



New diatoms (Bacillariophyta) from western North America

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Abstract

Twelve new species of diatoms are described from material collected in Colorado, Montana, Oregon, Washington, and Wyoming, USA, and in Alberta and British Columbia, Canada. The new species are *Cavinula davisiae*, *Craticula johnstoniae*, *Craticula sardiniana*, *Cymatopleura internationale*, *Cymbella cosleyi*, *Cymbopleura edlundii*, *Gomphonema johnsonii*, *Navicula supleorum*, *Navicula trilatera*, *Neidium bobmarshallensis*, *Stauroneis boyntoniae*, and *Staurophora columbiana*. Two varieties are elevated to species: *Neidium fogedii* (replaced synonym: *N. kozlowii* var. *densestriata*) and *Neidium undulatum* (replaced synonym: *N. kozlowii* var. *undulata*). Two species are transferred to new genera: *Cymbella rainierensis* to *Cymbopleura* and *Navicula soodensis* to *Staurophora*. An Alberta population of *Neidium inconstans* representing significant morphological variation and range extension for this species is also presented. Water quality preferences of these taxa run the gamut from ultraoligotrophic to hypereutrophic and fresh water to hypersaline. Thirteen of these taxa are either local or Northwest regional endemics. Four of these taxa are members of the Holarctic diatom flora or they are cosmopolitan.

Key words: Biodiversity, biogeography, endemism, water quality

Introduction

The Montana Diatom Collection (MDC) contains over 14,000 permanent slides and 2,000 vials of cleaned material representing diatom collections from over 5,000 localities in the northwest United States and western Canada. In 2012, about 100 samples were added to the MDC, including 50 samples from high elevation lakes collected by volunteers with Adventurers and Scientists for Conservation (ASC 2012), and samples from various habitats collected by other volunteers and the author.

As I consult old and new samples in the MDC for taxa to post to the Diatoms of the United States website (Spaulding et al. 2010), I often encounter species that are new to science, species that need to be transferred to another genus, and varieties that need to be elevated to species and given new names (e.g., Bahls 2010, 2011, 2012a, 2012c, 2012d). This paper is my latest contribution in an ongoing effort to refine and better define the varied and unique diatom flora of western North America.

Materials and Methods

Slides consulted for this study are deposited in the MDC at the University of Montana Herbarium (MONTU) in Missoula (Dyer 2012). MONTU is a regional public herbarium registered with Index Herbariorum. Isotype slides, when available, have been deposited in the ANSP Diatom Herbarium, Philadelphia.

The study area encompasses all or parts of the nine northwestern United States and parts of Alberta and British Columbia, Canada. Physiographically, the study area includes various ranges of the Rocky Mountains and Cascade Mountains, the Coast Range, Northwestern Great Plains, Columbia Plateau, and Great Basin (USEPA 2000).

At each site, diatoms were collected from all available nearshore substrates—macroalgae and aquatic macrophytes, rocks, fine sediments, and woody debris—using a tablespoon or a large-bore pipette with suction bulb. Subsamples were composited in a single container and preserved with Lugols (IKI) solution before transport to the laboratory, where they were treated with sulfuric acid (H₂SO₄), potassium dichromate (K₂Cr₂O₇), and hydrogen peroxide (H₂O₂) to remove organic matter (APHA *et al.* 1992). After several rinses in distilled water, cleaned diatom material was mounted permanently on slides using Hyrax or Naphrax.

Specimens were examined under light microscopy (LM) with differential interference contrast optics using a Leica DM LB2 research microscope and a Spot Insight Model 14.0 monochrome digital camera. Valve measurements were made from digital images using Spot Software (version 4.5). Scanning electron microscope images were taken with a Hitachi S-4700 Type II cold field emission SEM. Samples were filtered, air-dried, and mounted on aluminum stubs, then sputter coated with gold and palladium using a Pelco Model 3 Sputter Coater.

Specific conductance and pH were measured in the field with a Hanna Instruments waterproof meter, model 98129. Other water chemistry measurements, which are summarized here to indicate general water quality preferences, were made in the laboratory from grab samples that were collected at the time of benthic algae sampling. Water samples were analyzed by the Chemistry Laboratory of the Montana Department of Health and Human Services following methods proposed by the American Public Health Association (APHA *et al.* 1992).

Taxonomy

Division **Bacillariophyta**

Class **Bacillariophyceae** Haeckel 1878 emend D.G. Mann in Round *et al.* 1990: 651

Subclass **Bacillariophycidae** D.G. Mann in Round *et al.* 1990: 651

Order **Cymbellales** D.G. Mann in Round *et al.* 1990: 653

Family **Anomoeoneidaceae** D.G. Mann in Round *et al.* 1990: 658

Genus ***Staurophora*** C. Mereschowsky 1903: 20

Staurophora columbiana Bahls, *sp. nov.* (Figs 1–6)

Synonym:—*Navicula* sp. 6 PISCES Cumming *et al.* (1995: 38, pl. 29, figs 1–10; pl. 30, figs 1–6, 11–15).

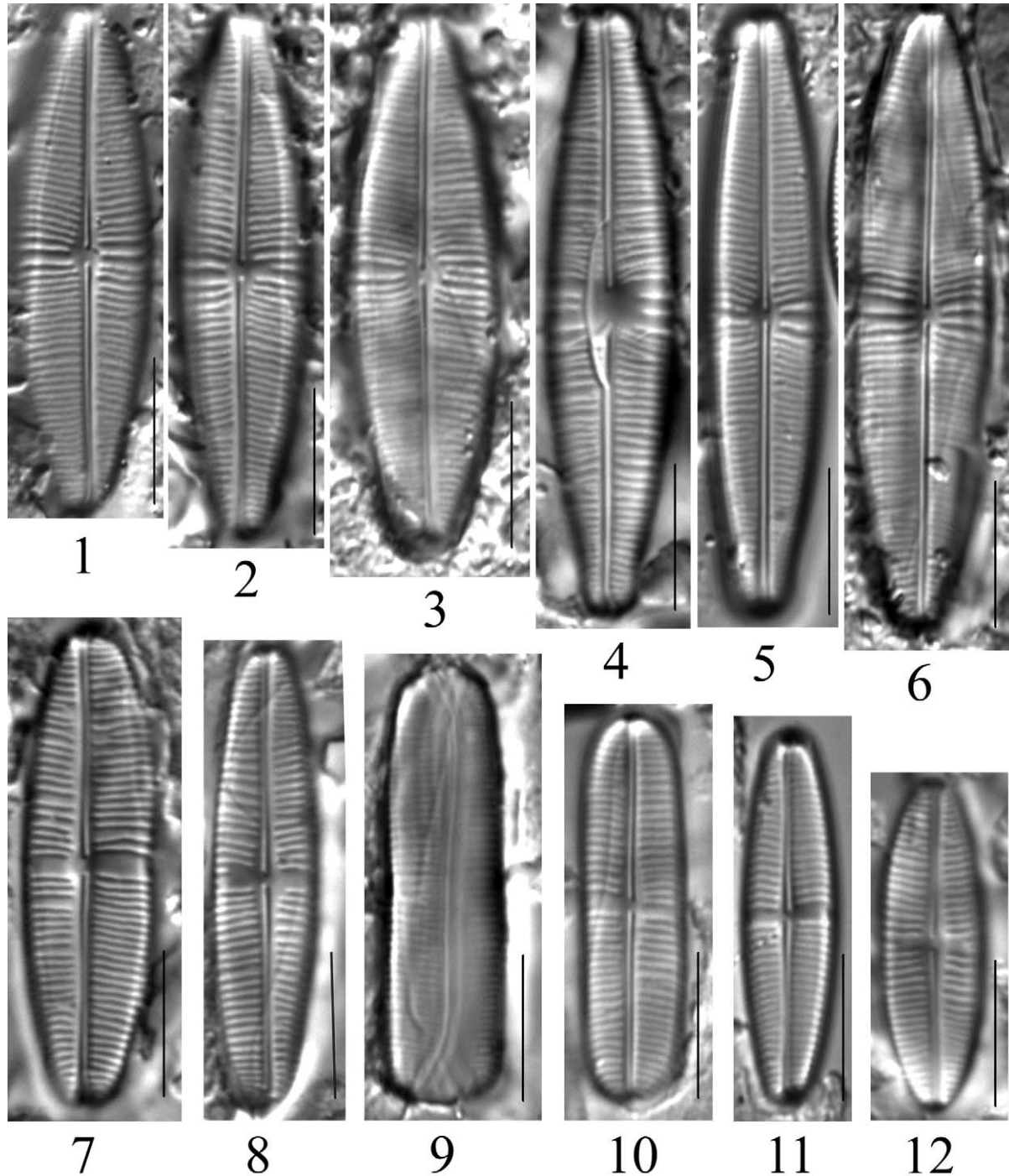
Valves linear-lanceolate to elliptic-lanceolate with subrostrate apices. Valves strongly arched in transapical axis; valve face and mantle indistinguishable. Valve length 35–54 µm; valve width 7.9–12.7 µm. Axial area very narrow. Central area small and irregular; transverse fascia lacking. Raphe filiform with straight and slightly expanded proximal ends. Terminal raphe fissures hooked in the same direction. Striae finely punctate, weakly radiate at valve center to parallel or slightly convergent at apices, 15–20 in 10 µm. Striae irregularly shortened and more widely spaced near valve center. Areolae difficult to resolve in LM. Janus valves present with large rounded central area, more distant proximal raphe ends, and more irregularly spaced striae.

Holotype:—USA, Montana: Chouteau County, Kingsbury Lake, 47.5583° N, 110.3428° W, elev. 970 m, coll. R. Apfelbeck, 21 June 1994. MDC sample 145401; MDC slide P3-17-4 (Figs 1, 2, 3, 6) (circled holotype specimen in Fig. 1). MONTU!

Isotype:—ANSP GC65174.

Paratypes:—USA, Montana: Stillwater County, Hailstone National Wildlife Refuge, 46.0066° N, 109.1810° W, elev. 1220 m, coll. R. Apfelbeck, 26 April 1993. MDC sample 123701; MDC slide P3-8-5 (Figs 4, 5). **MONTU!**—USA, Montana: Stillwater County, Big Lake, 45.8839° N, 109.0513° W, elev. 1200 m, coll. R. Apfelbeck, 6 April 1994. MDC sample 142901; MDC slide P3-15-19. **MONTU!**

Etymology:—*Staurophora columbiana* is named for the Canadian province of British Columbia, where it was first reported.



FIGURES 1–12: *Staurophora columbiana*, *Staurophora soodensis*. Figs 1–6: *Staurophora columbiana*. Figs 1, 2, 3, 6: Kingsbury Lake, Chouteau County, Montana (type locality). Fig. 1: Holotype specimen. Figs 4, 5: Hailstone National Wildlife Refuge, Stillwater County, Montana. Fig. 4: Janus valve. Figs 7–12: *Staurophora soodensis* from White Lake, Sheridan County, Montana. Fig. 9: Girdle view. Scale bars: 10 µm.

