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Some new and interesting desmids (Streptophyta, Desmidiales) from the northern USA

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Abstract
The lakes, ponds, and wetlands in the northern Washington state (USA) and southwestern British Columbia (Canada) contain a diverse, yet under-studied desmid flora. Samples collected from six sites revealed three taxa that are newly described: *Cosmarium methowense*, *Planotaenium tortitaenioides,* and *Pleurotaenium subnodulosum*.

keywords: algae, desmids, taxonomy, new taxa, *Cosmarium*, *Planotaenium, Pleurotaenium*, Cascades, Mt. Baker, Methow.

Introduction

The lakes and ponds in the northwestern region of the USA are influenced by the Cascades Range, which extends north to south for 1100 km from British Columbia (Canada) to Northern California (USA). The Cascades include numerous active volcanoes that are part of the Ring of Fire, a chain of volcanoes extending from the southern tip of South America, along the western portion of North America, across the Pacific Ocean, then south to New Zealand. The prevailing westerly winds pushes moist air in from the Pacific, which subsequently falls as rain or snow along the western slopes of the Cascades, forming a rain shadow along the eastern slopes. Many of the lakes, ponds, and wetlands along the western slopes of the Cascades have watersheds dominated by moisture-loving vegetation, including western hemlock, western red cedar, and douglas fir in the uplands, with ferns, mosses, sedges, heather, blueberries, and other acid-loving shrubs and herbaceous vegetation forming the understory. The eastern side of the Cascades is characterized by a much drier climate, especially during the summer. The upland forest is typically a diverse mixed conifer and deciduous forest, with grasses, sagebrush, and xeric vegetation becoming increasingly dominant at lower elevations.

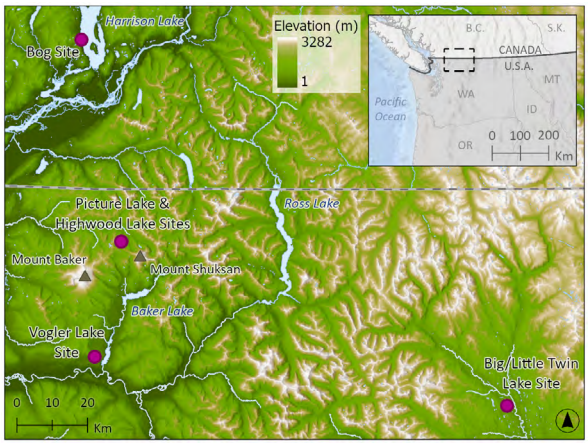

Figure 1. Map of study sites in Washington (USA) and British Columbia (Canada) showing major geological features and aerial imagery of site locations; figure provided by N. Furness, CENV Spatial Institute, Western Washington University, College of the Environment; data sources: USGS 1 arc second elevation rasters (2024).

We collected algal samples from five sites in northern Washington: Picture and Highwood Lakes in the Mt. Baker area; Vogler Lake in Skagit County; Big and Little Twin Lakes in Okanagan County (fig. 1). We also collected samples from a small boggy wetland along Morris Valley Road near Lake Harrison in southwestern British Columbia (fig. 1).

Highwood and Picture Lakes are small, high elevation lakes (surface area <1.5 ha; elevation >1250 m; Wong, et al., 2016) located above the tree line in the Mt. Baker Recreational Area (fig. 2a-b). These lakes are located in a popular ski area that is accessible most of the year, but the lakes are covered with ice and snow for about 8–9 months each year. These two lakes were formed by melting blocks of glacial ice (kettles), and although they are in close proximity to each other, there is no

Figure 2a,b. Site photos for Picture Lake (A), Highwood Lake (B). Photo credits: 2a © T. Craig, IWS-WWU, 2b © N. Boyé, IWS-WWU.

indication that they are hydrologically connected (Wong, et al., 2016). Summer water quality data from 2006–2024 collected by the Institute for Watershed Studies (IWS) at Western Washington University, Bellingham, Washington (USA) indicate that these lakes are poorly buffered (alkalinity <10 mg/L as $CaCO_3$), with low conductivities (<100 µS), and near neutral or slightly acidic pH values (6.2–7.6).

