk et al. 2012); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 128 µS/cm to 528 µS/cm; temperature 17.5-19.5, Nitrate slightly deviated from the standards (Noga et al. 2013 a, b, c); reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015); from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Frequent in Młynek and Radomno Lakes.

Distribution in Poland: Kobylanka stream northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013a,b,c); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village, south-east Poland (Szczepocka & Rakowska 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Placoneis parvapolonica* Lange-Bertalot & Wojtal 2014**

(Pl. 116, figs. 20-21)

Ref. Lange-Bertalot & Wojtal 2014, p. 408, figs. 29-44, 74-76; Kulikovskiy et al. 2016, p. 154, pl. 113, figs. 7-11.

Status of name: accepted taxonomically.

Synonym: *Witkowskia parvapolonica* (Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broadly elliptical. Apices are more or less protracted, subrostrate to moderately rostrate, bluntly rounded. Axial area is very narrow and linear. Central area is expanded transversely, irregular in shape, somewhat rectangular, or rounded and occupies about 1/3 of the valve breadth. Raphe is filiform, almost straight. Proximal raphe endings are distinctly expanded central pores, not deflected to any side. Distal raphe

endings are curving shortly to opposite sides. Two stigmata unilaterally set off from the adjacent central striae. Transapical striae are uniseriate, radiate throughout the valve, around the central nodule, often alternately shorter and longer, occasionally 4-5 irregularly shortened ones. Other striae are evenly spaced, about 14-15 in 10 μm. Length of the valve 16-20 μm, and the breadth 8.0-9.5 μm.

Ecological preference: The species was reported from springs and streams of alkaline, mesotrophic, oligo-β-mesosaprobic, calcium-rich waters with moderate to high conductivity **(**Lange-Bertalot & Wojtal 2014); mesotrophic-eutrophic water body (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009, Lange-Bertalot & Wojtal 2014).

***Placoneis porifera* (Hustedt) Cox 2003**

Ref. Hustedt 1944, p. 284, fig. 25; Krammer & Lange-Bertalot 1986, p. 141, pl. 47, figs. 19-24; Simonsen 1987, pl. 474, figs. 15-18; Cox 2003, p. 74; Miho & Lange-Bertalot 2006, p. 308, figs. 52-62; Wojtal 2009, p. 286, pl. 65, fig. 6; pl. 66, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Navicula porifera* Hustedt 1944

Witkowskia poriphera (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are broadly rhombic-elliptical to rhombic-lanceolate. Apices are subrostrate, not protracted, bluntly rounded. Axial area is very narrow and gradually slightly widening toward the valve centre. Central area is extended transversely, variable in shape due to the irregular length of the striae in the central area. Raphe is filiform, almost straight. Proximal raphe endings are distinctly expanded central pores that are not deflected to any side. Distal raphe endings are deflected to opposite sides. An isolated stigma unilaterally set off from the adjacent central striae. Transapical striae are finely punctate, strongly radiate throughout the valve, alternately shorter and longer around the central nodules, about 14-16 in 10 μm. Length of the valve 15-24 μm, and the breadth 8.0-10 μm.

Ecological preference: Widespread in Europe, in oligosaprobic waters of a broad range of electrolyte content (Krammer & Lange-Bertalot 1986); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); from low to moderate water conductivity range between 292 to 569 μS cm-1, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Known from Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); spring in Warta River valley (Żelazna-Wieczorek & Mamińska 2006); Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009).

***Placoneis pseudabundans* Levkov 2011**

(Pl. 117, figs. 1-12)

Ref. Levkov& Williams 2011, p. 14, figs. 92-95.

Status of name: accepted taxonomically.

Synonym: *Witkowskia pseudabundans* (Levkov) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are elliptical-lanceolate to broadly lanceolate. Apices are short, protracted, bluntly rounded, rostrate. Axial area is narrow and linear. Central area is small, elliptical to subrounded, formed by regular shortening of central striae. Raphe is filiform and straight; proximal raphe endings are weakly expanded with central pores, not deflected to any side; distal raphe endings are unilaterally deflected close to the ends. Two stigmata are present in the central area, located close to central striae. Transapical striae are punctate, slightly radiate at the valve centre, becoming strongly radiate towards the ends, about 13-15 in 10 μm. Length of the valve 25-30 μm, and the breadth 9.0-10.5 μm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake and frequent in Młynek Lake.

Distribution in Poland: New record.

***Placoneis signata* (Hustedt) Mayama 1998**

(Pl. 117, figs. 13-20)

Ref. Hustedt 1944, p. 283; Krammer & Lange-Bertalot 1986, p. 144, pl. 49, figs. 7-9; Miho & Lange-Bertalot 2006, p. 308, figs. 36-40.

Status of name: Uncertain

Synonyms: *Navicula gastrum* var. *signata* Hustedt 1944

Placoneis gastrum var. *signatum* (Hustedt) Haworth & Kelly 2002

Witkowskia signata (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear-elliptical, to elliptic-lanceolate with slightly cymbelloid symmetry. Apices are broadly rounded and shortly protracted. Axial area is narrow, linear, and very weakly widened towards the valve centre. Central area is small, irregular in shape, and somewhat indistinct. Raphe is filiform, weakly curved near the ends. Proximal raphe endings are expanded slightly by small central pores. Distal raphe endings are unilaterally deflected close to the ends towards one side. Transapical striae are punctate, strongly radiate throughout the valve, about 9-12 in l0 µm, irregular in length and alternately longer and shorter at the central area. Length of the valve 25-50 µm, and the breadth 11-16 µm.

Remarks: This species may be is more closely related to *Placoneis gastriformis* (Hustedt) Lange-Bertalot.

Ecological preference: Reported from shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak and Młynek Lakes.

Distribution in Poland: New record.

***Placoneis significans* Lange-Bertalot 2005**

(Pl. 118, figs. 1-5)

Ref. Hustedt 1944, p. 287, fig. 14; Krammer & Lange-Bertalot 1986, p. 139, pl. 46, fig. 18; Miho & Lange-Bertalot 2006, p. 308, figs. 46-51.

Status of name: accepted taxonomically.

Synonyms: *Navicula exigua* var. *signata* Hustedt 1944

Placoneis exigua var. *signata* (Hustedt) Haworth & Kelly 2002

Diagnosis: Valves are linear-elliptic to elliptic-lanceolate. Apices are more or less protracted, rostrate, and obtusely rounded. Axial area is very narrow and linear. Central area is small to moderate in size, transversely, subrounded. A single, isolated stigma is present close to the central nodule. Raphe is filiform, straight. Proximal raphe endings are slightly expanded by small central pores and not deflected. Distal raphe endings are unilaterally deflected close to the ends towards one side. Transapical striae are uniseriate, more finely punctate, radiate throughout the valve, about 10-11 in 10 µm. Length of the valve 20-30 µm, and the breadth 8-10 µm.

Ecological preference: It is reported from freshwater streams with pH near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Frequent in Radomno and Jeziorak Lakes.

Distribution in Poland: as *Placoneis exigua* var. *signata* (Hustedt) Haworth & Kelly found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Placoneis subundulata* Kezlya, Glushchenko, Kulikovskiy & Kociolek 2021**

(Pl. 118, figs. 6-8)

Ref. Kezlya et al. 2021, p. 8, figs. 6 -7.

Status of name: accepted taxonomically

Diagnosis: Valves are linear-elliptic, with slightly triundulate margins, sometimes only one side. Ends rostrate. Axial area is narrow and linear. Central area is irregular in shape because of alternating shorter and longer striae, asymmetrical, rectangular, subrounded to rhombic, or bow-tie-shaped. Raphe is filiform, narrow and straight; the proximal raphe endings are straight, drop-shaped and deflected to one side; the distal raphe endings are hook-shaped and curved on one side. Transapical striae are radiate throughout the valve, becoming parallel in the ends, about 14-15 in 10 μm. Length of the valve 25-27 μm, and the breadth 7.5-8.5 μm.

Ecological preference: Benthic, reported from freshwater, pH 7.63 and temperature 28°C (Kezlya et al. 2021).

Occurrence: Infrequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Placoneis undulata* (Østrup) Lange-Bertalot in Rumrich et al. 2000**

Ref. Østrup 1918, p. 25, pl. 3, fig. 33; Li & Qi 2018, p. 68, pl. 8, fig. 5; Rumrich et al. 2000, p. 212, pl. 60, figs. 11-12.

Status of name: accepted taxonomically.

Synonyms: *Navicula dicephala* var. *undulata* Østrup 1918
Placoneis elginensis var. *undulata* (Østrup) Lange-Bertalot 1996
Placoneis dicephala var. *undulata* (Østrup) Li & Qi 2018
Witkowskia undulata (Østrup) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

Diagnosis: Valves are linear-elliptic, with slightly triundulate margins, sometimes only one side. Apices are rostrate, subprotracted and acutely rounded. Axial area is very narrow, linear, and slightly widening towards the valve centre. Central area is irregular in shape, somewhat transverse, rounded to elliptic in shape, asymmetrical because of alternating shorter and longer striae, about half of the valve width. Raphe is filiform, straight. Proximal raphe ends are straight, drop-shaped; distal raphe ends are curved toward one side and extend to the valve margin. Transapical striae are uniseriate, radiate throughout the valve, becoming subparallel at the ends, about 12-14 in 10 μm. Length of the valve 18-22 μm, and the breadth 6.5-8 μm.

Remarks: This species resembles *Placoneis elginensis, P. paraelginensis, P. ignorata,* but it is distinguished from those taxa by slightly wavy margins.

Ecological preference: It is reported from freshwater rivers and streams of alkaline nature or close to neutral (7-9), low to medium electrolytic conductivity ranged from 100 to 700 μS/cm (Noga et al. 2014 a); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Infrequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015).

Genus *Witkowskia* Kulikovskiy, Mironov, Glushchenko & Kociolek 2024

Diagnosis: Valves are symmetrical, with variously rostrate to capitate apices. Axial area is narrow. Central area is usually expanded. Isolated pores (stigmoids) may be present near the central area. Distal raphe endings curved to the same side of the valve; proximal raphe endings appear to be straight externally and laterally deflected internally. Transapical striae uniseriate, often slightly radiate throughout the valve centre, more or less parallel towards the apices, composed of small, rounded poroids.

Holotype species: *Witkowskia neohambergii* (Glushchenko et al.) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024

***Witkowskia abiskoensis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024**

(Pl. 118, figs. 9-12)

Ref. Hustedt 1942, p. 118, fig. 36; Cleve-Euler 1953, p. 142, fig. 792d; Krammer & Lange-Bertalot 1986, p. 139, pl. 48, fig. 1; Metzeltin & Witkowski 1996, p. 44, pl. 6, figs. 1-6; Cox 2003, p.67, fig. 72; Kulikovskiy et al. 2016, p. 149, pl. 113, figs. 5, 6; Bahls et al. 2018, p. 47, pl. 10, fig. 1.

Status of name: accepted taxonomically.

Synonyms: *Navicula abiskoensis* Hustedt 1942

Navicula dicephala f. *abiskoensis* (Hustedt) A.Cleve 1953

Placoneis abiskoensis (Hustedt) Lange-Bertalot & Metzeltin 1996

Diagnosis: Valves are linear to slightly undulate, with parallel or weakly concave margins, somewhat triundulate in the largest specimens. Apices are rostrate to sub-capitate. Axial area is very narrow and widens slightly towards the valve centre. Central area is large and transversely rectangular. Raphe is weakly lateral and somewhat sinuous. Proximal raphe endings are inflated and curved to one side. Distal raphe endings are hooked towards the opposite side of the valve. Transapical striae are distinctly areolate, strongly curved and radiate throughout the valve, straight and parallel at the ends, about 9-11 in 10 µm. Areolae are about 26-30 in 10 µm. Length of the valve 30-46 µm, and the breadth 8-12 µm.

Ecological preference: Seems to be a more northern species, in oligotrophic to mesotrophic lakes. Abisko, Sweden (Hustedt 1942; Cox 2003); freshwater rivers and streams of alkaline or close to neutral water reactions (pH: 7-9), with conductivity ranging between 100 to above 700 µS/cm (Noga et al. 2014a).

Occurrence: Frequent in Radomno and Młynek Lakes, and infrequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: as *Navicula abiskoensis* from Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); as *Placoneis abiskoensis* found in Żołynianka stream, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015).

***Witkowskia anglophila* (Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024**

(Pl. 118, figs. 13-27)

Ref. Krammer & Lange-Bertalot 1985, p. 86, pl. 23, figs. 8-12; Krammer & Lange-Bertalot 1986, p. 137, pl. 46, fig. 13-15; Cox 1988, p. 155, figs. 11, 12, 17-19, 47, 49, 50; Lange-Bertalot & Metzeltin 1996, p. 284, pl. 83, fig. 6; Cox 2003, p. 66, figs. 66, 67; Miho & Lange-Bertalot 2006, p. 311, figs. 12-19; Kulikovskiy et al. 2016, p. 155, pl. 114, figs. 1-4; Bishop et al. 2017, p. 108, pl. 15, fig. 11.

Status of name: accepted taxonomically.

Synonyms: *Navicula anglophila* Lange-Bertalot 1987

Placoneis anglophila (Lange-Bertalot) Lange-Bertalot 2005

Navicula pseudanglica Lange-Bertalot 1985

Placoneis pseudanglica Cox 1988

Diagnosis: Valves are elliptical to linear-elliptical. Apices are well defined, subprotracted, rostrate to subcapitate. Axial area is narrow and linear. Central area is small and nearly rounded to weakly transversely widened due to shorter central striae. Raphe is filiform, straight. Proximal raphe endings are straight and slightly expanded; distal raphe endings are deflected to one side. A single isolated pore may be present on one side of the central area. Transapical striae are punctate, radiate throughout the valve, about 10-12 in 10 µm, slightly shorter in the central area. Puncta about 30-33 in 10 µm. Length of the valve 18-28 µm, and the breadth 7-10 µm.

Ecological preference: The species is found in slightly eutrophic to eutrophic freshwater (Cox 2003); in the littoral zone of lakes throughout Central Europe, it is not uncommon; in artificial lakes and oxbow lakes, it occurs with outstanding constancy; optimal distribution in streams and small rivers in the lowlands, in more or less alkaline, mesotrophic to eutrophic and oligosaprobic (Bąk et al. 2012); as *Placoneis pseudanglica* Cox reported from freshwater rivers and streams of alkaline or close to neutral water reactions (pH: 7-9), low to medium electrolytic conductivity ranged from 100 to 700 µS/cm (Noga et al. 2014 a); reported from the benthic habitats of alkaline, mesotrophic to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake, frequent in Jeziorak and Młynek Lakes; Eemian paleolake deposits of central Poland.

Distribution in Poland: As *Placoneis pseudanglica* is found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015).

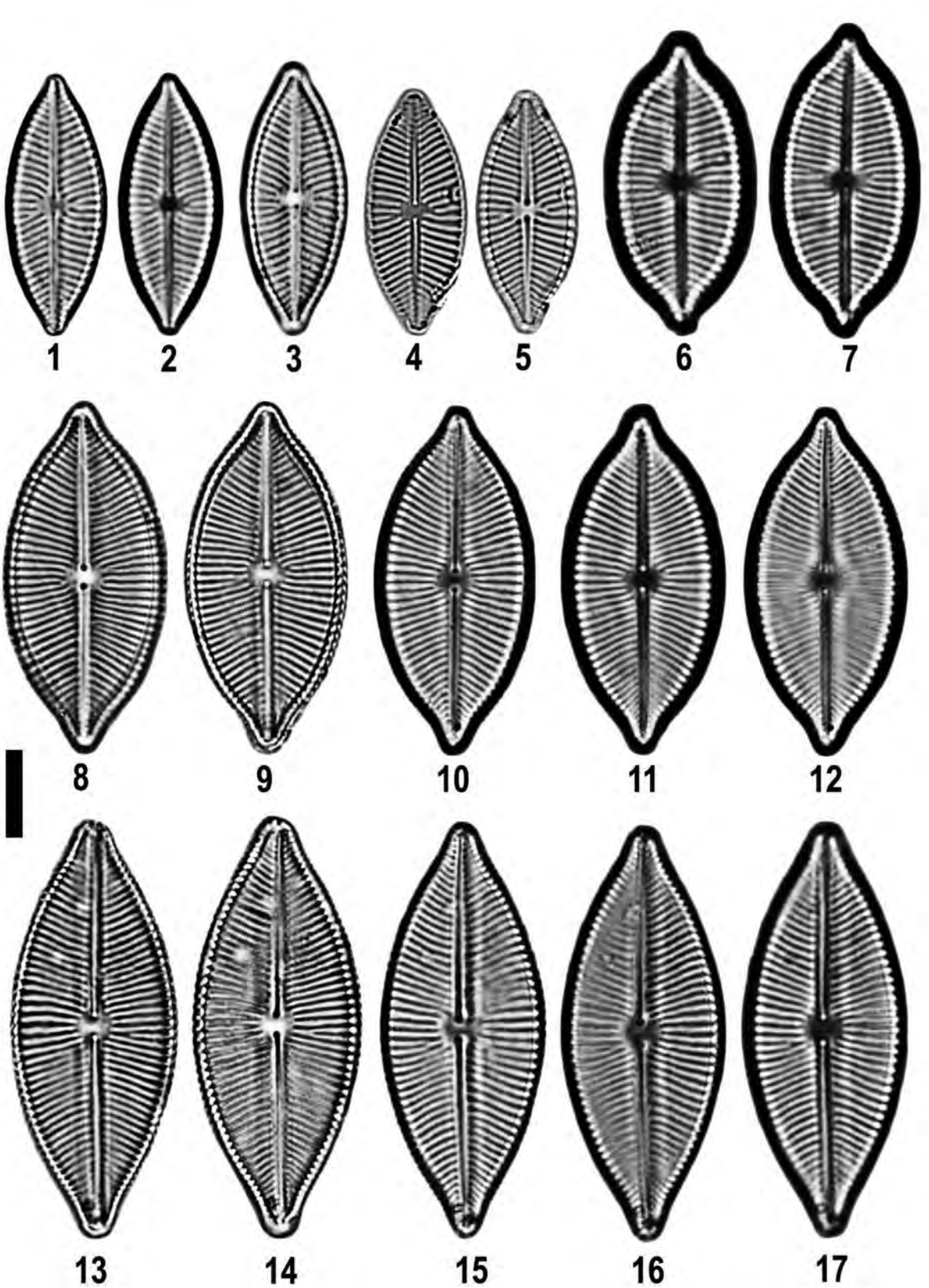


Plate 107: 1-3. *Paraplaconeis macedonica* (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012 , Młynek Lake; 4-5. *Paraplaconeis minor* (Grunow) Lange-Bertalot 2017, Radomno Lake; 6-12. *Paraplaconeis ohridana* (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012, 6-7. Młynek Lake; 8-12. Kamionka Lake; 13-17. *Paraplaconeis ohridana* var. *lanceolatum* Zalat nov. var., Kamionka Lake. Scale bar = 10 μm.

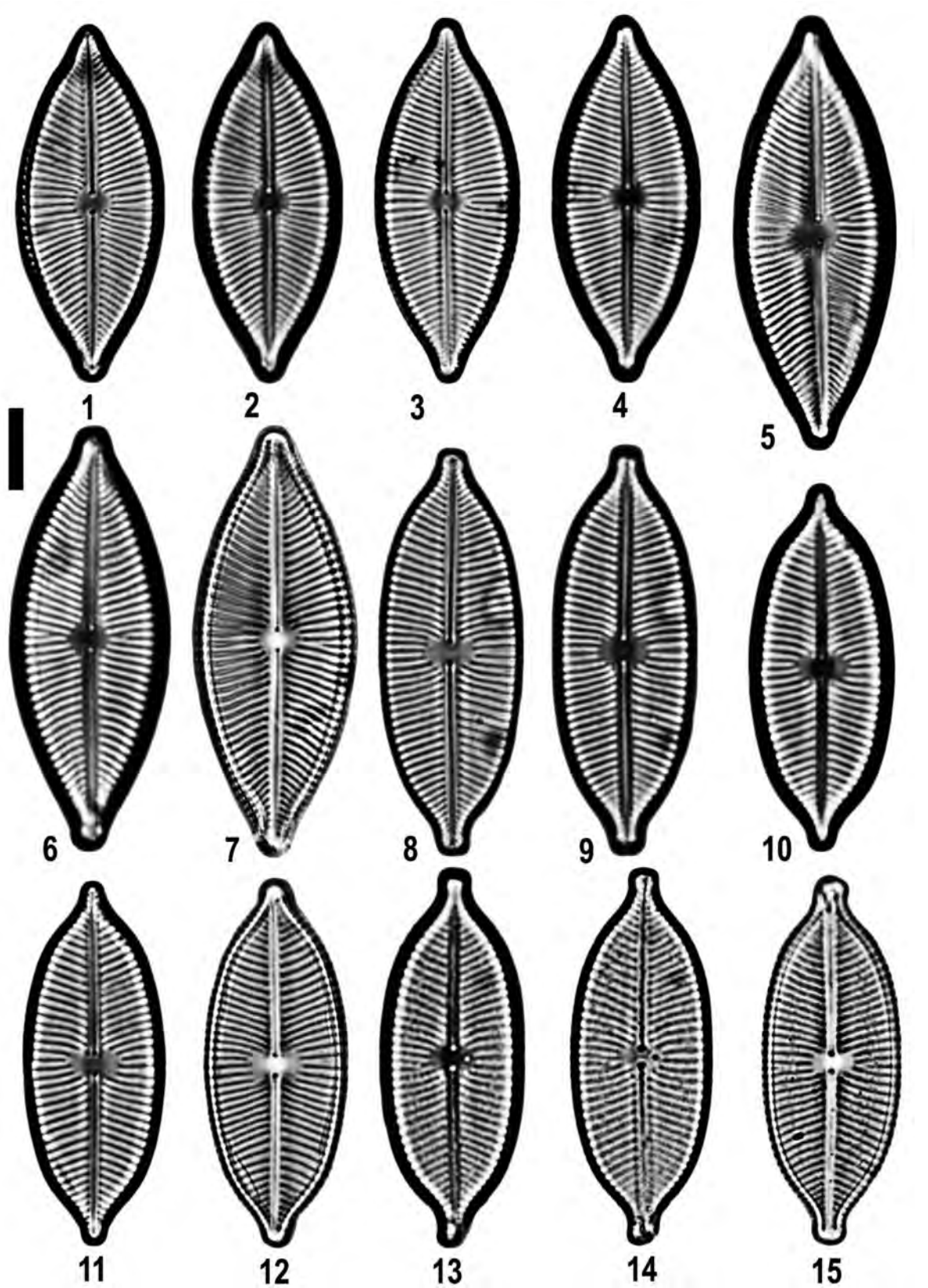


Plate 108: 1-7. *Paraplaconeis ohridana* var. *lanceolatum* Zalat nov.var., 1-5. Młynek Lake; 6-7. Eemian deposits; 8-15. *Paraplaconeis ohridana* var. *rostrata* Zalat nov.var. 8-9. Radomno Lake; 10-15. Młynek Lake. Scale bar = 10 µm.

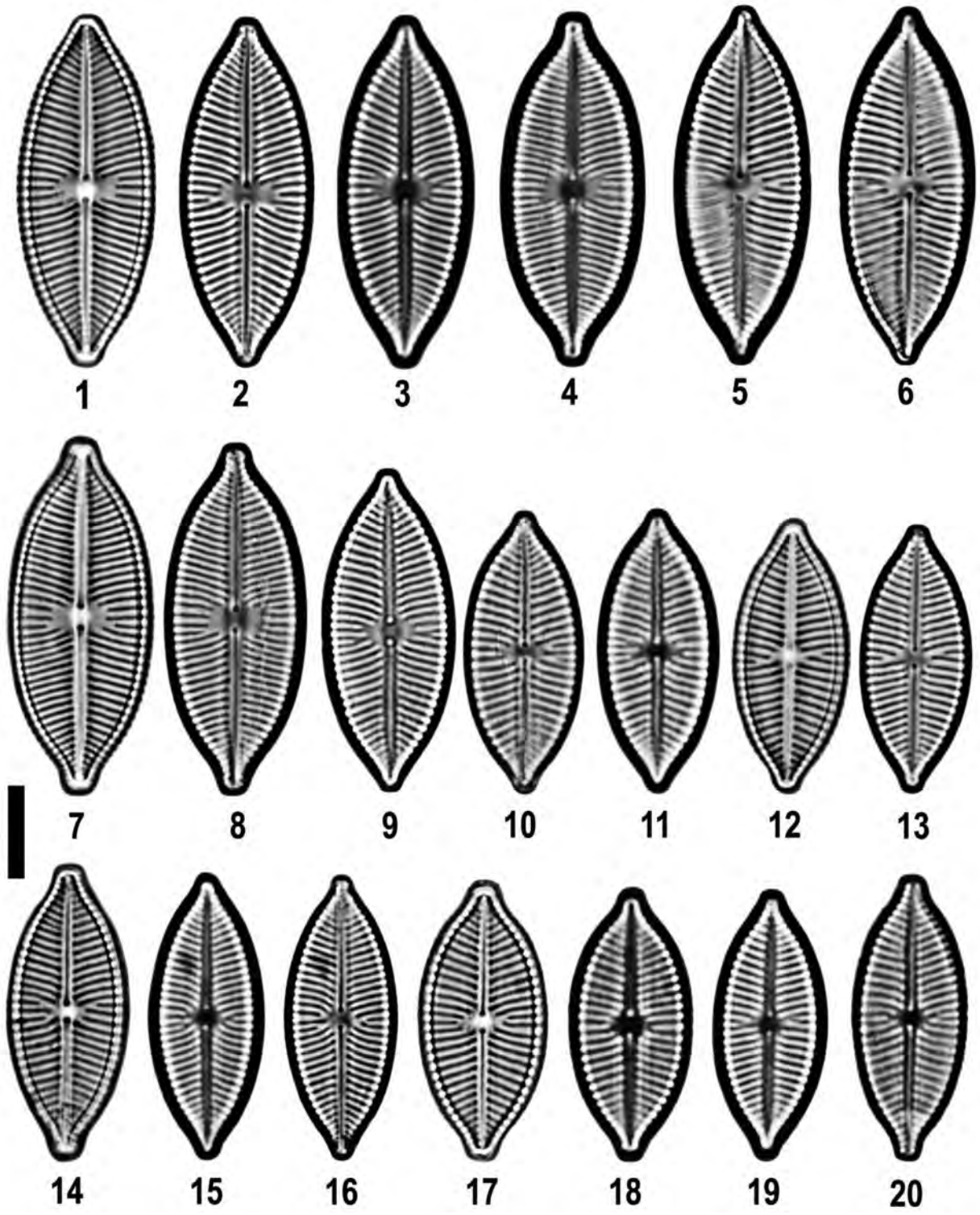


Plate 109: 1-20. *Paraplaconeis placentula* (Ehrenberg) Kulikovskiy & Lange-Bertalot 2012, 1-3. Radomno Lake; 4-13. Jeziorak Lake; 14-20. Młynek Lake. Scale bar = 10 µm.

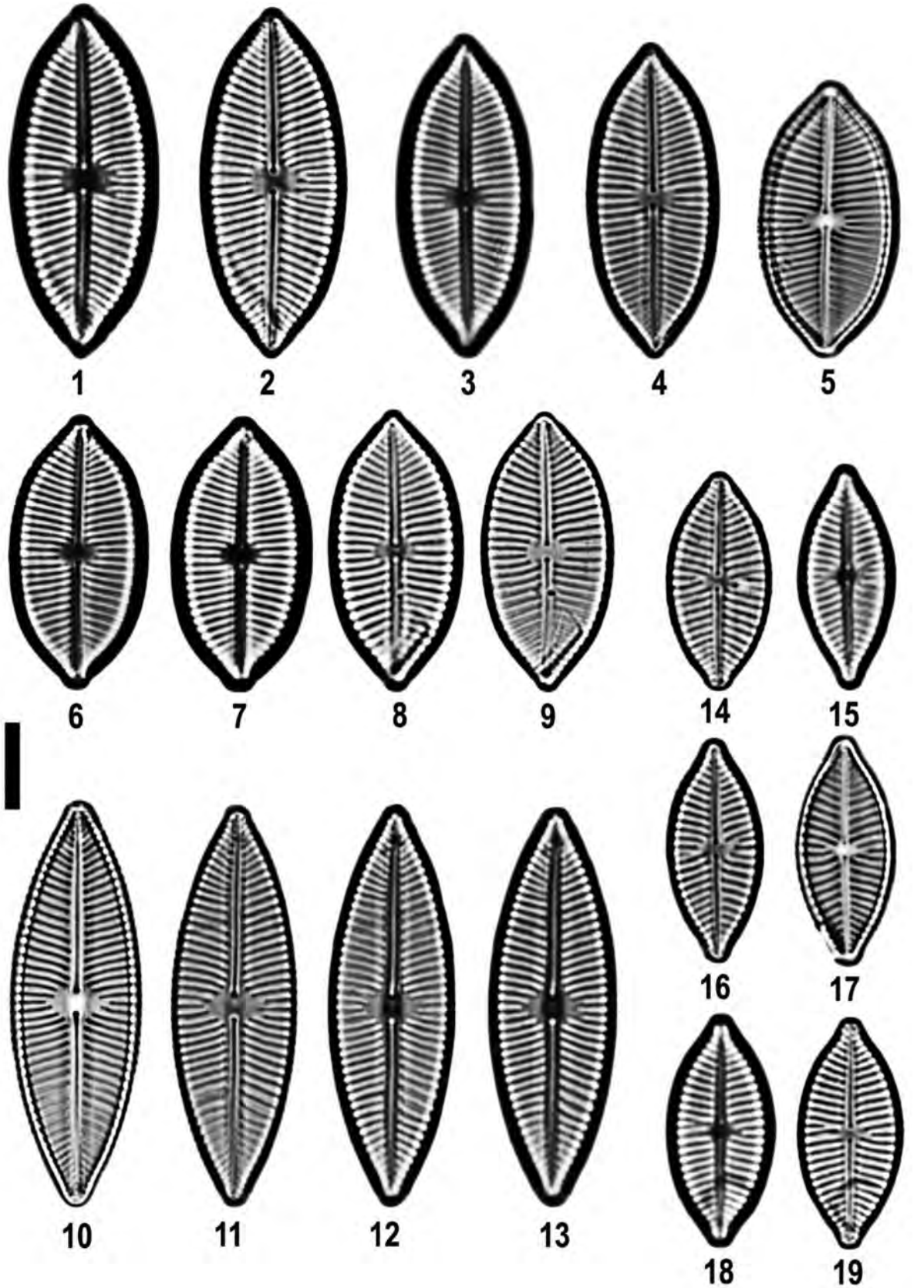


Plate 110: 1-9. *Paraplaconeis placentula* var. *cuneatum* Zalat nov. var., Radomno Lake; 10-13. *Paraplaconeis placentula* var. *jenisseyensis* (Bukhtiyarova) Zalat comb. nov., Radomno Lake; 14-19. *Paraplaconeis subplacentula* (Hustedt) Kulikovskiy & Lange-Bertalot 2012, 14-17. Młynek Lake; 18-19. Eemian paleolake deposits of central Poland. Scale bar = 10 μm.

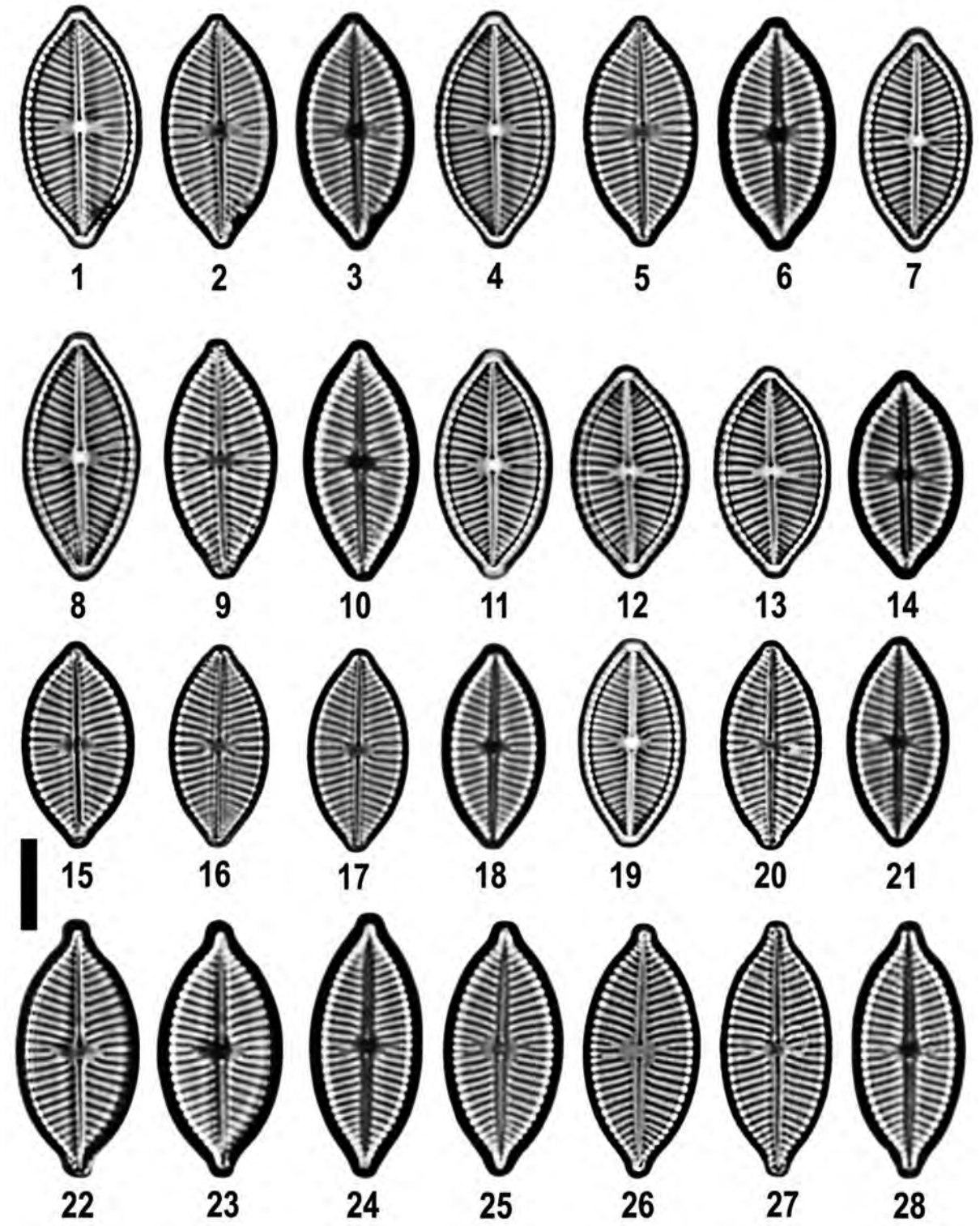


Plate 111: 1-28. *Paraplaconeis subplacentula* (Hustedt) Kulikovskiy & Lange-Bertalot 2012, 1-7, 22-23. Radomno Lake; 8-15, 24-25. Jeziorak Lake; 16-19, 26-28. Kamionka Lake; 20-21. Młynek Lake. Scale bar = 10 µm.

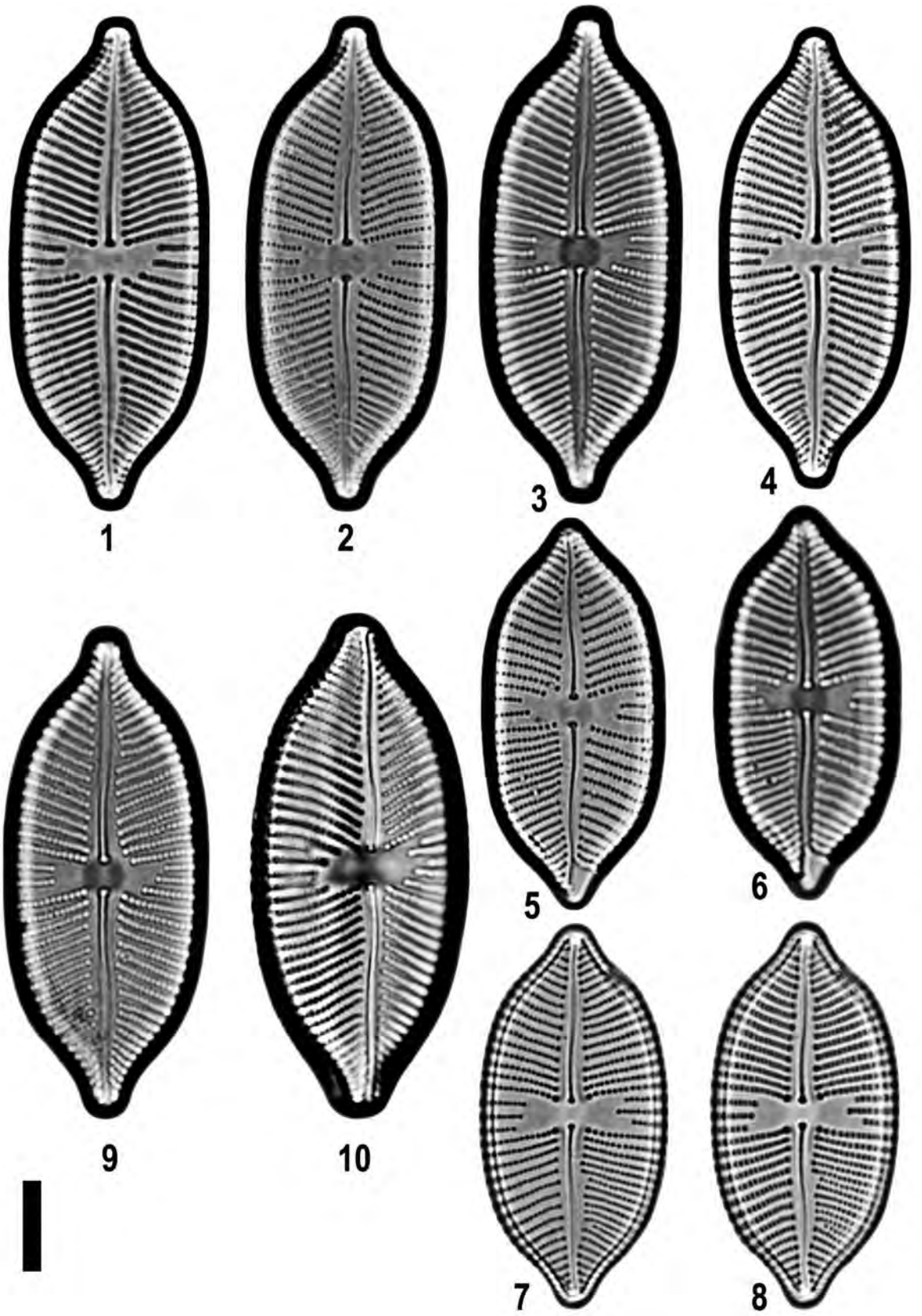


Plate 112: 1-10. *Placoneis amphibola* (Cleve) Cox 2003**,** 1-9. Jeziorak Lake; 10. Młynek Lake. Scale bar = 10 µm.

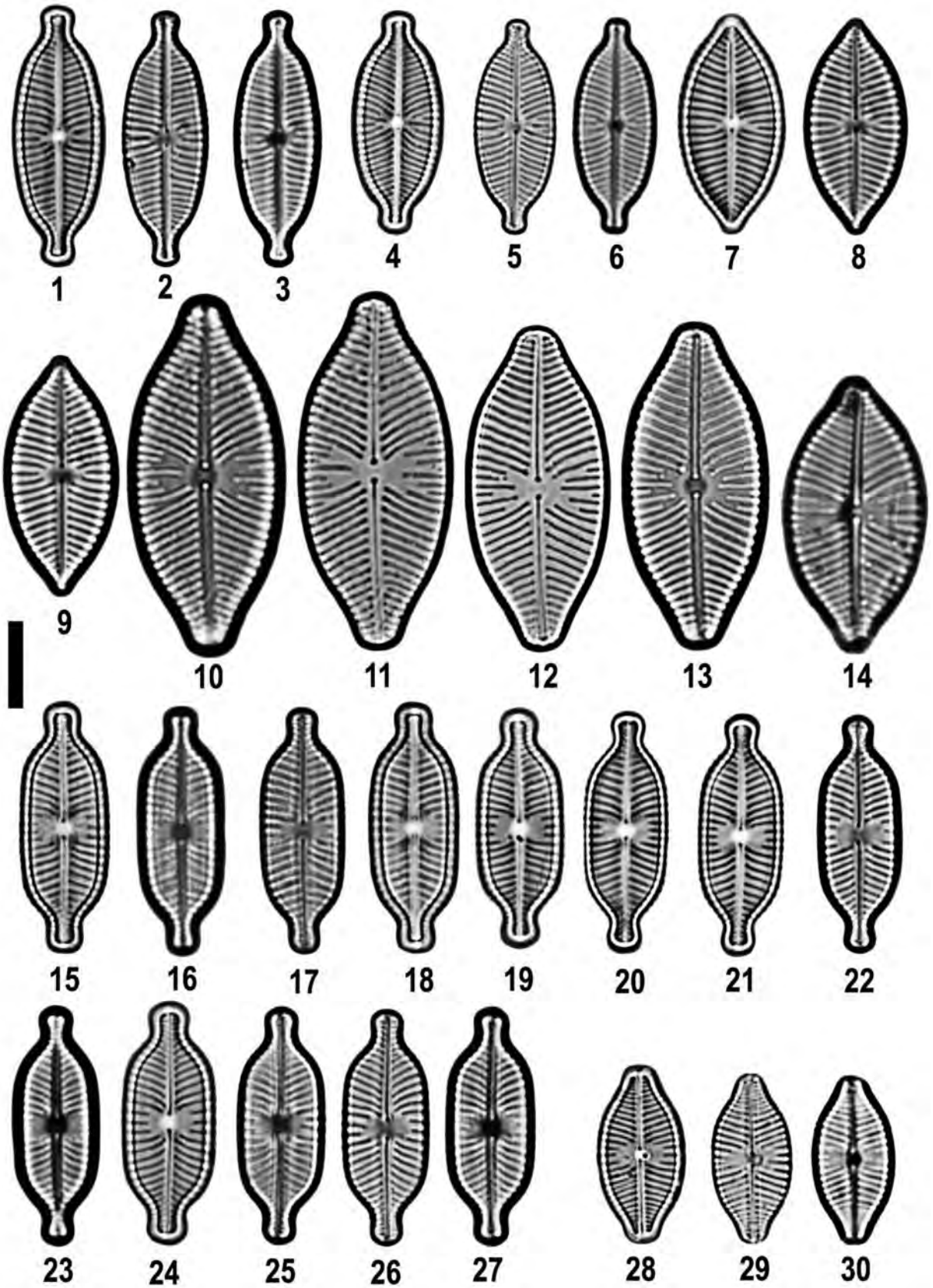


Plate 113: 1-6. *Placoneis clementioides* (Hustedt) Cox 1988, 1-3. Jeziorak Lake; 4-6. Młynek Lake ; 7-9. *Placoneis clementis* (Grunow) Cox 1987, Jeziorak Lake; 10-14. *Placoneis clementispronina* Lange-Bertalot & Wojtal 2014, 10-13. Jeziorak Lake; 14. Radomno Lake**;** 15-27. *Placoneis elginensis* (Gregory) Cox 1987, 15-23. Młynek Lake; 24-27. Radomno Lake; 28-30. *Placoneis elginensis* var. *elliptica* Zalat nov. var.; Młynek Lake. Scale bar = 10 µm.

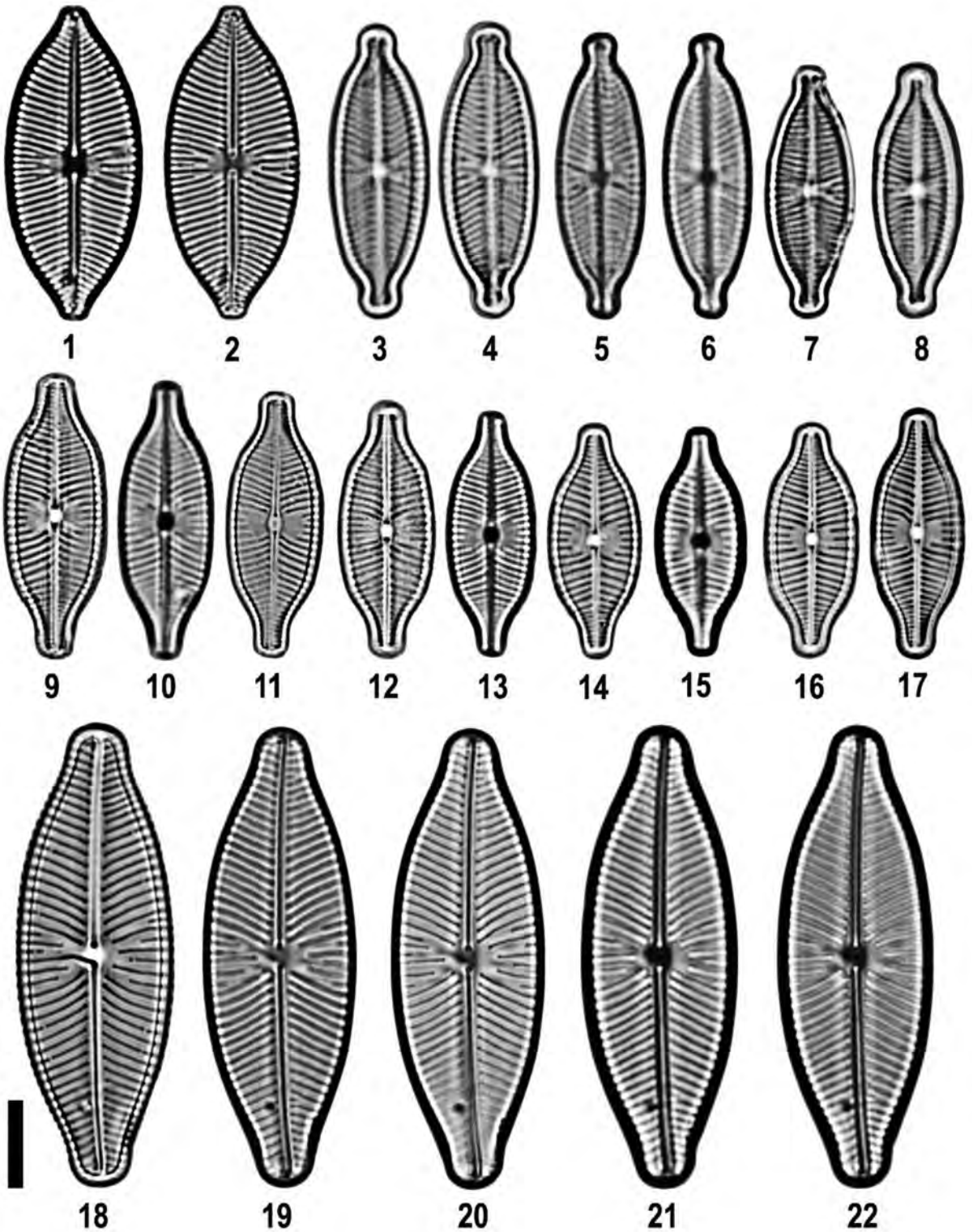


Plate 114: 1-2. *Placoneis densa* (Hustedt) Lange-Bertalot 2005, Radomno Lake; 3-8. *Placoneis exigua* (Gregory) Mereschkovsky 1903, 3-6. Jeziorak Lake; 7-8. Eemian paleolake deposits of central Poland; 9-17. *Placoneis explanata* (Hustedt) Lange-Bertalot 2000, 9-13. Kamionka Lake; 14-15. Młynek Lake; 16-17. Eemian paleolake deposits of central Poland; 18-22. *Placoneis gastriformis* (Hustedt) Lange-Bertalot 2005, Radomno Lake. Scale bar = 10 µm.

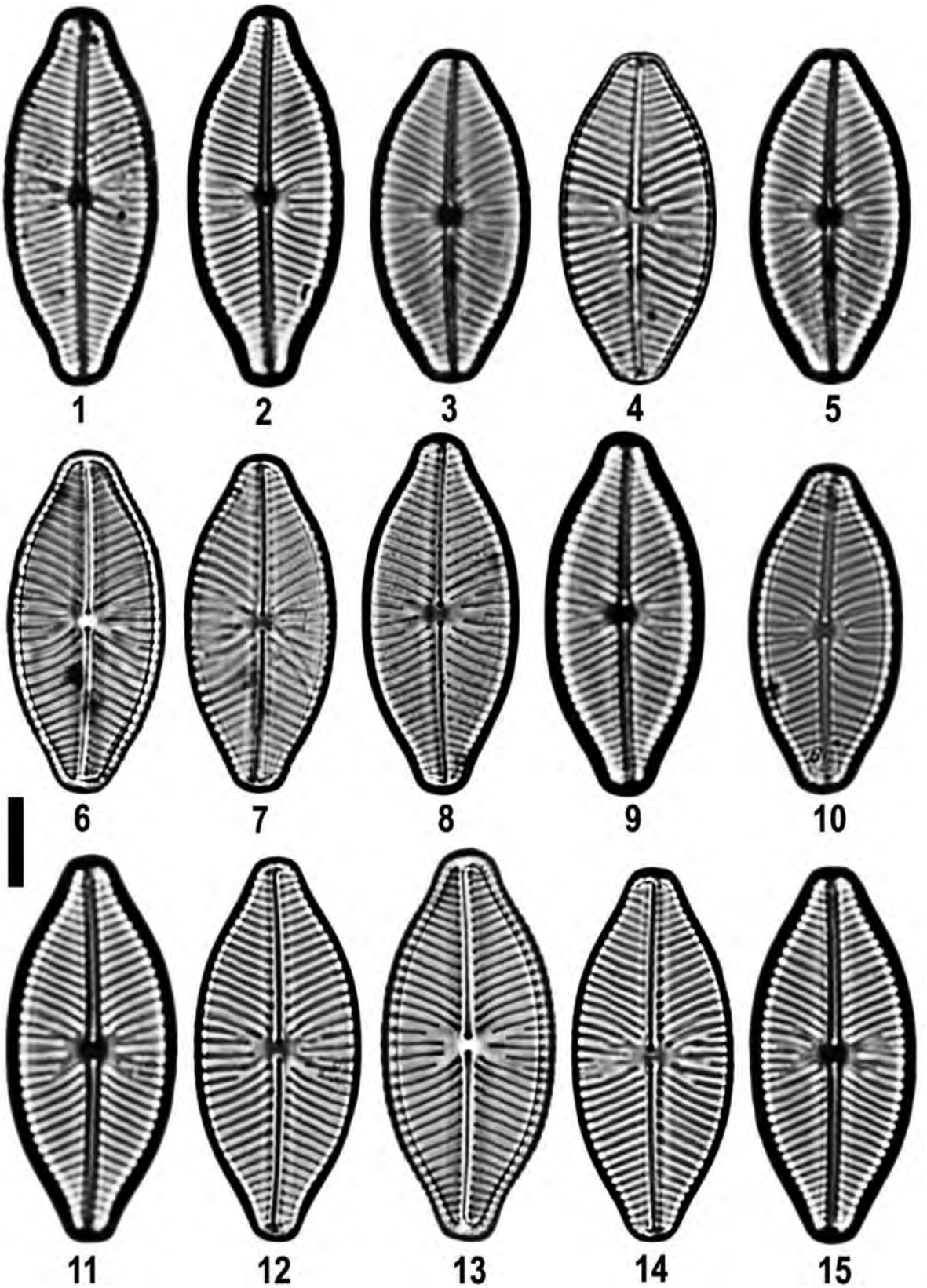


Plate 115: 1-15. *Placoneis gastrum* (Ehrenberg) Mereschkowsky 1903, 1. Kamionka Lake; 2-5. Jeziorak Lake; 6-10. Młynek Lake; 11-15. Radomno Lake. Scale bar = 10 µm.

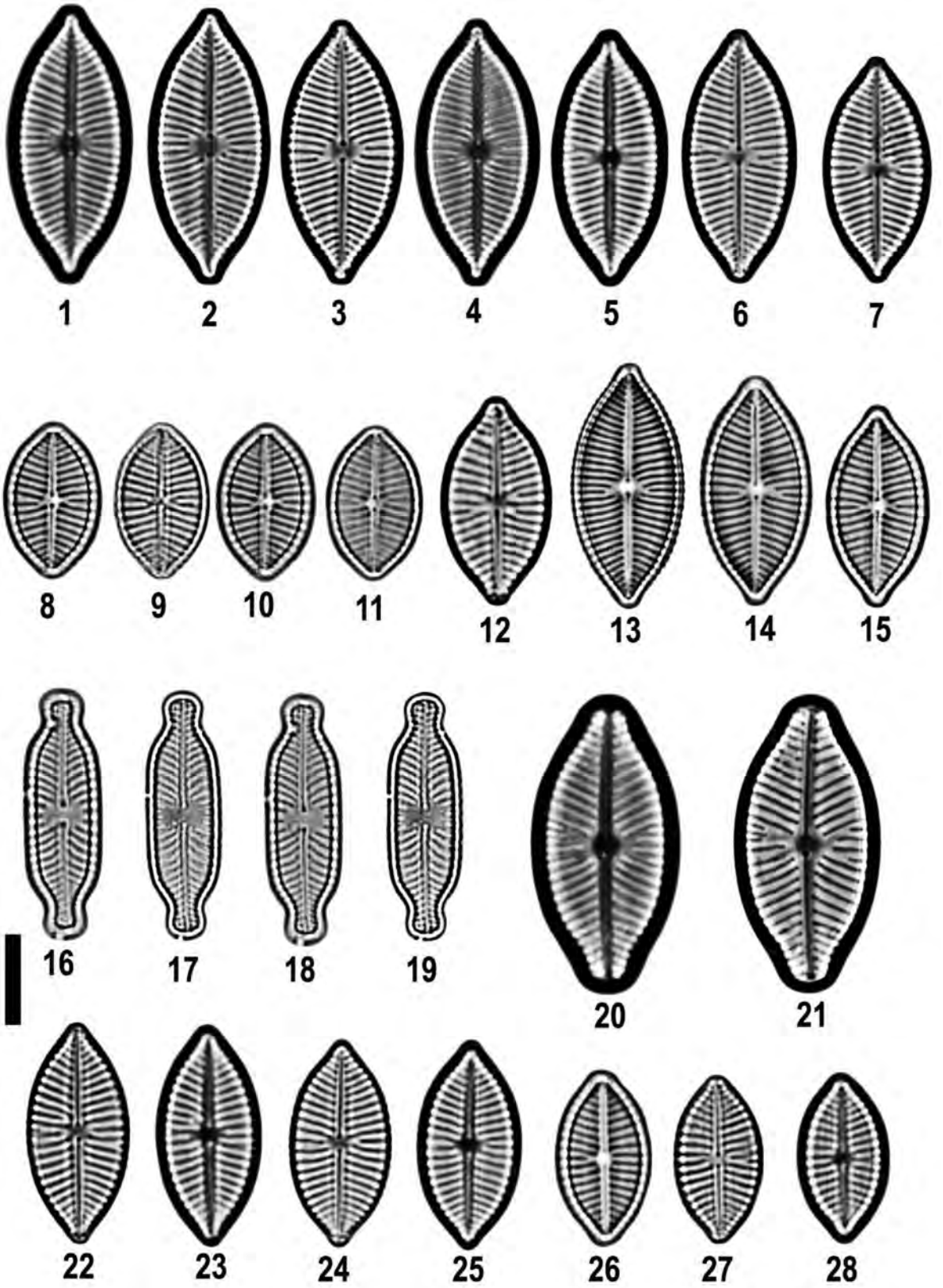


Plate 116: 1-7. *Paraplaconeis subplacentula* (Hustedt) Kulikovskiy & Lange-Bertalot 2012, Radomno Lake; 8-11 *Placoneis humilis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005, Kamionka Lake; 12. *Placoneis nanoclementis* Lange-Bertalot & Wojtal 2014, Młynek Lake; 13-15. *Placoneis neoexigua* Lange-Bertalot & Miho 2006,13-14. Jeziorak Lake ; 15. Młynek Lake; 16-19. *Placoneis paraelginensis* Lange-Bertalot 2000, Młynek Lake; 20-21. *Placoneis parvapolonica* Lange-Bertalot & Wojtal 2014, Jeziorak Lake; 22-28. *Paraplaconeis prespanensis* (Levkov, Krstic & Nakov) Kulikovskiy & Lange-Bertalot 2012, 22-25. Radomno Lake; 26-28. Kamionka Lake. Scale bar = 10 μm.

