University of South Bohemia, České Budějovice
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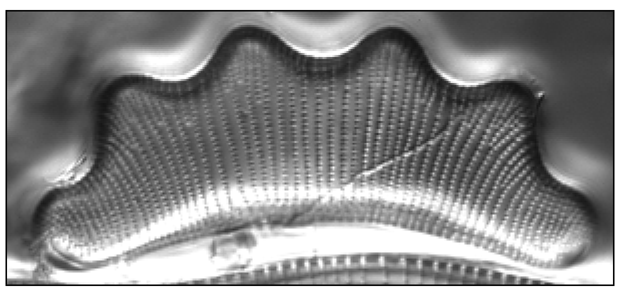
THE DIATOMS OF ACADIA NATIONAL PARK, MAINE, WITH A DETAILED ACCOUNT OF THE EUNOTIOPHYCIDAE



Master thesis
by

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2009

Veselá, J. (2009). The diatoms of Acadia National Park, Maine, with a detailed account of the Eunotiophycidae. M.S. thesis, in English. 165pp. Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic.

Annotation

Taxonomy of diatoms (Bacillariophyceae) was studied in 45 samples from Acadia National Park, Maine, U.S.A. Approximately 550 diatom taxa in 87 genera were observed in the samples from various habitats (i.e., lakes, streams, wetlands, wetwalls and brackish habitats). The most species rich group of diatoms, Eunotiophycidae, was studied in detail, resulting in a detailed documentation of 81 species and varieties with 18 probably new taxa.

Prohlašuji, že svoji magisterskou diplomovou práci jsem vypracovala samostatně pouze s použitím pramenů a literatury uvedených v seznamu citované literatury.

V Českých Budějovicích, dne 22. prosince 2009

……………………………….

ACKNOWLEDGMENTS

I would like to thank Dr. Jeff Johansen for giving me the opportunity to work on such a beautiful topic. I especially appreciate his patience and help during this work. Thanks also belong to Markéta and Honza for helping me with the sampling in Acadia National Park. I am very grateful for support and help from the Acadia National Park Service during the sample collection. I want to thank all the lab members, especially Melissa, for having fun during the long hours I spent there. Thanks to Marcie and Megan I was able to experience and enjoy more of Cleveland and the surrounding areas. My special thanks belong to my family and Honza for encouraging words, support and help till the very end.

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ABSTRACT

Acadia National Park (Acadia NP), Maine, is a small but heavily visited park composed of Mount Desert Island, Schoodic Peninsula, Isle au Haut and other islands. Due to its coastal location, varied geological history (volcanic activity, glaciation), humid climate and national park protective status, there is a high diversity of freshwater habitats present (large lakes, ponds, various wetlands, streams, wet-walls). Although this park was established 90 years ago and is located in New England, a region replete with universities, no studies have been conducted on freshwater algae (including diatoms) in the park. The focus of my study was a subset of the diatom flora, the Eunotiophycidae, a common and diverse group of diatoms present in clean and acidic waters. In this study, three major park areas were extensively sampled (Mount Desert Island, Schoodic Peninsula and Isle au Haut), resulting in 119 freshwater and brackish sample sites. Various water characteristics were measured (pH, temperature, conductivity and salinity). In this study a subset of 45 sites was studied in detail. Approximately 550 diatom taxa in 87 genera were found. The genus *Eunotia* was the most species rich genus in the Acadia NP samples. Seventy-seven species and varieties were observed within this genus with 17 possibly new taxa. Besides *Eunotia*, one species of *Actinella*, one species of *Semiorbis*, and two species of *Peronia* were found (one of them probably new to science). Altogether, 81 taxa within the Eunotiophycidae were found in Acadia NP. This richness is higher than that reported in any other recent publication, including a detailed study of genus *Eunotia* in the Great Smoky Mountains National Park.

1. INTRODUCTION

1.1 Acadia National Park

Acadia National Park (Acadia NP) is located on the Atlantic coast of Maine, U.S.A., and was established 90 years ago as the first national park east of the Mississippi (TREE & OXNARD 2003). It is composed of Mount Desert Island (MDI), Schoodic Peninsula, Isle au Haut, and several small islands nearby. Although it is the sixth smallest national park, it is one of the most popular in the U.S.A. with about 3 million visitors per year (compared to the 20 times larger Yosemite National Park with 3.5 million visitors annually) (EUGENE et al. 1994). Some people call this park "a land of contrast and diversity" due to its variety of habitats with diverse fauna and flora (Acadia NP Official website. Nature & Science 2008). Mountains as well as deep valleys, seashores with steep cliffs or sand beaches, numerous lakes and wetlands, barren mountain tops, meadows and deep forests all can be seen and enjoyed.

Acadia NP is somewhat unique among U.S. national parks in that its approximately 190 km^2 (47,000 acre) area is not all contiguous, but fragmented (KILLION & FOULDS 2007). Most of the national park area is located on Mount Desert Island ("island of barren mountains", MDI). It is the second largest island in New England (TREE & OXNARD 2003). It is bisected by Somes Sound, the only natural fjord (a bay originally carved by a glacier) on the Atlantic coast of North America. The elevation ranges from sea-level to the 467 m (1532 feet) high Cadillac Mountain, the highest point on the U.S. Atlantic coast (TREE & OXNARD 2003, KANDELL 2008). There are 26 mountains, 4 large lakes and countless ponds, streams and wetlands present on the island. Almost half of the island area (45%) is in Acadia NP ownership (STONE et al. 2001).

Schoodic Peninsula, situated east from MDI across Frenchman Bay, comprises the second largest part of the park. This area contains granite ledges and dramatic coastline (MITCHELL 2005). The remaining fragments of Acadia NP are on small offshore islands. The largest of them is a remote island, Isle au Haut ("high island"), in the Gulf of Maine.

The park is located at the transition of the temperate and boreal zone (KAHL et al. 2007), which is reflected in the local climate and vegetation. The climate is strongly oceanic and very humid. The area receives approximately 1,370 mm rain/year, and the precipitation is relatively evenly distributed among the seasons (KAHL et al. 2007). Clouds and fog cover are frequent. The local temperature is more moderate compared to that of inland Maine. The mean annual daytime and nighttime temperatures are 13˚C and 2˚C, respectively (Acadia NP Official website. Weather 2008). The wind blows mostly from the west to southwest direction (KAHL et al. 2007).

This area dates to approximately 500 million years before present (KARR 2005). A thick layer of sediment, accumulated on the bottom of an ancient sea, was transformed into bedrock by pressure and heat. The rock was liquified into magma due to volcanic activity in the Devonian (KAHL et al. 2007). The magma later hardened as a coarse-grained pink granite. Over time, erosion exposed the granite bedrock. About 18,000 years ago, distinctive U-shaped valleys and north-south oriented mountain ridges with rounded peaks were carved and shaped due to glacial activity (KARR 2005). When the ice sheet covering North America melted (about 10,000 years ago), the Atlantic Ocean level subsequently rose and gave MDI and other areas the shape we know today. In addition, many of the narrow valleys were filled with water, forming new lakes such as Jordan Pond and Eagle Lake. Today, granitic soils in the park are usually shallow and acidic

(KAHL et al. 2007), and there are vast areas of exposed bedrock with no developed soils present in the park.