Vogler Lake is a medium sized, low-elevation lake near the historic town of Concrete, Washington (fig. 2c; surface area 5.9 ha; elevation 325 m; WDFW, 2025). This popular fishing lake is surrounded by dense coniferous forests and is ice-free most of the year. Despite being at a much lower elevation, IWS summer water quality data from 2009–2024 indicates that Vogler Lake also has very low alkalinities and conductivities (≤10 mg/L as $CaCO_3$ and ≤15 µS, respectively), with near neutral or slightly acidic pH values (6.0–7.2).

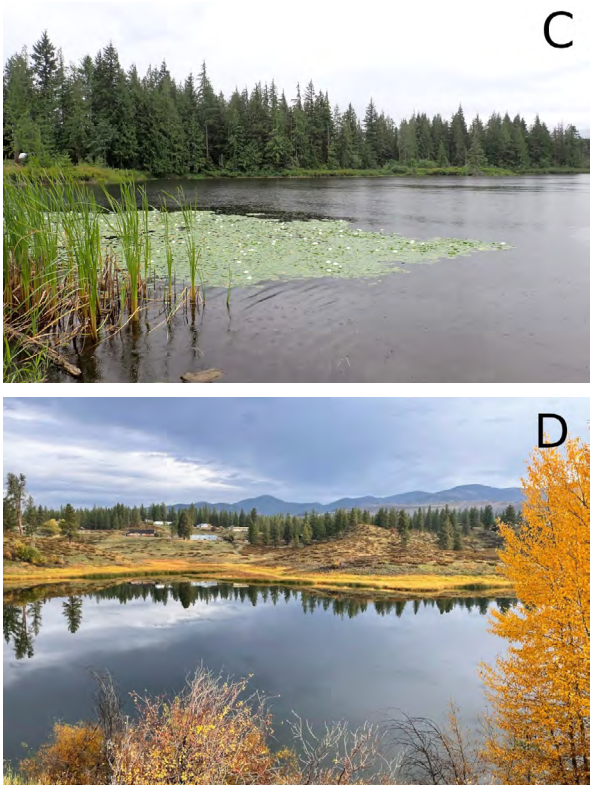

Figure 2c, d. Site photos for Vogler Lake (C), and Little Twin Lake (D). Photo credits: 2c © I. Schaefer Lorenz, IWS-WWU; 2d © Lidija Kamansky, Winthrop, Washington; all photos used with permission.

The Twin Lakes are small kettle lakes in the Methow River watershed on the eastern side of the Cascades at 550 m elevation (fig. 2d; WDFW, 2025). These lakes are in very close proximity to each other, but neither lake has inlet or outlet streams that would contribute to hydrologic connectivity. Big Twin Lake is the larger of the lakes (Big Twin = 26.5 ha; Little Twin = 7.7 ha). Big Twin Lake was determined to be mesotrophic in 1994 (Smith & Rector, 1997), with conductivities of 254–314 µS, pH levels of 7.7–9.0, and anaerobic conditions in the hypolimnion. Water quality data were not available for Little Twin Lake, but algae samples from these two sites consistently revealed greater desmid diversity in Little Twin Lake (Matthews, unpublished data).

The unnamed boggy wetland is located at 90 m elevation and is adjacent to Morrison Valley Road at 21.5 km from the intersection with BC West 7 in British Columbia. The wetland has a total surface area of approximately 2.3 ha, which includes a small (0.75 ha), unnamed lake. The wetland is only 0.2 km from the shoreline of Lake Harrison, and is surrounded by dense coniferous forest (or recently logged forest). No water quality data are available for this site, but sundews (*Drosera* sp.) were observed on partly submerged logs and are reported to be common in this region (Klinkenberg, 2025). The presence of these insectivorous macrophytes suggests that the water is low in dissolved inorganic nitrogen and probably slightly acidic. One interesting feature of this area is that the site is only 8 km from the Morris Valley wetland, which contains one of the few remaining populations of the endangered Oregon spotted frog (Feischl, 2018).