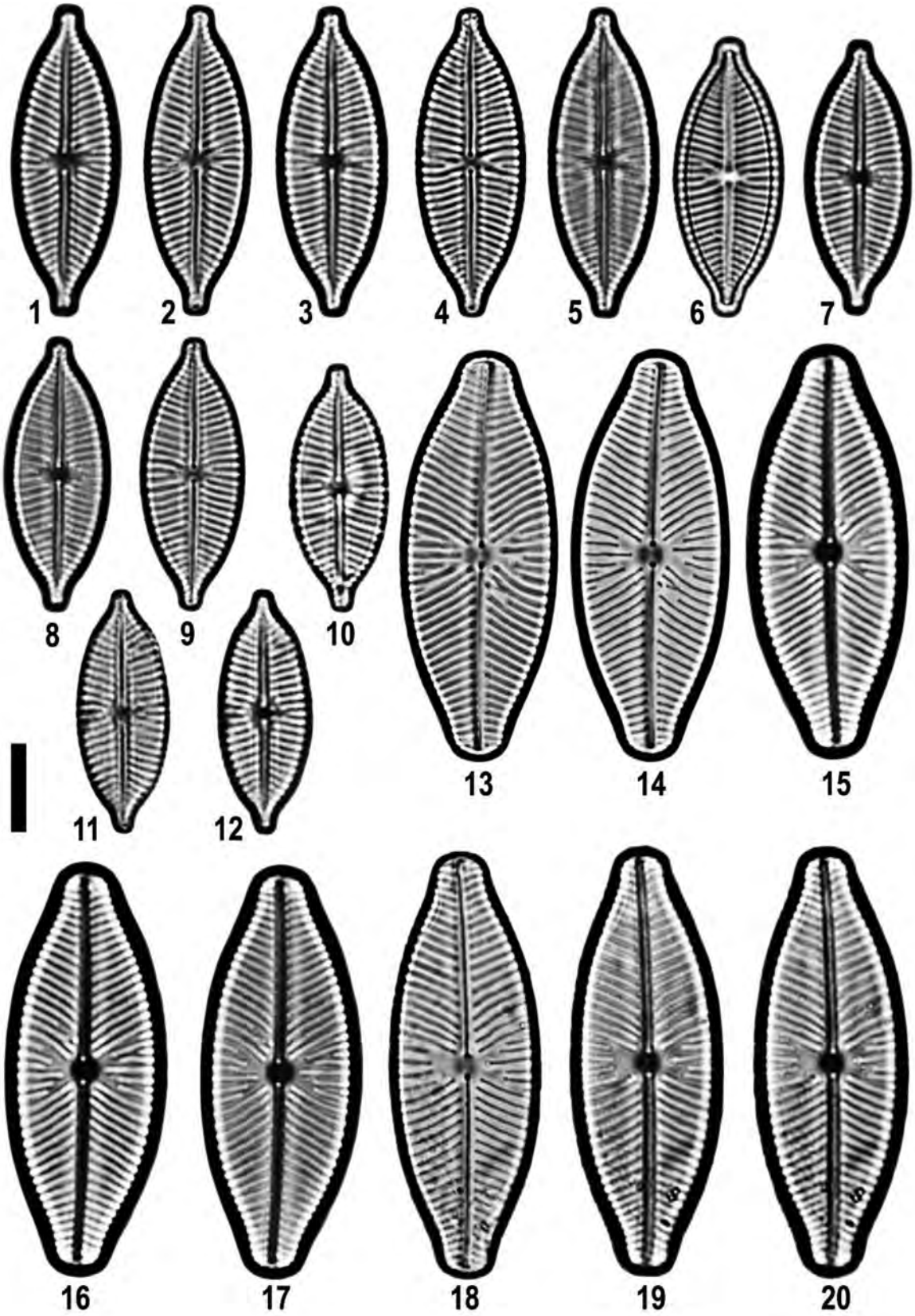


Plate 117: 1-12. *Placoneis pseudabundans* Levkov 2011, Radomno Lake; 13-20. *Placoneis signata* (Hustedt) Mayama 1998, 13-17. Jeziorak Lake; 18-20. Młynek Lake. Scale bar = 10 µm.

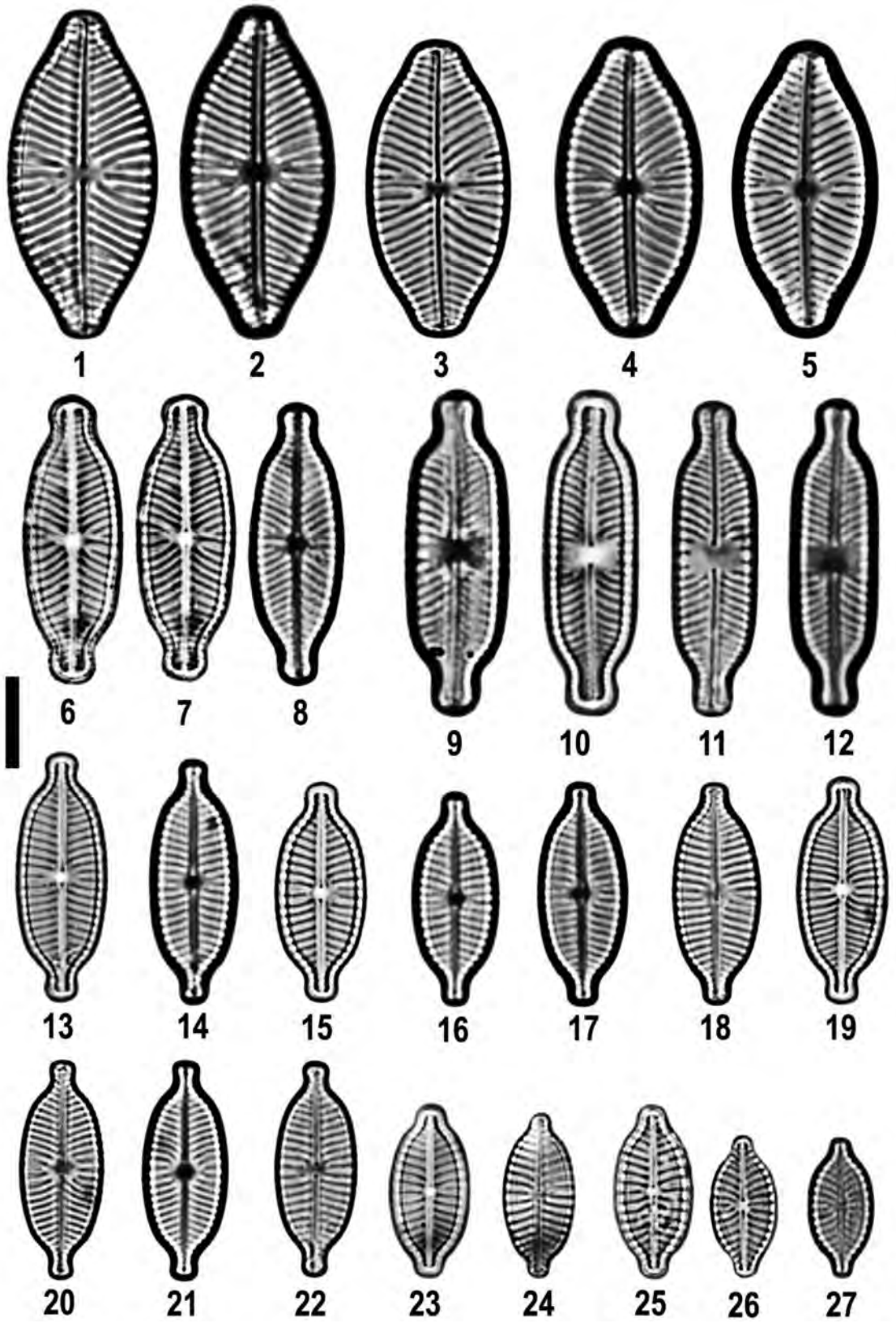


Plate 118: 1-5. *Placoneis significans* Lange-Bertalot 2005, 1-4. Radomno Lake; 5. Jeziorak Lake; 6-8. *Placoneis subundulata* Kezlya, Glushchenko, Kulikovskiy & Kociolek 2021, Eemian paleolake deposits of central Poland; 9-12. *Witkowskia abiskoensis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024, Radomno Lake; 13-27. *Witkowskia anglophila* (Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024, 13-14. Radomno Lake; 15-18. Jeziorak Lake; 19-24. Młynek Lake; 25-27. Eemian paleolake deposits of central Poland.. Scale bar = 10 μm.

Family *Gomphonemataceae* Kützing 1844

Genus *Didymosphenia* M. Schmidt in A. Schmidt et al. 1899

Diagnosis: Frustules are wedge-shaped in girdle view. Valves are asymmetric to the transapical axis and symmetric to the apical axis. One to several stigmata are present, a feature that may be variable within a given species. A large apical porefield is present at the footpole. Distal raphe endings are deflected before reaching the apical porefield, a feature that is key to showing that *Didymosphenia* shares a lineage with the cymbelloid diatoms. In contrast, the distal raphe endings of gomphonemoids bisect the apical porefield.

Holotype species: *Didymosphenia geminata* (Lyngbye) M. Schmidt 1899

***Didymosphenia geminata* (Lyngbye) Schmidt 1899**

Ref. Hustedt 1930, p. 367, fig. 682; Patrick & Reimer 1975, p. 146, pl. 19, fig. 5; Krammer & Lange-Bertalot 1986, p. 380, pl. 66, fig. 15; Metzeltin & Witkowski 1996, p. 76, pl. 22, fig. 14; Metzeltin & Lange-Bertalot 2014, p. 16, pl. 4, figs. 1-4; pl. 9, figs. 1-7; Kulikovskiy et al. 2016 p. 200, pl. 134, figs. 1-4; Uyua et al. 2016, p. 20, fig. 3:A-J; fig. 4: A-K; fig. 5:A-G; Bahls et al. 2018, p. 45, pl. 8, fig. 13.

Status of name: accepted taxonomically.

Synonyms: *Echinella geminata* Lyngbye 1819
Styllaria geminata (Lyngbye) Bory 1822
Gomphonema geminatum (Lyngbye) C.Agardh 1824
Lyngbyea pulvinata var. *geminata* (Lyngbye) Sommerfelt 1826
Gomphonema vulgare Brébisson 1838

Diagnosis: Valves are large, robust and slightly asymmetric to the apical axis. The headpole is distinctly capitate; the footpole is less capitate to bluntly rounded. Axial area is relatively linear. Central area is an expanded oval. About 2-5 stigmata are present; their numbers depend on valve size. Raphe is lateral; proximal raphe endings are expanded; distal raphe endings are deflected near the porefield at the footpole. The porefield is present at the footpole, large, distinct, and composed of fine porelli. Transapical striae are radiate for most of the valve, become nearly parallel close to the footpole, about 8-10 in 10 µm at the valve centre. Length of the valve 65-160 µm, and the breadth 25-45 µm.

Ecological preference: The species is recorded in Poland from oligotrophic streams in the Tatra Mts. (Siemińska 1964). This taxon prefers cool water of low conductivity (Patrick & Reimer 1975); it prefers clear streams and rivers with shallow, moderately-flowing water with a pH of 7 or above and rocky substrate, it has also been observed at temperatures of 27°C (Spaulding & Elwell 2007); predominantly benthic but has been observed in planktonic samples, occurring in eutrophic rivers, showing much greater tolerance for nutrient and flow conditions, while the species seems to be confined to cold areas, it reaches its highest biomass at higher water temperatures of ~20°C (Blanco & Ector 2009); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Frequent in Radomno**,** Młynek and Jeziorak Lakes.

Distribution in Poland: The species is recorded in oligotrophic streams in the Tatra Mts., south Poland (Siemińska 1964), in the Białka River (Kawecka 1965); spread to other Carpathian rivers: San, Soła, Skawa, and Raba (WIOŚ 1996, 2000); found in the seston of the Vistula (Kasza & Galas 2000); in the Czarna Orawa River and its tributaries in the Orawa region (Noga 2003); observed below the Solina and Myczkowce reservoirs (Kawecka & Sanecki 2003); the species is more frequently found in the running waters of south-east Poland (Kawecka, Sanecki 2003; Mrozińska-Broda & Czerwik-Marcinkowska 2004; Mrozińska-Broda et al. 2006); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

Genus *Gomphoneis* Cleve 1894

Diagnosis: Valves are clavate in valve view, wedge-shaped in girdle view, and symmetric to the apical axis. Asymmetric to the transapical axis, with one pointed end; the other bluntly rounded to pointed, but with the widest part of the valve often offset from the central area; the genus had also doubly-punctate striae. Two distinct groups are currently included within the genus *Gomphoneis*. One group contains species (including *G. herculeana* and *G. eriense*) with multiseriate striae crossed by longitudinal lines and with stigmata. The second group contains species (including *G. olivacea* and *G. quadripunctata*) that possess multiseriate striae, indistinct areolae, lack longitudinal lines and have a variable number of stigmata, from 0-4. Both groups possess septae and pseudoseptae. The foot pole contains an apical pore field, bisected by the terminal raphe ends.

Holotype species: *Gomphoneis elegans* (Grunow) Cleve 1894

***Gomphoneis clevei* (Fricke) Gil 1989**

Ref. Hustedt 1939, p. 441, pl. 27, figs. l4-18; Patrick & Reimer 1975, p. 138, pl. 18, fig. 6; Carter & Denny1982, p. 298, pl. 3, figs. 85, 87; Gasse 1986, p. 63, pl. 29, fig. l7; Krammer & Lange-Bertalot 1986, p. 372, pl. 164, figs. 20, 21; Gil 1989, p. 267, 271, pl. 1, figs. 4-12; pl. 4, figs. 1-4; pl. 5, figs. 1-4.

Status of name: accepted taxonomically.

Synonym: *Gomphonema clevei* Fricke 1902

Diagnosis: Valve is lanceolate-clavate to rhombiclanceolate with rounded headpole and very narrow, acutely rounded footpole. Axial area is narrow at the ends and expands toward the valve centre. Central area is a broad lanceolate space. Raphe is lateral, slightly undulate; proximal raphe endings are dilated slightly; distal raphe endings are deflected onto the valve mantle at the ends. A single stigma is present near the central pores. Transapical striae are punctate, slit-like, short, marginal, radiate, about 11-12 in 10 μm. Length of the valve 20-32 μm, and the breadth 4-7 μm.

Ecological preference: An optimum development of this species at pH 8.6 (Hustedt 39); whereas Cholnoky (1968) stated that its pHoptimum is about 7.4. It seemed to be characteristic of weakly acidic to circumneutral water, with a very low mineral content; it was best developed as an epiphyte on macrophytes in slowly running water (Gasse 1986); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a).

Occurrence: Infrequent in Młynek and Jeziorak Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014a; Peszek et al. 2015).

Genus *Gomphonella* Rabenhorst, 1853

Diagnosis: Valves are wedge-shaped. Raphe is filiform. Proximal raphe endings are slightly expanded externally and slightly unilaterally curved internally. Distal raphe endings internally terminate in helictoglossae that are somewhat removed from the apices. Apical porefield is bisected by the terminal raphe fissure and composed of porelli that are of the same size and shape of the areolae. Transapical striae are biseriate (to triseriate) and composed of small, round areolae. The areolae are unoccluded. A diagnostic feature of the genus is the absence of stigmoids or stigmata. Recent work demonstrates that *Gomphonella* is not closely related to *Gomphonema*, and that it is not even within the Gomphonemataceae (Jahn et al. 2019).

Holotype species: *Gomphonella olivacea* (Hornemann) Rabenhorst 1853

***Gomphonella calcarea* (Cleve) Jahn & Abarca 2019**

Ref. Hustedt 1930, p. 379, fig. 721; Patrick & Reimer 1975, p. 140, pl. 18, fig. 18; Krammer & Lange-Bertalot 1986, p. 374, pl. 165, figs. 9-10; Ehrlich 1995, p. 113, pl. 33, figs. 4-6; Huang et al. 1998, p. 41, pl. 90, fig.10; Li et al. 2007, p. 239, fig. 190.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema calcareum* Cleve 1868
Gomphonema olivaceum var. *calcareum* (Cleve) Van Heurck 1880
Gomphoneis olivacea var. *calcarea* (Cleve) B.Hartley 1996

Diagnosis: Valves are clavate, linear-lanceolate in larger specimens to rhombic-lanceolate in smaller specimens, with broadly rounded, rostrate headpole and narrowly rounded footpole. Axial area is narrow and linear. Central area is small, strongly dilated, rectangular, or bow-tie-shaped, bordered by two shortened striae on both sides. Raphe is filiform, straight; proximal raphe endings are dilated with small central pores; distal raphe endings are curved onto the valve mantle. Transapical striae are radiate in the mid-valve, about 10-11 in 10 μm, becoming parallel to slightly radiate and denser towards the ends, about 12-13 in 10 μm. Length of the valve 26-45 μm, and the breadth 5-7 μm.

Ecological preference: Alkaliphilous, epiphytic (Kaczmarska 1976); fresh-brackish water, alkalibiontic, high oxygen requirements, β-mesosaprobic (Van Dam et al. 1994); freshwater with pH 6.5, air temperature 19°C, water temperature 11°C (Li et al. 2007).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); as *Gomphonema calcareum* Cleve was reported from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Gomphonella calcifuga* (Lange-Bertalot & Reichardt) Tuji 2020**

Ref. Hustedt 1930, p. 378, fig. 720; Goma et al. 2005, p. 224, fig. 3: 1-5; Tuji 2005, p. 92, pl. 5, figs. 1-17; pl. 6, figs. 1-4; pl. 7, fig. 1; pl. 8, figs.1-2; Bąk et al. 2012, p. 168, pl. 66; Noga et al. 2013 c, p. 141, fig. 4: 4; Levkov et al. 2016, p. 199, pl. 39, figs. 29–53; Noga et al. 2018, p. 37, figs. 3AE-AU, 6G-L; Solak et al. 2021, p. 207, pl. 2, figs. 19, 20.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema olivaceum* var. *minutissimum* Hustedt 1930
Gomphoneis olivacea var. *minutissima* (Hustedt) Bukhtiyarova 1995
Gomphonema calcifugum Lange-Bertalot & Reichardt 1999
Gomphoneis calcifuga (Lange-Bertalot & Reichardt) Tuji 2005
Gomphoneis olivaceum (Hustedt) Aysel 2005

Diagnosis: Valves are clavate, linear lanceolate to elliptical lanceolate with broadly rounded headpole and narrowly to cutely rounded footpole. Axial area is very narrow and straight. Central area is rectangular, formed by shortened central striae. Four stigmata are present close to the proximal raphe pores in the central area. Raphe is filiform, slightly undulate, proximal raphe endings are dilated with small central pores; distal raphe endings are close to valve ends. Transapical striae are finely punctate, biseriate, radiate throughout the valve, about 11-13 in 10 μm. Length of the valve 13-30 μm, and the breadth 3.5-6.0 μm.

Remarks: *Gomphonema olivaceum* var. *minutissimum* is considered to be a synonym of *G. olivaceoides* (Kramer & Lange-Bertalot, 1985). However, Simonsen (1987) explained that the *G. olivaceum* var. *minutissimum* differs from *G. olivaceoides* in density of striae, the form of the central area and the size range of the valves. Therefore, Tuji (2005) considered *G. olivaceum* var. *minutissimum* as a distinct species *Gomphoneis calcifuga* (Lange-Bertalot & Reichardt) Tuji 2005

Ecological preference: Reported as *Gomphonema olivaceum* var. *minutissimum* Hustedt from freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligo-mesotraphentic (Van Dam et al. 1994); most abundant on stones, mud and mosses, occurring in waters poor in electrolytes and calcium, circumneutral to slightly acidic (Hofmann et al. 2011; Bąk et al. 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); often observed in oligotrophic, mountain streams in Macedonia (Levkov et al. 2016); Reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); it occurs mostly in in calcium-rich waters,

alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Infrequent in Młynek and Radomno Lakes.

Distribution in Poland: Reported from over a dozen sites in Poland as *G. olivaceum* var. *minutissimum*, from lotic and lentic waters (Sieminska & Wołowski 2003); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 b); Wisłok river and Stobnica stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); as *G. calcifugum* from Magura National Park, the species was described from the Wisłoka River and its tributaries: Wilsznia, Kłopotnica, Krempna, Rzeszówka, Zimna Woda and Baranie; in spring in the source reaches of the Wisłoka, the Krempna and the Wilsznia, and the Baranie stream; in the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 a, b); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-eastern Poland (Noga et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, southern Poland (Rybak et al. 2019).

***Gomphonella olivacea* (Hornemann) Rabenhorst 1853**

(Pl. 144, figs. 13-15)

Ref. Hustedt 1930, p. 378, fig. 719; Patrick & Reimer 1975, p. 139, pl. 18, figs. 13-14; Foged 1981, p. 101, pl. 52, fig. 12; pl. 53, fig. 20; Germain 1981, p. 312, pl. 111, figs. 14-16; pl. 161, fig. 5; pl. 168, fig. 11; Krammer & Lange-Bertalot 1986, p. 374, pl. 165, figs. 1-7; Krammer & Lange-Bertalot 1991, p. 424, pl. 88, figs. 10-13; Ehrlich 1995, p. 112, pl. 33, figs. 2-3; Lange-Bertalot & Metzeltin 1996, p. 334, pl. 108, figs. 15-17; Levkov et al. 2016, p. 91, pl. 184, figs. 1-47; Jahn et al. 2019, p. 231, figs. 5A-C, figs. 6-10.

Status of name: accepted taxonomically.

Synonyms: *Ulva olivacea* Hornemann 1810
Echinella olivacea (Hornemann) Lyngbye 1819
Frustulia olivacea (Hornemann) Kützing 1833
Cymbella olivacea (Hornemann) Brébisson 1835
Gomphonema olivaceum (Hornemann) Ehrenberg 1838
Gomphoneis olivacea (Hornemann) Dawson ex Ross & Sims 1978
Gomphonema clavatum Ehrenberg 1832
Styllaria olivacea (Lyngbye) Peragallo 1903
Gomphonema constrictum f. *clavata* A.Cleve 1955

Diagnosis: Valves are heteropolar, clavate and lanceolate to linear lanceolate with broadly rounded headpole and acutely rounded footpole. Axial area is narrow, linear, and expanded towards the valve centre. Central area is rectangular, bow-tie-shaped to transversely elliptical, or subrounded, bordered at the margins by 1-3 equally shortened striae arched around the central area. Raphe is linear to slightly lateral; external proximal raphe endings are dilated or drop-shaped, extending into the central area; external distal raphe endings extend straight or slightly deflected onto the valve mantle at both poles. Stigmata are lacking. Transapical striae are biseriate, strongly radiate in the central valve and towards the footpole, becoming slightly radiate towards the headpole, about 10-12 in 10 μm. The footpole has a large apical pore field with porelli of the same size. Length of the valve 20-42 μm, and the breadth 7-9 μm.

Remarks: The most important and conspicuous feature is that they do not have any stigmata; occasionally, there are a few isolated puncta visible in the central area, but they look like the areolae and seem to be continuations of the striae, just separated by a gap.

Ecological preference: Epiphytic; epipelic, oligohalobous (indifferent), alkaliphilous (Foged 1981); Cosmopolitan, occurring in oligosaprobic waters with a wide range of conductivity (Krammer & Lange- Bertalot 1986); widespread, tychoplanktonic, mesosaprobous and mesoeutraphentic species (Denys 1991; Hofmann 1994; Van Dam et al. 1994); classified as an alkaliphilous-alkalibiontic (Hakansson 1993) or an alkalibiontic diatom (Van Dam et al. 1994); the species was recorded as *Gomphonema clavatum* from water of temperature was 6.2-9.0°C, moderate conductivity, and pH varied from 6.4 to 7.6 (Wojtal 2003); reported as *Gomphonema olivaceum* from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water

temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater with pH 6.5-8.5, air temperature 14-30°C, water temperature 3-18°C (Li et al., 2007); *Gomphonella olivacea* is considered to be cosmopolitan, found across the world along with many varieties (Hofmann et al. 2013); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); Eutraphentic, indicative of nutrient-rich waters (Witak et al. 2017).

Occurrence: Frequent in Jeziorak, Radomno and Młynek Lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Reported as *Gomphonema olivaceum* from the Wyżyna Krakowsko-częstochowska Upland, fish ponds in Mydlniki (Siemińska 1947); Pilica River (Kadłubowska 1964 b); Sanka stream (Kądziołka 1963; Hojda 1971); Prądnik River (Stępień 1963); springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik 1970); Vistula River (Uherkovich 1970); sewage ponds in Pieskowa Skała (Pudo 1978); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); as *Gomphonema clavatum* and its synonyms were very commonly reported from Poland (Siemińska & Wołowski 2003). Kobylanka stream, north-west of Kraków Poland (Wojtal 2003); As *Gomphonema clavatum* from Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); as *Gomphonema olivaceum* from the Holocene sediments of Vistula Lagoon, north Poland (Witak et al, 2005); Gulf of Gdańsk (Zgrundo et al. 2008); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Górki Zachodnie and Swibno-Vistula River estuary in North Poland (Majewska et al. 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-eastern Poland (Zębek et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, the Wisłok River, Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, c, d); Lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok River and the catchment area including rivers and streams (Wisłok river, Zalew Rzeszowski, Łubienka, San (near Jarosław), Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, southern Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Lake Zabinskie in the Masurian Lake District, north-east Poland (Witak et al. 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Kłopotnica River, Magura National Park, south-east Poland (Noga 2019); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); as *Gomphoneis olivacea* from the Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020); headwaters of the Wisłoka River and selected tributaries in Magura National Park southeast Poland (Peszek et al. 2021).

***Gomphonella olivaceoides* (Hustedt) Tuji 2020**

(Pl. 144, figs. 16-18)

Ref. Hustedt 1950, p. 397, pl. 37, figs. 9-12; Patrick & Reimer 1975, p. 144, pl. 18, figs. 21a-b; Lange-Bertalot 1989, p. 159, pl. 97, figs. 1-20, 24, 25; Li et al. 2007, p. 239, fig. 191; Reichardt 2009, p. 168, figs. 60–65; Bąk et al. 2012, p. 177, pl. 65; Solak et al. 2021, p. 211, pl. 3, fig. 48.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema olivaceoides* Hustedt 1950

Gomphoneis olivaceoides (Hustedt) Carter ex Tuji 2005

Gomphonema olivaceum var. *olivaceoides* (Hustedt) Lange-Bertalot 1989

Diagnosis: Valves are clavate with broadly rounded, slightly truncated headpole and narrowly rounded protracted footpole; the widest part is the middle portion of the valve. Axial area is linear and very narrow. Central area is transverse, nearly half of the valve breadth. Raphe is filiform, not extending into the central area. Proximal and distal raphe endings are small and distinct. Four stigmata are present in the central area, opposite the proximal raphe endings. Transapical striae are radiate throughout the valve, about 12-14 in 10 μm, indistinctly punctate. Pseudoseptum was observed. Length of the valve 15-37 μm, and the breadth 5-10 μm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, mesotraphentic (Van Dam et al. 1994); freshwater with pH 8.0, air temperature 14°C, water temperature 3°C (Li et al. 2007); distributed in moderately rich calcium-rich lakes and waters flowing in the mountains and lowlands (Bąk et al. 2012); as *Gomphonema olivaceum* var. *olivaceoides* from alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014 a); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Frequent in Radomno Lake, and infrequent in Kamionka and Młynek Lakes.

Distribution in Poland: as *Gomphonema olivaceum* var. *olivaceoides* reported from Wisłok river and Łubienka, Stobnica, Mleczka, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); as *Gomphonema olivaceoides* from Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Gomphonella olivaceoides* var. *lanceolata* (Manguin) Zalat comb. nov.**

(Pl. 144, figs. 19-22)

Ref. Manguin 1961, p. 282, pl. 3, fig. 15

Synonym: *Gomphonema olivaceoides* var. *lanceolata* Manguin 1961

Diagnosis: Valve is clavate-lanceolate, naviculoid form, narrowing gradually from the centre of the valve towards the ends with broadly to obtusely rounded headpole and protracted, narrowly rounded footpole. Axial area is linear and very narrow. Central area is large, transverse. Raphe is filiform, straight, not extend into the central area. Proximal and distal raphe endings are small and distinct. Stigmata are present in the central area, opposite to the proximal raphe ends. Transapical striae are coarsely punctate, strongly radiate throughout the valve, about 12-13 in 10 μm. Length of the valve 28-36 μm, and the breadth 5-5.5 μm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonella olivaceolacua* (Lange-Bertalot & Reichart) Jahn & Abarca 2019**

Ref. Lange-Bertalot 1993, p. 67, pl. 80, figs. 1-8; pl. 81, figs. 3, 4; pl. 82, figs. 1-4; Werum & Lange-Bertalot 2004, p. 417, pl. 93, fig. 16; Bąk et al. 2012, p. 177, pl. 65.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema olivaceum* var. *olivaceolacuum* Lange-Bertalot & Reichardt 1993
Gomphonema olivaceolacuum (Lange-Bertalot & Reichardt) Lange-Bertalot & Reichardt 2004
Gomphoneis olivaceolacua (Lange-Bertalot & Reichardt) Kociolek & Kulikovskiy 2013

Diagnosis: Valves are clavate, broadly lanceolate, with broadly rounded to truncate headpole, and gradually narrowing towards the footpole to form subprotracted and narrowly rounded to subcapitate apex. Axial area is narrow, linear. Central area is variable in width and shape due to shortening of the central striae. Raphe is filiform, straight. Proximal raphe endings with distinct central pores, not deflected. Distal raphe endings at the head pole are slightly expanded at helictoglossa and continue as a slightly curved terminal fissure. Transapical striae are strongly radiate at the valve centre, becoming slightly radiate to subparallel near the poles, about 12-15 in 10 μm. Length of the valve 20-50 μm, and the breadth 7-13 μm.

Ecological preference: *Gomphonema olivaceolacuum* is observed in meso-to eutrophic lakes (Levkov & Williams 2011); in freshwaters, mesotrophic, calcium-rich lakes and rivers in the mountains, as well as on the lowlands, occurs up to the β-mesosaprobic zone (Bąk et al. 2012); freshwater of an alkaline or close to circumneutral reaction (pH 6.5-8.4), low to relatively high conductivity ranged from 100 µS/cm to 528 µS/cm (Noga et al. 2013a; 2014 a).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: *As Gomphonema olivaceum* var. *olivaceolacuum* reported from Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a); as *Gomphonema olivaceolacuum* from San River (near Jarosław) and Baryczka in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a).

Genus *Gomphonema* Ehrenberg 1831

Diagnosis: Frustules are wedge-shaped or cuneate in the girdle view. Valves are club-shaped, or clavate, linear or lanceolate, biraphid and heteropolar or symmetric to the apical axis, and asymmetric to the transapical axis. The headpole is broadly rounded, the footpole is narrower, protracted, acutely rounded, and somewhat rostrate or capitate. Axial area may be narrow or wide. Central area may be of various shapes that may have asymmetric striae. The true raphe is a straight or slightly sinuous raphe fissure, unequal in length, curved at the ends. Transapical Striae are uniseriate, occasionally biseriate, usually parallel to more radiate towards the ends. Striae are not crossed by longitudinal lines, as in *Gomphoneis*. One or a few stigmata are present on one side of the central area. Pore field is present at the footpole.

Holotype species: *Gomphonema acuminatum* Ehrenberg 1832

***Gomphonema acidoclinatum* Lange-Bertalot & Reichardt 2004**

(Pl. 119, fig. 1)

Ref. Werum & Lange-Bertalot 2004, p. 160, pl. 92, figs. 1-19; pl. 93, figs. 1-3; Kihara et al. 2009, p. 96, fig. 56; Bąk et al. 2012, p. 165, pl. 68; Hofmann et al. 2013, p. 98, pl. 294, figs. 28-32; Bahls et al. 2018, p. 45, pl. 8, fig. 15.

Status of name: accepted taxonomically.

Diagnosis: Valve is linearlanceolate to rhombic-lanceolate, and narrowing gradually from the centre toward the ends to form acutely rounded, subrostrate apices. Axial area is relatively narrow, linear. Central area is small, sometimes lateral, formed by shortened central striae on one side. Raphe is slightly lateral, broad, and narrows toward the proximal and distal ends. Proximal raphe endings are terminated with not deflected, small central pores; distal raphe endings are curved on one side. An isolated stigma is present close to the proximal central pores. Transapical striae are slightly radiate, lineate, about 1011 in 10 µm at the valve centre to 1214 in 10 µm near the ends. Puncta about 25-30 in 10 µm. Length of the valve 2055 µm, and the breadth 78.5 µm.

Ecological preference: Oligotrophic, alkaline freshwater reaction (pH 7.6-8.1) and moderate conductivity content (Noga et al. 2016a).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a)

***Gomphonema acuminatum* Ehrenberg 1836**

(Pl. 119, figs. 2-21; pl. 120, figs. 1-8)

Ref. Hustedt 1930, p. 370, fig. 683; Foged 1974, p. 59, pl. 28, figs. 1, 2; Patrick & Reimer 1975, p. 112, pl. 15, figs. 2, 4, 7; Krammer & Lange-Bertalot 1986, p. 365, pl. 160, figs. 1-12; Ehrlich, 1995, p. 109, pl. 32, fig. 15; Lange-Bertalot 1996, p. 244, pl. 63, fig. 1; pl. 97, fig. 7; pl. 108, fig. 13; Reichardt 1999, p. 45, pl. 52, figs. 1-14; pl. 53, figs. 1-17; pl. 55, figs. 1-4; Wojtal 2009, p. 216, pl. 13, fig. 1; Noga et al. 2013 c, p. 137, fig. 2: 25; Kulikovskiy et al. 2016, p. 207, pl. 125, figs. 1-7; Bahls et al. 2018, p. 161, pl. 124, fig. 24.

Status of name: accepted taxonomically.

Synonyms: *Exilaria panduriformis* Ehrenberg 1832
Meridion panduriforme (Ehrenberg) Ehrenberg 1838
Gomphonema laticeps Ehrenberg 1843
Gomphonema acuminatum var. *laticeps* (Ehrenberg) Grunow 1880
Gomphonema acuminatum f. *laticeps* (Ehrenberg) Dippel 1905
Gomphonema acuminatum f. *laticeps* (Ehrenberg) Mayer 1913

Diagnosis: Valves are clavate, with broad wedge-shaped, cuneate, tumid at the centre with two constrictions along the margin; near the headpole, the valve broadens and then becomes apiculate at the headpole, and narrow, elongated footpole. Axial area is moderately wide to slightly narrow, straight. Central area is irregularly shaped, moderately large, unilateral, with isolated puncta or stigma on the side opposite the shorter striae. Raphe is lateral and undulate. Proximal raphe endings are dilated; distal raphe endings are deflected onto the mantle in the direction opposite the stigma. Transapical striae are distinctly punctate, radiate throughout, strongly radiate at the footpole, about 911 in 10 µm at the valve centre, 12-14 in 10 µm towards the footpole. A bilobed apical pore field is present at the footpole. Length of the valve 35-74 µm, and the breadth 9-13 µm.

Ecological preference: Oligohalobous 'indifferent', alkaliphilous (Foged, 1959 1970); freshwater form, epiphytic, alkaliphilous with pH values 7.5 8.0 (Ehrlich 1973); cosmopolitan, alkaliphilous, oligo to β mesosaprobic (Krammer & LangeBertalot 1986); it occurs in fresh and brackish water, β-mesosaprobic, eutraphentic and sometimes recorded from aerophytic habitats (Van Dam et al. 1994); the species was recorded from eutrophicated water of temperature was 6.2-9.0°C, moderate conductivity, and pH varied from 6.4 to 7.6 (Wojtal 2003); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); widely distributed in waters from oligo- to weakly mesosaprobic and oligo- to eutrophic, usually with a medium content of electrolytes, less often in a slightly acidic, electrolyte-poor environment (Bąk et al. 2012); freshwater with pH had an alkaline character 7.1-8.3, relatively high conductivity (416-764 µSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a); alkaliphilous mainly occurring at pH >7 (Szulc & Szulc 2012); alkaliphilous, fresh brackish, eutraphentic (Malinowska-Gniewosz et al. 2018).

Occurrence: Common in Radomno, Młynek and Jeziorak Lakes, and frequent in the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kobylanka stream, 30 Km north-west of Kraków (Wojtal 2003); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); pond of the Botanical Garden in Kraków, south Poland (Wołowski & Kowalska 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south-east Poland (Noga et al. 2013a); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema acuminatum* var. *pantocsekii* A.Cleve 1932**

Ref. Kaczmarska 1977, p. 54, pl. 26, fig. 1.

Status of name: requires further investigation.

Diagnosis: Valves are clavate, linear-lanceolate with a wedge-shaped, more tumid and expanded upper part than at the valve centre, with two slight constrictions along the margin. The headpole is apiculate, acutely rounded, and the footpole is relatively narrow, protracted and bluntly rounded. Axial area is moderately wide to

slightly narrow at the ends. Central area is irregularly shaped, small to moderately large, unilateral, with isolated puncta or stigma on the side opposite the shorter striae. Raphe is lateral and sinuous. Proximal raphe endings are dilated with pronounced central pores that deflect towards the stigmata side; distal raphe endings are deflected onto the mantle in the direction opposite the stigma. Transapical striae are distinctly punctate, slightly radiate throughout, strongly radiate at the footpole, about 810 in 10 μm at the valve centre, 11-13 in 10 μm towards the footpole. Length of the valve 40-65 μm, and the breadth 8-12 μm.

Ecological preference: Freshwater, epiphytic taxon (Kaczmarska 1977).

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema acuminatum* var. *pusillum* Grunow 1880**

(Pl. 120, figs. 9-17)

Ref. Thomas et al. 2009, p. 202, pl. 1, figs. 5-8; Kulikovskiy et al. 2015, p. 270

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* f. *pusillum* (Grunow) Cleve 1894

Gomphonema pusillum (Grunow) Kulikovskiy and Kociolek in Kulikovskiy et al. 2015

Diagnosis: Valves are relatively slender, linear-acute and biconstricted, with the broadest portion of the valve near the headpole and slightly tumid at the valve centre. The headpole is acute to apiculate, and the footpole is narrow, elongated and acutely rounded. Axial area is narrow and straight. Central area is transversely expanded, somewhat rounded or elliptical. An isolated stigma is located close to the central nodule. Raphe is lateral and undulate; proximal raphe endings are dilated central pores that deflect towards the stigma side; distal raphe endings are curved onto the mantle in the direction opposite the stigma. Transapical striae are distinctly punctate, radiate about the middle portion of the valve, becoming parallel to radiate towards the headpole and parallel to strongly radiate towards the footpole, slightly separate at the central area. Striae about 1011 in 10 μm at the valve centre, 12-14 in 10 μm towards the footpole. Length of the valve 32-55 μm, and the breadth 6.5-9 μm.

Ecological preference: the species was reported from alkaline shallow water with pH 7.5-9.3, low conductivity and water temperature 18.2-25 °C (Kulikovskiy et al. 2015).

Occurrence: Infrequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema acuminatum* var. *scardicum* (Mitic-Kopanja, Wetzel, Ector & Levkov) Abarca & Jahn 2020**

(Pl. 141, figs. 12-16)

Ref. Mitic-Kopanja et al. 2014, p. 151, fig. 25-53; Abarca et al. 2020, p. 36.

Status of name: accepted taxonomically.

Synonym: *Gomphonema scardicum* Mitic-Kopanja, Wetzel, Ector & Levkov 2014

Diagnosis: Valve is heteropolar, linear–lanceolate with undulated valve margins. The largest valve width is near the valve centre. The headpole is narrowly rounded to cuneate, and the footpole is protracted, acutely rounded. Axial area is relatively narrow, linear-lanceolate, ornamented with shallow, irregularly arranged depressions. Central area is small, formed by shortening of a single central stria on both valve sides. One isolated stigma is present in the central area, located near the proximal raphe ends, and separated from the long, central stria. Raphe is lateral, slightly undulated. Proximal raphe endings with simple, slightly expanded central pores. Transapical striae are coarsely punctate, parallel to slightly radiate in the valve centre, about 9-12 striae in 10 μm, becoming radiate and denser towards the footpole, about 13-15 in 10 μm. Puncta about 22-25 in 10 μm. Length of the valve 36-63 μm, and the breadth 7.5-9.5 μm at the valve centre, 7.0-8.0 μm at the headpole.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema acutiusculum* (Otto Müller) Cleve-Euler 1955**

(Pl. 120, figs. 18-20)

Ref. Cleve-Euler 1955, p.184, fig. 1279; Li et al. 2007, p. 234, fig. 145.

Status of name: accepted taxonomically.

Synonym: *Gomphonema lanceolatum* var. *acutiusculum* O.Müller 1898

Diagnosis: Valves are lanceolate, rhombic-lanceolate with a very narrow, acutely rounded headpole and footpole. Axial area is linear, moderately narrow. Central area is small, unilateral, formed by one short stria on one side, and an isolated punctum or stigma on the other side. Raphe is filiform, straight. Proximal raphe endings with slightly expanded small central pores; distal raphe endings bent to one side. Transapical striae are radiate throughout the valve, about 10-12 in 10 μm. Length of the valve 36-55 μm, and the breadth 8-10 μm.

Ecological preference: The species is reported from littoral acidic water with pH value 4.58, conductivity 7.6 (μS/cm), and low in nutrients (Vélez et al. 2005); freshwater with pH 7.0, air temperature 27°C, water temperature 17°C (Li et al. 2007); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema adductum* Hustedt 1965**

(Pl. 121, figs. 1-13)

Ref. Hustedt 1965, p. 402, figs. 50-54; Simonsen 1987, p. 494-495, pl. 756, figs. 7-12.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, bluntly acuminate, linear-lanceolate with biconstricted margins, broadest near the headpole, but tumid at the centre of the valve. The headpole is cuneate to rostrate, acutely rounded, and the footpole is protracted, bluntly rounded. Axial area is distinct, narrow near the ends, widening gradually towards the valve centre. Central area is elliptical-lanceolate or is barely differentiated with distinct a single stigma. Raphe is lateral, becoming filiform at the proximal and distal ends. Proximal raphe endings are dilated with small central pores; distal raphe endings are deflected onto the mantle in the direction opposite the stigma. Transapical striae are subparallel at the mid-valve, radiate throughout and strongly radiate at the footpole, about 8-9 in 10 μm in the middle, becoming 12-14 in 10 μm at the ends. Puncta about 28-30 in 10 μm. A bilobed apical pore field is present at the footpole. Length of the valve 45-85 μm, and the breadth 7-11 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno, Młynek and Jeziorak Lakes.

Distribution in Poland: New record.

***Gomphonema affine* Kützing 1844**

(Pl. 121, figs. 14-18)

Ref. Patrick & Reimer 1975, p. 133, pl. 17, fig. 5; Krammer & Lange-Bertalot 1986, p. 366, pl. 161, figs. 1-3; Krammer & Lange-Bertalot 1991, p. 408, pl. 80, fig. 5; Ehrlich 1995, p. 109, pl. 33, figs. 12-14; Reichardt 1999, p. 13, pl. 7, figs. 1-9; pl. 8, figs. 1-14; pl. 9, figs. 1-14; Levkov et al. 2016, p. 24, pl. 41, figs. 1-12; Bahls et al. 2018, p. 45, pl. 8, fig. 18; Medeiros et al. 2018, p. 2, figs. 2-4, 77-80.

Synonyms: *Gomphonema dichotomum* var. *affine* (Kützing) Rabenhorst 1864
Gomphonema lanceolatum var. *affine* (Kützing) A.Cleve 1932
Gomphonema affine f. *major* Grunow 1880

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate-lanceolate, rhombic-lanceolate to almost lanceolate, with bluntly rounded headpole and tapering to attenuate, acutely rounded footpole. Axial area is moderately wide, linear. Central area is small, transverse, unilateral with a shortened central stria on one side. An isolated stigma is located adjacent

to the central nodule on the opposite side to the shortened stria. Raphe is lateral with distinct terminal fissures; proximal raphe endings with dilated small central pores; distal raphe endings are deflected and extending toward the valve mantle. Transapical striae are coarsely punctate, uniseriate, more widely spaced, parallel to weakly radiate in the middle, becoming more closely spaced and more radiate at the ends, about 9-12 in 10 µm. Puncta about 18-22 in 10 µm. Length of the valve 3178 µm, and the breadth 8 13 µm.

Ecological preference: Oligohalobous, alkaliphilous (Hustedt 1957); its pH optimum lies around 8 (Cholnoky 1968); oligohalobous "indifferent", pH- circumneutral (Foged 1980); it seems to prefer waters of low mineral content, a pH between 7 and 8, present in carbonate bicarbonate waters (Gasse 1986); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006);the species was observed to be common and widespread in eutrophic freshwaters of low conductivity, low to medium alkalinity with pH 6.9-8.2, unpolluted to slightly polluted waters, frequent in slightly brackish water (Zalat & Servant Vildary 2005); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015).

Occurrence: Frequent in Radomno, Kamionka and Młynek Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); found in the lower Vistula River between Wyszogrod and Dybowo, central Poland (Dembowska 2014); Wisłok river and Mleczka, Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema affine* var. *rhombicum* Reichardt 1999**

(Pl. 121, figs. 19-21)

Ref. Reichardt 1999, p. 15, pl. 10, figs. 1-15; Solak et al. 2021, p. 206, pl. 2, figs. 8-9.

Status of name: accepted taxonomically.

Diagnosis: Valves are rhombic-lanceolate, with attenuate, relatively narrow, bluntly rounded headpole, and acutely rounded footpole. Axial area is moderately narrow and weakly lanceolate. Central area is unilaterally expanded, limited by a shortened stria. Raphe is lateral, sinuous, with proximal endings dilated to small pores, curved to the opposite side of the stigma; distal raphe endings are deflected and extend toward the valve mantle. Stigma is present at the end of a median stria. Transapical striae are uniseriate, slightly radiate in the middle part of the valve and distinctly radiate toward the valve ends, about 9-11 in 10 µm. Puncta about 18-22 in 10 µm. Length of the valve 40-80 µm, and the breadth 10-13 µm.

Ecological preference: Reported from the shallow, benthic habitats of a slightly alkaline, mesotrophic freshwater environment.

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Gomphonema amoenum* Lange-Bertalot 1985**

(Pl. 122, figs. 1-3)

Ref. Krammer & Lange-Bertalot 1985, p. 42, pl. 35, figs. 1-6; pl. 42, figs. 7-8; Krammer & Lange-Bertalot 1986, p. 368, pl. 161, figs. 9-11; Reichardt 1999, p. 21, pl. 20, figs. 1-12.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-lanceolate to elliptical lanceolate, or broad lanceolate, naviculoid, somewhat with slight inflation in the middle part and obtusely rounded not protracted apices. Axial area is moderately narrow and widens gradually towards the valve centre to become wide lanceolate. Central area is unilateral, rectangular, and limited by a shortened stria. An isolated stigma is present close to the central nodule. Raphe is

strongly lateral; proximal raphe endings with small central pores; distal raphe endings are deflected and extend toward the valve mantle. Transapical striae are slightly radiate at the valve centre, strongly radiate towards the apices, about 10-11 in 10 μm. Length of the valve 30-65 μm, and the breadth 9-16 μm.

Ecological preference: Freshwater, periphyton, alkaliphilous pH 7.6-8.2, mesotrophic to eutrophic (Ivanov et al. 2006); reported from the shallow, benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes.

Distribution in Poland: New record.

***Gomphonema anglicum* Ehrenberg 1843**

(Pl. 122, figs. 4-18)

Ref. Thomas et al. 2009, p. 206, figs. 22-25; Bahls et al. 2018, p. 46, pl. 9, fig. 14.

Status of name: accepted taxonomically.

Diagnosis: Valve is broadly clavate, with distinctly undulate margins and broad tumid at the centre with two constrictions along the margin. The headpole is subtruncate, broadly rounded, and the footpole is narrow, acutely rounded. Axial area is linear, moderately narrow. Central area is somewhat unilateral, or transverse, irregular, formed by irregularly shortened striae. A single, large stigma is located in the central area. Raphe is strongly lateral; proximal raphe endings slightly undulate, expanded and deflected towards the stigmata side; distal raphe endings are deflected onto the mantle at both poles. Transapical striae are distinctly punctate, radiate around the middle of the valve, slightly radiate to parallel at the headpole; strongly radiate at the footpole, alternately longer and shorter at the centre, about 1112 striae in 10 μm. Length of the valve 30-55 μm, and the breadth 8-11 μm at mid-valve.

Remarks: A more accentuated constriction in the apical region and a truncate-capitate headpole are distinct characteristics of this species.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes, infrequent in Młynek and Jeziorak Lakes.

Distribution in Poland: New record.

***Gomphonema angustatum* (Kützing) Rabenhorst 1864**

(Pl. 123, figs. 1-7)

Ref. Hustedt 1930, p. 373, fig. 690; Patrick & Reimer 1975, p. 125, pl. 17, figs. 17-19; Foged 1978, p. 67, pl. 40, fig. 18; Germain 1981, p. 306, pl. 114, figs. 1-21; Jensen 1985, p. 826, fig. 690; Krammer & Lange-Bertalot 1986, p. 360, pl. 155, figs. 1-21; Reichardt 1999, p. 23, pl. 23, figs. 1-10, 13-16; pl. 24, figs. 1-37; Wojtal 2009, p. 218, pl. 13, figs. 2, 3; Levkov et al. 2016, p. 26, pl. 51, figs. 19-23; Medeiros et al. 2018, p. 4, figs. 8-11.

Status of name: accepted taxonomically.

Synonyms: *Sphenella angustata* Kützing 1844

Sphenoneis angustata (Kützing) Trevisan 1848

Diagnosis: Valves are lanceolate, linear-lanceolate to rhombic lanceolate, larger specimens are less club-shaped than the smaller. The headpole is wedge-shaped, blunter to more pointed, subrostrate and the footpole is barely narrower, attenuate. Axial area is narrow and linear. Central area is small, elliptical, or unilaterally expanded, limited by a shortened stria. Raphe is slightly sinuous to filiform, straight; proximal raphe endings are slightly curved toward the stigma. Transapical striae are slightly radiate throughout the valve, more spaced at the central region, about 10-12 in 10 μm. Length of the valve 17-38 μm, and the breadth 5-8 μm.

Ecological preference: Epiphyte, oligohalobous (indifferent), alkaliphilous (Foged 1981); Cosmopolitan species, which prefers mesotrophic waters with higher electrolyte content (Krammer & Lange-Bertalot 1986); recorded from water of temperature was 6.2-9.0°C, moderate conductivity, and pH varied from 6.4 to 7.6 (Wojtal 2003); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm^3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater

with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a, Noga et al. 2014 a); reported from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 μS cm-**1**) and low temperature 5.6-9.3 °C (Noga et al. 2016 b).

Occurrence: Frequent in Radomno and Młynek Lakes, and infrequent in Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. Młynowka stream (Gumiński 1947); Vistula River (Turoboyski 1962; Pudo 1977); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b); springs of Kobylanka stream (Skalna 1969); spring of Będkowka stream (Kubik 1970); Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kluczwoda stream (Nawrat 1993); Kobylanka stream, NW of Kraków, south Poland (Wojtal 2003); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005)**;** Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south Poland (Noga et al. 2013 a; 2014 a); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema angusticephalum* Reichardt & Lange-Bertalot in Reichardt 1999**

(Pl. 122, figs. 19-23)

Ref. Reichardt 1999, p. 49, pl. 55, figs. 5-8; pl. 60, figs. 1-26; Kulikovskiy et al. 2015, p.257, figs. 119-166, 268-274; Kulikovskiy et al. 2016, p. 208, pl. 125, figs. 8-14; Bahls et al. 2018, p. 46, pl. 9, fig. 3.

Status of name: accepted taxonomically.

Diagnosis: Valves are bluntly acuminate, moderately clavate with slightly undulate margins, biconstricted, broadest near the headpole, but slightly tumid at the centre of the valve. The headpole is cuneate to bluntly rounded, and the footpole is narrow, acutely rounded. Axial area is narrow, linear and distinct. Central area is small or hardly differentiated. Raphe is lateral and undulate; proximal raphe endings are dilated and straight to barely deflected towards the stigma side; distal raphe endings are deflected onto the mantle at the poles. An isolated stigma is located in the central area. Transapical striae are radiate about the valve centre, become parallel towards the headpole, convergent at the apex; parallel and then becoming strongly radiate at the footpole; about 11-13 striae in 10 μm. Apical pore fields are distinct at the footpole. Length of the valve 15-33 μm, and the breadth: 4.5-6 μm.

Ecological preference: The species is reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); the species was reported from alkaline shallow-water with pH 7.5-9.3, low conductivity and water temperature 18.2-25°C (Kulikovskiy et al. 2015).

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Gomphonema angustius* Reichardt 2009**

Ref. Reichardt 2009, p. 163, figs. 9-30, Levkov et al. 2016, p. 29, pl. 163, figs. 32-51; pl. 165, figs. 1-32; Żelazna-Wieczorek & Knysak 2017, p. 330, fig. 15; Solak et al. 2021, p. 206, pl. 2, figs. 14-15.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderately clavate, lanceolate to elliptic-lanceolate, with subcapitate to attenuate, obtusely rounded headpole and attenuate, acutely rounded footpole. Axial area is narrow and linear. Central area is unilaterally expanded, limited by a shortened stria. Raphe is straight to slightly lateral; the proximal raphe endings are slightly curved toward the stigma; the distal raphe endings are curved onto the mantle at the poles. An isolated stigma is present close to the central nodule. Transapical striae are weakly radiate, more spaced in the mid-valve, about 12-14 striae in 10 μm. Length of the valve 15-22 μm, and the breadth 5-6 μm..

