Composition of the epilithic diatom flora from a subtropical river, Southern Brazil

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ABSTRACT – Aiming to study the flora of epilithic diatoms of the Pardinho River, southern Brazil, we collected samples of epilithic diatoms in five sampling stations along the river during an annual cycle (August 2001 to July 2002). The epilithic diatom flora of Pardinho River was represented by 99 taxa which were distributed among 23 families and 41 genera. The most representative families were *Naviculaceae* (14 taxa), *Gomphonemataceae* (10) and *Bacillariaceae* (10). The genera richest in species were *Gomphonema* Ehrenberg, *Navicula* Bory, *Eunotia* Ehrenberg and *Nitzschia* Hassal. Two new species are proposed (*Nupela pardinhoensis* Bes, Torgan & Ector and *Surirella bouillonii* Bes, Ector & Torgan). Morphometric data, 234 LM and SEM photomicrographs are presented.

Key words: freshwater, taxonomy, new species, *Nupela, Surirella*

RESUMO – **Composição da flora de diatomáceas epilíticas de um rio subtropical, sul do Brasil**. Com o objetivo de estudar a flora das diatomáceas epilíticas do Rio Pardinho, sul do Brasil, foram coletadas amostras de diatomáceas epilíticas em cinco pontos de amostragem ao longo do rio durante um ciclo anual (agosto de 2001 a julho 2002). Foram identificadas 99 espécies, distribuídas em 23 famílias e 41 gêneros. As famílias mais representativas foram *Naviculaceae* (14 táxons), *Gomphonemataceae* (10) and *Bacillariaceae* (10). Os gêneros mais ricos em espécies foram *Gomphonema* Ehrenberg, *Navicula* Bory, *Eunotia* Ehrenberg and *Nitzschia* Hassal. Duas novas espécies são propostas (*Nupela pardinhoensis* Bes, Torgan & Ector and *Surirella bouillonii* Bes, Ector & Torgan). Além dos dados morfométricos de cada espécie, também são apresentadas 234 fotomicrografias em LM e MEV.

Palavras-chave: água doce, taxonomia, novas espécies, *Nupela, Surirella*

INTRODUCTION

Diatom investigations in Brazil have been carried out mostly in the southern region. In the State of Rio Grande do Sul, lentic systems are the most investigated (Torgan *et al.*, 1999), whereas in the lotic systems, few studies of diatom biodiversity have been published, and these were mainly on planktonic diatoms (Martau *et al.,* 1977, Buselato & Aguiar, 1979, Laudares-Silva, 1987 and Callegaro *et al.* 1993).

In lotic environments, epilithic diatoms are considered useful for the analysis of environmental conditions due to their sessile life modes, short life cycles, and efficient responses to changes occurred in the environment. Previous studies of epilithic diatom communities from the Pardinho River Basin were related to bioindication and evaluation of organic contamination (Lobo *et al.*, 1996, 2004, Lobo & Costa, 1997, Lobo & Bender, 1998, and Wetzel *et al.* 2002). Recently, Lobo *et al.* (2010) in a study on the response of the communities to eutrophication in the Rio Pardo Watershed, which includes the Pardinho River Basin, 270 diatom taxa distributed in 53 genera were

identified, however, only species tolerant to eutrophication were illustrated.

In this context, we present the taxonomic composition of the epilithic diatom flora in the Pardinho Watershed, including illustrations, morphometric data of the taxa and two new species proposed. This biological inventory will be useful for increasing the accuracy of the taxonomic basis of the water quality indices proposed regionally, like the BWQI (Biological Water Quality Index) of Lobo *et al.* (2004).

MATERIAL AND METHODS

The Pardinho River Hydrographical Watershed is situated in the middle of Rio Grande do Sul State, southern Brazil. The main watercourse has a length of 105 km; its highest altitude is 718 m, in the municipal district of Gramado Xavier; its lowest altitude is 17 m, in the municipal district of Rio Pardo. The average yearly precipitation is 1500 mm.

The samplings were carried out seasonally from August 2001 to July 2002, in five sites along the Pardinho River (Fig. 1, Table 1), where the water depth was 30 cm. The diatoms were scrubbed off the upper surfaces of submerged stones of 10-

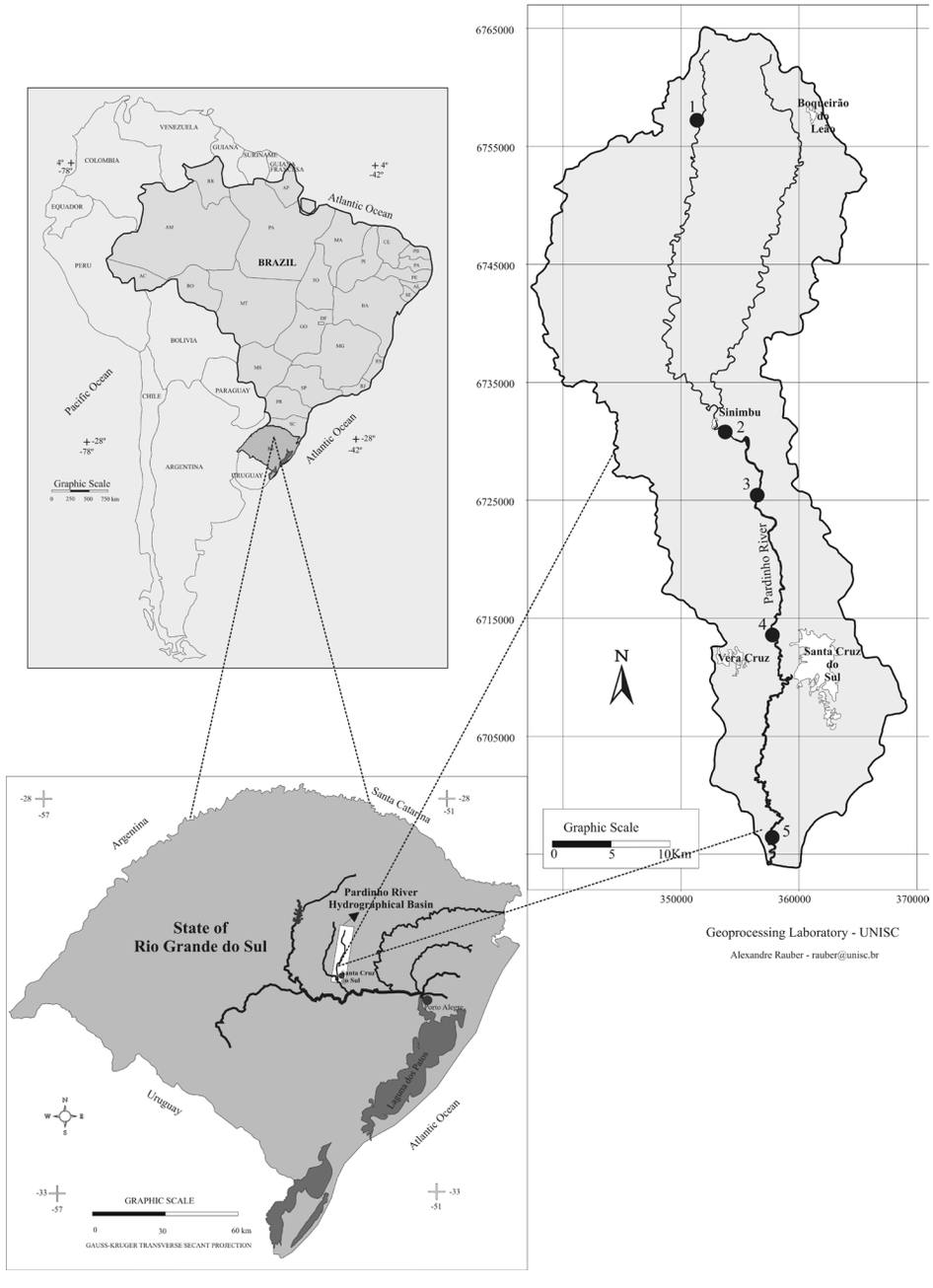

Fig. 1. Map of the study area showing the location of Pardinho River, State of Rio Grande do Sul, Brazil, and sampling stations.

15 cm in diameter using a toothbrush. Samples were fixed with formalin and cleaned following the method of Kobayasi & Mayama (1982), and mounted on a slide with Naphrax. Observations, measurements and photographs were performed using a light microscope (LM) Leica DMRB, equipped with a DC500 high-resolution digital camera. Treated samples were also mounted on stubs for scanning electron microscopy (SEM) observations, performed with a Leica Stereoscan 430i, operated at 20 kV.

The examined materials (slides) are stored in the Diatom Collection at the University of Santa Cruz do Sul, RS, Brazil (Table 2). The classification of the taxa followed the system proposed by Round *et al.* (1990) and modified by Medlin & Kaczmarska (2004). Abbreviations: D = diameter, L = length, H = height, W = width, Str = striae and Fib = fibulae.

For the site where the new species were found we present the dates of dissolved oxygen, biochemical oxygen demand (BOD_5) and total phosphate. These chemical variables were collected and analysed according to the American Public Health Association (APHA, 1992).

Table 1. List of sampling stations along the Pardinho River, Rio Grande do Sul, Brazil.

Sampling Station	Locality	S	W
1	Gramado Xavier	29°14'10"	53°30'49"
2	Sinimbu	29°32'10"	53°31'05"
3	Santa Cruz do Sul	29°41'23"	53°28'03"
4	Vera Cruz	29°43'56"	53°27'50"
5	Vera Cruz	29°47'32"	53°28'48"

Table 2. List of studied slides from Diatom Collection at the University of Santa Cruz do Sul, RS, Brazil, with associated collection data. The samples were collected by the first author, Daniela Bes.

Slide accession number	Collection date	Sampling Station
709	08-28-2001	1
710	08-28-2001	2
711	09-10-2001	3
712	09-10-2001	4
713	09-10-2001	5
721	12-19-2001	1
722	12-19-2001	2
723	11-20-2001	3
724	11-20-2001	4
725	11-20-2001	5
738	03-11-2002	1
739	03-11-2002	2
740	02-19-2002	3
741	02-19-2002	4
742	02-19-2002	5
759	05-07-2002	1
760	05-07-2002	2
761	05-06-2002	3
762	05-06-2002	4
763	05-27-2002	5

RESULTS AND DISCUSSION

The epilithic diatom flora of Pardinho River was represented by 99 taxa which were distributed among 23 families and 41 genera. The most representative families were *Naviculaceae* (14 taxa), *Gomphonemataceae* (10 taxa) and *Bacillariaceae* (10 taxa). The genera richest in species were *Gomphonema*, *Navicula*, *Eunotia* and *Nitzschia*.

Amongst the taxa studied, *Nupela pardinhoensis* Bes, Torgan & Ector and *Surirella bouillonii* Bes, Ector & Torgan are new species proposed for the Science.

In general, the taxa showed similar morphology and dimensions comparable to the original diagnoses and literature data; the observed differences are reported below.

Bacillariophyta
Coscinodiscophytina Medlin & Kaczmarska
Coscinodiscophyceae Round & Crawford, *emend* Medlin & Kaczmarska
Melosiraceae Kützing
Melosira C. Agardh

Melosira varians C. Agardh, Flora oder Botanische Zeitung, Regensburg 2, p. 628. 1827.
(Fig. 2)

Valve dimensions: D: 8-20 µm; H: 4-10 µm.
Examined material: slides 711, 722, 723, 724, 738, 740, 742, 762.
Reference: Krammer & Lange-Bertalot (1991*a*).

Bacillariophytina Medlin & Kaczmarska
Mediophyceae (Jousé & Proshkina-Lavrenko) Medlin & Kaczmarska
Stephanodiscaceae Glezer & I.V. Makarova
Cyclotella (Kützing) Brébisson

Cyclotella meneghiniana Kützing, Die Kieselschaligen Bacillarien oder Diatomeen, p. 50, pl. 30, fig. 68. 1884.

(Figs. 3, 4, 22, 23)
Valve dimensions: D: 5-43 μm; Str: 6-10 in 10 μm.
Examined material: slides 711, 712, 722, 738, 741, 742, 762, 763.
Reference: Krammer & Lange-Bertalot (1991*a*).

Thalassiosiraceae M. Lebour
Conticribra Stachura-Suchoples & D.M. Williams
Conticribra weissflogii (Grunow) Stachura-Suchoples & D.M. Williams, Eur. J. Phycol., 44(4): 482. 2009.
(Fig. 5)
Valve dimensions: D: 20 μm.
Examined material: slides 711, 712, 763.
Reference: Stachura-Suchoples & D.M. Williams (2009).
Observations: This species was reported as *Thalassiosira weissflogii* (Grunow) G.A. Fryxell & Hasle by Torgan & Santos (2006).

Triceratiaceae (F. Schütt) Lemmermann
Pleurosira (Meneghini) Trevisan
Pleurosira laevis (Ehrenberg) Compère, Bacill. 5: 177, figs. 1-17, 20, 39. 1982.
(Figs. 6, 24, 25)
Valve dimensions: L: 30-35 μm; W: 37-44 μm.
Examined material: slides 722, 723, 724, 725, 741, 762.
Reference: Compère (1982).

Bacillariophyceae Haeckel emend Medlin & Kaczmarska
Fragilariaceae Greville
Fragilaria Lyngbye
Fragilaria parva (Grunow *in* Van Heurck) Tuji & D. M. Williams, Diatom 24: 29. 2008.
(Figs. 7-9)
Valve dimensions: L: 21-50 μm; W: 3-4 μm; Str: 18-19 in 10 μm.
Examined material: slides 709, 721, 723, 724, 738.
Reference: Tuji & Williams (2008).

Ulnaria (Kützing) Compère
Ulnaria ulna (Nitzsch) Compère, Lange-Bertalot Festschrift Studies on Diatoms, p. 100. 2000.
(Figs. 10, 26, 27)
Valve dimensions: L: 80-210 μm; W: 2-9 μm; Str: 7-12 in 10 μm.
Examined material: slides 709, 713, 721, 723, 724, 738, 762.
Reference: Compère (2000).

Eunotiaceae Kützing
Eunotia Ehrenberg
Eunotia aff. ***bilunaris*** (Ehrenberg) Schaarschmidt, Algae in A Kanitz, Plantas Romaniae hucusque cognitas. Magyar Novenytani Lapok, v. 5, p. 159. 1881.
(Figs. 11-13, 30)
Valve dimensions: L: 15-66 μm; W: 2-3 μm; Str: 18-22 in 10 μm.
Examined material: slides 739, 741, 742.
Reference: Lange-Bertalot *et al.* (2011)

Eunotia aff. ***itapuana*** Torgan, Diatom Research 12 (1): 115, figs. 2-22. 1997.
(Figs. 14, 32)
Valve dimensions: L: 9-26 μm; W: 3-4 μm; Str: 18-20 in 10 μm.
Examined material: slides 739, 759.
Reference: Torgan & Becker (1997, 1998).
Observations: The type material presented one rimoportula at each pole of the valve, whereas the studied specimens showed only one rimoportula per valve.

Eunotia paludosa Grunow, Verh. Zool-Bot. Ges. Wien 12: 336, pl. 6, fig. 10. 1862.
(Fig. 18)
Valve dimensions: L: 20-56 μm; W: 2-3 μm; Str: 20-25 in 10 μm.
Examined material: slides 739, 740, 759, 760.
Reference: Krammer & Lange-Bertalot (1991*a*).

Eunotia pileus Ehrenberg, Abh. K. Akad. Wiss. Berlin, Physik. Kl. 414, pl. 2, fig. 5. 1843.
(Fig. 19)
Valve dimensions: L: 38 μm; W: 15 μm; Str: 11 in 10 μm.
Examined material: slide 725.
Reference: Metzeltin & Lange-Bertalot (1998).

Eunotia pseudosudetica Metzeltin, Lange-Bertalot & García-Rodríguez, Iconogr. Diatomol., v. 15, p. 57-59, pl. 24, figs. 15-18. 2005.
(Figs. 15-17, 33)
Valve dimensions: L: 15-54 μm; W: 3-6 μm; Str: 8-12 in 10 μm.
Examined material: slides 713, 738, 759.
Reference: Metzeltin *et al.* (2005)

Eunotia rabenhorstii Cleve & Grunow *in* Van Heurck, Syn. Diat. Belg. Atlas, pl. 35, fig. 12 A-B, 1881.
(Fig. 31)
Valve dimensions: L: 19-22 μm; W: 6-7 μm; Str: 12-13 in 10 μm.