Materials and Methods

Algae samples were collected during the summer from 2009–2024 at Picture, Highwood, and Vogler Lakes as part of the IWS lake monitoring program (https://diatom.cenv.wwu.edu/?page=lakeslist). Twin Lakes summer algae samples were collected approximately every other year from 2014–2024. The British Columbia wetland samples were collected 20 June and 16 July, 2019. Where feasible, the algae were collected by towing a 20-µm mesh plankton net through open water and near-shore vegetation at an angle from slightly above the sediments to 0.3 meters below the surface. Additional material was collected from submerged vegetation, rocks, woody debris, and the sediment surface. The algae samples were placed in 250-mL wide-mouth polycarbonate jars, leaving 5–10 cm of air space, and kept cool and out of direct sunlight until the samples could be processed in the laboratory. Live algae were examined as quickly as possible, usually within 48 hours of collection. Aliquots from all samples were preserved in 4% buffered formalin or 1–2% buffered glutaraldehyde.

The live and formalin-preserved algae were examined using a Nikon 80i microscope equipped with brightfield, phase contrast, and differential interference contrast (DIC). Digital images were collected using Nikon DS-Fi2, AmScope MU1403, or Excelis 4K UHD microscopy cameras, with cell measurements and scale annotations added using custom scripts and the Gnu Image Manipulation Program (GIMP 2.10–30). When possible, cell measurements were based on at least 8–10 cells, with measurement accuracy verified using a stage micrometer. The glutaraldehyde-preserved algae were used to create digital SEM images following protocols developed by IWS.

Taxonomic Account

***Pleurotaenium subnodulosum* Coesel et Matthews spec.nov. (figs. 3–5)**

Description: Cells elongate cylindric, only near the ends slightly tapering toward the apices. Semicells with a prominent basal inflation, a deep constriction immediately above it and a variable number of large, lateral undulations gradually weakening towards the apices. Apices truncately rounded and smooth-walled. Cell length 716–985 µm, breadth 58.0–67.7 µm, L/Br 11.7–15.8.

Type: Nearshore sample from Highwood Lake (GPS 48.8646, -121.6752), preserved as a fixed natural sample in 4% buffered formalin, collected by R. Matthews, 14 August 2024, archived at the United States Algal Collection (Accession No. 241239), Smithsonian Institution, Washington, D.C. (USA), partly illustrated in fig. 3.

Discussion: Our newly described *Pleurotaenium subnodulosum* should be compared to *Pleurotaenium nodulosum* (Ralfs) De Bary in Irénée-Marie (1938: 93, pl. 10: 1–2) discussed and depicted there under the name of *Pl. nodulosum* Brébisson. Both Irénée's description and pictures fully correspond to our figures; however, in the original diagnosis of *Pleurotaenium nodulosum* (as *Docidium nodulosum* Bréb.) in Ralfs (1848: 155, pl. 26: 1a,b) cell dimensions are 580 x 65 µm, resulting in a length to breadth ratio of about 9, which is much lower than that in our alga. Indeed, Ralf's pictures show distinctly plumper cells than those of our newly described taxon. Moreover, semicells in Ralfs' pictures slightly attenuate from base to apex and show only a small number of weak undulations in their basal part. Unfortunately, in desmid literature Ralf's concept of *Pleurotaenium nodulosum* is used widely, resulting in quite different morphotypes that can be seen when comparing the manuals of Růžička (1977: 279, pl. 42: 1–6), Prescott et al. (1975: 126, pl. 47, 8–11) and Coesel & Meesters (2023: 80, pl. 41: 3–4). Whereas Prescott et al. (l.c.) take over the above-mentioned pictures by Irénée-Marie and show some comparable morphotypes, the concept of *Pleurotaenium nodulosum* in Coesel & Meesters (l.c.) approaches that by Ralfs. In conclusion, we consider it advisable and justified to describe our alga under discussion as a new, separate species.