The land, where Acadia NP is now situated, was abandoned for most of the time until the middle of the 19th century. Native Americans populated this land 6,000 years ago (TREE & OXNARD 2003). The country, however, remained unknown to the Europeans until the turn of 16th and 17th century, when several sailors were exploring the coast. The most famous is Samuel de Champlain who named Mount Desert Island and Isle au Haut (FAHEY 2005). In 1613 French Jesuits tried to establish a mission on MDI, but they were massacred by an English ship. This event resulted in the fact that this part of Maine remained a war zone between French and English for next 150 years. Soon after MDI was connected with the mainland by a bridge in 1836 (TREE & OXNARD 2003), landscape painters Thomas Cole and Frederick Church caused an early touristic boom in Acadia. The area also attracted the attention of several wealthy industrialists, such as the Rockefellers, Vanderbilts, Carnegies and Astors (KARR 2005, MITCHELL 2005). They built more than 200 of massive summer "cottages" in around Bar Harbor on MDI (TREE & OXNARD 2003). George Dorr and Harvard president Charles Eliot along with others (e.g., John D. Rockefeller, Jr.) started to acquire the public land beginning 1901 (KANDELL 2008). Eventually, this land was donated to the federal government to preserve it. John D. Rockefeller, Jr. alone donated 11,000 acres, which is about one third of the present park area (TREE & OXNARD 2003). In 1919, the donated land was declared Lafayette National Park (FAHEY 2005) and was renamed Acadia National Park in 1929 (KARR 2005).

Its position on the coast, isolation from the mainland, great diversity of habitats, and protection as a national park have all contributed to a rich fauna and flora.

There are more than 300 species of birds present in the park. One of them, the bald eagle, is listed as a threatened species. The park also has 37 species of terrestrial mammals, 7 species of reptiles, 11 species of amphibians, 28 species of fish and thousands of species of invertebrates (STONE et al. 2001, KILLION & FOULDS 2007). Migrating whales, dolphins and seabirds are also common in the area. There are 1135 vascular plant records for the park. Fourteen of them are listed as endangered or threatened species in Maine (KILLION & FOULDS 2007). Conifers (such as spruce, fir, pine) and deciduous trees (e.g., maple, beech, oak, birch, aspen) are native to the park, due to its location at the temperate and boreal transition zone (KARR 2005, KAHL et al 2007). A rich macroalgal community is known on the coast (Acadia NP Official website. Field Guide to Algae 2009). However, there is little known about the algae from freshwater and brackish habitats within the park.

Freshwater habitats are very diverse and abundant in Acadia NP. There are a variety of lakes and ponds, which together comprise about 7.4% of the park's surface area. As well, there are several large lakes with shorelines bordering the park. A fifth of the park is classified as a wetland, including communities such as forested wetlands, freshwater marshes, peatlands, salt marshes, marine aquatic beds and intertidal shellfish flats (Acadia NP Official website. Wetland, Marshes, and Swamps 2007). The geography of the area supports numerous first-order streams. Due to a humid climate, wetwalls are present in the park, but their occurrence is limited.

1.2 Freshwater algae in Acadia NP

Given the diversity of freshwater habitats, the age of the park, and its location in New England (a region replete with universities), it is very surprising that no studies have been conducted on the park's freshwater algae. Recently, several studies have been done on fish diversity (STONE et al. 2001) and salamanders on MDI (CROCKER et al. 2007, BANK et al. 2006). There are also many studies on water quality (e.g, KAHL et al. 2007, NELSON et al. 2007), but only BANK et al. (2007) referred to freshwater phytoplankton and zooplankton. However, BANK et al. (2007) studied only the concentration of mercury in the phytoplankton and did not provide any names of algal species or genera.

1.3 Diatoms of Acadia NP and North America

The original aim of this study was to provide a complete diatom (Bacillariophyceae) flora for Acadia National Park. Diatoms are very good bioindicators of water quality and can show changes in the environment, such as eutrophication (REAVIE & SMOL 2001), heavy metal pollution (DENICOLA 2000), acidification (DIXIT et al. 1999), and regional climate changes. To study all these ecological problems, excellent knowledge of diatom taxonomy is needed. Although there was some effort to make a list of diatom species and to describe new taxa for North America half a century ago, most of the key diatom literature used for species identification originates in Europe. HOHN & HELLERMAN (1963) encountered about 450 taxa in their study of North American rivers and described over 100 of them as species (or varieties) new to science. However, the last comprehensive study of the North American diatom flora was conducted by PATRICK & REIMER (1966, 1975). These authors reported approximately 6,000 of diatom species.

Since then, many scientists have described limited numbers of new taxa for North America in single site or regional studies (e.g., BIXBY et al. 2005, BRANT 2003, GAISER & JOHANSEN 2000, MANOYLOV et al. 2003, MORALES 2003). Recently, a couple of larger floras were published. The diatom flora of Cape Cod, Massachusetts, was published by SIVER et al. (2005), and ANTONIADES et al. (2008) reported diatoms from the Canadian Arctic Archipelago. Nevertheless, there is still a substantial lack of knowledge of diatoms in North America compared to what is known of diatoms in Europe.

1.4 Species concepts and phenotypic plasticity of diatoms

Species concepts are critical to taxonomic study. There are many species concepts used by scientists for recognition of new or existing species, but only some of them are suitable for certain organisms and satisfactory in modern systematics. JOHANSEN & CASAMATTA (2005) describe and discuss nine different species concepts and suggest the best candidate for asexual organisms such as cyanobacteria.

It is clear now that a phenetic species concept, a traditional approach when morphology alone is used, is inadequate in either recognizing biodiversity or in arriving at a systematically correct taxonomy. Microalgae are often poor in morphological traits, and the genetic variability within some of the morphologically defined species has been found to exceed the morphological variability. Consequently, many scientists suggest that there are numerous cryptic species that we are not able, so far, to recognize morphologically or by some other phenotypic character (BOYER et al. 2002). Accordingly, there is a growing practice of obtaining other data, e.g. ecological, biochemical and molecular data in order to recognize all biodiversity. Molecular data are especially useful, as they can be used to detect evolutionary relationships, an essential part of modern species recognition. Phylogenetic species concepts are popular and used to support recognition of new species (JOHANSEN & CASAMATTA 2005). Four of those phylogenetic species concepts are discussed and suggested as good candidates for asexual organisms in JOHANSEN & CASAMATTA (2005). However, molecular data alone do not provide sufficient information for species recognition, and their use in ecological studies is frequently impractical.

Diatoms as a group are often difficult to sequence. Most of the diatoms are not easily cultivatable, which means it is very difficult to obtain a pure population suitable for sequencing. In addition \, sexual reproduction in diatoms is very rare, compared to the frequency of their asexual reproduction. This fact makes diatoms similar in gene flow among populations to strictly asexual organisms, such as bacteria or cyanobacteria. In contrast to prokaryotic organisms and even most other eukaryotic algal groups, diatoms are rich in morphological characters due to their finely structured silica walls. The difficulty of isolation and sequencing combined with the complex and fixed morphology of the frustule has contributed to the persistence of morphology as the primary character set for diatom taxonomy. Furthermore, the scanning electron microscope has made it possible to recognize even more taxa than was possible with light microscopy alone.

Given the combination of rare sexual reproduction, difficulty of obtaining molecular based phylogeny, and relatively easily observable morphological traits and ecological preferences, the best working species concept for diatoms at present may be the Ecotypic Species Concept (JOHANSEN & CASAMATTA 2005). This concept postulates that ecological niches define ecotypes. These ecotypes experience periodic episodes of severe selection which acts as a cohesive force similar to the cohesion experienced in sexual organisms. This concept seems a good fit for diatoms as 1) high ecological specificity is found among even slight morphological variants, indicating that the morphology has ecological significance, 2) diatoms likely do experience severe selection events, particularly with regard to the rapidly changing ecological conditions most of them experience in lake and stream habitats, 3) phylogenetic species concepts, which have greater appeal among many systematists, cannot yet be applied given the very limited phylogenetic understanding of diatom taxa at any taxonomic level. The Ecotypic Species Concept is applied in this study in recognition of taxa, the ones corresponding with existing taxa in literature and the possibly new ones. The assumption is made that morphologically distinct populations likely represent lineages that are genetically distinct and environmentally constrained by the ecological niches they occupy.