Observations:—Cumming et al. (1995), noted two forms of this taxon: form 1 with a larger, circular central area, more variable striae spacing, and more widely spaced proximal raphe ends (pl. 29, figs 1–5); and form 2, the typical form (pl. 29, figs 6–10; pl. 30, figs 1–6, 11–15). Examination of Montana specimens shows that form 1 represents occasional janus valves (Fig. 4) opposite the more typical valves (Fig. 5). *Staurophora columbiana* may be distinguished from other *Staurophora* species by the size and shape of its valves and by its very small central area. The highly arched valves, finely punctate striae, and saline water habitats (see below) are all characteristics of *Staurophora* species.

Distribution and Ecology:—*Staurophora columbiana* has been collected from 11 shallow hypersaline lakes: eight in southern British Columbia (Cumming et al. 1995) and three on the Northwestern Great Plains in central Montana (holotype, paratypes). The British Columbia lakes have a salinity range of 40.83–248.31 g/L. The pH of all three Montana lakes measured a constant 9.20 and specific conductance ranged from 44100 to 67800 $\mu\text{S}/\text{cm}$.

Staurophora soodensis (Krasske) Bahls, *comb. nov.* (Figs 7–12)

Basionym:—*Navicula soodensis* Krasske (1927, Diatomeen deutscher Solquellen und Gradierwerke. *Archiv für Hydrobiologie* 18: p. 272, pl. 10, figs 20–22). Holotype: GERMANY: Solquellen, A III 4, KASSEL (Lange-Bertalot et al. 1996).

Synonyms:—*Stauroneis soodensis* (Krasske) Chohnoky (1962: 47); *Stauroneis legleri* Hustedt (1959a: 793, fig. 1138; 1959b: 418, figs 5–7) (designated a synonym by Krammer & Lange-Bertalot 1986: 233).

Voucher:—USA, Montana: Sheridan County, White Lake, 48.5834° N, 104.1176° W, elev. 598 m, coll. R. Apfelbeck, 31 May 1994. MDC sample 141901; MDC slide P3-15-9 (Figs 7–12). MONTU!

Observations:—From salt springs in Germany, Krasske (1927) described valves of *Navicula soodensis* as 20–26 μm long by 5 μm wide with 18 striae in 10 μm . Valves from a hypersaline lake in Montana (Figs 7–12) are 22–33 μm long and 4.4–8.8 μm wide with 16–20 striae in 10 μm . The highly arched valves (Fig. 9), finely punctate striae, and saline water habitats of this species indicate that it belongs in the genus *Staurophora*. *Staurophora tackei* (Hustedt) Bahls (2012b: 36) has a higher stria density (24–26 in 10 μm at valve center, up to 32 in 10 μm near the apices).

Ecology:—White Lake, Sheridan County, Montana has a pH of 10.0 and a specific conductance of 87000 $\mu\text{S}/\text{cm}$.

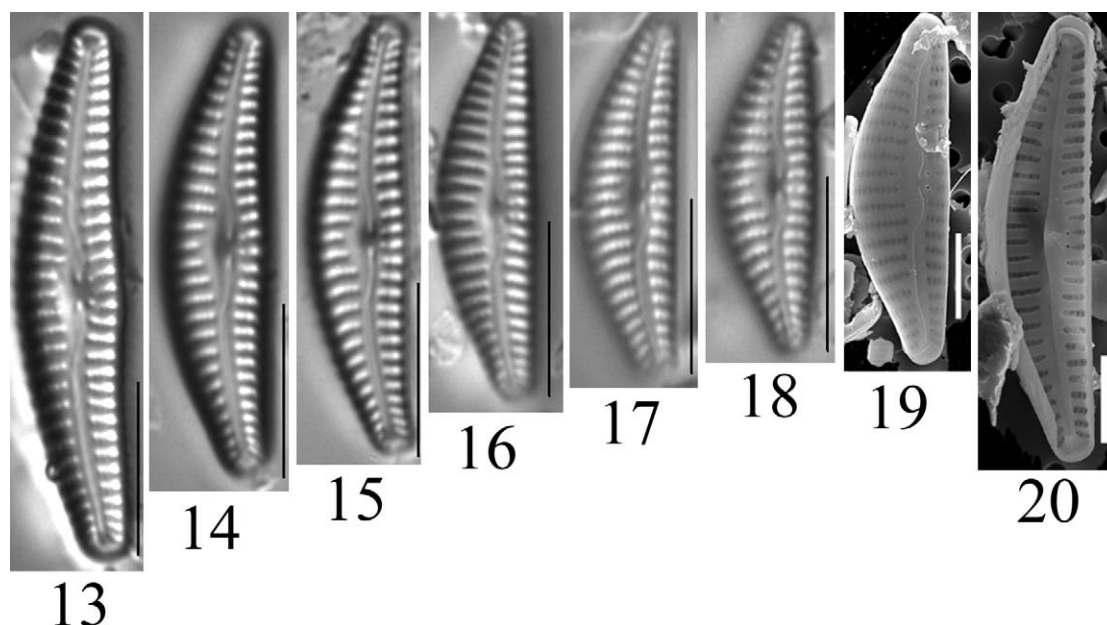
Family **Cymbellaceae** Greville 1833: 263, 409

Genus **Cymbella** C. Agardh 1830: 1

Cymbella cosleyi Bahls, *sp. nov.* (Figs 13–20)

Valves distinctly dorsiventral with subrostrate or simply rounded apices. Dorsal margin strongly arched, ventral margin nearly flat or weakly concave and slightly gibbous in the middle. Valve length 20–31 μm ; valve width 5.5–7.1 μm . Axial area narrow, central area small and asymmetric, rounded on the dorsal side and flat on the ventral side. Raphe lateral, becoming reverse-lateral near the proximal pores, which are slightly expanded. Proximal raphe ends deflected ventrally, then recurved slightly toward the dorsal margin. Distal raphe ends deflected dorsally. Striae slightly radiate near valve middle, becoming more strongly radiate near apices, 10–12 at valve center, 14–16 near apices. Two indistinct stigmata at ends of middle ventral striae. Areolae easily resolved under LM, 28–30 in 10 μm .

Holotype:—USA, Montana: Flathead County, Glacier National Park, Bowman Lake, 48.8356° N, 114.1967° W, elev. 1228 m, coll. L. Bahls, 1 August 2007. MDC sample 404801; holotype slide MDC 117-31 (Figs 14, 16–20) (circled holotype specimen in Fig. 16). MONTU!



FIGURES 13–20: *Cymbella cosleyi*. Figs 13–18: LM images. Fig. 13: Belly River, Glacier National Park, Montana. Figs 14, 16–18: Bowman Lake, Glacier National Park, Montana (type locality). Fig. 16: Holotype specimen. Fig. 15: North Fork Flathead River, Glacier National Park, Montana. Figs 19, 20: SEM images (type locality). Fig. 19: External valve view showing proximal raphe ends deflected ventrally and distal raphe fissures deflected dorsally. Fig. 20: Internal valve view showing arched intermissio and distal raphe ends terminating in helictoglossae. Scale bars: Figs 13–18: 10 μ m; Figs 19, 20: 5 μ m.

Isotypes:—MDC slide 38-32 (MONTU!); ANSP GC64931.

Paratypes:—USA, Montana: Glacier County, Glacier National Park, Belly River, 48.9681° N, 113.6822° W, elev. 1392 m, coll. S. Nadeau, 16 August 1980. MDC sample 076101; MDC slide B1-1-1 (Fig. 13). MONTU!—USA, Montana: Flathead County, North Fork Flathead River, 48.4933° N, 114.1253° W, elev. 975 m, coll. R. Greene, 22 March 1979. MDC sample 050803; MDC slide P2-8-14 (Fig. 15). MONTU!—CANADA, Alberta: Waterton Lakes National Park, Cameron Lake, 49.0000° N, 114.0578° W, elev. 1660 m, coll. L. Bahls, 24 July 2009. MDC sample 452001; MDC slides 39-88, 123-59. MONTU!

Etymology:—This species is named after the legendary Joe Cosley, ranger turned outlaw in Glacier National Park's Belly River country (McClung 1998).

Observations:—Under SEM in external valve view (Fig. 19), ventrally deflected proximal raphe ends and dorsally deflected terminal raphe fissures are evident. Internally (Fig. 20), the intermissio is arched and the distal raphe ends terminate in helictoglossae. Valves of *Cymbella cosleyi* have nearly flat ventral margins in contrast to the strongly concave ventral margins of *Cymbella subarctica* Krammer (2002: 103) and *Cymbella cleve-eulerae* Krammer (2002: 105).

Distribution and Ecology: *Cymbella cosleyi* has been collected from four lakes and rivers in Glacier National Park, Montana and Waterton Lakes National Park, Alberta (holotype, paratypes). These waters have somewhat alkaline pH (7.80–8.54) and low specific conductance (92–209 μ S/cm).

Genus: *Cymboplectura* (Krammer) Krammer 1999: 292

Cymboplectura edlundii Bahls, sp. nov. (Figs 21–26)