Our *Pleurotaenium subnodulosum* might be confused with *Pl. repandum* (Wolle) Krieger. Cells of that latter species, however, are less wide and much more slender than those of *Pl. subnodulosum*, compare Prescott et al. (1974: 129, pl. 41: 9–14).

Occurrence: *Pleurotaenium subnodulosum* appears to be widely distributed along the western side of the Cascades, having been collected from numerous sites in Whatcom, Snohomish, and Skagit Counties.

Figure 3. *Pleurotaenium subnodulosum* in frontal view; Highwood Lake. Photo © R. Matthews.

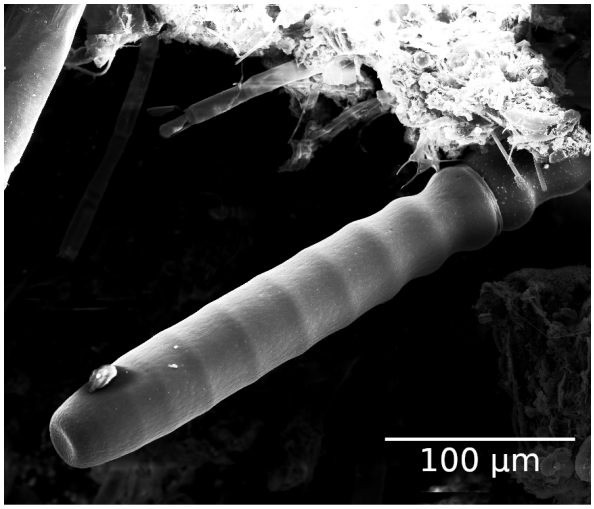

Figure 4. SEM photo of *Pleurotaenium subnodulosum* showing undulation series extending to near apex; Vogler Lake. Photo © R. Matthews.

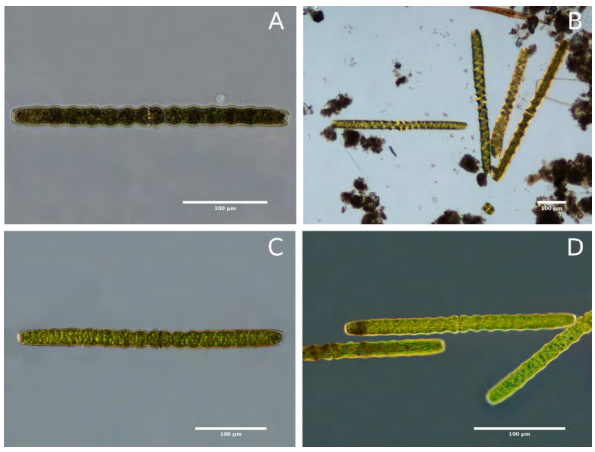

Figure 5. *Pleurotaenium subnodulosum* in frontal views from Picture Lake (A-B), Vogler Lake (C), and Highwood Lake (D). Photos © R. Matthews.

***Cosmarium methowense* Coesel et Matthews spec. nov. (figs. 6–8)**

Description: Cells slightly wider than long with a deep, acute-angled, open sinus. Semicells in frontal view flattened pyramidal with an undulate-dentate outline. Cell wall predominantly smooth in the central region, with the rest of the wall furnished with irregularly scattered small granules. Semicells in apical view elliptic with produced poles, and approximately spherical in lateral view. Cell length 24.9–28.0 µm, breadth 26.0–31.2 µm, thickness 13.1–14.5 µm, L/Br 0.8–1.0.

Type: Nearshore sample from Little Twin Lake (GPS 48.4490, -120.1911), preserved as a fixed natural sample in 4% buffered formalin, collected by R. Matthews, 28 July 2024, archived at the United States Algal Collection (Accession No. 241240), Smithsonian Institution, Washington, D.C. (USA), partly illustrated in fig. 6.

Discussion: Morphologically, *C. methowense* is a very characteristic species. Despite an extensive research of desmid literature we could not find any matching taxon. It is a little bit reminiscent of *C. vossenbergense* Coesel et Van Westen (2013: 49, figs. 11–12, 18) but both cell dimensions, outline, and ornamentation are distinctly different.