Ecological preference: the species is reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema angustivalva* Reichardt 1997**

Ref. Reichardt 1997, p. 112, pl. 6, figs. 1-29; Buczkó et al. 2021, p. 44, figs. 1-6.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly heteropolar, clavate, narrowly linear to linear-lanceolate, with a weakly inflated central part of the valve and a narrowly rounded or cuneate headpole and footpole. Axial area is narrow and linear. Central area is a small, rectangular and bordered by two shortened striae. Raphe is filiform to weakly lateral, slightly undulate; external proximal raphe endings are tear-drop shaped, slightly deflected towards the isolated stigma. One isolated stigma is present in the central area. Transapical striae are fine, uniseriate, slightly radiate in mid-valve, about 14-16 in 10 μm, becoming parallel or slightly radiate towards the apices. Central striae are distantly spaced from the other striae. Length of the valve 14–34 μm, and the breadth 2.5-4 μm.

Ecological preference: *G. angustivalva* is reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017); frequently observed from a variety of oligotrophic habitats (lakes, ponds, peat bogs, and small streams) in North Macedonia, it is an indicator of oligotrophic waters. (Buczkó et al. 2021).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-eastern Poland (Żelazna-Wieczorek & Knysak, 2017).

***Gomphonema angustum* Agardh 1831**

(Pl. 123, figs. 8-14)

Ref. Hustedt 1930, p. 375, fig. 697; Patrick & Reimer 1975, p. 134, pl. 18, fig. 1; Germain 1981, p. 304, pl. 113, figs. 12-15; Krammer& Lange-Bertalot 1986, p. 370, pl. 164, figs. 1-16; Krammer & Lange-Bertalot 1991, p. 416, pl. 84, figs. 9-14; Reichardt 1994, p. 120, figs. 9-12; Ehrlich 1995, p. 110, pl. 33, fig. 1; Bąk et al. 2012, p. 166, pl. 67.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema intricatum* Kützing 1844
Gomphonema dichotomum Kützing 1834
Gomphonema intricatum var. *pumilum* Grunow 1880

Diagnosis: Valves are narrow heteropolar, linear-lanceolate, club-shaped with rounded or bluntly wedge-shaped headpole and attenuate, acutely rounded footpole. Axial area is moderately narrow, linear, expanding gradually towards the valve centre to form a lanceolate area. Central area is relatively broad, rectangular, extending on one side to the valve margin with very short median striae. Raphe is straight, filiform to slightly lateral; proximal raphe endings are dilated into small pores; distal raphe endings are deflected to one side at the apices. One isolated stigma is separated from the median striae present. Transapical striae are finely punctate, slightly radiate to subparallel, about 8-10 in 10 μm. Length of the valve 25-53 μm, and the breadth 5-8 μm.

Ecological preference: Fresh-brackish, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); reported from freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015); alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017); found in benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, and Lubcza and Trzcianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2013a, 2014 a); found in Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema angustum* var. *lunatum* (Germain) Aboal 2003**

(Pl. 123, figs. 15-18)

Ref. Germain 1981, p. 306, pl. 113, fig. 6-10; pl. 161, fig. 2-3

Status of name: accepted taxonomically.

Synonym: *Gomphonema intricatum* var. *lunatum* Germain 1981

Diagnosis: Valve is narrow, linearlanceolate, with a slight swelling in the middle portion; obtusely rounded headpole and narrow, acutely rounded footpole. Axial area is distinct, relatively narrow near the ends and expanding towards the valve centre. Central area is large, transverse, and somewhat unilaterally formed by shortening of the marginal striae. Raphe is straight, filiform; proximal raphe endings with not deflected small central pores; distal raphe endings are deflected towards one side at the apices. An isolated stigma is located close to the proximal raphe ends. Transapical striae are short, punctate, radiate throughout, strongly radiate at the foot pole, about 7-9 in l0 μm in the mid-valve, up to 10-12 at the ends. Length of the valve 18-55 μm, and the breadth 3-6 μm.

Ecological preference: Found in shallow benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema asiaticum* Liu & Kociolek in Liu, Kociolek & Wang 2013**

(Pl. 124, figs. 1-9)

Ref. Liu et al., 2013, p. 312, figs. 45-60; Lee et al. 2020, p. 19, figs. 40, 41.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate to weakly linear with clearly triundulate margins, constricted above the valve middle. The headpole is broadly rhomboid to even quadrangular with a protracted and rostrate apex. The footpole is acutely rounded. The breadth of the headpole is wider than at mid-valve. Axial area is narrow, linear to linear-lanceolate. Central area is small, rectangular, and unilaterally expanded with a shortened stria. One stigma is present at the end of the central stria. Raphe is lateral, external fissures are undulate; proximal raphe endings are straight; distal raphe endings curve towards the side of the stigma, externally deflected onto the valve mantle at the headpole. Transapical striae are distinctly punctate, almost parallel in the middle, about 6-10/10 μm, slightly radiate towards the apices, about 9-12/10 μm. Length of the valve 47-70 μm, and the breadth at the valve centre 10-13 μm, at the headpole 11-14 μm.

Ecological preference: Planktonic and benthic taxon, reported from freshwater in the Jablanica Mountain (Levkov et al. 2016); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno, Kamionka and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema augur* Ehrenberg 1841**

(Pl. 124, figs. 10-17)

Ref. Hustedt 1930, p. 372, fig. 688; Patrick & Reimer 1975, p. 111, pl. 15, fig. 9; Germain 1981, p. 301, pl. 111, figs. 2-3; Krammer & Lange-Bertalot 1986, p. 363, pl. 157, figs. 1-8; pl. 158, figs. 1-6; Bąk et al. 2012, p. 167, pl. 63;Van De Vijver et al. 2013, p. 112, figs. 6-11, 27-41; Levkov et al. 2016, p. 32, pl. 35, figs. 1-23; Medeiros et al. 2018, p. 4, figs. 12-13.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema apiculatum* Ehrenberg 1843

Gomphonema augur var. *genuinum* Mayer 1913

Diagnosis: Valves are heteropolar, clavate-lanceolate with apiculate, cuneate, broadly rounded, subrostrate headpole and subcapitate-acutely rounded footpole. Axial area is moderately broad, linear to narrowly lanceolate. Central area is expanded unilaterally, rectangular, narrow, and limited by a shortening stria. Raphe is lateral, slightly sinuous; Proximal raphe endings are expanded, drop-like, almost straight to weakly deflected towards the isolated stigma; distal raphe endings are unilaterally slightly deflected, continuing onto the valve mantle. One isolated stigma is present at a median shortened stria. Transapical striae are punctate, radiate and curved near the middle of the valve, becoming more strongly radiate towards the poles, about 9-11 in 10 µm, equally spaced throughout the entire valve. Length of the valve 30-55 µm, and the breadth 11-13.5 µm.

Ecological preference: Fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, meso- to eutraphentic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); found in alkaline, fertile lakes and large rivers, tolerant to organic pollutants and thus to the critical zone (β-α-meso-saprobic) (Bąk et al. 2012); freshwater **f**reshwater rivers and streams of an alkaline or close to circumneutral reaction (pH 6.5-8.4), low to medium electrolytic conductivity ranged from 100 µS/cm to 700 µS/cm, temperature 3.0-17.5 (Noga et al. 2013 b; 2014 a)

Occurrence: Frequent in Młynek and Radomno Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 b); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Wielopolka, Żołynianka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema auritum* Braun 1849**

(Pl. 123, figs. 19-21)

Ref. Mayer 1928, p. 118, pl. 4, fig. 7; Bąk et al. 2012, p. 167, pl. 67; Noga et al. 2013c, p. 137, fig. 2: 22; Kihara et al. 2015, p. 25, fig. 88; Bahls et al. 2018, p. 45, pl. 8, fig. 11; p. 82, pl. 45, figs. 22-23; Lee et al. 2020, p. 19, figs. 46-49; Van de Vijver et al. 2020, p. 2, figs. 2-55.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema dichotomum* var. *auritum* (Braun) Rabenhorst 1864

Gomphonema gracile var. *auritum* (A. Braun ex Kützing) Van Heurck 1885

Diagnosis: Valves are naviculoid but still distinctly heteropolar, linear-lanceolate to narrowly rhombic-lanceolate with acutely rounded headpole and footpole. Valves are tapering gradually from the mid-valve towards the headpole, more abruptly narrowing towards the footpole. Axial area is moderately broad, linear, and weakly narrowing near ends. Central area is asymmetrical, bordered by curved shortened striae. One isolated stigma

is present at the end of shortened stria. Raphe is lateral; the proximal raphe endings are close to each other, weakly deflected, inflated; the distal raphe endings are elongated, hooked, continuing onto the valve mantle at the footpole, ending abruptly at the headpole. Internally, the distal raphe endings terminate onto well-developed helictoglossae. Apical pore field at footpole bisected by distal raphe fissure. Transapical striae are uniseriate, almost parallel to radiate throughout the entire valve, about 13-15 in 10 μm. Length of the valve 15-45 μm, and the breadth 4-6 μm.

Ecological preference: This species often occurs in oligotrophic and slightly mesotrophic waters, in lakes rich in calcium and was primarily found in the mountains, less often in the lowlands (Bąk et al. 2012); freshwater with pH 8.0-8.5, air temperature 16-18°C, water temperature 7-23°C (Li et al., 2007); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon, (calcareous waters with silica) (Szczepocka & Rakowska, 2015); found in oligotrophic and weakly mesotrophic level (Lange-Bertalot et al. 2017).

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013c); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015).

***Gomphonema bavaricum* Reichardt & Lange-Bertalot 1991**

Ref. Reichardt & Lange-Bertalot 1991, p. 534, pl. 7, figs. 1-12; Reichardt 1995, p. 88, pl. 1, figs. 14-16.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, narrow linear lanceolate, with acutely rounded headpole and footpole. Axial area is narrow and linear. Central area is cross-rectangular to square, reaching the margins with a lack of central striae. Raphe is straight, slightly lateral, proximal raphe endings are dilated with small central pores; distal raphe endings are deflected onto the mantle at the apices and bisect the apical pore field at the footpole. An isolated stigma is present close to the central nodule. Transapical striae are slightly radiate to parallel throughout the valve, widely spaced, about 9-12 in 10 μm. Length of the valve 12.5-34 μm, and the breadth 4.5-5.5 μm.

Ecological preference: Epilithic, in neutral to alkaline freshwater (pH 6.6 to 8.4), warm at temperatures 12.5 and 19.1ºC (Delgado et al. 2013); alkaline or close to neutral water reactions (pH 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a).

Distribution in Poland: Morawa stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

***Gomphonema bohemicum* Reichelt & Fricke in Schimidt 1902**

Ref. Hustedt 1930, p. 377, fig. 718; Reichardt 1999, p. 53, pl 61, figs. 1-22; pl. 63, figs. 1-5; Martinez-Goss et al. 2023, p. 1666, figs. 35-38, 56, 57.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema intricatum* var. *bohemicum* (Reichelt & Fricke) A.Cleve 1955

Gomphonema vibrio var. *bohemicum* (Reichelt & Fricke) Ross 1986

Diagnosis: Valves are linear-lanceolate to rhombic-lanceolate and gradually tapering into not protracted, bluntly rounded poles. Axial area is moderately wide, linear-lanceolate. Central area is large, rectangular, and limited by shortened median striae. An isolated stigma is present in the central nodule. Raphe is straight, slightly lateral; the proximal raphe endings are straight, slightly dilated into central pores which are slightly curved; the distal raphe endings are weakly deflected, extend onto the mantle and bisect the apical pore field at the footpole. Transapical striae are uniseriate, punctate, radiate throughout the valve, widely spaced at the centre, more radiate at the poles, about 9-11 in 10 μm at the valve centre, 12-14 in 10 μm at the ends. Length of the valve 18-36 μm, and the breadth 4.5-7 μm.

Ecological preference: Freshwater, circumneutral, oligotraphentic (Van Dam et al. 1994); eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied

within 0.15-3.49‰, and water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater of alkaline character or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); it was observed in freshwater with pH values ranging from 7.05-8.20, DO 4.41-8.83 $mg \cdot L^{-1}$, conductivity 182.37-432.33, and TDS (ppm) 120.47-301.67 (Martinez-Goss et al. 2023).

Occurrence: Infrequent in Radomno and Kamionka Lakes.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Wisłok River and Morawa stream in the Podkarpacie Province, south Poland (Noga et al. 2014 a); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema brebissonii* Kützing 1846**

(Pl. 125, figs. 1-16; pl. 126, figs. 1-16)

Ref. Lange-Bertalot & Metzeltin 1996, p. 244, pl. 63, figs. 4-7; pl. 97, fig. 8; pl. 108, figs. 6-8; Metzeltin & Witkowski 1996, p. 74, pl. 21, fig. 15; Reichardt 1999, p. 46, pl. 56, figs. 1-14; pl. 57, figs. 1-13; Wojtal 2003, p. 215, pl. 2, fig. 9; Kulikovskiy et al. 2016, p. 208, pl. 125, figs. 18-20; Levkov et al. 2016, p. 37, pl. 5, figs. 1-16; Bahls et al. 2018, p. 46, pl. 9, fig. 11; p. 82, pl. 45, figs. 12-15; p. 104, pl. 67, fig. 5; p. 132, pl. 95, figs. 17, 18.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* var. *brebissonii* (Kützing) Grunow 1880
Gomphonema acuminatum f. *brebissonii* (Kützing) Cleve 1894

Diagnosis: Valves are bluntly acuminate, heteropolar, narrowly clavate to linear with slightly undulate margins. The headpole is narrowly rhomboid, protracted, obtusely rounded, and slightly wider than the central part of the valve, and the footpole is acutely rounded. Axial area is moderately broad, linear to narrowly lanceolate. Central area is irregular to elliptical, narrow, bordered by one or two shortened striae on each side. One isolated stigma is present in the central area, separated from the shortened central stria. Raphe is lateral and slightly undulate; the proximal raphe endings are dilated with small central pores; the distal raphe endings are unilaterally curved onto the mantle. Transapical striae are radiate about the valve centre, become slightly radiate to parallel towards the headpole; parallel and then strongly radiate at the footpole, about 10-12 in 10 µm. Apical pore fields are distinct at the footpole. Length of the valve 20-55 µm, and the breadth 7.5-9.5 µm.

Ecological preference: An alkaliphilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); it occurs in water of lower and moderate electrolyte contents, widespread but prefers cold waters and more often reported from northern region (Reichardt 1999); freshwater with pH 8.5, air temperature 18°C, water temperature 23°C (Li et al. 2007); inhabit oligosaprobic, oligo- to eutrophic waters, in medium electrolyte content (Bąk et al. 2012); from freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Common in Młynek, Kamionka, Radomno and Jeziorak Lakes, and the Eemian paleolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowsko- Częstochowska Upland; Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Sanka stream (Kądziołka 1963; Hojda 1971); Pilica River (Kadłubowska 1964b); Vistula River (Kyselowa & Kysela 1966); ponds near Krakow (Hanak-Szmagier 1967); springs of Kobylanka stream (Skalna 1969); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Polish acidic mountain streams in the Silesian Beskid (section of the Western Carpathians), the Świętokrzyskie Mts, and in the Karkonosze range in the Sudetic Mts (Kwandrans 1993); Kobylanka stream, north-western of Kraków Poland (Wojtal 2003); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); Lake Piaski in Western

Pomerania, north-west Poland (Witkowski et al. 2011); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, and Duszatyńskie Lakes (Western Bieszczady Mts. South Poland (Noga et al. 2013 a, c); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020); Lakes Łazduny and Rzésniki in the Masurian Lake District in northeast Poland (Szczerba et al. 2023).

***Gomphonema brebissonii* var. *cuneata* Zalat nov. var.**

(Pl. 127, figs. 1-4)

Diagnosis: Valves are bluntly acuminate, heteropolar, linear-lanceolate with nearly straight margins. The headpole is cuneate, acutely rounded, and slightly wider than the central part of the valve, and the footpole is acutely rounded. Axial area is narrow and linear. Central area is small, bordered by one shortened striae on each side. One isolated stigma is present in the central area, separated from the shortened central stria. Raphe is weakly lateral; proximal raphe endings are slightly dilated with small central pores. Transapical striae are slightly radiate to subparallel throughout, radiate towards the ends, about 10-11 in 10 µm. Length of the valve 29-30 µm, and the breadth 7-8 µm.

Remarks: This new variety differs from the nominate species by having a cuneate headpole, nearly straight valve margins and a small or indistinct central area.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecology.

Etymology. The epithet of the new variety refers to the cuneate shape of the headpole.

Holotype: the specimens illustrated in plate 127, figures 1-4.

Type locality: Radomno Lake.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema brebissonii* var. *grosspunctata* Zalat nov. var.**

(Pl. 127, figs. 5-8)

Diagnosis: Valves are bluntly acuminate, heteropolar, linear-lanceolate with markedly undulate margins. The headpole is narrowly rhomboid, subprotracted, bluntly rounded, and slightly narrower than the central part of the valve. Axial area is moderate and linear. Central area is distinct, irregular, and bordered by one shortened stria on each side. One isolated stigma is present in the central area, separated from the shortened central stria. Raphe is lateral and filiform at the ends. The eproximal raphe endings are expanded with distinct central pores; the distal raphe endings are deflected onto the mantle. Transapical striae are coarsely punctate, widely spaced, subparallel at the valve centre, become radiate throughout the valve, about 7-8 in 10 µm. Length of the valve 95-100 µm, and the breadth 14-16 µm.

Remarks: This new variety differs from the nominate species by having coarsely punctate, widely spaced striae, the headpole is slightly narrower than the central part of the valve, and the size dimensions of the valve.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments. It is recorded as associated with the nominate species, and it has the same ecology.

Etymology. The epithet of the new variety refers to the coarsely punctate striae.

Holotype: the specimens illustrated in plate 127, figures 5-8.

Type locality: Radomno Lake.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema capitatum* Ehrenberg 1838**

(Pl. 127, figs. 9-17)

Ref. Hustedt 1930, p. 377, fig. 715; Reichardt 2001, p. 192, pl. 1, figs. 1-22; pl. 2, figs. 1-9; pl. 4, figs. 12-14, pl. 14, figs. 1-6; Kulikovskiy et al. 2015, p. 260, figs. 228-236, 295-298; Kulikovskiy et al. 2016, p. 208, pl. 126, figs. 25-28; Levkov et al. 2016, p. 40, pl. 32, figs. 1-17; Bahls et al. 2018, p. 46, pl. 9, fig. 9; p. 104, pl. 67, figs. 1-4; Medeiros et al. 2018, p. 11, figs. 26-27.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema constrictum* var. *capitatum* (Ehrenberg) Grunow 1880
Gomphonema truncatum var. *capitatum* (Ehrenberg) Woodhead & Tweed 1954
Gomphonema constrictum f. *capitata* (Ehrenberg) Hustedt 1957

Diagnosis: Valves are clavate, linear-lanceolate with inflated central part of the valve and a large subcapitate, truncate, rounded headpole. Valve margins tapering strongly towards a narrowly rounded footpole. Axial area is narrow and linear. Central area is slightly irregular, elliptic to transversally expanded, limited by irregular shortening median striae of different lengths. One stigma is present near the shortened stria in the central area. Raphe is lateral, undulate; the proximal raphe endings are dilated into distinct central pores and curved toward the stigma side; the distal raphe endings are hook-shaped, curved onto the valve mantle oppositely to the stigma side. Transapical striae are distinctly radiate from the valve centre to the footpole, becoming almost parallel or slightly radiate towards the headpole, about 10-12 in 10 μm. Length of the valve 29-56 μm, and the breadth 9-12 μm.

Ecological preference: Alkaliphilous, epiphytic (Kaczmarska 1976); it is generally distributed in alkaline waters, oligo- to β-mesosaprobic flowing and stagnant waters, inhabits waters with a wide spectrum of trophic (Bąk et al. 2012); the species was reported from alkaline shallow-water with pH 7.5-9.3, low conductivity and water temperature 18.2-25°C (Kulikovskiy et al. 2015); oligotrophic, alkaline freshwater reaction (pH 7.6-8.1) and low to relatively high conductivity content (Noga et al. 2016a).

Occurrence: Common in Młynek and Radomno Lakes, frequent in Jeziorak Lake, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Duszatyńskie Lakes, Western Bieszczady Mts., and Rzeszów, Przyrwa stream, Województwo Podkarpackie, southeast Poland (Noga et al. 2013c; 2016a).

***Gomphonema clavatulum* Reichardt 1999**

(Pl. 128, figs. 11-15)

Ref. Reichardt 1999, p. 25, pl. 25, figs. 1-23, 27-28; pl. 26, fig. 23; Bąk et al. 2012, p. 169, pl. 64; Hofmann et al. 2013, p. 97, pl. 300, figs. 7-9; Kulikovskiy et al. 2016, p. 209, pl. 128, fig. 5; Vidaković et al. 2018, p. 266, fig. 2: 4; Solak et al. 2021, p. 207, pl. 2, fig. 22.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate with broadly rounded headpole and narrow, acutely rounded footpole. Axial area is moderately narrow, linear, and widened slightly from the ends toward the centre. Central area is small, irregular in shape, and formed by a shortened central stria. Stigma is present on one side of the central area. Raphe is narrow, lateral, with slightly undulated raphe fissures. Proximal raphe endings are dilated into central pores that are deflected toward the stigma side; the distal raphe endings bend onto the valve mantle oppositely to the stigma. Transapical striae are weakly radiate throughout the valve to nearly parallel at the ends, about 10-12 in 10 μm. Length of the valve 18-40 μm, and the breadth 5-7 μm.

Ecological preference: The species was observed frequently in freshwater habitats of low conductivity and alkalinity, with pH values 7.2-7.5. It is considered to be an oligohalobous, alkaliphilous, oligosaprobic form; it often inhabits eutrophic waters with medium to elevated electrolyte content (Bąk et al. 2012); reported from the benthic habitats of alkaline, mesotrophic to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013c).

***Gomphonema contraturris* Lange-Bertalot & Reichardt 1993**

(Pl. 128, fig. 6)

Ref. Lange-Bertalot 1993, p. 57, pl. 78, figs. 2-9; pl. 79, figs. 1-5; Vouilloud et al. 2010, p. 57, figs. 42-45; Kihara et al. 2015, p. 25, fig. 91; Medeiros et al. 2018, p. 11, figs. 28-30; Martinez-Goss et al. 2023, p. 1662, fig. 16.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate-lanceolate, with cuneate-apiculate headpole and narrow, attenuate, acutely rounded footpole. The margin towards the head pole is angular. Axial area is relatively broad, linear and narrowing at the ends. Central area is unilaterally expanded, limited by the shortening of a median stria. Raphe sinuous and slightly lateral, the proximal endings are dilated into small central pores, which are curved toward the stigma side; the distal raphe endings are in a hook shape, curved toward the opposite side of the stigma. One Stigma is located at the end of a median elongated stria. Transapical striae are punctate, parallel to slightly radiate, and more spaced at the mid-valve, slightly radiate towards the headpole, and strongly radiate at the footpole, about 8-10 striae in 10 µm. Areolae conspicuous, about 16-20 in 10 µm. Length of the valve 75-87 µm, and the breadth 11-14 µm.

Ecological preference: Reported from slightly alkaline freshwater with pH 7.0-7.97, and low conductivity 167.13-294.00 (Martinez-Goss et al. 2023)

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema contraturris* var. *pideki* Zalat nov. var.**

(Pl. 128, figs. 7-10)

Diagnosis: Valves are heteropolar, linear-lanceolate with nearly straight to weakly arched margins. The headpole is cuneate, subprotacted to subapiculate, acutely rounded, and slightly narrower than the central part of the valve, and the footpole is acutely rounded. Axial area is narrow and linear. Central area is indistinct or small, bordered by one shortened striae on each side. Non-stigmata are present. Raphe is lateral; the proximal raphe endings are dilated with small central pores. The distal raphe endings are curved onto the mantle. Transapical striae are coarsely punctate and widely spaced, radiate throughout the valve, about 7-8 in 10 µm. Length of the valve 54-57 µm, and the breadth 8-10µm.

Remarks: This new variety differs from the nominate species by having a cuneate subpiculate headpole, nearly straight to weakly arched margins and coarsely punctate, widely spaced striae.

Etymology. The epithet of the new variety refers to Prof. Irena A. Pidek.

Holotype: the specimens illustrated in plate 128, figures 7-10.

Type locality: Eemian paleolake deposits of central Poland.

Occurrence: Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema coronatum* Ehrenberg 1840**

(Pl. 128, figs. 1-5)

Ref. Hustedt 1930, p. 370, fig. 684; Germain 1981, p. 301, pl. 110, fig. 1; Reichardt 1999. p. 43, pl. 49, figs. 1-5, 7-11; pl. 50, figs. 1-8; pl. 51, figs. 1-8; Thomas et al. 2009, p. 204, figs. 9-12; Bąk et al. 2012, p. 170, pl. 63; Kihara et al. 2015, p.25, fig. 92.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* var. *coronatum* (Ehrenberg) Rabenhorst 1864
Gomphonema acuminatum f. *coronatum* (Ehrenberg) Cleve 1894

Diagnosis: Valves are acuminate-apiculate, linear with strongly undulate margins, the broadest portion of the valve is near the headpole and/or the central portion of the valve. The headpole is acute to blunt protracted, while the footpole is narrowly rounded. Axial area is straight, relatively narrow, broadening slightly at the valve centre. Central area is irregular in shape, transverse, somewhat unilateral, and formed by a shortened central stria. An isolated stigma is present close to the central stria. Raphe is lateral and undulate; the proximal raphe

endings are slightly expanded into central pores that deflect toward the stigma side; the distal raphe endings are curved onto the valve mantle. Transapical striae are punctate, radiate throughout the mid-valve, becoming parallel toward the poles, returning to radiate at the headpole and strongly radiate towards the footpole, about 8-10 striae in 10 µm. Puncta about 15-21 in 10 µm. Length of the valve 40-110 µm, and the breadth 8-12 µm.

Ecological preference: Alkaliphilous, epiphytic (Kaczmarska 1976); a species characteristic of electrolyte-poor, oligotrophic waters and often weakly acidic water containing calcium (Bąk et al. 2012); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in the Eemian paleolake deposits of central Poland; frequent in Młynek and Radomno lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Gomphonema cuneolus* Reichard 1997**

Ref. Reichardt 1997, p. 123, pl. 11, figs. 1-18; Noga et al. 2018, p. 30, figs. 2A-Y, 4A-F; Martinez-Goss et al. 2023, p. 1666, figs. 41-42.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, narrowly lanceolate to elliptic-lanceolate and cuneate. The headpole is bluntly round to cuneate, and the footpole is gradually narrowing into a cuneate or attenuated rounded end. Axial area is relatively narrow and linear. Central area is transverse, rectangular, and expanded on the opposite side of the stigma. Raphe is straight, filiform; the proximal raphe endings are dilated with small central pores; the distal raphe endings are deflected onto the mantle in the same direction. An isolated, rounded stigma is present close to the central pores. Transapical striae are slightly radiate to parallel, strongly radiate at the footpole, about 10-12 in 10 µm in the mid-valve, up to 16 at the apices. Length of the valve 13-25 µm, and the breadth 3-4.5 µm.

Ecological preference: the species seems to prefer calcium-rich waters, alkaline or close-to-neutral waters with low or medium electrolytic conductivity (78-530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018); it was observed in a habitat with pH value of 6.75, dissolved oxygen 5.79 $mg \cdot L^{-1}$, conductivity 68.27 $\mu S \cdot cm^{-1}$, and TDS 46.80 (ppm) (Martinez-Goss et al. 2023).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Wisłoka River and its tributaries: Kłopotnica, Swierzówka, Rzeszówka, Krempna, Zimna Woda and Baranie. In the Swierzówka, Wołosaty stream and the Terebowiec tributary, San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al. 2018)

***Gomphonema cymbelliclinum* Reichardt & Lange-Bertalot 1999**

(Pl. 129, figs. 1-4)

Ref. Reichardt 1999, p. 36, pl. 39, figs. 11-14, 24-26; pl. 40, figs. 1-33; pl. 41, figs. 10-17; Li et al. 2007, p. 236, fig. 164; Bąk et al. 2012, p.171, pl. 67; Vidaković et al. 2018, p. 266, fig.2:7; fig.5:1.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate and narrow elliptical-lanceolate, with subcapitate to rostrate head- and footpoles; somewhat the valve poles are curved in the same direction and opposite the stigma side. Axial area is linear and narrow, extending toward the valve centre. Central area is unilaterally rectangular, formed by shortening one stria at one side and a slightly shortened stria at the opposite side. An isolated stigma is present at the central nodule. Raphe is straight, filiform. Proximal raphe endings are slightly expanded with small central pores. Transapical striae are radiate throughout the valve, more spaced at the mid-valve, about 9-12 in 10 µm at the valve centre, up to 15-16 in 10 µm at the ends. Length of the valve 24-35 µm, and the breadth 6-7.5 µm.

Ecological preference: Freshwater with pH 6.0-6.5, air temperature 19-23°C, water temperature 11-13°C (Li et al. 2007); probably a cosmopolitan form; alkaline and calciphilous species, sensitive to stronger organic pollutants (Bąk et al. 2012); reported from freshwater rivers and streams of an alkaline or close to circumneutral reaction (pH 6.5-8.4), low to medium electrolytic conductivity ranged from 100 µS/cm to 700 µS/cm, temperature 3.0-17.5 (Noga et al. 2013 b; 2014 a; Peszek et al. 2015); reported from the benthic habitat of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream, left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b); Baryczka, Mleczka and Żołynianka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015).

***Gomphonema dichotomum* Kützing 1834**

(Pl. 129, figs. 5-6)

Ref. Hustedt 1930, p. 375; Tuji 2003, p. 100, pl. 4, figs. 8-15; Reichardt 2018, p.150, pl.320, fig. 23.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema intricatum* var. *dichotomum* (Kützing) Grunow 1880
Gomphonema gracile var. *dichotomum* (Kützing) Grunow 1880

Diagnosis: Valves are extremely variable in shape, ranging from linear-clavate, lanceolate-elliptical to linear-elliptical, with bluntly rounded to broadly subcapitate headpole and narrowly rounded footpole. Valve with a marked swelling in the central region. Axial area is moderately narrow, widening towards the valve centre. Central area is widely transverse, with an extremely shortened median stria on one or both sides. An isolated stigma is located adjacent to the central nodule. Raphe is filiform, straight to undulate; proximal raphe endings are dilated into small pores; distal raphe endings are deflected to one side at the apices. Transapical striae are punctate, weakly radiate throughout the valve, generally more widely spaced in the central region, about 14-18 in 10 μm. Length of the valve 17-25 μm, and the breadth 3.5-5 μm.

Ecological preference: alkaliphilous, epiphytic (Kaczmarska 1976); fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, meso- to eutraphentic (Van Dam et al. 1994).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011).

***Gomphonema difformum* Karthick & Kociolek 2011**

(Pl. 129, figs. 7-9)

Ref. Karthick et al. 2011, p. 223, figs. 20-40

Status of name: accepted taxonomically.

Synonym: *Indiconema difforme* (Karthick & Kociolek) Karthick & Kociolek 2023

Diagnosis: Valves are linear-clavate to linear-lanceolate with attenuated, broadly rounded to quadrate headpole, narrow, acutely rounded footpole. Axial area is narrow at the ends, expanded towards the valve centre. Central area is distinct, a linear-elliptical. An isolated stigma is located in the central nodule, close to the proximal raphe ends. Raphe is lateral, weakly undulate. External proximal raphe endings are tear-dropped shaped, distinctly dilated; distal raphe endings are deflected onto the valve mantle. Transapical striae appear costate, parallel to weakly radiate, about 12-14 in 10 μm. A bilobed unornamented area is present at the headpole. Septa and pseudosepta are present at both poles. The apical pore field is distinct at the footpole. Length of the valve 19-32 μm, and the breadth 4-6 μm.

Ecological preference: The species occurred in a stream with neutral pH (7.16 ± 0.27), poor nutrients (Phosphate: 0.04 ± 0.02 mgl^{-1}; Nitrates: 0.29 ± 0.37 mgl^{-1}) and conductivity between 79.71 ± 11.12 μScm^{-1} (Karthick & Kociolek 2011).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema diminutum* Karthick & Kociolek 2011**

(Pl. 129, figs. 10-11)

Ref. Karthick et al. 2011, p. 227, fig. 41-51.

Status of name: accepted taxonomically.

Diagnosis: Valves are narrowly linear-clavate to linear lanceolate with not protracted acutely rounded head and foot poles. Axial area is moderate, linear-lanceolate, narrow at the ends, gradually widening towards the valve centre. Central area is indistinct from the axial area. Raphe is lateral, slightly undulate. External proximal raphe endings are expanded, dilated with distinct, rounded central pores. An isolated round stigma is present in the central nodule close to the central pores. Transapical striae are slightly radiate throughout the valve, parallel near the headpole, about 16-17 in 10 μm. Apical pore field evident, bilobed. Septa and pseudosepta are present at the poles. Length of the valve 21-27 μm, and the breadth 3-4 μm.

Ecological preference: This species occurred in a stream with circumneutral freshwater pH (7.08 ± 0.17), poor nutrients (Phosphate: 0.04 ± 0.02 mgl^{-1}; Nitrates: 0.29 ± 0.37 mgl^{-1}) and conductivity between 89.86 ± 26.18 μScm^{-1} (Karthick et al. 2011); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema distinctistriatum* Kociolek, Woodward & Graeff 2016**

(Pl. 129, figs. 12-16)

Ref. Kociolek et al. 2016, p. 153, fig. 47-62.

Status of name: accepted taxonomically.

Diagnosis: Valve is clavate-lanceolate, linear-lanceolate, weakly constricted immediately below the rostrate, slightly protracted headpole. The footpole is narrow and acutely rounded. Axial area is moderately narrow and straight, weakly expanded at the valve centre. Central area is undistinguished from the axial area. Raphe is very weakly undulate and slightly expanded laterally; the proximal raphe endings are dilated with small central pores; the distal raphe endings deflect away from the stigma side and terminate at slightly offset helictoglossae at the poles. An isolated stigma is present in the central nodule, at the end of the central stria, rounded externally, slit-like internally. Transapical striae are parallel to slightly radiate from the centre to headpole, radiate to strongly radiate from the centre to footpole, about 10-11 in 10 μm at the centre, 11-12 in 10 μm at the footpole. Length of the valve 24-26 μm, and the breadth 6-7 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema drutelingense* Reichardt 1999**

Ref. Reichardt 1999, p. 38, pl. 39, figs. 21-23; pl. 42, figs. 1-18; Noga et al. 2018, p. 32, figs. 2AI-AU, 5A-C; Vidaković et al. 2018, p. 267, pl. 2, fig. 6.

Status of name: accepted taxonomically.

Diagnosis: Valve is gomphonemoid clavate, almost rhombic-lanceolate, linear-lanceolate or naviculoid shape with indistinct protracted, cuneate, rounded headpole and narrowly rounded footpole. Axial area is narrow and straight. Central area is unilateral, quadratic, and formed by absent striae on one side of the valve. An isolated stigma is present on the other side of the central area. Raphe is filiform, straight; the proximal raphe endings with pronounced, not dilated central pores; the distal raphe endings are deflected onto the valve mantle. Transapical striae are radiate throughout the valve, more spaced, strongly radiate at the ends, about 8-12 in 10 μm. Length of the valve 20-41 μm, and the breadth 6.5-8.5 μm.

Ecological preference: The species is usually found among mosses, and less often on stones and mud, it was described from calcium-rich puddles (Reichardt 1999); observed in eutrophic to hyper-eutrophic conditions (Levkov et al. 2016); freshwater stream of alkaline, or close-to-neutral waters (pH 6.4-8.4), with low or medium electrolytic conductivity (78-530 $\mu S\ cm^{-1}$), highly saturated in oxygen, calcium-rich waters with calcium content ranged from 32.41 to 40.30 mg/l^{-1}, low nutrient content and low temperature 5.6-9.3°C (Noga et al. 2016 b; Noga et al. 2018);

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: The Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); found in the Wołosaty, the Wisłoka rivers and the Kłopotnica streams and in the San River; Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a; 2018); Rzeczyca stream and its tributaries, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema elegantissimum* Reichardt & Lange-Bertalot 2011**

Ref. Reichardt 1997, p. 103, pl. 1, figs. 1-6; pl. 2, figs. 1-29; pl. 4, figs. 20-23; Noga et al. 2013 a, p. 137, fig. 2: 23; Levkov et al. 2016, p. 48, pl. 153, figs. 28-55; Solak et al. 2021, p. 207, pl. 2, figs. 23-24.

Status of name: accepted taxonomically.

Synonym: *Gomphonema pumilum* var. *elegans* Reichardt & Lange-Bertalot 1997

Diagnosis: Valves are clavate to narrowly linear lanceolate, with bluntly round headpole and narrowly rounded footpole. Axial area is moderate, relatively lanceolate, narrow at the ends, gradually broadening towards the valve centre. Central area is indistinct from the axial area, sometimes transversely expanded, rectangular or unilateral, with shortened striae on the other side. Raphe is lateral and undulate. External proximal raphe endings are dilated with small central pores; the external distal raphe endings are deflected onto the mantle in the same direction. An isolated, rounded stigma is present in the central nodule. Transapical striae are radiate throughout the valve to subparallel at the headpole, strongly radiate at the footpole, about 11-12 in 10 μm at the valve centre, and 13-15 in 10 μm near the ends. Length of the valve 22-30 μm, and the breadth 4-5 μm.

Ecological preference: Freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μS cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013a; 2014a); reported from the benthic habitat of alkaline, eutrophic freshwater environment.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Matysówka stream, a right-bank tributary of Strug River, district of Tyczyn and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013a, c; 2014a).

***Gomphonema elongatum* W. Smith 1855**

(Pl. 129, figs. 17-23)

Ref. Kaczmarska 1977, p. 53, pl. 26, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* var. *elongatum* (W.Smith) Carruthers 1864

Gomphonema acuminatum f. *elongatum* (W.Smith) Rabenhorst 1864

Diagnosis: Valves are acuminate-apiculate, with protracted, blunt and slightly expanded headpole and protracted, narrowly rounded footpole. The central portion of the valve is tumid. The axial area is straight and wider at the apices than at the valve centre. The central area is transversely widened, formed by two shortened central striae (one on each side). A single isolated stigma is present in the central area. Transapical striae are punctate, radiate and widely spaced about the centre, becoming parallel towards the ends, then becoming radiate at the headpole and footpole, about 10-12 in 10 μm. Length of the valve 74-80 μm, and the breadth 7-11 μm.

Ecological preference: Shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema exilissimum* (Grunow) Lange-Bertalot & Reichardt 1996**

(Pl. 130, figs. 1-3)

Ref. CleveEuler 1955, p. 178, fig. 1269 df; Lange-Bertalot & Metzeltin 1996, p. 70, pl. 62, figs. 23-27; Levkov et al. 2016, p. 49, pl. 127, figs. 1-33; Bahls et al. 2018, p. 45, pl. 8, fig. 9; p. 68, pl. 31, fig. 15; p. 161, pl. 124, fig. 17; Medeiros et al. 2018, p. 11, figs. 31-33; 100-107; Solak et al. 2021, p. 207, pl. 3, figs. 25-26.

Status of name: accepted taxonomically.

Synonym: *Gomphonema parvulum* var. *exilissimum* Grunow 1880

Diagnosis: Valves are clavate, linear lanceolate, elliptic-lanceolate, with broadly convex margins, subrostrate to subcapitate, acutely rounded apices, which are sometimes slightly deflected. Axial area is linear, narrow, extending toward the valve centre. Central area is small, rounded or transversely slightly expanded, formed by shortening striae at the valve centre. An isolated stigma is present close to the central nodule. Raphe is filamentous and slightly lateral. Proximal raphe endings are externally with rounded central pores, which are not, or only very slightly, deflected, and internally curved in a sickle shape. Distal raphe endings are deflected onto the mantle; internally terminate in prominent helictoglossa. Transapical striae are uniseriate, parallel to slightly radiate, widely spaced at the central area, about 12-13 in 10 µm in the mid-valve, 15-16 in 10 µm at the ends. Length of the valve 23-38 µm, and the breadth 5-7.5 µm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); freshwater with pH had an alkaline character or circumneutral (pH 6.5-8.4), electrolytic conductivity ranged from 100 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b; 2014 a); Dystrophic and oligotrophic waters, poor in electrolytes and rich in calcium and silicon, silicate waters (Szczepocka & Rakowska 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); distributed in freshwater habitats, benthic species, in electrolyte-poor, weakly acidic, nutrient-poor (Lange-Bertalot et al. 2017).

Occurrence: Frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Czarna Staszowska River near the Smyków village in south-east Poland (Szczepocka & Rakowska 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al., 2016a, b).

***Gomphonema extentum* Reichardt & Lange-Bertalot 1994**

Ref. Reichardt 1994, p. 128, pl. 1, figs. 16-21; pl. 5, figs. 5-8; Reichardt 1999, p. 40, pl. 44, figs. 14-23; Hofmann et al. 2013, p. 97, pl. 306, figs. 21- 22; Kheiri et al. 2018, p. 362, figs. 137-138; Vidaković et al. 2018, p. 267, fig. 2: 3.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-lanceolate to elliptic-lanceolate, with subcapitate to rostrate, obtusely rounded head- and footpoles. Axial area is linear and narrow, extending toward the valve centre. Central area is unilateral, transverse, formed by shortening stria on one side and a slightly shortened stria at the opposite side. An isolated stigma is present close to the central nodule. Raphe is filamentous, straight; the proximal raphe endings are straight, terminating with not deflected small central pores; the distal raphe endings are curved at the ends and bisect the apical pore field. Transapical striae are radiate throughout the valve, about 11-12 in 10 µm. Length of the valve 31-40 µm, and the breadth 6-8 µm.

Ecological preference: The species is reported from oligotrophic, moderately alkaline water (pH range 7.4-8), poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Distribution in Poland: Czarna Staszowska River near the Drogowle village in south-east Poland (Szczepocka & Rakowska 2015)

***Gomphonema gautieri* (Van Heurck) Lange-Bertalot & Metzeltin 2009**

Ref. Hustedt 1930, p. 372, fig. 689; Lange-Bertalot & Metzeltin 2009, p. 51, pl. 164, figs. 1-9; Van De Vijver et al. 2013, p. 106, figs. 1-5; 12-26; Kihara et al. 2015, p.25, fig. 96.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema augur* var. *gautieri* Van Heurck 1885

Gomphonema constrictum var. *gautieri* (Van Heurck) Cholnoky 1957

Diagnosis: Valves are heteropolar, clavate, with the largest valve width near the headpole, and very weakly constricted between the headpole and the mid-valve. The headpole is broadly rounded, apiculate, and truncate. The footpole is narrowing, acutely rounded. Axial area is narrow, linear-lanceolate. Central area is small, formed by several shortened striae. One isolated stigma is present at the end of a long, isolated stria. Raphe is lateral, slightly undulating; the proximal raphe endings are simple and slightly expanded central pores; the distal raphe endings are externally deflected onto the mantle, and internally terminated at the helictoglossa. Transapical striae are coarsely areolate, parallel in mid-valve, about 9-12 in 10 µm, becoming radiate and denser towards headpole and footpole, about 12-15 in 10 µm. Areolae are about 18-22 in 10 µm. Length of the valve 25-55 µm, and the breadth 13-15µm at the headpole, and 12-13.5 at the mid-valve.

Ecological preference: Alkaliphilous, epiphytic (Kaczmarska 1976); reported from shallow, macrophyte-dominated pond, alkaline water with pH 7.6-8.4, relatively high conductivity 769-788 ($\mu S \cdot cm^{-1}$), high dissolved oxygen (Celewicz-Gołdyn & Kuczyńska-Kippen 2008); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008).

***Gomphonema gautieriforme* Mitic-Kopanja, Wetzel, Ector & Levkov 2014**

(Pl. 130, figs. 4-8)

Ref. Mitic-Kopanja et al. 2014, p. 157, figs. 54-76.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate with broad wedge-shaped, nearly flat margins, broadening towards the headpole and then becoming apiculate at the apex. The footpole is narrow, elongated and acutely rounded. Axial area is slightly narrow and straight. Central area is absent. Raphe is slightly lateral; the proximal raphe endings are slightly expanded with central pores; the distal raphe endings are deflected onto the mantle. Transapical striae are punctate, radiate throughout the valve, curved at the headpole, and strongly radiate at the footpole, about 1011 in 10 µm at the valve centre, 12-13 in 10 µm towards the footpole. Length of the valve 38-41 µm, and the breadth 12 µm at the valve centre to 14 µm at the headpole.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: New record.

***Gomphonema gracile* Ehrenberg 1838**

(Pl. 130, figs. 9-10)

Ref. Hustedt 1930, p. 376, fig. 702; Patrick & Reimer 1975, p. 131, pl. 17, figs. 1-3; Foged 1978, p. 69, pl. 39, fig. 7; pl. 40, figs. 21, 22, 24; pl. 41, fig. 8; Germain 1981, p. 310, pl. 115, figs. 1-14; pl.168, fig. 12; Gasse 1986, p. 64, pl. 29, figs. 5, 6, 9-13; Krammer & Lange-Bertalot 1986, p. 361, pl. 154, figs. 26, 27; pl. 156, figs. 1-11; Krammer & Lange-Bertalot 1991 b, p. 406, pl. 79, figs. 1-7; Ehrlich 1995, p. 111, pl. 32, figs. 1-3; Reichardt 2015, p. 369, figs. 1-6; Kulikovskiy et al. 2016, p. 209, pl. 128, figs. 1-3; Bahls et al. 2018, p. 68, pl. 31, fig. 19; p. 132, pl. 95, fig, 22; p. 161, pl. 124, fig. 15.

Status of name: accepted taxonomically.

Diagnosis: Valves are weakly to distinctly asymmetric to the apical axis; linearlanceolate to rhombic-lanceolate and narrow gradually from the centre toward the ends to form acutely rounded apices. Axial area is narrow and linear. Central area is small, rounded and sometimes lateral, formed by shortened central striae on one side, somewhat expanded to both margins, and each side contains a single, isolated stria. An isolated stigma is present in the central area. Raphe is slightly lateral, broad, and narrows toward the proximal ends. Transapical striae are slightly radiate, lineate, about 10-11 in 10 µm at the valve centre to 1214 in 10 µm near the ends, strongly radiate at the footpole, about 14-17 in 10 µm. Length of the valve 23-64 µm, and the breadth 6-9 µm.

Ecological preference: It is particularly abundant in the tropics, it prefers stagnant waters and epiphytic habitats (Hustedt 1930, 1957); its pH optimum is probably between 7.2 and 7.4 (Cholnoky 1968); oligohalobous, indifferent to small amounts of salts, and prefers water of low nutrient content (Patrick & Reimer 1975); oligohalobous "indifferent", alkaliphilous (Foged 1980); brackish water, oligosaprobic to β-mesosaprobic, typical of environments with low conductivity and nutrients (Krammer & Lange-Bertalot 1986); fresh-brackish water, circumneutral, high oxygen requirements, oligosaprobic, mesotraphentic (Van Dam et al. 1994); it occurred in slightly alkaline pH (7.3-8.2), fresh and slightly brackish water and eutrophic conditions (Zalat & Servant-Vildary 2005); Circumneutral mainly occurring at pH about 7 (Szulc & Szulc 2012); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); water alkaline (pH 7.8-9.4) (Rybak et al. 2019).

Occurrence: Frequent in Jeziorak, Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn (Noga et al. 2013 a); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Morwawa, Pielnica, Stobnica, Mleczka, Ryjak, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); outflow of drainage water in urban areas, Stalowa Wola City, south-east Poland (Rybak et al. 2019); Rzeczyca stream and its tributaries, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema gregarium* Kociolek, Woodward & Graeff 2016**

(Pl. 130, figs. 11-16)

Ref. Kociolek et al. 2016, p. 156, figs. 63-74.

Status of name: accepted taxonomically.

Diagnosis: Valve is clavate-angular, linear lanceolate, weakly asymmetrical to the apical axis from centre to footpole, with acutely to bluntly rounded head- and footpoles. Axial area is relatively narrow and straight. Central area is unilateral, extended opposite the stigma side with a shortened one stria. Raphe is undulated and laterally expanded; the proximal raphe endings are dilated with small central pores; the distal raphe endings extend onto the mantle at the poles and are deflected away from the stigma side. Transapical striae are distinctly punctate, weakly radiate to radiate throughout the valve, about 10-11 in 10 μm in the centre, 12-14 in 10 μm at the footpole. Length of the valve 40-70 μm, and the breadth 9-11 μm.

Remarks: This species can be compared with *Gomphonema gracile, G. augur, G. pseudoaugur*, since these taxa have a similar valve outline.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema grunowii* Patrick & Reimer 1975**

Ref. Hustedt 1930, p. 376, fig. 700; Patrick & Reimer 1975, p. 131, pl. 17, fig. 6; Azevedo et al. 2018, p. 769, figs. 2e, f.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema lanceolatum* Ehrenberg 1843
Gomphonema lanceolatum Kützing 1844
Gomphonema gracile var. *lanceolatum* (Kützing) Cleve 1894

Diagnosis: Valve is clavate-lanceolate to distinctly lanceolate, with a broad, bluntly rounded headpole and long, tapered, acutely pointed footpole. Axial area is moderately narrow and linear. Central area is small, transverse, usually unilateral. An isolated stigma is present at the end of the median stria. Raphe is filiform, slightly arcuate to undulate. Transapical striae are finely punctate, almost parallel and more widely spaced in the central part to weakly radiate throughout the rest of the valve, about 12-14 in 10 µm. Length of the valve 35-58 µm, and the breadth 5-9 µm.

Ecological preference: pH-indifferent, epiphytic (Kaczmarska 1976); It is reported in several literatures as *Gomphonema lanceolatum* Ehrenberg, and observed in alkaline, highly polluted waters (Venkatachalapathy & Karthikeyan 2013).

Occurrence: Infrequent in Radomno Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema hebridense* Gregory 1854**

Ref. Krammer & Lange-Bertalot 1986, p. 362, pl. 156, figs. 12-14; Krammer & Lange-Bertalot 1991 b, p. 406, pl. 79, figs. 13-17; Reichardt 1994, p. 120, pl. 1, figs. 5-8; Lange-Bertalot & Metzeltin 1996, p. 246, pl. 64, figs. 18-25; pl. 98, fig. 1; Bąk et al. 2012, p. 172, pl. 67; Kulikovskiy et al. 2016, p. 211, pl. 128, fig. 11; Rivera-Rondón & Catalan 2017, pl. 115, figs. 26-31; pl. 116, figs. 1-4; Bahls et al. 2018, p. 45, pl. 8, figs. 6, 7.

Status of name: accepted taxonomically.

Synonym: *Gomphonema vibrio* var. *hebridense* (W.Gregory) Rabenhorst 1864

Diagnosis: Valve is almost symmetrical to transapical axis, linearlanceolate to slight rhombic-lanceolate, and narrowing gradually from the centre toward the ends to form rostrate, acutely rounded head- and footpoles. Axial area is moderate, linear. Central area is moderate, unilateral, and formed by shortened central striae on one side. An isolated stigma is present in the central nodule, facing the central area. Raphe is strongly lateral, narrowing toward the apices. Proximal raphe endings are curved towards the side of the stigma. Transapical striae are lineate, slightly radiate throughout, somewhat parallel towards the apices, about 1012 in 10 µm. Length of the valve 30-60 µm, and the breadth 4-8 µm.

Ecological preference: The species inhabits electrolyte-poor, often oligotrophic, circumneutral lakes and waters flowing in the mountains, rare in the lowlands, frequent in the limestone mountains (Krammer & Lange-Bertalot 1991 b); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 µSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream, a right-bank tributary of Strug River, district of Tyczyn, and Duszatyńskie Lakes, Western Bieszczady Mts. (Noga et al. 2013a, c); Szuwarka and Jagielnia streams, Podkarpacie province, south Poland (Noga et al. 2014 a; Peszek et al. 2015).

***Gomphonema helveticum* Brun 1895**

Ref. Hustedt 1930, p. 373, fig. 712; Krammer & Lange-Bertalot 1986, p. 373, pl. 162, figs. 14-18; Krammer & Lange-Bertalot 1991 b, p. 420, pl. 86, figs. 17-19; Lange-Bertalot & Metzeltin 1996, p. 314, pl. 98, fig. 29.

Status of name: accepted taxonomically.

Diagnosis: Valve is elliptical or rhombic-lanceolate, almost naviculoid form with capitate, obtusely rounded headpole, and narrow acutely rounded footpole. Axial area is narrow at the ends, widening gradually towards the valve centre to form a lanceolate area. Central area is moderate, elliptic to rhombic in shape, somewhat unilateral due to shortened central striae on one side. Raphe is narrow, slightly eccentric, lateral; the proximal raphe endings with slightly deflected small central pores; the distal raphe endings are curved onto the valve mantle. Transapical striae are radiate throughout the valve, about 13-15 in 10 µm. Length of the valve 32-45, and the breadth 5-8 µm.

Ecological preference: Freshwater of alkaline nature with pH 8.0, air temperature 20°C, water temperature 16°C (Li et al. 2007); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema innocens* Reichardt 1999**

Ref. Reichardt 1999, p. 32, pl. 33, figs. 1-21, 24-29, 32-34; Bąk et al. 2012, p. 172, pl. 67; Lange-Bertalot et al. 2017, p.307, pl.99, figs. 51-55; Noga et al. 2018, p. 32, figs 2Z-AH, 4G-L.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, elliptical-lanceolate to nearly oval in small forms, with a bluntly rounded headpole, subprotracted, narrow, acutely rounded footpole. Axial area is very narrow, linear, and sometimes indistinct. Central area is small, transversally expanded, formed by a shortened one, and somewhat two central striae. An isolated stigma is present in the central area. Raphe is filiform, nearly straight; the proximal raphe endings terminate with indistinct central pores that are weakly deflected towards the stigma side. Transapical striae are slightly radiate throughout the valve to nearly parallel at the ends, about 1416 in 10 µm. Length of the valve 16-28 µm, and the breadth 5-7 µm.

Ecological preference: The species was observed in freshwater habitats of low conductivity and low to medium alkalinity, in unpolluted to weakly polluted waters and also in slightly brackish water. It is considered to be oligohalobous "indifferent", alkaliphilous. It was observed in standing waters (fish ponds or backwaters), medium rich in electrolytes, and meso- to eutrophic (Reichardt 1999; Hofmann et al. 2011; Bąk et al. 2012); the species was reported from small oligotrophic ponds located on calcareous bedrock (Levkov et al. 2016); it occur mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78–530 µS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Reported from springs in central Poland (Zelazna-Wieczorek 2011); San River, Wisłoka, Wołosaty rivers, and their tributaries, south-east Poland (Noga et al., 2018).