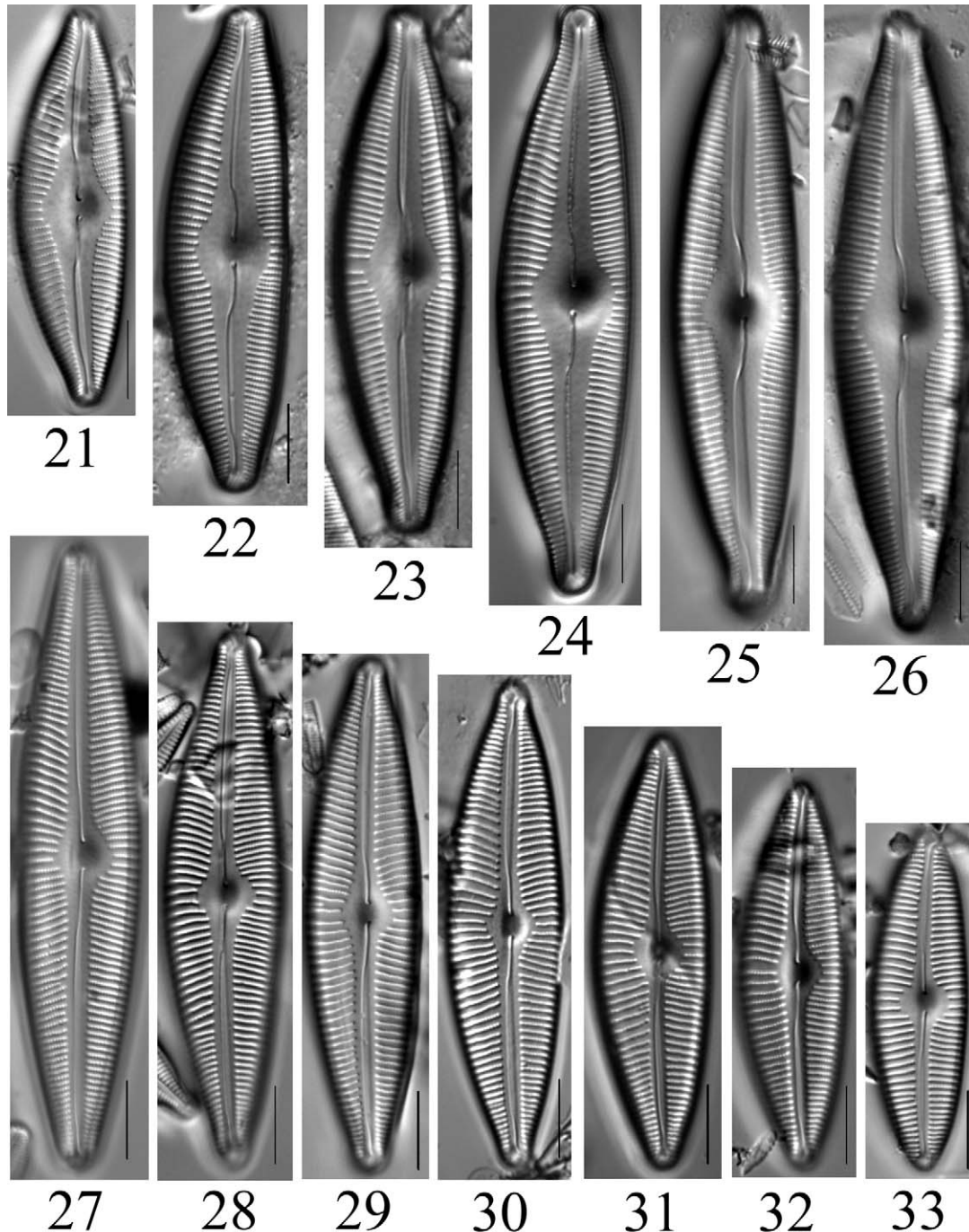
Valves lanceolate with rounded subrostrate apices, distinctly dorsiventral in small specimens, slightly dorsiventral in larger specimens. Valve length 51–87 μ m; valve width 14.3–17.9 μ m. Axial and central areas very wide, 1/3 to 1/2 valve width, together forming a lanceolate space with a tumid center somewhat offset towards the ventral margin. Raphe distinctly lateral, becoming weakly reverse-lateral near proximal and distal ends. Proximal raphe ends offset to the ventral side, tipped with distinctly expanded pores. Distal raphe ends hooked towards the dorsal side. Striae radiate throughout, 9–13 in 10 μ m at valve center, 14–16 in 10 μ m near the apices. Areolae 25–30 in 10 μ m.

Holotype:—USA, Montana: Flathead County, Glacier National Park, Starvation Ridge Pond, 48.9739° N, 114.3247° W, elev. 1500 m, coll. E. W. Schweiger, 17 July 2008. MDC sample 438501; holotype slide MDC 121-84 (Figs 21–26) (circled holotype specimen in Fig. 24). MONTU!

Isotypes:—MDC slide 39-67 (MONTU!); ANSP GC65018.

Etymology:—This species is named in honor of Mark Edlund, distinguished diatomist and respected colleague.

Observations:—*Cymbopleura edlundii* may be distinguished from similar *Cymbopleura* species, including *C. rainierensis* (this paper, Figs 27–33), by its very wide axial and central areas.



FIGURES 21–33: *Cymbopleura edlundii*, *Cymbopleura rainierensis*. Figs 21–26: *Cymbopleura edlundii* from Starvation Ridge Pond, Glacier National Park, Montana (type locality). Fig. 24: Holotype specimen. Figs 27–33: *Cymbopleura rainierensis*. Fig. 27: Surprise Lake, King County, Washington. Figs 28, 29, 32: Frog Pond above Dewey Lake, Mount Rainier National Park, Washington. Figs 30, 31: Paradise Pond, Glacier National Park, Montana. Fig. 33: No Name Hanging Fen, Glacier National Park, MT. Scale bars: 10 μ m.

Distribution and Ecology:—*Cymboppleura edlundii* is known only from the type locality, a small pond near the Montana border with British Columbia, Canada. Water quality data for this pond are not available, but based on other waters in the area it is presumed to have circumneutral pH and low levels of nutrients and dissolved solids.

Cymboppleura rainierensis (Sovereign) Bahls, *comb. nov.* (Figs 27–33)

Basionym:—*Cymbella rainierensis* Sovereign (1963, New and rare diatoms from Oregon and Washington, Proceedings of the California Academy of Sciences, 4th Series, 31: 363, fig. 20).

Holotype:—USA, Washington: Mount Rainier National Park, Mowich Lake, CAS accession no. 600718, CAS holotype slide no. 206007, CAS isotype slide no. 187092 (Kociolek et al. 1999).

Vouchers:—USA, Washington: King County, Surprise Lake, 47.6689° N, 121.1392° W, elev. 1374 m, coll. L. White, 25 August 2012. MDC sample 496301; MDC slides 41–60 (Fig. 27), 126–54. MONTU!—USA, Washington: Yakima County, Mount Rainier National Park, Frog Pond above Dewey Lake, 46.8558° N, 121.4883° W, elev. 1573 m, coll. R. Davis, 18 August 2012. MDC sample 496001; MDC slides 41–54 (Figs 28, 29, 32), 126–48. MONTU!—USA, Montana: Glacier County, Glacier National Park, Paradise Pond, 48.4792° N, 113.3692° W, elev. 1600 m, coll. L. Bahls, 7 September 2006. MDC sample 375701; MDC slides 117–10 (Figs 30, 31), 38–10. MONTU!—USA, Montana: Glacier County, Glacier National Park, No Name Hanging Fen, 48.4786° N, 113.4492° W, elev. 1829 m, coll. L. Bahls, 28 June 2009. MDC sample 451401; MDC slides 123–53 (Fig. 33), 39–82. MONTU!

Observations:—This taxon has neither an apical pore field nor stigmata and therefore belongs more appropriately in *Cymboppleura*.

Distribution and Ecology:—*Cymboppleura rainierensis* is widespread and locally abundant in lakes, ponds and fens of the Pacific Northwest, where it prefers circumneutral waters with low levels of electrolytes.

Family **Gomphonemataceae** Kützing 1844: 82

Genus **Gomphonema** C.G. Ehrenberg 1832: 87

Gomphonema johnsonii Bahls, *sp. nov.* (Figs 34–42)

Valves lanceolate with narrow subrostrate apices. Valve length 24–50 µm; valve width 6.9–8.5 µm. Pore field present at the footpole. Valves somewhat asymmetric about the apical axis. Axial area narrow and linear, widening to merge with a moderately large elliptic central area. Raphe straight and weakly lateral, becoming filiform at the proximal and distal ends. Proximal raphe ends weakly expanded; terminal raphe fissures hooked to the side opposite the central stigma. Striae strongly radiate, 9–12 in 10 µm at the valve center, 14–18 in 10 µm near the apices. Areolae 30–35 in 10 µm. One stigma present at the end of the longest central stria.

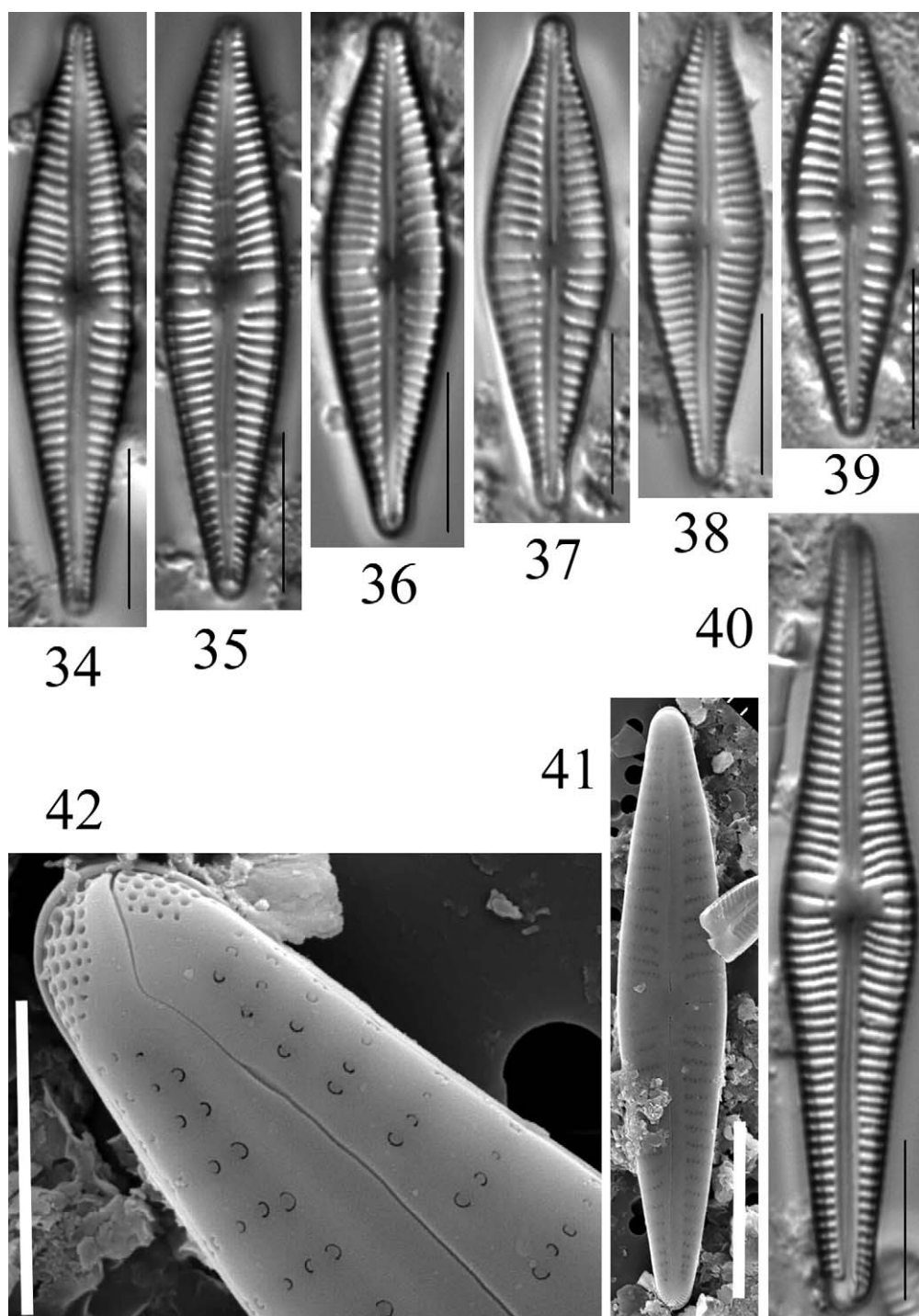
Holotype:—USA, Oregon: Lane County, Spring along Forest Road No. 1900482, 44.1342° N, 122.2286° W, elev. 604 m, coll. A. Johnson, 10 August 2011. MDC sample 500301; holotype slide MDC 42-2 (Figs 34–42) (circled holotype specimen in Fig. 38). MONTU!