Occurrence: *Cosmarium methowense* may have a restricted range, having only been collected in Big and Little Twin Lakes in the Methow Valley near Winthrop, Washington.

Etymology: the species is named after original placename (mətxʷu) used by the Methow tribe, whose historic lands included the region where this desmid was collected. The Methow people are members of the Confederated Tribes of the Colville Reservation, which is the US branch of the Syilx Nation, which also includes the Syilx Okanagan Tribe in Canada (Terbasket, 2025).

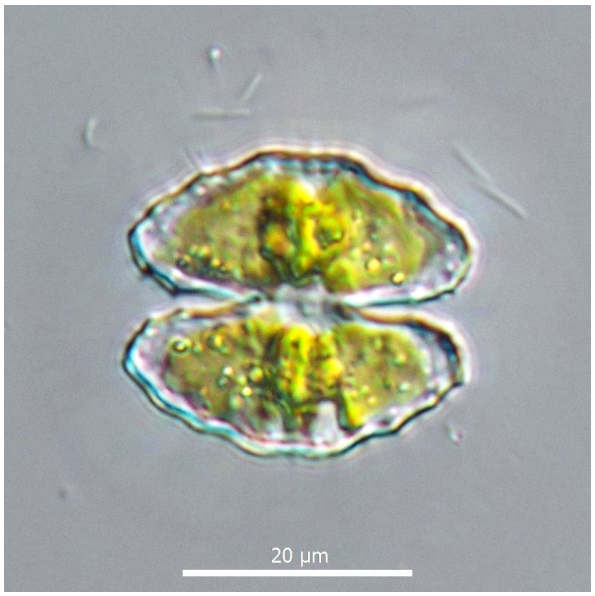

Figure 6. *Cosmarium methowense* in frontal view; Little Twin Lake. Photo © R. Matthews.

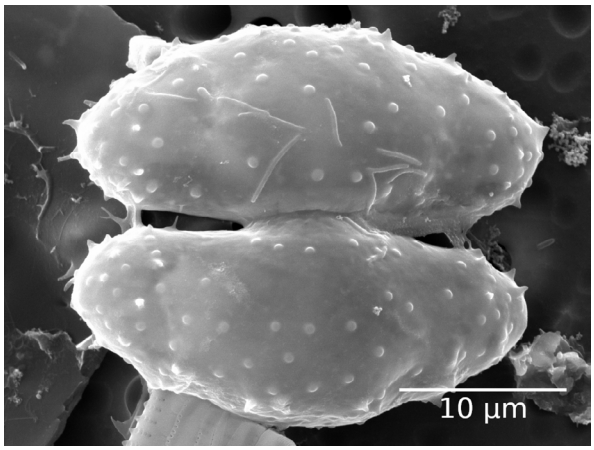

Figure 7. SEM photo of *Cosmarium methowense* in frontal view; Little Twin Lake. Photo © R. Matthews.

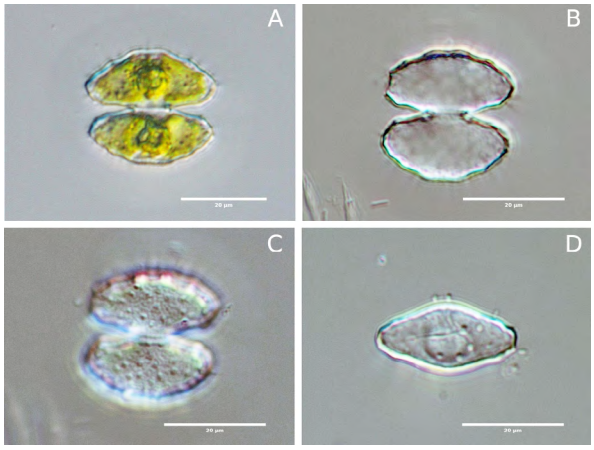

Figure 8. *Cosmarium methowense* in frontal view (A-B) including surface features (C), and in apical view (D); Little Twin Lake. Photos © R. Matthews.