***Gomphonema insigne* Gregory 1856**

(Pl. 131, figs. 1-8)

Ref. Hustedt 1930, p. 376, fig. 701; Andrews 1970, p. 20, pl. 3, figs.1216; Krammer & LangeBertalot 1986, p. 366, pl.161, figs. 4, 5, 7, 8; Krammer & Lange-Bertalot 1991 b, p. 412, pl. 82, figs 1-7; Ehrlich 1995, p. 112, pl. 32, figs. 11-12; Reichardt 1999, p. 9, pl. 1, figs. 1-14; pl. 2, figs. 1-8; Levkov et al. 2016, p. 60, pl. 50, figs. 1-17.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema lanceolatum* var. *insigne* (W.Gregory) Cleve 1894
Gomphonema affine var. *insigne* (W.Gregory) G.W.Andrews 1970
Gomphonema insigne var. *genuinum* Mayer 1928
Gomphonema lanceolatum var. *genuinum* (Mayer) A.Cleve 1932

Diagnosis: Valves are broadlylanceolate to lanceolateclavate, with a bluntly rounded headpole, which is sometimes with a subrostrate, not protracted apex, and narrow, acutely rounded footpole; the median part of the valve is slightly swollen. Axial area is moderately wide, narrow at the ends, broadening slightly towards the valve centre. Central area is relatively large, asymmetrical, and formed by shortening of a single stria on one side of the valve. A single stigma is present on the opposite side from the shortened central striae. Raphe is lateral, undulate; the proximal raphe endings terminate with small central pores, which are deflected slightly toward the stigma; the distal raphe endings are curved onto the valve mantle at the apices. Transapical striae are distinctly punctate, radiate at the valve centre, parallel towards the headpole, and strongly radiate towards the footpole, about 78 in 10 µm. Areolae are about 18-23 in 10 µm. Length of the valve 27-68 µm, and the breadth 8-12 µm.

Ecological preference: Oligohalobous "indifferent", pH circumneutral (Foged 1980); the species was observed in freshwater habitats of low conductivity and low to medium alkalinity with pH values 7.2-8.0, and also in slightly brackish water (Zalat & Servant-Vildary 2005); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017); shallow, benthic habitats of slightly alkaline, mesotrophic to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake, frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Wisłok river and Morawa, Mleczka, Wielopolka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema insigniforme* Reichardt & Lange-Bertalot 1999**

(Pl. 131, figs. 9-14; pl. 132, figs. 1-16)

Ref. Reichardt 1999, p. 10, pl. 3, figs. 1-22; pl. 4, figs. 1-7; Kihara et al. 2015, p. 25, fig. 95; Bahls et al. 2018, p. 82, pl. 45, fig. 29; Martinez-Goss et al. 2023, p. 1664, figs. 23-24.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate to lanceolate with narrow cuneate, bluntly rounded headpole and strongly tapering toward the footpole. Axial area is moderately broad, narrow at the ends, broadening slightly towards the valve centre. Central area is relatively large, unilateral, and formed by shortening of a single stria on one side of the valve. A single stigma is present on the opposite side from the shortened central striae. Raphe is lateral, almost straight; the proximal raphe endings with small central pores, which are deflected toward the stigmata; the distal raphe endings are curved onto the valve mantle at the apices. Transapical striae are punctate, radiate throughout the valve, about 8-9 in 10 µm at the valve centre, up to 12 in 10 µm near the ends. Puncta about 19-25 in 10 µm. Length of the valve 27-55 µm, and the breadth 6.5-8 µm.

Ecological preference: It was observed in slightly alkaline freshwater habitats with average values of pH 7.15, dissolved oxygen 6.68 ($mg \cdot L^{-1}$), conductivity 204.47 ($\mu S \cdot cm^{-1}$), and TDS 141.90 (ppm) (Martinez-Goss et al. 2023); reported from the shallow, benthic habitats of slightly alkaline, mesotrophic to eutrophic freshwater environments.

Occurrence: Common in Jeziorak and Radomno Lakes.

Distribution in Poland: Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011)

***Gomphonema insigniforme* var. *elongatum* Zalat nov. var.**

(Pl. 133, figs. 1-4)

Diagnosis: Valves are linear-lanceolate, subclavate with nearly flat margins that have a slight tumid at the valve centre. The headpole is cuneate, subprotracted and bluntly rounded; the footpole is protracted, not tapering and obtusely rounded. Axial area is narrow and linear. Central area is unilateral, formed by shortening of a single stria on one side of the valve. An isolated, distinct stigma is present on the opposite side from the shortened central striae. Raphe is lateral, almost straight, and filiform at the ends; the proximal raphe endings are dilated with small central pores, which are deflected toward the stigma side; the distal raphe endings are curved onto the valve mantle at the apices. Transapical striae are coarsely punctate, radiate throughout the valve, about 8-9 in 10 µm at the valve centre, up to 12 in 10 µm near the ends. Puncta about 19-25 in 10 µm. Length of the valve 27-55 µm, and the breadth 6.5-8 µm.

Remarks: This variety differs from the nominate species by having a different outline, an elongated valve, markedly swelling the mid-valve, coarse striae and the same broadening towards the head and foot poles.

Etymology. The epithet of the new variety refers to the elongate valve.

Holotype: the specimens illustrated in plate 133, figures 1-4.

Type locality: Radomno Lake.

Ecological preference: Reported from the benthic habitat of a slightly alkaline, mesotrophic freshwater environment.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema intricatum* Kützing 1844**

(Pl. 133, figs. 5-7)

Ref. Hustedt 1930, 375, fig. 697; Patrick & Reimer 1975, p. 134, pl. 18, fig. 1; Foged 1980, p. 644, pl. l0, fig. 18; Germain 1981, p. 304, pl. 113, figs. 1-5; Gasse 1986, p. 65, pl. 29, figs. 18-19; Kociolek & Stoermer 1990, p. 1559, figs. 1-14, 17-25.

Status of name: accepted taxonomically.

Synonym: *Gomphonema vibrio* var. *intricatum* (Kützing) Ross 1986

Diagnosis: Valve is narrow, sublinear to linearlanceolate, with slight swelling in the middle portion; obtusely rounded headpole and narrow, acutely rounded footpole. Axial area is distinct, narrow near the ends and expanding towards the valve centre. Central area is a large transverse formed by shortening of the marginal striae, somewhat unilateral. An isolated stigma is located close to the proximal raphe ends. Raphe is filiform to slightly lateral, straight; proximal raphe endings are dilated into small central pores; distal raphe endings are deflected to one side at the apices. Transapical striae are punctate, short, slightly radiate to parallel, strongly radiate at the footpole, about l0-12 in l0 µm at the valve centre, up to 13 at the footpole, 14-15 in l0 µm at the headpole. Length of the valve 50-58 µm, and the breadth 6.5-7 µm.

Ecological preference: It is usually regarded as being oligohalobous and alkaliphilous (Jørgensen 1948); fresh to slight brackish water, meso- and eutrophic lakes (CleveEuler 1955); its maximum growth was reached in oligotrophic, moderately oxygenated water (Schoeman 1973); alkaliphilous, aerophilous (Kaczmarska 1976); oligohalobous 'indifferent', alkaliphilous (Foged 1980); reported from shallow, macrophyte-dominated pond, alkaline water with pH 7.6-8.4, relatively high conductivity 769-788 ($\mu S \cdot cm^{-1}$), high dissolved oxygen (Celewicz-Gołdyn & Kuczyńska-Kippen 2008).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Dąbrówka water body, in the central part of the Wielkopolska region (Oborniki district), west Poland (Celewicz-Gołdyn & Kuczyńska-Kippen 2008).

***Gomphonema italicum* Kützing 1844**

(Pl. 133, figs. 8-15; pl. 134, figs. 1-7)

Ref. Mayer 1928, p. 92, pl. 1, fig. 8-9; Foged 1964, p. 137, pl. 20, fig. 13; Reichardt 2001, p. 202, pl. 6, figs. 1- 24; pl. 7, figs. 1-6; pl. 14, figs. 7-13; Bąk et al. 2012, p. 173, pl. 65; Kulikovskiy et al. 2016, p. 211, pl. 127, figs. 9-14; Levkov et al. 2016, p. 63, pl. 15, figs. 1-16; Solak et al. 2016, p. 574, fig. 4: 58, 59; Medeiros et al. 2018, p. 13, fig. 43.

Status of name: accepted taxonomically.

Synonyms: *Sphenella italica* (Kützing) Kützing 1849
Gomphonema capitatum var. *italicum* (Kützing) G.Rabenhorst 1864
Gomphonema constrictum var. *italicum* (Kützing) Grunow 1880
Gomphonema constrictum f. *italicum* (Kützing) Mayer 1928
Gomphonema truncatum f. *italica* (Mayer) Woodhead & Tweed 1954
Gomphonema constrictum f. *italica* (Kützing) Foged 1964

Diagnosis: Valves are clavate, linear-lanceolate with a weakly inflated central part of the valve and a large, truncate, broadly rounded head pole, and tapering towards a narrowly acuminate-rounded footpole. Axial area is narrow and straight. Central area is slightly irregular, elliptic to slightly transversally expanded, limited by 2-3 irregular shortening median striae of different lengths. One stigma is located near the valve centre, set apart from shortened striae. Raphe is lateral, slightly sinuous; the proximal raphe endings are dilated into

distinct central pores and bent toward the stigma side; the distal raphe endings are curved onto the valve mantle oppositely to the stigma. Transapical striae are radiate throughout the valve, strongly radiate towards the footpole, about 9-11 in 10 μm. Length of the valve 30-60 μm, and the breadth 11-15 μm.

Remarks: *Gomphonema italicum* differs from other similar taxa in the shape of the headpole, which is not pointed at the apex, and the valves are only very weakly constricted below the headpole.

Ecological preference: Cosmopolitan, occurring in mesotrophic waters (Krammer & Lange-Bertalot 1986); It is reported from freshwater streams with pH near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranging from 158 to 369 μS/cm (Peszek et al. 2015); from saline brackish water habitats, pH 6.4-7.99, high conductivity 2930-5170 $\mu S \cdot cm^{-1}$ (Żelazna-Wieczorek et al. 2015); freshwater, alkaline with pH 7.8-9.4 (Rybak et al. 2019); reported from the benthic habitats of alkaline, mesotrophic to eutrophic freshwater environments.

Occurrence: Common in Jeziorak and Młynek Lakes and frequent in Radomno and Kamionka Lakes, and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: In the Wyżyna Krakowsko Wieluńska upland it was found in Jaskinia nad Matką Boską and Jaskinia Mamutowa caves, south Poland (Czerwik-Marcinkowska & Mrozinska 2011); the Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); outflow of drainage water in urban areas, Stalowa Wola City, south-east Poland (Rybak et al. 2019).

***Gomphonema jadwigae* Lange-Bertalot & Reichardt 1996**

(Pl. 134, figs. 8-9)

Ref. Lange-Bertalot & Metzeltin 1996, p. 70, pl. 98, figs. 11-14; Levkov et al. 2016, p. 67, pl. 81, figs. 1-30; Solak et al. 2021, p. 594, pl. 4, fig. 20.

Status of name: accepted taxonomically.

Diagnosis: Valves are heteropolar, clavate-lanceolate with apiculate, cuneate, acutely rounded, subrostrate headpole and sprotracted, acutely rounded footpole. Axial area is narrow and linear. Central area is expanded unilaterally, rectangular, narrow, and limited by a shortening stria. Raphe is slightly lateral; the proximal raphe endings are dilated with small central pores that are weakly deflected towards the isolated stigma; distal raphe endings are deflected to the valve mantle. One isolated stigma is present at a median shortened stria. Transapical striae are punctate, slightly radiate throughout the valve, about 12-13 in 10 μm, equally spaced throughout the entire valve. Length of the valve 34-37 μm, and the breadth 7-8 μm.

Occurrence: Infrequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema khentiiense* Lange-Bertalot, Metzeltin & Nergui 2009**

(Pl. 134, figs. 10-12)

Ref. Metzeltin et al. 2009, p. 51, pl. 166, figs. 1-3, 5-7; Kulikovskiy et al. 2016, p. 211, pl. 127, figs. 5-8.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate, with slightly tumid at the mid-valve. The headpole is large, capitate, and broadly rounded. Valve margins are tapering towards a narrow, acutely rounded footpole. Axial area is narrow and straight. Central area is subrounded to slightly irregular, limited by irregular shortening median striae of different lengths. One stigma is present in the central area. Raphe is lateral, undulate; the proximal raphe endings are dilated into distinct central pores and curved toward the stigma side; the distal raphe endings are hook-shaped, curved onto the valve mantle oppositely to the stigma side. Transapical striae are radiate at the valve centre, strongly radiate towards the footpole, and almost parallel or slightly radiate towards the headpole, about 10-11 in 10 μm. Length of the valve 44-47 μm, and the breadth 7.5-8 μm at the valve centre, and 10.5-12 μm at the headpole.

Ecological preference: Oligotrophic slightly acidic water bodies with low mineralization (Kulikovskiy et al. 2016).

Occurrence: Infrequent in the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema lagenula* Kützing 1844**

Ref. Metzeltin et al. 2005, p. 145, figs. 12-18; Li et al. 2007, p. 237, figs. 175-177; Sala et al. 2008, p. 1171, figs. 25-27; Levkov et al. 2016, p. 102, pl. 71, figs. 39-47; Vidaković et al. 2018, p. 267, fig. 2: 14.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema parvulum* f. *lagenula* (Kützing) O.Müller 1905

Gomphonema parvulum var. *lagenula* (Kützing) Frenguelli 1923

Diagnosis: Valves are heteropolar, ovate to clavate, lanceolate with rounded, subcapitate both headpole and footpole. The footpole is somewhat more protracted than the headpole. Axial area is narrow and straight. Central area is small, transversely rectangular, delimited by the shortening of one median stria. A single stigma is placed at the central nodule at the end of the long central stria. Raphe is straight and filiform; proximal and distal raphe ends are simple; proximal raphe endings are dilated with small central pores, and the distal raphe endings are bent to the same side. Transapical striae are uniseriate, punctate, slightly radiate at the centre and slightly denser, more radiate at the poles, about 9-12 in 10 μm at the centre, 12-15 in 10 μm at the headpole. Puncta are about 30-36 in 10 μm. Length of the valve 21-35 μm, and the breadth 5-7.5 μm.

Remarks: *Gomphonema lagenula* is similar to *G. parvulum*, and many literatures treat *G. lagenula* as a variety of *G. parvulum*. The morphologic feature of capitate to rostrate apices has been considered a distinguishing feature of *G. lagenula* (Abarca et al. 2014), a feature also noted by Patrick & Reimer (1966).

Ecological preference: Freshwater with pH 5.0-7.0, air temperature 24-28°C, water temperature 14-18°C (Li et al. 2007); conductivity: 126-213 μS cm^{-1}; water temperature: 23.2-30.0 ºC; pH 5.5- 8.1; dissolved oxygen: 7.1-7.9 mgl^{-1}. (Sala et al. 2008).

Occurrence: Infrequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema lagerheimii* Cleve 1895**

Ref. Krammer & Lange-Bertalot 1986, p. 361, pl. 155, figs. 22-24; Wojtal 2003, p. 216, fig. 2: 14; Kulikovskiy et al. 2016, p. 211, pl. 127, figs. 17-20; Bahls et al. 2018, p. 103, pl. 66, figs. 4-12; p. 132, pl. 95, figs. 1-7; p. 161, pl. 124, figs. 5-9.

Status of name: accepted taxonomically.

Synonym: *Gomphonema angustatum* var. *lagerheimii* (A.Cleve) Krasske 1938

Diagnosis: Valves are slightly heteropolar, narrow linear to linear-lanceolate, somewhat with a slight swelling in the middle and bluntly rounded subrostrate apices. Axial area is relatively narrow and linear. Central area is unilateral, formed by the shortening of the marginal striae on one side. Raphe is lateral, becoming filiform near the proximal and terminal ends; proximal raphe endings are dilated with small central pores; distal raphe endings are deflected in the same direction. An isolated stigma is located close to the proximal raphe ends. Transapical striae are slightly radiate to subparallel from the valve centre to the headpole, more radiate towards the footpole and more widely spaced in the middle part of the valve, about 8-12 in 10 μm. Length of the valve 30-60 μm, and the breadth 4-8 μm.

Ecological preference: It occurs in oligosaprobic waters with low electrolyte content (Krammer & Lange-Bertalot 1986); prefers freshwater circumneutral, oligosaprobous and oligotrophic waters with continuously high dissolved oxygen level (Van Dam et al. 1994); it is reported in epiphytic communities collected from submerged mosses in unpolluted part of Kobylanka stream (Wojtal 2003); oligotrophic alkaline or weakly acidic water bodies (Kulikovskiy et al. 2016).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Kobylanka stream, 30 km NW of Kraków, Poland (Wojtal 2003).

***Gomphonema lateripunctatum* Reichardt & Lange-Bertalot 1991**

(Pl. 134, figs. 13-28)

Ref. Reichardt & Lange-Bertalot 1991, p. 530, pl. 5, figs. 1-19; pl. 6, figs. 1-3; Bąk et al. 2012, p. 173, pl. 66; Delgado et al. 2013, p. 98, figs. 130-135; p. 99, fig. 150; Levkov et al. 2016, p. 73, pl. 143, figs. 1-31; Bahls et al. 2018, p. 103, pl. 66, figs. 2, 3; p. 132, pl. 95, figs. 13, 14; p. 161, pl. 124, figs. 10-13; Jüttner et al. 2018, p. 308, figs. 187-210; Noga et al. 2018, p. 33, figs. 3A-Q, 5D-L; Solak et al. 2021, p. 210, pl. 3, figs. 34-36.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear to linear-lanceolate, clavate with rounded head and foot poles. Axial area is moderate, slightly widening towards the valve centre. Central area is wide, nearly rectangular, extending to the valve margin or bordered by one, rarely two, very short striae. A single, round stigma is located in the central area, near the proximal raphe ends. Raphe is lateral, straight or weakly undulate; external proximal raphe endings are distinct, dilated; distal raphe endings are deflected before extending onto the valve mantle. Transapical striae are uniseriate, weakly radiate throughout, becoming more radiate towards head and foot poles, about 9-11 in 10 μm in the valve centre, condensed at both the head- and footpoles, about 14-16 in 10 μm. Septa and pseudosepta are distinct. A bilobed apical pore field is evident at the footpole. Length of the valve 20-55 μm, and the breadth 4.07.0 μm.

Ecological preference: Fresh-brackish water, alkaliphilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); it is considered as indicator of very good water quality (Reichardt & Lange-Bertalot 1991; Hofmann et al. 2011); it is often found in peat bogs, streams and lakes, in oligotrophic, circumneutral or slightly acidic habitats (Levkov et al. 2016); it is typically found in oligotrophic montane waters (Jüttner et al. 2018); the species occur mostly in in calcium-rich waters, alkaline or close-to-neutral waters (pH 7.3-8.0), with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018); reported from shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Jeziorak and Radomno Lakes; infrequent in Młynek Lake.

Distribution in Poland: The species was reported from Lake Rosnowskie Duze in the Wielkopolska National Park, west-central Poland (Celewicz-Gołdyn 2006); from springs in central Poland (Zelazna-Wieczorek 2011); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); found in the Wisłoka, the Wilsznia, the Ryjak and the Kłopotnica rivers and in the streams: Swierzówka, Rzeszówka, Zimna Woda and Baranie; it was found in the streams Wołosaty and Terebowiec; occurred most often in the San River, south-east Poland (Noga et al. 2018).

***Gomphonema laticollum* Reichardt 2001**

(Pl. 135, figs. 1-13)

Ref. Reichardt 2001, p. 199, pl. 5, figs. 1-14; Kulikovskiy et al. 2015, p. 258, figs. 167-175, 275-281; Kulikovskiy et al. 2016, p. 212, pl. 126, figs. 1-7; Kulikovskiy et al. 2016, p. 212, pl. 126, figs. 1-7; Levkov et al. 2016, p. 74, pl. 22, figs. 1-15; pl. 23, figs. 1-5; pl. 24, figs. 1-25; pl. 25, figs. 1-8; pl. 26, figs. 13-19; Bahls et al. 2018, p. 68, pl. 31, figs. 21-22; p. 161, pl. 124, fig. 23; Medeiros et al. 2018, p. 15, figs. 47-49; 120-126.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, with a weakly inflated central part of the valve and a large, truncate, broadly rounded headpole, tapering towards a narrowly acuminate-rounded footpole. Axial area is moderately narrow, straight, and slightly broadening at the valve middle. Central area is slightly irregular, transversally expanded, and limited by 2-3 irregular shortening median striae. An isolated stigma is present near the valve centre, set apart from shortened striae. Raphe is lateral, strongly undulate; the proximal raphe endings are dilated with distinct central pores and deflected toward the stigma side; the distal raphe endings are indistinct and curved to the opposite side of the stigma and onto the valve mantle. Transapical striae are uniseriate, punctate, radiate throughout the valve, strongly radiate towards the footpole, about 10-12 in 10 μm, irregularly shortened striae at the mid-valve. Puncta about 20-22 in 10 μm. Length of the valve 38-60 μm, and the breadth 11-13 μm.

Ecological preference: the species was reported from alkaline shallow-water with pH 7.5-9.3, low conductivity and water temperature 18.2-25°C, mesotrophic and eutrophic water bodies (Kulikovskiy et al. 2015, 2016); reported from the shallow benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno, Młynek and Kamionka lakes; Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema laticollum* var *truncata* Zalat & Pidek nov. var.**

(Pl. 135, figs. 14-15)

Diagnosis: Valves are clavate, with weakly inflated mid-valve and large, truncate, flat to broadly rounded headpole; slightly tapering towards a cutely rounded footpole. Axial area is moderately narrow and straight. Central area is subrounded to slightly irregular in shape, limited by 2-3 irregular shortening median striae. An isolated stigma is present near the valve centre. Raphe is lateral, undulate; the proximal raphe endings are slightly dilated with distinct central pores that are deflected toward the stigma side; the distal raphe endings are curved to the same side of the stigma and onto the valve mantle. Transapical striae are punctate, radiate throughout the valve, about 9-11 in 10 μm. Length of the valve 54 μm, and the breadth 12 μm.

Remarks: This variety differs from the nominate species by having a truncate, flat to broadly rounded headpole and the distal raphe endings are curved to the same side of the stigma.

Ecological preference: Reported from the shallow benthic habitats of a slightly alkaline, mesotrophic freshwater environment.

Etymology. The epithet of the new variety refers to the truncate headpole.

Holotype: the specimens illustrated in plate 135, figures 14-15.

Type locality: The Eemian paleolake deposits from the Struga site in central Poland.

Occurrence: Frequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema latipes* Reichardt 2001**

(Pl. 135, figs. 16-18)

Ref. Reichardt 2001, p. 196, pl. 3; figs. 1-13.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear to slightly club-shaped, with equally weak upwellings at the mid-valve and a large, broadly rounded headpole, slightly elongated towards a bluntly rounded footpole. Axial area is moderately wide, straight, and slightly broadening at the valve middle. Central area is slightly irregular, transversally expanded, less than half the width of the valve and limited by 2-3 irregular shortening median striae. An isolated stigma is present near the central area. Raphe is broad, strongly lateral; the proximal raphe endings are dilated with distinct central pores and deflected toward the stigma side; the distal raphe endings are curved to the opposite side of the stigma and onto the valve mantle. Transapical striae are punctate, radiate throughout the valve, subparallel to slightly convergent at the footpole, about 10-11 in 10 μm, irregularly shortened striae at the mid-valve. Length of the valve 67 μm, and the breadth 12.5 μm.

Ecological preference: Benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema lippertii* Reichardt & Lange-Bertalot 1999**

Ref. Reichardt 1999, p. 21, pl. 21, figs. 1-15; Li et al. 2007, p. 238, figs. 182-183; Hofmann et al. 2013, p. 98, pl. 295, figs. 1-5; Noga et al. 2018, p. 36, figs. 3R-AD, 6A-F; Vidaković et al. 2018, p. 267, fig. 2: 2.

Status of name: accepted taxonomically.

Diagnosis: Valves are lanceolate to rhombic-lanceolate, slightly clavate with narrow, acutely rounded, nearly short subcapitate to slightly rostrate headpole and very narrow, produced footpole. Axial area is narrow and linear. Central area is small, unilateral, transverse, rectangular, and formed by shortened central striae on

one side. An isolated stigma is present opposite the central area, at the end of the median stria. Raphe is narrow, lateral, slightly curved to nearly straight; proximal raphe endings are slightly dilated with small central pores. Transapical striae are slightly radiate throughout the valve, subparallel at the ends, fine to indistinct punctate; about 10-12 in 10 μm. Length of the valve 25-45 μm, and the breadth 7-9 μm.

Ecological preference: The species was observed in freshwater and slightly brackish water habitats of low to medium conductivities and alkalinities, pH values 7.2-7.5, in low to moderately polluted waters. It is considered to be oligosaprobic to mesosaprobic, mesotrophic, oligohalobous 'indifferent', alkaliphilous (Reichardt 1999; Hofmann et al. 2011); freshwater with pH 5.0-7.0, air temperature 27-28°C, water temperature 17-18°C (Li et al. 2007); occur mostly in in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/L^{-1}) (Noga et al. 2018).

Occurrence: Infrequent in Młynek and Jeziorak Lakes.

Distribution in Poland: In the Low Beskids, where the species occurred in the Wisłoka, Wilsznia, Kłopotnica, Krempna, Swierzówka and the Baranie. In the Bieszczady National Park, occurred in the Wołosaty, Rzeczyca, and the San River, south-east Poland (Noga et al. 2018); Rzeczyca stream and its tributaries, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema longiceps* Ehrenberg 1854**

(Pl. 136, figs. 1-6)

Ref. Mayer 1928, p. 113, pl. 3, figs. 12-13; Hustedt 1930, p. 375, fig. 704; Hartley et al. 1996, p. 234, pl. 109, fig. 8.

Status of name: requires further investigation.

Synonyms: *Gomphonema acuminatum* var. *mustela* (Ehrenberg) Nylander 1861
Gomphonema longiceps var. *mustela* (Ehrenberg) Grunow 1878
Gomphonema subclavatum var. *mustela* (Ehrenberg) Cleve 1894
Gomphonema montanum var. *mustela* (Ehrenberg) Mayer 1928
Gomphonema acuminatum var. *longiceps* (Ehrenberg) Abarca & Jahn 2020

Diagnosis: Valves are clavate, heteropolar, linear-lanceolate, with relatively narrow acutely rounded footpole and a broadly rounded headpole. Axial area is moderately narrow, linear, and widened slightly from the ends toward the valve centre. Central area is small, rhomboid to subrounded, formed by a shortened central stria. Raphe is lateral; the proximal raphe endings are simple, slightly expanded, but without central pores or similar structures. An isolated stigma is present on one side of the central area. The pore field at the foot pole is separated from the striae and mostly located on the mantle. Transapical striae are slightly radiate in the middle part of the valve, nearly parallel towards the ends, about 9-11 in 10 μm. Puncta 28-31 in 10 μm. Length of the valve 45-90 μm, and the breadth 10-14 μm.

Remarks: This species is accepted as *Gomphonema acuminatum* var. *longiceps* (Ehrenberg) Abarca & Jahn in Abarca et al. 2020, but it differs in several structures, such as valve outline, the shape of headpole, and the raphe structure; valve dimensions, therefore, it should be separated from the group of *Gomphonema acuminatum*.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema longiceps* var. *radomnoensis* Zalat nov. var.**

(Pl. 136, figs. 7-8)

Diagnosis: Valves are clavate, heteropolar, linear-lanceolate, with slight swelling at the valve centre. The headpole is broadly rounded, and the footpole is relatively narrower than the headpole and bluntly rounded. Axial area is moderate and linear. Central area is small or irregularly shaped, formed by a shortened one central stria. An isolated stigma is present in the central area. Raphe is strongly lateral; the proximal raphe

endings are slightly dilated but without central pores or similar structures; the distal raphe endings are curved onto the mantle. Transapical striae are coarsely punctate, widely spaced, radiate along the entire valve, about 6-7 in 10 μm. Puncta 13-15 in 10 μm. Length of the valve 95 μm, and the breadth 14 μm.

Remarks: This new variety differs from the nominate species by the shape of the outline, small central area, distinctly radiate striae along the entire valve, coarsely punctate striae and the number of striae and the puncta per 10 μm.

Ecological preference: Benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Etymology. The epithet of the new variety refers to Radomno Lake.

Holotype: the specimens illustrated in plate 136, figures 7-8.

Type locality: Radomno Lake.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema maclaughlinii* Reichardt 1999**

(Pl. 136, figs. 9-18)

Ref. Reichardt 1999, p. 22, pl. 22, figs. 1-10; Li et al. 2007, p. 239, fig. 185; Reichardt 2015, p. 35, figs. 60-66.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly clavate, linearlanceolate to rhombic-lanceolate with a slight swelling in the mid-valve and narrowing gradually from the centre toward the ends to form an obtusely rounded protracted headpole and a narrowing acutely rounded footpole. Axial area is relatively narrow, linear to narrow lanceolate. Central area is small, unilateral, transversally expanded, and formed by shortened central striae on one side. An isolated stigma is present on the other side of the central area. Raphe is distinctly lateral, narrowing toward the ends; proximal raphe endings are slightly dilated with small central pores; distal raphe endings are deflected onto the mantle and opposite the stigma side. Transapical striae are slightly radiate to parallel at the ends, about 810 in 10 μm at the centre, up to 1214 in 10 μm near the ends. Length of the valve 4065 μm, and the breadth 8 9 μm.

Remarks: This species is relatively similar to *Gomphonema procerum* E.Reichardt & Lange-Bertalot 1991.

Ecological preference: Freshwater, slightly acidic with pH 6.0, air temperature 23°C, water temperature 13°C (Li et al. 2007); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: New record.

***Gomphonema macropunctatum* Krishnamurthy 1954**

(Pl. 137, figs. 1-7)

Ref. Krishnamurthy 1954, p. 373, fig. 59.

Status of name: accepted taxonomically.

Diagnosis: Valve is lanceolate, gradually tapering towards the ends to form a slightly subcapitate to subrostrate, obtusely rounded headpole and narrowing acutely rounded footpole. Axial area is narrow at the ends, slightly expanded towards the valve centre. Central area is small, unilateral, and formed by shortened central striae on one side. An isolated coarse stigma is present on the other side of the central area. Raphe is slightly lateral; proximal raphe endings are slightly dilated with small central pores; distal raphe endings are deflected onto the mantle and opposite the stigma side. Transapical striae are coarsely punctate, radiate throughout the valve, about 1112 in 10 μm. Puncta about 22-25 in 10 μm. Length of the valve 17-20 μm, and the breadth 4-5 μm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema megalobrebissonii* Chudaev, Kociolek & Golobova 2014**

(Pl. 137, figs. 8-15)

Ref. Chudaev et al. 2014, p. 260, figs. 1-20; Solak et al. 2021, p. 210, pl. 3, fig. 39.

Status of name: accepted taxonomically.

Diagnosis: Frustule wedge-shaped in girdle view. Valves are heteropolar, clavate, and slightly constricted above the mid-valve. The headpole is cuneate, often with a very slightly apiculus; the basal part is elongately cuneate, gradually narrowing to an acutely rounded footpole. Apical inflation is wider than the middle one. Axial area is moderately narrow, linear, tapering at the poles. Central area is small, indistinct, and asymmetrical due to the shortening of the central stria. Raphe is lateral, slightly undulate, the proximal raphe endings are small, tear-shaped, curved to the primary valve side; the distal raphe endings are curved to the secondary valve side, and extend from the valve face to the mantle. An isolated stigma terminates a central stria on the primary valve side. Apical pore field present at the foot pole. Transapical striae are punctate, parallel to slightly radiate in the centre, more radiate at the head and footpoles, about 8-10 in 10 μm. Striae about the headpole are usually slightly arched. Length of the valve 35-56 μm, and the breadth 8-10 μm in the middle part, 11-15 at the headpole.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Kamionka Lakes.

Distribution in Poland: New record.

***Gomphonema meridionalum* Kociolek & Thomas in Thomas et al. 2009**

(Pl. 137, fig. 16)

Ref. Thomas et al. 2009, p. 216, figs. 68-71, 75-82.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-clavate, linear-lanceolate with a narrow, obtusely rounded headpole, and produced, acutely rounded footpole. Axial area is narrow at the ends, gradually broadening into the valve centre to form a lanceolate area. Central area is an irregular, elliptic or unilateral, rectangular-shaped, formed by a shortened stria on one side and an elongated stria on the other side. An isolated, rounded stigma is situated on the other side of the central area. Raphe is lateral, slightly undulate; external proximal raphe endings are small central pores, deflected towards the stigma, internal proximal endings are recurved; external raphe distal endings are deflected onto the mantle and bisect the apical pore field at the footpole. Transapical striae are coarsely punctate, parallel to slightly radiate, coarser around the centre of the valve, about 8-9 in 10 μm at the centre, 11-12 in 10 μm at the ends. Length of the valve 25-55 μm, and the breadth 4.5.0-7.5 μm.

Remarks: This taxon resembles *Gomphonema bohemicum* Reichelt & Fricke *sensu* Reichardt (1999) in valve outline but differs in the structure of the central area and internal proximal raphe ends.

Ecological preference: Reported from the benthic habitat of an alkaline, eutrophic freshwater environment.

Occurrence: Infrequent in Kamionka Lake.

Distribution in Poland: New record.

***Gomphonema microlaticollum* Kulikovskiy, Kociolek & Solak 2015**

(Pl. 137, figs. 17-21)

Ref. Kulikovskiy et al. 2015, p. 260, figs. 176-190, 282-288; Kulikovskiy et al. 2016, p. 212, pl. 128, figs. 17-24.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, slightly swollen at the valve centre, strongly asymmetrical to the transverse axis, with a truncate, broadly rounded headpole and narrower acutely rounded footpole. Axial area is narrow and linear. Central area is small, indistinct, somewhat rectangular, with irregularly longer and shorter striae on each side. An isolated stigma is small and round, present in the central area close to the proximal raphe ends. Raphe is lateral, strongly undulate; proximal raphe endings are dilated with small central pores and deflected slightly

toward the stigma side; distal raphe endings are curved onto the valve mantle. Transapical striae are punctate, radiate throughout the valve, strongly radiate towards the footpole, about 13-14 in 10 μm, Puncta about 22-25 in 10 μm. Length of the valve 14-30 μm, and the breadth 7-9 μm.

Remarks: This taxon is easily distinguished from *Gomphonema laticollum* by its smaller size and higher number of striae in 10 μm (Kulikovskiy et al. 2015).

Ecological preference: Reported from the benthic habitats of alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Radomno, Jeziorak and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema micropumilum* Reichardt 1997**

(Pl. 137, figs. 22-24)

Ref. Reichardt 1997, p. 107, pl. 4, figs. 1-19; Fujita & Otsuka 2005, p. 77, fig. 50.

Status of name: accepted taxonomically.

Diagnosis: Valves are heteropolar, clavate-lanceolate with an obtusely rounded headpole, attenuate, acutely rounded footpole. Axial area is narrow and linear. Central area is symmetric with very short median striae and transversely dilated. Raphe is straight, filiform; the proximal raphe endings are dilated into small central pores, curved to the stigma side; the distal ends are curved to the same side onto the mantle. An isolated stigma is placed on the central nodule at the median stria end. Transapical striae are punctate, radiate throughout the valve, more widely spaced, about 14-18 in 10 μm. Length of the valve 10-22 μm, and the breadth 3.5-4.4 μm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema micropus* Kützing 1844**

(Pl. 137, figs. 25-30; pl. 138, figs. 1-8)

Ref. Cleve-Euler 1955, p. 178, fig. 1269 k-m; Krammer & Lange-Bertalot 1991b, pl. 74, figs. 1-14; Reichardt 1999, p. 34, pl. 36, figs. 1-14; pl. 37, figs. 1-29; pl. 38, figs. 1-15; pl. 39, figs. 15-17, 27-29; Wojtal, 2009, p. 218, pl. 13, figs. 10-14; pl. 73, figs. 2-5; Delgado et al. 2013, p. 98, figs. 140-141, 165; Levkov et al. 2016, p. 83, pl. 96, figs. 21-40; pl. 97, figs. 1-37; Bahls et al. 2018, p. 68, pl. 31, figs. 10-13; p. 82, pl. 45, figs. 5-10; p. 103, pl. 66, fig. 1; Solak et al. 2021, p. 210, pl. 3, figs. 40, 41.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema tenellum* var. *micropus* (Kützing) G.Rabenhorst 1864
Gomphonema parvulum var. *micropus* (Kützing) Cleve 1894

Diagnosis: Valves are lanceolate-clavate to linear-lanceolate, heteropolar with protracted, subrostrate rounded headpole and a narrower, subrostrate to subcapitate, acutely rounded footpole. Axial area is narrow and linear. Central area is relatively broad, unilateral, somewhat transversally rectangular, formed by one or two very shortened striae. An isolated stigma is present on the opposite side of the central area. Raphe is filiform, straight; the proximal raphe endings with small central pores that are curved slightly to the stigma side. Transapical striae are radiate throughout the valve, about 11-13 in 10 μm at the valve centre, up to 13-15 in 10 μm near the ends. Length of the valve 1930 μm, and the breadth 5.5-7.5 μm.

Ecological preference: Alkaliphilous, occurring in both fresh and brackish water habitats with fairly high oxygen level, neutrophilous, B-mesosaprobous, eutraphentic, often recorded from aerophytic habitats (Van Dam et al. 1994); widespread, alkaliphilous (Reichardt 1999); freshwater, low alkaline of some springs (Żelazna-Wieczorek & Ziułkiewicz 2004, Ziułkiewicz 2005); freshwater, circumneutral with pH 7.0, air temperature 20°C, water temperature 15°C (Li et al. 2007); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4),

low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); it is reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Common in Radomno, Kamionka and Młynek Lakes; frequent in Jeziorak Lake and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Wyżyna Krakowsko- Częstochowska Upland. Springs of Będkowka stream (Kubik 1970); Vistula River (Pudo 1977); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kobylanka stream, north-west of Kraków, south Poland (Wojtal 2003); some springs located in the area of the Łódź Hills scarp, between Ozorków, Stryków and Brzeziny (Żelazna-Wieczorek & Ziułkiewicz 2004; Ziułkiewicz 2005); Common, in epilithon, epipelon, periphyton of Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Wisłoka River, the Magura National Park and the Wołosaty River, the Bieszczady National Park, south Poland (Noga et al. 2017); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Kłopotnica River, Magura National Park, south-east Poland (Noga 2019); Rzeczyca stream and its tributarity, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Gomphonema micropus* var. *aequale* (Gregory) Reichardt 1999**

(Pl. 137, figs. 31-36)

Ref. Reichardt 1999, p. 36, pl. 39, figs. 1-6; Levkov et al. 2016, p. 23, pl. 91, figs. 1-42; Solak et al. 2020, p. 204, pl. 2, figs. 5-6.

Status of name: requires further investigation.

Diagnosis: Valves are almost symmetrical to very slightly asymmetrical about the apical axis, elliptic-lanceolate, with protracted subcapitate to rostrate head-and footpoles. Axial area is narrow, extending toward the valve centre. Central area is small, formed by shortening one stria on one side and a slightly shortened stria at the opposite side, with one stigma. Raphe is slightly lateral; proximal raphe endings are straight to slightly curved, and the distal raphe endings terminate at the apices. Transapical striae are radiate throughout the valve, widely spaced at the central area, about 9-12 in 10 µm. Length of the valve 20-35 µm, and the breadth 6.0-7.5 µm.

Ecological preference: Reported from the shallow, benthic habitats of slightly alkaline, meso- to eutrophic freshwater environments.

Occurrence: Frequent in Kamionka and Radomno Lakes.

Distribution in Poland: New record.

***Gomphonema minusculum* Krasske 1932**

(Pl. 138, figs. 9-13)

Ref. Krasske 1932, p. 444, pl. 16, figs. 18-19; Bąk et al. 2012, p. 175, pl. 66; Levkov et al. 2016, p. 5, pl. 161, figs. 1-25; Bahls et al. 2018, p. 161, pl. 124, fig. 18; Jüttner et al. 2018, p. 300, figs. 118-145; Solak et al. 2021, p. 210, pl. 3, figs. 42, 43.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-lanceolate, clavate, with narrowly rounded or cuneate head and foot poles. Axial area is narrow at the ends, broadening gradually towards the valve centre. Central area is small, rectangular, and bordered by two shortened striae. An isolated, rounded stigma is situated near the valve centre and close to the proximal raphe ends. Raphe is straight, weakly lateral; external proximal raphe endings are slightly dilated with central rounded pores; the distal raphe endings are curved onto the valve mantle at headpole on opposite valve side to the stigma, terminating more or less in centre at footpole and bisecting the apical pore field. Transapical striae are uniseriate, radiate, more distantly spaced at the valve centre, about 12-13 in 10 μm at the valve centre, 14-16 near the apices. Length of the valve 21.0-40.0 μm, and the breadth 4.0-5.0 μm.

Ecological preference: *Gomphonema minusculum* is a widely distributed and, having a wide ecological amplitude, from oligo- to eutrophic, standing freshwater habitats on carbonate to siliceous substrata (Bąk et al. 2012; Buczkó et al. 2021); reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 μS/cm (Peszek et al. 2015).

Occurrence: Infrequent in Jeziorak Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015).

***Gomphonema minutiforme* Lange-Bertalot & Reichardt 1993**

(Pl. 138, figs. 14-16)

Ref. Lange-Bertalot 1993, p. 61, pl. 83, figs. 16-20;

Status of name: accepted taxonomically.

Diagnosis: Valves are club-shaped, lanceolate with obtusely rounded headpole, and strongly narrow, acutely rounded footpole. Axial area is very narrow and linear. Central area is very small, unilateral, formed by a shortened stria on one side, and an isolated stigma on the other side near the central area. Raphe is slightly lateral; the proximal raphe endings are slightly deflected with small central pores; the distal raphe endings are curved onto the valve mantle at the headpole. Transapical striae are radiate at the valve centre, becoming parallel to slightly radiate towards the headpole, and more radiate towards the footpole, about 13-14 in 10 μm. Length of the valve 18-22 μm, and the breadth 5-6 μm.

Ecological preference: Shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Infrequent in Młynek Lake

Distribution in Poland: New record.

***Gomphonema minutum* (Agardh) Agardh 1831**

(Pl. 138, figs. 17-22)

Ref. Lange-Bertalot 1980, p. 589, figs. 1 B-F; fig. 2; Gasse 1986, p. 67, pl. 30, fig. 3; Krammer & LangeBertalot 1986, p. 370, pl.159, figs. 510; pl. 167, fig. 1; Krammer & Lange-Bertalot 1991b, p. 410, pl. 81, figs. 1-5; Wojtal 2009, p. 220, pl. 73, fig. 6; Bąk et al. 2012, p. 175, pl. 66; Levkov et al. 2016, p.87, pl.171, figs. 1-22; pl. 172, figs. 1-8; Bahls et al. 2018, p. 45, pl. 8, fig. 8; Solak et al. 2021, p. 211, pl. 3, figs. 44, 45.

Status of name: accepted taxonomically.

Synonyms: *Licmophora minuta* C.Agardh 1827

Gomphoneis heterominuta S.Mayama & A.Kawashima 2002

Diagnosis: Valves are club-shaped, ovallanceolate with obtusely rounded headpole, and strongly narrow, acutely rounded footpole. Axial area is very narrow and linear. Central area is very small, unilateral, irregularly transverse and rectangular with a single distinct stigma on one side near the central nodule. Raphe is slightly

lateral; the proximal raphe endings are slightly dilated with central pores; the distal raphe endings are curved onto the valve mantle. Transapical striae are radiate throughout the valve, becoming parallel to slightly radiate towards the poles, relatively widely spaced, about 12-14 in 10 µm. Length of the valve 12-28 µm, and the breadth 4-7 µm.

Ecological preference: Fresh and slightly brackish water (Cleve-Euler 1955); eutrophic water, beta mesosaprobic (Krammer & Lange-Bertalot 1986); in slowly running water, usually as an epiphyte on macrophytes (Gasse 1986); a neutrophilous, β-mesosaprobous, eutraphentic and fresh brackish water species (Van Dam et al.1994); the species was recorded from water of temperature was 6.2-9.0 C, moderate conductivity, and pH varied from 6.4 to 7.6 (Wojtal 2003); widely distributed and often very abundant in large rivers with higher trophic levels, it is sensitive to organic pollution and does not occur outside the β-mesosaprobic zone (Bąk et al. 2012); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 µSx cm $^{-1}$), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); Benthic, oligohalobous indifferent, pH- indifferent, eutraphentic, β-mesosaprobous (Witak & Jankowska 2014); reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Frequent in Radomno, Młynek and Jeziorak Lakes.

Distribution in Poland: It is recorded from fossil and recent samples in Poland from various type of water environments. Kobylanka stream, 30 km NW of Kraków, south Poland (Wojtal 2003); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, south-east Poland (Noga et al. 2013 a); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), , Lubcza, Pielnica, Stobnica, Mleczka, Strug, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Holocene sediments of the south-western part of the Gulf of Gdańsk between Hel Peninsula and Gdańsk – Gdynia south-western region, north Poland (Witak & Jankowska 2014); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema minutum* f. *pachypus* Lange-Bertalot & Reichardt in Lange-Bertalot 1993**

Ref. Lange-Bertalot 1993, p. 64, pl. 81: figs. 16-19.

Status of name: accepted taxonomically.

Diagnosis: Valves are lanceolate-clavate and broadest near the valve centre. The valve is narrowing gradually from the centre towards the end to form an obtusely rounded headpole and expanded, narrow, rounded footpole. Axial area is relatively narrow and tapered at the apices. Central area is small, unilateral, with a single distinct stigma on one side near the central nodule. Raphe is slightly lateral; proximal raphe endings are dilated into small central pores, deflected towards the stigma side; distal raphe endings are bent to the same side onto the valve mantle. Transapical striae are radiate throughout the valve, about 10-12 in 10 µm. Length of the valve 15-19 µm, and the breadth 5-6 µm.

Ecological preference: This taxon has the same ecological preference of the nominate species; freshwater, alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014a).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Wisłok river in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

***Gomphonema montanum* (Schumann) Grunow 1878**

(Pl. 138, figs. 23-31)

Ref. Hustedt 1930, p. 375, fig. 707; Thomas et al. 2009, p. 216, figs. 61-64; Bąk et al. 2012, p. 176, pl. 64; Kulikovskiy et al. 2016, p. 213, pl. 127, figs. 1-4.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* var. *montanum* Schumann 1867
Gomphonema subclavatum var. *montanum* (Schumann) Cleve 1894
Gomphonema longiceps var. *montanum* (Schumann) Hustedt 1930

Diagnosis: Valves are clavate, heteropolar, linear-lanceolate, with undulate margins and broadest at the central part. The headpole is subprotracted, broadly rounded, and the footpole is produced, relatively narrow and acutely rounded. Axial area is moderate, linear lanceolate, widening at the centre. Central area is subrounded and formed by shortened central striae. An isolated stigma is present at the central nodule. Raphe lateral is slightly undulate; proximal raphe endings are dilated with small central pores toward the stigmata side; distal raphe endings are curved onto the mantle. Transapical striae are punctate, slightly radiate in the middle of the valve, distinctly radiate at the ends, about 9-12 in 10 μm. Puncta 20-23 in 10 μm. Length of the valve 40-70 μm, and the breadth 6.5-9.5 μm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, mesotraphentic (Van Dam et al. 1994); oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015); mesotrophic water body with low pH (Kulikovskiy et al. 2016); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Frequent in Radomno, Młynek and Jeziorak Lakes.

Distribution in Poland: Czarna Staszowska River near the Drogowle village in south-east Poland (Szczepocka & Rakowska 2015).

***Gomphonema montanum* var. *broadness* Zalat nov. var**.

(Pl. 139, figs. 1-3)

Diagnosis: Valves are clavate, heteropolar, linear-lanceolate, with distinct undulate margins, and relatively equal broadening at the centre and near the headpole. The headpole is subprotracted, obtusely rounded, and the footpole is protracted and bluntly rounded. Axial area is relatively narrow, linear, widening at the centre and the ends. Central area is subrounded and formed by shortened central striae. An isolated stigma is present at the central nodule. Raphe is lateral and slightly undulate; the proximal raphe endings are expanded with small central pores toward the stigma side; the distal raphe endings are deflected onto the mantle in the direction opposite the stigma. Transapical striae are punctate, strongly radiate in the middle of the valve, and towards the footpole; slightly radiate towards the headpole, about 11-12 in 10 μm. Length of the valve 64 μm, and the breadth at the valve centre and near the headpole is about 12 μm. bloateness.

Remarks: This new variety differs from the nominate species and other similar taxa by the broadest shape of the outline, relatively equal swellings at the centre and near the headpole, obtusely rounded headpole; striae are strongly radiate in the middle of the valve, and towards the footpole; slightly radiate towards the headpole

Ecological preference: Reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Etymology. The epithet of the new variety refers to the broadness valve shape.

Holotype: the specimens illustrated in plate 139, figures 1-3.

Type locality: Radomno Lake.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema occultum* Reichardt & Lange-Bertalot 1991**

Ref. Reichardt & Lange-Bertalot 1991 b, p. 538, pl. 10, figs. 1-17; Bąk et al. 2012, p. 176, pl. 67.

Status of name: accepted taxonomically.

Diagnosis: Valves are sublinear-clavate to narrow elliptical-lanceolate, with subcapitate to subrostrate obtusely rounded headpole, and narrow, acutely rounded footpole. Axial area is linear, narrow at the ends, widening slightly towards the valve centre. Central area is expanded unilaterally to the valve margin, transversally broad, formed by shortening one stria on one side and slightly shortened stria on the opposite side. An isolated stigma is present at the central nodule. Raphe is slightly lateral, distinctly undulate; proximal raphe endings with small central pores, slightly dilated towards the stigma side. Transapical striae are radiate in the middle of the valve, strongly radiate near the ends, about 11-14 in 10 μm. Length of the valve 12-35 μm, and the breadth 4-6 μm.

Ecological preference: abundant in calcium-rich, oligotrophic lakes, less frequently in the waters flowing in the mountains, an indicator of very good ecological conditions (Bąk et al. 2012); reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm-1, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema pala* Reichardt 2001**

(Pl. 139, figs. 4-18)

Ref. Patrick & Reimer 1975, p. 119, pl. 16, fig. 4; Reichardt 2001, p. 212, pl. 10, figs. 1-22; pl. 11, figs. 4-7; Bąk et al. 2012, p. 178, pl. 65; Kulikovskiy et al. 2016, p. 213, pl. 127, fig. 15; Bahls et al. 2018, p. 46, pl. 9, figs. 4-7.

Status of name: accepted taxonomically.

Synonym: *Gomphonema truncatum* var. *capitatum* (Ehrenberg) Patrick 1975

Diagnosis: Valve is clavate with a slightly swollen median region, and truncate, broadly rounded headpole; narrow, acutely rounded footpole. Axial area is narrow and linear. Central area is variable, limited by irregularly shortened median striae. An isolated stigma is present at the central region. Raphe is undulate, the proximal raphe endings are dilated into small pores and deflected weakly toward the stigma side; the distal raphe endings are curved oppositely to the stigma onto the mantle. Transapical striae are punctate, radiate throughout the valve, about 10-13 in 10 μm. Length of the valve 32-55 μm, and the breadth 9-12 μm.

Remarks: This taxon is similar to *Gomphonema truncatum* but differs by having a slightly swollen median region.

Ecological preference: Observed primarily in meso- to eutrophic lakes, tolerant to organic pollutants almost outside the β-α-mesososaprobia zone (Bąk et al. 2012); reported from freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 μS/cm (Peszek et al. 2015); oligotrophic, alkaline freshwater reaction (pH 7.6-8.1) and low to relatively high conductivity content, (Noga et al. 2016 a); alkaliphilous, fresh brackish, meso-eutraphentic (Malinowska-Gniewosz et al. 2018); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno and Młynek Lakes, frequent in Kamionka Lake.

Distribution in Poland: Found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016a); industrial water biotopes of Trzuskawica S.A., south Poland (Malinowska-Gniewosz et al. 2018).

***Gomphonema paludosum* Reichardt 1999**

(Pl. 139, figs. 19-21)

Ref. Reichardt 1999, p. 26, pl. 26, figs. 1-22; pl. 27, figs. 1-9; Reavie 2023, p. 55, fig. 23B.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly heteropolar, elongate, linear-lanceolate to sublinear-clavate with bluntly rounded headpole, and narrow, acutely rounded footpole. Axial area is linear, moderate. Central area is unilateral or transversely elongated, made by slight shortening of central striae on both valve sides. An isolated stigma is located in the central nodule close to the proximal raphe endings. Raphe is straight, slightly lateral, narrowing at the ends; proximal raphe endings with two central pores that are deflected slightly towards the stigmata side; distal raphe endings are bent towards the opposite side. Transapical striae are finely punctate, slightly radiate to subparallel, relatively widely spaced, about 9-11 in 10 μm; Puncta 31-36 in 10 μm. Length of the valve 30-60 μm, and the breadth 5.5-7 μm.

Ecological preference: Reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema paracapitatum* Kulikovskiy, Kociolek & Solak 2015**

(Pl. 139, figs. 22-25)

Ref. Kulikovskiy et al. 2015, p. 260, figs. 214-227, 294; Kulikovskiy et al. 2016, p. 213, pl. 126, figs. 29-32.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear, clavate, with undulated margins and swollen at the valve centre, which is slightly larger than the headpole. The headpole is capitate, broadly rounded, and the footpole is more narrow, acutely rounded, with broadening at the end to form a flipper-like structure. Axial area is narrow and linear. Central area is small, rectangular, and limited by shortening of central striae on both valve sides. An isolated round stigma is located in the central nodule close to the proximal raphe endings. Raphe is lateral, undulate. proximal raphe endings are dilated into small pores that deflect slightly towards the stigma side; distal raphe endings are turned onto the mantle. Transapical striae are punctate, distinctly radiate throughout the valve, about 11-12 in 10 μm. Apical pore fields are evident at the footpole. Length of the valve 27-44 μm, and the breadth 8.5-10 μm.

Remarks: This species is distinguished from *Gomphonema capitatum* and other closely related taxa by the unusual flipper-like structure of the footpole (Kulikovskiy et al. 2015).

Ecological preference: Mesotrophic and eutrophic alkaline ecosystems **(**Kulikovskiy et al. 2016); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema parallelistriatum* Lange-Bertalot & Reichardt 1993**

Ref. Krammer & Lange-Bertalot 1991 b, p. 408, pl. 80, figs. 7-11; Krammer & Lange-Bertalot 1993, p. 68, pl. 76, figs.11-16; Lange-Bertalot & Reichardt 1993, p. 68, pl. 76, figs. 11-16; Wojtal 2003, p. 216, pl. 3, fig. 9-11; Wojtal 2009, p. 220, pl. 14, fig. 7.

Status of name: accepted taxonomically.

Diagnosis: Valves are distinctly clavate, slightly heteropolar, lanceolate to elliptical-clavate, in smaller individuals, with broadly rounded headpole and attenuated, bluntly rounded footpole. Axial area is narrow and linear. Central area is unilateral, delimited by the shortening of the median striae. An isolated stigma is present in the central nodule. Raphe is straight to slightly lateral; proximal raphe endings are dilated in small central pores and flexed to the side of the stigma; distal raphe endings are turned onto the mantle. Transapical striae are uniseriate, parallel, slightly more spaced in the mid-valve, about 11-13 in 10 μm. Areolae inconspicuous. Length of the valve 20-32 μm, and the breadth 6.5-7.5 μm.

Ecological preference: Known from Germany, co-occurring with *Gomphonema micropus*, in oligosaprobic, mesotrophic to eutrophic waters (Lange-Bertalot 1993).