Examined material: slides 713, 759.
Reference: Krammer & Lange-Bertalot (1991*a*).

Eunotia tridentula Ehrenberg, Abh. Ber. K. Akad. Wiss. Berlin: 414, pl. 2/1, fig. 14. 1843.
(Figs. 20, 28, 29)
Valve dimensions: L: 27-31 μm; W: 7-9 μm; Str: 11-13 in 10 μm.
Examined material: slides 721.
Reference: Lange-Bertalot *et al.* (1996).

***Eunotia* sp.**
(Fig. 21)
Valve dimensions: L: 7-14 μm, W: 3-4 μm; Str: 10-15 in 10 μm.
Examined material: slides 721, 739, 759.

Cymbellaceae Greville
Cymbopleura (Krammer) Krammer
Cymbopleura naviculiformis (Auerswald *ex* Heiberg) Krammer, Diat. Eur. v. 4, pl. 56, pl. 76, figs. 1-11. 2003.
(Fig. 34)
Valve dimensions: L: 32-36 μm; W: 7-9 μm; Str: 12-14 in 10 μm.
Examined material: slide 738.
Reference: Krammer (2003).

Cymbella C. Agardh
Cymbella tumida (Brébison *ex* Kützing) Van Heurck, Syn. Diat. Belg. Atlas, p. 64, pl. 2, fig. 10. 1880-1881.
(Fig. 35)
Valve dimensions: L: 65-83 μm; W: 12- 9 μm; Str: 8-12 in 10 μm.
Examined material: slides 724, 738.
Reference: Krammer & Lange-Bertalot (1986).

Encyonema Kützing
Encyonema neogracile Krammer, Biblioth. Diatomol., v. 36, p. 177-178, pl. 82, figs. 1-7, 12-13. 1997.
(Fig. 36)
Valve dimensions: L: 21-35 μm; W: 5-6 μm; Str: 12-14 in 10 μm.
Examined material: slide 762.
Reference: Krammer (1997).

Encyonema neomesianum Krammer, Biblioth. Diatomol., v. 36, p. 84, pl. 40, figs. 6-9; pl. 54, figs. 6, 7; pl. 99, figs. 4-7. 1997.
(Figs. 37, 38)
Valve dimensions: L: 15-46 μm; W: 7-14 μm; Str: 8-12 in 10 μm; Areolae: 19-20 in 10 μm.
Examined material: slides 724, 738, 741, 742, 761, 762.
Reference: Krammer (1997).
Observations: The studied specimens have lower areolae density (21-24 in 10 μm) than specimens from the type material.

Encyonema cf. ***silesiacum*** (Bleisch *in* Rabenhorst) D.G. Mann in Round *et al.*, The Diatoms, p. 667. 1990.
(Figs. 39, 91)
Valve dimensions: L: 15-49 μm; W: 7-14 μm; Str: 8-12 in 10 μm.
Examined material: slides 710, 711, 712, 725, 738, 740, 742.
Reference: Krammer (1997).

Encyonema sprechmannii Metzeltin, Lange-Bertalot & García-Rodríguez *in* Metzeltin & García-Rodríguez, Las diatomeas uruguayas, p. 38, pl. 43, figs. 1-10. 2003.
(Figs. 40, 41)
Valve dimensions: L: 14-30 μm; W: 3-5 μm; Str: 9-13 in 10 μm.
Examined material: slide 724.
Reference: Metzeltin & García-Rodríguez (2003).
Observations: The specimens differ from the type by being narrower and have greater striae density.

Placoneis Mereschkowsky
Placoneis disparilis (Hustedt) Metzeltin & Lange-Bertalot, Iconogr. Diatomol. v. 5, p. 197, pl. 92, figs. 1-6. 1998.
(Figs. 42, 43, 219)
Valve dimensions: L: 32-54 μm; W: 14-19 μm; Str: 12-16 in 10 μm.
Examined material: slides 711, 712, 713, 722, 724, 738, 740, 761, 762.
Reference: Metzeltin & Lange-Bertalot (1998).

Placoneis witkowskii Metzeltin, Lange-Bertalot & García-Rodríguez, Iconogr. Diatomol. v. 15, p. 200, pl. 71, figs. 8-15. 2005.
(Fig. 44)
Valve dimensions: L: 25 μm; W: 9 μm; Str: 13 in 10 μm.
Examined material: slide 738.
Reference: Metzeltin *et al.* (2005)

Gomphonemataceae Kützing
Gomphonema Ehrenberg
Gomphonema aff. ***affine*** Kützing, Bacillarien, p. 86, pl. 30, fig. 54. 1844.
(Fig. 45)
Valve dimensions: L: 30-100 μm; W: 7-12 μm; Str: 8-13 in 10 μm.

Examined material: slides 709, 711, 712, 713, 722, 724, 738, 760.
Reference: Reichardt (1999).
Gomphonema aff**. *affine*** var. ***rhombicum*** Reichardt, Iconogr. Diatomol., v. 8: 15, pl. 1, figs. 1-15. 1999.
(Fig. 46)
Valve dimensions: L: 31 µm; W: 7 µm; Str: 12 in 10 µm.
Examined material: slide 709.
Reference: Reichardt (1999).

Gomphonema brasiliensoide Metzeltin, Lange-Bertalot & García-Rodríguez, Iconogr. Diatomol., v. 15, p. 80-82, pl. 149, figs. 1-10. 2005.
(Figs. 47-49)
Valve dimensions: L: 25-44 µm; W: 5-7 µm; Str: 11-13 in 10 µm.
Examined material: slide 738, 740.
Reference: Metzeltin *et al.* (2005).

Gomphonema lujanense E.Reichardt & Maidana *in* Reichardt, Diatom Research, 23 (1):110, figs. 26-41. 2008.
(Figs. 50-52)
Valve dimensions: L: 21-35 µm; W: 7-9 µm; Str: 8-10 in 10 µm.
Examined material: slides 711, 738.
Reference: Reichardt (2008).

Gomphonema mexicanum Grunow *in* Van Heurck, Syn. Diat. Belg. Atlas, pl. 24, fig. 3. 1880.
(Fig. 57)
Valve dimensions: L: 31-50 µm; W: 11-13 µm; Str: 9-12 in 10 µm.
Examined material: slides 723, 740.
Reference: Rumrich *et al.* (2000).

Gomphonema parvulum Kützing, Spec. Alg., p. 65. 1849.
(Figs. 54, 58-64, 92, 93)
Valve dimensions: L: 14-32 µm; W: 4-7 µm; Str: 8-17 in 10 µm.
Examined material: slides 709, 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 742, 760, 761, 762, 763.
Reference: Krammer & Lange-Bertalot (1986).

Gomphonema pseudoaugur Lange-Bertalot, Arch. Hydrobiol. Suppl. 56, Algol Stud. 23: 213, 214, figs. 11-16, 79, 80. 1979.
(Figs. 65, 66)
Valve dimensions: L: 35-44 µm; W: 8-12 µm; Str: 12-14 in 10 µm.
Examined material: slides 710, 711, 712, 738.
Reference: Krammer & Lange-Bertalot (1986).
Observations: The specimens differ from the type by the width and striae density.

Gomphonema pumilum (Grunow) E. Reichardt & Lange-Bertalot var. ***rigidum*** E. Reichardt & Lange-Bertalot, Nova Hedwigia, 65: 105, pl. 1, fig. 7, pl. 3, figs. 1-41, pl. 4, figs. 24-25. 1997.
(Figs. 67-70)
Valve dimensions: L: 11-34 µm; W: 4-6 µm; Str: 12-14 in 10 µm.
Examined material: slides 711, 712, 713, 724, 725, 740, 741, 760, 762.
Reference: Reichardt (1997).

Gomphonema turris fo. ***coarctata*** (Fricke *in* Schmidt *et al.*) Frenguelli, Anales Mus. Nac. Hist. Nat. 37: p. 423, pl. 4, figs. 35, 36. 1933.
(Fig. 71)
Valve dimensions: L: 75-86 µm; W: 12-15 µm; Str: 7-9 in 10 µm.
Examined material: slide 740.
Reference: Sar *et al.* (2009)

Gomphonema **sp.**
(Figs. 55, 56)
Valve dimensions: L: 30-100 µm; W: 7-12 µm; Str: 8-13 in 10 µm.
Examined material: slide 761.

Cocconeidaceae Kützing
Cocconeis Ehrenberg

Cocconeis placentula Ehrenberg var. ***euglypta*** (Ehrenberg) Grunow, Denkschr. Akad. Wiss. Math.-nat. Wien, 48: 97, pl. 1 (A), fig. 3. 1884.
(Fig. 72)
Valve dimensions: L: 39-64 µm; W: 15-25 µm; Str: 17-22 in 10 µm.
Examined material: slides 713, 723, 724, 740, 741, 760, 761, 762.
Reference: Krammer & Lange-Bertalot (1991*b*).

Cocconeis placentula var. ***lineata*** (Ehrenberg) Van Heurck, Syn. Diat. Belg., p. 133, Atlas pl. 30, figs. 31, 32. 1885.
(Fig. 73)
Valve dimensions: L: 20-30 µm; W: 12-16 µm; Str: 19-23 in 10 µm.
Examined material: slides 712, 713, 722, 723, 724, 740, 741, 760, 761, 762.

Reference: Patrick & Reimer (1966).

Achnanthidaceae D.G. Mann
Achnanthidium Kützing

Achnanthidium exiguum var. ***heterovalvum*** (Krasske) Czarnecki, Proc. 11th Intern. Diat. Symp., p. 157. 1994.
(Figs. 74-76, 98)
Valve dimensions: L: 10-17µm; W: 4-5 µm; Str: 22-24 in 10 µm (rapheless valve).
Examined material: slides 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 742, 760, 761, 762, 763.
Reference: Metzeltin & Lange-Bertalot (1998) as *A. exiguum* var. *constricta* (Torka) Hustedt.

Lemnicola Round & Basson

Lemnicola hungarica (Grunow) Round & Basson, Diatom Research, 12 (1): 77, 78, figs. 4-7, 26-31. 1997.
(Fig. 130)
Valve dimensions: L: 19-22 µm; W: 6-7 µm; Str: 19-21 in 10 µm.
Examined material: slide 710.
Reference: Round & Basson (1997).

Planothidium Round & Bukhtiyarova

Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot *sensu lato*, Iconogr. Diatomol., v. 6, p. 282. 1999.
(Figs. 77-81, 95-97)
Valve dimensions: L: 12-33 µm; W: 8-10 µm; Str: 11-13 in 10 µm.
Examined material: slides 710, 711, 712, 713, 723, 724, 725, 738, 739, 740, 741, 742, 759, 760, 761, 762, 763.
Reference: Rumrich *et al.* (2000).

Platessa Lange-Bertalot

Platessa hustedtii (Krasske) Lange-Bertalot *in* Krammer & Lange-Bertalot, Süßwasserflora von Mitteleuropa 2/4, p. 445, pl. 17, figs. 35-42. 2004.
(Figs. 82, 83)
Valve dimensions: L: 10-16 µm; W: 4-6 µm; Str: 19-23 in 10 µm.
Examined material: slides 710, 712, 724, 760, 761, 762, 763.
Reference: Krammer & Lange-Bertalot (2004).

Diadesmidaceae D.G. Mann *in* Round *et al.*
Diadesmis Kützing

Diadesmis contenta (Grunow ex Van Heurck) D.G. Mann *in* Round *et al*., The Diatoms, p. 666. 1990.
(Figs. 85-87)
Valve dimensions: L: 7-10 µm; W: 2.6 µm.
Examined material: slides 712, 713, 724, 725, 741, 742, 760, 761, 762, 763.
Reference: Torgan & Santos (2008).

Diadesmis subtropica Metzeltin, Lange-Bertalot & García-Rodríguez, Iconogr. Diatomol. v. 15, p. 47, pl. 56, figs. 25-31. 2005.
(Fig. 84)
Valve dimensions: L: 16 µm; W: 3 µm.
Examined material: slides 712, 713, 724, 725, 741.
Reference: Metzeltin *et al.* (2005)

Luticola D.G. Mann in Round *et al.*

Luticola aff. ***aequatorialis*** (Heiden) Lange-Bertalot & Ohtsuka, Diatom, 18: 35, figs. 23-56. 2002.
(Fig. 88)
Valve dimensions: L: 13-16 µm; W: 7-10 µm; Str: 17-19 in 10 µm.
Examined material: slide 741.
Reference: Rumrich *et al.* (2000).

Luticola goeppertiana (Bleisch *in* Rabenhorst) D.G. Mann *in* Round *et al.*, The Diatoms, p. 670. 1990.
(Figs. 99-101, 131)
Valve dimensions: L: 17-32 µm; W: 6-8 µm; Str: 16-22 in 10 µm.
Examined material: slides 710, 712, 713, 722, 725, 739, 741, 742, 762.
Reference: Pavlov *et al.* (2009).

Luticola cf. ***simplex*** Metzeltin, Lange-Bertalot & García-Rodríguez, Iconogr. Diatomol. v.15, p. 116, 117, pl. 87, figs. 1-9. 2005.
(Fig. 89)
Valve dimensions: L: 12-30 µm; W: 6 µm; Str: 22 in 10 µm
Examined material: slides 712, 713, 725, 741, 742, 761, 762.
Reference: Metzeltin *et al.* (2005).

***Luticola* sp.**
(Fig. 90)
Valve dimensions: L: 18-24 µm; W: 8-9 µm; Str: 19-28 in 10 µm.
Examined material: slides 722, 724, 742.

Amphipleuraceae Grunow
Amphipleura Kützing

Amphipleura lindheimeri Grunow, Verh. K. Zool.-Bot. Ges. Wien. 12: 469, pl. 11, figs. 11a,b. 1862.
(Fig. 102)
Valve dimensions: L: 154-170 µm; W: 20-25 µm.
Examined material: slides 712, 722, 724, 725, 738,

741, 761.
Reference: Krammer & Lange-Bertalot (1986).

Frustulia Rabenhorst
Frustulia crassinervia (Brébisson) Lange-Bertalot & Krammer *in* Lange-Bertalot & Metzeltin, Iconogr. Diatomol. v. 2, p. 57. 1996.
(Fig. 103)
Valve dimensions: L: 30-40 µm; W: 8-13 µm; Str: 30-35 in 10 µm.
Examined material: slide 738.
Reference: Lange-Bertalot (2001).

Frustulia guayanensis Metzeltin & Lange-Bertalot ssp. ***ecuadoriana*** Lange-Bertalot & Rumrich *in* Rumrich *et al.*, Iconogr. Diatomol. v. 9, p. 133, pl. 99, figs. 9-14. 2000.
(Figs. 104-106, 132-135)
Valve dimensions: L: 30-64 µm; W: 8-12 µm; Str: 29-31 in 10 µm.
Examined material: slides 712, 713, 722, 739, 759.
Reference: Rumrich *et al.* (2000).

Frustulia neomundana Lange-Bertalot & Rumrich *in* Rumrich *et al.*, Iconogr. Diatomol., v. 9, p. 135, pl. 97, figs. 1-12. 2000.
(Fig. 108)
Valve dimensions: L: 37 µm; W: 8 µm.
Examined material: slides 710, 713.
Reference: Rumrich *et al.* (2000).

Frustulia weinholdii Hustedt *in* Rabh. Kryptog. Fl. Deutschland, v. 7 (2), p. 731, fig. 1101. 1937.
(Fig. 107)
Valve dimensions: L: 44-45 µm; W: 8.5-9 µm.
Examined material: slides 724, 725, 739, 761.
Reference: Graeff & Kociolek (2011).

Brachysiraceae D.G. Mann
Brachysira Kützing
Brachysira brebissonii R. Ross *in* Hartley, J. Mar. Biol. Ass. U. K. 66 (3): 607. 1986.
(Figs. 109, 110, 136, 137)
Valve dimensions: L: 21-25 µm; W: 5-6 µm.
Examined material: slides 713, 721, 722, 738, 739, 759, 760.
Reference: Lange-Bertalot & Moser (1994).

Neidiaceae Mereschkowsky
Neidium Pfitzer
Neidium infirmum Metzeltin & Krammer *in* Metzeltin & Lange-Bertalot, Iconogr. Diatomol. v. 5, p. 152, pl. 118, figs. 1-8. 1998.
(Figs. 111, 138)
Valve dimensions: L: 37-38 µm; W: 13 µm; Str: 18-19 in 10 µm.
Examined material: slides 725, 741.
Reference: Metzeltin & Lange-Bertalot (1998).