If species recognition is to be based on relatively minor morphological differences, it is appropriate to address the degree of phenotypic plasticity in diatoms. As stated above, diatom taxonomy presently is based on morphology of their silica frustules and their ecology. We focus on the siliceous cell walls, because the protoplast morphology of diatoms is less informative at the species level. The most critical features for identification of species are valve shape and arrangement and density of striae, fibulae, and costae. Frustule measurements, such as length and width or diameter are also important as diatoms seem constrained by their life cycles to vary within specific cardinal points. Diatoms have their maximum size immediately following sexual reproduction, and their minimum size immediately preceding sexual reproduction. These limits appear to be under genetic control. Length and diameter are consequently more variable than other dimensions (such as striae in 10 μm). Valve shape can vary during the life cycle and is especially uninformative at the lower end of the size range, when the apices tend to lose distinctive morphology as they become more rounded. If a taxon does not conform precisely to the length or diameter reported in the literature, it is usually not regarded as problematic, as often the original description is not based on observations of the entire life cycle and size range (sexual reproduction often occurs once per year).

While striae counts are generally considered to be fairly constant and with limited variability, various species in the genus *Eunotia* are frequently observed with "missing striae" or with variable striae density due to desiccation stress. This variability makes differentiation of *Eunotia* species more problematic than many other species in other genera. *Eunotia* can also change in valve shape as size reduction occurs, so it is important to observe large populations whenever possible to be certain of correct identification.

Ecology is also important to consider. Most diatoms are habitat specific (strictly planktonic, epiphytic or epipsamic). Some occur only in very clean waters, some indicate pollution, and some of them prefer certain combinations pH and conductivity, etc. The environmental specificity makes diatoms very good indicators of water quality and attractive for use by resource managers as bioindicators.

1.5 Eunotiophycidae in North America

Because of an exceptionally high richness of diatoms in Acadia National Park and limited time, the focus of this thesis was narrowed down to the Eunotiophycidae, which includes the most speciose genus in the Acadia NP samples, *Eunotia*. Eunotiophycidae are most abundant in oligotrophic or dystrophic waters (PATRICK & REIMER 1966), and they are excellent indicators of low pH. *Eunotia* was used to demonstrate anthropogenic acidification in Adirondack region, with *Eunotia* being the most dominant genus in the acidic streams (PASSY et al. 2006). DENICOLA (2000) found 22 *Eunotia* species from various environments from all over the world with a pH ≤ 3.5 (having natural and anthropogenic acid sources). However, in the study there were many more taxa present in environments at pH 4.5-5.0.

Besides acidification, Eunotiophycidae are also great indicators of eutrophication and heavy metal deposition. The large genus *Eunotia* includes species both sensitive and tolerant to these stresses, meaning that the Eunotiophycidae assemblages change along a pollution gradient. All three stresses mentioned above are current problems in the New England region (DIXIT et al. 1999). Water acidification is a threat to Acadia NP due to acidic precipitation combined with the already acidic soils and bedrock and poorly buffered waters. It is well known that the park receives elevated inputs of atmospheric pollutants, such as mercury (Hg), from the Midwest (e.g., NELSON et al. 2007, PECKENHAM et al. 2007).

Despite the ecological importance of Eunotiophycidae, the taxonomy of this group is understudied, especially in North America. Most of the taxonomic literature for the genus *Eunotia*, as well as for other diatom genera, originates from Europe. For North America, PATRICK & REIMER (1966) reported 66 Eunotiophycidae to be present on the continent (62 *Eunotia* species and varieties, 1 *Actinella*, 1 *Desmogonium* and 2 *Peronia* species). Twelve of these species were indigenous to this hemisphere, with type locality in the U.S.A.: *Actinella punctata* (New Hampshire), *Eunotia arcus* var. *uncinata* (Maine), *E. bidens* (uncertain, USA), *E. carolina* (Georgia), *E. luna* (Oregon), *E. obesa* (Alabama), *E. parallela* (uncertain, USA), *E. pectinalis* var. *ventricosa* (New York), *E. praerupta* (uncertain, USA), *E. rostellata* (Nevada), *E. tautoniensis* (Massachusetts), and *Peronia intermedium* (Tennessee).

Other more localized studies have described taxa within the Eunotiophycidae from North America. *Peronia heribaudi* and 63 species and varieties of *Eunotia* were observed in Alaska by FOGED (1981). *Eunotia septentrionalis* var. *capitata* was described in Foged's study as a new variety to science. Seven years later, CARTER & FLOWER (1988) described *Eunotia pirla* as a new species occurring in Michigan. GAISER & JOHANSEN (2000) encountered *Actinella punctata* and 24 *Eunotia* taxa in their study of the Carolina Bays. Two species, *E. pocosinensis* and *E. sarraceniae*, were described as new to science. SIVER et al. (2005) found 24 *Eunotia* species in the lakes of the Cape Cod Peninsula, MA; none of them were new to science. Similarly, 22 *Eunotia* taxa were found in the study of Canadian Arctic Archipelago (ANTONIADES et al. 2008); although none of them were new to science. Finally, the Great Smoky Mountains National Park (GSM NP) has been extensively studied due the All Taxa Biodiversity Inventory (ATBI). This ambitious research, initiated in 1997, encompasses all species, including algae (LOWE et al. 2007). Particularly relevant to this study, the genus *Eunotia* was studied in detail by FUREY (2008). She found 55 subgeneric *Eunotia* taxa. Fourteen of them likely will be described as new to science in FUREY et al. (in review).

Given the importance of *Eunotia* as an indicator of low pH and its understudied diversity, this genus is especially worthy of study in Acadia National Park. The objective of this work is to provide a list of diatom genera present within the diverse freshwater and brackish habitats of Acadia NP and to study in detail diatom species within the Eunotiophycidae.

2. MATERIALS AND METHODS

Algal samples were collected from freshwater and brackish habitats within Acadia National Park, Maine, U.S.A., during June 4-14, 2008. Most of them were sampled on Mount Desert Island (MDI, 107 samples); eight samples were collected from Schoodic Peninsula. Four samples were taken by park naturalists and sent after this collection period. Two of those samples were taken from Mount Desert Island in July 2008. The other two samples were collected from Isle au Haut in October 2008. Altogether, 119 sites were sampled within the park or from large lakes bordering the park (Fig. 1): 7 lakes, 42 ponds, 40 streams, 16 wetlands, 9 brackish sites and 5 wetwalls. All sites are listed and described in Table 1. In this study, a lake is defined as a large pond with its area over 0.4 km^2 (100 acres; usually much larger). A pond is a water body with an area smaller than 0.4 km^2 and usually with developed aquatic vegetation along the shores. Wetland is a habitat with well developed aquatic vegetation and no large open water. This category includes marshes, bogs, forested wetlands, etc. Brackish habitats are all sites with tidal influence (i.e., ponds, wetlands and streams with brackish water). Wetwall is a wet rock with developed algal assemblages. The sites were chosen using a topographic map with a 1:35000 scale (Acadia National Park Trail Map, National Geographic), so that any water body visible on the map was included.

Samples of phytoplankton, periphyton, epilithon or epipsamon were taken from several brackish and all possible freshwater habitats (i.e., lakes, ponds, creeks, wetlands or wetwalls) present in the park. Phytoplankton was collected using a plankton-net (40 μm mesh). Other diatom assemblages were collected using a toothbrush (from rocks, stones) or a spoon. Pieces of wood or stones were also included in the samples. All samples were placed in *Nasco Whirl-Packs*® (150 ml) and were refrigerated before cleaning. One sample (029) had to be preserved in 4% glutaraldehyde immediately because of many *Daphnia* in the water which might consume the algae before processing.

UTM coordinates (using Garmin GPSII plus) and several water characteristics were recorded for each site. The temperature (˚C), conductivity (μS; Siemen = $A \cdot V^{-1}$) and salinity (ppt, i.e. parts per thousand) were measured using a YSI meter model 63. The pH measurements were taken using ColorpHast® pH-indicator strips with a resolution of 0.1-0.2 pH units. The temperature, conductivity and salinity were not measured on wetwalls due to measurement limitation of the YSI meter. Differences among means of four water characteristics (pH, temperature, conductivity and salinity) of individual freshwater categories, all freshwater sites and all brackish sites were analyzed with one-way ANOVA using STATISTICA v8.