Isotypes:—MDC slide 126-96 (MONTU!); circled specimens on ANSP! GC65164.

Etymology:—This taxon is named for Al Johnson, hydrologist with the Willamette National Forest and collector of the type sample.

Observations:—Under SEM, a well-developed apical pore field at the footpole and C-shaped external openings of the areolae are evident (Fig. 42). *Gomphonema parvulum* (Kützing) Kützing (1849: 65) is smaller (10–36 µm long) with less strongly radiate striae. *Gomphonema gracile* Ehrenberg (1838: 217) lacks protracted apices and also has more weakly radiate striae. Valves of *Gomphonema mexicanum* Grunow in Van Heurck (1880: pl. 24, fig. 3) are larger and lack the protracted headpole.

Distribution:—*Gomphonema johnsonii* is known to date only from the type locality.



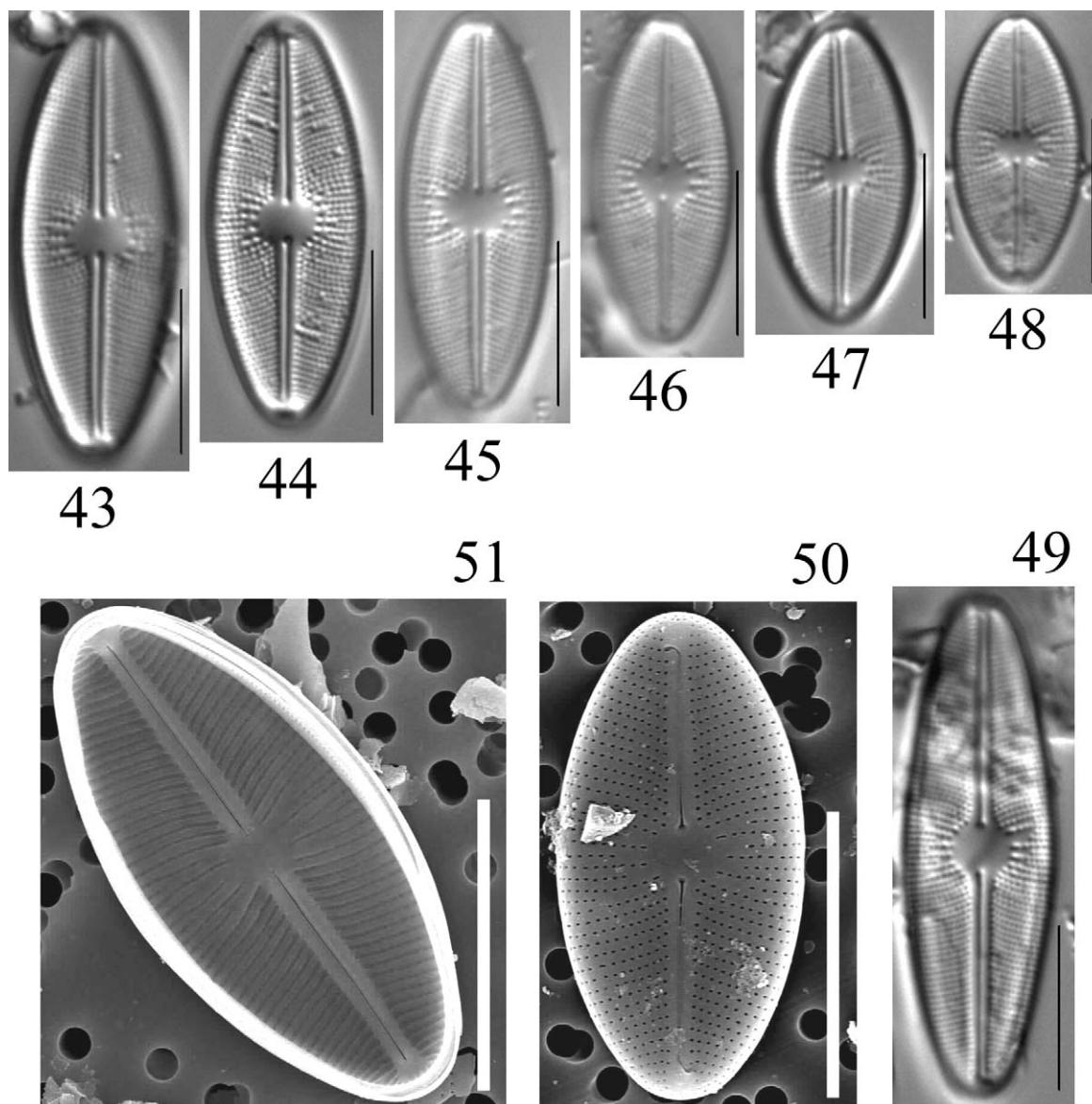
FIGURES 34–42: *Gomphonema johnsonii* from Spring on Road 1900482, Willamette National Forest, Oregon (type locality). Figs 34–40: LM images. Fig. 38: Holotype specimen. Fig. 40: Initial valve. Figs 41, 42: SEM images. Fig. 41: Whole valve, external. Fig. 42: Close up view of footpole showing apical pore field, distal raphe fissure, and C-shaped external areolae openings. Scale bars: Figs 34–41: 10 μ m; Fig. 42: 3 μ m.

Order **Naviculales** Bessey 1907: 10

Family **Cavinulaceae** D.G. Mann in Round et al. 1990: 659

Cavinula davisiae Bahls, sp. nov. (Figs 43–51)

Valves elliptic-lanceolate with broadly rounded apices. Valve length 14–31 μm ; valve width 7.5–9.9 μm . Axial area narrow and linear; central area orbicular and large, about 1/2 valve width. Raphe filiform and straight with distinctly expanded proximal ends. Terminal raphe fissures hooked abruptly in opposite directions some distance from each apex. Striae radiate throughout, alternately long and short around the central area, 26–32 in 10 μm . Areolae round, 26–35 in 10 μm . Areolae of striae adjacent to central area larger and somewhat elongate transapically. Internally, proximal raphe ends T-shaped and areolae occluded by hymenes.



FIGURES 43–51: *Cavinula davisiae* from Clover Lake, Mount Rainier National Park, Washington (type locality). Figs 43–49: LM images. Fig. 48: Holotype specimen. Figs 50, 51: SEM images. Fig. 50: External valve view showing distal raphe ends hooked in opposite directions well short of the apices. Fig. 51: Internal valve view showing (with some additional magnification) T-shaped proximal raphe ends. Scale bars: 10 μm .

Holotype:—USA, Washington: Pierce County, Mount Rainier National Park, Clover Lake, 46.9289° N, 121.5925° W, elev. 1750 m, coll. R. Davis, 18 August 2012. MDC sample 496201; holotype slide MDC 41-56 (Figs 43–51) (circled holotype specimen in Fig. 48). MONTU!

Isotypes:—MDC slide 126-50 (MONTU!); circled specimens on ANSP! GC65165.

Reported as:—*Navicula variostrata* (Hein 1990: 76, pl. 31, figs 7–9); *Navicula cf. variostrata* (Pienitz et al. 2003: 47, pl. 14, fig. 6).

Etymology:—This species is named after Ryan Davis, volunteer with Adventurers and Scientists for Conservation and collector of the holotype sample.

Observations:—Under SEM (Fig. 50), the terminal raphe ends are shown to be hooked in opposite directions well short of the apices. Internally (Fig. 51), with some additional magnification, the proximal raphe ends may be seen as T-shaped. *Cavinula variostrata* (Krasske) D.G. Mann in Round et al. (1990: 665) has more linear valves and an even larger central area. The central area of *Navicula lapidosa* Krasske (1929: 354) is shaped like a bow tie, not rounded.

Distribution and Ecology:—*Cavinula davisiae* appears to be endemic to the Pacific Northwest, where it is widespread and locally common in circumneutral waters with low conductivity. Previously, this species had been confused with *Navicula variostrata* Krasske (1923: 197). Hein (1990) reported it from Adak Island, Alaska and Pienitz et al. (2003) reported it from islands off the Pacific Coast of western British Columbia.

Family **Neidiaceae** Mereschkowsky 1903: 127

Genus **Neidium** E. Pfitzer 1871: 39

Neidium bobmarshallensis Bahls, *sp. nov.* (Figs 56–59)

Valves lanceolate with broadly rounded, very weakly protracted apices. Valve length 60–79 µm; valve width 14.8–17.8 µm. A longitudinal line evident along each margin. Axial area straight and narrow, flaring a bit near the central area. Central area wide, rectangular, oriented diagonally to the apical axis. Central area bordered by short faint striae along valve margins. Raphe lateral, becoming filiform at the proximal ends, which are hooked sharply in opposite directions. Striae oriented diagonally across the valve face, 13–15 in 10 µm. Areolae 20–24 in 10 µm.

Holotype:—USA, Montana: Flathead County, Bob Marshall Wilderness, Dean Lake, 47.9237° N, 113.1073° W, elev. 2244 m, coll. L. Bahls, 23 August 1983. MDC sample 087501; holotype slide MDC P2-25-11 (Figs 57, 59) (circled holotype specimen in Fig. 57). MONTU!

