



Three new *Eunotia* (Bacillariophyta) species from Acadia National Park, Maine, USA

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Abstract

Three new species in the diatom genus *Eunotia* were found in the freshwater ponds and streams of Acadia National Park, Maine, USA. *Eunotia novaeangliae* sp. nov. belongs to the *E. incisa* group, species with nose-like apices and terminal raphe fissures distant from the ends. It is most similar to *E. tenelloides* in that species cluster, although differs in the valve shape, geographical distribution, several ultrastructural details and slight but consistent differences in valve dimensions and striae density. *Eunotia panda* sp. nov. is in the *E. bilunaris* group, species with slight even curvature and smooth margins of the valves. However, *E. panda* can be distinguished from *E. bilunaris* by dorsally slightly recurved apices with rounded ends, ultrastructural details and noticeably constant valve width. *Eunotia spatulata* sp. nov. is most similar to *E. eurycephala*, but differs from that taxon by having straighter and significantly larger valves with more swollen apices. All three taxa were sufficiently abundant in the samples collected from the park that they could be found in both SEM and LM microscopes. *Eunotia novaeangliae* and *E. panda* have both been illustrated in other publications before but not named. All three species occurred in waters of low conductivity and pH, typical for the genus. Acadia National Park appears to be a hotspot for *Eunotia* species diversity, and further study of the oligotrophic waters of this site is certainly warranted.

Key words: Acadia National Park, biodiversity, diatom, *Eunotia novaeangliae*, *Eunotia panda*, *Eunotia spatulata*, North America

Introduction

Eunotia Ehrenberg (1837: 44) is a large, commonly-occurring genus in the division Bacillariophyta. It was the 11th most species rich genus in VanLandingham (1967–79), but with the splitting of many of the large genera that followed the advent of widespread usage of the scanning electron microscope (e.g. *Navicula* Bory [1822b: 128], *Achnanthes* Bory [1822a: 79], *Cymbella* C. Agardh [1830: 1], *Amphora* Ehrenberg ex Kützing [1844: 107]) it is likely now the 4th most diverse (behind *Nitzschia* Hassall [1845: 435], *Pinnularia* Ehrenberg [1843: 45], and *Surirella* Turpin [1828: 363]) (Lange-Bertalot *et al.* 2011, Veselá *et al.* 2013). Unlike many diatom genera, *Eunotia* has remained intact as a single and perhaps monophyletic genus. Species delineation within *Eunotia* has long been difficult because of the inexact nature of the description of valve outline, the key morphological criterion used to identify species. With the advent of electron microscopy, new features are being observed, and combined with a change in species concepts, many new diatom species are starting to be recognized and described. In *Eunotia* nearly 100 species new to science were described within the last four years. Lange-Bertalot *et al.* (2011) described 54 new species of *Eunotia* from Europe; Furey *et al.* (2011) described 14 new species from the Great Smoky Mountains National Park, USA; six new *Eunotia* species were described from the Atlantic Coastal Plain, USA (Siver & Hamilton 2011); six new species were described from Macedonia (Pavlov & Levkov 2013); and 16 new species together with two new genera from Eunotiophycidae have been reported from Brazil within the last few years (e.g., Wetzel *et al.* 2010, Metzeltin & Tremarin 2011, Wetzel *et al.* 2011, Burliga & Kociolek 2012, Wetzel *et al.* 2012, Burliga *et al.* 2013, Canani & Torgan 2013, Fuhrmann *et al.* 2013).

Eunotia is widespread in the Holarctic Plant Realm (Lange-Bertalot *et al.* 2011). It most commonly occurs in nutrient-limited waters of low conductivity and low pH (Patrick & Reimer 1966). Lange-Bertalot *et al.* (2011) reported

groups has been falling, and will likely continue to fall as revision continues. At the same time, there has been an unprecedented number of new species within *Eunotia* recently described (e.g. Metzeltin & Lange-Bertalot 1998, 2007, Lange-Bertalot *et al.* 2011, see introduction). With these trends in place, it is likely that *Eunotia* will retain its position as the fourth most species-rich genus for the foreseeable future.

Usually only a few dozen species of *Eunotia* are present within European countries (Lange-Bertalot *et al.* 2011). Exceptions to this observation include Scandinavia, northwest Poland, the European part of Russia, and the Alps, each of which has 50 – 80 species. Mainland USA had 62 species at the time of Patrick & Reimer (1966), but indications of higher diversity (although mostly unnamed) was evident in the observation of 102 *Eunotia* species during the PIRLA project (Camburn *et al.* 1984–1986). The high arctic of North America has at least 70 species (Foged 1981, Antoniadis *et al.* 2008, Zimmermann *et al.* 2010). A total of 157 taxa have been reported for the European Holarctic (Lange-Bertalot *et al.* 2011), a region that includes all of Europe and arctic islands under European jurisdiction. Lange-Bertalot & Metzeltin (1996) found 70 *Eunotia* taxa in a single lake in Finnish Lapland, and 73 *Eunotia* species in a peat bog in Nova Scotia. With 80 taxa (half the number in the entirety of Europe) encountered in Acadia National Park, this relatively small park land is certainly a hotspot for *Eunotia* biodiversity. The high number of oligotrophic taxa indicates that measures to protect water quality in the park have been fairly effective. *Eunotia spatulata* has not been observed anywhere else, although now reported it is very possible that it will be found in other localities in New England and the Maritimes. Our impression is that, given the widespread occurrence of many species of *Eunotia* in both Europe and North America, geographical restrictions perceived now may disappear with more intensive study.

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