Distribution in Poland: Dam reservoir in Dobczyce (Wojtal et al. 2005); Kobylanka stream, 30 km NW of Kraków, south Poland (Wojtal 2003; Wojtal & Sobczyk 2006)

***Gomphonema parvulius* (Lange-Bertalot & Reichardt) Lange-Bert. & Reichardt 1996**

(Pl. 140, figs. 1-6)

Ref. Lange-Bertalot 1993, p. 70, pl. 76, figs. 22-29; Lange-Bertalot & Metzeltin 1996, p. 246, pl. 64, figs. 9-12; pl. 118, fig. 2; Wojtal 2009, p. 222, pl. 14, fig. 13; Bąk et al. 2012, p. 178, pl. 68; Kulikovskiy et al. 2023, p. 1834, fig. 3I-L.

Status of name: accepted taxonomically.

Synonym: *Gomphonema parvulum* var. *parvulius* Lange- Bertalot & Reichardt 1993

Diagnosis: Valves are linear lanceolate, to rhombic-lanceolate, with subrostrate, produced, narrow, acutely rounded both the headpole and footpole. Axial area is very narrow and linear. Central area is small, limited by irregular shortening of the median stria. An isolated stigma is present on one side of the central area. Raphe is slightly lateral, filiform; proximal raphe endings are slightly deflected to the stigma side; distal raphe endings are indistinct. Transapical striae are slightly radiate to parallel throughout the valve, about 12-14 in 10 µm. Length of the valve 1430 µm, and the breadth 47 µm.

Ecological preference: Freshwater, acidophilous, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994); the species is distributed in oligotrophic waters, poor in electrolytes, most often weakly acidic stagnant waters, together with acidophilic species (Bąk et al. 2012); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 µSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a; 2014 a); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 µS/cm (Peszek et al. 2015); known from northern and central Europe and is characterized as an oligotrophic species (Lange-Bertalot et al. 2017).

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, and Duszatyńskie Lakes (Western Bieszczady Mts), south-east Poland (Noga et al. 2013 a, c); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); suburban Przyrwa stream, in Rzeszów, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema parvulum* (Kützing) Kützing 1849**

(Pl. 140, figs. 7-12)

Ref. Hustedt 1930, p. 372, fig. 713 a; Patrick & Reimer 1975, p.122, pl. 17, figs. 7-12; Foged 1980, p. 645, pl. 10, figs. 16,17; Germain 1981, p. 308, pl. 114, figs. 23-28; Gasse 1986, p. 67, pl. 30, figs. 4-6, 8-10; Krammer & Lange-Bertalot 1986, p. 358, pl. 154, figs. 1-25; Krammer & Lange-Bertalot 1991 b, p. 400, pl. 76, figs. 1-7; Ehrlich 1995, p. 113, pl. 32, figs. 4-10; Lange-Bertalot & Metzeltin 1996, p. 334, pl. 108, figs. 18-19; Moreno et al. 1996, p. 76, pl. 21, fig. 13; Wojtal 2009, p. 220, pl. 14, figs. 8-12; Kulikovskiy et al. 2016, p. 213, pl. 128, figs. 12-17; Levkov et al. 2016, p. 98, pl. 102, figs. 1-38; pl. 103, figs. 1-14; Bahls et al. 2018, p. 82, pl. 45, fig. 21.

Status of name: accepted taxonomically.

Synonyms: *Sphenella parvula* Kützing 1844
Sphenoneis parvula (Kützing) Trevisan 1848
Gomphonella parvula (Kützing) Rabenhorst 1853
Gomphonema parvulum var. *exile* Grunow 1878
Gomphonema parvulum var. *lanceolatum* Grunow 1880
Gomphonema parvulum var. *subcapitatum* Grunow 1880
Gomphonema parvulum var. *subcapitata* Grunow 1880
Gomphonema parvulum f. *lanceolata* (Grunow) O.Müller 1905
Gomphonema parvulum f. *subcapitata* (Grunow) O.Müller 1905
Gomphonema parvulum var. *curta* R. d'Aubert 1920
Gomphonema parvulum f. *semiaperta* A.Mayer 1928

Diagnosis: Valves are clavate, cuneatelanceolate, to elliptic-lanceolate, with subrostrate, obtuse headpole and produced, slightly capitate, attenuate-rounded footpole. Axial area is linear and narrow. Central area is small, asymmetrical and narrow, unilateral, and limited by irregular shortening of a median stria. An isolated stigma is present on one side of the central nodule. Raphe is straight filiform to slightly lateral; the proximal raphe endings are curved towards the stigma side; the distal raphe endings are deflected on the mantle and bisect the apical pore field. Transapical striae are uniseriate, almost parallel to slightly radiate, about 13-16 in 10 μm; more widely spaced at the valve centre. Length of the valve 1830 μm, and the breadth 5-7 μm.

Ecological preference: Freshwater, meso to eutrophic water (CleveEuler 1955); its pHoptimum lies between 7.2 and 7.8 (Cholnoky 1968); alkaliphilous with pH value 7.58, epiphytic (Ehrlich 1973); oligohalobous ʻindifferent', pH circumneutral (Foged 1980); widespread, tychoplanktonic, polysaprobous and eutraphentic diatom (Krammer & Lange-Bertalot 1986; Denys 1991; Hofmann 1994); a neutrophilous, α-meso- polysaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); developed in the highly polluted sector of the Vistula, Poland (Kwandrans et al. 1998); the species was recorded commonly in waters of low conductivity, low to medium alkalinity with pH 6.9-8 and in unpolluted to moderately polluted waters (Zalat & Servant-Vildary 2005); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74 mg/dm^3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); considered to be tolerant and resistant with respect to organic water pollution (Szczepocka & Szulc 2009); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); epiphyte, eutraphentic, indicative of nutrient-rich waters (Witak et al. 2017); reported from the water of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 μS cm^{-1} (Pociecha et al. 2020).

Occurrence: Frequent in Radomno, Młynek, Kamionka and Jeziorak Lakes; the Eemian palaeolake deposits of central Poland.

Distribution in Poland: the Wyżyna Krakowskoczęstochowska Upland. Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Vistula River (Turoboyski 1962; Kyselowa & Kysela 1966); Sanka stream (Kądziołka 1963); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 b), springs of Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Biała Przemsza River (Wasylik 1985); Rivers in Kraków province, the Vistula, Raba and their affluents, south Poland (Kwandrans et al. 1998); the coastal areas of the Puck Bay and the Gulf of Gdansk (Stachura & Witkowski 1997; Bogaczewicz-Adamczak et al. 2001); Kobylanka stream, north-west of Kraków south Poland (Wojtal 2003); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2004; 2006); peat bog in Modlniczka near Kraków, situated in the Wyżyna Krakowsko-Czecstochowska upland, south Poland (Piątek 2007); dominant in limnocrenic spring-Piękne Spring vicinity of Łódź in the Moszczenica River catchment basin-Central Poland (Żelazna-Wieczorek & Ziułkiewicz 2007); the Bzura River and Pilica River, Central Poland, (Szczepocka & Szulc 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Górki Zachodnie and Swibno – Vistula River estuary, north Poland (Majewska et al. 2012); Korzeń mir, Lódź province, Warta and Widawka Landscape Park, Central Poland (Szulc & Szulc 2012); Podkarpacie voivodeship in Dąbrowa village, the Subcarpathian Province, south-east Poland (Stanek-Tarkowska & Noga 2012); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al., 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn, Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes, Western Bieszczady Mts., south-east Poland (Noga et al. 2013 a, b. c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek

et al. 2015); Rzeszów, Przyrwa stream, Województwo Podkarpackie, and Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Lake Zabinskie in the Masurian Lake District, northeastern Poland (Witak et al. 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020); the ponds in the middle course of the Chechło River that impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020); Lakes Łazduny and Rzésniki in the Masurian Lake District in north-east Poland (Szczerba et al. 2023).

***Gomphonema procerum* Reichardt & Lange-Bertalot 1991**

Ref. Reichardt & Lange-Bertalot 1991, p. 526, pl. 4, figs. 1-12; Thomas et al. 2009, p. 222, figs. 94-96; Bąk et al. 2012, p. 179, pl. 66; Hofmann et al. 2013, p. 96, pl. 313, fig. 27; Bahls et al. 2018, p. 68, pl. 31, fig. 20.

Status of name: accepted taxonomically.

Diagnosis: Valve is narrow, linear-lanceolate, elongate, slightly inflated in the middle part and narrowing gradually towards the ends to form narrow, acutely rounded apices. The headpole is slightly broader than the footpole. Axial area is narrow and linear. Central area is small, expanded transversally and formed by a shortened one central stria. An isolated stigma is present in the central nodule at the end of the stria. Raphe is straight to weakly undulate; the proximal raphe endings with elongated central pores, deflected slightly towards the stigma side; the distal raphe endings are curved on the mantle and bisect the apical pore field at the footpole. Transapical striae are slightly radiate throughout the valve, about 11-12 in 10 μm, condensed at the apices. Length of the valve 38-57 μm, and the breadth 5.5-6.5 μm.

Ecological preference: abundant in calcium-rich waters, oligo to mesotrophic lakes in the mountains, indicator species of very good ecological quality (Bąk et al. 2012); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a).

Distribution in Poland: Wisłok River in the territory of the Podkarpacie Province, southern Poland (Noga et al. 2014a)

***Gomphonema productum* (Grunow) Lange-Bertalot & Reichardt in Lange-Bertalot 1993**

Ref. Hustedt 1930, p. 373, fig. 693; Cleve-Euler 1955, p. 179, fig. 1270 f-k; Germain 1981, p. 308, pl. 114, figs. 3-6; Krammer & Lange-Bertalot 1991, p. 394, pl. 73, figs. 9-10; pl. 75, figs. 15-22; Lange-Bertalot 1993, p. 71, pl. 73, figs. 14-17; pl. 74, figs. 1-3; Reichardt 1999, p. 31, pl. 32, figs. 1-18; Bąk et al. 2012, p. 180, pl. 68; Noga et al. 2013 c, p. 137, fig. 2: 24; Levkov et al. 2016, p. 106, pl. 96, figs. 1-20.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema angustatum* var. *productum* Grunow 1880

Gomphonema angustatum f. *productum* Grunow 1880

Diagnosis: Valves are linear-lanceolate to elliptic-lanceolate with subparallel to weakly convex margins and protracted, capitate, attenuate-rounded apices. Axial area is narrow and linear. Central area is broad, transverse, rectangular, unilateral, and limited by irregular shortening of a median stria. An isolated stigma is located at the median stria end. Raphe is straight to slightly sinuous; proximal raphe endings are deflected towards the stigma side. Transapical striae are punctate, slightly radiate the entire valve, about 9-11 in 10 μm. Length of the valve 25-40 μm, and the breadth 7-9 μm.

Ecological preference: Fresh-brackish water, circumneutral, high oxygen requirements, β-mesosaprobic, oligo-mesotraphentic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15–3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater with pH 6.0-8.5, air temperature 12-23°C, water temperature 3-15°C (Li et al. 2007); high abundance in waters silicate, poor in electrolytes, often weakly acidic, mainly in mountain streams (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013a, b).

Occurrence: Infrequent in Radomno and Kamionka Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Lubcza, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, south-east Poland **(**Peszek et al. 2021).

***Gomphonema pseudoaugur* Lange-Bertalot 1979**

(Pl. 140, figs. 15-29)

Ref. Lange-Bertalot 1979, p. 202, figs. 11-16; Krammer & Lange-Bertalot 1986, p. 364, pl. 159, figs. 1-4; Wojtal 2009, p. 222, pl. 14, figs. 15, 16; Azevedo et al. 2018, p. 773, fig. 4h; Medeiros et al. 2018, p. 19, figs. 64-66; 142-145; Solak et al. 2021, p. 212, pl. 3, fig. 55; Kulikovskiy et al. 2023, p. 7, figs. 8A-R, figs. 9A-D.

Status of name: accepted taxonomically.

Diagnosis: Valves are distinctly heteropolar, clavate, elliptic to elliptical-lanceolate, with a broadly rounded, subrostrate headpole, and acutely tapered, rounded to subrostrate, subcapitate footpole. Valve is markedly wider above the middle part of the valve. Axial area is narrow and linear. Central area is small, transverse, and unilateral, limited by shortening of a median stria on one side. An isolated stigma is present on the other side. Raphe is slightly sinuous, the proximal raphe endings are dilated into small pores that are curved toward the stigma. Transapical striae are uniseriate, parallel to radiate, more spaced at the med-valve, about 10-12 in 10 µm. Length of the valve 23-55 µm, and the breadth 7-10 µm.

Ecological preference: It occurs in mesotrophic to eutrophic, β -α-mesosaprobic waters (Krammer & Lange-Bertalot 1986); a neutrophilous, ά-mesosaprobic, eutraphentic and fresh brackish water species (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); low to moderate water conductivity range between 292 to 569 µS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 µS/cm (Noga et al. 2014 a); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake; frequent in Młynek and Jeziorak.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Zalew Rzeszowski stream in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014a).

***Gomphonema pseudopusillum* Reichardt 1999**

(Pl. 140, figs. 30-31)

Ref. Reichardt 1999, p. 48, pl. 59, figs. 1-15; Kulikovskiy et al. 2015, p. 256, figs. 88-106; Kulikovskiy et al. 2016, p. 214, pl. 125, figs. 21-26.

Status of name: accepted taxonomically.

Diagnosis: Valves are heteropolar, clavate, with biconstricted margins. Headpole is cuneate to obtusely rounded; the basal part is gradually narrowing to form an acutely rounded footpole. Apical inflations are slightly wider than the middle ones or have the same breadth. The marginal undulations are strongly evident. Axial area is distinct and relatively narrow. Central area is distinct, subrounded or irregularly shaped due to shortened one or two central striae. Raphe is lateral and slightly undulate; the proximal raphe endings are dilated with small central pores; the distal raphe endings are unilaterally curved onto the mantle. An isolated stigma is located in the central area. Transapical striae are radiate in the valve centre, strongly radiate at the footpole, slightly radiate to subparallel at the headpole, about 11-13 in 10 μm. Length: 28-35 μm, breadth: 5.5-7 μm.

Ecological preference: It prefers oligotrophic water bodies (Kulikovskiy et al. 2016); reported from the shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environment.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema pseudotenellum* Lange-Bertalot 1985**

Ref. Krammer & Lange-Bertalot 1985, p. 51, pl. 35, figs. 7-12; Krammer & Lange-Bertalot 1986, p. 372, pl. 164, figs. 22-24.

Status of name: accepted taxonomically.

Diagnosis: Valves are slightly heteropolar, linear to narrow-lanceolate, almost naviculoid form with acutely rounded not protracted headpole and footpole. Axial area is narrow and linear. Central area is rectangular, limited by shortening of median striae on both sides. One isolated stigma is present in the central area. Raphe is slightly lateral; the proximal raphe endings are slightly deflected towards the stigma side. Transapical striae are finely punctate, slightly radiate throughout, about 15-22 in 10 μm. Central striae on both valve sides are relatively distantly spaced from the other striae. Length of the valve 10-28 μm, and the breadth 2.5-4 μm.

Ecological preference: Distributed in oligotrophic water (Krammer & Lange-Bertalot 1985); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006).

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011).

***Gomphonema pulvillum* Spaulding & Kociolek 1998**

(Pl. 140, figs. 32-34)

Ref. Spaulding & Kociolek 1998, p. 366, figs. 19-24;

Status of name: uncertain and requires further investigation.

Diagnosis: Valves are club-shaped, linear to broadly lanceolate. The headpole is subprotracted and bluntly rounded. The footpole is protracted and acutely rounded, except in smaller specimens. Axial area is slightly lanceolate and narrow at the poles. Central area is small, subrounded, or irregular due to a shortened one central stria. An isolated stigma is present. Raphe is lateral, undulate, with proximal endings that are dilated slightly and curved towards the stigma side. Transapical striae are slightly radiate and more widely spaced at the valve centre, about 10-12 in 10 μm; slightly radiate and becoming parallel at the headpole, about 12 in 10 μm, strongly radiate at the footpole, about 13-14 in 10 μm. Length of the valve 17-36 μm, and the breadth 6 μm

Ecological preference: It is observed in the shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema pumilum* (Grunow) Reichardt & Lange-Bertalot 1991**

(Pl. 140, figs. 35-38)

Ref. Hustedt 1930, p. 375, fig. 699; Krammer & Lange-Bertalot 1986, p. 370, pl. 164, fig. 7; Krammer & Lange-Bertalot 1991 b, p. 418, pl. 85, figs. 13-19; Reichardt & Lange-Bertalot 1991, p. 528, pl. 6, figs. 4-11; Reichardt 1995, p. 89, pl. 1, figs. 17-19; Wojtal 2003, p. 217, pl. 4, figs. 1-6; Wojtal 2009, p. 222, pl. 14, figs. 17-22; pl. 74, figs. 1-6; Delgado et al. 2013, p. 98, figs. 136-139; Kulikovskiy et al. 2016, p. 214, pl. 125, figs. 15-17; Levkov et al. 2016, p. 110, pl. 151, figs. 26-52; Solak et al. 2016, p. 575, pl. 4, figs. 62–64; Medeiros et al. 2018, p. 19, figs. 67-69; Rybak et al. 2019, fig. 2: 17.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema vibrio* var. *pumilum* (Grunow) Ross 1986
Gomphonema intricatum f. *pumila* Grunow 1880
Gomphonema intricatum var. *pumila* A.Cleve 1932

Diagnosis: Valves are heteropolar, lanceolate, with a bluntly rounded headpole and attenuated, rounded footpole. Axial area is relatively narrow, linear to lanceolate. Central area is relatively broad, rectangular, and formed by shortening of median striae on both sides. An isolated, rounded stigma is placed on the central nodule close to the proximal raphe ends. Raphe is straight; the external proximal raphe endings are dilated into pores, curved to the stigma side; the distal raphe endings are bent to the same side. Transapical striae are uniseriate, parallel to radiate throughout, about 10-12 in 10 μm. Apical pore fields are small. Length of the valve 15-35 μm, and the breadth 3.5-6.5 μm.

Ecological preference: Fresh brackish water species indifferent to trophic state (Van Dam et al. 1994); found in almost all types of carbonate-containing waters, optimum lies in the streams and rivers of mountainous areas, others in lowland lakes, in waters contain calcium, are oligosaprobic to at least at most weakly β-mesosaprobic and have a medium to high degree of trophic (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); occurs mostly in calcium-rich waters, alkaline or close-to-neutral waters with medium or low electrolytic conductivity (78-530 μS cm^{-1}), low nutrient content and medium-to-high calcium ion content (12.4-76.4 mg/l^{-1}) (Noga et al. 2018).

Occurrence: Frequent in Radomno Lake and the Eemian paleolake deposits of central Poland.

Distribution in Poland: Wyżyna Krakowsko-Częstochowska Upland; Springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik 1970); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kobylanka stream, north-west of Kraków Poland (Wojtal 2003, 2009); Holocene sediments of Vistula Lagoon, north Poland (Witak et al. 2005); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Gołębiówka, Baryczka, Trzcianka, Żołynianka, and Matysówka streams in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Wołosate peat bog (Bieszczady National Park), south Poland (Rybak et al. 2018); San River, Wisłoka, Wołosaty rivers, and their tributaries, Swierzówka stream, south-east Poland (Noga et al. 2018); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Headwaters of the Wisłoka River and selected tributaries in Magura National Park and its protective buffer zone, south-east Poland **(**Peszek et al. 2021).

***Gomphonema pumilum* var. *rigidum* Reichardt & Lange-Bertalot 1997**

(Pl. 140, fig. 39)

Ref. Reichardt & Lange-Bertalot 1997, p. 105, pl. 1, fig. 7; pl. 3, figs. 1-41; pl. 4, figs. 24, 25; Metzeltin et al. 2005, p. 145, figs. 37-44; Blanco et al. 2010, p. 74, pl. 77, figs. 28-49; pl. 88, figs. 1-8; Hofmann et al. 2011, p. 315, pl. 97, figs. 15-20; Lange-Bertalot et al. 2017, p. 319, pl. 99, figs. 15-20.

Status of name: accepted taxonomically.

Diagnosis: Valves are narrow, linear lanceolate to narrow ellipticallanceolate with bluntly rounded headpole, and narrow, acutely rounded footpole. Axial area is narrow and linear. Central area is transversely rectangular and limited by shortening of median striae on both sides. An isolated, distinct stigma is sited on one side near the central nodule. Raphe is slightly lateral, straight; proximal raphe endings are dilated into central pores that deflect to the stigma side. Transapical striae are subparallel in the middle part of the valve, becoming radiate towards the poles, relatively widely spaced, about 11-13 in 10 μm. Length of the valve 16-30 μm, and the breadth 3.5-5.5 μm.

Ecological preference: Reported from the benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema ravidum* Kociolek, Spaulding, Sabbe & Vyverman 2004**

(Pl. 140, figs. 40-43)

Ref. Kociolek et al. 2004, p. 427, figs 85-90, 101-104.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-clavate with narrow and acutely rounded poles. Axial area is narrow and linear. Central area is small, unilateral, and formed by one shortened stria. A single stigma is present at the end of an elongated stria. Raphe is slightly undulate and lateral. The proximal raphe endings are dilated slightly. The distal raphe endings are curved in the same direction onto the valve mantle. Transapical striae are punctate, radiate throughout the valve, and strongly radiate at the footpole, about 10-12 in 10 μm. Length of the valve 40-42 μm, and the breadth 5-6 μm.

Ecological preference: Shallow, benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema reichardtii* Lange-Bertalot in Lange-Bertalot & Metzeltin 1996**

Ref. Lange-Bertalot & Metzeltin 1996, p. 72, pl. 65, figs. 16-19; pl. 121, figs. 1-3.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear-elliptic to elliptical-lanceolate, almost naviculoid form, and narrowed abruptly to form protracted, cuneate, subcapitate, bluntly rounded headpole and footpole. Margins of the valve are linear, parallel or weakly arched and are somewhat very slightly undulate. Axial area is relatively narrow and linear. Central area is distinctly unilateral, formed by missing the central striae on one side. Raphe is slightly lateral, straight; proximal raphe endings with small dilated central pores; distal raphe endings are curved onto the valve mantle. Transapical striae are uniseriate, radiate the entire valve, about 8-10 in 10 μm. Length of the valve 25-45 μm, and the breadth 6-8 in 10 μm.

Ecological preference: Freshwater, alkaline or close to neutral water reactions (pH: 7-9), conductivity ranged between 100 to above 700 μS/cm (Noga et al. 2014a).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: Wisłok River in the territory of the Podkarpacie Province, southern Poland (Noga et al. 2014a).

***Gomphonema saprophilum* (Lange-Bertalot & Reichardt) Abraca, Jahn, Zimmermann & Enke 2014**

(Pl. 140, figs. 13-14)

Ref. Krammer & Lange-Bertalot 1991, p. 394, pl. 73, fig. 7; pl. 76, figs. 8-13; Lange-Bertalot 1993, p. 69, pl. 76, figs. 8-13; pl.77, figs. 5-9; Wojtal 2009, p. 222, pl. 14, fig. 14; Levkov et al. 2016, p. 104, pl. 116, figs. 25-33; Medeiros et al. 2018, p. 19, figs. 71-73.

Status of name: accepted taxonomically.

Synonym: *Gomphonema parvulum* fo. *Saprophilum* Lange-Bertalot & Reichardt 1993

Diagnosis: Valves are lanceolate, linear-lanceolate, elliptical-lanceolate to ovate with widely subrostrate, bluntly rounded headpole and subrostrate, attenuated, rounded footpole. Axial area is linear and narrow. Central area is unilaterally expanded and limited by shortened median striae. An isolated stigma is located at the end of the median striae in the central area. Raphe straight, weakly undulate; proximal raphe endings in pore shape and curved toward the stigma; distal raphe endings are deflected and extend onto the valve mantle. Transapical striae are parallel in the middle portion of the valve to slightly radiate towards the ends, about 12-14 in 10 μm. Length of the valve 15-22 μm, and the breadth 6-8 μm.

Remarks: *Gomphonema saprophilum* differs from *Gomphonema parvulum* (Kützing) Kützing mostly by the rhomboidal valve shape, and by its wider headpole with wider valves (Abarca et al. 2014, Levkov et al. 2016).

Ecological preference: Described from urban aquatic environment (Lange-Bertalot 1993); neutrophilous, α-mesopolysaprobous, eutraphentic and fresh brackish water species (Van Dam et al. 1994); the species occurs in organically polluted waters, α-mesosaprobic and polysaprobic conditions, it covers the entire saprobic spectrum and the entire trophic state. Avoids strictly oligotrophic habitats, relatively dystrophic and moderately to strongly acidic (Bąk et al. 2012); freshwater of an alkaline or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm (Noga et al. 2013 b); water alkaline with pH 7.8-9.4 (Rybak et al. 2019).

Occurrence: Frequent in Młynek Lake.

Distribution in Poland: Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); as *Gomphonema parvulum* f. *saprophilum* from springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Baryczka stream left bank tributary of the River San flowing through the Dynowskie Foothills, south-east Poland (Noga et al. 2013 b); Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a); outflow of drainage water in urban areas, Stalowa Wola City, south-east Poland (Rybak et al. 2019).

***Gomphonema sarcophagus* Gregory 1856**

(Pl. 141, figs. 1-11)

Ref. Krammer & Lange-Bertalot 1991 b, pl. 75, figs. 1-12; Reichardt 1999, p. 30, pl 30, figs. 1-30; pl. 31, figs. 1-6; Wojtal 2003, p. 218, pl. 4, figs. 7-8; Wojtal 2009, p. 224, pl. 13, figs. 15, 16; Bąk et al. 2012, p. 181, pl. 68; Noga et al. 2014 a, p. 22, pl. 1, fig. 33; Levkov et al. 2016, p. 116, pl. 94, figs. 1-27; Bahls et al. 2018, p. 45, pl. 8, figs. 1-3; p. 161, pl. 124, fig. 14.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema angustatum* var. *sarcophagus* (Gregory) Grunow 1880
Gomphonema angustatum f. *sarcophagus* (Gregory) Hustedt 1957
Gomphonema sarcophagus f. *minor* Rabenhorst null
Gomphonema angustatum f. *heteromorphum* A.Cleve 1922

Diagnosis: Valves are clavate, linear- to elliptic-lanceolate, with rostrate, slightly capitate to truncate apices. Valves are asymmetric to the transapical axis, with the footpole slightly more tapered than the headpole. Valve margins can be more or less parallel in the central part of the valve and then taper more abruptly towards the poles than in valves with slightly convex margins, which taper more gradually towards the poles. Axial area is narrow, distinctly linear. Central area is asymmetric, rectangular, with one very short stria on one side and a slightly shortened stria on the opposite side. A single stigma is present in the central area. Raphe is undulate with slightly expanded proximal ends that deflected towards the stigma side. Transapical striae are finely punctate, slightly radiate to parallel, bending inward at the centre of the valve, about 9-10 in 10 μm in the mid-valve, and 11-13 in 10 μm near the apices. Length of the valve 16-35, and the breadth 7-8 μm.

Ecological preference: it has been reported to inhabit primarily mesotrophic waters with moderate conductivity (Patrick & Reimer 1975); it occurs in both fresh and brackish water, an alkaliphilous, β-mesosaprobous, mesotraphentic and often recorded in aerophytic habitats (Van Dam et al. 1994); from Poland, the species has moderate conductivity and neutral pH (Reichardt 1999); reported from eutrophicated

and β-mesosaprobic waters of the Szczecin Lagoon with water temperature ranges from 2.41ºC to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); found in eutrophic ponds across Europe (Hofmann et al. 2011); oligosaprobic, in moderately eutrophic small reservoirs with an average electrolyte content (Bąk et al. 2012); freshwater with pH had an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Common in Młynek Lake, frequent in Radomno and Kamionka Lakes and the Eemian palaeolake deposits of central Poland.

Distribution in Poland: Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); the Gulf of Gdansk (Witkowski 1994); found in a stream in the Dolina Kobylanska valley, Poland (Reichardt 1999); Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2003, Wojtal 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, San (near Jarosław), Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); San River on the San Valley Landscape Park area, south Poland (Noga et al. 2014 b); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); found in Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); the Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema spatiosum* Thomas & Kociolek 2009**

(Pl. 141, figs. 17-19)

Ref. Thomas et al. 2009, p. 220, figs. 72-74, 83-90.

Status of name: accepted taxonomically.

Diagnosis: Valves are rhomboid-clavate, to rhombic-lanceolate, narrowing gradually from the broadest centre towards the poles to form attenuated, acutely rounded apices. Axial area is narrow at the poles, becoming wider towards the centre. Central area is not distinguished from the axial area, with a shortened one stria on one side, an elongated one stria on the other side terminating near the single stigma. Raphe is lateral, slightly undulate, the external proximal raphe endings are slightly dilated with small, rounded central pores that are slightly deflected towards the stigmata side; the distal raphe endings extend onto the mantle and are deflected away from the side of the stigma. Transapical striae are distinctly punctate, uniseriate, lineolate, slightly radiate throughout the valve, strongly radiate at the footpole, subparallel at the headpole, about 7-10 in 10 µm. Length of the valve 58-81 µm, and the breadth 10-14 µm.

Ecological preference: It is reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema sphaerophorum* Ehrenberg 1845**

Ref. Hustedt 1930, p. 372, fig. 695; Kaczmarska 1977, p. 54, pl. 27, fig. 2.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema augur* var. *sphaerophorum* (Ehrenberg) Grunow 1878
Gomphoneis sphaerophorum (Ehrenberg) Tempère & Peragallo 1915

Diagnosis: Valves are clavate, elliptical-lanceolate with a distinctly capitate headpole and a narrow footpole. Axial area is moderate, becoming narrow, linear-lanceolate in smaller specimens. Central area is transversally elliptic or subrectangular with a shortened one stria on one side. A single stigma is present opposite a single shortened stria. The raphe is undulate and lateral with slightly expanded proximal ends that deflected towards the stigma side. Transapical striae are coarsely punctate, nearly parallel mid-valve, becoming radiate at the apices, about 12-16 in 10 μm. Areolae are about 25-27 in 10 μm. A distinct porefield is present at the footpole. Length of the valve 36-56 μm, and the breadth 12-13.5 μm.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema sphenovertex* Lange-Bertalot & Reichardt 1996**

Ref. Lange-Bertalot & Metzeltin 1996, p. 73, pl. 65, figs. 22- 23; Hofmann et al. 2013, p. 98, pl. 315, figs. 26-27; Vidaković et al. 2018, p. 268, pl. 2, fig. 13.

Status of name: accepted taxonomically.

Diagnosis: Valves are linear, moderately clavate form, almost elliptical-lanceolate or naviculoid shape with indistinct protracted, cuneate, rounded, subrostrate headpole and narrowly rounded footpole. Axial area is moderate, linear. Central area is unilateral and formed by the lack of striae on one side of the valve. An isolated stigma is present on the other side of the central area. Raphe is distinctly lateral; proximal raphe endings with central pores that are slightly deflected towards the stigmata side. Transapical striae are radiate throughout, widely spaced, strongly radiate at the ends, about 10-12 in 10 μm. Length of the valve 15-40 μm, and the breadth 5-7 μm.

Ecological preference: oligotrophic waters, poor in electrolytes and rich in calcium and silicon (Szczepocka & Rakowska 2015).

Distribution in Poland: Czarna Staszowska River near the Drogowle village in south-eastern Poland (Szczepocka & Rakowska 2015)

***Gomphonema stonei* Reichardt 1999**

(Pl. 141, figs. 20-25)

Ref. Reichardt 1999, p. 16, pl. 13, figs. 1-17; Kihara et al. 2007, p. 86, fig. 33; Solak et al. 2016, p. 575, fig. 4: 68-69.

Status of name: accepted taxonomically.

Diagnosis: Valves are moderate clavate, linearlanceolate to rhombic-lanceolate, and narrowing gradually from the centre toward the ends to form an acutely rounded, not protracted headpole, and narrow, attenuated, acutely rounded footpole. Axial area is moderate, linear to weakly lanceolate. Central area is small, sometimes lateral, rectangular, and formed by shortened central striae on one side. An isolated stigma is found on the other side of the central area. Raphe is lateral, broad, narrowing toward the proximal and distal ends. Proximal raphe endings are dilated, with small central pores that deflected towards the stigma side; the distal raphe endings are curved onto the valve mantle and deflected opposite the stigma side. Transapical striae are uniseriate, lineolate, slightly to moderately radiate throughout the valve, about 1113 in 10 μm; Puncta 21-24 in 10 μm. Length of the valve 35-68 μm, and the breadth 8.5-11 μm.

Ecological preference: Found in benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: New record.

***Gomphonema subclavatum* (Grunow) Grunow 1884**

Ref. Hustedt 1930, p. 375, fig. 705; Germain 1981, p. 304, pl. 111, fig. 13; Krammer & Lange-Bertalot 1986, p. 367, pl. 163, fig. 7; Bąk et al. 2012, p. 182, pl. 66; Kihara et al. 2015, p. 25, fig. 104; Levkov et al. 2016, p. 123, pl. 64, figs. 1-19; Bahls et al. 2018, p. 45, pl. 8, figs. 16, 17; p. 82, pl. 45, figs. 24-28; Medeiros et al. 2018, p.19, fig. 74; Solak et al. 2021, p. 213, pl. 4, figs. 62, 63.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema montanum* var. *subclavatum* Grunow 1880

Gomphonema longiceps var. *subclavatum* (Grunow) Hustedt 1930

Diagnosis: Valves are clavate, rhombic-lanceolate to linear-lanceolate, with broadly rounded not protracted headpole and attenuate-narrow, rounded footpole. Axial area is narrow and linear. Central area is small, somewhat elliptic, and limited by shortening of the median striae. An isolated stigma is present close to the proximal central pores at the median stria end. Raphe is slightly undulate; the proximal raphe endings are dilated into pore shape, deflected toward the stigma; the distal raphe endings are slightly curved to the same side onto the valve mantle. Transapical striae are radiate throughout the valve, tending to be parallel close to the ends, about 9-11 in 10 μm. Length of the valve 25-52 μm, and the breadth 7-10 μm.

Ecological preference: Fresh-brackish water, circumneutral, high oxygen requirements, β-mesosaprobic, oligo-mesotraphentic (Van Dam et al. 1994); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 100 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013a, b; 2014 a); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Frequent in Radomno and Młynek Lakes

Distribution in Poland: Springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Duszatyńskie Lakes (Western Bieszczady Mts.); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Lubcza, Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributaries, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema sublaticollum* Levkov, Mitic-Kopanja & Reichardt 2016**

(Pl. 142, figs. 1-3)

Ref. Levkov et al. 2016, p. 124, pl. 27, figs. 1-27; pl. 28, figs. 1-35; pl. 29, figs. 1-7; Bahls et al. 2018, p. 46, pl. 9, figs. 15-20; Jüttner et al. 2018, p. 290, figs. 56–87.

Status of name: accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate with a slightly swollen central part and a large subcapitate, broadly rounded headpole, and a narrow, acutely rounded footpole. Axial area is narrow and linear. Central area is a slightly irregular shape, somewhat rectangular, bordered by 3-4 shortened striae of different lengths. One stigma is located near the valve centre at shortened striae. Raphe is lateral, undulate; external proximal raphe endings dilated with small central pores that deflected slightly towards the stigma side; the distal raphe endings are curved onto the valve mantle opposite the stigma side at the headpole and are bisected by the apical pore field at the footpole. Transapical striae are uniseriate, weakly punctate, markedly radiate from the valve centre to the footpole, becoming weakly radiate towards the headpole, are about 12-14 in 10 μm. Length of the valve 30-55 μm, and the breadth 7-9 μm.

Ecological preference: *Gomphonema sublaticollum* was originally described from Macedonia, where it was found in a montane oligotrophic lake and stream (Levkov et al. 2016); it is reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Jeziorak Lake.

Distribution in Poland: New record.

***Gomphonema subtile* Ehrenberg 1843**

Ref. Hustedt 1930, p. 376, fig. 709; Krammer & Lange-Bertalot 1986, p. 369, pl. 162, figs. 10-13; Lange-Bertalot & Metzeltin 1996, p. 246, pl. 64, fig. 4; Bąk et al. 2012, p. 182, pl. 64; Reichardt 2015, p. 28, figs. 1-14; Bahls et al. 2018, p. 46, pl. 9, fig. 10; p. 104, pl. 67, fig. 8.

Status of name: accepted taxonomically.

Synonym: *Gomphoneis subtilis* (Ehrenberg) Tempère & Peragallo 1915

Diagnosis: Valves are narrow lanceolate, with marked constriction below the headpole and obvious swelling in the mid-valve. The headpole is truncated to a broadly capitate, flatly rounded, sitting on a narrow 'neck', and the footpole is distinctly protracted, attenuated, narrow and acutely rounded. Axial area is narrow and linear. Central area is moderate, somewhat unilateral, formed by only one short stria. A single stigma is present in the central area. Raphe is lateral; the proximal raphe endings are dilated, drop-shaped pores that are deflected slightly to the stigma side; the distal raphe endings are deflected to the same side onto the valve mantle. Transapical striae are finely punctate, slightly radiate or nearly parallel throughout, about 11-13 in 10µm. Puncta about 28-30 in 10µm. Length of the valve 32-51 µm, and the breadth 5.5-8.0 µm.

Ecological preference: Freshwater, circumneutral, high oxygen requirements, oligosaprobic, oligo-mesotraphentic (Van Dam et al. 1994).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: New record.

***Gomphonema subtile* var. *sagitta* (Schumann) Grunow 1880**

Ref. Hustedt 1930, p. 377, fig. 710; Metzeltin & Witkowski 1996, p. 74, pl. 21, figs. 11-13; Reichardt 2015, p. 34, figs. 31-48; Bahls et al. 2018, p. 104, pl. 67, fig. 9.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema sagitta* Schumann 1863

Diagnosis: Valves are linear-lanceolate, with cuneate or rhombus–shaped headpole and narrow, protracted, acutely rounded footpole. Axial area is narrow and linear. Central area is unilateral, formed by only one short stria. On the opposite side, one shortened stria ends with a distinct stigma. Raphe is lateral, narrow at the proximal end. The proximal raphe endings are distinct, wider apart and deflected towards the stigma side. Transapical striae are radiate at the centre, nearly parallel towards the ends, about 10-13 in 10µm. Puncta indistinct, about 28-32 in 10µm. Length of the valve 35-62 µm, and the breadth 5.5-7.0 µm.

Ecological preference: *G. sagitta* is distributed in the same habitat of *G. subtile* (Reichardt 2015); It is reported from the water of ponds of circumneutral to slightly alkaline pH (6.7-7.9), with conductivity ranging between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); as *Gomphonema sagitta* Schumann reported from the ponds in the middle course of the Chechło River that were impacted by the discharge of mine waters and municipal sewage, south Poland (Pociecha et al. 2020).

***Gomphonema supertergestinum* Reichardt 2009**

Ref. Novais et al. 2009, p. 264, figs. 266-282; figs. 288-292; Reichardt 2009, p. 168, figs. 66-81, 93-96; Levkov et al. 2016, p.127, pl. 165, figs. 33-42.

Status of name: accepted taxonomically.

Diagnosis: Valve is clavate, sublinear-elliptic to elliptic in smaller individuals, with broadly rounded headpole, and rostrate, acutely rounded footpole. Axial area is very narrow and linear. Central area is large, expanded unilaterally to the valve margin and the presence of a short stria on the opposite side. Raphe is slightly lateral; the proximal raphe endings are dilated with small central pores; the distal raphe endings are curved onto the valve mantle. An isolated stigma is positioned almost in between the proximal raphe ends. Transapical striae are radiate in the middle part of the valve to almost parallel at the ends, about 11-12 striae in 10 µm. Length of the valve 16.5-35 µm, and the breadth 6.0-9.0 µm.

Remarks: *G. supertergestinum* is relatively similar to *G. tergestinum*, but it can be easily distinguished in LM by the more robust valve outline, larger dimensions and lower density of striae in 10 μm in *G. supertergestinum*.

Ecological preference: This taxon has been found in epilithic samples from several European watercourses (Novais et al. 2009); lentic habitats and standing waters (Reichardt 2009).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: The Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015).

***Gomphonema tergestinum* (Grunow) Fricke 1902**

Ref. Hustedt 1930, p. 377, fig. 717; Patrick & Reimer 1975, p. 136, pl. 18, fig. 5; Germain 1981, p. 304, pl. 113, figs. 12-15; Krammer & Lange-Bertalot 1986, p. 373, pl. 162, figs. 6-7; Reichardt & Lange-Bertalot 1991, pl. 10, figs. 14-17; Lange-Bertalot & Metzeltin 1996, p. 314, pl. 98, fig. 19; Levkov et al. 2007, p. 486, pl. 166, fig. 19; Novais et al. 2009, p. 262, figs. 1, 80-252; Wojtal 2009, p. 224, pl. 12, figs. 30-33; Bąk et al. 2012, p. 182, pl. 66; Levkov et al. 2016, p. 128, pl. 163, 1-31; Solak et al. 2016, p. 575, pl. 4, figs. 72-74; Jüttner et al. 2018, p. 310, figs. 211-230.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema semiapertum* var. *tergestinum* Grunow 1880
Gomphonema lanceolatum f. *tergestina* (Grunow) A.Cleve 1880
Gomphonema parvulum var. *tergestina* (Grunow) Cleve 1894
Gomphonema lanceolatum f. *tergestina* (Grunow) A.Cleve 1955

Diagnosis: Valves are linear-elliptic, elliptical-lanceolate to elliptic with subrostrate, somewhat subcapitate, broadly rounded headpole and narrow, attenuate, rounded footpole. Axial area is linear and narrow. Central area is asymmetric, large, expanded unilaterally to the valve margin and the presence of a short stria on the opposite side. An isolated stigma is located near the valve centre, almost between the proximal raphe ends. Raphe is filiform and straight; the proximal raphe endings are dilated; the distal raphe endings are weakly bent before curving onto the mantle. Transapical striae are uniseriate, radiate throughout the valve, and strongly radiate at the valve centre, about 13-15 in 10 μm. Length of the valve 15-35 μm, and the breadth 5-8 μm.

Ecological preference: An alkaliphilous, oligosaprobous, oligo-mesotraphentic and fresh brackish water species (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); very common and often very abundant in fast-flowing waters or in the wave zone in lakes (Bąk et al. 2012); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4); electrolytic conductivity ranged from 164 μS/cm to 528 μS/cm, temperature 10.0-19.9 (Noga et al. 2013a, b); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Frequent in Młynek and Radomno Lakes.

Distribution in Poland: the Vistula River (Turoboyski 1962); Mszanka stream (Starmach 1966a); Skawa River (Chudyba 1968); Czarny Dunajec River tributary (Wasylik 1971); Mazurian lakes (Chudyba 1975, 1979); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Wisłok River and the catchment area including rivers and streams (Zalew Rzeszowski, Łubienka, San (near Jarosław), Różanka, Morwawa, Baryczka, Pielnica, Stobnica, Mleczka, Strug, Ryjak, Wielopolka, Trzcianka, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of

the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak, 2017); Rzeczyca stream and its tributaries, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Gomphonema trigonocephalum* Ehrenberg 1854**

(Pl. 142, figs. 4-16)

Ref. Hustedt 1930, p. 371, fig. 686; Hartley et al. 1996, p.230, pl. 107, fig. 6

Status of name: accepted taxonomically.

Synonym: *Gomphonema acuminatum* var. *trigonocephalum* (Ehrenberg) Van Heurck 1880

Diagnosis: Valves are heteropolar, linear-lanceolate to rhombic-lanceolate, broadest near mid-valve with narrowly rounded to broadly cuneate headpole, and acutely rounded footpole. Larger valves with a weakly constricted margin between headpole and mid valve, while the constriction in smaller specimens is indistinct. Axial area is narrow, linear-lanceolate. Central area is small, formed by the shortening of a single central stria on both valve sides. A single stigma is present in the central area and separated from the long central stria. Raphe is lateral, weakly undulated; the proximal raphe endings are simple, slightly expanded. Transapical striae are coarsely punctate, parallel in mid-valve, about 9-12 in 10 μm, becoming radiate and denser towards the footpole, about 12-15 in 10 μm. Puncta about 22-25 in 10 μm. Length of the valve 40-60 μm, and the breadth 7-9 μm at mid valve.

Ecological preference: Alkaliphilous, aerophilous (Kaczmarska 1976); benthic habitats of slightly alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes, and the Eemian paleolake deposits from the Struga site in central Poland.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema truncatum* Ehrenberg 1832**

(Pl. 142, figs. 17-24)

Ref. Hustedt 1930, p. 377, fig. 714; Patrick & Reimer 1975, p. 118, pl. 16, fig. 3; Germain 1981, p. 301, pl. 112, figs. 1-12; pl. 161, fig. 4; Krammer & Lange-Bertalot 1986, p. 369, pl. 159, figs. 11-18; Ehrlich 1995, p. 114, pl. 32, fig. 16; Lange-Bertalot & Metzeltin 1996, p. 244, pl. 63, figs. 13-14; pl. 97, figs. 1-6; Metzeltin & Witkowski 1996, p. 74, pl. 21, figs. 17-18; Reichardt 2001, p. 208, pl. 2, figs. 10–11; pl. 9, figs. 1-21; pl. 11, figs. 1-3; pl. 14, figs. 14-20; Wojtal 2009, p. 224, pl. 14, figs. 23-25; pl. 73, figs. 7-8; Kihara et al. 2015, p. 25, fig. 105; Bahls et al. 2018, p. 46, pl. 9, figs. 12-13.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema constrictum* Ehrenberg 1844

Gomphonema constrictum var. *truncatum* (Ehrenberg) Gutwinski 1887

Gomphonema acuminatum var. *constrictum* (Kützing) Carruthers 1864

Diagnosis: Valves are broadly clavate, marked swollen at the centre with subtruncate, capitate, broadly rounded headpole, and narrow, attenuated, acutely rounded footpole. Axial area is linear, moderate. Central area is irregular, transapically broadened, somewhat unilateral, stellate, or transverse, formed by irregularly shortened striae. An isolated stigma is located in the central area. Raphe is strongly lateral, undulate; the proximal raphe endings are slightly expanded, deflected towards the stigma side; the distal raphe endings are curved onto the mantle at both poles. Transapical striae are punctate, radiate throughout the valve, slightly radiate at the headpole, widely spaced and alternately longer and shorter at the valve centre, about 1012 in 10 μm. Length of the valve 2462 μm, and the breadth 812 μm.

Ecological preference: Eutrophic lakes and slightly brackish water (CleveEuler 1955); oligohalobous "indifferent", alkaliphilous (Foged 1980); cosmopolitan, often recorded in streams with water of high conductivity, up to β-mesosaprobic (Krammer & Lange-Bertalot 1986); an alkaliphilous, β-mesosaprobous, meso- to eutraphentic and fresh brackish water species (Van Dam et al. 1994); recorded from water of temperature

was 6.2-9.0 C, moderate conductivity, and pH varied from 6.4 to 7.6 (Wojtal 2003); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and water pH varied within 7.25-9.58 (Bąk et al. 2006); freshwater with pH had an alkaline character or close to neutral water reactions 7.0-8.3, low to relatively high conductivity (100-764 μSx cm^{-1}), temperature 10.0-19.9 (Noga et al. 2013 a; Noga 2014 a); freshwater streams with pH was near neutral or alkaline (6.5-8.2), low to medium electrolytic conductivity ranged from 158 to 435 μS/cm (Peszek et al. 2015).

Occurrence: Common in Radomno Lake, frequent in Młynek, Kamionka and Jeziorak lakes, infrequent in the Eemian deposits from the Struga site in central Poland.

Distribution in Poland: The Wyżyna Krakowskoczęstochowska Upland. Młynowka stream (Gumiński 1947); fish ponds in Mydlniki (Siemińska 1947); Vistula River (Turoboyski 1956; Kyselowa & Kysela 1966); Pilica River (Kadłubowska 1964 b); spring of Szklarka stream (Skalska 1966 a); springs of Będkowka stream (Kubik 1970); Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Kobylanka stream, 30 km NW of Kraków Poland (Wojtal 2003); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); Periphyton of the littoral zone of lake Jeziorak Mały – Masurian Lake District, north-east Poland (Zębek et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn (Noga et al. 2013 a); Wisłok River and the catchment area including rivers and streams (Wisłok river, Zalew Rzeszowski, San (near Jarosław), Gołębiówka, Szuwarka, Świerkowiec, Lubcza, Różanka, Morwawa, Pielnica, Stobnica, Mleczka, Strug, Żołynianka, Matysówka) in the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); Żołynianka and Jagielnia streams, Podkarpacie province, south Poland (Peszek et al. 2015); Gulf of Gdansk and surrounding waters, the southern Baltic Sea (Plinski & Witkowski 2020).

***Gomphonema truncatum* var. *elongatum* (Peragallo & Héribaud) Patrick 1975**

(Pl. 141, figs. 26-28; pl. 143, figs. 1-8)

Ref. Patrick & Reimer 1975, p. 120, pl. 16, fig. 8; Hartley et al. 1996, p. 234, pl. 109, fig. 21.

Status of name: accepted taxonomically.

Synonym: *Gomphonema constrictum* var. *elongata* Peragallo & Héribaud 1893

Diagnosis: Valves are clavate, elongate with distinct undulation margins and marked swollen at the valve centre that is slightly larger than the headpole. The headpole is broadly rounded, capitate, and the footpole is narrower and protracted. Axial area is narrow and linear. Central area is small and subrounded or transversally expanded. A single stigma is distinct and located in the central nodule. Raphe is lateral, slightly undulate, filiform at the proximal and distal ends; the proximal raphe endings are slightly dilated with small central pores that are deflected slightly towards the stigma side; the distal raphe endings are deflected onto the mantle. Transapical striae are punctate, radiate throughout the valve, but become parallel towards the headpole, about 10-11 in 10 μm. length of the valve 48-50 μm, the breadth 8-11 μm.

Ecological preference: Reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Common in Radomno Lake, frequent in Młynek and Jeziorak Lakes.

Distribution in Poland: New record.

***Gomphonema turris* Ehrenberg 1843**

Ref. Hustedt 1930, p. 372, fig. 687; Foged 1980, p. 643, pl. 10, fig. 1; Krammer & Lange-Bertalot 1985, p. 44, pl. 37, figs 1-7; pl. 38, figs. 1-4, 8-12; Krammer & Lange-Bertalot 1986, p. 363, pl. 158, figs. 1-6; Zalat 1997, p. 114, pl. 3, fig.7; Azevedo et al. 2018, p. 773, figs. 4i, j; Medeiros et al. 2018, p. 9, figs. 14-15.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema acuminatum* var. *turris* (Ehrenberg) Wolle 1890

Gomphonema augur var. *turris* (Ehrenberg) Lange-Bertalot 1985

Diagnosis: Valves are clavate, somewhat obovate wedge-shaped with slight swelling in the median portion, and narrowing slightly from the middle toward the headpole, and abruptly forming wedge-shaped, cuneate, apiculate or rostrate apex, while narrowing gradually toward attenuate-rounded footpole. Axial area is linear, moderately broad. Central area is relatively wide, subrounded to quadrate or slightly elliptic, somewhat expanded unilaterally, limited by shortening median striae. An isolated stigma is present in the central area. Raphe is slightly sinuous; proximal raphe endings terminating with distinct central pores, deflected to the side of stigma; distal raphe endings are ventrally deflected. Transapical striae are uniseriate, coarsely punctate, slightly radiate, somewhat parallel at the valve centre, with more space between each other to radiate toward the ends, about 912 in 10 µm. Puncta about 18-20 in 10 µm. Length of the valve 5075 µm, and the breadth 10-14 µm.

Ecological preference: This taxon has the same ecological characters of *Gomphonema augur* Ehrenberg; alkaliphilous, aerophilous (Kaczmarska 1976).

Occurrence: Infrequent in Młynek and Radomno Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema utae* Lange-Bertalot & Reichardt 1999**

Ref. Reichardt 1999, p. 27, pl. 28, figs. 1-37; pl. 29, figs. 1-7; Bąk et al. 2012, p. 183, pl. 67; Kulikovskiy et al. 2016, p. 215, pl. 128, figs. 18-21.

Status of name: accepted taxonomically.

Diagnosis: Valves are lanceolate to linear-lanceolate, almost naviculoid form, sometimes with weakly triundulate margins. Valve tapering gradually from the centre towards the ends to form attenuated, bluntly rounded head- and footpoles. Axial area is narrow and linear. Central area is unilateral, rectangular and formed by the shortened median striae on one side of the central nodule. An isolated stigma is present on the other side of the central area, close to the proximal raphe endings. Raphe is slightly lateral and slightly undulate; the proximal raphe endings terminate with simple central pores; the distal raphe endings are deflected on the opposite side of the stigma. Transapical striae are finely punctate, slightly radiate to parallel, about 10-12 in 10 µm. Length of the valve 15-48 µm, and the breadth 5.0-6.5 µm.

Ecological preference: Freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 µS/cm to 528 µS/cm, temperature 10.0-19.9 (Noga et al. 2013 a, b); freshwater streams with pH was near neutral or slightly alkaline (6.5-7.4), low to medium electrolytic conductivity ranged from 158 to 369 µS/cm (Peszek et al. 2015); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); freshwater of ponds was from circumneutral to slightly alkaline pH (6.7-7.9), conductivity ranged between 412 and 892 µS cm^{-1} (Pociecha et al. 2020).

Occurrence: Infrequent in Młynek and Radomno Lakes.

Distribution in Poland: Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Baryczka stream left bank tributary of the River San, south-east Poland (Noga et al. 2013 a, b); Wisłok river and Baryczka, Stobnica, Mleczka, Matysówka streams of the territory of the Podkarpacie Province, south Poland (Noga et al. 2014 a); found in Jagielnia stream, Podkarpacie province, south Poland (Peszek et al. 2015); Saline waters of Pełczyska village, Łęczyca in the Łodź province, central Poland (Żelazna-Wieczorek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); the ponds in the middle course of the Chechło River, south Poland (Pociecha et al. 2020).

***Gomphonema vancampianum* Van de Vijver, Pottiez & Chavaux 2024**

(Pl. 143, figs. 9-10)

Ref. Van de Vijver, Pottiez & Chavaux 2024, p. 3, figs. 1-3.

Status of name: accepted taxonomically.

Diagnosis: Valves are apiculate-clavate, elliptic-lanceolate. Headpole is acutely rounded with a narrow, protracted, cuneate apex. The lower valve part abruptly narrows near the valve centre, then gradually tapers towards the acutely rounded footpole. The largest width is right above the mid-valve. Axial area is moderately broad and linear. Central area is asymmetrical, with a single long stria on one side and a shortened stria on the other side. Raphe is lateral and weakly undulating; the proximal raphe endings are indistinct, almost straight and small drop-like; the distal raphe endings are bisecting the apical pore field and continuing to the mantle. A single stigma is found in the central area close to the shortened stria. Transapical striae are punctate, parallel in the middle, becoming radiate towards the headpole, but remaining almost parallel or slightly radiate towards the footpole, about 9-11 in 10 μm, more closely spaced near the apices. Length of the valve 30-60 μm, and the breadth – 12 μm.