***Neidium* sp.**
(Fig. 112)
Valve dimensions: L: 40-52 µm; W: 8-9 µm; Str: 25-26 in 10 µm.
Examined material: slide 761.

Sellaphoraceae Mereschkowsky
Adlafia Gerd Moser, Lange-Bertalot & Metzeltin
Adlafia drouetiana (R.M. Patrick) Metzeltin & Lange-Bertalot *in* Lange-Bertalot, Iconogr. Diatomol. v. 5, p. 21, pl. 8, figs. 14-19, pl. 186, fig. 6. 1998.
(Figs. 113, 114)
Valve dimensions: L: 16-19 µm; W: 4-5 µm; Str: 20-25 in 10 µm.
Examined material: slides 709, 712, 761, 762.
Reference: Metzeltin & Lange-Bertalot (1998).

Eolimna Lange-Bertalot & W. Schiller *in* Schiller & Lange-Bertalot
Eolimna minima (Grunow *in* Van Heurck) Lange-Bertalot *in* Moser *et al*., Biblioth. Diatomol. v. 38, p. 153. 1998.
(Figs. 94, 115, 116, 125)
Valve dimensions: L: 5-14 µm; W: 3-5 µm; Str: 24-25 in 10 µm.
Examined material: slides 710, 713, 721, 722, 723, 724, 738, 739, 740, 741, 742, 759, 760, 761, 762.
Reference: Krammer & Lange-Bertalot (1986).

Eolimna subminuscula (Manguin) Gerd Moser, Lange-Bertalot & Metzeltin, Biblioth. Diatomol. v. 38, p. 154. 1998.
(Figs. 117, 118)
Valve dimensions: L: 9-11 µm; W: 4-5 µm; Str: 20-21 in 10 µm.
Examined material: slides 710, 713, 722, 739, 740, 741, 760, 763.
Reference: Krammer & Lange-Bertalot (1986)

Fallacia Stickle & D.G. Mann *in* Round *et al.*
Fallacia aff. ***omissa*** (Hustedt) D.G. Mann *in* Round *et al.,* The Diatoms, p. 669. 1990.
(Figs. 119, 120)
Valve dimensions: L: 9-18 µm; W: 5-6 µm; Str: 20-22 in 10 µm.
Examined material: slides 725, 741, 763.
Reference: Hustedt (1945)

Sellaphora Mereschkowsky

Sellaphora auldreekie D.G. Mann & S.M. McDonald *in* Mann *et al.*, Phycologia, 43 (4): 477, figs. 4m-o, 21, 43. 2004.

(Figs. 127, 128, 140)

Valve dimensions: L: 20,6-29 μm; W: 7.3-8.6 μm; Str: 19-25 in 10 μm.

Examined material: slides 710, 725, 740, 741, 742.

Reference: Mann *et al.* (2004).

Sellaphora blackfordensis D.G. Mann & S. Droop *in* Mann *et al*., Phycologia 43(4): 476, figs. 4g-i, 19, 33-37. 2004.

(Fig. 126)

Valve dimensions: L: 35 μm; W: 9.3 μm; Str: 22 in 10 μm.

Examined material: slides 710, 741, 742.

Reference: Mann *et al.* (2004).

Sellaphora garciarodriguezii Metzeltin & Lange-Bertalot *in* Metzeltin *et. al* Iconogr. Diatomol., v. 15, p. 207, pl. 68, figs. 8-11. 2005.

(Fig. 142)

Valve dimensions: L: 53 μm; W: 12 μm; Str: 19-23 in 10 μm.

Examined material: slide 710.

Reference: Metzeltin *et al.* (2005).

Sellaphora seminulum (Grunow) D.G. Mann, Brit. Phycol. J., 24: 2. 1989.

(Figs. 122-124, 139)

Valve dimensions: L: 6-13 μm; W: 2-4 μm; Str: 19-21 in 10 μm.

Examined material: slides 710, 711, 712, 713, 721, 722, 723, 725, 738, 739, 740, 741, 742, 759, 760, 761, 762, 763.

Reference: Krammer & Lange-Bertalot (1986).

Mayamaea Lange-Bertalot

Mayamaea permitis (Hustedt) Bruder & Medlin, Diatom Research, 23 (2), p. 327. 2008.

(Fig. 121)

Valve dimensions: L: 6-9 μm; W: 3 μm.

Examined material: slides 710, 711, 712, 713, 722, 724, 725, 738, 740, 741, 742, 759, 763.

Reference: Bruder & Medlin (2008).

Pinnulariaceae D.G. Mann *in* Mann *et al.*

Pinnularia Ehrenberg

Pinnularia acoricola Hustedt var. ***linearis*** Wydrzycka, Lange-Bertalot & Metzeltin *in* Wydrzycka & Lange-Bertalot, Brenesia, 55-56: 13, pl. 5, figs. 13-19, pl. 6, figs. 13-19, pl. 6, fig. 3. 2001.

(Fig. 143)

Valve dimensions: L: 22-35 μm; W: 4-6 μm; Str: 12-14 in 10 μm.

Examined material: slide 759.

Reference: Wydrzycka & Lange-Bertalot (2001).

Pinnularia borealis Ehrenberg var. ***sublinearis*** Krammer, Diatoms of Europe, v. 1, p. 25, pl. 7, figs. 14-19. 2000.

(Fig. 144)

Valve dimensions: L: 29-40 μm; W: 6-8 μm; Str: 5-6 in 10 μm.

Examined material: slide 724.

Reference: Krammer (2000).

Pinnularia aff. ***gibba*** Ehrenberg, Abh. K. Akad. Wiss. Berlin (96): 384, pl. 2/1, fig. 24, pl. 3/1, fig. 4. 1843.

(Fig. 145)

Valve dimensions: L: 56 μm; W: 10.7 μm; Str: 12 in 10 μm.

Examined material: slides 713, 722, 725, 741, 761, 762, 763.

Reference: Metzeltin *et al.* (2005).

Pinnularia cf. ***latarea*** Krammer, Diatoms of Europe, v. 1, p. 110, pl. 84, figs. 13-15. 2000.

(Fig. 147)

Valve dimensions: L: 41-56 μm; W: 8-10 μm; Str: 12-13 in 10 μm.

Examined material: slides 709, 713, 724, 725, 738, 762.

Reference: Krammer (2000).

Observations: The specimens differ from the type by striae density, and by length to width ratio.

Pinnularia aff. ***meridiana*** Metzeltin & Krammer *in* Metzeltin & Lange-Bertalot, Iconogr. Diatomol., v. 5, p. 180, pl. 181, figs. 1, 2, 4, 5. 1998.

(Fig. 146)

Valve dimensions: L: 47 μm; W: 12 μm; Str: 9 in 10 μm.

Examined material: slides 713, 722, 725.

Reference: Metzeltin *et al.* (2005).

Naviculaceae Kützing

Geissleria Lange-Bertalot & Metzeltin

Geissleria aikenensis (Patrick) Torgan & Oliveira**,** Proc. 16th Intern. Diat. Symp., p. 115-125. 2000.

(Figs. 148-151, 168-170)

Valve dimensions: L: 16-29 μm; W: 5-8 μm; Str:

14-20 in 10 μm.
Examined material: slides 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 759, 760, 761, 762, 763.
Reference: Torgan & Oliveira (2001).
Observations: The specimens differ from *G. punctifera* (Hustedt) Metzeltin, Lange-Bertalot & García-Rodríguez *in* Metzeltin *et al.* (2005) by the absence of the siliceous elements internally in the elongated striae at the valve end. On the other hand, the population that was found in Southen Brazil has in the central area striae shorter and clearly farther apart than in the rest of the valve, a feature that is not seen in the population from Río Santa Lucía Chico, Uruguay. A new revision of the type in SEM would be necessary before considering *G. punctifera* and *G. aikenenesis* as conspecific taxa.

Geissleria ignota (Krasske) Lange-Bertalot & Metzeltin, Iconogr. Diatomol. v. 2, p. 65, pl. 31, fig. 3, pl. 124, figs. 5-7. 1996.
(Fig. 152)
Valve dimensions: L: 23-25 μm; W: 4-5 μm; Str: 13-14 in 10 μm.
Examined material: slide 761.
Reference: Metzeltin *et al.* (2005).

Geissleria cf. ***neosubtropica*** Metzeltin, Lange-Bertalot & García-Rodríguez, Iconographia Diatomologica, v. 15, p. 70, pl. 91, figs. 20-23, pl. 76, fig. 5. 2005.
(Fig. 171)
Valve dimensions: L: 23 μm; W: 8 μm; Str: 21-22 in 10 μm.
Examined material: slides 740.
Reference: Metzeltin *et al.* (2005).
Observations: The specimen differs from the type by striae density.

Hippodonta (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski

Hippodonta capitata ssp. **iberoamericana** Metzeltin *et al. in* Iconogr. Diatomol. v. 15, p. 102, pl. 59, figs 1-14. 2005.
(Figs. 153, 154)
Valve dimensions: L: 19-22 μm; W: 5-6 μm; Str: 9-10 in 10 μm.
Examined material: slide 725.
Reference: Metzeltin *et al.* (2005).

Navicula Bory

Navicula antonii Lange-Bertalot, Iconogr. Diatomol. v. 9, p. 155. 2000.
(Fig. 157)
Valve dimensions: L: 15-25 μm; W: 5-6 μm; Str: 14-15 in 10 μm.
Examined material: slides 710, 711, 712, 721, 722, 725, 738, 741, 762, 763.
Reference: Lange-Bertalot (2001).

Navicula cryptocephala Kützing, Bacillarien, p. 95, pl. 3, figs. 20-26. 1844.
(Figs. 155, 156)
Valve dimensions: L: 25-45 μm; W: 6-7 μm; Str: 14-18 in 10 μm.
Examined material: slides 709, 711, 712, 713, 722, 723, 724, 738, 740, 741, 742, 760, 761, 762, 763.
Reference: Lange-Bertalot (2001).

Navicula gregaria Donkin, Quart. J. Micr. Sc. 2 (1): 10, pl. 10, fig. 9. 1861.
(Figs. 158, 159, 173)
Valve dimensions: L: 13-28 μm; W: 5-7 μm; Str: 15-16 in 10 μm.
Examined material: slides 709, 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 761, 762.
Reference: Krammer & Lange-Bertalot (1986).

Navicula jacobii Manguin *in* Bourrelly & Manguin, Algues d´eau douce de la Guadeloupe et dépendences, Societé d´Edition d´Enseignement Supérieur, Paris, p. 69, pl. 4, fig. 86. 1952.
(Fig. 161, 175)
Valve dimensions: L: 30-49 μm; W: 6-8 μm; Str: 11-15 in 10 μm.
Examined material: slide 741.
Reference: Metzeltin *et al.* (2005).

Navicula notha J.H. Wallace, Not. Nat. Acad. Nat. Sc. Philad. 331: 4, pl. 1, fig. 4. 1960.
(Figs. 164, 172)
Valve dimensions: L: 19-32 μm; W: 4-6 μm; Str: 15-17 in 10 μm.
Examined material: slides 709, 711, 723, 725, 738, 741.
Reference: Wallace (1960).

Navicula rostellata Kützing, Die Kieselalgen Bacillarien oder Diatomeen, p. 95, pl. 3, fig. 65. 1844.
(Figs. 165, 166, 178)
Valve dimensions: L: 34-50 μm; W: 8-10 μm; Str: 11-14 in 10 μm.
Examined material: slides 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 742, 760, 761, 762, 763.
Reference: Lange-Bertalot (2001).

Navicula symmetrica Patrick, Bul. Mus. Nac. Rio de Jan. Bot 2 (5), fig. 6. 1944.

(Figs. 160, 174)

Valve dimensions: L: 44-52 μm; W: 8-9 μm; Str: 17-19 in 10 μm.

Examined material: slides 710, 711, 712, 713, 722, 723, 724, 725, 738, 741, 742, 761, 762. 763.

Reference: Patrick (1944).

Navicula trivialis Lange-Bertalot, Cryptog. Algol. 1: 31, pl. 1, figs. 5-9, pl. 9, figs. 1-2. 1980.

(Figs. 167, 176)

Valve dimensions: L: 25-55 μm; W: 9-11 μm; Str: 11-12 in 10 μm.

Examined material: slides 712, 722, 723, 724, 738, 741, 763.

Reference: Krammer & Lange-Bertalot (1986).

***Navicula* sp.**

(Figs. 162, 163, 177)

Valve dimensions: L: 18-35 μm; W: 4-6 μm; Str: 14-15 in 10 μm.

Examined material: slides 713, 741

Nupela Vyvermann & Compère

Nupela pardinhoensis Bes, Torgan & Ector sp. nov.

(Figs. 179-201)

Description: Valves lanceolate, slightly asymmetric about the transapical plane, with subrostrate ends (Figs. 179-195). Length 10-15 μm, width 5-6 μm. One valve with long raphe slits (Figs. 198, 199), the other valve with slightly shorter raphe (Figs. 196, 197). External terminal raphe fissures are curved towards one side of the valve, and central raphe fissure with conspicuous central nodules. Axial area linear-narrow, central area small and round or lacking (Fig. 200). Transapical striae slightly radiate, *c.* 40 in 10 μm. Areolae form 3-6 longitudinal rows on each side of the raphe. The areolae are circular to elliptical, *c.* 40 in 10 μm.

Holotype: Circled specimens on slide 6024, Herbário Dr. Alarich Schultz (HAS), Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Brazil. Specimen illustrated in Fig. 194.

Paratype: Circled specimen on slide BR-4280, Herbarium of the National Botanic Garden, Belgium.

Type locality: Epilithon, station 1, Pardinho River, Gramado Xavier, Rio Grande do Sul, Brazil. Collector: Daniela Bes.

Etymology: Specific epithet is derived from Rio Pardinho, type locality of the species.

Observations: *Nupela pardinhoensis* resembles in outline *N. neglecta* Ponader, R.L. Lowe & Potapova and *N. carolina* Potapova & Clason, two species from the temperate region (Potapova *et al.* 2003). The new species differs from these species mainly by the shape of the apices, and by the valve width. *Nupela carolina* also has a different central area and terminal raphe fissure. The new species differs from *N. exotica* O. Monnier, Lange-Bertalot & J. Bertrand (Monnier *et al.* 2003, p. 278, figs. 1-8, 12-20) by the striae pattern, valve width and raphe length. Comparative data of *N. pardinhoensis* and the related species are shown in Table 3.

This species was found in samples collected from slow moving waters with elevated oxygen dissolved (> 7.1 mg L^{-1}), low biochemical oxygen demand (BOD_5 < 3.1 mg L^{-1}) and elevated total phosphate concentration (0.1 mg L^{-1}).

Examined material: slides 712, 721, 722, 723, 724, 725, 739, 741, 742, 759, 760, 763.

Pleurosigmataceae Mereschkowsky

Gyrosigma Hassall

Gyrosigma obtusatum (Sullivant & Wormley) C.S. Boyer, Contrib. Biol. & Micr. Sect. Acad. Nat. Sc. Philad., 1: 7. 1922.

(Fig. 203)

Valve dimensions: L: 50-70 μm; W: 8-11 μm; Str (transverse): 20-25 in 10 μm.

Examined material: slides 711, 712, 713, 722, 724, 738, 741, 761.

Reference: Patrick & Reimer (1966).

***Gyrosigma* sp.**

(Fig. 202)

Valve dimensions: L: 120-180 μm; W: 15-18 μm; Str (transverse): 17-18 in 10 μm.

Examined material: slides 713, 724, 725, 740, 741, 761, 762.

Stauroneidaceae D.G. Mann

Craticula Grunow

Craticula ambigua (Ehrenberg) D. G. Mann, *in* Round *et al.*, The Diatoms, p. 666. 1990.

(Fig. 204)

Valve dimensions: L: 42-80 μm; W: 14-20 μm; Str: 15-18 in 10 μm.

Examined material: slides 741, 742.

Reference: Mann & Stickle (1991).