The samples were cleaned using a standard procedure described in SGRO & JOHANSEN (1995) (boiled in nitric acid, centrifuged six times at 10,000 rpm and rinsed with distilled water). In order to avoid a concentration of diatom valves that was too high on the slides, the cleaned material was diluted with distilled water. Permanent diatom slides were made by mounting air-dried coverslips (with diatom valves) onto slides with Naphrax® resin. Two complete sets of slides and one set of diatom pellets (for scanning electron microscopy) were made. One set of slides was used for diatom determination and will be deposited along with the diatom pellets in Dr. Johansen's collection at John

Carroll University. The second set will be archived in the Herbarium of Acadia National Park.

Due to time constraints and high richness of diatoms in the samples, slides from only 45 sites were examined (Table 1, Fig. 1). These 45 sites were chosen so that all lakes, ponds, brooks and wetlands named on the park map (as well as listed in Acadia National Park Research Fellowship Grant, June 1, 2008 – May 31, 2009) were included. More brooks, wetlands, some wetwalls and brackish sites were added to the list in order to include all habitat types. The 45 studied sites were: 6 lakes, 13 ponds, 10 streams, 7 wetlands, 7 brackish habitats and 2 wetwalls (Fig. 1). Thirty-eight sites were from Mount Desert Island, 5 from the Schoodic Peninsula and 2 from Isle au Haut.

All the diatom slides were examined using a Zeiss HBO 50 microscope with high resolution Nomarski DIC optics. Digital photographs were taken with a Diagnostic Digital Camera Macrofire Optronics 60808. At least 120 diatom valves or 7 transects on each slide were closely examined. A representative population of each taxon was photographed, and measured (length, width, number of striae per 10 μm, plus other relevant characteristics), and species presence in the samples was recorded. Position of each measured and photographed specimen was noted, in case more information about the specimen was needed (e.g., a different focus level, focus on a particular feature). Photographs were processed in Adobe Photoshop CS4.

Identification of Eunotiophycidae was based on a variety of sources. Classical (e.g., HUSTEDT 1959, PATRICK & REIMER 1966) as well as modern literature was used (especially the *Iconographia Diatomologica* and *Bibliotheca Diatomologica* series).

Taxonomic works used are cited in the results and reported in the references. Systematic-taxonomical order within the Eunotiophycidae is adapted from ROUND et al. (1990).

All *Eunotia* taxa found in Acadia National Park are reported with dimensions of key characters as seen in the Acadia National Park samples (as opposed to measurements from the literature) together with site numbers (Table 1) where they were observed. All the species are discussed with relation to available literature. Descriptions include as many details as appropriate for individual taxa, i.e. problematic species are discussed in detail as opposed to other, easily recognizable or less questionable, taxa. Several species did not conform to any described taxon in the literature. These taxa are identified as "*Eunotia* sp. #" and are putative new species. Other taxa are referenced to similar taxa by indicating "*Eunotia* cf. *species-name*". Those species referenced with cf. do not fit the taxon in some regard, or the population observed was too small to be confidently assigned to the species. Some of these taxa may be in those referenced species, or they may be new to science.

3. RESULTS

A summary of means (with standard deviations) and ranges of measured data for four water characteristics (pH, temperature, conductivity and salinity) is presented in Table 2. There was a difference in pH observed between freshwater and brackish sites ($F_{1, 115} = 130.85$, $P < 0.001$). All freshwater sites were strongly or moderately acidic; the brackish sites were slightly acidic to neutral (Table 2). There was no difference observed in pH among freshwater site categories ($F_{4,103} = 0.658$, p = 0.622). The water temperature was similar in non-brackish and brackish sites ($F_{1, 110} = 0.135$, p = 0.714). Nevertheless, the temperature was not similar among freshwater sites ($F_{3,99} = 16.5$, $p < 0.001$) with a slightly lower temperature in streams and higher temperature in ponds (Table 2). This characteristic, though, (if measured only once) is not very informative due to frequent and diurnal changes in water temperature. Conductivity and salinity were very low in freshwater samples, but naturally high in brackish waters (Table 2). Although both characteristics were rather variable, they represented a strict difference between the freshwater and brackish sites (conductivity: $F_{1, 103} = 978.2$, $p < 0.001$; salinity: $F_{1, 103} = 1017.0$, $p < 0.001$). Within the freshwater categories, conductivity was slightly elevated in several ponds, and was generally lower in lakes (Table 2). Nevertheless, no statistical difference was evident ($F_{3, 96} = 0.390$, $p = 0.760$). Similarly, very low salinity was consistently found in all freshwater sites ($F_{1, 103} = 1017.0$, $p < 0.001$).

Altogether, approximately 550 taxa within 87 different genera were observed in the 45 samples examined from Acadia National Park (Table 3). *Eunotia* (77 taxa), *Pinnularia* (45 taxa), *Nitzschia* (29 taxa) and *Navicula* (27 taxa) were the most diverse genera in the samples.

Eunotia (Eunotiophycidae) was the most speciose genus in the examined samples. There were 77 species or varieties found in Acadia National Park. Seventeen of them did not conform to any described *Eunotia* taxon in the literature and might be new to science. The Eunotiophycidae also include other genera, such as *Actinella*, *Semiorbis* and *Peronia*. For these genera, only one (*Actinella*, *Semiorbis*) or two (*Peronia*) species were observed. One of the *Peronia* species is probably new. All species are described and discussed in the Taxonomy part of the Results.

There were only 7 species occurring in 10 or more samples (out of 45 sites, Table 4). The most frequent species were *Eunotia pectinalis* and *E. incisa*. *Eunotia pectinalis* occurred in 16 different sites, mostly in ponds (8 sites) but also in streams (4 sites). *Eunotia incisa* was observed in 15 different localities, predominantly in ponds (9 sites) and streams (4 sites). The following five *Eunotia* species were observed in 11 or in 10 various sites. *Eunotia exigua* preferred streams (8 of 11 sites). *Eunotia flexuosa* was observed mostly in ponds (6 of 11 sites) and streams (3 sites). *Eunotia bilunaris* occurred mostly in ponds (5 of 10 sites) and lakes (3 sites). *Eunotia faba* was found solely in standing waters, such as ponds (6 of 10 sites) and lakes (4 sites). *Eunotia rhomboidea* preferred both ponds (5 of 10 sites) and streams (3 sites).

Some taxa strictly preferred only one habitat type. *Eunotia bidentula*, *E. botellus* and *Eunotia* sp. 13 were found strictly in ponds. *Eunotia* cf. *rushforthiana* and *E. trinacria* were observed in streams only (Table 4). *Actinella punctata* was observed solely in ponds and lakes. *Peronia* species preferred ponds and lakes too. *Semiorbis hemicyclus* was found in ponds (Table 4). However, most of the Eunotiophycidae taxa occurred rarely (i.e., in less than 10 sites of the 45 studied), which made it difficult to decide about the habitat preference).

The most species rich habitat categories in Acadia NP were ponds and streams. Ponds were the most species rich habitat type with 58 Eunotiophycidae observed (in 15 studied ponds). There were 54 *Eunotia*, 1 *Actinella*, 1 *Semiorbis* and 2 *Peronia* taxa recorded. In 11 streams, 48 taxa of Eunotiophycidae were found (i.e., 46 *Eunotia* and 2 *Peronia* species). Thirty-five Eunotiophycidae were found in 6 large lakes (32 *Eunotia*, 1 *Actinella* and 2 *Peronia* species). Five studied wetlands supported 23 *Eunotia* species; 7

Eunotia species occurred on three wetwalls. There was a one valve of *Eunotia* found in one of the five brackish sites examined.