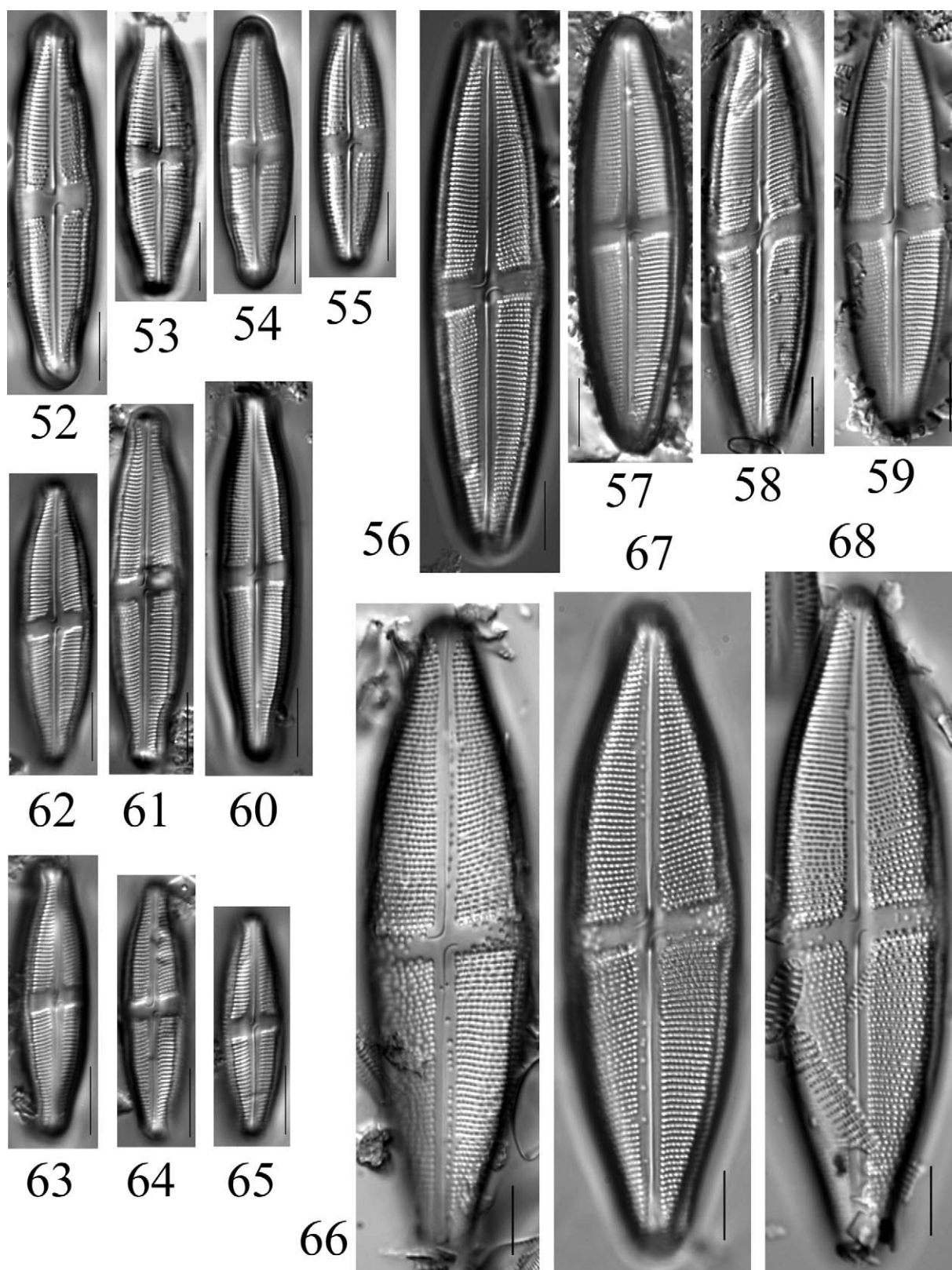
Paratypes:—USA, Montana: Flathead County, Bob Marshall Wilderness, Upper Trilobite Lake, 47.9806° N, 113.1393° W, elev. 2012 m, coll. L. Bahls, 21 August 1983. MDC sample 087401; MDC slide P2-25-10 (Fig. 58). MONTU!—USA, Montana: Flathead County, Glacier National Park, Logging Lake, 48.7431° N, 114.1239° W, elev. 1162 m, coll. L. Bahls, 31 July 2007. MDC sample 404401; MDC slides 117-27 (Fig. 56), 38-28. MONTU!

Reported as:—*Neidium kozlowii* (Metzeltin et al. 2009: 336, pl. 102, figs 2–7); *N. kozlowii* var. *elliptica* (Foged 1981: 135, pl. XXVI, fig. 6).

Etymology:—This species is named for the Bob Marshall Wilderness in northwestern Montana.

Observations:—*Neidium undulatum* *stat. nov.* (this paper, Figs 66–68) and *Neidium kozlowii* (Mereschkowsky 1906: 16) have wider valves, distinctly protracted apices, and a lower stria density (10–12 in 10 µm). Valves of *Neidium kozlowii* var. *ellipticum* (Mereschkowsky 1906: 16) are elliptic, not lanceolate in shape. A population from Mongolia, reported as *N. kozlowii*, is very similar to *N. bobmarshallensis* in size and stria density and appears to be conspecific. They differ only in the degree to which apices of larger valves are protracted. Specimens from Alaska (Foged 1981) and Mongolia have a stria density of 14 in 10 µm, which matches *N. bobmarshallensis* but is higher than stria density in *N. kozlowii*.

Distribution and Ecology:—*Neidium bobmarshallensis* has been recorded from two lakes in the Bob Marshall Wilderness of northwestern Montana and from Logging Lake in nearby Glacier National Park. On the date the Logging Lake sample was collected, ambient pH measured 7.78 and specific conductance measured 43 µS/cm. This species has also been reported from a small pond in the Brooks Range of Alaska (Foged 1981) and from a lake and two rivers in Mongolia (Metzeltin et al. 2009).



FIGURES 52–68: *Neidium inconstans*, *Neidium bobmarshallensis*, *Neidium fogedii*, *Neidium undulatum*. Figs 52–55: *Neidium inconstans* from Indian Springs Pond, Waterton Lakes National Park, Alberta. Figs 56–59: *Neidium bobmarshallensis*. Fig. 56: Logging Lake, Glacier National Park, Montana. Figs 57, 59: Dean lake, Bob Marshall Wilderness, Montana (type locality). Fig. 57: Holotype specimen. Fig. 58: Upper Trilobite Lake, Bob Marshall Wilderness, Montana. Figs 60–65: *Neidium fogedii* from Mexican Cut Upper Pond No. 56, Gunnison County, Colorado. Figs 66–68: *Neidium undulatum* from Grassy (Axolotl) Lake, Madison County, Montana. Scale bars: 10 μ m.

Neidium fogedii Bahls, *stat. nov., nom. nov.* (Figs 60–65)

Replaced Synonym:—*Neidium kozlowi* var. *densestriata* Foged (1981: 135, pl. XXV, fig. 11).

Holotype:—USA, Alaska: Brooks Range, Desperation Lake, freshwater, 68.3333° N, 158.7500° W, coll. C. Holmquist, 30 July 1969. Slide No. 13/1969, Foged Collection, Natural History Museum of Denmark (C), Copenhagen.

Vouchers:—USA, Colorado: Gunnison County, Mexican Cut Preserve, Upper Pond #56, 39.0247° N, 107.0675° W, elev. 3458 m, coll. M. Penton, 7 July 2012. MDC sample 494301; MDC slides 41–40 (Figs 60–65), 124–34. MONTU!

Etymology:—This species is named after Niels Foged. The new name is necessary because the name *N. densestriatum* is already occupied.

Observations:—Foged (1981) described valves of this taxon as 37 µm long by 9 µm wide with 18–20 striae in 10 µm. Specimens recently collected from a pond in Colorado (Figs 60–65) are 33–55 µm long by 9.3–11.1 µm wide with 17–18 striae in 10 µm. *Neidium fogedii* has a higher stria density and narrower central area than *Neidium inconstans* (Figs 52–55).

Distribution and Ecology:—To date this taxon has been collected only from the type locality and from a high elevation pond in Colorado. It appears to be a North American endemic. The type locality registered a pH of 7.3 and specific conductance of 27 µS/cm (Foged 1981). The pond in Colorado had a pH of 7.2 and specific conductance of 102 µS/cm (M. Penton, unpublished data).

Neidium inconstans Sovereign (1963: 351, fig. 13) (Figs 52–55)

Type:—USA, Washington: Adams County, Finnel Lake, elev. 550 m, CAS accession no. 600683, CAS holotype slide no. 205090, CAS isotype slide no. 187016 (Kociolek et al. 1999).

Vouchers:—CANADA, Alberta: Waterton Lakes National Park, Indian Springs Pond, 49.1297° N, 113.8731° W, elev. 1340 m, coll. B. Johnston, 5 June 2009. MDC sample 454301; MDC slides 124–1 (Figs 52–55), 40–26. MONTU!

Observations:—Valves lanceolate to linear-lanceolate with subrostrate to subcapitate apices and weakly triundulate margins. Valve length 38–56 µm; valve width 9.9–13.0 µm. A longitudinal line evident along each margin. Axial area narrow; central area very wide, rectangular but distinctly asymmetric and oriented diagonally to the apical axis. Short striae present in central area at valve margins. Raphe weakly lateral, becoming filiform near the proximal ends. Proximal ends hooked sharply in opposite directions. Striae slightly radiate near the central area, parallel to weakly convergent near the apices, 14–15 in 10 µm. Areolae 20–24 in 10 µm.

The Alberta population differs from the type population in its somewhat smaller valves and lack of capitate apices, and perhaps represents the small end of this taxon. *Neidium inconstans* has a wider central area and a lower stria density than *Neidium fogedii* *stat. nov., nom. nov.* (Figs 60–65).

Distribution and Ecology:—The occurrence in Alberta represents a significant range extension for this species. Until now it had been known only from the type locality. The pond in Alberta is alkaline (pH 8.1) with intermediate specific conductance (302 µS/cm).

Neidium undulatum Bahls, *stat. nov.* (Figs 66–68)

Basionym:—*Neidium kozlowi* var. *undulata* Stoermer (1963: p. 6, text fig. 1).

Type:—USA, Iowa: Dickinson County, West Lake Okoboji, coll. E.F. Stoermer, 26 June 1959, holotype slide ANSP GC8299a.

Reported as:—*Neidium kozlowii* (Krammer & Lange-Bertalot 1986: 276, fig. 102: 12)

Vouchers:—USA, Montana: Madison County, Grassy (Axolotl) Lake, 45.2422° N, 111.8836° W, elev. 2190 m, coll. L. Bahls, 29 September 2011. MDC sample 490701, MDC slides 41-5 (Figs 66–68), 125-68. MONTU!

Observations:—Stoermer (1963) described this taxon as 98 µm long by 24 µm wide with 10–12 striae in 10 µm. Specimens recently collected from Grassy Lake in Montana (Figs 66–68) are 82–110 µm long and 23–26 µm wide with 11–12 striae in 10 µm. This species differs from *Neidium kozlowii* Mereschkowsky (1906: 16, fig. 5) by having more rounded (less truncate) apices and a wider axial area with a longitudinal row of depressions on the external valve surface along one side of the raphe. There are also obvious scattered depressions along the margins of the central area, which are not evident in Mereschkowsky's original drawing of *N. kozlowii*. Valve margins of *N. undulatum* are somewhat undulate in Stoermer's illustration, less pronounced in the Montana specimens and not at all evident in the drawing of *N. kozlowii*. Krammer & Lange-Bertalot (1986) published an image (fig. 102: 12) of what appears to be *N. undulatum* from Zürichsee and called it *N. kozlowii*. Metzeltin et al. (2009) pictured a similar taxon (pl. 102, fig. 1) from Mongolia and called it *Neidium* spec. cf. *kozlowii*. However, the Mongolian taxon has very blunt ends, an elliptic-lanceolate valve shape, and distinctly undulating valve margins. Another taxon illustrated on the same plate (figs 2–7) more closely matches Mereschkowsky's illustration of *N. kozlowii* except that it has 14 striae in 10 µm, which is too high for *N. kozlowii* (10–12 in 10 µm). In Mereschkowsky's original drawing of *N. kozlowii*, the proximal raphe ends are straight, not bent, and the axial area is very narrow (see also Hustedt 1930: 247, fig. 387). Given the straight proximal raphe ends, one might suppose that Mereschkowsky made his drawing from an internal valve view. However the axial area would also be narrow on the outside and it is unlikely that he overlooked the conspicuous depressions on the external valve surface. The type for *N. kozlowii* and original material from Tibet are unavailable for study. See also observations for *N. bobmarshallensis*.