Catenulaceae Mereschkowsky

Halamphora (Cleve) Levkov

Halamphora cf. ***acutiuscula*** (Kützing) Levkov, Diatom of Europe, v. 5, p. 167, pl. 96, figs. 10-18, pl. 109,

Table 3. Comparison of *Nupela pardinhoensis* with related species: *N. neglecta* and *N. carolina* (Potapova *et al.* 2003) and *N. exotica* (Monnier *et al.* 2003).

Character	*N. pardinhoensis* Bes, Torgan & Ector sp. nov.	*N. neglecta* Ponader, R.L. Lowe & Potapova	*N. carolina* Potapova & Clason	*N. exotica* O. Monnier, Lange-Bertalot & J. Bertrand
Valve length (µm)	10-15	3-15	5-15	8.6-13.3
Valve width (µm)	5-6	2.6-4.5	2.4-4.4	3-4.1
Apices	subrostrate	protracted	protracted	obtuse or protracted
Valve shape	lanceolate	lanceolate to elliptical-lanceolate	elliptical-lanceolate	elliptical-lanceolate
Axial area	linear-narrow	linear-lanceolate	linear-narrow	linear-narrow
Central area	round or lacking	round or elliptical	square or lyreform	barely developed or lacking
Striae in 10 µm	*c.* 40	40-48	42-54	40-45

figs. 36-44, pl. 234, figs. 1-4. 2009.
(Fig. 205)
Valve dimensions: L: 37 µm; W: 7 µm; Str: 16 in 10 µm.
Examined material: slide 740.
Reference: Levkov (2009).

Halamphora montana (Krasske) Levkov, Diatom of Europe, v. 5, p. 207, pl. 93, figs. 10-19, 26-45, pl. 213, figs. 1-6. 2009.
(Figs. 206, 207, 222, 223)
Valve dimensions: L: 22.8 µm; W: 3 µm.
Examined material: slides 710, 711, 712, 713, 724, 725, 738, 740, 741, 761, 762, 763.
Reference: Levkov (2009).

Bacillariaceae Ehrenberg
Hantzschia Grunow
Hantzschia cf. ***abruptirostrata*** Lange-Bertalot & Metzeltin *in* Metzeltin et. al., Iconogr. Diatomol., v. 15, p. 93, 94, pl. 213, figs. 1-5. 2005.
(Fig. 208)
Valve dimensions: L: 60-64 µm; W: 8-10 µm; Fib: 12-14 in 10 µm; Str: 13-15 in 10 µm.
Examined material: slides 710, 713, 741, 742, 761, 762 e 763.
Reference: Metzeltin *et al*. (2005).
Observations: The specimens differ from the type by dimensions and apiculate ends.

Nitzschia Hassall
Nitzschia amphibia Grunow, Verh. K. Zool.-Bot. Ges. Wien., 12: 574, pl. 28/12, fig. 23. 1862.
(Figs. 214, 215)
Valve dimensions: L: 15-35 µm; W: 4-5 µm; Fib: 7-12 in 10 µm.
Examined material: slides 710, 711, 712, 713, 722, 723, 724, 725, 738, 740, 741, 761, 762, 763.
Reference: Krammer & Lange-Bertalot (1988).

Nitzschia denticula Grunow *in* Cleve & Grunow**,** K. Svenska Vet.-Akad. Handl., 17 (2): 82. 1880.
(Fig. 216)
Valve dimensions: L: 30-35 µm; W: 7-9 µm; Fib: 5-6 in 10 µm; Str: 15-17 in 10 µm.
Examined material: slide 741.
Reference: Rumrich *et al*. (2000).
Nitzschia dissipata (Kützing) Grunow, Alg. Sachs. 948. 1860.
(Fig. 209)
Valve dimensions: L: 42-66 µm; W: 4-7 µm; Fib: 9-11 in 10 µm.
Examined material: slides 712, 741, 761.
Reference: Krammer & Lange-Bertalot (1988).

Nitzschia intermedia Hantzsch *ex* Cleve & Grunow, K. Svenska Vet.-Akad. Handl., 17 (2): 95. 1880.
(Fig. 210)
Valve dimensions: L: 42-59 µm; W: 3-5 µm; Fib: 11-13 in 10 µm.
Examined material: slides 709, 710, 711, 712, 713, 722, 723, 725, 740, 742, 760, 761, 763.
Reference: Krammer & Lange-Bertalot (1988).
Nitzschia linearis (C. Agardh) W. Smith, Syn. Brit. Diat. 1: 39, pl. 13, fig. 110, Supp. pl. 31, fig. 110. 1853.

(Fig. 211)
Valve dimensions: L: 55-70 μm; W: 3-5 μm; Fib: 9-16 in 10 μm.
Examined material: slides 710, 711, 712, 713, 722, 724, 725, 741, 761, 762.
Reference: Krammer & Lange-Bertalot (1988).

Nitzschia palea (Kützing) W. Smith, Syn. Brit. Diat. 2: 89. 1856.
(Figs. 213, 220)
Valve dimensions: L: 15-44 μm; W: 3-4 μm; Fib: 9-14 in10 μm.
Examined material: slides 709, 710, 711, 712, 713, 721, 722, 723, 725, 738, 740, 741, 742, 760, 761, 762, 763.
Reference: Krammer & Lange-Bertalot (1988).

Nitzschia cf. ***scalpelliformis*** Grunow *in* Cleve & Grunow, K. Svenska Vet.-Akad. Handl. 17 (2): 92. 1880.
(Fig. 212)
Valve dimensions: L: 35-50 μm; W: 3-4 μm; Fib: 7-9 in 10 μm; Str: 32-38 in 10 μm.
Examined material: slides 710, 741, 763.
Reference: Krammer & Lange-Bertalot (1988).
Observations: The specimens differ from the type in dimensions and striae density.

Tryblionella W. Smith
Tryblionella debilis Arnott *ex* O'Meara, Quart. J. Micr. Sc. 13: 310, 1873.
(Fig. 217)
Valve dimensions: L: 18-25 μm; W: 7-9 μm; Fib: 8-9 in 10 μm.
Examined material: slide 763.
Reference: Krammer & Lange-Bertalot (1988).

Tryblionella victoriae Grunow, Verh. K. Zool.-Bot. Ges. Wien. 12: 553, pl. 28/12, fig. 34. 1862.
(Figs. 218, 221)
Valve dimensions: L: 50-62 μm; W: 18-23 μm; Fib: 9-12 in 10 μm.
Examined material: slide 762.
Reference: Krammer & Lange-Bertalot (1988).

Rhopalodiaceae (G. Karsten) Topachevs'kyj & Oksiyuk
Rhopalodia O. Müller
***Rhopalodia* sp.**
(Fig. 232)
Valve dimensions: L: 32-40 μm; W: 10-14 μm; Costae: 3-4 in 10 μm; Str: 6-7 in 10 μm.
Examined material: slide 762.

Surirellaceae Kützing
Surirella Turpin
Surirella bouillonii Bes, Ector & Torgan sp. nov.
(Figs. 224-231)
Description: Valves isopolar, elliptical-lanceolate, with subrostrate apices (Figs. 224-226). Length 25-39 μm, width 9-12 μm. Valve surface slighly undulate in apical direction due to the groups of 1-2 costae raised above the level of the valve (Figs. 227, 228). The costae are connected by fine siliceous elements that are irregular in arrangement. Siliceous granules are present (Fig. 229). Axial area linear-lanceolate. Internally, each interfibular space with one portula, 5-8 fibulae in 10 μm. Presence of 3-5 groups of 3-4 rows of striae within interfibular space (Fig. 231). Girdle with 3 open bands with granules. Ligula present (Fig. 230).
Holotype: Circle specimen on slide 6026, Herbário Dr. Alarich Schultz (HAS), Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Brazil. Specimen illustrated in Fig. 225.
Paratype: Circled specimen on slide BR-4281, Herbarium of the National Botanic Garden, Belgium.
Type locality: Epilithon, station 5, Pardinho River, Vera Cruz, Rio Grande do Sul, Brazil. Collector Daniela Bes.
Etymology: This taxon is dedicated to our colleague Christophe Bouillon, the SEM technician at the Department Environment and Agro-Biotechnologies of the Public Research Centre - Gabriel Lippmann, Luxembourg.
Observations: Under the light microscope *Surirella bouillonii* resembles *S. angusta* Kützing (see Kützing type material in Krammer & Lange-Bertalot 1988, pl. 133, Figs. 7, 12, 13), differing in valve outline, where *S. bouillonii* is elliptical-lanceolate with subrostrate apices while *S. angusta* has linear valves with cuneate apices. The morphometric features (dimensions, fibulae density) of the two species are similar. Both species can be also distinguished through scanning electron microscope. *Surirella angusta* has groups of 2-3 costae raised above the valve level and internally the species has 3 groups of 3-4 rows of striae within interfibular space. The axial area is linear and weakly differentiated (Fabri & Leclercq, 1984, pl. 33, figs. 855-857; Vyverman, 1991, pl. 160, fig. A; Silva-Benavides 1996, p. 142, fig. 172).

Surirella bouillonii also resembles the materials that were found in Crater Lake, Oregon, U.S.A. identified as *Surirella* cf. *angusta* (Ruck & Kociolek 2004, plates 8-10). The Crater Lake specimens differ from S. *bouillonii* by the valve shape and structure. In external view, they have groups of 3-4 costae that are raised above the valve level, and internally the interfibular space is triangular in shape.

Surirella bouillonii was collected in slow-moving waters with high dissolved oxygen (> 6.3 mg L^{-1}), biochemical oxygen demand (BOD_5 < 5.7 mg L^{-1}) and elevated total phosphate (0.1 mg L^{-1}).
Examined material: slides 713, 724.

Surirella tenera W. Gregory, Quart. J. Micr. Sc. 4: 11,12, pl. 1, fig. 38. 1856.
(Fig. 235)
Valve dimensions: L: 42-75 μm; W: 15-35 μm; Fib: 2-3 in 10 μm.
Examined material: slide 741.
Reference: Krammer & Lange-Bertalot (1988).

***Surirella* sp.**
(Figs. 233, 234)
Valve dimensions: L: 58-64 μm; W: 15-18 μm; Fib: 4-6 in 10 μm
Examined material: slide 724.
Observations: Very similar forms were found by Metzeltin & Lange-Bertalot (1998, pl. 207, fig. 9) at Iguaçu River (Paraná, Brazil), identified as *Surirella* sp.

Acknowledgements

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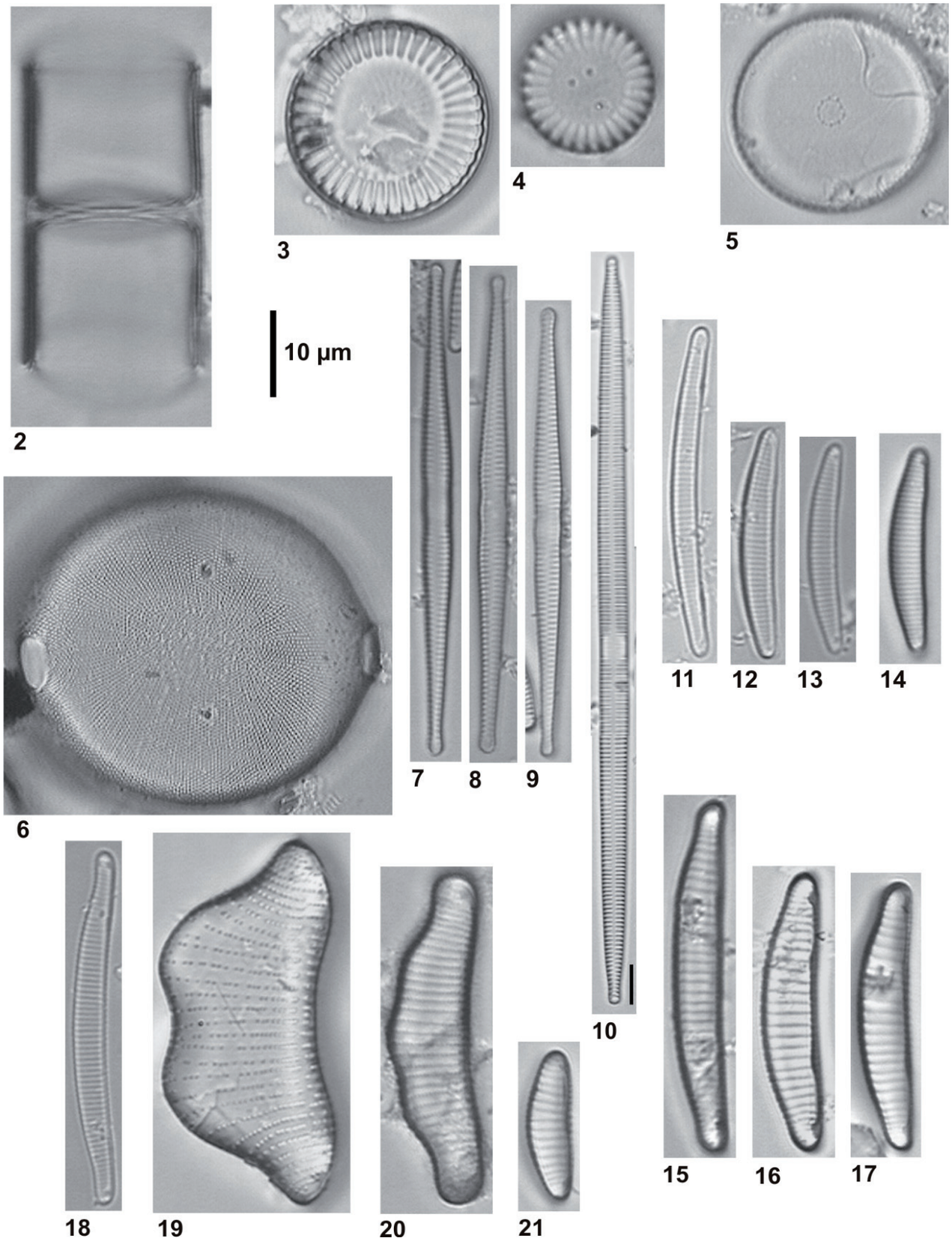
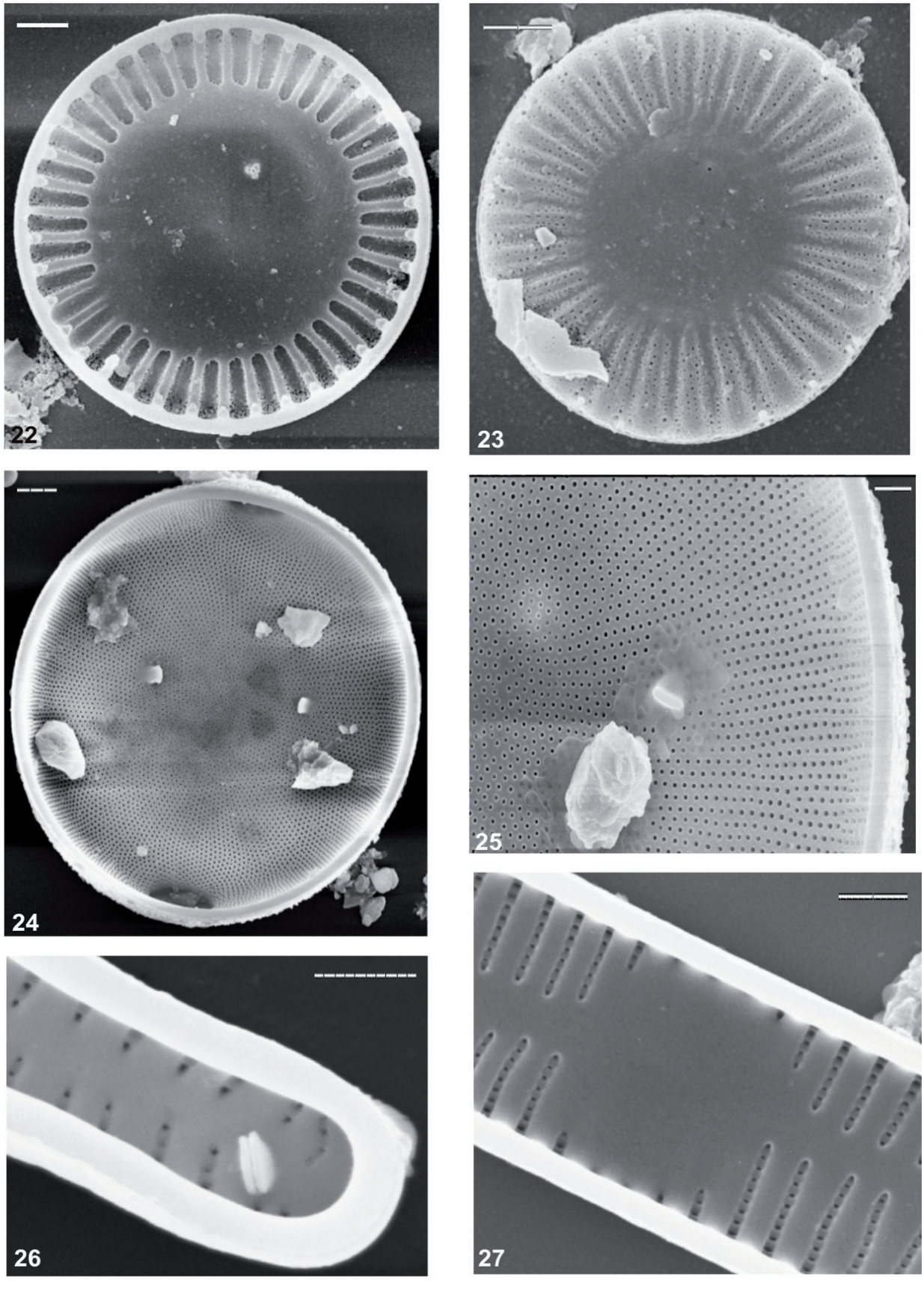
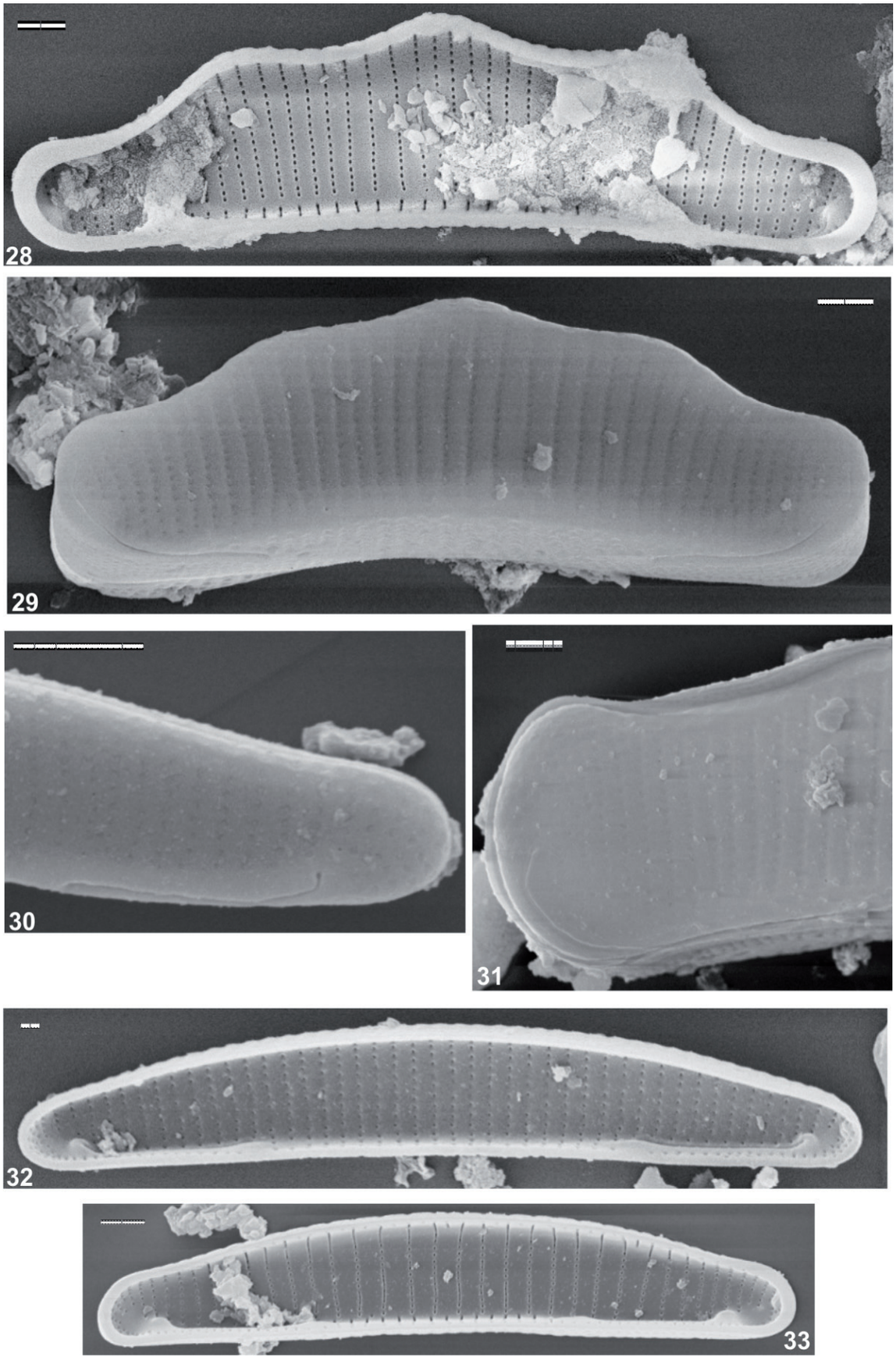