Aunt Betty Pond (site 087), a pond in woods west of Eagle Lake on MDI, was the most species rich locality with 20 *Eunotia* species observed (no other Eunotiophycidae genera were present, Table 5). Eagle Lake (site 068) was the second most species rich site in terms of number of different Eunotiophycidae taxa in the sample (with 17 taxa observed). Lurvey Brook (site 018) in west part of MDI had 14 taxa present in the sample. Heath Swamp (site 016), Witch Hole Pond (site 076), Breakneck Ponds (site 080), Halfmoon Pond (site 081), and Long Pond (site 116, on Isle au Haut) were also very species rich sites, all with 13 different Eunotiophycidae. Twelve different species were found in Cromwell Brook (site 058), and in a bog near West Pond (site 109, on the Schoodic Peninsula). This enumeration of sites shows that all three major parts of the national park are rich in species of Eunotiophycidae. Although the majority of species was definitely found on MDI, Schoodic Peninsula and Isle au Haut also have species rich localities. On the other hand, there were no taxa from class Eunotiophycidae present in several localities. These sites were all brackish with pH around 7: Adams Bridge (009), Stanley Brook (050), Sand Beach (sites 064 and 065) on MDI and East Pond (sites 113 and 114) on the Schoodic Peninsula (Table 5).

3.1 SPECIES DESCRIPTIONS

Class: **Bacillariophyceae**

Subclass: **Eunotiophycidae**

Order: **Eunotiales**

3.1.1 Family: **Eunotiaceae**

Actinella punctata Lewis Plate 32: Figs. 1-4

Sites 016, 068, 076, 081

Valves 43-94 µm long, 3.5-4.5 µm wide in the center valve, 8-9 µm wide at head pole, 3.5-5 µm wide at foot pole; striae 16-18 in 10 µm in the center valve.

Although this genus has a center of richness in the southern hemisphere, this particular species is typical for the northern hemisphere and was originally described from a pond in New Hampshire. It is a good indicator for acidic waters. My population fits the description of the species (with typical valve outline and dimensions) and extends the length limit for this taxon down to 43 µm (given as not less than 65 µm in PATRICK & REIMER 1966 and KRAMMER & LANGE-BERTALOT 1991). *Actinella punctata* was observed in ponds and lakes on Mount Desert Island.

Eunotia arculus (Grun.) Lange-Bertalot & Nörpel Plate 28: Figs. 19-24

Sites 081, 087

Valves 17.5-21 µm long, 2.75-3.25 µm; striae 15-17.5 in 10 µm.

The Acadia NP population matches the designation of *E. arculus* in KRAMMER & LANGE-BERTALOT (1991). It is also consistent with the populations of this same taxon in LANGE-BERTALOT & METZELTIN (1996) and WERUM & LANGE-BERTALOT (2004). SIVER et al. (2005) show several specimens of *E. exigua* from Cape Cod, some of which resemble *E. arculus*. These last authors recognize and discuss the resemblance of their specimens to *E. arculus*. My specimens were found in Halfmoon Pond and Aunt Betty Pond on Mount Desert Island.

Eunotia* cf. *arculus (Grun.) Lange-Bertalot & Nörpel Plate 28: Figs. 32-33

Site 116

Valves 19-22 µm long, 2.75-3 µm wide; striae 16-18 in 10 µm.

These two specimens resemble *E. arculus* (Plate 28: Figs. 19-24) in their shape and fit the dimensions of this taxon described in KRAMMER & LANGE-BERTALOT (1991). However, their ventral valve margin is distinctly linear and the capitate ends are smaller than typical for *E. arculus*. *Eunotia arculus* was found on Mount Desert Island. In contrast, *E*. cf. *arculus* was found only in Long Pond on Isle au Haut. Given the limited number of specimens observed and limited biogeography, I am unsure if these morphotypes should be included within *E. arculus* or should be placed in a separate taxon.

Eunotia bidens Ehr. Plate 3: Figs. 12-14

Sites 057, 058

Valves 38-56 µm long, 8.5-13 µm wide in the center, 9.5-14 µm wide at widest part; striae 8.5-13 in 10 µm in the center valve, 10.5-15 in 10 µm near the apices.

My specimens fit well the description (valve outline and dimensions) of *E. bidens* or *E. praerupta* var. *bidens*, a later synonym used in the literature (KRAMMER & LANGE-BERTALOT 1991, PATRICK & REIMER 1966) but recently re-elevated to species (WERUM & LANGE-BERTALOT 2004). This taxon was found in Great Meadow wetland and in Cromwell Brook on Mount Desert Island.

Eunotia bidentula W. Smith Plate 25: Figs. 1-7

Sites 031, 076, 107

Valves 23-42 µm long, 4-6 µm wide in the center valve, 6-8 µm wide at undulation; striae 16-19 in 10 µm in the center valve, up to 20 in 10 µm near the apices.

My population of *E. bidentula* is a good fit for this species with regards to valve outline and dimensions (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991). This taxon was found in small ponds on Mount Desert Island (Duck Pond, Witch Hole Pond and The Tarn).

Eunotia bilunaris (Ehr.) Mills Plate 15: Figs. 1-12

Sites 003, 020, 032, 054, 055, 058, 068, 081, 087, 116

Valves 29-102 µm long, 4-4.5 µm wide; striae 13-15 in 10 µm in the center valve, 15-18 in 10 µm near the apices.

Eunotia bilunaris sensu lato is a very variable taxon. My populations of *E. bilunaris* fit within the descriptions based on valve outline and dimensions in the literature (KRAMMER & LANGE-BERTALOT 1991, RUMRICH et al. 2000).

There is considerable confusion in the literature with regards to this taxon, and the correct name for the taxon is still contestable. Three species epithets have been in common use in recent times for this taxon: *E. bilunaris, E. lunaris* (Ehr.) Grunow, and *E. curvata* (Kütz.) Lagerstedt. The problem lies in the fact that all three taxa were originally described as species in other genera, and all appeared at nearly the same time in the literature. *Synedra lunaris* EHRENBERG (1831-32) was the first name to appear, followed by *Exilaria curvata* KÜTZING (1833-1836), and finally by *Synedra bilunaris* EHRENBERG

(1838). The transfer of these taxa to *Eunotia* occurred in this order: *E. lunaris* (Ehr.) Grunow in VAN HEURCK (1881), *E. curvata* (Kütz.) LAGERSTEDT (1884), and finally *E. bilunaris* (Ehr.) MILLS (1933-1935). These dates of publication are given by VANLANDINGHAM (1969) and HUSTEDT (1959). Subsequently, KRAMMER & LANGE-BERTALOT (1991) give an earlier publication date for *S. bilunaris* EHRENBERG (1831-32), and reject *E. lunaris* (Ehr.) Grunow in VAN HEURCK (1881) because it is a later homonym of the marine taxon *E. lunaris* Brébisson *in* RABENHORST (1864), which DETONI (1892) placed in synonomy with *Pseudo-eunotia lunaris* (Ehr.) GRUNOW (1865). In all of the most recent treatments (LANGE-BERTALOT & METZELTIN 1996, RUMRICH et al. 2000, SIVER et al. 2005, FUREY et al. in review), *E. bilunaris* is accepted as the legitimate correct name for the species based on KRAMMER & LANGE-BERTALOT'S (1991) reasoning.

My population occurred on Isle au Haut and in a number of lakes and brooks on Mount Desert Island.

Eunotia* cf. *bilunaris (Ehr.) Mills Plate 16: Figs. 4-7

Sites 018, 040, 055, 058, 068, 087

Valves 66-86 µm long, 3.75-4.5 µm wide; striae 13.5-15.5 in 10 µm in the center valve, up to 19 in 10 µm near the apices.

This taxon shares a common shape and size with *E. bilunaris sensu lato* (KRAMMER & LANGE-BERTALOT 1991). The raphe of *E. binularis* is long (in long specimens, i.e. longer than 50 µm), parallel to valve ends and perpendicular to the striae. However, the raphe of this taxon is short and distinctly curved towards the dorsal valve margin (compared to *E. bilunaris*). Also, the valve ends are somewhat flexed dorsally. A larger population would be desirable to be able to recognize this taxon as a new species or to conclude it belongs in *E. bilunaris*. This taxon was observed in samples from various habitats on Mount Desert Island (ponds, streams, lakes and wetlands).