Ecological preference: typically found in calcium-carbonate-rich, oligotrophic lakes with low nutrient concentrations and low saprobity.

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema variscohercynicum* Lange-Bertalot & Reichardt 1999**

(Pl. 143, figs. 11-12)

Ref. Reichardt 1999, p. 37, pl. 41, figs. 1-4; Żelazna-Wieczorek & Knysak, 2017, p. 330, figs. 9-10.

Status of name: accepted taxonomically.

Synonym: *Gomphonema angustatum* var. *cymbelloides* P.Fusey 1951

Diagnosis: Valves are lanceolate, linear-lanceolate, naviculoid to cymbelloid form, with a wedge-shaped, subrostrate, attenuate and bluntly rounded poles. Axial area is narrow and linear. Central area is small, elliptical, or unilaterally expanded, limited by a shortened stria. An isolated stigma is present in the central area. Raphe is slightly lateral to filiform, straight at the ends; the proximal raphe endings are simple with small central pores that are deflected slightly towards the stigma; the distal raphe endings are curved onto the valve mantle on the opposite side of the stigma. Transapical striae are radiate throughout the valve, more spaced at the central part of the valve, about 10-13 in 10 μm. Length of the valve 41-48 μm, and the breadth 6-6.5 μm.

Ecological preference: the species reported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 μS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017); reported from the benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Infrequent in Jeziorak Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017).

***Gomphonema ventricosum* Gregory 1856**

Ref. Hustedt 1930, p. 377, fig. 716; Krammer & Lange-Bertalot 1986, p. 373, pl. 162, figs. 4-5; Yoshitake et al. 2009, p. 421, pl. 1, figs. 1-12; pl. 2, figs. 13-23; pl. 3, figs. 24-29; Van de Vijver et al. 2023, p. 2, figs. 1-15.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema capitatum* var. *ventricosum* (Gregory) Rabenhorst 1864
Gomphonema constrictum f. *ventricosum* (Gregory) Mayer 1928
Gomphonema constrictum var. *ventricosum* (Gregory) Z.X.Shi 2014

Diagnosis: Valves are lanceolate-clavate, broadest at the centre with steeply concave towards the apex, forming a protruding broadly rounded headpole and tapering gradually to form a protracted, narrower, rounded footpole. Axial area is relatively broad, narrowly lanceolate, widening towards the valve centre. Central area is distinct, mostly irregularly elliptic, formed by 4-5 shortened radiating striae on either side. A single stigma is present in the central area. Raphe is weakly undulate and lateral; the proximal raphe endings are simple to weakly inflated, deflected towards the stigma side, internally hooked and recurved; the distal raphe endings are long, unilaterally bent, continuing onto the valve mantle and internally terminating onto well-developed helictoglossae. Transapical striae are distinctly punctate, uniseriate, curved in the central area, radiate throughout the entire valve, about 12-14 in 10 μm. Length of the valve 23-60 μm, and the breadth 9-15 μm.

Ecological preference: Freshwater, high oxygen requirements, oligosaprobic, oligotraphentic (Van Dam et al. 1994).

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976).

***Gomphonema vibrio* Ehrenberg 1843**

(Pl. 143, figs. 13-17)

Ref. Hustedt 1930, p. 376, fig. 698; Reichardt & Lange-Bertalot 1991, p. 522, pl. 2, figs. 1-9; Bąk et al. 2012, p. 184, pl. 66; Das & Adhikary 2014, p. 250, pl. 19, fig. 10; Liu et al. 2021, p. 1054, figs. 110-126; Solak et al. 2021, p. 215, pl. 4, figs. 64, 65.

Status of name: accepted taxonomically.

Synonyms: *Gomphonema intricatum* var. *vibrio* (Ehrenberg) Cleve 1894
Gomphonema dichotomum var. *vibrio* (Ehrenberg) Compère 1975

Diagnosis: Valves are linear-lanceolate, clavate with weakly inflated centre, weakly protracted, broadly rounded, rostrate or weakly subcapitate headpole and narrow, rounded to cuneate footpole. Axial area is narrow at the poles, widening slightly towards the valve centre. Central area is asymmetric, large, unilateral, rectangular, bordered by one short stria, opposite a longer central stria on the other side. An isolated stigma is present in the central area. Raphe is straight, slightly lateral; the proximal raphe endings are straight and slightly dilated, internally hooked; the distal raphe endings are weakly deflected, extend onto the mantle and bisect the apical pore field at the footpole. Transapical striae are uniseriate, punctate, radiate throughout the valve, widely spaced at the centre, strongly radiate at the poles, about 7-9 in 10 μm at the valve centre, 11-12 in 10 μm at the ends. A distinct bilobed apical pore field is present at the footpole. Length of the valve 60-80 μm, and the breadth 7-10 μm.

Ecological preference: Fresh-brackish water, alkaliphilous, high oxygen requirements, β-mesosaprobic, meso- to eutraphentic (Van Dam et al. 1994); oligotrophic and dystrophic waters, poor in electrolytes with good ecological quality (Szczepocka & Rakowska 2015); reported from the shallow, benthic habitats of alkaline, meso-to eutrophic freshwater environments.

Occurrence: Frequent in Radomno and Młynek Lakes.

Distribution in Poland: Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Lake Piaski in Western Pomerania, north-west Poland (Witkowski et al. 2011); Czarna Staszowska River in south-east Poland (Szczepocka & Rakowska 2015).

***Gomphonema vibrio* var. *subcapitatum* (A. Mayer) Lee 1992**

(Pl. 144, figs. 1-4)

Ref. Mayer 1928, p. 121, pl. 4, figs. 17-18; Eliasz-Kowalska 2017, p. 266, figs. 2-14, 21-25.

Status of name: accepted taxonomically.

Synonym: *Gomphonema intricatum* f. *subcapitatum* Mayer 1928

Diagnosis: Valves are linear-lanceolate, with slightly swollen mid-valve, weakly protracted, capitate, broadly rounded headpole; protracted, narrow, acutely rounded footpole and both poles with heavily silicified pseudosepta. Axial area is narrow at the ends, widening slightly towards the valve centre. Central area is asymmetric, large, unilateral, rectangular, and bordered by one short stria. An isolated stigma is present at the end of the median stria. Raphe is straight, slightly lateral; the proximal raphe endings are straight and slightly dilated; the distal raphe endings are deflected onto the mantle and bisect the apical pore field at the footpole. Transapical striae are uniseriate, weakly radiate in the mid-valve, becoming more radiate and denser towards headpole and footpole, about 8-9 in 10 μm at the valve centre, 11-13 at the ends and Puncta about 20-25 in 10 μm. Length of the valve 45-76 μm, and the breadth 8-11 μm.

Ecological preference: Unknown, it is reported from freshwater lakes with pH values 4.0-8.3 and conductivity 25-395 μS cm L-1 during spring, summer and fall (Eliasz-Kowalska 2017); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: From the lakes of the Pojezierze Suwalskie lakeland in Wigry National Park, northeast Poland (Eliasz-Kowalska 2017)

***Gomphonema vibrioides* Reichardt & Lange-Bertalot 1991**

(Pl. 144, figs. 5-8)

Ref. Reichardt & Lange-Bertalot 1991, p. 524, pl. 3, figs. 1-9; Slate & Stevenson 2007, p. 369, fig. 30.

Status of name: accepted taxonomically.

Diagnosis: Valves are narrowly linear-lanceolate, with a bluntly rounded headpole and narrow, acutely rounded footpole. Valves are inflated or tumid in the middle, a feature more pronounced in larger valves. Axial area is straight, moderately wide, narrow at the apices, widening slightly towards the valve centre. Central area is small, elliptical, somewhat transversally expanded and limited by shortened median striae. An isolated stigma is present next to a shortened median stria along the central area. Raphe is lateral, straight to slightly undulated, narrow at the ends; the proximal raphe endings are slightly dilated with small central pores that deflected towards the stigma side; the distal raphe endings are weakly curved and extend onto the mantle. Transapical striae are uniseriate, punctate, radiate throughout the valve, somewhat subparallel at the poles, about 8-10 in 10 μm at the valve centre, 11-13 in 10 μm at the ends. Length of the valve 74-110 μm, and the breadth 10-12 μm.

Ecological preference: This species is recorded as oligohalobous and found in periphyton, tychoplankton, and plankton, tolerant to a wide range of conductivity (Patrick & Reimer 1975; Reichardt & Lange-Bertalot 1991); reported from the benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

***Gomphonema vidarbhense* Sarode & Kamat 1984**

(Pl. 144, figs. 9-12)

Ref. Sarode & Kamat 1984, p. 189, pl. 23, fig. 546.

Status of name:. accepted taxonomically.

Diagnosis: Valves are clavate, linear-lanceolate, with a broadly rounded headpole and footpole. Valves are swollen in the middle. Axial area is moderate, linear, and widening slightly towards the valve centre. Central area is large, transversally expanded and limited by shortened median striae. An isolated stigma is present on the central nodule, at a distance from a shortened median stria. Raphe is lateral, straight, narrow at the ends; the proximal raphe endings are slightly dilated with small central pores that deflect towards the stigma side; the distal raphe endings are curved and extend onto the mantle. Transapical striae are uniseriate, coarsely punctate, widely spaced, slightly radiate throughout the valve, strongly radiate at the footpole, about 6-7 in 10 μm at the valve centre, 8-9 in 10 μm at the ends. Length of the valve 94-100 μm, and the breadth 13-15 μm.

Ecological preference: Benthic habitats of slightly alkaline, mesotrophic freshwater environments.

Occurrence: Frequent in Radomno Lake.

Distribution in Poland: New record.

Genus *Reimeria* Kociolek & Stoermer 1987

Diagnosis: Valves are asymmetric to the longitudinal axis. Central area is unilateral, extending to the ventral margin. Central nodule is small. Raphe is straight, expanded laterally; internal proximal raphe endings are recurved in the same direction toward the apices. One dorsal stigma is positioned near the proximal raphe ends. Apical pore fields are located at the poles, restricted to the ventral margin and mantle or divided into two parts by the curvature of the external distal raphe ending, the two parts unequal in size, the smaller on the mantle of the valve apex, the larger on the ventral mantle. Striae of one or two rows of puncta, C-shaped foramina present or absent.

Holotype species: *Reimeria sinuata* (Gregory) Kociolek & Stoermer 1987

***Reimeria fontinalis* Levkov & Ector 2010**

Ref. Levkov & Ector 2010, p. 473, figs. 1-13, 42-47; Kulikovskiy et al. 2016, p. 220, pl. 128, figs. 40-42; Rybak et al. 2019, fig. 3: 5.

Status of name: accepted taxonomically.

Diagnosis: Frustules are rectangular or wedge-shaped in girdle view. Valves are slightly asymmetrical to the longitudinal axis. The dorsal and ventral margins are convex, and the ventral margin is sometimes tumid in the middle. Apices are subprotracted, rounded and slightly ventrally bent. Axial area is broad and linear. Central area is wide and extends to the ventral margin, widened on the dorsal side by the shortening of one central stria. A single isolated stigma is sited slightly to the dorsal side of the central area, or sometimes situated on the valve centre. Raphe is linear, filiform or slightly lateral. The proximal raphe endings are slightly bent towards the ventral side of the valve, and the internal raphe endings are dorsally curved. The distal raphe endings are ventrally curved. Transapical striae are subparallel or slightly radiate throughout the valve, about 6-9 in 10 µm. Apical pore fields are present at each pole and restricted to the ventral valve mantle. Length of the valve 14-40 µm, and the breadth 6-9 µm.

Ecological preference: This taxon is considered as typical oligotrophic ecosystems, develops in circumneutral to slightly alkaline waters (pH of 7.2-7.6), low specific conductivity of 120-180 µS/cm, orthophosphate concentration of 6.4-8.9 µg/L, and nitrate concentration of 0.12-0.80 mg/l (Levkov & Ector 2010); eported from alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Rdomno Lake.

Distribution in Poland: Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady, Eastern Carpathians, south Poland (Rybak et al. 2019).

***Reimeria ovata* (Hustedt) Levkov & Ector 2010**

Ref. Hustedt 1930, p. 361, fig. 668 c; Hartley et al. 1996, p. 518, pl. 251, fig.12; Levkov & Ector 2010, p. 479, figs. 14-20, 48-53; Kulikovskiy et al. 2016, p. 220, pl. 128, figs. 32-34; Noga et al. 2017, p. 126, fig. 2 m-u, fig. 3.

Status of name: accepted taxonomically.

Synonyms: *Reimeria sinuata* var. *ovata* (Hustedt) Metzeltin & Lange-Bertalot
Cymbella sinuata var. *ovata* Hustedt 1922
Cymbella sinuata f. *ovata* (Hustedt) Hustedt 1930
Reimeria sinuata f. *ovata* (Hustedt) Hartley 1996

Diagnosis: Valves are slightly dorsiventral, asymmetrical to the longitudinal axis, and reniform to elliptical in smaller specimens. The dorsal and ventral margins are convex; usually, the ventral margin is slightly tumid in the central valve region. Apices are broadly rounded to slightly truncated and not separated from the valve body. Axial area is narrow and linear. Central area is a broad unilateral fascia extending to the ventral valve margin, on the dorsal side, small and flanked by a shortened central stria. One isolated stigma is present on the dorsal side of the central area, sometimes in the valve centre between the proximal raphe endings and separated from the dorsal central stria. Raphe branches are linear, filiform, or slightly lateral. Proximal raphe endings are indistinct and slightly ventrally bent; distal raphe endings are dorsally curved. Transapical striae are parallel or slightly radiate throughout the valve, about 9-10 in 10 µm. Length of the valve 14-30 µm, and the breadth 6-8 µm.

Ecological preference: *R. ovata* occurs often in oligotrophic cold waters, it was recorded from alkaline water or close to neutral pH, very high saturation of oxygen (always >10 mg/l^{-1}) and a low nutrient content (Levkov & Ector 2010); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 µS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b); alkaline water, low electrolytic conductivity ranged from 78 to 284 µS cm-1; the oxygen saturation level was high (Noga et al. 2017); alkaline freshwater with pH 7.6-8.4, low conductivity 86-186 µS cm^{-1}, water temperature 5.5-13.0 (Żelazna-Wieczorek & Knysak 2017).

Occurrence: Infrequent in Młynek Lake.

Distribution in Poland: The species was often described as *Cymbella sinuata* f. *ovata*, and less commonly as *Cymbella sinuata* var. *ovata* (Sieminska & Wołowski 2003); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); identified from the Wołosatka, Wołosaty, Rzeczyca and Terebowiec streams, Bieszczady National Park, south Poland (Noga et al. 2016 b, 2017); Spring at the Goprowska

Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

***Reimeria sinuata* (Gregory) Kociolek & Stoermer 1987**

Ref. Hustedt 1930, p. 361, fig. 668 a, b; Foged 1959, p.74, pl. 10, figs. 5, 6; Patrick & Reimer 1975, p. 51, pl. 9, figs. 3 a- 4 b; Foged 1980, p. 639, pl. 9, figs. 15, 16; Krammer & Lange-Bertalot 1986, p. 341, pl. 148, figs. 10-17; Kociolek & Stoermer 1987, p. 457, figs. 1-10; Ehrlich 1995, p. 99, pl. 30, figs. 13-15; Lange-Bertalot & Metzeltin 1996, p. 300, pl. 91, fig. 14; pl. 105, fig. 6; Metzeltin & Witkowski 1996, p. 66, pl. 17, figs. 15-18; Wojtal 2009, p. 292, pl. 12, figs. 17–22; pl. 72, figs. 1, 2; Levkov & Ector 2010, p. 482, figs. 34-40, 54-58; Noga et al. 2013 c, p. 139, fig. 3: 1; Kulikovskiy et al. 2016, p. 221, pl. 128, figs. 35-39.

Status of name: accepted taxonomically.

Synonyms: *Cymbella sinuata* Gregory 1856
Cymbella curta Schmidt 1875
Cymbella abnormis Grunow 1880
Cymbella cistula f. *curta* (Schmidt) Østrup 1899
Cymbella sinuata var. *ovata* (Hustedt) A.Cleve 1955

Diagnosis: Valves are slightly dorsiventral, linear-elliptical to narrowly lanceolate. Dorsal margin is smoothly convex, and the ventral margin is slightly convex to straight with slight swelling at the centre. Apices are broadly rounded, capitate to subprotracted. Axial area is narrow, linear and located closer to the ventral margin. Central area is one-sided, extending to the ventral margin. A shortened stria is present on the dorsal side of the central area. A single stigma is located to the dorsal side of the central area. Raphe is filiform, eccentric, straight but sometimes slightly lateral; proximal raphe endings with small central pores which are deflected toward the ventral margin; distal raphe endings are curved onto the mantle. Transapical striae are slightly radiate, but appearing parallel in some specimens, about 10-12 in 10 μm in the middle of the dorsum and 14-15 at the ends. Length of the valve 17-25 μm, and the breadth 5-7 μm.

Ecological preference: the species is regarded as being oligohalobous, pH- indifferent (Hustedt 1957, Patrick & Reimer 1975); cosmopolitan, halobien indifferent, pH: alkaliphilous (Foged 1959); it develops well at a pH of about 8 (Cholnoky 1968); it is sensitive or highly sensitive to pollution, cosmopolitan, alkaliphilous, and oligohalobous indifferent (Lowe 1974; Krammer & Lange-Bertalot 1986; Steinberg & Schiefele 1988); fresh-brackish water, circumneutral, high oxygen requirements, β-mesosaprobic, mesotraphentic (Van Dam et al. 1994); reported from eutrophicated and β-mesosaprobic waters of the Szczecin Lagoon with water temperature 2.41 to 21.34ºC, salinity varied within 0.15-3.49‰, the dissolved oxygen concentration ranged within 42.4-224.9% (5.12-22.74mg/dm3) and Water pH varied within 7.25-9.58 (Bąk et al. 2006); low to moderate water conductivity range between 292 to 569 μS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); freshwater of an alkaline character or close to circumneutral reaction (pH 6.5-8.4), electrolytic conductivity ranged from 164 μS/cm, to 528 μS/cm, temperature 10.0-19.9, Nitrate slightly deviated from the standards (4.10-4.68 mg/l^{-1} (Noga et al. 2013 a, c); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86–246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016 b).

Occurrence: Infrequent in Radomno Lake.

Distribution in Poland: *Reimeria sinuata* is a more common species in Poland, occurring all over the country (Sieminska 1964; Rakowska 2001; Sieminska & Wołowski 2003; Wojtal & Sobczyk 2006; Wojtal 2009, Bak et al. 2012, Noga et al. 2014). The species was reported from Wyżyna Krakowskoc-zęstochowska Upland; fish ponds in Mydlniki (Siemińska 1947); Prądnik River (Stępień 1963); Pilica River (Kadłubowska 1964 a, b); springs of Kobylanka stream (Skalna 1969); springs of Będkowka stream (Kubik 1970); Sanka stream (Hojda 1971); Eemian freshwater sediments at Imbramowice near Wroclaw, south-west Poland (Kaczmarska 1976); Vistula River (Pudo 1977); Szczecin Lagoon, southern Baltic Sea, north-west Poland (Bąk et al. 2006); Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland,

south Poland (Wojtal 2009); Limnocrene and rheokren springs located in Mstów, Kraków-Częstochowa Upland south Poland (Żelazna-Wieczorek & Bik 2009); springs of Lódz Hills, Central Poland (Zelazna-Wieczorek 2011); found in Swibno-Vistula River estuary, north Poland (Majewska et al. 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn and Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Żołynianka stream, Podkarpacie province, south Poland (Peszek et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, and Rzeszów, Przyrwa stream, Województwo Podkarpackie, south-east Poland (Noga et al. 2016 a, b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributary, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019); Gulf of Gdansk and surrounding waters, southern Baltic Sea (Plinski & Witkowski 2020).

***Reimeria uniseriata* Sala, Guerrero & Ferrario 1993**

Ref. Sala et al. 1993, p. 445, figs. 7-10; Wojtal 2009, p. 292, pl. 12, figs. 24-29; Levkov & Ector 2010, p. 485, figs. 25-32, 59-64; Bąk et al. 2012, p. 297, pl. 62.

Status of name: accepted taxonomically.

Diagnosis: Valves are dorsiventral, slightly asymmetric to the longitudinal axis, linear-lanceolate with a convex dorsal margin, more or less straight and inflated in the mid-valve of the ventral margin. Apices are subcapitate or broadly rounded and not separated from the valve body. Axial area is narrow, linear, and more expressed ventrally. Central area is large, well-defined, unilateral, extending to the ventral margin; An isolated stigma is present near the central nodule, close to the proximal raphe ends. Raphe is straight, expanded laterally; the internal proximal raphe endings bend dorsally, and the external ends are curved slightly ventrally. The distal raphe endings are curved to the ventral side and bisect the apical pore fields. Transapical striae are uniseriate, slightly radiate to subparallel throughout the valve, about 9-11 in 10 μm in the middle of the dorsal side. One apical pore field in each pole is located on the ventral mantle and extends to the valve face. Length of the valve 15-40 μm, and the breadth 4-9 μm.

Ecological preference: The species was reported from alkaline, meso- to eutrophic waters with a moderate electrolyte content (Taylor et al. 2007); low to moderate water conductivity range between 292 to 569 μS cm^{-1}, and pH close to neutral, generally fluctuates around 7, water temperatures 5.5-15°C, high Nitrate value 15.5-20.3 mg/l^{-1}, and calcium content: 9.0-36.6 mg/l^{-1} (Wojtal 2009); it is probably a cosmopolitan species, common in benthic habitats (Wojtal 2009); it grows in mesotrophic rivers and lakes (Bąk et al. 2012); the species has a wide range of occurrence in various types of flowing waters, it develops in alkaline or neutral waters (usually pH 6.6-8), electrolytic conductivity ranged from 128 μS/cm to 528 μS/cm, Nitrate slightly deviated from the standards (4.10-4.68 mg/l^{-1}, oligo-, meso- and eutrophic waters (Noga et al. 2013 a, c; 2014); freshwater stream of alkaline, most frequently close to a pH level of 8 (6.4-8.4), the water was highly saturated in oxygen, calcium content ranged from 32.41 to 40.30 mg/l^{-1} and was characterized by low or average values of electrolytic conductivity (86-246 μS cm^{-1}) and low temperature 5.6-9.3°C (Noga et al. 2016b).

Occurrence: Infrequent in Radomno and Jeziorak Lakes.

Distribution in Poland: The species is reported from the Kobylanka stream (Kraków-Czestochowa Upland) (Wojtal & Sobczyk 2006); common in rivers and streams of south-east Poland (Noga 2012; Pajaczek et al. 2012; Noga et al. 2013; 2014; 2015); the Wołosaty stream and its tributaries, Kobylanka stream about 30 km northwest of Krakow and its springs, southern Wyżyna Krakowsko-Częstochowska upland, south Poland (Wojtal 2009); Springs and riverhead stream sections in the upper part of the San river, south Poland (Żelazna-Wieczorek 2012); Matysówka stream a right-bank tributary of Strug River, district of Tyczyn; Baryczka stream left bank tributary of the River San, and Duszatyńskie Lakes (Western Bieszczady Mts.), south-east Poland (Noga et al. 2013 a, b, c); Biała Tarnowska River, a right-bank tributary of Dunajec, south Poland (Noga et al. 2015); Terebowiec stream, south-eastern part of the Bieszczady National Park, south Poland (Noga et al. 2016 b); Spring at the Goprowska Pass (Bieszczady National Park), south-east Poland (Żelazna-Wieczorek & Knysak 2017); Rzeczyca stream and its tributarity, Western Bieszczady**,** Eastern Carpathians, south Poland (Rybak et al. 2019).

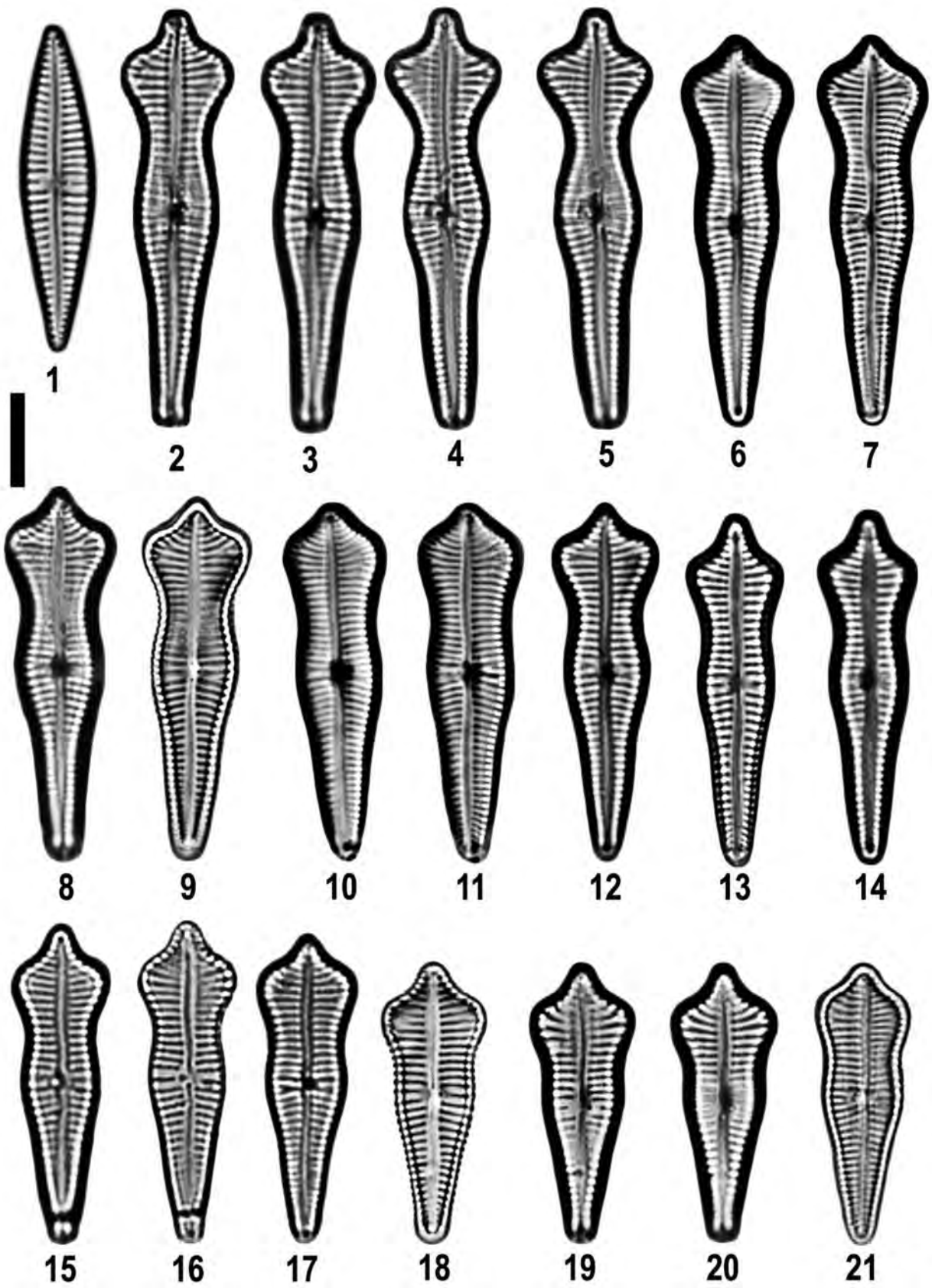


Plate 119: 1. *Gomphonema acidoclinatum* Lange-Bertalot & Reichardt 2004, Młynek Lake; 2-21. *Gomphonema acuminatum* Ehrenberg 1836, 2-5, 15-20. Radomno Lake; 6-12, 21. Młynek Lake; 13-14. Jeziorak Lake. Scale bar = 10 µm.

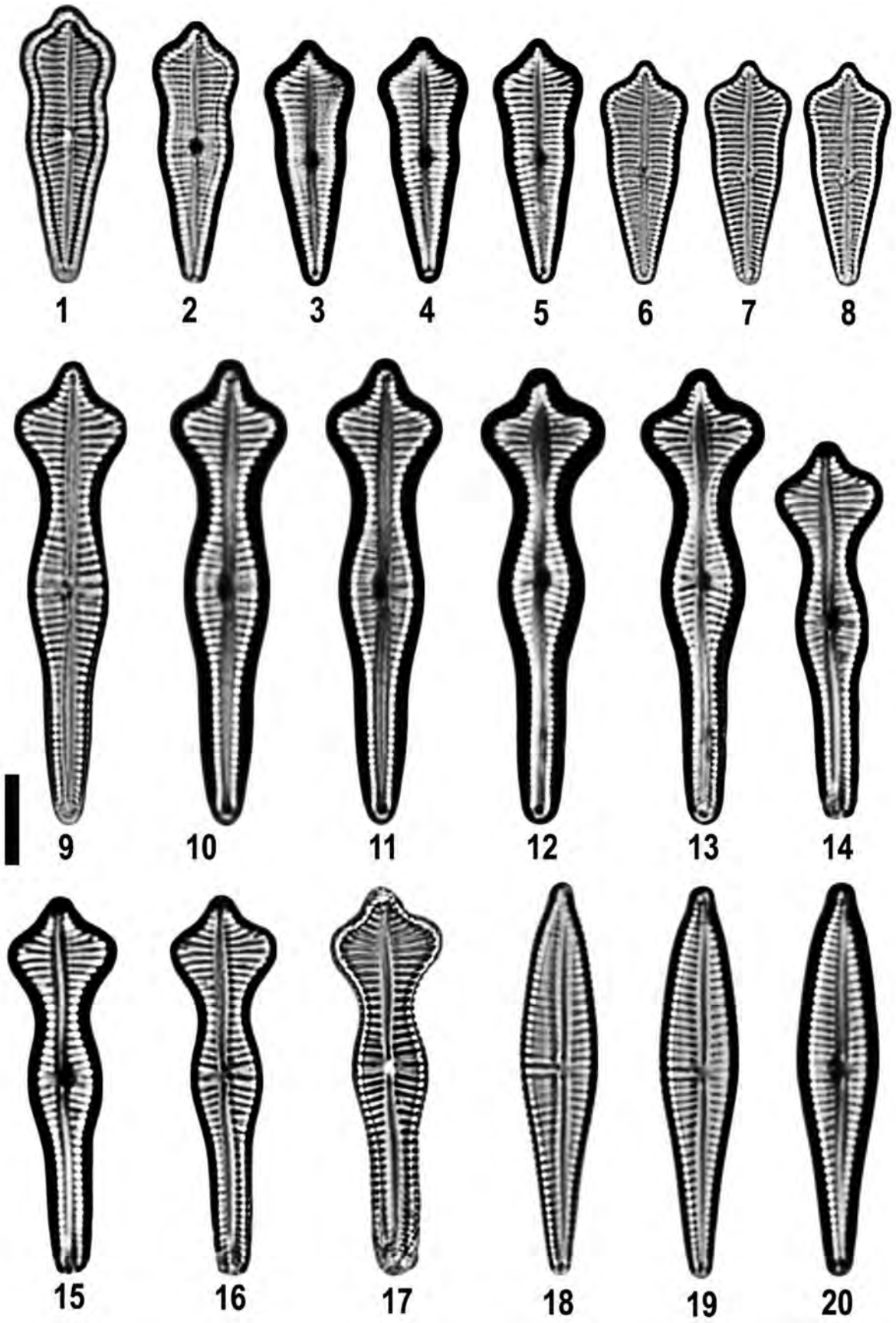


Plate 120: 1-8. *Gomphonema acuminatium* Ehrenberg 1836, Młynek Lake; 9-17. *Gomphonema acuminatum* var. *pusillum* Grunow 1880, 9-11. Radomno Lake; 12-17. Eemian paleolake deposits of central Poland; 18-20. *Gomphonema acutiusculum* (Otto Müller) Cleve-Euler 1955, Radomno Lake. Scale bar = 10 μm.

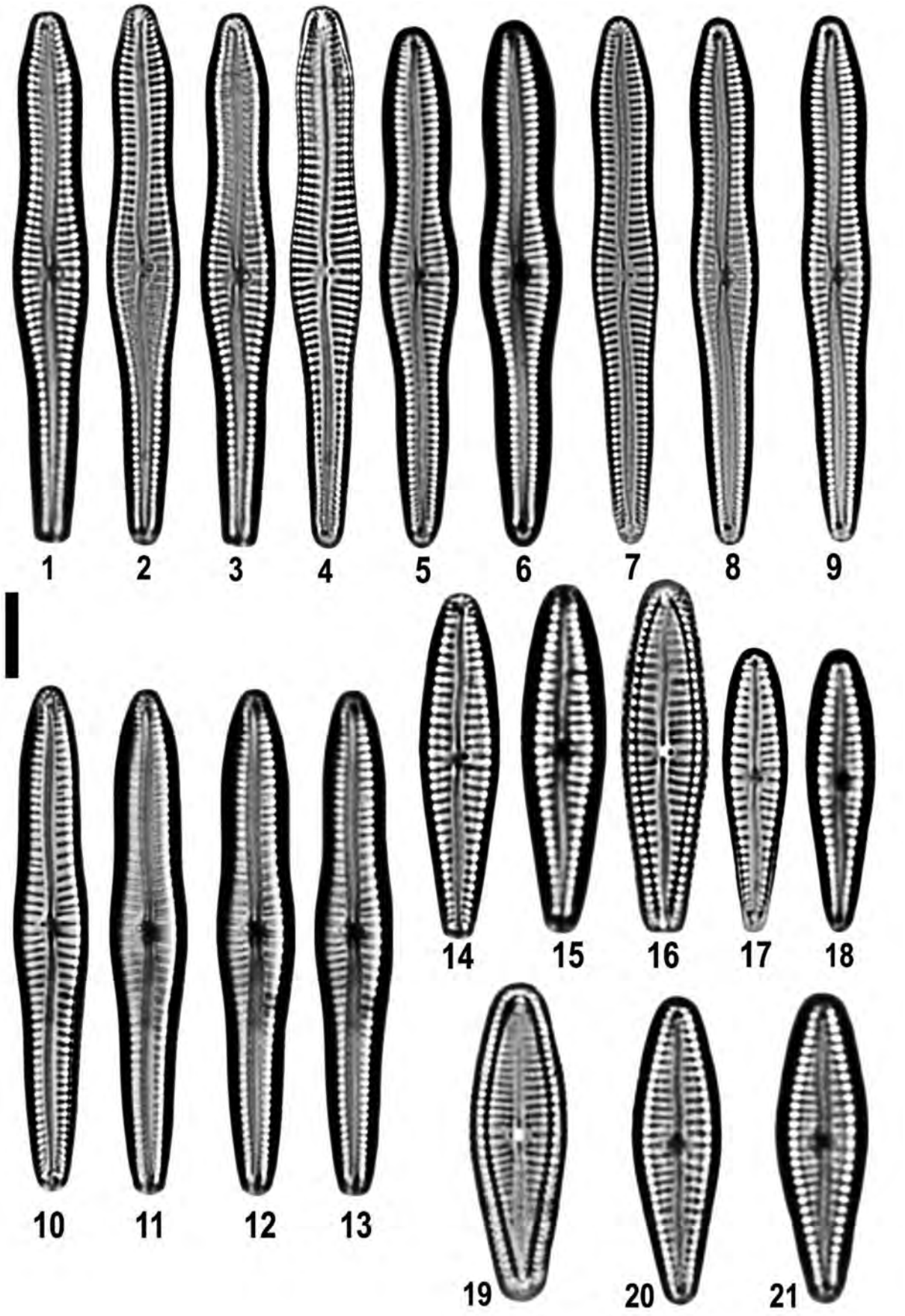


Plate 121: 1-13. *Gomphonema adductum* Hustedt 1965, Radomno Lake; 14-18. *Gomphonema affine* Kützing 1844, 14-16. Radomno Lake; 17-18. Młynek Lake; 19-21. *Gomphonema affine* var. *rhombicum* Reichardt 1999, Młynek Lake. Scale bar = 10 µm.

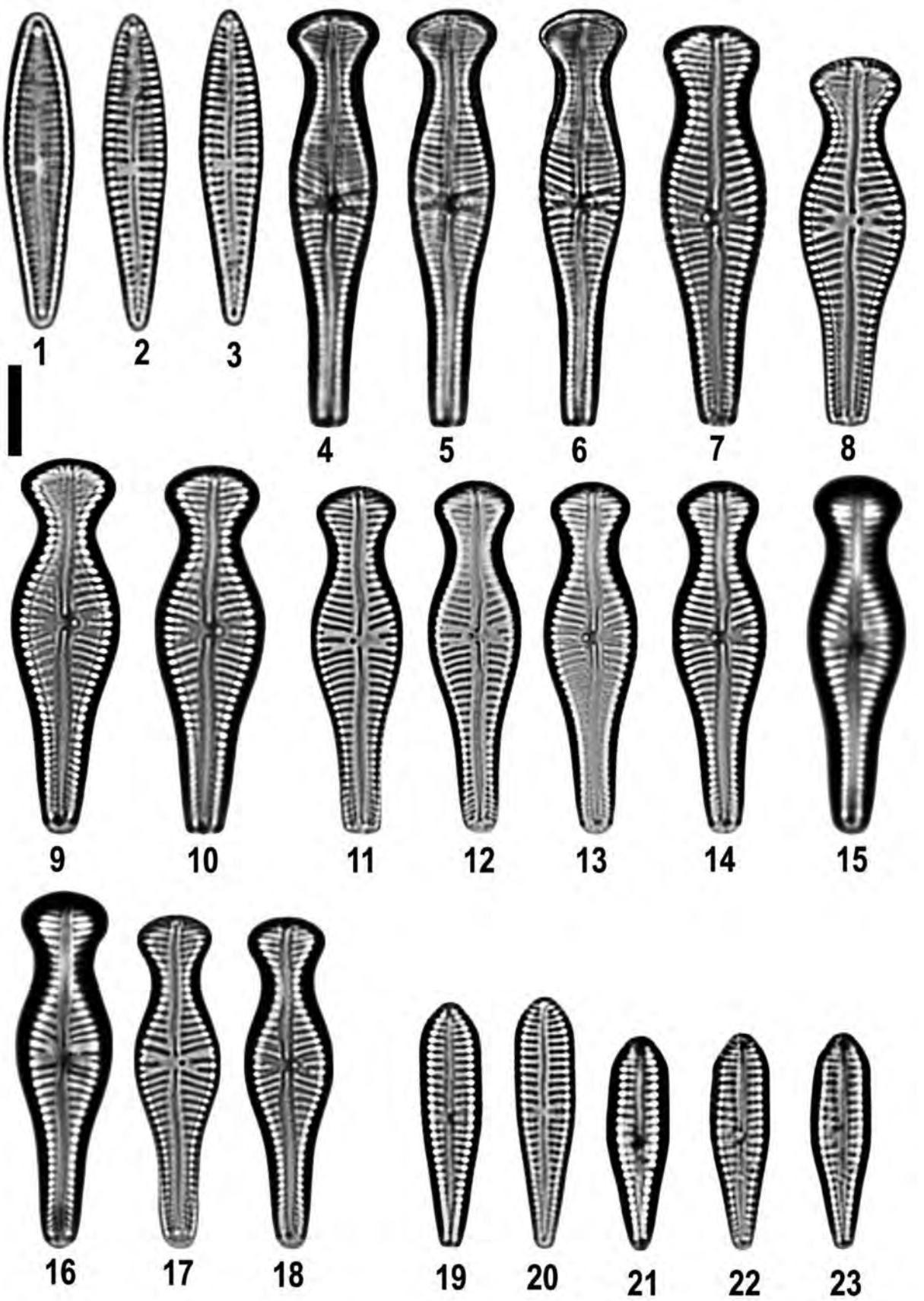


Plate 122: 1-3. *Gomphonema amoenum* Lange-Bertalot 1985, Kamionka Lake; 4-18. *Gomphonema anglicum* Ehrenberg 1843, 4-7. Kamionka Lake; 8-18. Radomno Lake; 19-23. *Gomphonema angusticephalum* Reichardt & Lange-Bertalot in Reichardt 1999, Radomno Lake. Scale bar = 10 μm.

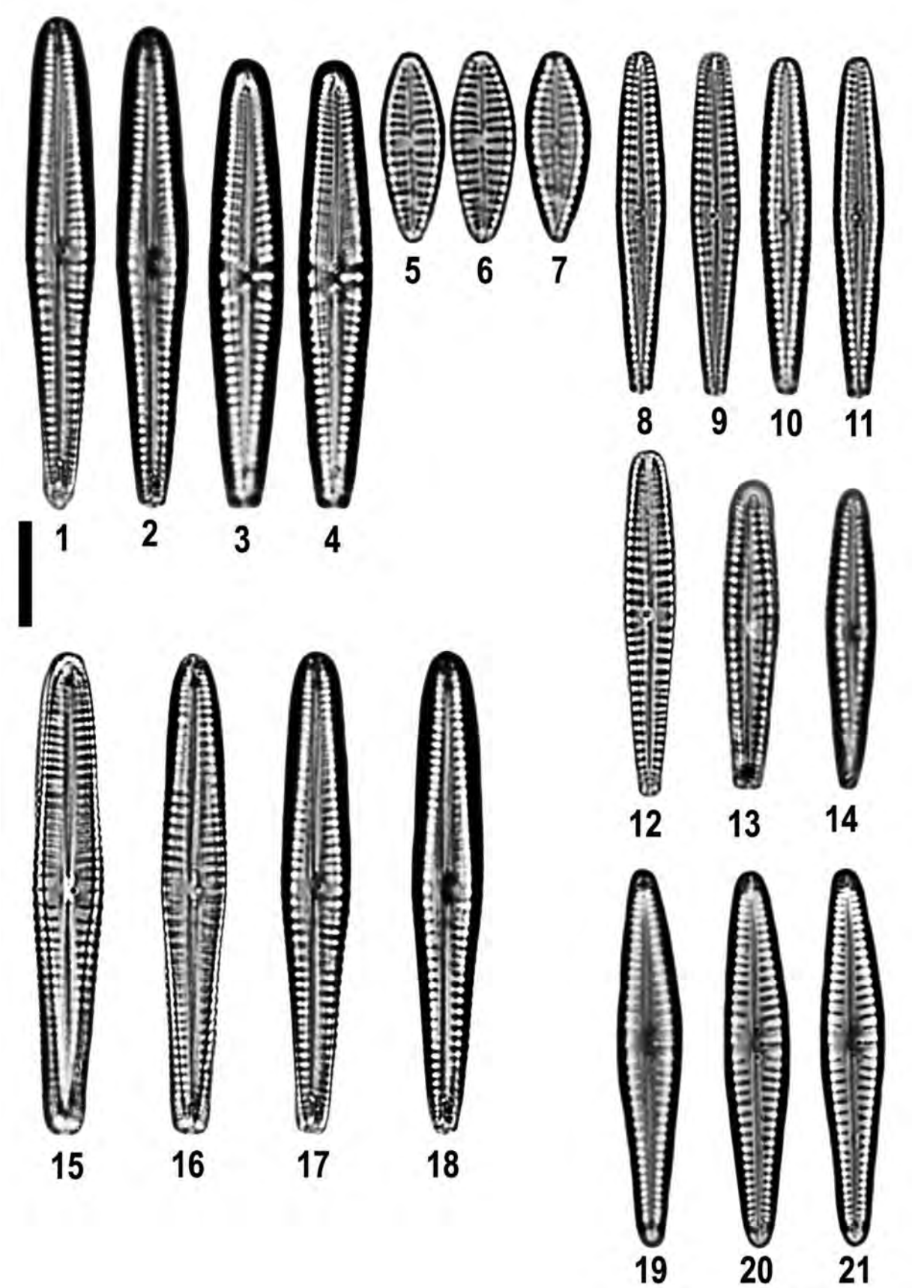


Plate 123: 1-7. *Gomphonema angustatum* (Kützing) Rabenhorst 1864, 1-4. Radomno Lake; 5-7. Młynek Lake; 8-14. *Gomphonema angustum* Agardh 1831, Radomno Lake; 15-18. *Gomphonema angustum* var. *lunatum* (Germain) Aboal 2003, Radomno Lake; 19-21. *Gomphonema auritum* Braun 1849, Jeziorak Lake. Scale bar = 10 µm.

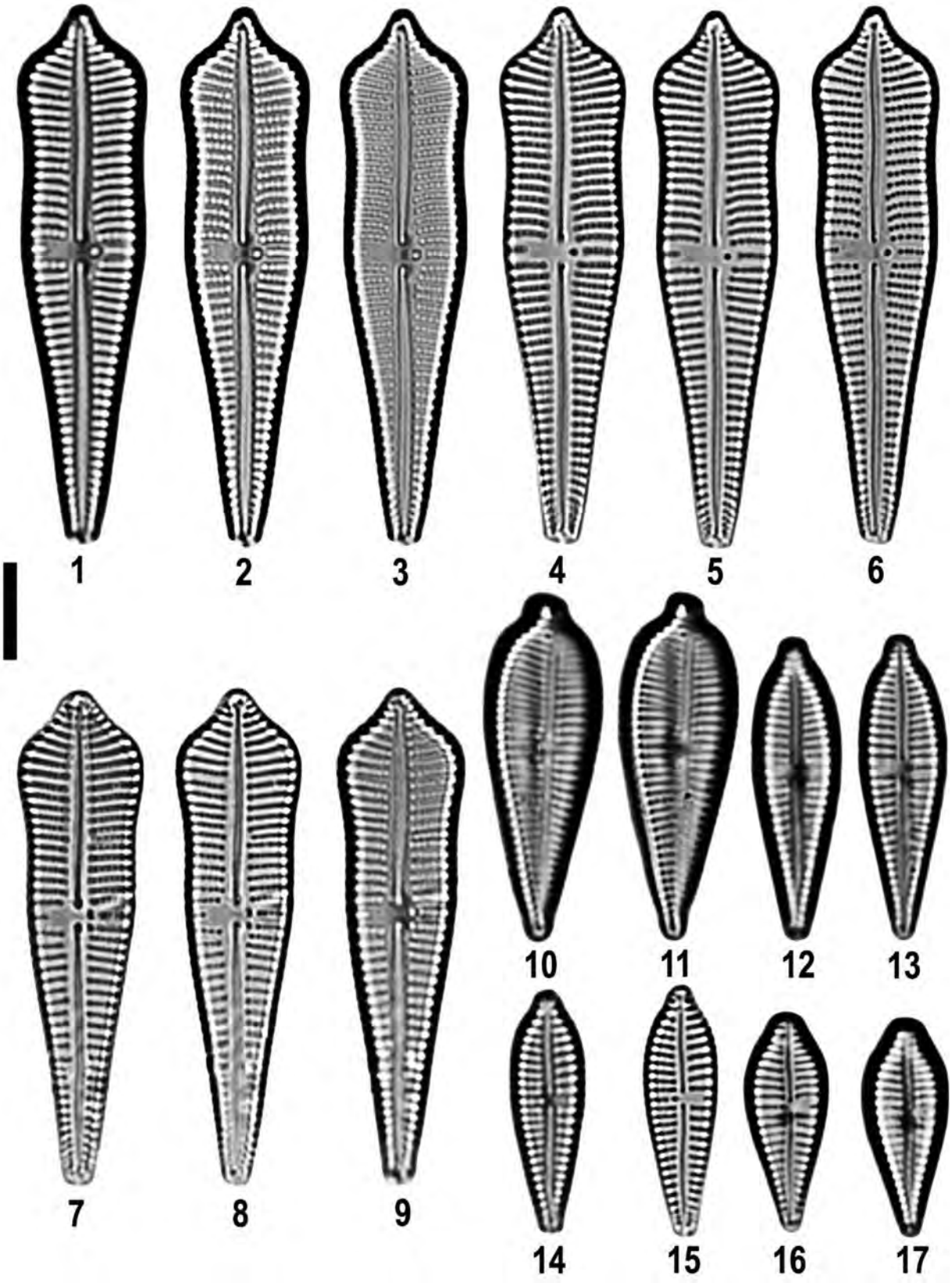


Plate 124: 1-9. *Gomphonema asiaticum* Liu & Kociolek in Liu, Kociolek & Wang 2013, Radomno Lake; 10-17. *Gomphonema augur* Ehrenberg 1841, 10-11. Młynek Lake; 12-17. Radomno Lake. Scale bar = 10 µm.

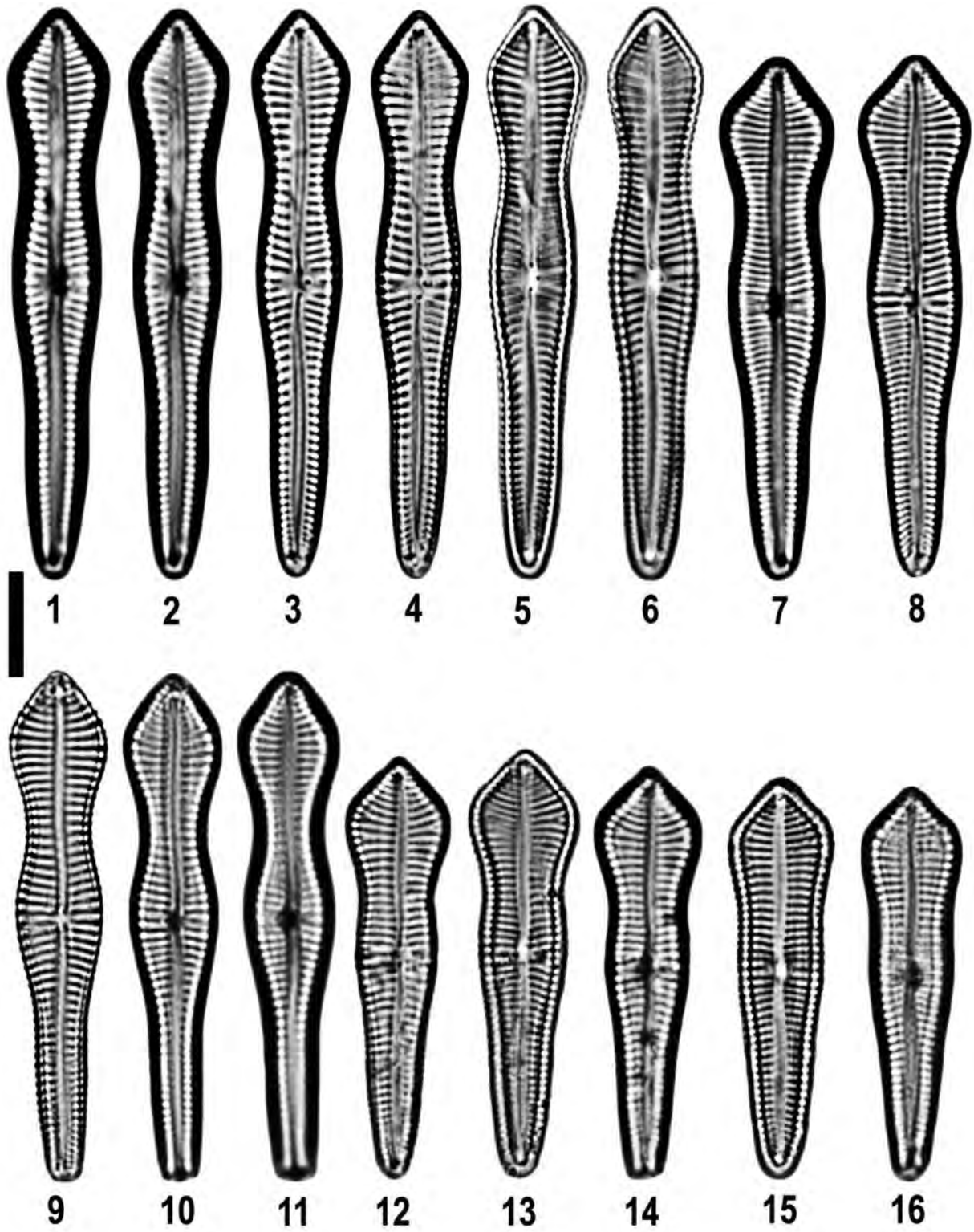


Plate 125: 1-16. *Gomphonema brebissonii* Kützing 1846, 1-8, 12-16. Młynek Lake; 9-11. Kamionka Lake. Scale bar = 10 µm.

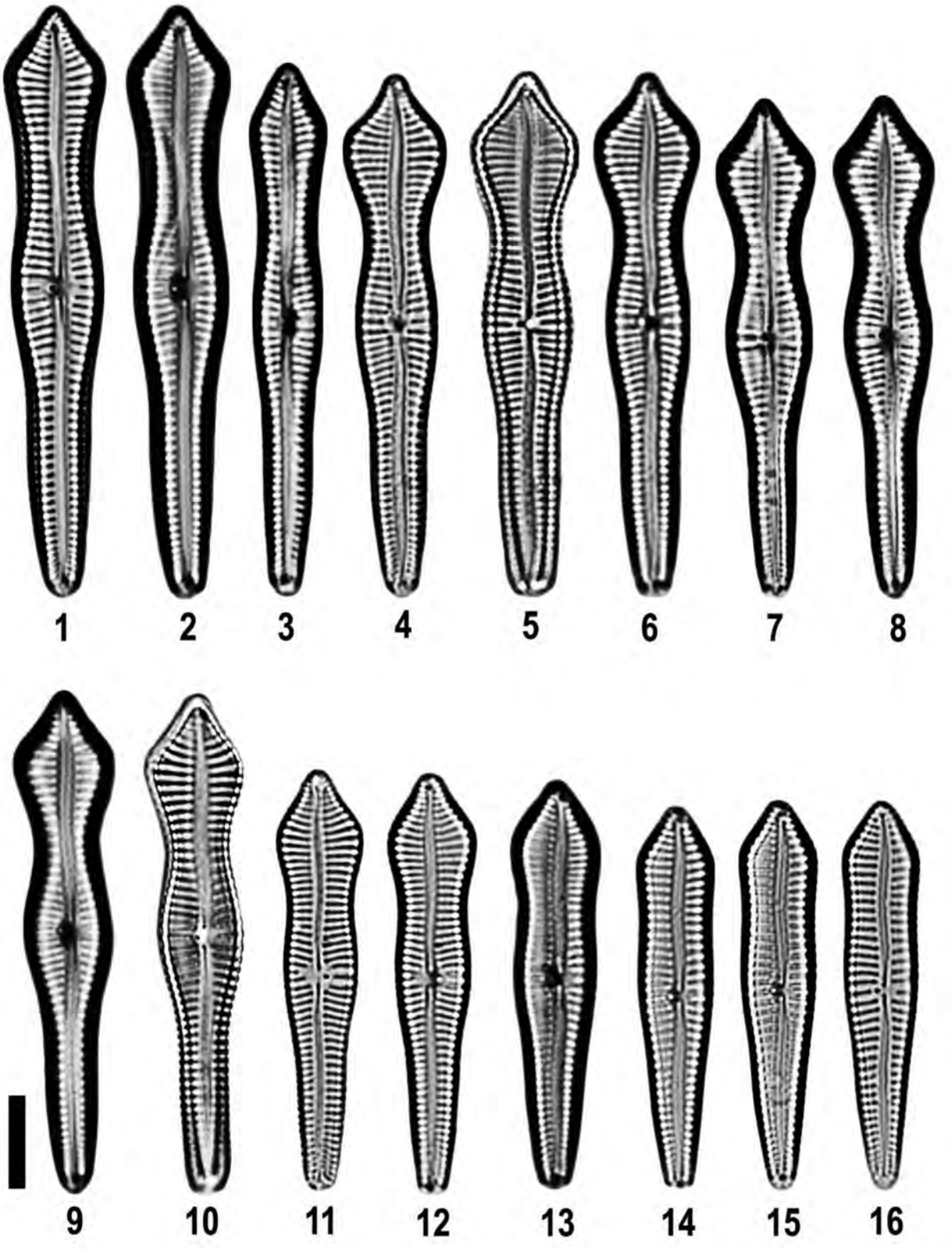


Plate 126: 1-16. *Gomphonema brebissonii* Kützing 1846, Radomno Lake. Scale bar = 10 μm.

