



## *Encyonema appalachianum* (Bacillariophyta, Cymbellaceae), a new species from Western Pennsylvania, USA

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### Abstract

A new species of *Encyonema* was found in several rivers and reservoirs in Western Pennsylvania, USA, in 2013. The new species, *E. appalachianum*, has only very slightly dorsiventral valves, which is one of the characters separating the genus *Encyonopsis* from *Encyonema*. On the other hand, the long, sharply bent terminal raphe fissures and lateral raphe indicate that it should be placed in *Encyonema*. Some valves with occasionally biseriate striae have been observed in the type population of the new species. The finding of this species that apparently combines features of both *Encyonema* and *Encyonopsis* highlights the problem of poorly defined boundaries between some genera of cymbelloid diatoms.

**Key words:** *Encyonema*, *Encyonopsis*, diatoms, rivers, reservoirs, Pennsylvania

### Introduction

In summer 2013 a survey of diatoms in State Parks of Southwestern Pennsylvania, was conducted. Water bodies of Southwestern Pennsylvania have been strongly affected in the past by the coal mining and logging, and currently the region experiences the impact of the oil and gas industry. The diatom flora of this region has never been studied in detail and the goal of our survey was to study the composition of diatom assemblages of currently protected areas and thus to provide baseline data for future environmental assessments. Although most diatoms found in Southwestern Pennsylvania were fairly common freshwater taxa, a new cymbelloid diatom species was discovered in several rivers and reservoirs. This diatom combines morphological characters of two genera, *Encyonema* Kützing (1833: 589) and *Encyonopsis* Krammer (1997a: 156). These two genera are characterized by the “cymbelloid” valve symmetry with primary dorsal side and terminal raphe fissures turned to ventral side. The main morphological difference between them as outlined by Krammer (1997b) is less pronounced asymmetry in valve outline in *Encyonopsis* and more complex raphe with comma-shape terminal raphe fissures in *Encyonema*. The aim of this paper is to formally describe the new taxon, describe its morphology, and discuss its generic placement and characters distinguishing it from similar species.

### Materials and methods

Materials used in this study were 20 benthic diatom samples collected from 12 water bodies in Southwestern Pennsylvania in May–September 2013 (Table 1) and the permanent slides made from these samples. Conductivity and pH were measured in the field using the Extech EC500 conductivity/pH meter. All materials are stored in the Diatom Herbarium at the Academy of Natural Sciences of Philadelphia (ANSP), Pennsylvania, USA. To digest organic matter, the samples were boiled with nitric acid and mounted with Zrax on permanent slides and air-dried on SEM stubs. The slides were examined using the Zeiss AXIO Imager A1 light microscope (LM) equipped with Nomarski differential interference contrast (DIC) optics and Zeiss AxioCam MRm. For scanning electron microscopy (SEM) samples were air-dried on aluminum stubs and examined with Zeiss Supra 50VP scanning electron microscope at 10 kV at Drexel University, Philadelphia, USA.

Tremarin *et al.* (2011) observed both uni- and biseriata striae in *E. exuberans* Tremarin *et al.* [2011: 109] and discussed variability of this character within *Encyonema* and other gomphocymbelloid diatoms. The occasionally biseriata striae have also been observed in *Encyonema cespitosum* by Krammer (1997a).

**TABLE 2.** Comparison of *Encyonema appalachianum* (this study) with similar *Encyonema* species (based on text and illustrations in Krammer 1997b).

| Character                   | <i>E. appalachianum</i> | <i>E. lacustre</i>                       | <i>E. rumrichae</i>                     | <i>E. aueri</i>                        |
|-----------------------------|-------------------------|--|---|--|
| Valve outline               | linear-lanceolate       | linear-lanceolate to elliptic            | lanceolate-elliptic                     | lanceolate-elliptic                    |
| Valve asymmetry             | weak                    | weak                                     | moderate                                | moderate                               |
| Valve width, $\mu\text{m}$  | 6–7                     | 8–12                                     | 6–7                                     | 7–8                                    |
| Valve length, $\mu\text{m}$ | 26–34                   | 28–65                                    | 23–38                                   | 28–47                                  |
| Axial area                  | narrow linear           | narrow linear                            | lanceolate                              | lanceolate                             |
| Central area                | ventrally expanded      | small round                              | small                                   | small                                  |
| Striae in 10 $\mu\text{m}$  | 9–10                    | 7–10                                     | 10–11                                   | 8–10                                   |
| Dorsal striae               | parallel                | radiate in center to convergent at poles | radiate                                 | radiate                                |
| Ventral striae              | parallel                | radiate in center to convergent at poles | parallel-radiate to convergent at poles | radiate in center to parallel at poles |
| Areolae in 10 $\mu\text{m}$ | ~26                     | 21–25                                    | 30–31                                   | 30–34                                  |

The structure of the silica flap internally covering the central nodule in *E. appalachianum* is apparently variable: in some specimens it seemed to be plain without any fissures, while in others there was a very small intermissio, which may be described as Type 3 sensu Krammer (1997a). No data are available at present on the within-species or within-population variability of this character in *Encyonema* taxa.

It is difficult to determine why *E. appalachianum* has never been detected before. One possibility is that this is an endemic of the Western Pennsylvania where thorough diatom surveys have not been conducted in the past. Another possibility is that this species is currently expanding its range and increasing abundance. Its presence in a variety of water bodies with a wide range of water chemistry may indicate that this species recently acquired some competitive advantage that allows its rapid expansion across habitats.

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