Eunotia bilunaris* var. *linearis (Okuno) Lange-Bertalot & Nörpel Plate 16: Figs. 1-3
Sites 032, 104, 116

Valves 73-102 µm long, 4.5-4.75 µm wide; striae 12-14 in 10 µm in the center valve, up to 16 in 10 µm near the apices.

This variety of *E. bilunaris* has straight or slightly curved valves with constant width of the valve (from center to the ends). It also has a coarser striation (9-12 in 10 µm) compared to *E. bilunaris* var. *bilunaris* (KRAMMER & LANGE-BERTALOT 1991). My specimens match the description in KRAMMER & LANGE-BERTALOT (1991). Figure 2 (Plate 16) is more finely striated (14 in 10 µm) than typical. This taxon was found in Seal Cove Pond and in a wetland on Mount Desert Island, and in Long Pond on Isle au Haut.

Eunotia boomsma Furey, Lowe & Johansen Plate 23: Figs. 10-12
Sites 020, 029, 057

Valves 23-41 µm long, 5-7 µm wide in the center valve, 5.5-7.5 µm wide at undulation; striae 12-13 in 10 µm in the center valve, up to 16 in 10 µm near the apices.

This taxon closely resembles the newly described species *E. boomsma* (FUREY et al. in review). It is almost identical in its valve outline and striae count, although the Acadia National Park populations of *E. boomsma* expand both the length and width ranges for the taxon. This taxon also bears some similarity to *E. circumborealis* (KRAMMER & LANGE-BERTALOT 1991). However, *E. circumborealis* is more finely striated and the dorsal valve margin is more distinctly undulated. *Eunotia boomsma* was found in Marshall Brook, Long Pond and Great Meadow on Mount Desert Island.

Eunotia boreoalpina Lange-Bertalot & Norpel-Schempp Plate 30: Figs. 7-10

Sites 107, 115, 119

Valves 15-19 µm long, 3-4.25 µm wide; striae 15-19 in 10 µm.

This taxon originally appeared as a figure under the unpublished manuscript name *E. incisa* “var. *boreoalpina*” in KRAMMER & LANGE-BERTALOT (1991). It was subsequently elevated to the species level and published without a figure in METZELTIN & LANGE-BERTALOT (1998). My specimens are thin for this taxon, which was reported to have widths of 5-6 µm, and at the short end of the length range, which is given as 14-40 µm. The authors mention that some of the pictures were taken from samples from Canada and Nevada. My specimens occurred in The Tarn and Hunters Brook on Mount Desert Island and in a pond near the park exit on Schoodic Peninsula.

Eunotia botellus Moser, Lange-Bertalot & Metzeltin Plate 23: Figs. 3-7

Sites 043, 081, 087

Valves (21)30-58 µm long, (3.5)4-5 µm wide; striae 20.5-21 in 10 µm in the center valve, 21 in 10 µm near the apices.

This taxon is characterized by its rounded apices, slightly arched valves, fine striation, and distinct terminal nodules on the ventral side of the apices (looking like dark spots at the apices). The valve outline of my population is very similar to *E. botellus*. The dimensions match the description in MOSER et al. (1998) as well, except for the smallest specimen (Plate 23: Fig. 7) which might not be part of this taxon series. This species was originally described from New Caledonia and I have not seen any other reports of its presence. My specimens occurred in The Bowl, Halfmoon Pond and Aunt Betty Pond on Mount Desert Island.

Eunotia botuliformis Wild, Nörpel & Lange-Bertalot Plate 26: Figs. 18-19

Site 087

Valves 23-29 µm long, 2.9-3.1 µm wide; striae 16-20 in 10 µm.

These two specimens fit the description based on valve outline and dimensions of *E. botuliformis* in LANGE-BERTALOT (1993). This taxon was later reported in LANGE-BERTALOT & METZELTIN (1996) and WERUM & LANGE-BERTALOT (2004). This species was found in Aunt Betty Pond on Mount Desert Island.

Eunotia chelonia Nörpel-Sch., Metzeltin & Lange-Bertalot Plate 27: Figs. 31-33

Site 116

Valves 13.5-14 µm long, 3.5-4 µm wide; striae 15-17 in 10 µm.

This small population (i.e., three specimens) of *E. chelonia* matches the description (in dimensions and overall valve outline) of this species in LANGE-BERTALOT & METZELTIN (1996). However, their specimens have more distinctly protracted apices at one valve end. This feature is not that distinct in my specimens. *Eunotia chelonia* was found in Long Pond on Isle au Haut.

Eunotia* cf. *circumborealis Nörpel-Sch. & Lange-Bertalot Plate 24: Fig. 1

Site 116

Valve 32 µm long, 4-5 µm wide; striae 12 in 10 µm.

This taxon is similar in its shape and dimensions to *E. circumborealis* (KRAMMER & LANGE-BERTALOT 1991). However, *E. circumborealis* has rounded wider apices and is typically more strongly undulated than my specimen. This taxon also resembles *E. implicata*, but this species is more finely striated than my taxon. *Eunotia* cf. *circumborealis* was found in Long Pond on Isle au Haut.

Eunotia curtagrunowii Nörpel-Sch. & Lange-Bertalot Plate 3: Figs. 3-7

Sites 020, 023, 057, 087

Valves 19-25 µm long, 6.5-8.3 µm wide; striae 11-14 in 10 µm.

This taxon bears a close resemblance to *E. praerupta* var. *musicola* Petersen, but differs in that the apices are not reflexed dorsally. In my populations, some forms had ends set off similar to *E. praerupta* var. *musicola* (Plate 3: Figs. 6, 7), but they were not as distinct as illustrated by ANTONIADES et al. (2008). I have chosen to place all of these forms in *E. curtagrunowii*, but recognize that larger populations (more than three specimens) of either form might lead to recognition of separate taxa if clear discontinuities are maintained. This species was observed in four localities on Mount Desert Island: in Marshall Brook, Fresh Meadow, Great Meadow and Aunt Betty Pond.

Eunotia diadema Ehr. Plate 1: Figs. 5, 6

Sites 003, 068

Valves with six undulations on the dorsal side of valve, 44-46 µm long, 14.5-16 µm wide in center valve, 17-18 µm wide at widest point; striae not always crossing entire valve, 9-11 in 10 µm on the ventral side, 17 in 10 µm on the dorsal side, 13-16 in 10 µm near the apices.

Eunotia diadema is described as a species with six undulations only (KRAMMER & LANGE-BERTALOT 1991). However, LANGE-BERTALOT & METZELTIN (1996) included some specimens with four undulations in *E. diadema*, but I see no reason for this decision. In my work the taxa with four undulations are *E. tetraodon*, while those with six belong to *E. diadema*. This species was found in two large lakes, Echo Lake and Eagle Lake, on Mount Desert Island.

Eunotia elegans Østrup Plate 28: Figs. 25-29

Sites 003, 016, 087

Valves 22-30 µm long, 2.25-2.5 µm wide; striae 18-19 in 10 µm in the center valve, up to 20 in 10 µm near the apices.

My population of *E. elegans* fits well the descriptions of the typical valve outline and the dimensions in the classical literature (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996). SIVER et al. (2005) also found this taxon in their study of Cape Cod Peninsula, Massachusetts. PATRICK & REIMER (1966) include a distribution of *E. elegans* from Pennsylvania and South Carolina. However, FUREY (2008) did not encounter this species in the Great Smoky Mountains National Park. My specimens were found in Echo Lake, Heath Swamp, and Aunt Betty Pond on Mount Desert Island.