Ecology:—Grassy (Axolotl) Lake in the Gravelly Range of southwestern Montana has a pH of 9.73 and specific conductance of 177 µS/cm.

Family **Naviculaceae** Kützing 1844: 88

Genus **Navicula** J.B.M. Bory de St.-Vincent 1822: 128

Navicula supleeorum Bahls, *sp. nov.* (Figs 69–75)

Valves lanceolate in larger specimens to elliptic-lanceolate in smaller specimens. Valve length 23–32 µm; valve width 6.1–7.0 µm. Apices acutely rounded, not protracted in larger specimens, weakly protracted in smaller specimens. Axial area narrow, barely wider than the raphe, widening into a small elliptic central area. Raphe straight and weakly lateral, becoming filiform near the proximal and distal ends. External proximal raphe ends dilated. Striae radiate, becoming parallel then weakly convergent at the apices, 12–14 in 10 µm. Alternate short-long-short striae typical in the central area. Areolae 30–32 in 10 µm.

Holotype:—USA, Montana: Valley County, Rock Creek, 48.5903° N, 107.0011° W, elevation 680 m, coll. Montana DEQ, 6 September 2004. MDC sample 339511; holotype slide MDC 108-22 (Figs 69–75) (circled holotype specimen in Fig. 72). MONTU!

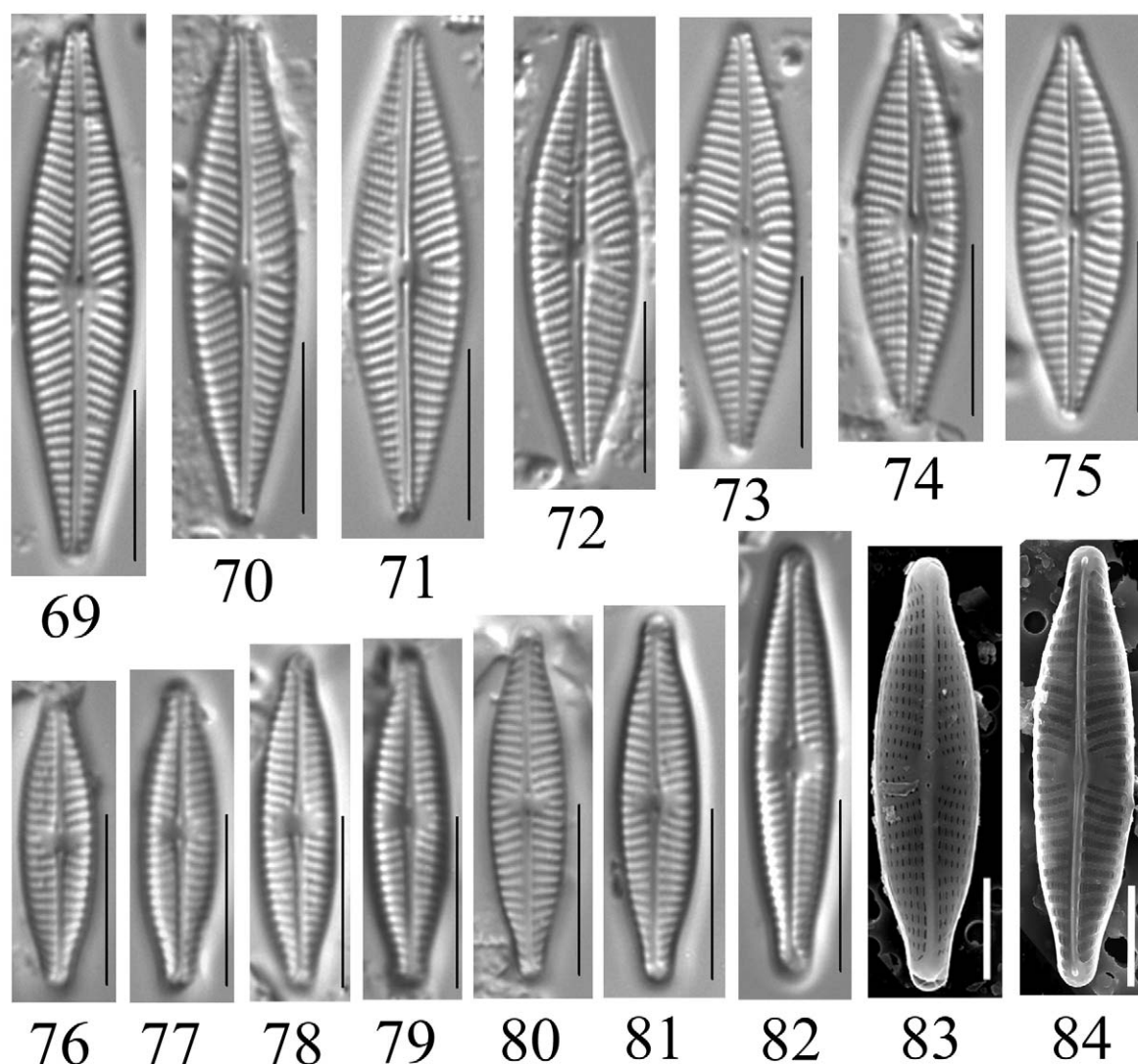
Isotype:—MDC slide 28-59 (MONTU!).

Etymology:—This species is named in honor of Rosie Sada de Suplee and Michael Suplee, Montana Department of Environmental Quality.

Observations:—*Navicula supleeorum* has a lower stria density than *N. cryptotenella* Lange-Bertalot in Krammer & Lange-Bertalot (1985: 62) (14–16 in 10 µm) and *N. wygaschii* Lange-Bertalot (2001: 81) (16–18 in 10 µm). It also has a lower areolae density than *N. cryptotenella* (38 in 10 µm), *N. wygaschii* (36–38 in 10 µm), and *N. mediocostata* Reichardt (1988: 241) (35 in 10 µm).

Distribution and Ecology:—*Navicula supleeorum* is known only from the type locality. It probably has

been mistaken for and lumped with *N. cryptotenella* in biological surveys. On the date the type sample was collected, pH in Rock Creek measured 8.30 and specific conductance measured 1402 $\mu\text{S}/\text{cm}$.



FIGURES 69–84: *Navicula supleorum*, *Navicula trilatera*. Figs 69–75: *Navicula supleorum* from Rock Creek, Valley County, Montana (type locality). Fig. 72: Holotype specimen. Figs 76–84: *Navicula trilatera* from Blakiston Beaver Pond A, Waterton Lakes National Park, Alberta (type locality). Figs 76–82: LM images. Fig. 78: Holotype specimen. Figs 83, 84: SEM images. Fig. 83: External valve view showing lineate striae and distal raphe ends hooked toward the same (secondary) side of the valve. Fig. 84: Internal valve view showing thickened raphe sternum and distal raphe ends terminating in helictoglossae. Scale bars: Figs 69–82: 10 μm ; Figs 83, 84: 5 μm .

***Navicula trilatera* Bahls, sp. nov. (Figs 76–84)**

Valves linear-lanceolate with subrostrate apices. Valve length 17.6–26.3 μm ; valve width 4.5–5.5 μm . Axial area very narrow, widens into a moderately large but irregular central area. Raphe filiform with weakly expanded and widely spaced proximal ends. Terminal raphe fissures shaped like question marks. Striae radiate near the valve center, convergent toward the apices, 15–17 in 10 μm . Striae in the central area irregularly shortened or missing. Areolae about 40 in 10 μm .

Holotype:—CANADA, Alberta: Waterton Lakes National Park, Blakiston Beaver Pond A, 49.0928° N, 113.8864° W, elev. 1340 m, coll. B. Johnston, 2 June 2009. MDC sample 453301; holotype slide MDC 123-91 (Figs 76–84) (circled holotype specimen in Fig. 78). MONTU!

Isotypes:—MDC slide 40-16 (MONTU!); ANSP GC65091.

Paratypes:—USA, Montana: Stillwater County, Horseman Flat Lake, 45.4165° N, 109.8716° W, elev. 1646 m, coll. C. Levine, 14 September 1993. MDC sample 132901; MDC slide P3-12-19. MONTU!—USA, Montana: Flathead County, Glacier National Park, Camas Creek, 48.6233° N, 114.0264° W, elev. 1146 m, coll. Montana DEQ, 26 September 2006. MDC sample 404201; MDC slides 32-51, 116-50. MONTU!—CANADA, Alberta: Waterton Lakes National Park, Sofa Wetland A, 49.0656° N, 113.7450° W, elev. 1524 m, coll. B. Johnston, 5 June 2009. MDC sample 454001; MDC slides 40-23, 123-98. MONTU!—CANADA, Alberta: Waterton Lakes National Park, Sofa Mountain Ponds, 49.0333° N, 113.7536° W, elev. 2134 m, coll. B. Johnston, 27 July 2009. MDC sample 457001; MDC slides 40-53, 124-28. MONTU!

Etymology:—This species is named for its geographical distribution in headwaters on all three sides of the Continental Divide in the northern Rocky Mountains.

Observations:—Lineate striae and distal raphe fissures hooked to the same (secondary) side of the valve are evident externally under SEM (Fig. 83). Internally, a thickened raphe sternum is present along with distal raphe ends that terminate in helictoglossae (Fig. 84). *Navicula veneta* Kützinger (1844: 95) has wedge-shaped apices and a smaller central area. Unlike *N. trilatera*, *N. veneta* is typically found in waters with elevated nutrients and dissolved solids. *Navicula trilatera* may be distinguished from *N. longicephala* Hustedt (1944: 277), *N. tenelloides* Hustedt (1937: 269), and *N. vilaplanii* Lange-Bertalot & Sabater in Rumrich et al. (2000: 173) by the shape and larger size of its central area. *Navicula trilatera* has the largest central area of all these *Navicula* species.

Distribution and Ecology:—In addition to the type locality, *Navicula trilatera* has been collected from two other wetlands in Waterton Lakes National Park, from Camas Creek on the west side of Glacier National Park, and from Horseman Flat Lake in the Beartooth Mountains of southern Montana (paratypes). These waters drain three sides of the Continental Divide: north to the Saskatchewan River, west to the Columbia River, and east to the Missouri River, respectively. *Navicula trilatera* prefers cool waters at higher elevations with somewhat alkaline pH and low conductivity.

Family **Stauroneidaceae** D.G. Mann in Round et al. 1990: 662

Genus **Stauroneis** C.G. Ehrenberg 1843: 45

Stauroneis boyntoniae Bahls, *sp. nov.* (Figs 85–89)

Valves broadly lanceolate with narrow subrostrate to apiculate apices. Valve length 31–52 µm; valve width 7.6–10.6 µm. Axial area narrow. Stauros narrow but wider than the axial area, rectangular. Raphe lateral with straight, weakly expanded proximal ends. Striae weakly radiate near the valve center, more strongly radiate toward the apices, 28–32 in 10 µm. Areolae transapically oblong and irregularly spaced, 24–30 in 10 µm.