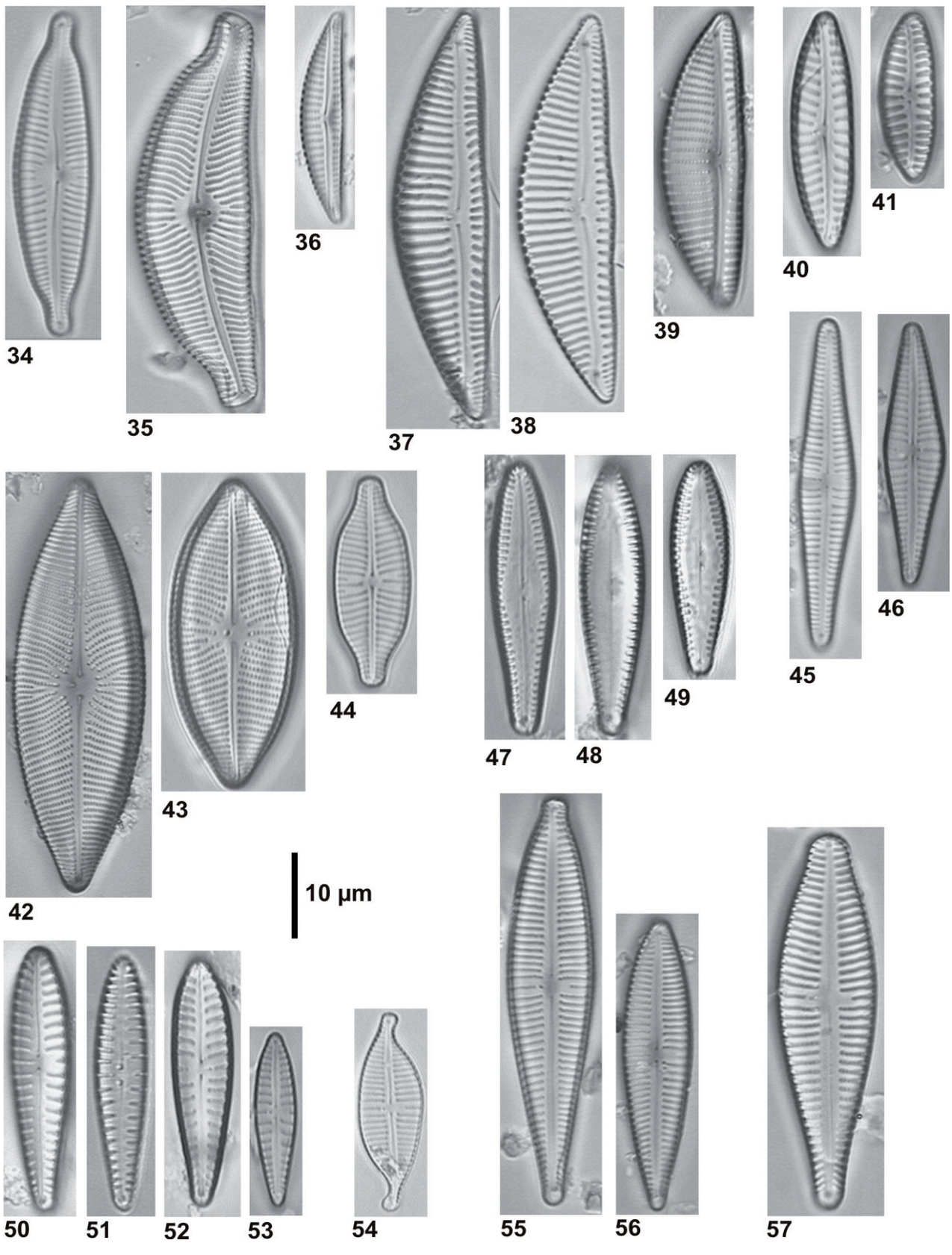
Figs. 2-21. LM. **2.** *Melosira varians*; **3, 4.** *Cyclotella meneghiniana*; **5**. *Conticribra weissflogii*; **6.** *Pleurosira laevis*; **7-9.** *Fragilaria parva*; **10.** *Ulnaria ulna*; **11-13.** *Eunotia* aff. *bilunaris*; **14.** *Eunotia* aff. *itapuana*; **15-17**. *E. pseudosudetica*; **18.** *E. paludosa*; **19**. *E. pileus*; **20.** *E. tridentula*; **21**. *Eunotia* sp. Bars = 10 µm.



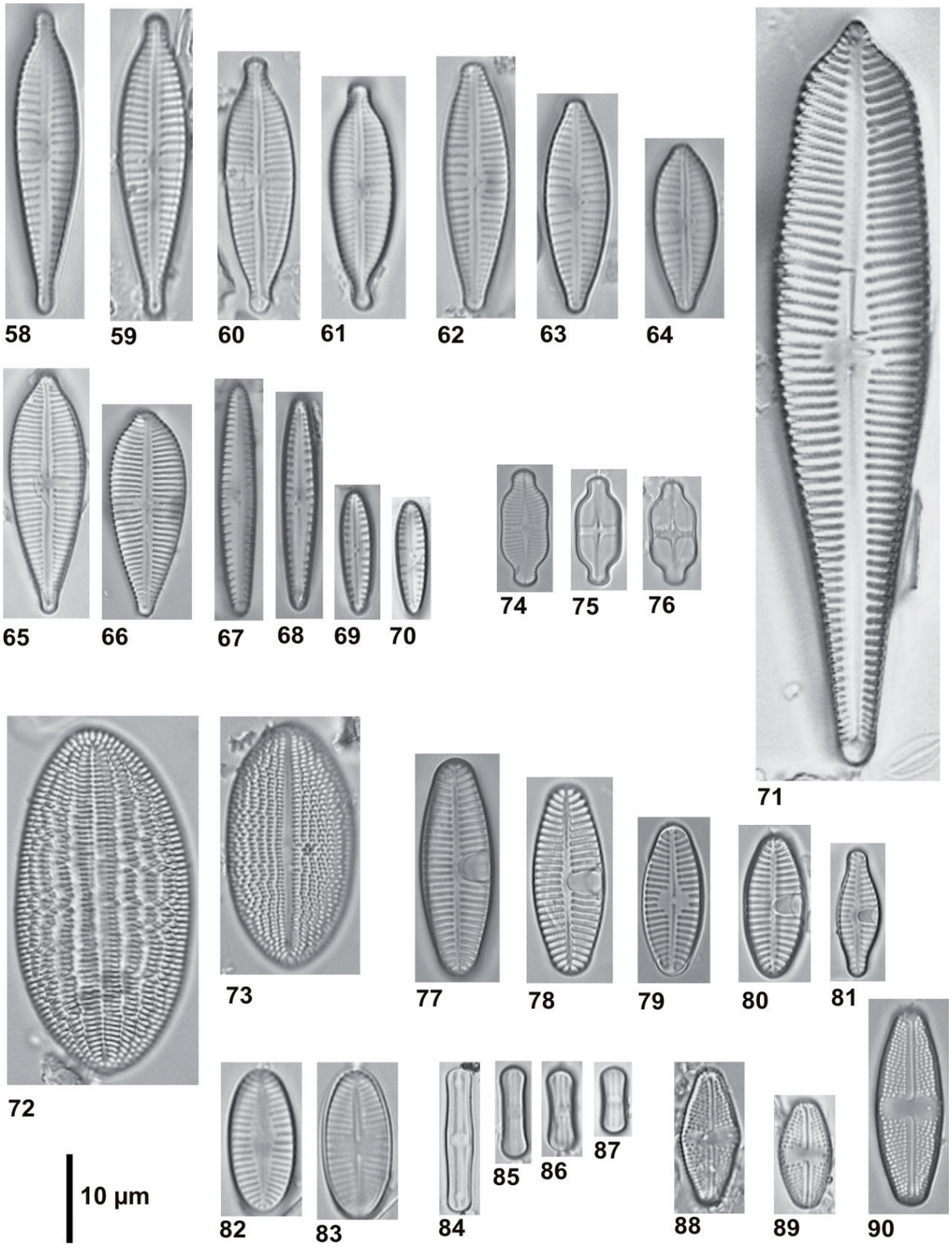
Figs. 22-27. SEM. **22, 23.** *Cyclotella meneghiniana*; **22.** Internal view; **23.** External view; **24, 25.** *Pleurosira laevis*; **24.** Internal view.; **25.** Detail of the rimoportula; **26, 27.** *Ulnaria ulna*; **26.** Internal view with rimoportula; **27.** Internal view central area. Bars: **Figs**. **22, 23, 25-27** = 2 μm. **Fig. 24** = 6 μm.



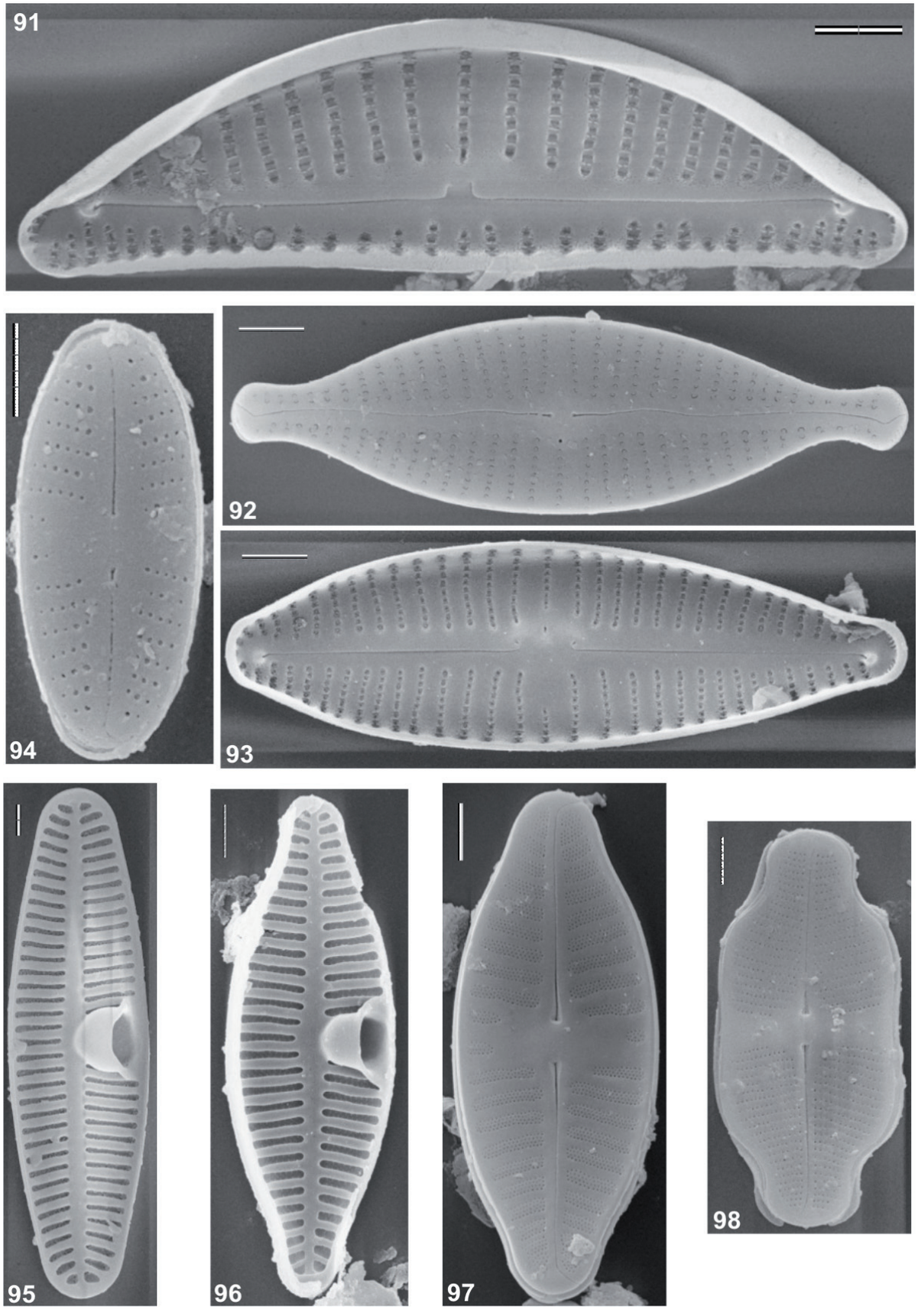
Figs. 28-33. SEM. **28, 29.** *Eunotia tridentula*; **28.** Internal view; **29**. External view; **30.** *E.* aff. *bilunaris,* external view of a valve apex; **31.** *E. rabenhorstii*, detail of one end of the frustule; **32.** *E.* aff. *itapuana*, internal view; **33.** *E. pseudosudetica*, internal view. Bars = 2 µm.