Eunotia exigua (Brébisson) Rabenhorst Plate 30: Figs. 12-72

Sites 018, 037, 081, 090, 093, 094, 109, 111, 117, 118, 119

Valves 7.5-17.5(19) µm long, 2.25-3 µm wide; striae 20-24 in 10 µm; length-breadth ratio 3:1-7.6:1.

My population of *E. exigua* fits within the description of dimensions and overall valve outline in HUSTEDT (1959), PATRICK & REIMER (1966), and KRAMMER & LANGE-BERTALOT (1991). This taxon has been broadly defined in the past and likely came to include many species. LANGE-BERTALOT et al. (1996) more narrowly circumscribed *E. exigua* (especially measurements), and my populations conform to their description of this species, although considerable variability in the valve outline was present in my populations. *E. exigua* has been confused in the past with *Eunotia nymanniana*, and I discuss this confusion under *Eunotia* cf. *nymanniana*. GAISER & JOHANSEN (2000) encountered this taxon in acidic waters in the Carolina Bays study, and it was also seen by FUREY et al. (in review) in the Great Smoky Mountains. *Eunotia exigua* was very common and abundant in the samples from Acadia National Park. It occurred in all three studied parts of the park, mostly in small streams.

Eunotia* cf. *exigua (Brébisson) Rabenhorst Plate 26: Fig. 17

Site 119

Valve 13 µm long, 3 µm wide; striae 23-24 in 10 µm.

This specimen resembles *E. exigua* in its valve outline and dimensions. However, the apices of this specimen are sharply pointed. It might be a teratological specimen of *E. exigua*. *Eunotia* cf. *exigua* was found in Hunters Brook on Mount Desert Island.

Eunotia faba Ehr. Plate 8: Figs. 1-13

Sites 001, 003, 029, 054, 068, 076, 080, 087, 107, 116

Valves 28-67 µm long, 6.5-9 µm wide; striae 13-18 in 10 µm in the center valve, 18-20 in 10 µm near the apices; punctae 31-34 in 10 µm.

Eunotia faba is a commonly reported taxon in the literature. It usually does not exceed the length of 60 µm (KRAMMER & LANGE-BERTALOT 1991, HUSTEDT 1959). Two of my specimens (Plate 8: Figs. 1, 2) were longer than 60 µm, but they share a common shape and other features for *E. faba*. Some of my specimens were also more finely striated, compared to most of the descriptions in the literature (HUSTEDT 1959, LANGE-BERTALOT et al. 1996). Overall, the Acadia National Park populations of *E. faba* fit the broader dimension limits of this taxon in KRAMMER & LANGE-BERTALOT (1991). This species was only found in ponds and lakes on Mount Desert Island and Isle au Haut.

Eunotia flexuosa (Brébisson) Kützing Plate 14: Figs. 1-10

Sites 018, 023, 034, 068, 073, 076, 078, 081, 109, 115, 116

Valves 133-169 µm long, 4-5.5 µm wide in the center valve, 4-6 µm wide at the head pole; striae 13-17 in 10 µm in the center valve, up to 18 in 10 µm near the apices.

The Acadia National Park populations of *E. flexuosa* closely correspond to the description of this species in the literature (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991). This taxon occurred mostly in ponds and brooks in all three major parts of the park (Mount Desert Island, Schoodic Peninsula, and Isle au Haut).

Eunotia flexuosa* var. *eurycephala Grunow Plate 13: Figs. 1-7

Sites 016, 058, 076, 078, 080, 081

Valves 153-228 µm long, 3-4 µm wide in the center valve, 3.5-6.5 µm wide at the head poles; striae 17-19 in 10 µm in the center valve, 20-23 in 10 µm near the apices.

This taxon has distinctly swollen, capitate ends (PATRICK & REIMER 1966). My population of *E. flexuosa* var. *eurycephala* fits the measurement limits in the literature (PATRICK & REIMER 1966), however some specimens slightly differ in the shape of the capitate ends. PATRICK & REIMER (1966), SCHMIDT et al. (1874-1959), and HUSTEDT (1959) show rounded apices almost symmetrical to the apical axis. While some of my specimens had this shape and symmetry (Plate 14: Figs. 3, 7), more typically the apices in Acadia had flattened capitate ends swollen on one side. This distinct shape is not shown in the literature. This taxon was mostly observed in shallow ponds on Mount Desert Island.

Eunotia* cf. *flexuosa* var. *eurycephala Grunow Plate 13: Fig. 8

Site 114

Valve 307 µm long, 4 µm wide, 8 µm wide at the head pole; striae 15-15.5 in 10 µm in the center valve, up to17 in 10 µm near the apices; punctae ca. 31 in 10 µm.

This specimen is probably related to *E. flexuosa* var. *eurycephala,* but differs in having a length greater than the maximal length reported of 260 µm and a head pole that is more rounded (see PATRICK & REIMER 1966). It fits the striae density reported for *E. flexuosa* var. *eurycephala*. More specimens would be needed to be able to recognize this taxon as something distinct from our other specimens. This taxon was found in a brackish pond on Schoodic Peninsula, but I strongly suspect it was flushed into the pond from a freshwater habitat during heavy precipitation.

Eunotia* cf. *formica Ehr. Plate 4: Figs. 1,2

Sites 003, 058

Valves 114-161 µm long, 11-13.5 µm wide in the swallowed center, 10-10.5 µm wide at off-center part; striae 8.5-10.5 in 10 µm in the center valve, 13 in 10 µm near the apices; punctae 22-26 in 10 µm.

This taxon resembles *Eunotia formica* and fits the measurements of this species (KRAMMER & LANGE-BERTALOT 1991). However, ends of my specimens are broadly rounded instead of cuneate as in *E. formica*. Specimens in FUREY et al. (in review) were rounded similar to my specimens. However, the early concept of this taxon was always with cuneate ends (SCHMIDT et al. 1874-1959, HUSTEDT 1959), and I suspect that the specimens with rounded ends belong to a separate, possibly new taxon. This taxon was observed in Echo Lake and in Cromwell Brook on Mount Desert Island.

Eunotia genuflexa Nörpel-Schempp Plate 20: 1-13

Sites 020, 023, 040, 058, 073, 087, 115, 117

Valves 47-97 µm long, 2.5-3 µm wide; striae 17-20 in 10 µm in the center valve, up to 22 in 10 µm near the apices.

In general, my populations of *E. genuflexa* resemble *E. naegelii sensu lato* in their valve outline, as well as fit the measurements of this taxon in PATRICK & REIMER (1966) and in KRAMMER & LANGE-BERTALOT (1991). However, the shape of most specimens fits better *E. genuflexa* Nörpel-Schempp (LANGE-BERTALOT & METZELTIN 1996, RUMRICH et al. 2000), a species split from *E. naegelii* (LANGE-BERTALOT & METZELTIN 1996). Valve margins of *E. genuflexa* are supposed to be parallel in the central 15-20 µm of the valve, which means they are less arched than *E. naegelii*. *Eunotia genuflexa* also has wider, rounded ends. Although the dimensions of my population do not fit within the narrow description of *E. genuflexa*, I believe my population can be called *E. genuflexa* (due to its identical valve outline, striae density and parallel central area) and thus expand the dimension limits for this species. This taxon was found in brooks, wetlands and ponds in all three parts of Acadia National Park.

Eunotia glacialis Meister Plate 7: Figs. 1-7

Sites 055, 087, 104, 109, 117

Valves 62-115 µm long, 7-10 µm wide; striae 12-16 in 10 µm in the center valve, 14.5-18 in 10 µm near the apices; punctae 28-33 in 10 µm.

Eunotia glacialis is not a commonly reported taxon in the literature. It might be due to confusion with *E. gracilis* Ehr. WERUM & LANGE-BERTALOT (2004) include a lectotype for this taxon (pl. 9, fig. 1) along with photos of their population in their study of European springs. Although they do not report measurements for this species, I was able to obtain measurements of the lectotype from their photographs. The overall shape and measurements coincide with my population of *E. glacialis*. PATRICK & REIMER (1966) give a drawing of *E. glacialis* with a description in the text. Their concept of this taxon (shape and dimensions) does not correspond with the lectotype or my population. Due to similarity with the lectotype in WERUM & LANGE-BERTALOT (2004), I decided to name my populations *E. glacialis*. This species was found in samples from ponds and a wetland on Mount Desert Island and in two streams on Schoodic Peninsula and Isle au Haut.