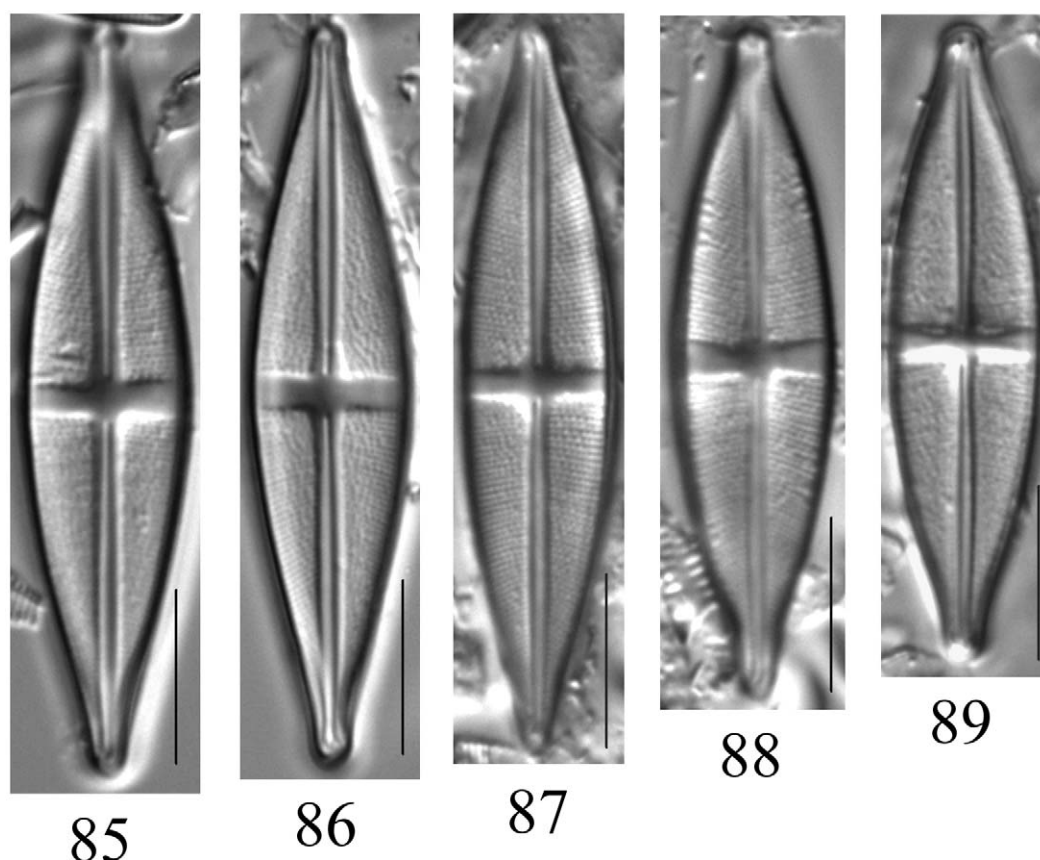
Holotype:—USA, Wyoming: Sublette County, Lower Twin Lake, 43.1242° N, 109.7328° W, elev. 3154 m, coll. B. Boynton, 26 August 2012. MDC sample 496801; holotype slide MDC 41-65 (Figs 85–89) (circled holotype specimen in Fig. 86). MONTU!

Isotypes:—MDC slide 126-59 (MONTU!); circled specimens on ANSP! GC65167.

Etymology:—This species is named after Beverly Boynton, a volunteer with Adventurers and Scientists for Conservation and collector of the holotype sample.

Observations:—*Stauroneis boyntoniae* belongs to the group of *Stauroneis* species with small to medium valves, fine striae, and transapically oblong and irregularly spaced areolae (Bahls 2010). *Stauroneis neohyalina* Lange-Bertalot & Krammer in Lange-Bertalot & Metzeltin (1996: 104) has narrower valves (6–9 µm) and higher stria density (32–40 in 10 µm). *Stauroneis siberica* (Grunow) Lange-Bertalot & Krammer in Lange-Bertalot & Metzeltin (1996: 104) has more elliptic and larger valves (54–68 µm long by 12–16 µm wide) with more abruptly protracted apices.

Distribution and Ecology:—*Stauroneis boyntoniae* is known only from the type locality, a lake high in the Wind River Range of Wyoming. Environmental data are not available for this lake, but it is presumed to have low concentrations of nutrients and dissolved solids.



FIGURES 85–89: *Stauroneis boyntoniae* from Lower Twin Lake, Sublette County, Wyoming (type locality). Fig. 86: Holotype specimen. Scale bars: 10 μ m.

Genus *Craticula* A. Grunow 1867: 20

Craticula johnstoniae Bahls, *sp. nov.* (Figs 90–95)

Valves lanceolate with rostrate to subcapitate apices. Valve length 78–105 μ m; valve width 18.0–19.3 μ m. Axial area narrow, flaring somewhat to merge with an elliptic and slightly wider central area. Raphe filiform and somewhat sinuous with inflated and relatively distant proximal ends that are bent to the same side. Striae parallel in the middle, becoming weakly radiate and then convergent near the apices, 14 in 10 μ m at valve center, 17 in 10 μ m at the apices. One or more striae in the central area slightly shorter than adjacent striae. Areolae 28 in 10 μ m. “*Heribaudii*” valves present with more strongly radiate striae and lower stria density; craticula valves not observed.

Holotype:—CANADA, Alberta: Waterton Lakes National Park, Akamina Pools, 49.0314° N, 114.0428° W, elev. 1646 m, coll. B. Johnston, 7 July 2009. MDC sample 456101; holotype slide MDC 124-19 (Figs 90–93) (circled holotype specimen in Fig. 90). MONTU!

Isotypes:—MDC slide 40-44 (MONTU!); ANSP GC65109.

Paratypes:—CANADA, Alberta: Waterton Lakes National Park, Indian Springs Pond, 49.1297° N, 113.8731° W, elev. 1372 m, coll. B. Johnston, 5 June 2009. MDC sample 454301; MDC slides 40-26, 124-1 (Fig. 95). MONTU!—USA, Montana: Jefferson County, Pond near Park Lake, 46.4417° N, 112.1731° W, elev. 2,000 m, coll. L. Bahls, 30 May 2012. MDC sample 492101; MDC slides 41-17 (Fig. 94), 126-11. MONTU!

Etymology:—This species is named for Barb Johnston, the Parks Canada biologist who collected the holotype sample and one of the paratype samples.

Observations:—“Heribaudii” valves (Fig. 91) have more strongly radiate striae and lower stria density. The rostrate to subcapitate apices of *C. johnstoniae* distinguish this taxon from *C. acidoclinata* Lange-Bertalot & Metzeltin (1996: 41), in which the apices are never or only slightly protracted. *Craticula cuspidata* (Kützing) D.G. Mann in Round et al. (1990: 666) has rhombic-lanceolate valves with very narrow apices and a central area with concave sides. *Craticula sardiniana* sp. nov. (this paper, Figs 96–101) has wider, unprotracted apices.

Distribution and Ecology:—*Craticula johnstoniae* evidently tolerates a wide range of water quality conditions. One habitat, a pond in Jefferson County, Montana is circumneutral (pH 6.98) with low specific conductance (46 $\mu\text{S}/\text{cm}$). Another, Indian Springs Pond in Waterton Lakes National Park, is alkaline (pH 8.1) with moderate specific conductance (313 $\mu\text{S}/\text{cm}$). At these locations *Craticula johnstoniae* was found in association with *C. acidoclinata*, *C. cuspidata*, and *C. sardiniana*.

Craticula sardiniana Bahls, sp. nov. (Figs 96–101)

Synonym:—“*Craticula silviae*” nov. spec. prov. Lange-Bertalot (2001: 412)

Reported as:—(?) *Craticula acidoclinata* Lange-Bertalot et al. (2003: 176).

Valves lanceolate with broadly rounded, unprotracted apices. Valve length 68–113 μm ; valve width 15.6–19.5 μm . Axial area linear and narrow. Central area elliptic with convex sides, about two times wider than axial area. Raphe weakly lateral with straight and slightly inflated proximal ends. Striae parallel in the middle, becoming weakly radiate, then convergent near the apices, 14 in 10 μm at the valve center to 18 in 10 μm near the apices. Areolae 26 in 10 μm . *Craticula* valves observed; “Heribaudii” valves not observed.

Holotype:—CANADA, Alberta: Waterton Lakes National Park, Indian Springs Pond, 49.1297° N, 113.8731° W, elev. 1372 m, coll. B. Johnston, 5 June 2009. MDC sample 454301; holotype slide MDC 124-1 (Figs 96, 98) (circled holotype specimen in Fig. 96). MONTU!

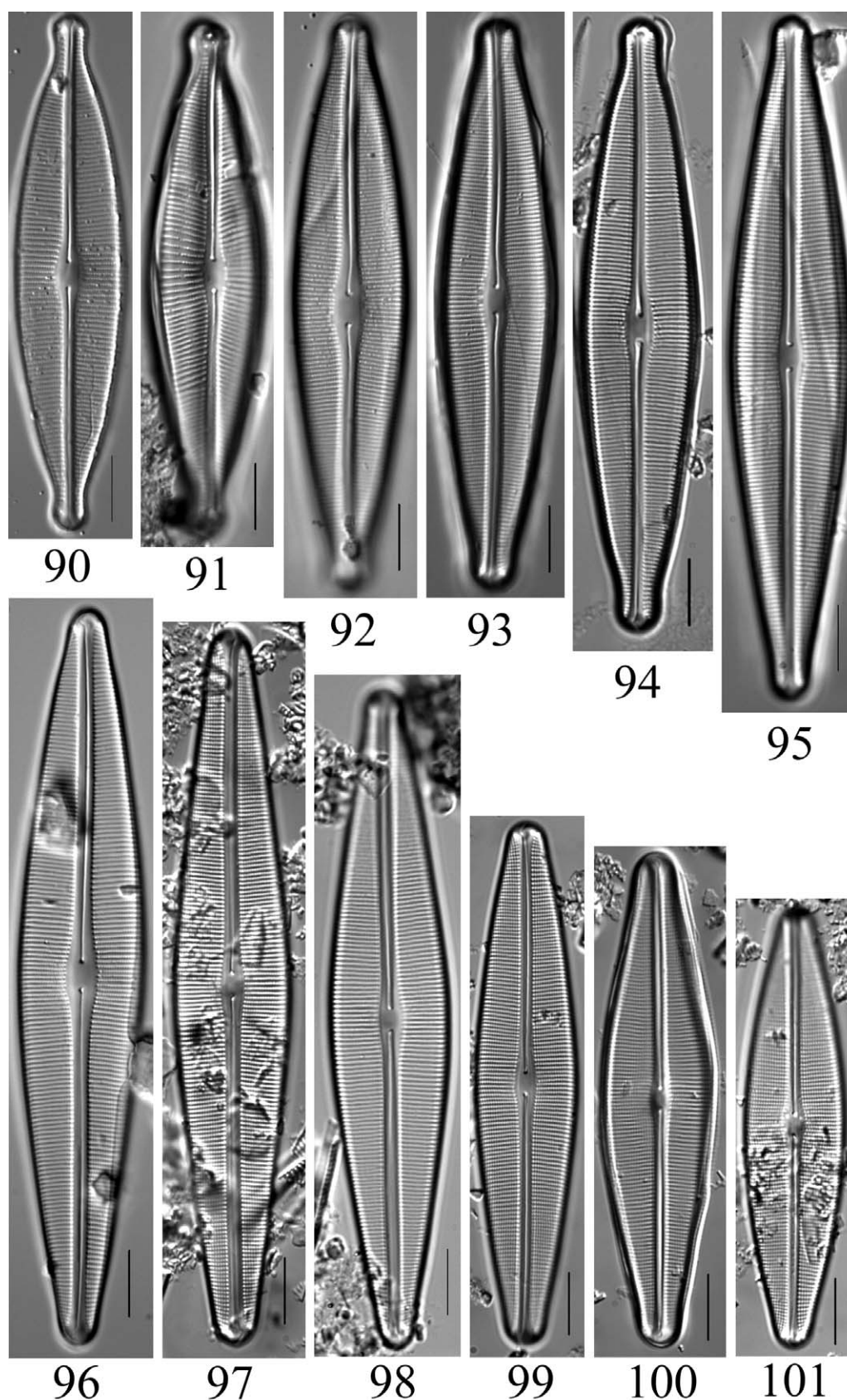
Isotypes:—MDC slide 40-26 (MONTU!); ANSP GC65100.