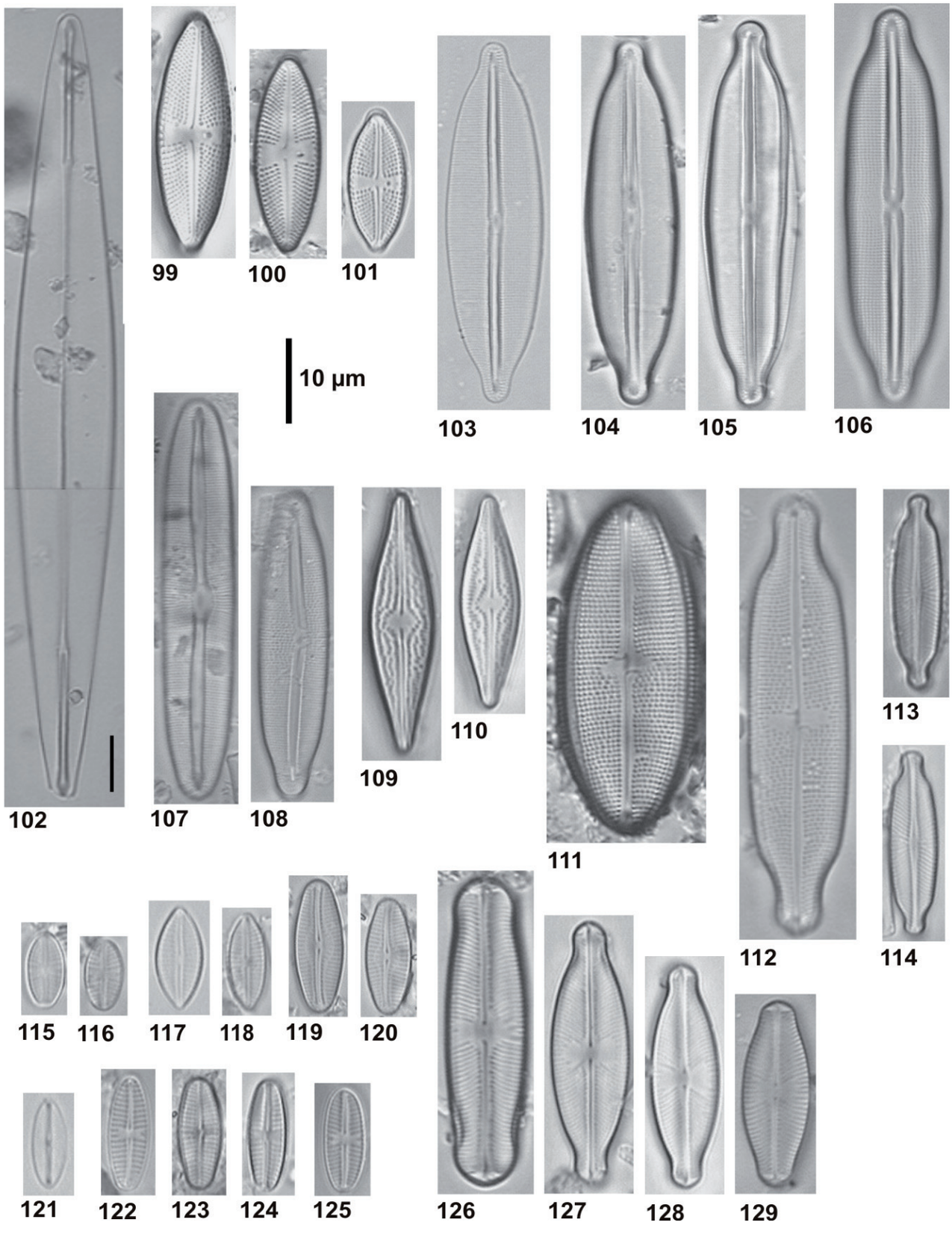
Figs. 34-57. LM. **34.** *Cymbopleura naviculiformis*; **35.** *Cymbella tumida*; **36.** *Encyonema neogracile*; **37, 38.** *E. neomesianum*; **39.** *E.* cf. *silesiacum*; **40, 41.** *E. sprechmannii*; **42, 43.** *Placoneis disparilis*; **44.** *P. witkowskii*; **45.** *Gomphonema* aff. *affine*; **46.** *G.* aff. *affine* var. *rhombicum*; **47-49.** *G. brasiliensoide*; **50-52.** *G. lujanense*; **53, 55, 56.** *Gomphonema* sp.; **54.** *G. parvulum* (teratological form); **57.** *G. mexicanum*. Bars = 10 µm



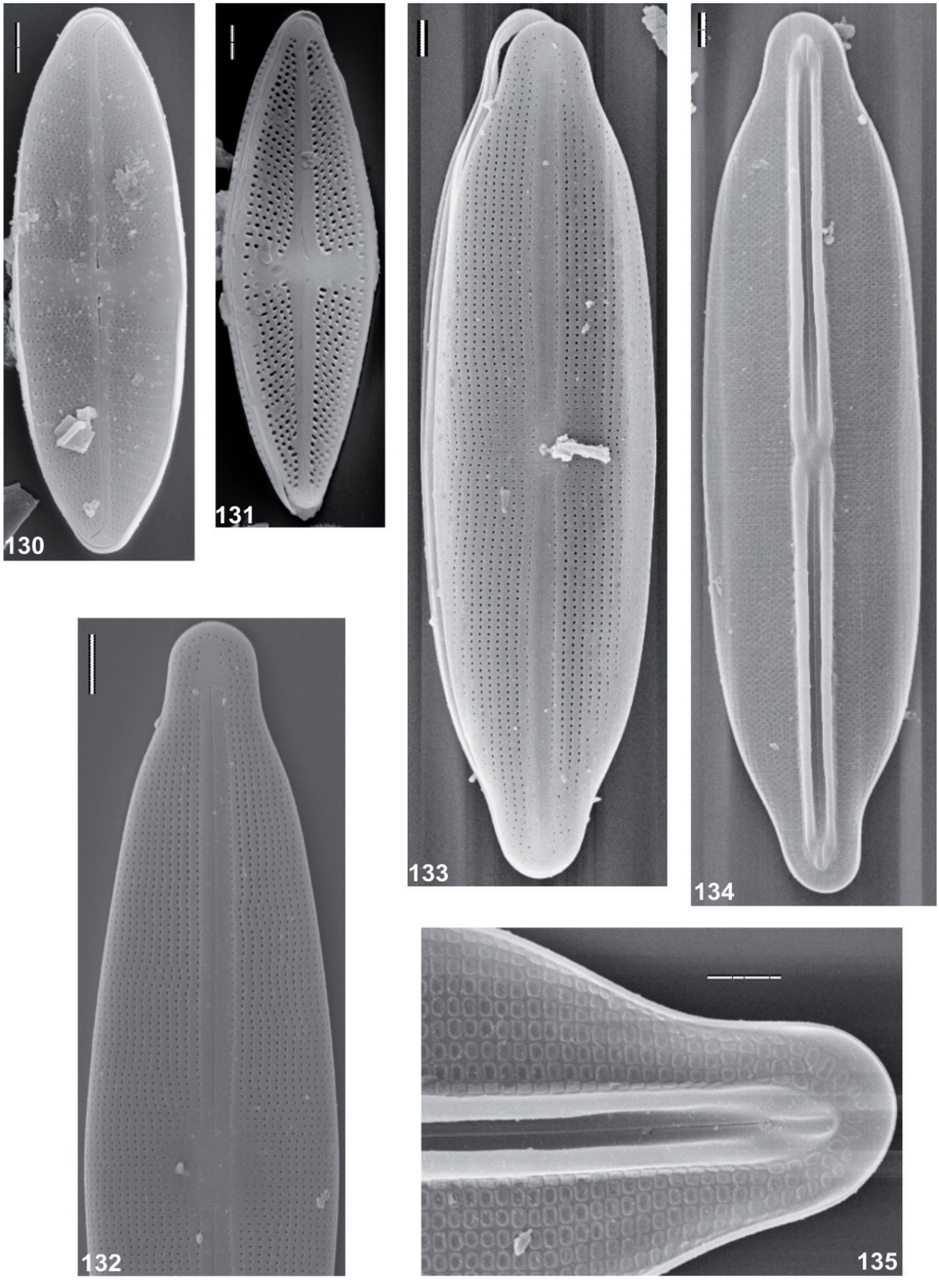
Figs. 58-90. LM. **58-64.** *Gomphonema parvulum*; **65, 66.** *G. pseudoaugur*; **67-70.** *G. pumilum* var. *rigidum*; **71.** *G. turris* f. *coarctata*; **72.** *Cocconeis placentula* var. *euglypta*; **73.** *C. placentula* var. *lineata*; **74-76.** *Achnanthidium exiguum* var. *heterovalvum*; **77-81.** *Planothidium frequentissimum sensu lato*; **82, 83.** *Platessa hustedtii*; **84.** *Diadesmis subtropica*; **85-87.** *D. contenta*; **88.** *Luticola* aff. *aequatorialis*; **89.** *L.* cf. *simplex*; **90.** *Luticola* sp. Bars = 10 µm.



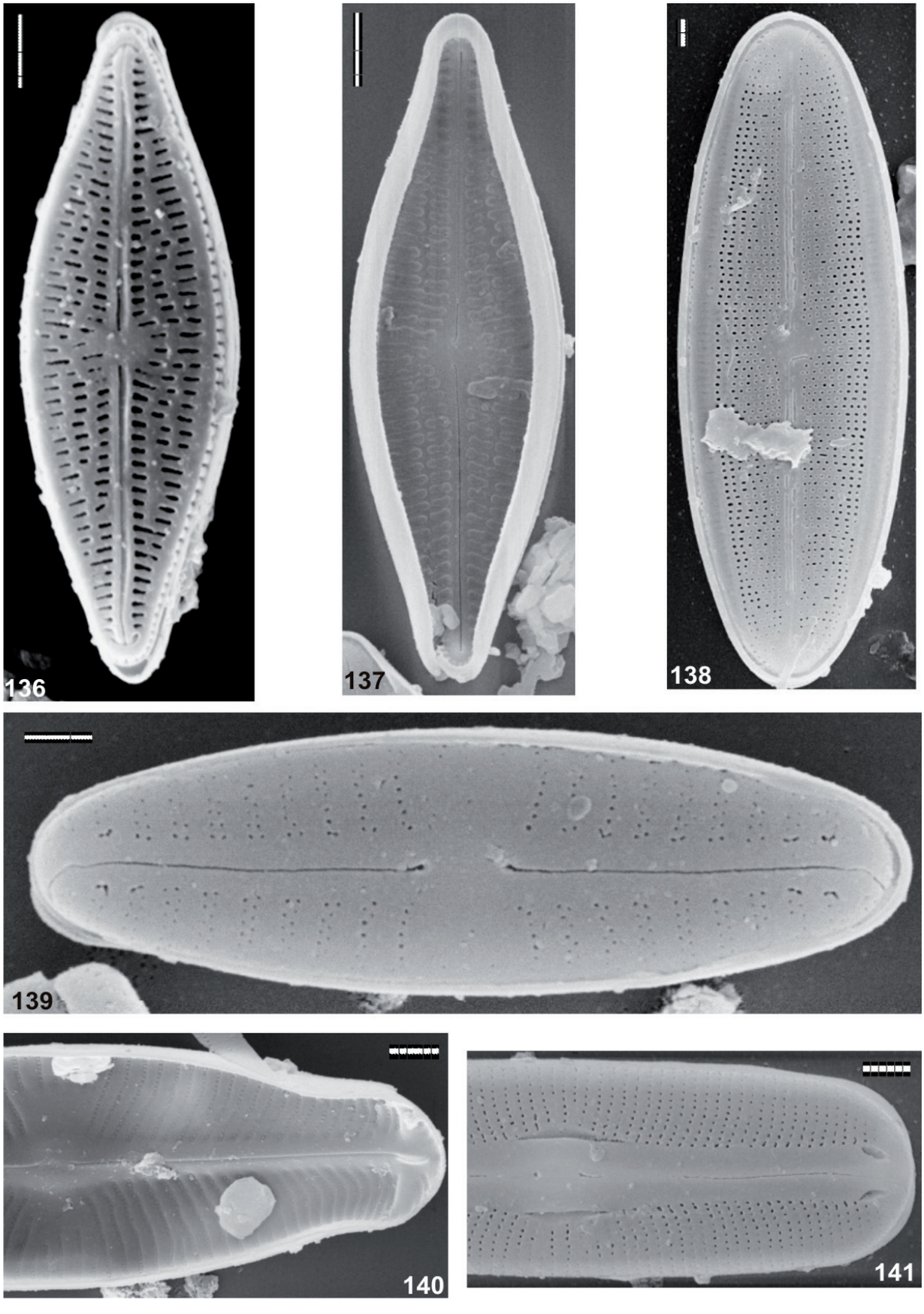
Figs. 91-98. SEM. **91.** *Encyonema* cf. *silesiacum*, internal view; **92, 93**. *Gomphonema parvulum*; **92.** External view; **93.** Internal view; **94.** *Eolimna minima*, external view; **95-97.** *Planothidium frequentissimum sensu lato*; **95, 96.** Internal views; **97.** External view; **98**. A*chnanthidium exiguum* var. *heterovalvum*, external view. Bars = 2 µm.