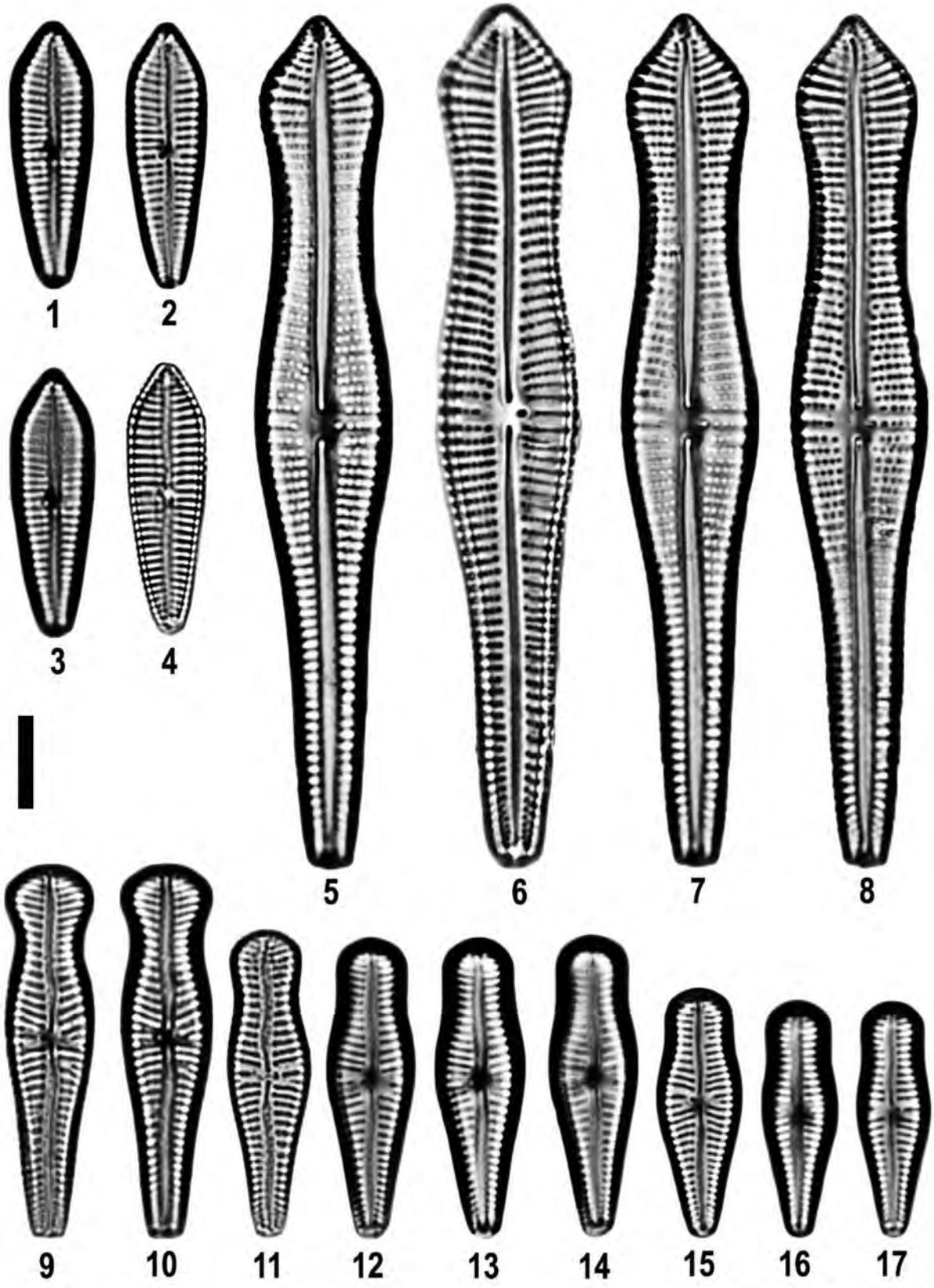


Plate 127: 1-4. *Gomphonema brebissonii* var. *cuneata* Zalat nov. var., Radomno Lake; 5-8. *Gomphonema brebissonii* var. *grosspunctata* Zalat nov. var. Radomno Lake; 9-17. *Gomphonema capitatum* Ehrenberg 1838, 9-10. Młynek Lake; 11-17. Radomno Lake. Scale bar = 10 µm.

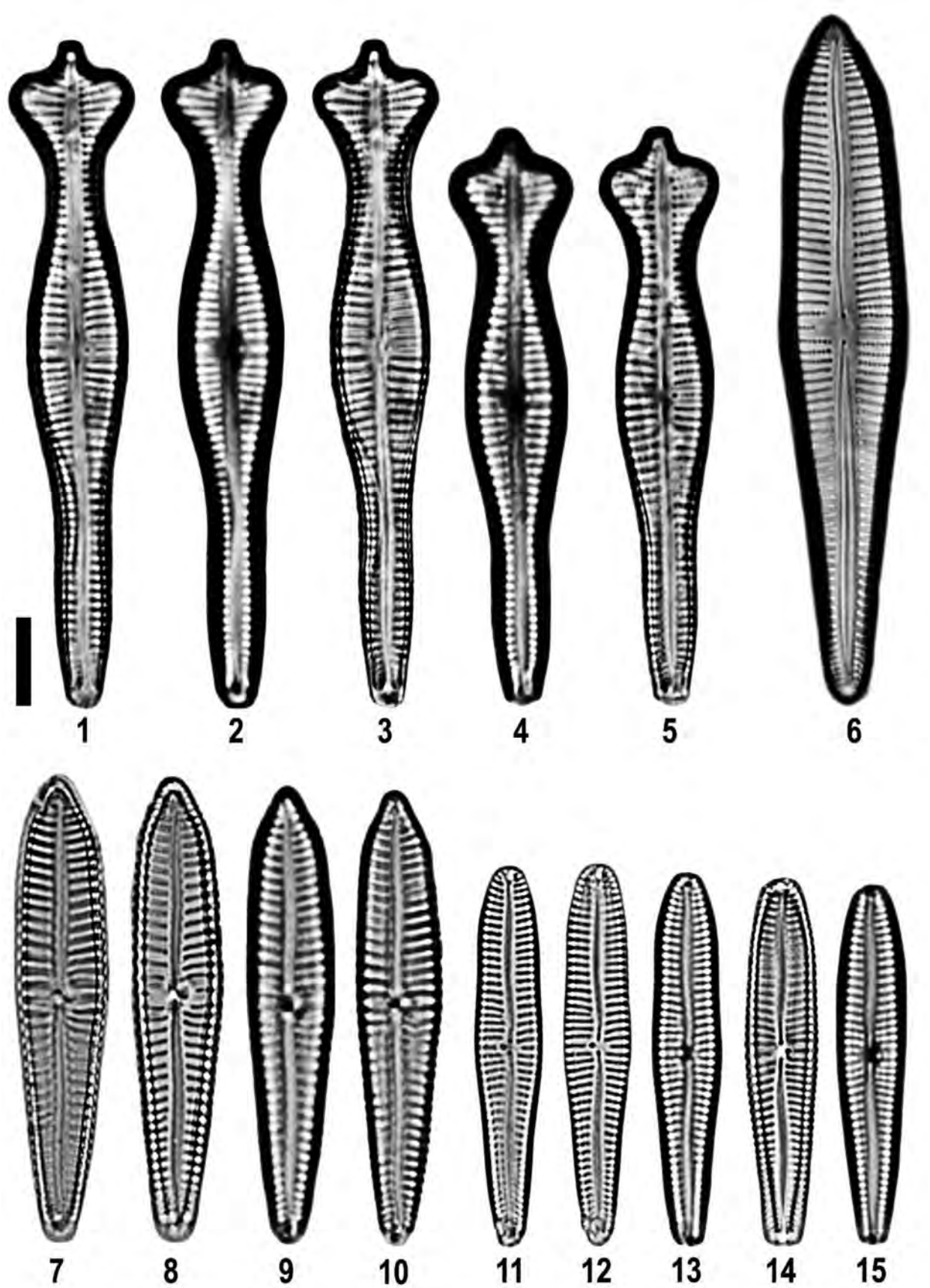


Plate 128: 1-5. *Gomphonema coronatum* Ehrenberg 1840, Eemian deposits; 6. *Gomphonema contraturris*, Radomno Lake; 7-10. *Gomphonema contraturris* var. *pideki* Zalat nov. var., Eemian paleolake deposits of central Poland; 11-15. *Gomphonema clavatulum* Reichardt 1999, Radomno Lake. Scale bar = 10 µm.

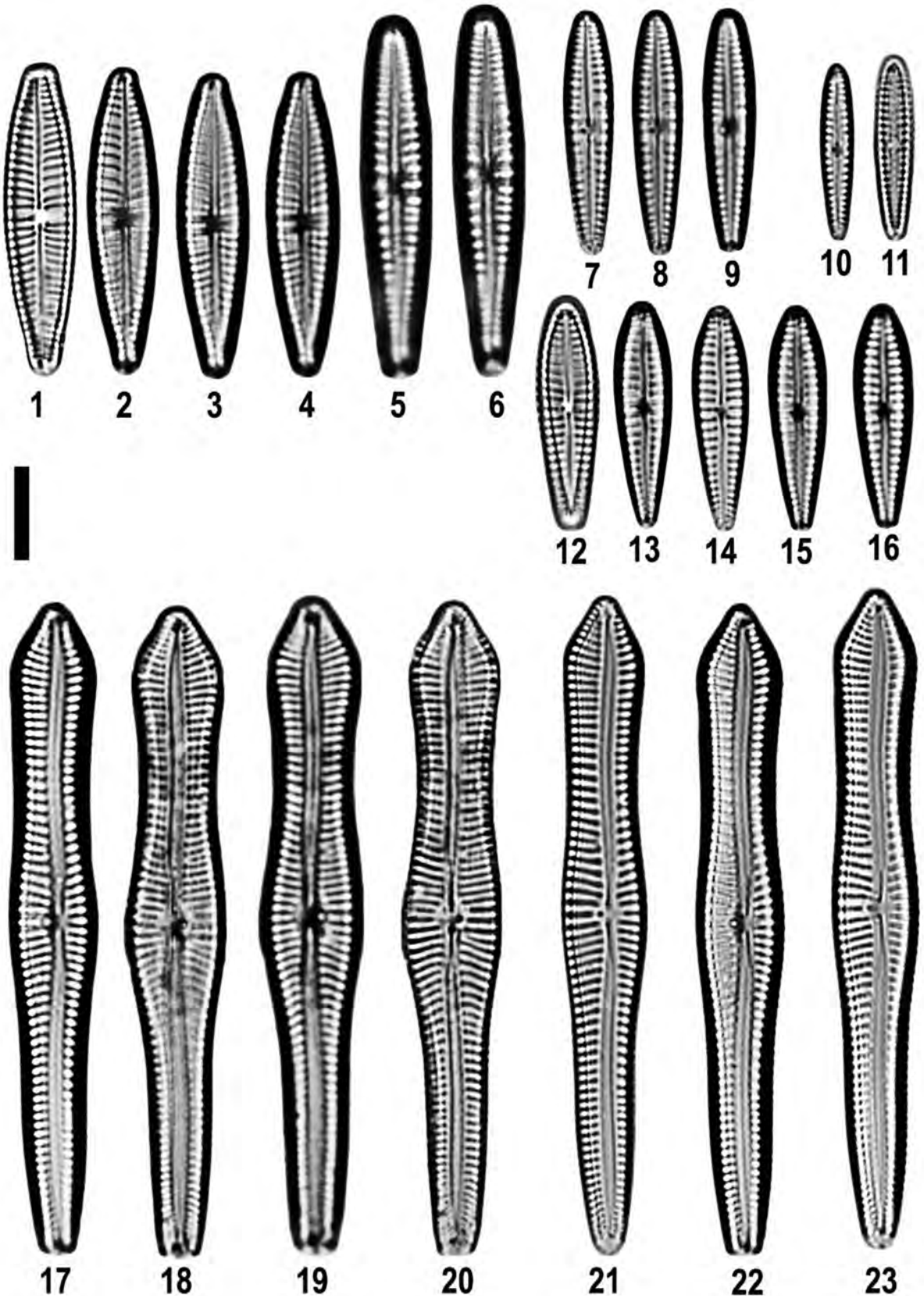


Plate 129: 1-4. *Gomphonema cymbelliclinum* Reichardt & Lange-Bertalot 1999, Radomno Lake; 5-6. *Gomphonema dichotomum* Kützing 1834, Radomno Lake; 7-9. *Gomphonema difformum* Karthick & Kociolek 2011, Radomno Lake; 10-11. *Gomphonema diminutum* Karthick & Kociolek 2011, Radomno Lake; 12-16. *Gomphonema distinctistriatum* Kociolek, Woodward & Graeff 2016, Radomno Lake; 17-23. *Gomphonema elongatum* W.Smith 1855, Radomno Lake. Scale bar = 10 µm.

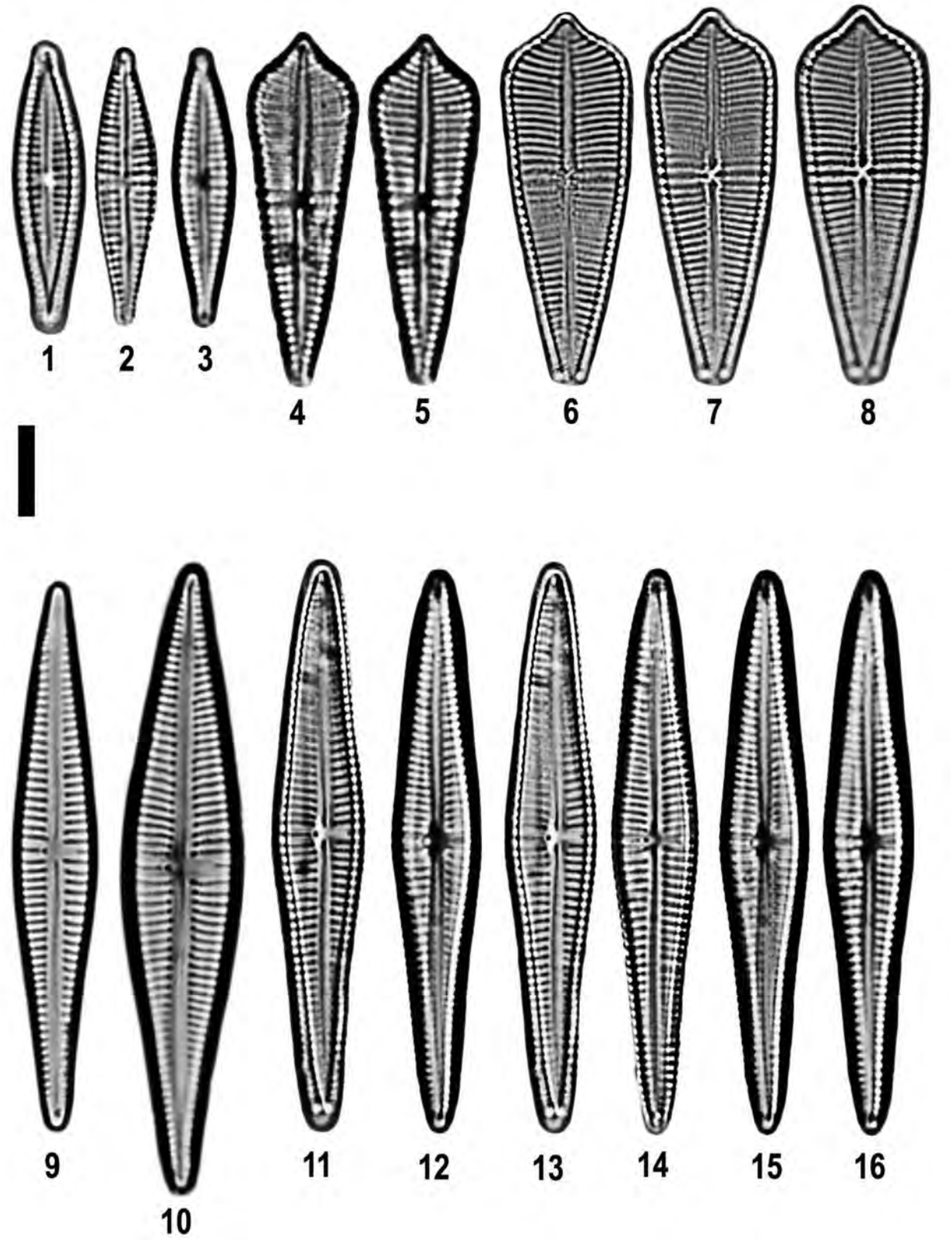


Plate 130: 1-3. *Gomphonema exilissimum* (Grunow) Lange-Bertalot & Reichardt 1996, Młynek Lake; 4-8. *Gomphonema gautieriforme* Mitic-Kopanja, Wetzel, Ector & Levkov 2014, Młynek Lake; 9-10. *Gomphonema gracile* Ehrenberg 1838, Jeziorak Lake; 11-16. *Gomphonema gregarium* Kociolek, Woodward & Graeff 2016. Radomno Lake. Scale bar = 10 µm.

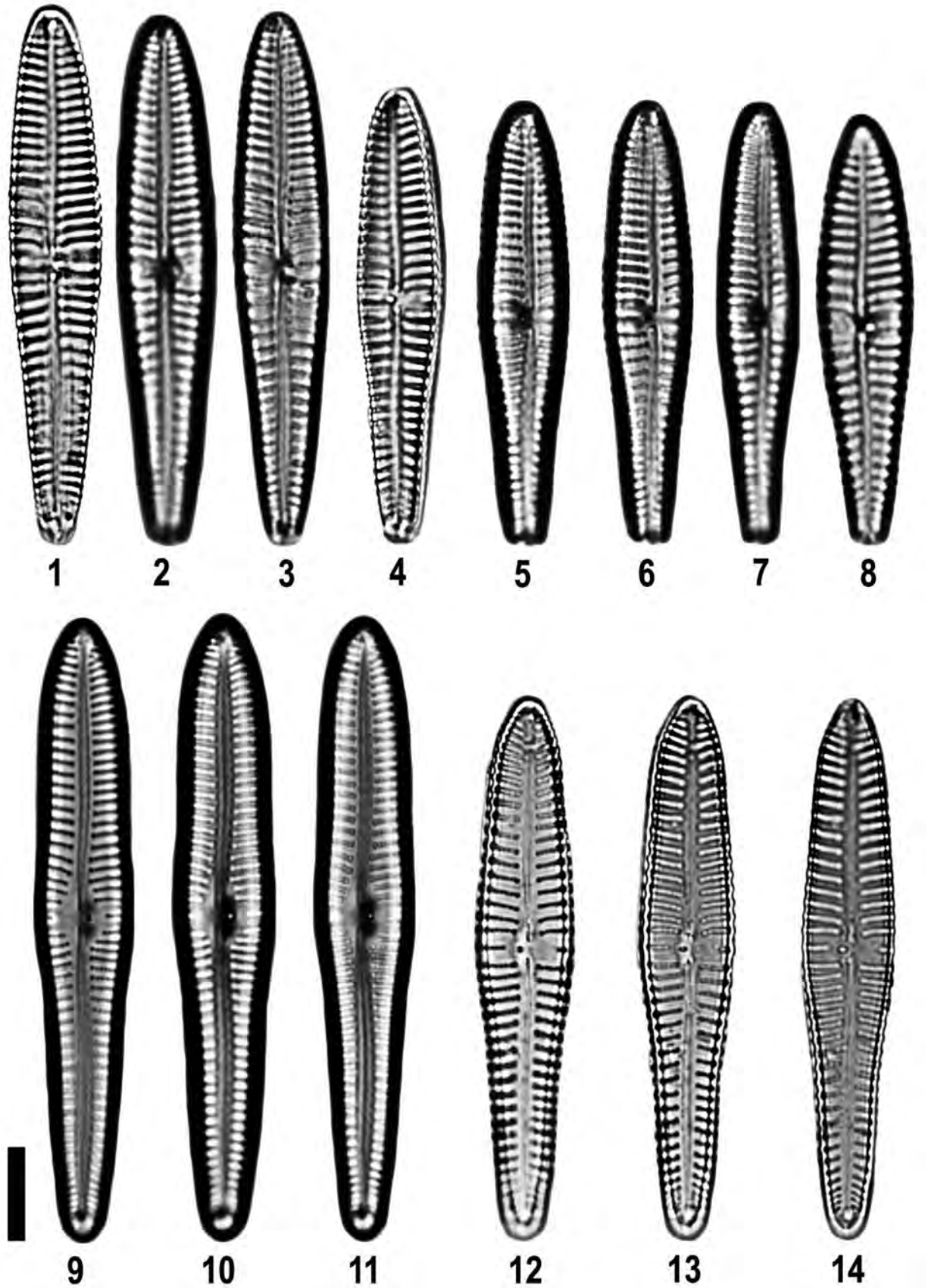


Plate 131: 1-8. *Gomphonema insigne* Gregory 1856, Radomno Lake; 9-14. *Gomphonema insigniforme* Reichardt & Lange-Bertalot 1999, Jeziorak Lake. Scale bar = 10 μm.

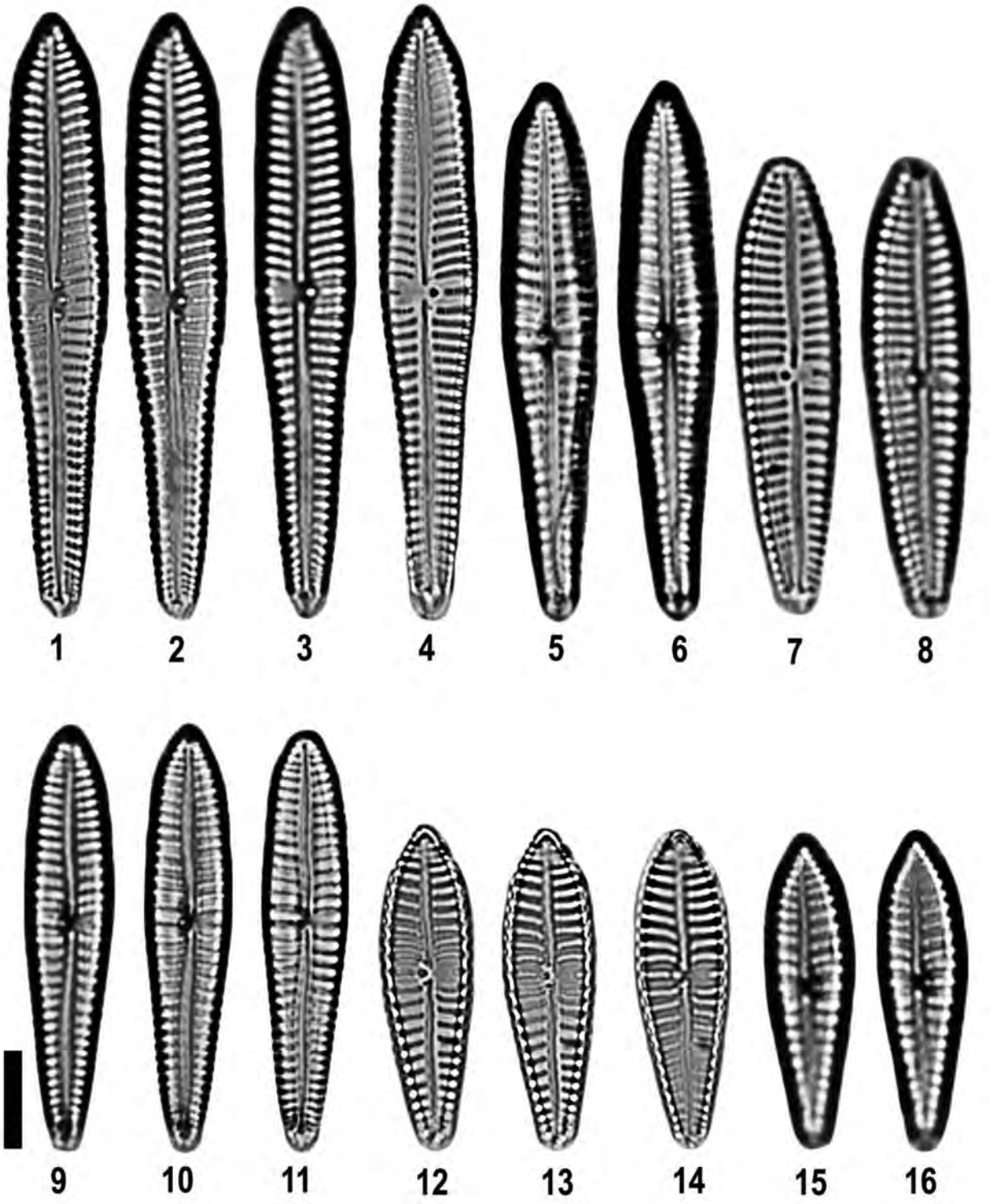


Plate 132: 1-16. *Gomphonema insigniforme* Reichardt & Lange-Bertalot 1999, Radomno Lake. Scale bar = 10 µm.

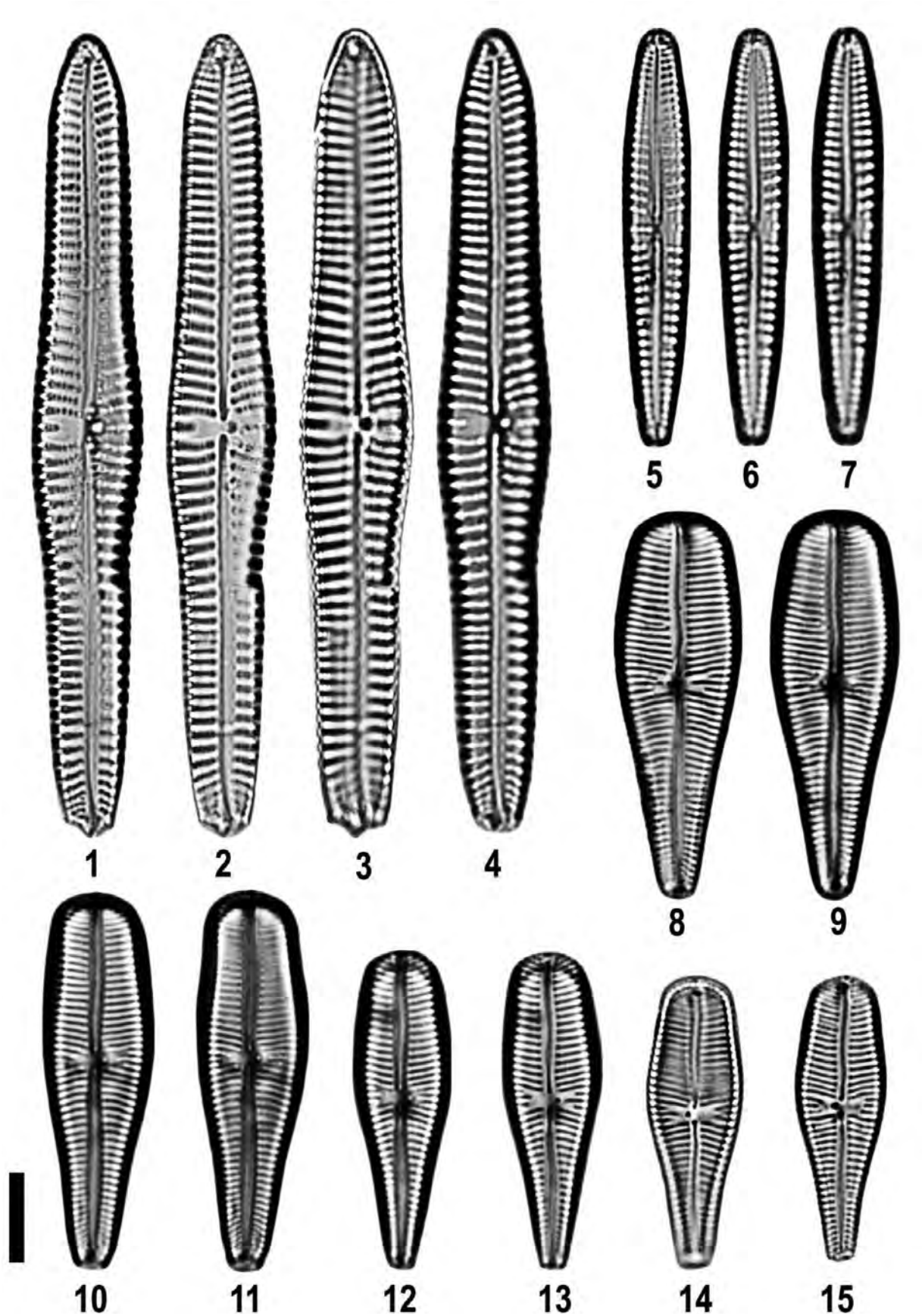


Plate 133: 1-4. *Gomphonema insigniforme* var. *elongatum* Zalat nov. var., Radomno Lake; 5-7. *Gomphonema intricatum* Kützing 1844, Radomno Lake; 8-15. *Gomphonema italicum* Kützing 1844, 8-11, 14-15. Młynek Lake; 12-13. Radomno Lake. Scale bar = 10 µm.

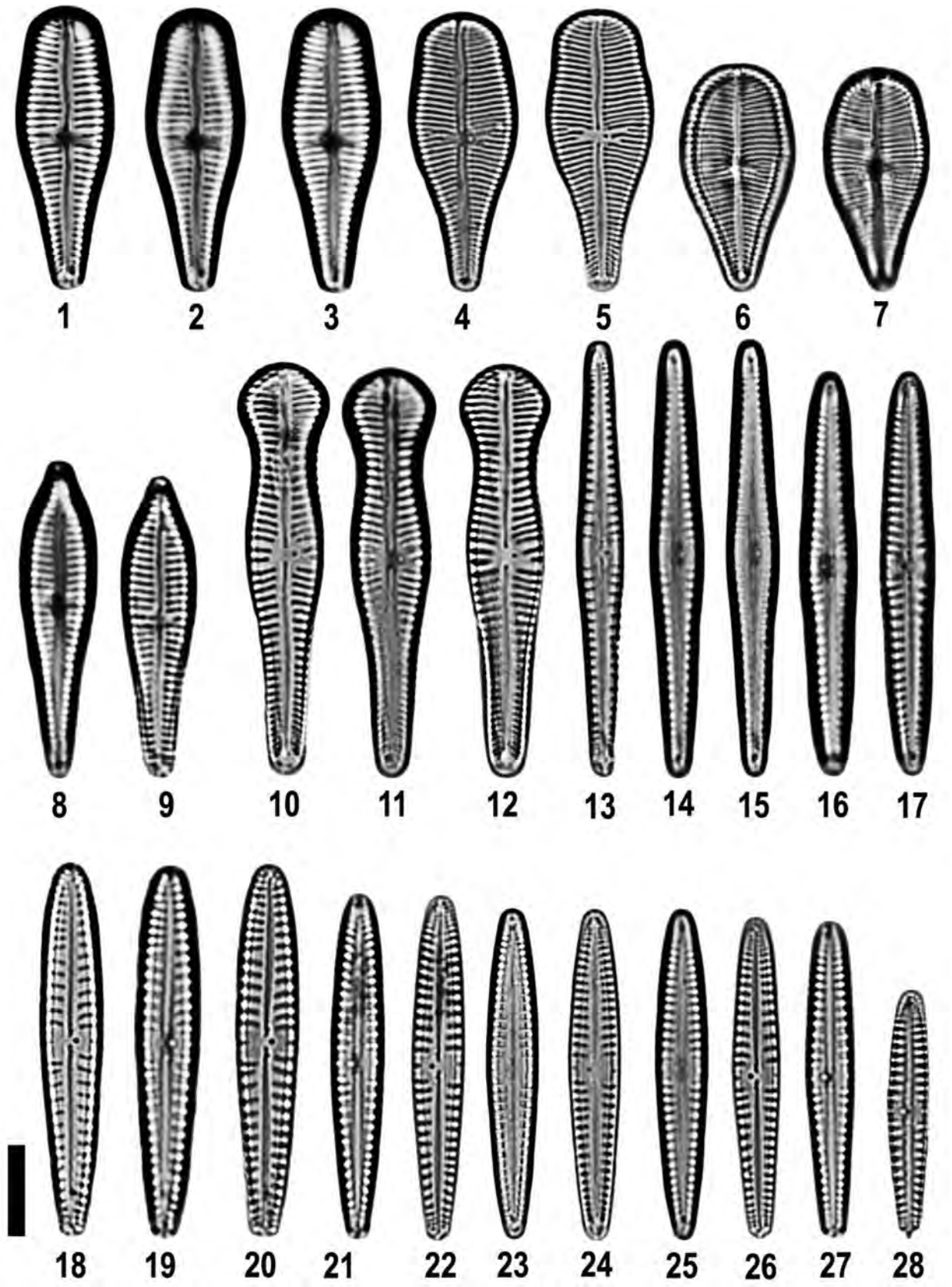


Plate 134: 1-7. *Gomphonema italicum* Kützing 1844, 1-3. Jeziorak Lake; 4-7. Młynek Lake; 8-9. *Gomphonema jadwigae* Lange-Bertalot & Reichardt 1996, Eemian paleolake deposits of central Poland; 10-12. *Gomphonema khentiiense* Lange-Bertalot, Metzeltin & Nergui 2009, Eemian paleolake deposits of central Poland; 13-28. *Gomphonema lateripunctatum* Reichardt & Lange-Bertalot 1991, 13-17. Jeziorak Lake; 18-28. Radomno Lake. Scale bar = 10 μm.

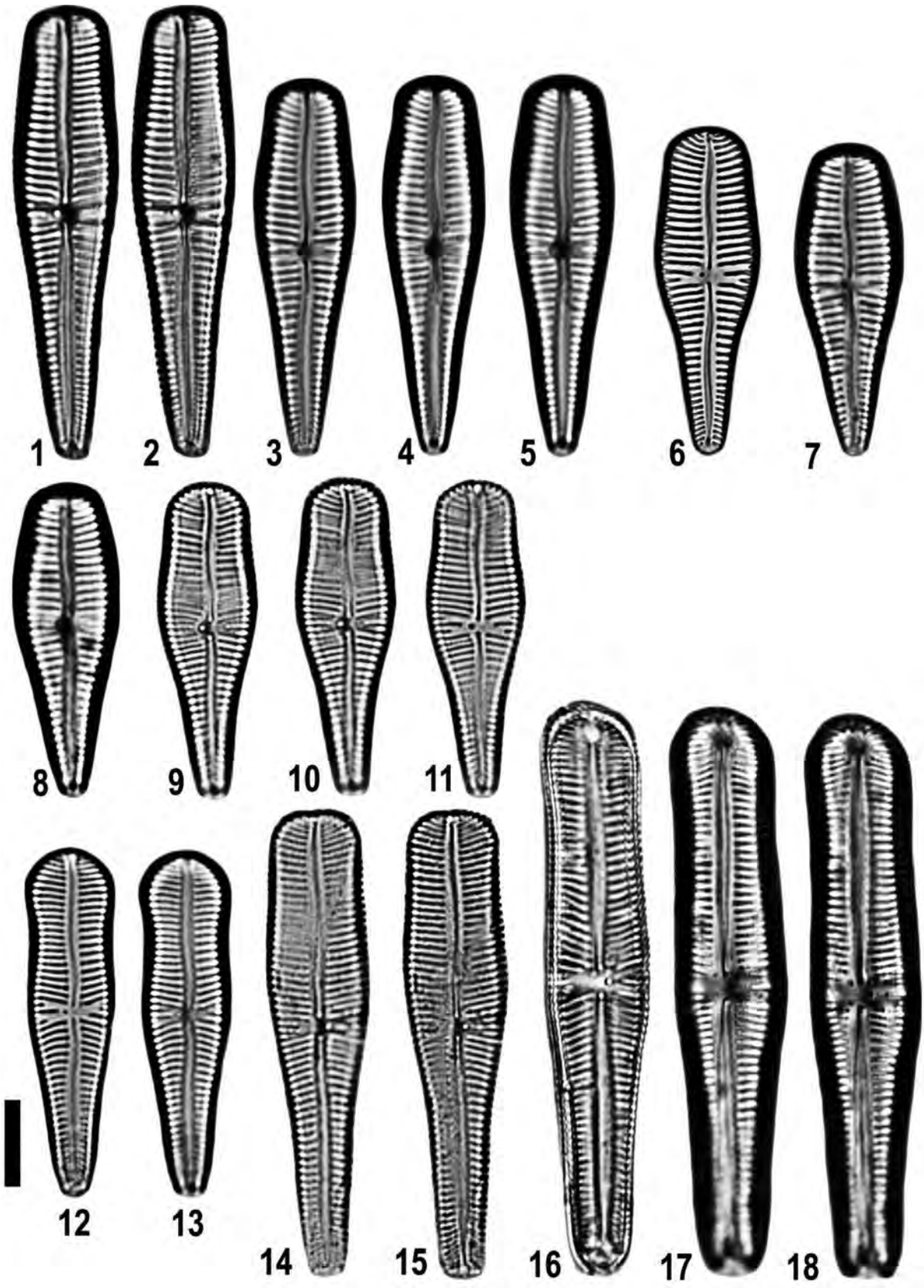


Plate 135: 1-13. *Gomphonema laticollum* Reichardt 2001, 1-8. Radomno Lake; 9-11. Kamionka lake; 12-13. Eemian deposits; 14-15. *Gomphonema laticollum* var *truncata* Zalat & Pidek nov. var., Radomno Lake; 16-18. *Gomphonema latipes* Reichardt 2001, Radomno Lake. Scale bar = 10 μm.

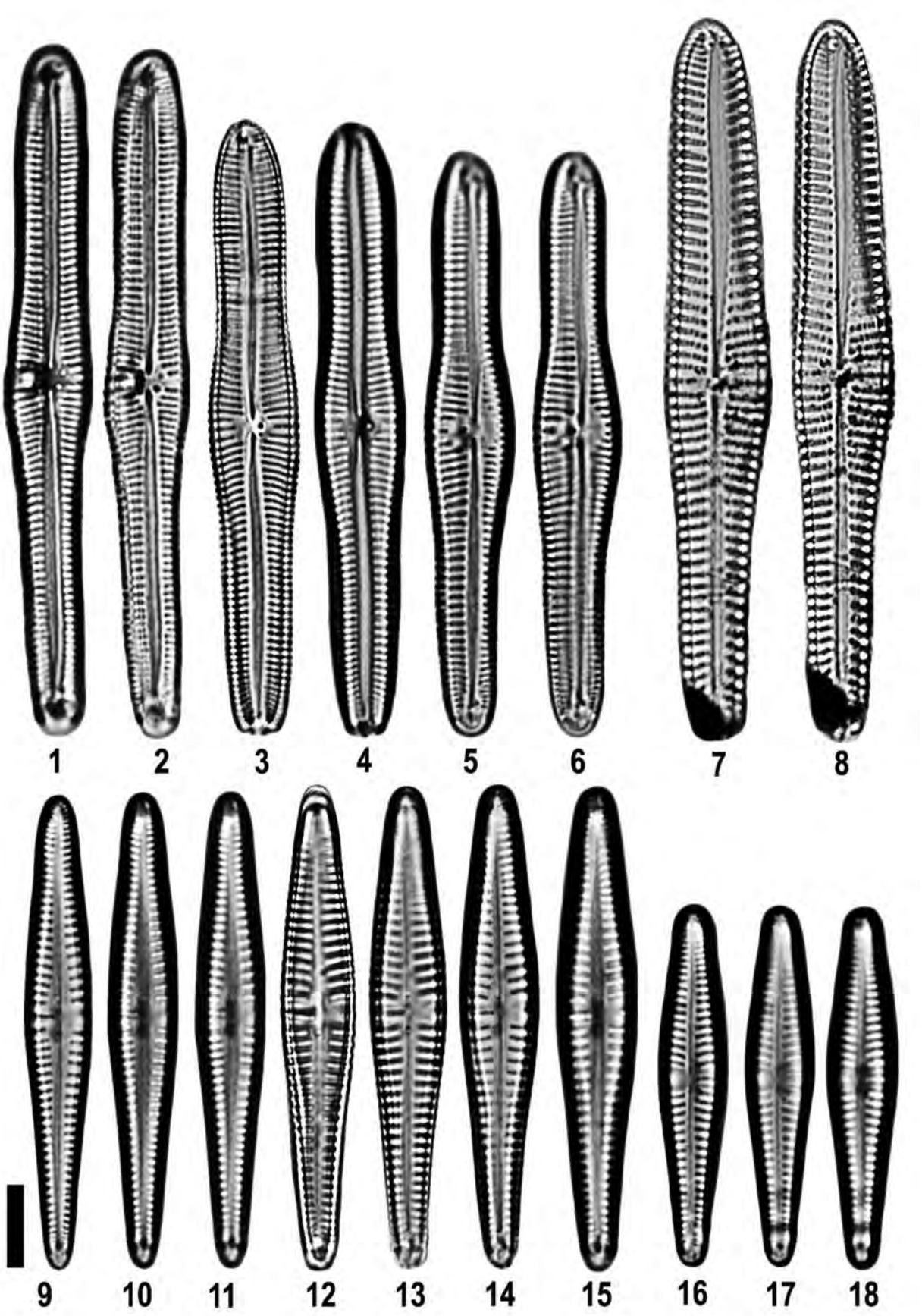


Plate 136: 1-6. *Gomphonema longiceps* Ehrenberg 1854, Radomno Lake; 7-8. *Gomphonema longiceps* var. *radomnoensis* Zalat nov. var., Radomno Lake; 9-18. *Gomphonema maclaughlinii* Reichardt 1999, 9-15. Jeziorak Lake; 16-18. Eemian paleolake deposits of central Poland. Scale bar = 10 µm.

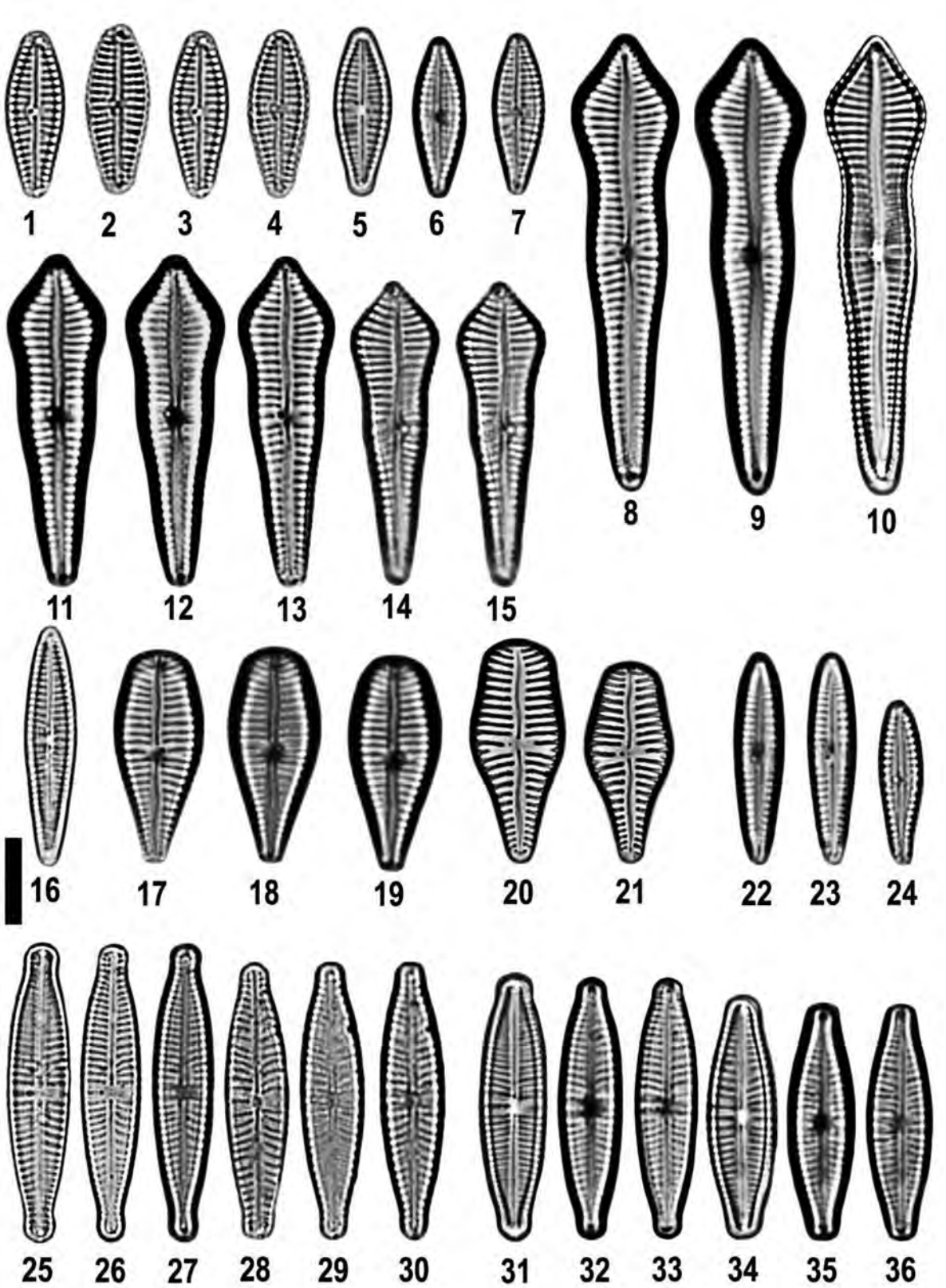


Plate 137: 1-7. *Gomphonema macropunctatum* Krishnamurthy 1954, Radomno Lake; 8-15. *Gomphonema megalobrebissonii* Chudaev, Kociolek & Golobova 2014. 8-13. Radomno Lake; 14-15. Kamionka Lake; 16. *Gomphonema meridionalum* Kociolek & Thomas in Thomas et al. 2009, Kamionka Lake; 17-21. *Gomphonema microlaticollum* Kulikovskiy, Kociolek & Solak, 2015, 17-19. Radomno Lake; 20-21. Jeziorak Lake; 22-24. *Gomphonema micropumilum* Reichardt 1997, Jeziorak Lake; 25-30. *Gomphonema micropus* Kützing 1844, 25-27. Radomno Lake; 28-30. Młynek Lake; 31-36. *Gomphonema micropus* var. *aequale* (Gregory) Reichardt 1999, Kamionka Lake. Scale bar = 10 μm.

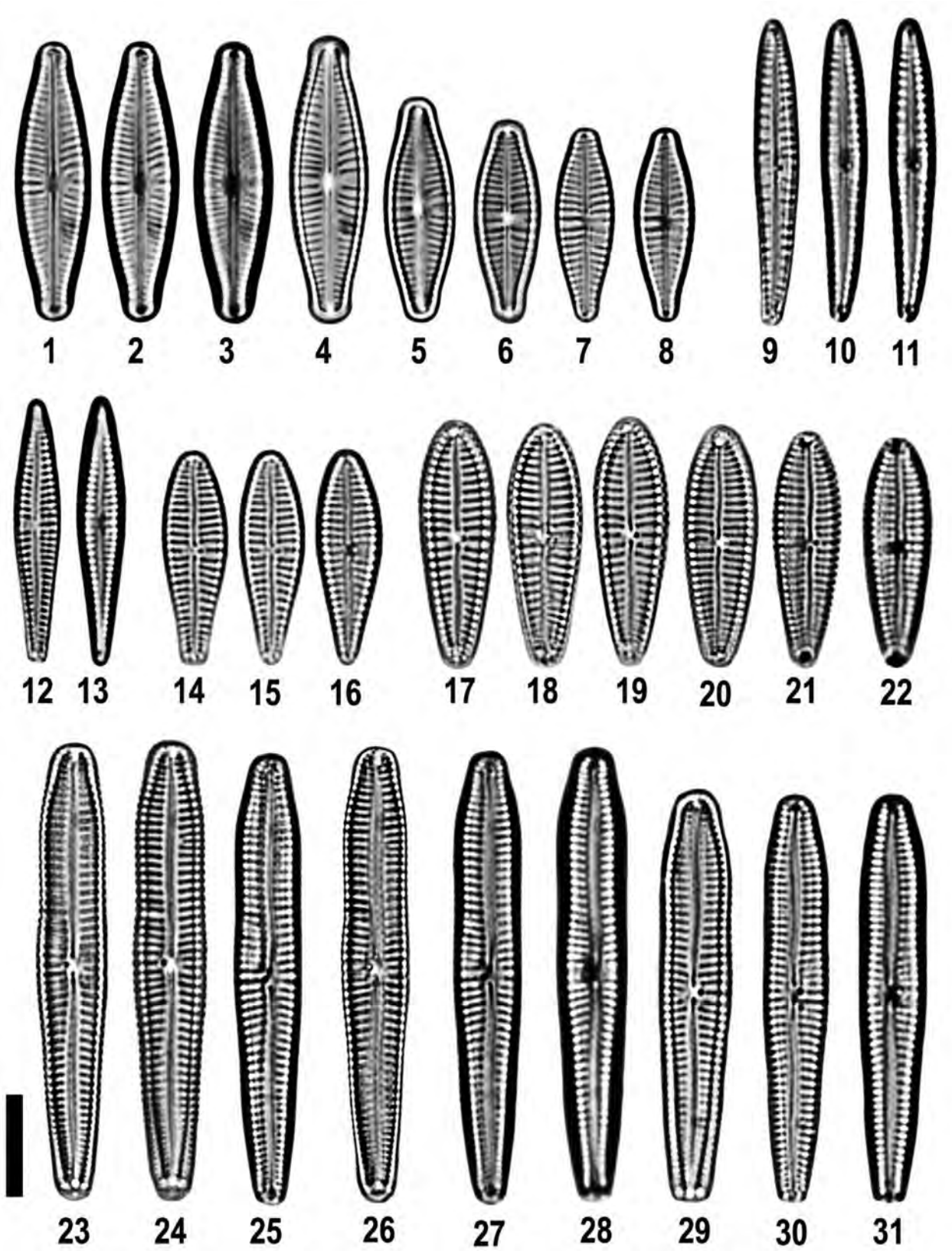


Plate 138: 1-8. *Gomphonema micropus* Kützing 1844, 1-3. Kamionka Lake; 4-8. Młynek Lake; 9-13. *Gomphonema minusculum* Krasske 1932, 9-11. Jeziorak Lake; 12-13. Eemian deposits; 14-16. *Gomphonema minutiforme* Lange-Bertalot & Reichardt 1993, Młynek Lake; 17-22. *Gomphonema minutum* (Agardh) Agardh 1831, Radomno Lake; 23-31. *Gomphonema montanum* (Schumann) Grunow 1878, Radomno Lake. Scale bar = 10 µm.

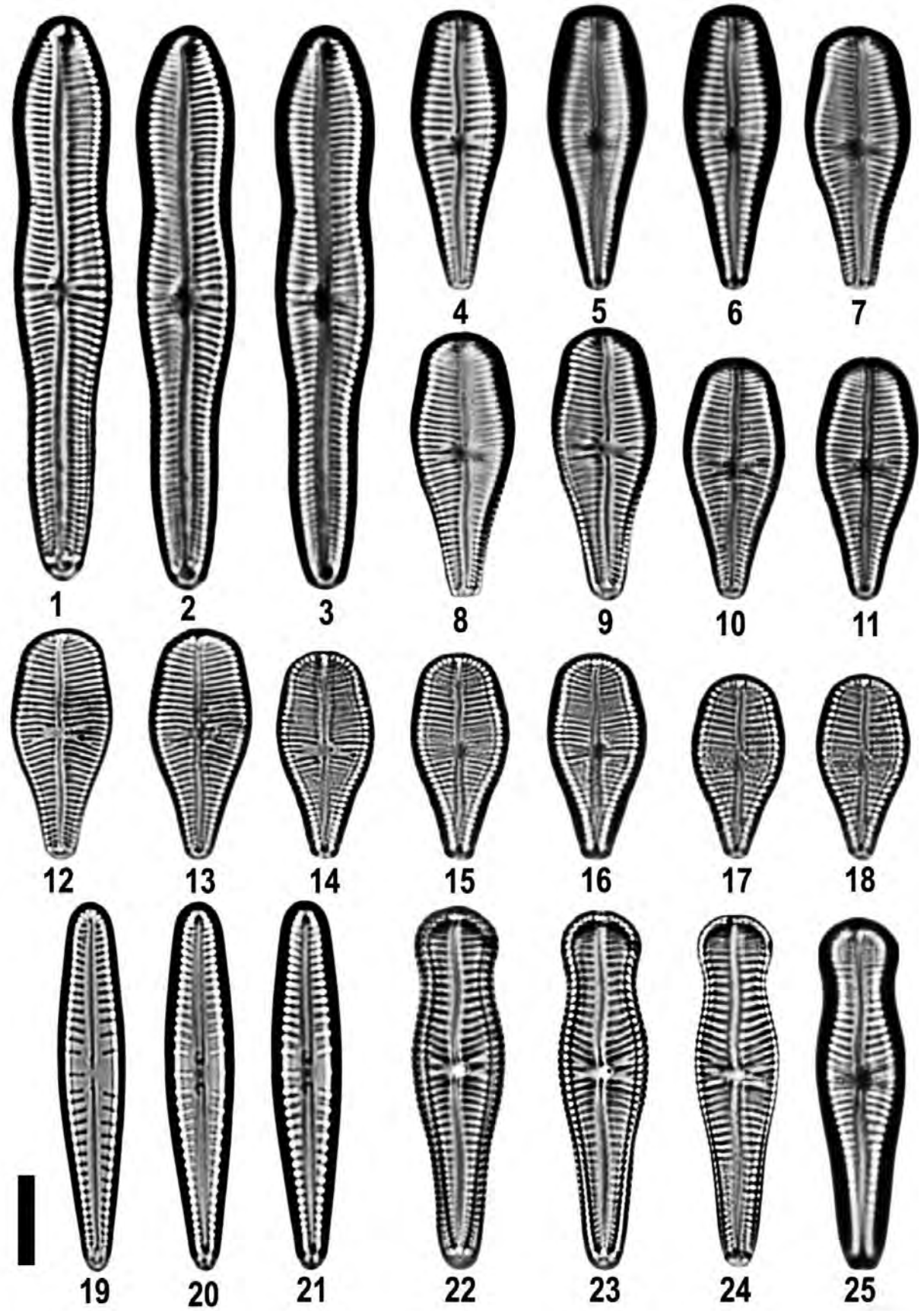


Plate 139: 1-3. *Gomphonema montanum* var. *broadness* Zalat nov. var., Radomno Lake; 4-18. *Gomphonema pala* Reichardt 2001, 4-6. Radomno Lake; 7-18. Młynek Lake; 19-21. *Gomphonema paludosum* Reichardt 1999, Radomno Lake; 22-25. *Gomphonema paracapitatum* Kulikovskiy, Kociolek & Solak 2015, Radomno Lake. Scale bar = 10 µm.