Paratypes:—USA, Montana: Beaverhead County, Skinner Pond No. 1, 45.1728° N, 113.5136° W, elev. 2252 m, coll. L. Bahls, 11 July 2010. MDC sample 460301; MDC slides 37-22, 124-54 (Figs 97, 99–101). MONTU!

Etymology:—This taxon is named after the island of Sardinia, where it was first reported.

Observations:—*Craticula acidoclinata* (Lange-Bertalot & Metzeltin 1996: 41) has wider valves (16–24 μm) with narrower, weakly protracted apices. *Craticula cuspidata* has rhombic-lanceolate valves, much narrower apices, and a central area with concave sides. *Craticula johnstoniae* sp. nov. (Figs 90–95) has rostrate to subcapitate apices.

Distribution and Ecology:—*Craticula sardiniana* has been collected from two ponds in the northern Rocky Mountains where pH ranges from 7.8 to 8.1 and specific conductance from 302 to 313 $\mu\text{S}/\text{cm}$. Its preference for alkaline waters with higher electrolyte content sets this taxon apart from *Craticula acidoclinata*, which prefers acidic or circumneutral waters with very low concentrations of dissolved solids. In Sardinia, *C. sardiniana* was collected from rock pools rich in electrolytes (Lange-Bertalot et al. 2003).



FIGURES 90–101: *Craticula johnstoniae*, *Craticula sardiniana*. Figs 90–95: *Craticula johnstoniae*. Figs 90–93: Akamina Pools, Waterton Lakes National Park, Alberta (type locality). Fig. 90: Holotype specimen. Fig. 91: “Heribaudii” valve. Fig. 94: Pond near Park Lake, Jefferson County, Montana. Fig. 95: Indian Springs Pond, Waterton Lakes National Park, Alberta. Figs 96–101: *Craticula sardiniana*. Figs 96, 98: Indian Springs Pond, Waterton Lakes National Park, Alberta (type locality). Fig. 96: Holotype specimen. Figs 97, 99–101: Skinner Pond No. 1, Beaverhead County, Montana. Scale bars: 10 μ m.

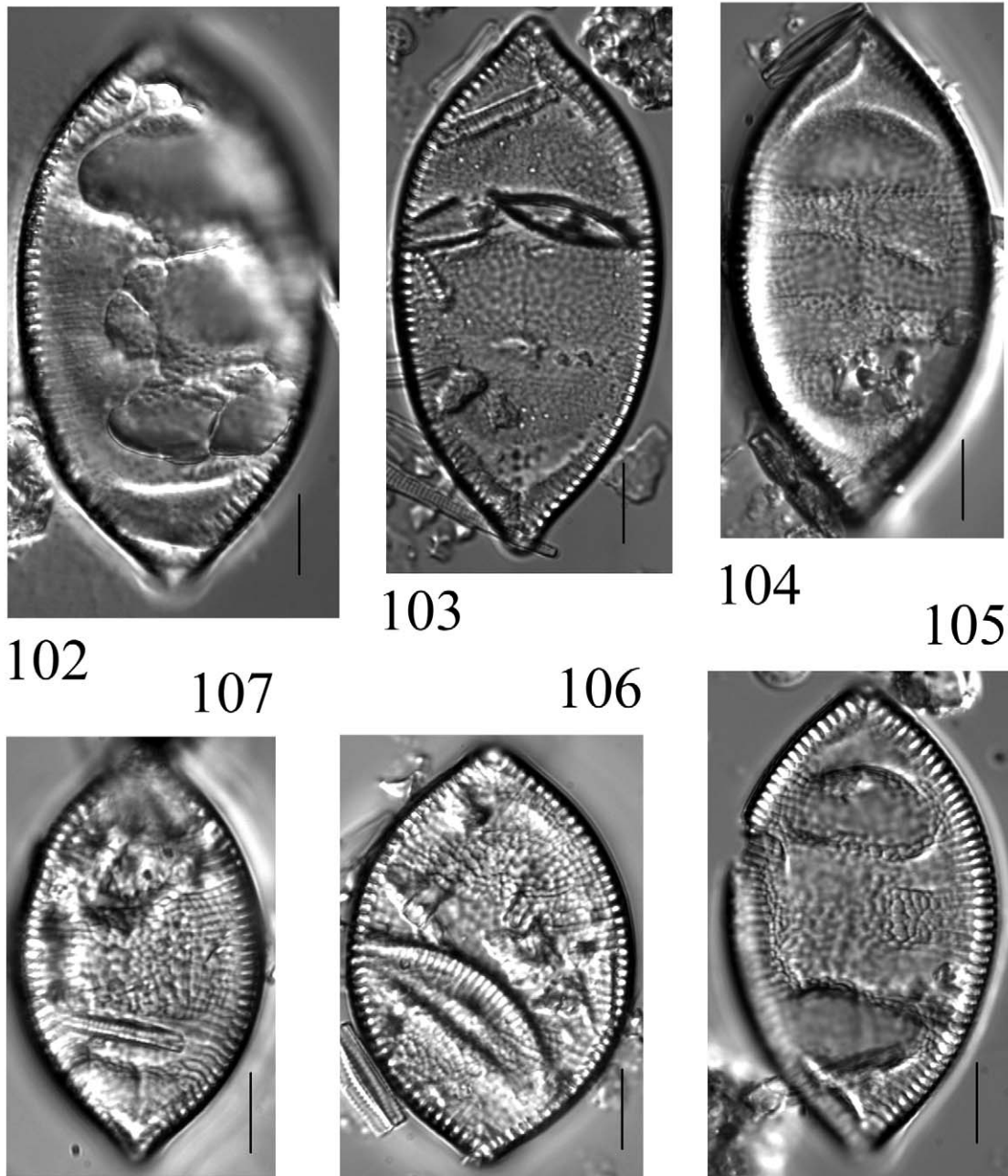
Order **Surirellales** D.G. Mann in Round et al. 1990: 656

Family **Surirellaceae** Kützing 1844: 58

Genus ***Cymatopleura*** W. Smith 1851: 12

Cymatopleura internationale Bahls, *sp. nov.* (Figs 102–107)

Valves elliptic with short apiculate apices. Valve length 54–72 μm ; valve width 31–39 μm . One to 3 (typically 2) undulations evident across the valve face. Marginal ribs regularly spaced, 8–9 in 10 μm . Striae very irregular, often disorganized, 8–18 in 10 μm . Areolae of variable size and shape, 10–15 in 10 μm .



FIGURES 102–107: *Cymatopleura internationale* from Waterton Lake at Goat Haunt, Glacier National Park, Montana (type locality).
Fig. 104: Holotype specimen. Scale bars: 10 μm .

Holotype:—USA, Montana: Glacier National Park, Waterton Lake at Goat Haunt, 48.9583° N, 113.8908° W, elev. 1279 m, coll. L. Bahls, 22 July 2009. MDC sample 451901; holotype slide MDC 123-58 (Figs 102–107) (circled holotype specimen in Fig. 104). MONTU!

Isotypes:—MDC slide 39-87 (MONTU!); ANSP GC65119.

Etymology:—This species is named for the Waterton/Glacier International Peace Park.

Observations:—Valves of *Cymatopleura solea* (Brébisson) W. Smith (1851: 12) are constricted in the middle. Valves of *C. elliptica* (Brébisson) W. Smith (1851: 13) are larger with fewer marginal ribs in 10 µm.

Distribution and Ecology:—*Cymatopleura internationale* is known only from the type locality. On the date this sample was collected, pH was 8.53 and specific conductance measured 133 µS/cm.

Discussion

Lange-Bertalot (1996) noted that Germany shares a large number of diatom taxa with temperate and subarctic regions of Europe, Asia, and North America. Lange-Bertalot & Genkal (1999) refer to this common floristic element as representing the Holarctic Kingdom of plants (Good 1974, Takhtajan 1986). Based on a checklist of 1,348 taxa in the MDC (Bahls 2009), the Northwest United States shares about 70% of its diatom flora with Germany, mainly cosmopolitan and Holarctic species (Bahls 2011). The remaining Northwest taxa—30% of the known flora—are either endemics or taxa with counterparts in other regions, e.g., northeastern Asia (Bahls 2011). The Northwest checklist does not include 351 taxa in the MDC database (20% of the total flora) that could not be identified by qualified analysts using available floras and monographs. Many of these taxa are presumed to be new to science and endemic to the region.

Bahls (2011) enumerated 80 species and varieties of endemic diatoms that define the Northwest United States as a distinct phytogeographic region. Subsequently, Bahls (2012b, 2012c, 2012d) described seven additional endemic species from the region. In the current study, 13 of the 17 taxa appear to be either local or Northwest regional endemics. Three taxa—*Neidium bobmarshallensis*, *Neidium undulatum* and *Craticula sardiniana*—have been reported from Europe or central Asia and appear to be members of the greater Holarctic diatom flora. The final taxon—*Staurophora soodensis*—has been reported from South Africa and therefore has a more widespread distribution.

Staurophora columbiana and *Staurophora soodensis* are found in warm, shallow, eutrophic to hypereutrophic, saline to hypersaline lakes at lower elevations. But most of the taxa treated here occupy habitats at the other end of the water quality spectrum: cold, circumneutral, oligotrophic to dystrophic waters with very low concentrations of dissolved solids in the mountains. A few of the taxa reported here occupy habitats with intermediate or unknown water quality conditions.

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