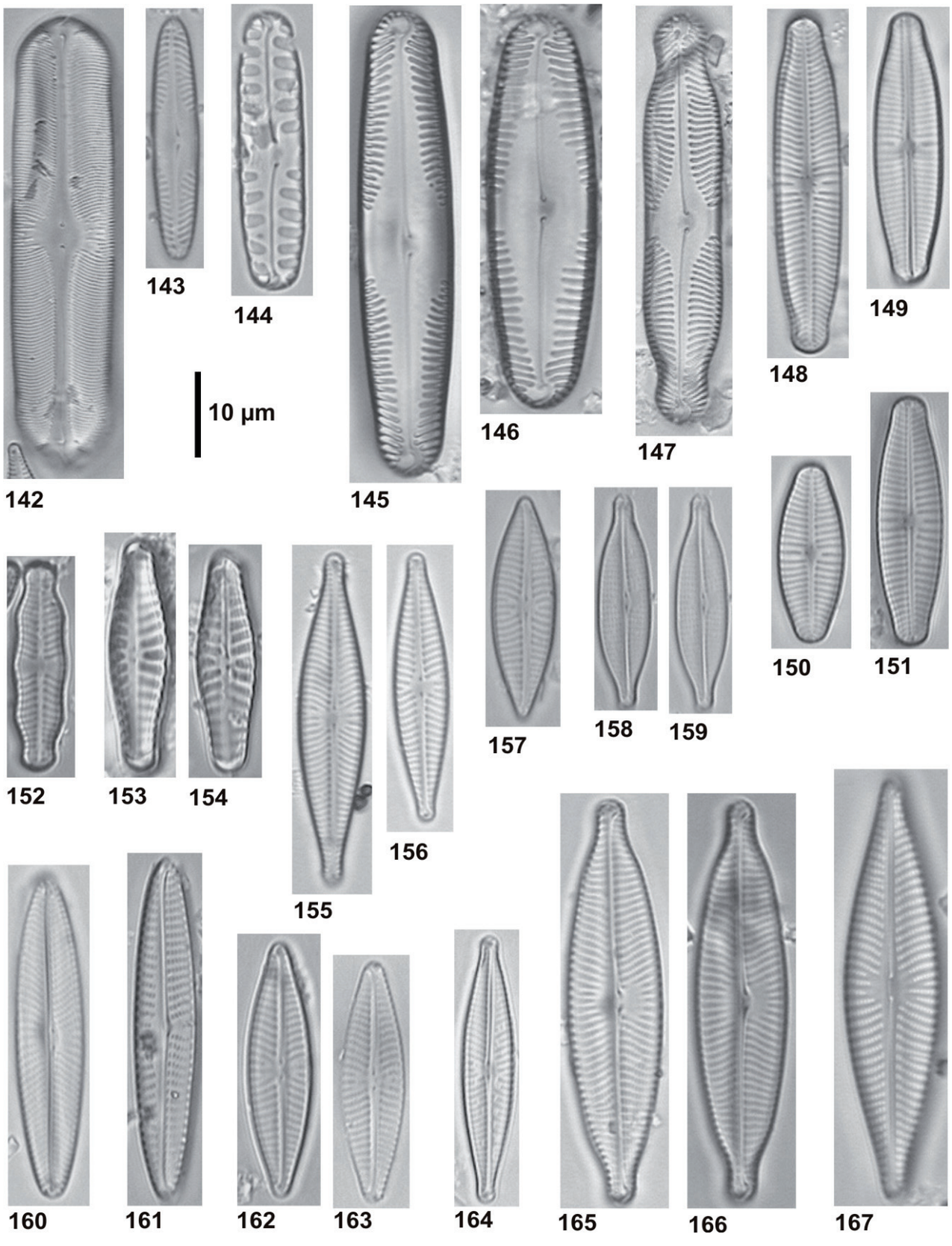
Figs. 99-129. LM. **99-101.** *Luticola goeppertiana*; **102.** *Amphipleura lindheimeri*; **103.** *Frustulia crassinervia;* **104-106.** *F. guayanensis* ssp. *ecuadoriana*; **107.** *F. weinholdii* **108.** *F. neomundana*; **109, 110.** *Brachysira brebissonii*; **111.** *Neidium infirmum*; **112.** *Neidium* sp.; **113, 114.** *Adlafia drouetiana*; **115, 116, 125.** *Eolimna minima*; **117, 118.** *E. subminuscula*; **119, 120.** *Fallacia* aff. *omissa*; **121.** *Mayamaea permitis*; **122-124.** *Sellaphora seminulum*; **126.** S. *blackfordensis*; **127-128.** *S. auldreekie;* **129.** *Sellaphora* sp. Bars = 10 µm.



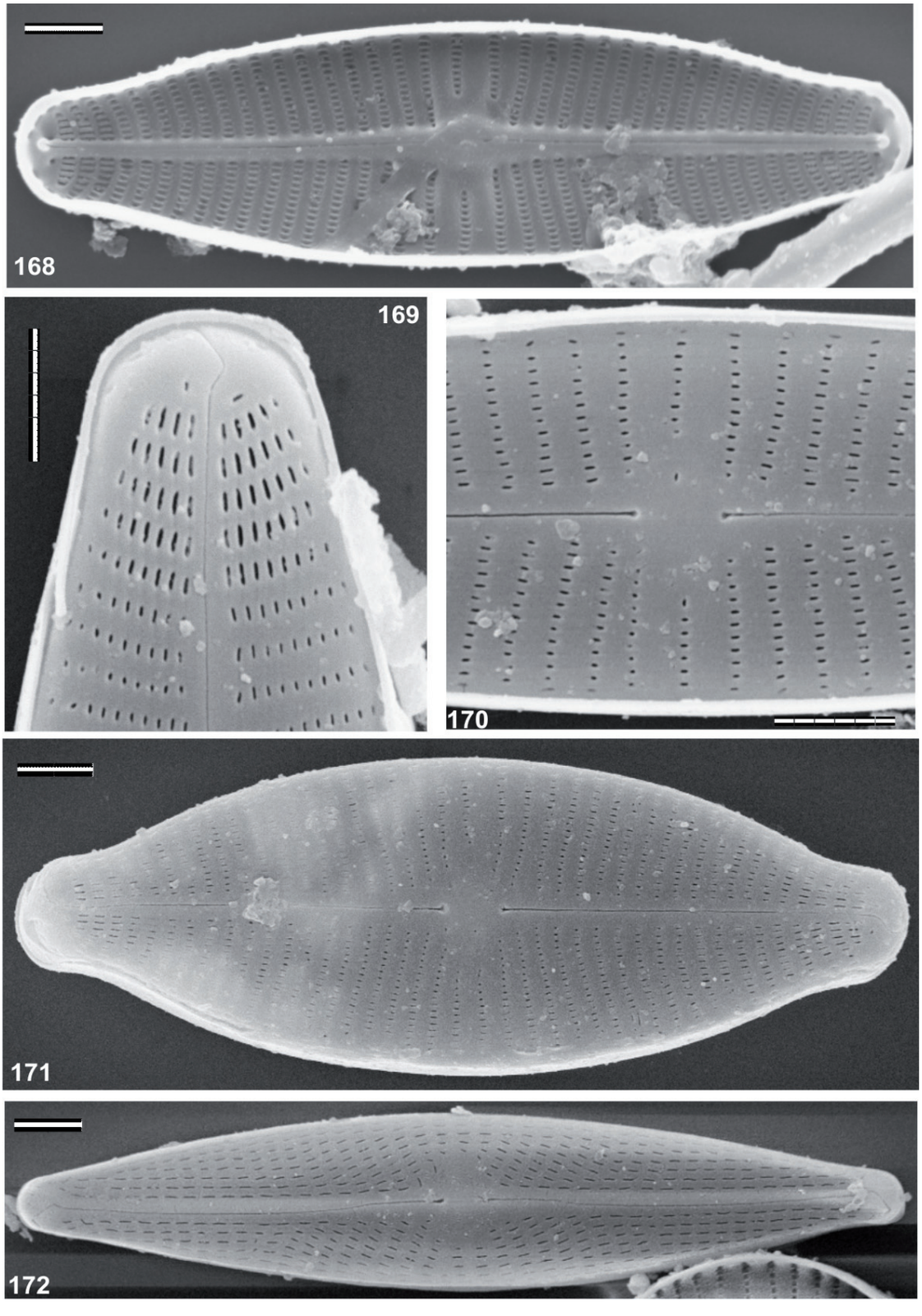
Figs. 130-135. SEM. **130.** *Lemnicola hungarica*, external valve view; **131**. *Luticola goeppertiana*, external view; **132-135.** *Frustulia guayanensis* ssp. *ecuadoriana*; **132, 133.** External valve views; **134.** Internal valve view; **135.** Internal view of a valve apex. Bars = 2 µm.



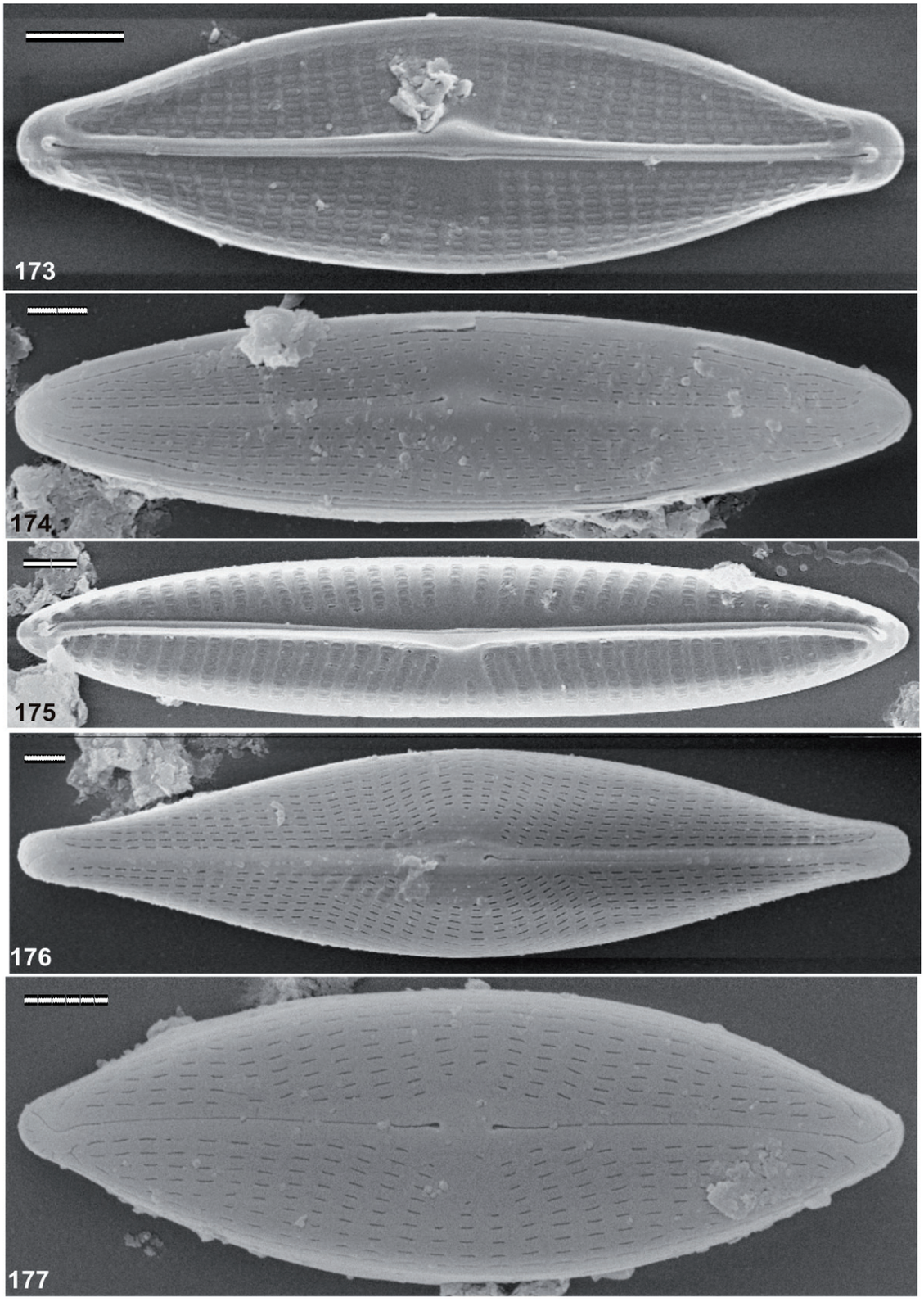
Figs. 136-141. SEM. **136-137.** *Brachysira brebissonii*; **136.** External view; **137**. Internal view; **138.** *Neidium infirmum*, external view; **139.** *Sellaphora seminulum*, external view; **140.** *S. auldreekie*, internal view; **141.** *Sellaphora* sp., external view. Bars = 2 µm.



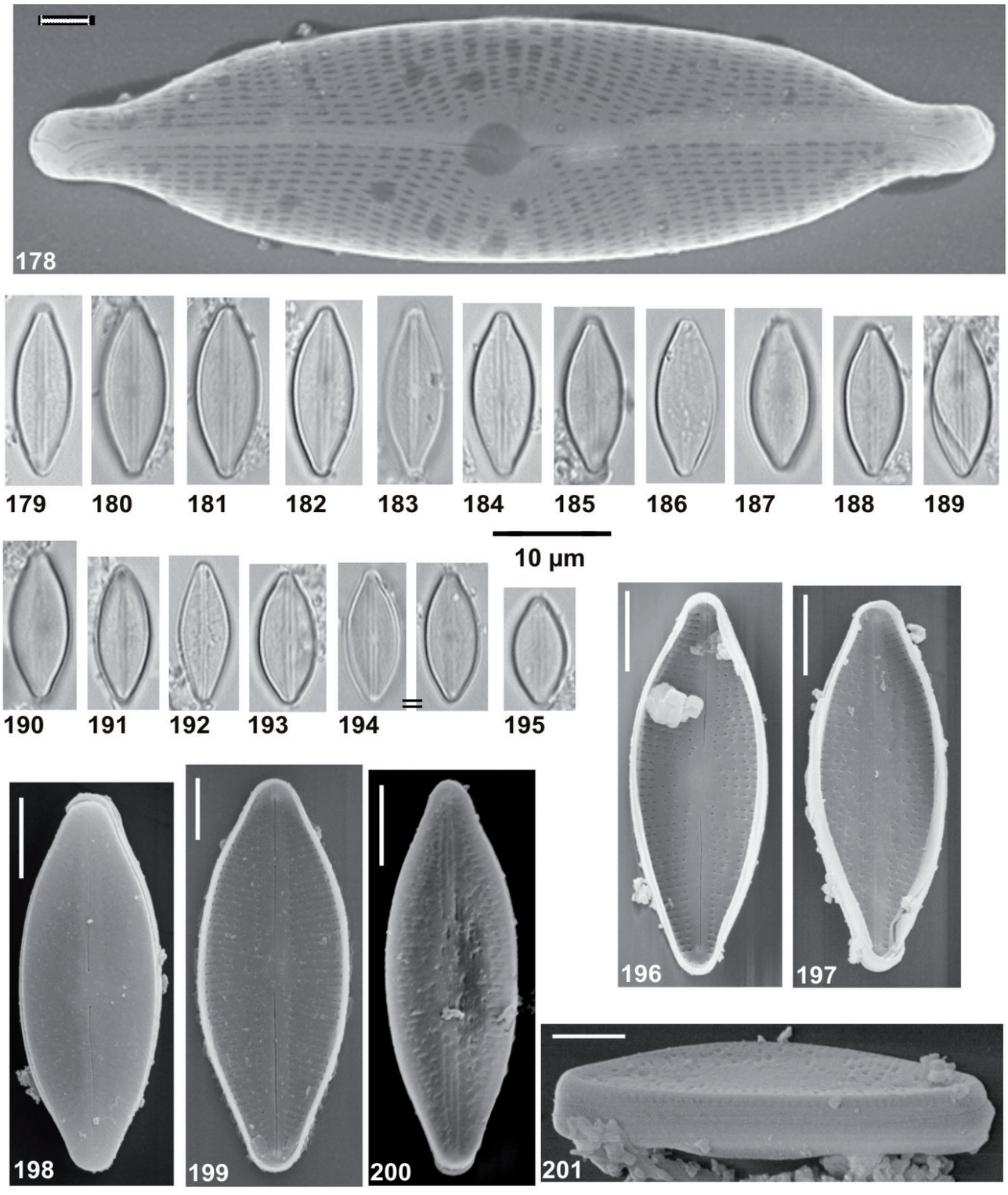
Figs. 142-167. LM. **142.** *Sellaphora garciarodriguezii*; **143.** *Pinnularia acoricola* var. *linearis*; **144.** *P. borealis* var. *sublinearis*; **145.** *P.* aff. *gibba*; **146.** *P.* aff. *meridiana*; **147.** *P.* cf. *latarea*; **148-151.** *Geissleria aikenensis*; **152.** *G. ignota*; **153, 154.** *Hippodonta capitata* spp. *iberoamericana*; **155, 156.** *Navicula cryptocephala*; **157.** *N. antonii*; **158, 159.** *N. gregaria*; **160.** *N. symmetrica*; **161.** *N. jacobii;* **162, 163.** *Navicula* sp.; **164.** *N. notha*; **165, 166.** *N. rostellata*; **167.** *N. trivialis.* Bars = 10 µm.