***Planotaenium tortitaenioides* Coesel et Matthews spec. nov. (figs. 9–10)**

Description: Cells cylindrical, near the ends slightly attenuating to the broadly rounded poles, 3.2–3.3 times longer than broad with apical vacuoles containing a single, big granule. Chloroplasts two in each cell with some six longitudinal, more or less spiralized ridges and one central pyrenoid. Cell length 29.5–45.8 µm, breadth 11.5–12.5 µm, L/Br 2.9–4.0.

Type: Nearshore sample from unnamed wetland in British Columbia (GPS 49.3805, -121.8410), preserved as a fixed natural sample in 4% buffered formalin, collected by R. Matthews, 16 July 2019, archived at the United States Algal Collection (Accession No. 241241), Smithsonian Institution, Washington, D.C. (USA), partly illustrated in fig. 9.

Discussion: Initially, identification of the above described species made us evaluate representatives of the genera *Cylindrocystis* and *Netrium*. But the presence of distinct terminal vacuoles containing a single granule put us on the trail of the genus *Planotaenium*. Actually, in cell outline our *Planotaenium tortitaenioides* much resembles *Pl. ohtanii* as described from Germany by Gontcharov & Melkonian (2010: 350,

figs. 4c, d). However, *Pl. ohtanii* differs by larger cell dimensions (45.3–69.5 x 15.6–18.4 µm) and a larger number of straight chloroplast ridges (9–12). Interestingly, *Pl. ohtanii* was recorded from the Cascades Range in Washington too (Matthews, 2023: 610, figs. 14.13–14.14).

Occurrence: *Planotaenium tortitaenioides* was only collected in the unnamed wetland along Morris Valley Road in British Columbia; however, that area contains many similar boggy wetlands, so the distribution could easily extend to other sites in the region.

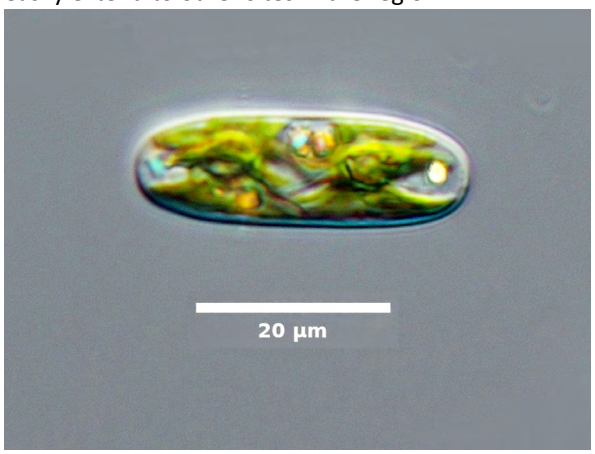

Figure 9. *Planotaenium tortitaenioides* in frontal view; unnamed wetland along Morris Valley Road. Photo © R. Matthews

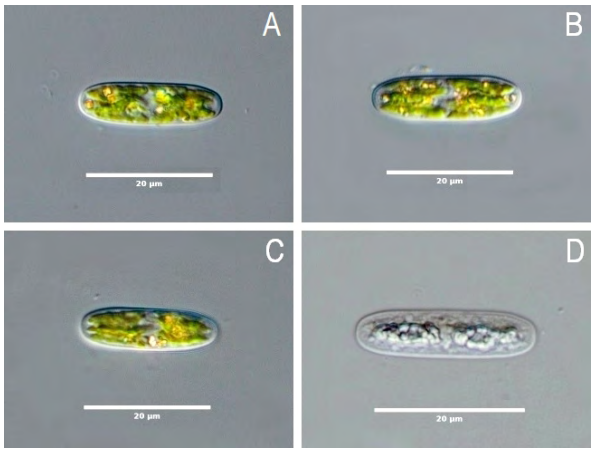

Figure 10. *Planotaenium tortitaenioides* in frontal view (A-D); unnamed wetland along Morris Valley Road; cell in image D preserved in 4% formalin. Photo © R. Matthews.

Acknowledgments

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