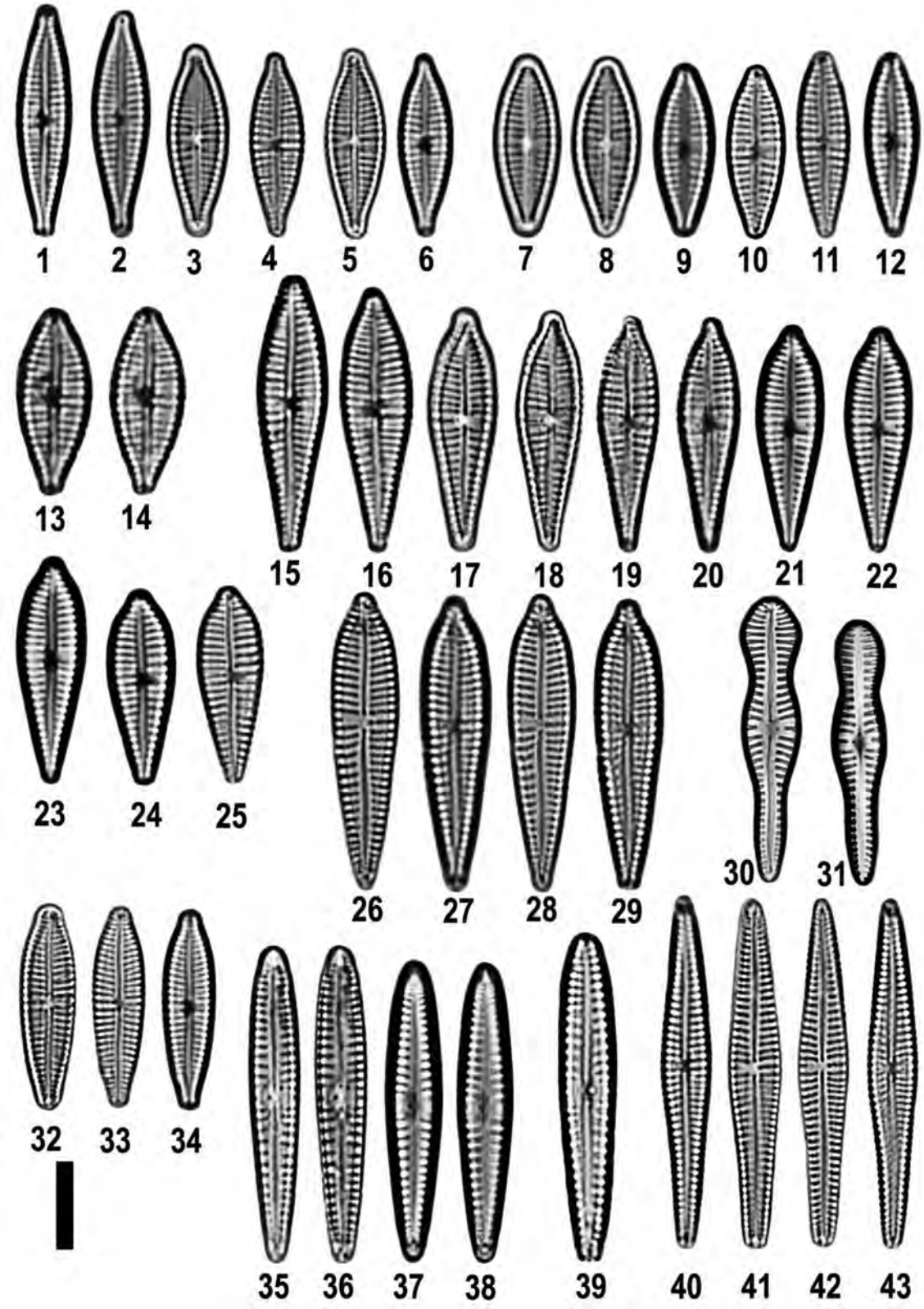


Plate 140: 1-6. *Gomphonema parvulius* (Lange-Bertalot & Reichardt) Lange-Bert. & Reichardt 1996, Radomno Lake; 7-12. *Gomphonema parvulum* **(**Kützing) Kützing 1849, Radomno Lake; 13-14. *Gomphonema saprophilum* (Lange-Bertalot & Reichardt) Abraca, Jahn, Zimmermann & Enke 2014, Młynek Lake; 15-29. *Gomphonema pseudoaugur* Lange-Bertalot 1979, Radomno Lake; 30-31. *Gomphonema pseudopusillum* Reichardt 1999, Jeziorak Lake; 32-34. *Gomphonema pulvillum* Spaulding & Kociolek 1998, Radomno Lake; 35-38. *Gomphonema pumilum* (Grunow) Reichardt & Lange-Bertalot 1991, 35-36. Eemian deposits; 37-38. Radomno Lake; 39. *Gomphonema pumilum* var. *rigidum* Reichardt & Lange-Bertalot 1997, Jeziorak Lake; 40-43. *Gomphonema ravidum* Kociolek, Spaulding, Sabbe & Vyverman 2004 , Jeziorak Lake. Scale bar = 10 µm.

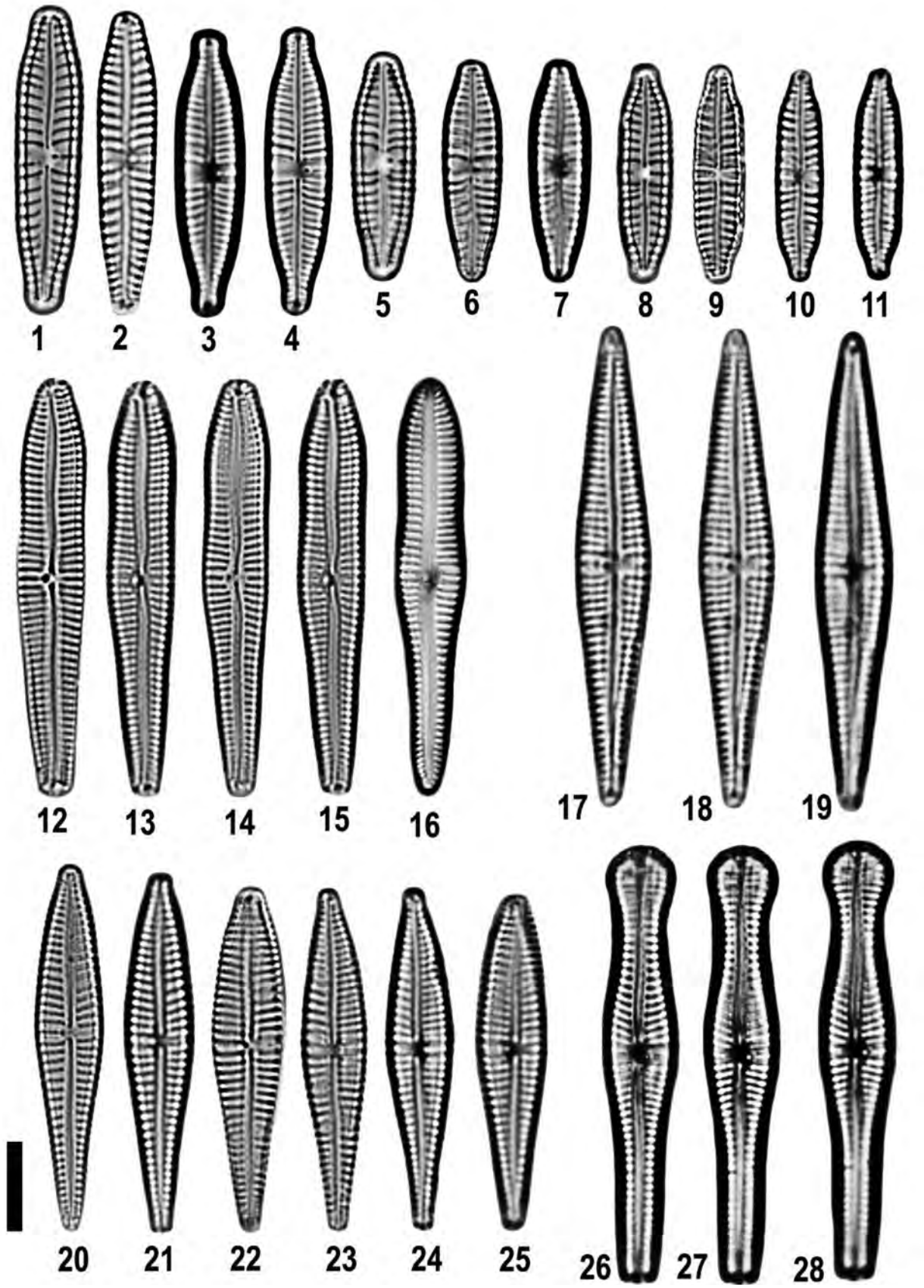


Plate 141: 1-11. *Gomphonema sarcophagus* Gregory 1856, Młynek Lake; 12-16. *Gomphonema acuminatum* var. *scardicum* (Mitic-Kopanja, Wetzel, Ector & Levkov) Abarca & Jahn 2020, 12-15. Radomno Lake; 16. Młynek Lake; 17-19. *Gomphonema spatiosum* Thomas & Kociolek 2009, Jeziorak Lake; 20-25. *Gomphonema stonei* Reichardt 1999, Radomno Lake; 26-28. *Gomphonema truncatum* var. *elongatum* (Peragallo & Héribaud) Patrick 1975, Radomno Lake. Scale bar = 10 μm.

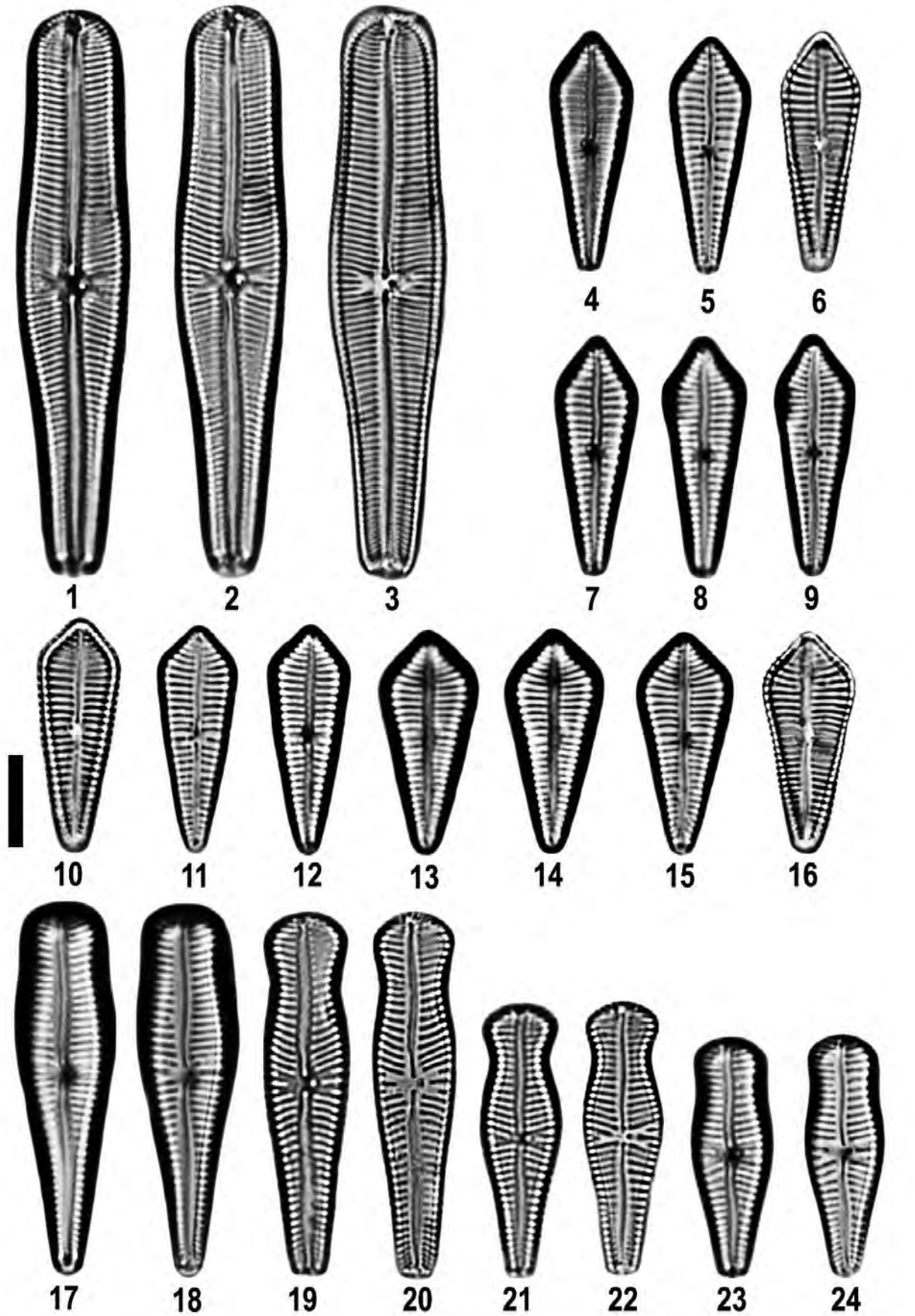


Plate 142: 1-3. *Gomphonema sublaticollum* Levkov, Mitic-Kopanja & Reichardt 2016; 4-16. *Gomphonema trigonocephalum* Ehrenberg 1854, 4-6. Radomno Lake; 7-16. Młynek Lake; 17-24. *Gomphonema truncatum* Ehrenberg 1832, Radomno Lake. Scale bar = 10 µm.

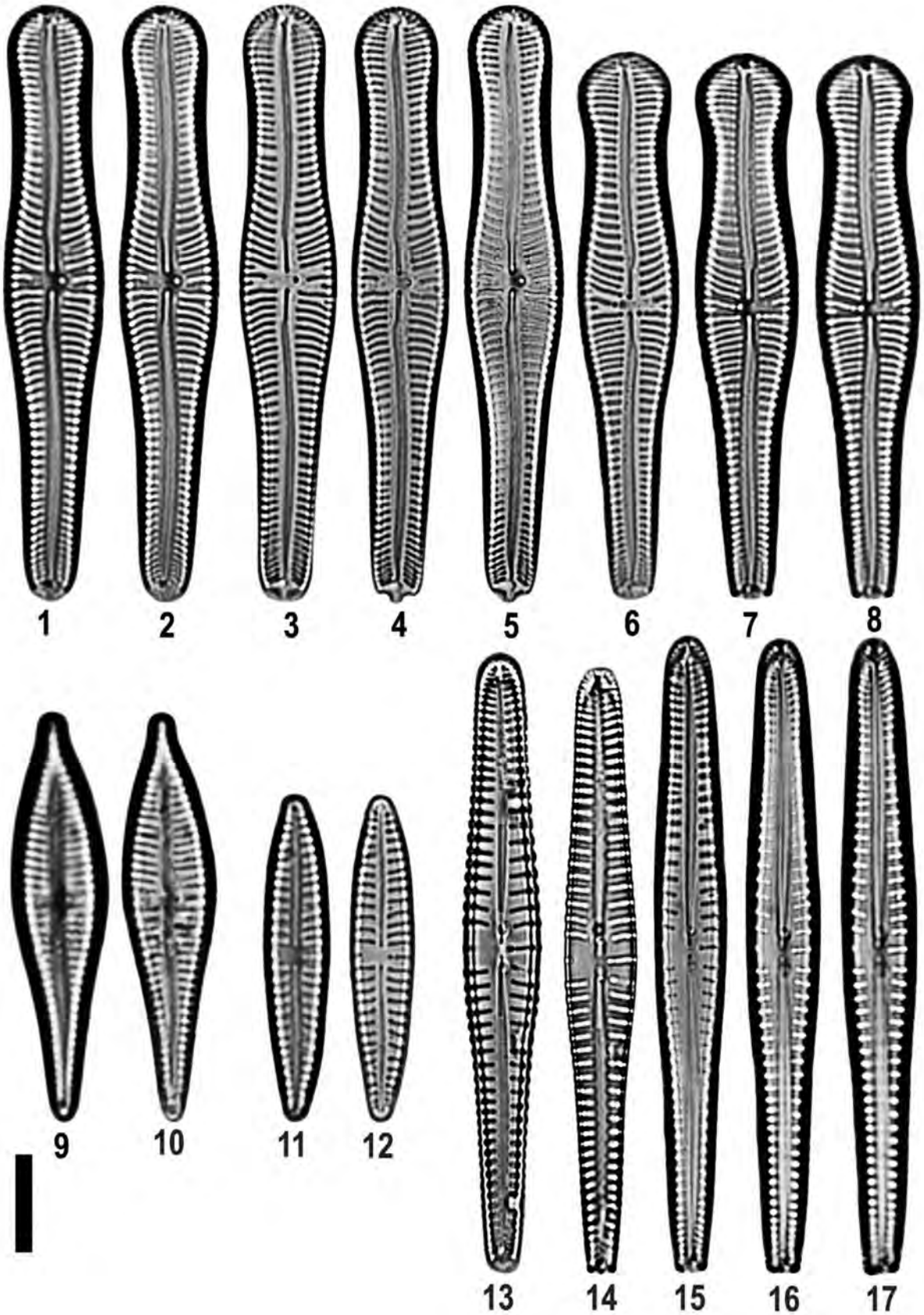


Plate 143: 1-8. *Gomphonema truncatum* var. *elongatum* (Peragallo & Héribaud) Patrick 1975, Radomno Lake; 9-10. *Gomphonema vancampianum* Van de Vijver, Pottiez & Chavaux 2024, Jeziorak Lake; 11-12. *Gomphonema variscohercynicum* Lange-Bertalot & Reichardt 1999, Jeziorak Lake; 13-17. *Gomphonema vibrio* Ehrenberg 1843, Radomno Lake. Scale bar = 10 µm.

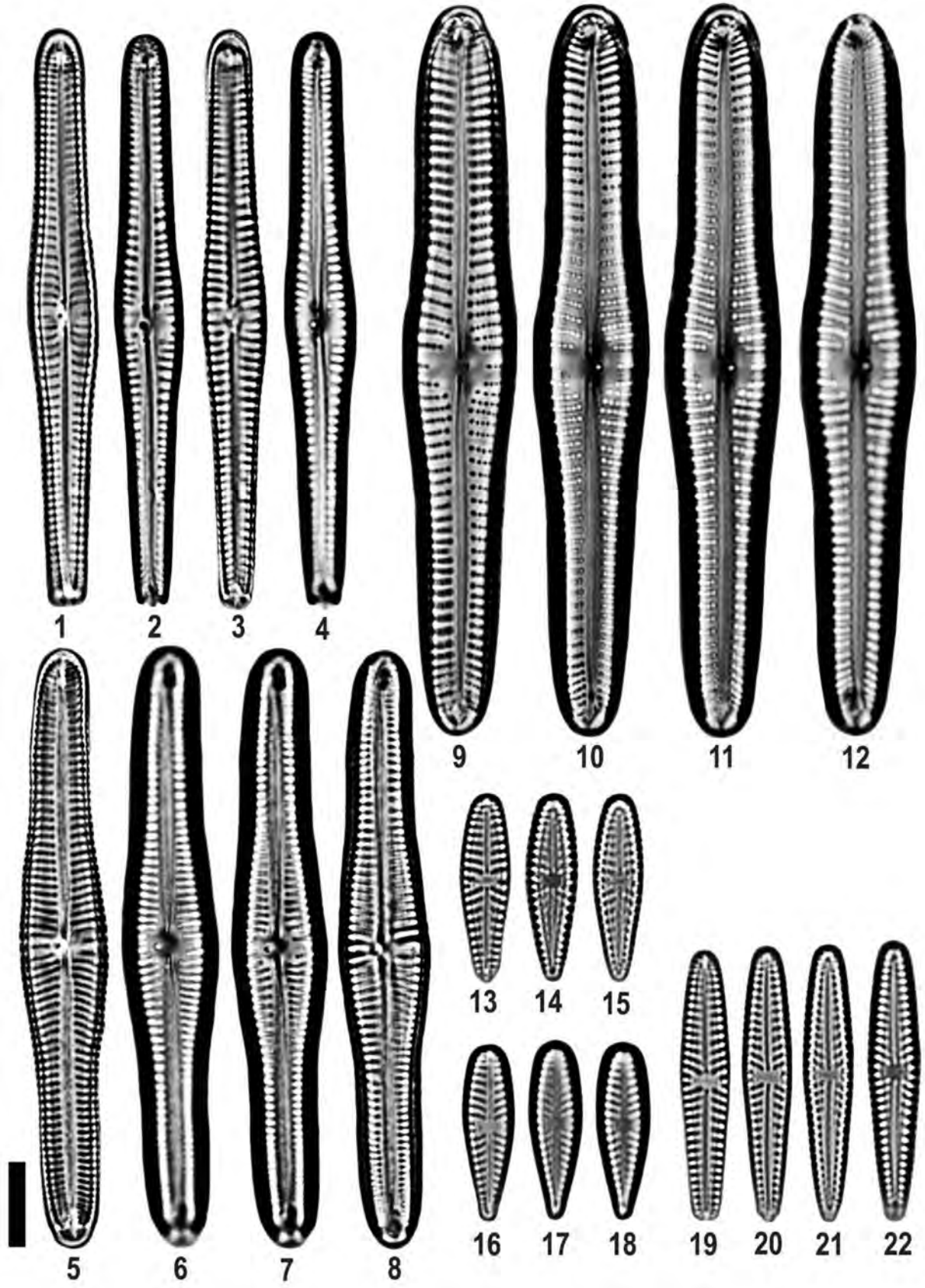


Plate 144: 1-4. *Gomphonema vibrio* var. *subcapitatum* (A. Mayer) Lee 1992, Radomno Lake; 5-8. *Gomphonema vibrioides* Reichardt & Lange-Bertalot 1991, Radomno Lake; 9-12. *Gomphonema vidarbhense* Sarode & Kamat 1984, Radomno Lake; 13-15. *Gomphonella olivacea* (Hornemann) Rabenhorst 1853, Jeziorak Lake; 16-18. *Gomphonella olivaceoides* (Hustedt) Tuji 2020, Radomno Lake; 19-22. *Gomphonella olivaceoides* var. *lanceolata* (Manguin) Zalat, comb. nov. Radomno Lake, Scale bar = 10 μm.

4. References

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5. List of diatom taxa

Achnanthes Bory 1822
- *Achnanthes adnata* Bory 1822
- *Achnanthes coarctata* (Brébisson) Grunow in Cleve & Grunow 1880
- *Achnanthes expressa* Carter 1986
- *Achnanthes intermedia* Kützing 1833
- *Achnanthes lemmermannii* Hustedt 1933
- *Achnanthes leonardii* Witkowski & Lange-Bertalot 2000
- *Achnanthes minuscula* Hustedt 1945
- *Achnanthes parvula* Kützing 1844

Achnanthes rupestoides Hohn 1961
- *Achnanthidium* Kützing 1844
- *Achnanthidium acsiae* Van de Vijver, Wojtal, Morales & Ector 2011
- *Achnanthidium affine* (Grunow) Czarnecki 1994
- *Achnanthidium anastasiae* (Kaczmarska) Chaudev & Gololobova 2016
- *Achnanthidium atomoides* Monnier, Lange-Bertalot & Ector 2004
- *Achnanthidium atomus* (Hustedt) Monnier, Lange-Bertalot & Ector 2004
- *Achnanthidium caledonicum* (Lange-Bertalot) Lange-Bertalot 1999
- *Achnanthidium catenatum* (Bily & Marvan) Lange-Bertalot 1999
- *Achnanthidium delmontii* Pérès, Le Cohu & Barthès 2012
- *Achnanthidium duriense* Novais & Ector 2015
- *Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot 1999
- *Achnanthidium exile* (Kützing) Heiberg 1863
- *Achnanthidium gracillimum* (Meister) Lange-Bertalot 2004
- *Achnanthidium indistinctum* Van de Vijver & Kopalová 2014
- *Achnanthidium kranzii* (Lange-Bertalot) Round & Bukhtiyarova 1996
- *Achnanthidium lineare* W. Smith 1855
- *Achnanthidium microcephalum* Kützing 1844
- *Achnanthidium minutissimum* (Kützing) Czarnecki 1994
- *Achnanthidium minutissimum* f. *inconspicuum* (Østrup) Compère & Riaux-Gobin 2009
- *Achnanthidium minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot 1989
- *Achnanthidium nodosum* (Cleve) Tseplik & Chudaev 2020
- *Achnanthidium petersenii* (Hustedt) Wetzel, Ector, Williams & Jüttner 2019
- *Achnanthidium pfisteri* Lange-Bertalot 2004
- *Achnanthidium polonicum* Van de Vijver, Wojtal, Morales & Ector 2011
- *Achnanthidium pusillum* (Grunow) Czarnecki 1996
- *Achnanthidium pyrenaicum* (Hustedt) Kobayasi 1997
- *Achnanthidium reimeri* (Camburn) Ponader & Potapova 2007
- *Achnanthidium rosenstockii* (Lange-Bertalot) Lange-Bertalot 2004
- *Achnanthidium saprophilum* (Kobayasi & Mayama) Round & Bukhtiyarova 1996
- *Achnanthidium straubianum* (Lange-Bertalot) Lange-Bertalot 1999
- *Achnanthidium subatomus* (Hustedt) Lange-Bertalot 1999
- *Achnanthidium thienemannii* (Hustedt) Lange-Bertalot 2004
- *Achnanthidium trinodis* Ralfs 1861

Anomoeoneis Pfitzer 1871
- *Anomoeoneis sculpta* (Ehrenberg) Cleve 1895
- *Anomoeoneis sphaerophora* (Ehrenberg) Pfitzer 1871

Anorthoneis Grunow 1868
- *Anorthoneis vortex* Sterrenburg 1987

Brebissonia Grunow 1860
- *Brebissonia lanceolata* (Agardh) Mahoney & Reimer 1986

Cocconeis Ehrenberg 1837

Cocconeis czarneckii Stancheva, Mora & Jahn 2021
Cocconeis disculus (Schumann) Cleve 1895
Cocconeis disculus var. *minor* Fontell 1922
Cocconeis euglypta Ehrenberg 1854
Cocconeis hauniensis Witkowski 1993
Cocconeis lineata Ehrenberg 1849
Cocconeis neodiminuta Krammer 1990
Cocconeis neothumensis Krammer 1991
Cocconeis pediculus Ehrenberg 1838
Cocconeis peltoides Hustedt 1939
Cocconeis placentula Ehrenberg 1838
Cocconeis placentula var. *intermedia* (Peragallo & Héribaud) Cleve 1895
Cocconeis placentula var. *klinoraphis* Geitler 1927
Cocconeis pseudolineata (Geitler) Lange-Bertalot 2004
Cocconeis pseudothumensis Reichardt 1982
Crenotia Wojtal 2013
Crenotia thermalis (Rabenhorst) Wojtal 2013
Cymbella C.Agardh 1830
Cymbella affiniformis Krammer 2002
Cymbella affinis Kützing 1844
Cymbella affinis var. *neoprocera* Silva 2015
Cymbella affinis var. *subcapitata* (Krammer) Silva 2015
Cymbella asiatica Metzeltin, Lange-Bertalot & Li 2009
Cymbella aspera (Ehrenberg) Cleve 1894
Cymbella aspera var. *elongata* Skvortzov 1928
Cymbella baicalaspera Glushchenko, Kulikovskiy and Kociolek 2022
Cymbella cistula (Ehrenberg) Kirchner 1878
Cymbella cistula var. *siamense* Hirano 1967
Cymbella cistuliformis Krammer 2002
Cymbella cistuloides var. *angulata* Skvortzov 1971
Cymbella compacta Østrup 1910
Cymbella cursiformis Hufford & Collins 1972
Cymbella cymbiformis Agardh 1830
Cymbella cymbiformis var. *nonpunctata* Fontell 1917
Cymbella cymbiformis var. unipunctata A. Cleve 1955
Cymbella diversiformis Krammer 2002
Cymbella diversistigmata Krammer 2002
Cymbella dorsenotata Østrup 1910
Cymbella excisa Kützing 1844
Cymbella hantzschiana Krammer 2002
Cymbella helmckei Krammer 1982
Cymbella helvetica Kützing 1844
Cymbella himalaspera Jüttner & Van de Vijver 2010
Cymbella hustedtii Krasske 1923
Cymbella hustedtii var. *compacta* Krammer 2002
Cymbella laevis Nägeli in Kützing 1849
Cymbella lancettula (Krammer) Krammer 2002
Cymbella lange-bertalotii Krammer 2002
Cymbella lange-bertalotii var. *lanceolata* Zalat nov. var.
Cymbella leptoceroides Hustedt 1942
Cymbella neocistula Krammer 2002
Cymbella neocistula var. *lunata* Krammer 2002
Cymbella neocistula var. *radomnoensis* Zalat nov. var.

Cymbella neolanceolata Silva 2013
Cymbella neolanceolata var. *bottnica* (Krammer) Silva 2013
Cymbella neoleptoceros Krammer 2002
Cymbella neoleptoceros var. *rhombica* Zalat & Chodyka nov. var.
Cymbella nepalensis (Jttner & Van de Vijver) Vishnjakov 2015
Cymbella parva (W. Smith) Kirchner 1878
Cymbella peraspera Krammer 2002
Cymbella perparva Krammer 2002
Cymbella proxima Reimer 1975
Cymbella proxima var. *bottnica* Krammer 2002
Cymbella radomnoensis Zalat nov. sp.
Cymbella sp.1
Cymbella stigmaphora Østrup 1910
Cymbella stigmaphora var. *polonica* Zalat nov. var.
Cymbella subaspera Krammer 2002
Cymbella subaspera var. *fabianii* Zalat nov. var.
Cymbella subaspera var. *salina* Krammer 2002
Cymbella subcistula Krammer 2002
Cymbella subhelvetica Krammer 2002
Cymbella subhimalaspera Jüttner & Van de Vijver 2010
Cymbella subleptoceros Krammer 2002
Cymbella subleptoceros var. *rostrata* Zalat nov. var.
Cymbella tumida (Brbisson) Van Heurck 1880
Cymbella tumida f. *major* Rich 1937
Cymbella tumida var. *nitychorukii* Zalat nov. var.
Cymbella tumidula Grunow 1875
Cymbella vidarbhensis Sarode & Kamat 1984
Cymbella vulgata Krammer 2002
Cymbellafalsa Lange-Bertalot & Metzeltin 2009
Cymbellafalsa diluviana (Krasske) Lange-Bertalot & Metzeltin 2009
Cymbopleura (Krammer) Krammer 1999
Cymbopleura acuta (Schmidt) Krammer 2003
Cymbopleura amphicephala (Nägeli) Krammer 2003
Cymbopleura anglica (Lagerstedt) Krammer 2003
Cymbopleura angustata (W.Smith) Krammer 2003
Cymbopleura apiculata Krammer 2003
Cymbopleura austriaca (Grunow) Krammer 2003
Cymbopleura budayana (Pantocsek) Krammer 2003
Cymbopleura citrus (Carter & Bailey-Watts) Krammer 2003
Cymbopleura cuspidata (Kützing) Krammer 2003
Cymbopleura cuspidata var. *compacta* Zalat nov.var.
Cymbopleura diminuta (Grunow) Krammer 2003
Cymbopleura florentina (Grunow) Krammer 2003
Cymbopleura florentina var. *brevis* Krammer 2003
Cymbopleura florentiniformis Krammer 2003
Cymbopleura frequens Krammer 2003
Cymbopleura hercynica (A. Schmidt) Krammer 2003
Cymbopleura hybrida (Grunow) Krammer 2003
Cymbopleura hybrida var. *capitata* (Grunow) Krammer 2003
Cymbopleura inaequaliformis Krammer 2003
Cymbopleura inaequalis (Ehrenberg) Krammer 2003
Cymbopleura inaequalis var. *ellipticum* Zalat nov. var.
Cymbopleura inaequalis var *rhomboidea* Zalat & Nitychoruk nov. var.

Cymbopleura inaequilatera (Lagerstedt) Krammer 2003
Cymbopleura incerta (Grunow) Krammer 2003
Cymbopleura incertiformis Krammer 2003
Cymbopleura incertiformis var. *crassipunctata* Krammer 2003
Cymbopleura incertiformis var. *inariensis* Krammer 2003
Cymbopleura incertiformis var. *laterostrata* Krammer 2003
Cymbopleura lata (Grunow) Krammer 2003
Cymbopleura lata var. *americana* Krammer 2003
Cymbopleura lata var. *irrorata* Krammer 2003
Cymbopleura lata var. *jeziorakensis* Zalat nov. var.
Cymbopleura lata var. *lura* Miho & Krammer 2003
Cymbopleura lata var. *truncata* Krammer 2003
Cymbopleura margalefii Delgado, Novais, Blanco & Ector 2013
Cymbopleura naviculiformis (Auerswald) Krammer 2003
Cymbopleura novafundlandica Krammer 2003
Cymbopleura peranglica Krammer 2003
Cymbopleura percuspidata Krammer 2003
Cymbopleura procera (Hustedt) Krammer 2003
Cymbopleura subaequalis (Grunow) Krammer 2003
Cymbopleura subaequalis var. *alpestris* Krammer 2003
Cymbopleura subaequalis var. *pertruncata* Krammer 2003
Cymbopleura subaequalis var. *chodykai* Zalat nov. var.
Cymbopleura subaequalis var. *truncata* (Grunow) Krammer 2003
Cymbopleura subapiculata Krammer 2003
Cymbopleura subcuspidata (Krammer) Krammer 2003
Cymbopleura sublanceolata Krammer 2003
Cymbopleura sublanceolata var. *javanica* Krammer 2003
Delicata Krammer 2003
Delicata delicatula (Kützing) Krammer 2003
Didymosphenia Mart.Schmidt 1899
Didymosphenia geminata (Lyngbye) Schmidt 1899
Encyonema Kützing 1834
Encyonema auerswaldii Rabenhotst 1853
Encyonema caespitosum Kützing 1849
Encyonema cespitosum var. *comensis* Krammer 1997
Encyonema distinctum Lange-Bertalot & Krammer 1997
Encyonema elginense (Krammer) Mann 1990
Encyonema gaeumannii (Meister) Krammer 1997
Encyonema hebridicum Grunow ex Cleve 1891
Encyonema lacustre (Agardh) Mills 1934
Encyonema lange-bertalotii Krammer 1997
Encyonema leibleinii (Agardh) Silva, Jahn, Ludwig, & Menezes 2013
Encyonema lunatum (W. Smith) Van Heurck 1880
Encyonema mesianum (Cholnoky) Mann 1990
Encyonema minutum (Hilse) Mann 1990
Encyonema neogracile Krammer 1997
Encyonema neomesianum Krammer 1997
Encyonema norvegicum (Grunow) Mayer 1947
Encyonema obscuriforme Krammer 1997
Encyonema perpusillum (Cleve) Mann 1990
Encyonema reichardtii (Krammer) Mann 1990
Encyonema silesiacum (Bleisch) Mann 1990
Encyonema silesiacum var. *altense* Krammer 1997

Encyonema silesiacum var. *lata* Krammer 1997
Encyonema subelginense Krammer 1997
Encyonema ventricosum (Agardh) Grunow 1875
Encyonema ventricosum var. *angustum* Krammer 1997
Encyonema vulgare Krammer 1997
Encyonopsis Krammer 1997
Encyonopsis cesatii (Rabenh.) Krammer 1997
Encyonopsis descripta (Hustedt) Krammer 1997
Encyonopsis falaisensis (Grunow) Krammer 1997
Encyonopsis krammeri Reichardt 1997
Encyonopsis lanceola (Grunow) Krammer 1997
Encyonopsis microcephala (Grunow) Krammer 1997
Encyonopsis minuta Krammer & Reichardt 1997
Encyonopsis naviculacea (Grunow) Krammer 1997
Encyonopsis subminuta Krammer & Reichardt 1997
Eucocconeis Cleve ex F.Meister 1912
Eucocconeis alpestris (Brun) Lange-Bertalot 1999
Eucocconeis austriaca (Hustedt) Lange-Bertalot 1999
Eucocconeis flexella (Kützing) Meister 1912
Eucocconeis laevis (Østrup) Lange-Bertalot 1999
Eucocconeis quadratarea (Østrup) Lange-Bertalot 1999
Eucocconeis quadratarea var. *ninckei* (Guermeur & Manguin) Zalat comb. nov.
Eunotia Ehrenberg 1837
Eunotia ambivalens Lange-Bertalot & Tagliaventi 2011
Eunotia arcubus Nörpel & Lange-Bertalot 1993
Eunotia arcubus var. *bidens* (Grunow) Lange-Bertalot 2011
Eunotia arculus Lange-Bertalot & Nörpel 1993
Eunotia arcus Ehrenberg 1837
Eunotia arcus var. *fallax* Hustedt 1930
Eunotia arcus var. *uncinata* (Ehrenberg) Grunow 1881
Eunotia bidens Ehrenberg 1843
Eunotia bigibba Kützing 1849
Eunotia bilunaris (Ehrenberg) Schaarschmidt 1880
Eunotia boreotenuis Nörpel-Schempp & Lange-Bertalot 1996
Eunotia botuliformis Wild, Nörpel & Lange-Bertalot 1993
Eunotia cantonatii Lange-Bertalot & Tagliaventi 2011
Eunotia curtagrunowii Nörpel-Schempp & Lange-Bertalot 1996
Eunotia curtiraphe Metzeltin & Lange-Bertalot 2007
Eunotia denticulata (Brébisson ex Kützing) Rabenhorst 1864
Eunotia diadema Ehrenberg 1837
Eunotia diodon Ehrenberg 1837
Eunotia eurycephaloides Nörpel-Schempp & Lange-Bertalot 1996
Eunotia exigua (Brébisson ex Kützing) Rabenhorst 1864
Eunotia exsecta (A.Cleve) Nörpel-Schempp & Lange-Bertalot 1996
Eunotia faba Ehrenberg 1837
Eunotia fallax Cleve-Euler 1895
Eunotia fennica (Hustedt) Lange-Bertalot 2004
Eunotia flexuosa (Brébisson ex Kützing) Kützing 1849
Eunotia formica Ehrenberg 1843
Eunotia formicina Lange-Bertalot 2011
Eunotia fureyae Lange-Bertalot 2011
Eunotia gallica Lange-Bertalot & Witkowski 2011
Eunotia genuflexa Nörpel-Schempp 1996

Eunotia glacialifalsa Lange-Bertalot 2000
Eunotia glacialis Meister 1912
Eunotia glacialispinosa Lange-Bertalot & Cantonati 2010
Eunotia gracilis (Ehrenberg) Rabenhorst 1864
Eunotia groenlandica Nörpel-Schempp & Lange-Bertalot 1996
Eunotia hexaglyphis Ehrenberg 1854
Eunotia implicata Nörpel-Schempp, Lange-Bertalot & Alles 1991
Eunotia incisa Smith ex Gregory 1854
Eunotia incisadistans Lange-Bertalot & Sienkiewicz 2011
Eunotia inflata (Grunow) Nörpel-Schempp & Lange-Bertalot 1996
Eunotia intermedia (Krasske ex Hustedt) Nörpel & Lange-Bertalot 1993
Eunotia islandica Østrup 1918
Eunotia juettnerae Lange-Bertalot 2011
Eunotia lapponica Grunow ex A. Cleve 1895
Eunotia longicollis Metzeltin & Lange-Bertalot 1998
Eunotia lunaris (Ehrenberg) Grunow 1877
Eunotia major (W.Smith) Rabenhorst 1864
Eunotia meisteri Hustedt 1930
Eunotia meridiana Metzeltin & Lange-Bertalot 1998
Eunotia metamonodon Lange-Bertalot 2011
Eunotia michaelii Metzeltin, Witkowski & Lange-Bertalot 1996
Eunotia minor (Kützing) Grunow 1881
Eunotia minor var. *undulata* Zalat nov. var.
Eunotia minutula Grunow 1862
Eunotia monodon Ehrenberg 1843
Eunotia mucophila (Lange-Bertalot, Nörpel & Alles) Lange-Bertalot 2007
Eunotia naegelii Migula 1905
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Eunotia novaisiae Lange-Bertalot & Ector 2011
Eunotia nymanniana Grunow 1881
Eunotia palatina Lange-Bertalot & Krüger 2004
Eunotia paludosa Grunow 1826
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Eunotia paralleladubia Lange-Bertalot & Mayama 2011
Eunotia paratridentula Lange-Bertalot & Kulikovskiy 2010
Eunotia pectinalis (Kützing) Rabenhorst 1864
Eunotia pectinalis var. *ventricosa* (Ehrenberg) Grunow 1881
Eunotia pomeranica Lange-Bertalot, Bak & Witkowski 2011
Eunotia praerupta Ehrenberg 1843
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Eunotia pseudopaludosa Van de Vijver, Haan & Lange-Bertalot 2014
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Eunotia rhomboidea Hustedt 1950
Eunotia rhynchocephala Hustedt 1936
Eunotia seminulum Nörpel-Schempp & Lange-Bertalot 1996
Eunotia septentrionalis Østrup 1897
Eunotia serra Ehrenberg 1837
Eunotia silvahercynia Nörpel, Van Sull & Lange-Bertalot 1991
Eunotia soleirolii (Kützing) Rabenhorst 1864
Eunotia subarcuatoides Alles, Nörpel & Lange-Bertalot 1991
Eunotia sudetica O.Müller 1898

Eunotia suecica A. Cleve 1895
Eunotia superpaludosa Lange-Bertalot 2011
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Eunotia tetraodon Ehrenberg 1838
Eunotia torula Hohn 1961
Eunotia trinacria Krasske 1929
Eunotia triodon Ehrenberg 1837
Eunotia valida Hustedt 1930
Eunotia veneris (Kützing) De Toni 1892
Gogorevia Kulikovskiy, Glushchenko, Maltsev & Kociolek 2020
Gogorevia australexigua (Van de Vijver) Kulikovskiy & Kociolek 2020
Gogorevia exilis var. *angustirostrata* Zalat comb. nov.
Gogorevia exilis (Kützing) Kulikovskiy & Kociolek 2020
Gogorevia exilis var. *constricta* Zalat & Pidek comb. nov.
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Gomphocymbellopsis Krammer 2003
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Gomphoneis Cleve 1894
Gomphoneis clevei (Fricke) Gil 1989
Gomphonella Rabenhorst 1853
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Gomphonella olivaceoides var. *lanceolata* (Manguin) Zalat comb. nov.
Gomphonella olivaceolacua (Lange-Bertalot & Reichart) Jahn & Abarca 2019
Gomphonema Ehrenberg 1832
Gomphonema acidoclinatum Lange-Bertalot & Reichardt 2004
Gomphonema acuminatum Ehrenberg 1836
Gomphonema acuminatum var. *pantocsekii* A.Cleve 1932
Gomphonema acuminatum var. *pusillum* Grunow 1880
Gomphonema acuminatum var. *scardicum* (Mitic-Kopanja, Wetzel, Ector & Levkov) Abarca & Jahn 2020
Gomphonema acutiusculum (Otto Müller) Cleve-Euler 1955
Gomphonema adductum Hustedt 1965
Gomphonema affine Kützing 1844
Gomphonema affine var. *rhombicum* Reichardt 1999
Gomphonema amoenum Lange-Bertalot 1985
Gomphonema anglicum Ehrenberg 1843
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Gomphonema angusticephalum Reichardt & Lange-Bertalot in Reichardt 1999
Gomphonema angustius Reichardt 2009
Gomphonema angustivalva Reichardt 1997
Gomphonema angustum Agardh 1831
Gomphonema angustum var. *lunatum* (Germain) Aboal 2003
Gomphonema asiaticum Liu & Kociolek in Liu, Kociolek & Wang 2013
Gomphonema augur Ehrenberg 1841
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Gomphonema bavaricum Reichardt & Lange-Bertalot 1991
Gomphonema bohemicum Reichelt & Fricke in Schimidt 1902
Gomphonema brebissonii Kützing 1846
Gomphonema brebissonii var. *cuneata* Zalat nov. var.
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Gomphonema capitatum Ehrenberg 1838
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Gomphonema contraturris var. *pideki* Zalat nov. var.
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Gomphonema dichotomum Kützing 1834
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Gomphonema diminutum Karthick & Kociolek 2011
Gomphonema distinctistriatum Kociolek, Woodward & Graeff 2016
Gomphonema drutelingense Reichardt 1999
Gomphonema elegantissimum Reichardt & Lange-Bertalot 2011
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Gomphonema exilissimum (Grunow) Lange-Bertalot & Reichardt 1996
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Gomphonema gregarium Kociolek, Woodward & Graeff 2016
Gomphonema grunowii Patrick & Reimer 1975
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Gomphonema helveticum Brun 1895
Gomphonema innocens Reichardt 1999
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Gomphonema insigniforme Reichardt & Lange-Bertalot 1999
Gomphonema insigniforme var. *elongatum* Zalat nov. var.
Gomphonema intricatum Kützing 1844
Gomphonema italicum Kützing 1844
Gomphonema jadwigae Lange-Bertalot & Reichardt 1996
Gomphonema khentiiense Lange-Bertalot, Metzeltin & Nergui 2009
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Gomphonema lagerheimii Cleve 1895
Gomphonema lateripunctatum Reichardt & Lange-Bertalot 1991
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Gomphonema laticollum var *truncata* Zalat & Pidek nov. var.
Gomphonema latipes Reichardt 2001
Gomphonema lippertii Reichardt & Lange-Bertalot 1999
Gomphonema longiceps Ehrenberg 1854
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Gomphonema maclaughlinii Reichardt 1999
Gomphonema macropunctatum Krishnamurthy 1954
Gomphonema megalobrebissonii Chudaev, Kociolek & Golobova 2014
Gomphonema meridionalum Kociolek & Thomas in Thomas et al. 2009
Gomphonema microlaticollum Kulikovskiy, Kociolek & Solak 2015
Gomphonema micropumilum Reichardt 1997
Gomphonema micropus Kützing 1844
Gomphonema micropus var. *aequale* (Gregory) Reichardt 1999
Gomphonema minusculum Krasske 1932
Gomphonema minutiforme Lange-Bertalot & Reichardt 1993
Gomphonema minutum (Agardh) Agardh 1831
Gomphonema minutum f. *pachypus* Lange-Bertalot & Reichardt in Lange-Bertalot 1993

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Gomphonema productum (Grunow) Lange-Bertalot & Reichardt in Lange-Bertalot 1993
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Gomphonema pseudotenellum Lange-Bertalot 1985
Gomphonema pulvillum Spaulding & Kociolek 1998
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Gomphonema pumilum var. *rigidum* Reichardt & Lange-Bertalot 1997
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Gomphonema reichardtii Lange-Bertalot in Lange-Bertalot & Metzeltin 1996
Gomphonema saprophilum (Lange-Bertalot & Reichardt) Abraca, Jahn, Zimmermann & Enke 2014
Gomphonema sarcophagus Gregory 1856
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Gomphonema sphaerophorum Ehrenberg 1845
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Gomphonema subclavatum (Grunow) Grunow 1884
Gomphonema sublaticollum Levkov, Mitic-Kopanja & Reichardt 2016
Gomphonema subtile Ehrenberg 1843
Gomphonema subtile var. *sagitta* (Schumann) Grunow 1880
Gomphonema supertergestinum Reichardt 2009
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Gomphonema trigonocephalum Ehrenberg 1854
Gomphonema truncatum Ehrenberg 1832
Gomphonema truncatum var. *elongatum* (Peragallo & Héribaud) Patrick 1975
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Gomphonema vidarbhense Sarode & Kamat 1984
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Karayevia Round & Bukhtiyarova ex Round 1998
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Karayevia bottnica (Cleve) Lange-Bertalot 2004
Karayevia clevei (Grunow) Bukhtiyarova 1999
Karayevia clevei var. *balcanica* (Hustedt) Levkov & Krstic 2007
Karayevia clevei var. *minor* Zalat nov. var.

Karayevia jeziorakensis Zalat nov. sp.
Karayevia kolbei (Hustedt) Bukhtiyarova 1999
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Karayevia suchlandtii (Hustedt) Bukhtiyarova 1999
Kolbesia Round & Bukhtiyarova ex Round 1998
Kolbesia gessneri (Hustedt) Aboal 2003
Kurtkrammeria Bahls 2015
*Kurtkrammeria neoamphioxy*s (Krammer) Bahls 2015
Lemnicola Round & Basson 1997
Lemnicola hungarica (Grunow) Round & Basson 1997
Paraplaconeis Kulikovskiy, Lange-Bertalot & Metzeltin 2012
Paraplaconeis cracoviensis Lange-Bertalot & Wojtal 2014
Paraplaconeis macedonica (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012
Paraplaconeis minor (Grunow) Lange-Bertalot 2017
Paraplaconeis ohridana var. *lanceolatum* Zalat nov.var.
Paraplaconeis ohridana var. *rostrata* Zalat nov.var.
Paraplaconeis ohridana (Levkov & Metzeltin) Kulikovskiy, Metzeltin & Lange-Bertalot 2012
Paraplaconeis placentula (Ehrenberg) Kulikovskiy & Lange-Bertalot 2012
Paraplaconeis placentula var. *cuneatum* Zalat nov. var.
Paraplaconeis placentula var. *jenisseyensis* (Bukhtiyarova) Zalat comb. nov.
Paraplaconeis prespanensis (Levkov, Krstic & Nakov) Kulikovskiy & Lange-Bertalot 2012
Paraplaconeis subplacentula (Hustedt) Kulikovskiy & Lange-Bertalot 2012
Pauliella Round & Basson 1997
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Placoneis exigua (Gregory) Mereschkovsky 1903
Placoneis explanata (Hustedt) Lange-Bertalot in Rumrich et al. 2000
Placoneis gastriformis (Hustedt) Lange-Bertalot 2005
Placoneis gastrum (Ehrenberg) Mereschkowsky 1903
Placoneis hambergii (Hustedt) Bruder 2007
Placoneis humilis Metzeltin, Lange-Bertalot & García-Rodríguez 2005
Placoneis ignorata (Schimanski) Lange-Bertalot 2000
Placoneis nanoclementis Lange-Bertalot & Wojtal 2014
Placoneis neoexigua Lange-Bertalot & Miho 2006
Placoneis paraelginensis Lange-Bertalot 2000
Placoneis parvapolonica Lange-Bertalot & Wojtal 2014
Placoneis porifera (Hustedt) Cox 2003
Placoneis pseudabundans Levkov 2011
Placoneis signata (Hustedt) Mayama 1998

Placoneis significans Lange-Bertalot 2005
Placoneis subundulata Kezlya, Glushchenko, Kulikovskiy & Kociolek 2021
Placoneis undulata (Østrup) Lange-Bertalot in Rumrich et al. 2000
Planoplatessa Kulikovskiy, Glushchenko & Kociolek 2022
Planoplatessa joursacensis (Héribaud) Kulikovskiy, Glushchenko & Kociolek 2022
Planoplatessa joursacensis var. *elongatum* Zalat nov.var.
Planoplatessa joursacensis var. *ovatum* Zalat nov.var.
Planothidium Round & Bukhtiyarova ex Round 1996
Planothidium amphibium Wetzel, Ector & Pfister 2014
Planothidium bagualensis Wetzel & Ector 2014
Planothidium biporomum (Hohn & Hellerman) Lange-Bertalot 1999
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Planothidium cryptolanceolatum Jahn & Abarca 2017
Planothidium daui (Foged) Lange-Bertalot 1999
Planothidium delicatulum (Kützing) Round & Bukhtiyarova 1996
Planothidium distinctum (Messikommer) Lange-Bertalot 1999
Planothidium dubium (Grunow) Round & Bukhtiyarova 1996
Planothidium ellipticum (Cleve) Edlund 2001
Planothidium engelbrechtii (Cholnoky) Round & Bukhtiyarova 1996
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot 1999
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Planothidium granum (Hohn & Hellerman) Lange-Bertalot 1999
Planothidium grimmei (Krasske) Bishop & Spaulding 2018
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot 1999
Planothidium lilianeanum Van de Vijver 2018
Planothidium pericavum (Carter) Lange-Bertalot 1999
Planothidium reichardtii Lange-Bertalot & Werum 2004
Planothidium rostratum (Østrup) Lange-Bertalot 1999
Planothidium septentrionalis (Østrup) Round & Bukhtiyarova 1996
Planothidium taeansa Jahn & Abarca 2017
Planothidium victori Novis, Braidwood & Kilroy 2012
Platessa Lange-Bertalot 2004
Platessa conspicua (A. Mayer) Lange-Bertalot 2004
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Platessa guianensis Le Cohu, Tudesque & Wetzel 2016
Platessa holsatica (Hustedt) Lange-Bertalot 2004
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Platessa montana (Krasske) Lange-Bertalot 2004
Platessa oblongella (Østrup) Wetzel, Lange-Bertalot & Ector 2017
Platessa stewartii (Patrick) Potapova 2012
Platessa ziegleri (Lange-Bertalot) Lange-Bertalot 2004
Psammothidium Bukhtkiyarova & Round 1996
Psammothidium acidoclinatum (Lange-Bertalot) Lange-Bertalot 1999
Psammothidium altaicum (Poretzky) Bukhtiyarova 1996
Psammothidium bioretii (Germain) Bukhtiyarova & Round 1996
Psammothidium daonense (Lange-Bertalot) Lange-Bertalot 1999
Psammothidium grischunum (Wuthrich) Bukhtiyarova & Round 1996
Psammothidium helveticum (Hustedt) Bukhtiyarova & Round 1996
Psammothidium helveticum var. *minus* (Flower & Jones) Buczkó 2016
Psammothidium kryophilum (Petersen) Reichardt 2004
Psammothidium lauenburgianum (Hustedt) Bukhtiyarova & Round 1996

Psammothidium levanderi (Hustedt) Bukhtyiarova & Round 1996
Psammothidium marginulatum (Grunow) Bukhtiyarova & Round 1996
Psammothidium microscopicum (Cholnoky) Blanco 2016
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Psammothidium punctulatum (Simonsen) Bukhtiyarova et Round 1996
Psammothidium rechtense (Leclercq) Lange-Bertalot 1999
Psammothidium rossii (Hustedt) Bukhtiyarova et Round 1996
Psammothidium semiapertum (Hustedt) Aboal 2003
*Psammothidium subatomoides (*Hustedt) Bukhtiyarova & Round 1996
Psammothidium ventrale (Krasske) Bukhtiyarova & Round 1996
Reimeria Kociolek & Stoermer 1987
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Reimeria uniseriata Sala, Guerrero & Ferrario 1993
Rhoicosphenia Grunow 1860
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot 1980
Skabitschewskia Kuliskovskiy & Lange-Bertalot 2015
Skabitschewskia oestrupii (A.Cleve) Kuliskovskiy & Lange-Bertalot 2015
Skabitschewskia peragalloi (Brun & Héribaud) Kuliskovskiy & Lange-Bertalot 2015
Staurophora Mereschkowsky 1903
Staurophora salina (W. Smith) Mereschkowsky 1903
Witkowskia Kulikovskiy, Mironov, Glushchenko & Kociolek 2024
Witkowskia abiskoensis (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024
Witkowskia anglophila (Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek 2024



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