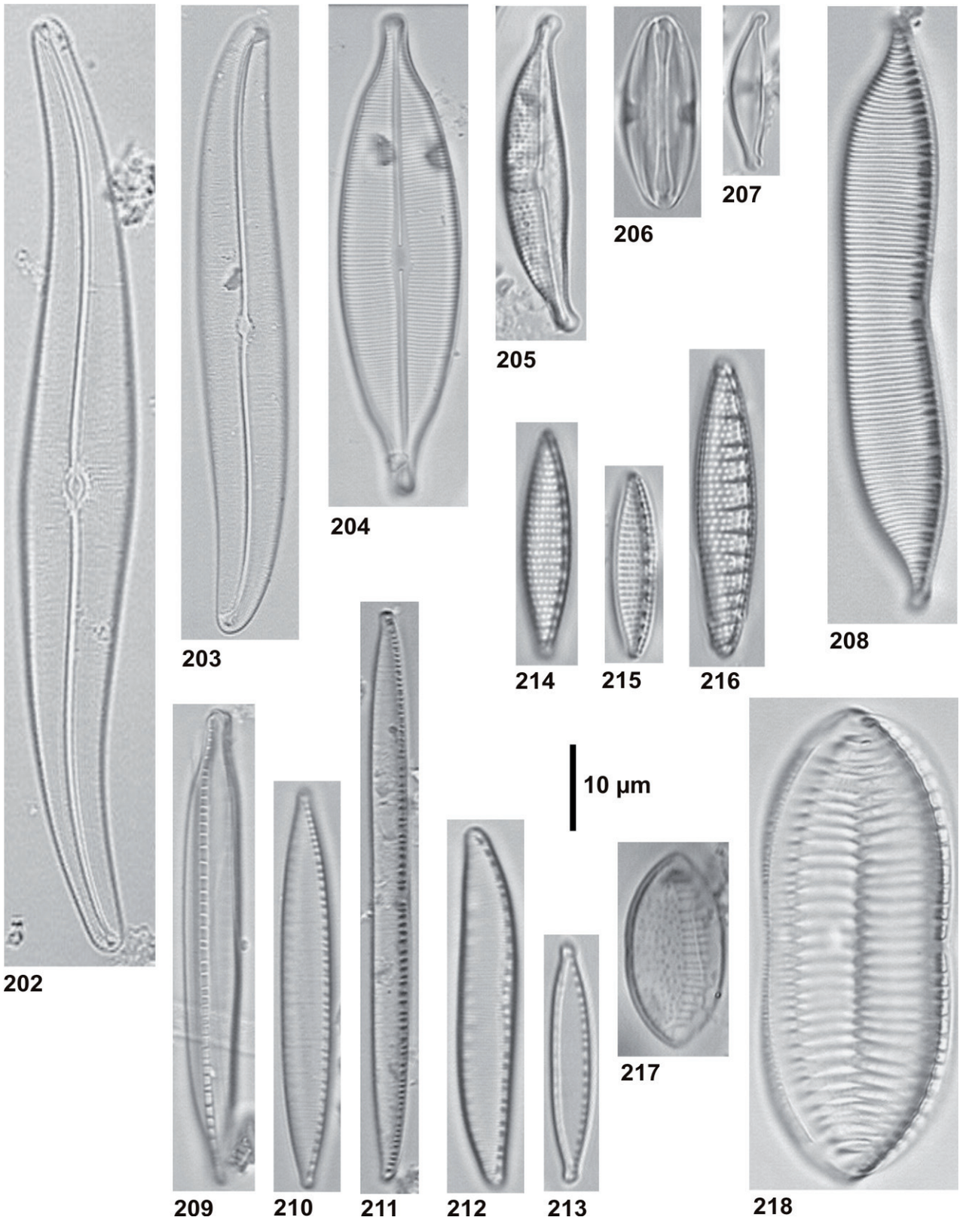
Figs. 168-172. SEM. **168-170.** *Geissleria aikenensis*; **168.** Internal view; **169.** External view of a valve apex; **170**. Central area, external view; **171.** *Geissleria* cf. *neosubtropica*. External valve view; **172.** *Navicula notha*, external valve view. Bars = 2 µm.



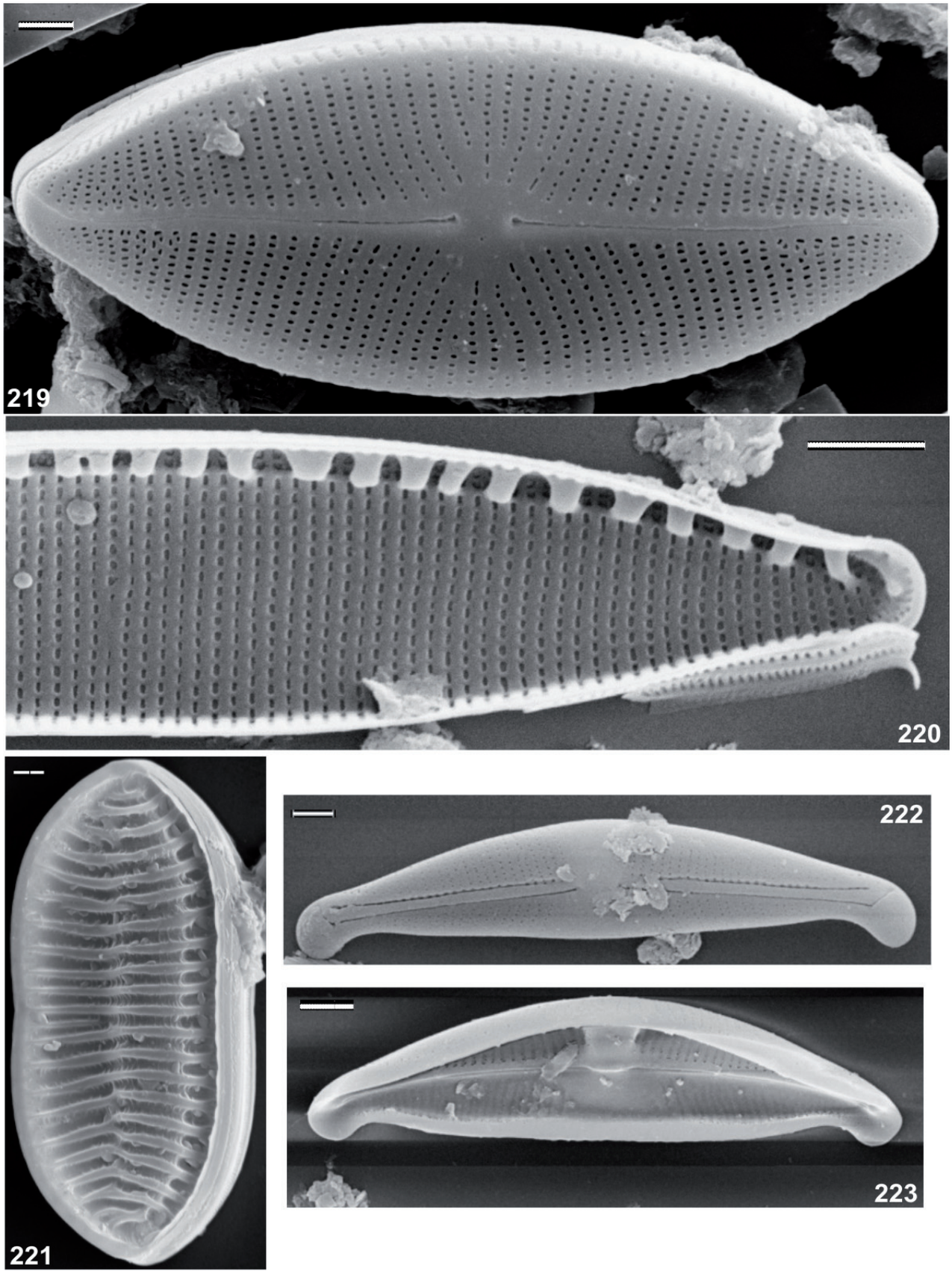
Figs. 173-177. SEM. **173.** *Navicula gregaria,* internal view; **174.** *N. symmetrica* (external view); **175.** *N. jacobii* (internal view); **176.** *N. trivialis*, external view; **177.** *Navicula* sp., external view. Bars = 2 μm.



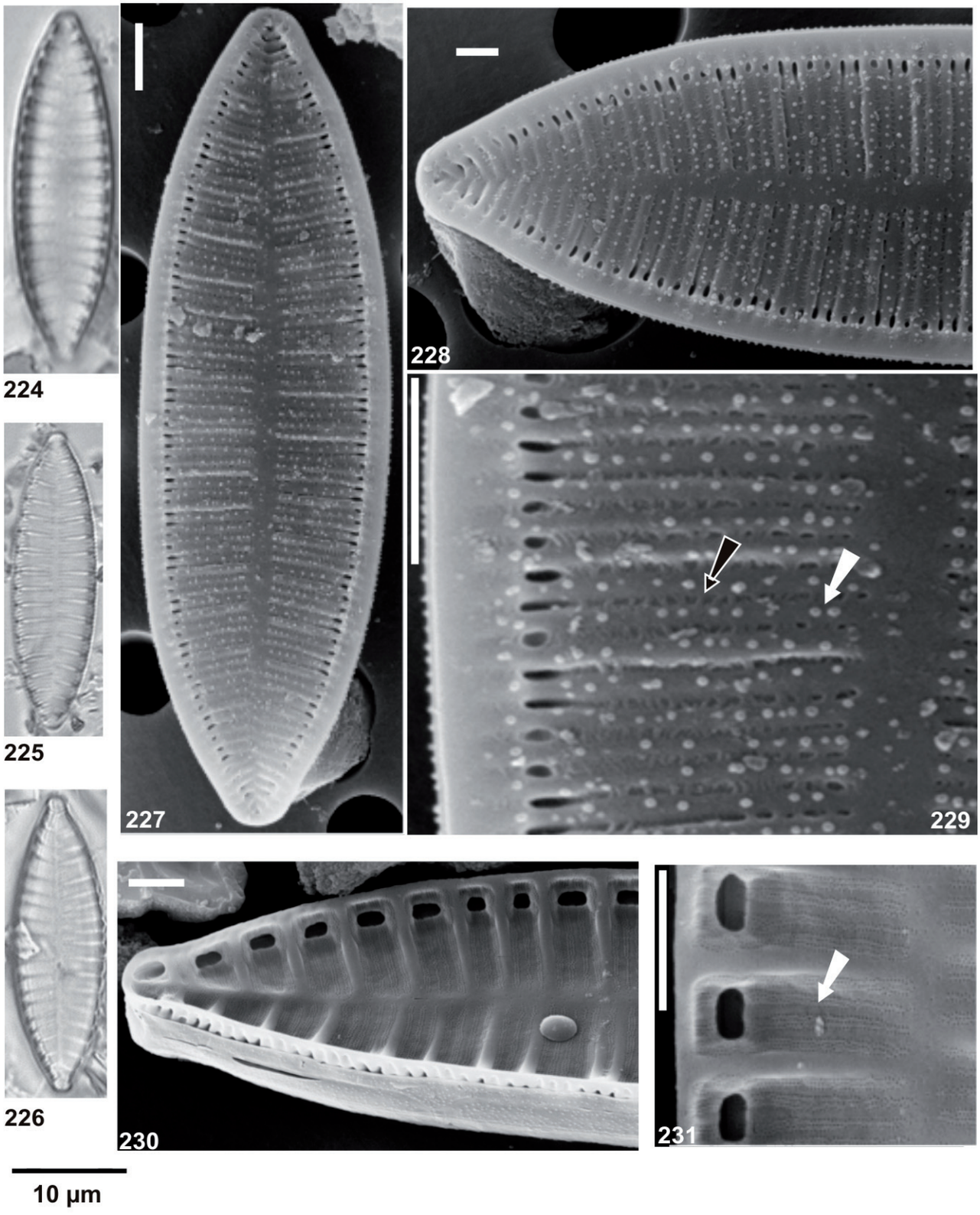
Figs. 178-201. LM and SEM. **178.** *Navicula rostellata*, external view; **179-201.** *Nupela pardinhoensis* sp. nov.; **179-195 (Fig. 194.** holotype specimen) LM. **196, 197.** SEM, internal valve views; **198-201.** SEM, external valve views. Bars: **Figs. 178, 196-201** = 2 µm; **Figs. 179-195** =10 µm.



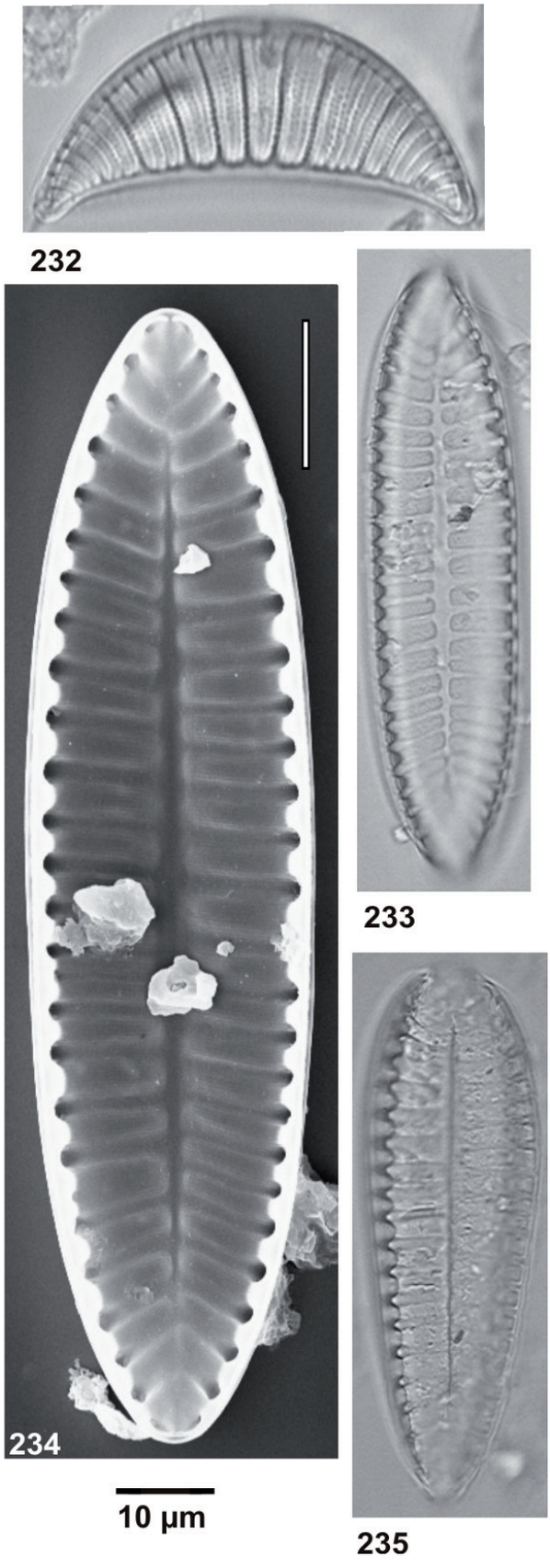
Figs. 202-218. LM. **202**. *Gyrosigma* sp.; **203.** *G. obtusatum*; **204.** *Craticula ambigua*; **205.** *Halamphora* cf. *acutiuscula*; **206, 207.** *H. montana*; **208.** *Hantzschia* cf. *abruptirostrata*; **209.** *Nitzschia dissipata*; **210**. *N. intermedia*; **211.** *N. linearis*; **212.** *N.* cf. *scalpelliformis*; **213.** *N. palea*; **214, 215.** *N. amphibia*; **216.** *N. denticula*; **217.** *Tryblionella debilis*; **218.** *T. victoriae*. Bars = 10 µm.



Figs. 219-223. SEM. **219.** *Placoneis disparilis,* external view; **220.** *Nitzschia palea,* external view; **221.** *Tryblionella victoriae,* internal view; **222, 223.** *Halamphora montana*; **222.** External view; **223.** Internal view. Bars = 2 µm.



Figs. 224-231. LM and SEM. **224-231**. *Surirella bouillonii* sp. nov. ; **224-226** (Fig. 225 holotype specimen) LM; **227.** SEM, external valve view; **228.** SEM, external view of a valve apex; **229**. SEM, external valve view showing siliceous elements (black arrow) and siliceous granules (white arrow); **230.** SEM, internal valve view; **231.** SEM, detail of a valve, internal view, showing fibulae, portulae, and striae of puncta between costae (white arrow). Bars: **Figs. 224-226** = 10 µm; **Figs. 227, 228, 230** = 2 µm; **Figs. 229, 231** = 1 µm.



Figs. 232-235. LM and SEM. **232.** LM, *Rhopalodia* sp.; **233, 234**. *Surirella* sp.; **233.** LM. **234.** SEM, internal view; **235**. LM, *S. tenera*. Bars = 10 µm.