Eunotia implicata Nörpel-Sch. & Lange-Bertalot Plate 24: Figs. 2-14

Sites 016, 032, 068, 073, 080, 087, 115

Valves 25-32 µm long, 3.25-5 µm wide; striae (12)15-18 in 10 µm in the center valve, up to 21 in 10 µm near the apices.

The Acadia National Park populations of *E. implicata* fit the description in KRAMMER & LANGE-BERTALOT (1991), and the description of *E. pectinalis* var. *minor* f. *impressa* (Ehr.) Hust., a synonym of *E. implicata*, in HUSTEDT (1959). Although my populations are variable in valve outline, one of the specimens (Plate 24: Fig. 13) is identical in its valve outline to the type specimen shown in KRAMMER & LANGE-BERTALOT (1991). Typically, the dorsal margin of the valve is slightly double-undulated (e.g., RUMRICH et al. 2000). However, some short specimens (Plate 24: Figs. 11, 14) lack this undulation and might not belong to this taxon. *Eunotia implicata* was found mostly in lakes on Mount Desert Island and Schoodic Peninsula.

Eunotia incisa Gregory Plate 9: Figs. 3-26

Sites 016, 018, 032, 034, 054, 073, 076, 078, 080, 081, 087, 093, 098, 115, 119

Valves 11-40 µm long, 3-5.5 µm wide; striae 13-21 in 10 µm in the center valve, up to 22 in 10 µm near the apices.

Eunotia incisa is a diverse taxon in terms of length, width and striae density, but it always possesses a very distinct shape with regards to the valve outline and apices. My population of *E. incisa* fits the description of this species (valve outline, length and width) in the literature (as *E. veneris*: HUSTEDT 1959, as *E. incisa*: KRAMMER & LANGE-BERTALOT 1991, PATRICK & REIMER 1966, FUREY et al. in review), but it is slightly more finely striated than most previous descriptions. This taxon was for many years confused with *E. veneris* (Kütz.) O. Müller (HUSTEDT 1959). *E. veneris* was found to encompass two taxa, one that is more coarsely striated, longer, and with a slightly concave ventral margin (*E. veneris*), and the other more finely-striated, slightly shorter, and with a flat ventral margin (*E. incisa*) (KRAMMER & LANGE-BERTALOT 1991). It appears from the literature that *E. incisa* is actually the more widespread taxon. This species typically occurred in ponds and streams on Mount Desert Island.

Eunotia* cf. *incisa Gregory Plate 9: Figs. 1-2

Site 054

Valves 55-62 µm long, 5-6.5 µm wide; striae 17-19 in 10 µm in the center valve, up to 22 in 10 µm near the apices.

These two specimens resemble *E. incisa*. However, they are both longer than the limit for *E. incisa*, and their valve ends are less acute than is typical for this taxon. *Eunotia exsecta* (Cleve-Eu.) Nörpel-Sch. & Lange-Bertalot, originally a variety of *E. veneris,* can have longer valves (up to 73 µm, LANGE-BERTALOT & METZELTIN 1996), but it is usually much more coarsely striated. I consider these longer forms as likely members of the *E. incisa* clade. They were found associated with *E. incisa* in Upper Hadlock Pond on Mount Desert Island.

Eunotia inflata (Grun.) Nörpel-Sch. & Lange-Bertalot Plate 3: Figs. 1-2

Sites 020, 029, 090

Valves are 41-51 µm long, 13-13.5 µm wide, striae 7.5-8 in 10 µm in the center valve, 9.5-11.5 in 10 µm near the apices.

Acadia National Park specimens match the specimens labeled as forming a continuum between *Eunotia praerupta* and *E. praerupta* var. *inflata* Grunow in KRAMMER and LANGE-BERTALOT (1991), and those authors recommended subsuming *E. praerupta* var. *inflata* into *E. praerupta* var. *praerupta*. The taxon was later elevated to a species status, *Eunotia inflata*, by Nörpel-Schempp & Lange-Bertalot in LANGE-BERTALOT & METZELTIN (1996), and it has been consistently separated from *E. praerupta* in subsequent treatments (LANGE-BERTALOT & GENKAL 1999, WERUM & LANGE-BERTALOT 2004). This species was found in Marshall Brook, Richardson Brook and Long Pond on Mount Desert Island.

Eunotia lapponica Grun. Plate 22: Figs. 1-5

Site 031

Valves 71-83 µm long, 6-7 µm wide; striae 17-19 in 10 µm in the center valve, 19-22 in 10 µm near the apices.

My population of *E. lapponica* fits the description of this taxon in HUSTEDT (1959) and KRAMMER & LANGE-BERTALOT (1991). PATRICK & REIMER (1966) observed this species only in Connecticut within North America. My population was found only in Duck Pond on the west part of Mount Desert Island.

Eunotia meisteri Hust. Plate 29: Figs. 21-27

Sites 016, 023, 040, 055, 058, 107

Valves 12.5-16 µm long, 3-3.5 µm wide; striae 17-19 in 10 µm.

The valve outline and measurements of Acadia NP populations fit the description of *E. meisteri* (KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996). This taxon also matches the descriptions in the older literature, with the exception that both HUSTEDT (1959) and PATRICK & REIMER (1966) report a finer striae density for this taxon (both ca. 21 striae in 10 µm). The valve outline of some specimens of *E. meisteri* is similar to *E. microcephala*. However, *E. microcephala* is thinner and has rather parallel striae at the terminal nodules as opposed to the slightly radiate striae in *E. meisteri* (PATRICK & REIMER 1966). This species was found mostly in wetlands and ponds on Mount Desert Island.

Eunotia* cf. *melanogaster Moser, Lange-Bertalot & Metzeltin Plate 27: Fig. 28-30

Site 068, 078, 087

Valve 10-13.5 µm long, 3.25-3.5 µm wide; striae 16-18 in 10 µm.

These specimens resemble *E. melanogaster* described from New Caledonia (MOSER et al. 1998). They share a common valve outline, placement of terminal nodules and dimensions. However, *E. melanogaster* has a lower striae density (10-13 striae in 10 µm) than my populations. This species was found in Eagle Lake, Lake Wood and Aunt Betty Pond on Mount Desert Island.

Eunotia microcephala Krasske Plate 25: Figs. 23-29

Sites 018, 109

Valves 10-13 µm long, 2-2.75 µm wide; striae 19-20 in 10 µm.

The Acadia National Park population of *E. microcephala* fits the valve outline and measurements reported in both the classical (HUSTEDT 1959, PATRICK & REIMER 1966) and modern literature (KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996, LANGE-BERTALOT et al. 1996, WERUM & LANGE-BERTALOT 2004). It is also consistent with the lectotype for this taxon shown in LANGE-BERTALOT et al. (1996). *Eunotia microcephala* was found in previous studies from the United States in the Great Smoky Mountains (FUREY 2008), Pennsylvania, North Carolina and Tennessee (PATRICK & REIMER 1966). My population was found in two sites within Acadia National Park, in Lurvey Brook on the west side of Mount Desert Island and in a wetland near West Pond on Schoodic Peninsula.

Eunotia monodon Ehr. Plate 5: Figs. 1-3

Sites 016, 018, 029

Valves 72-100 µm long, 10-12 µm wide; striae 8-10.5 in 10 µm in the center valve, 12-13 in 10 µm near the apices; punctae 24-26 in 10 µm.

These specimens fit well to concept of *E. monodon* in HUSTEDT (1959), PATRICK & REIMER (1966), or KRAMMER & LANGE-BERTALOT (1991). This taxon was found in a lake, swamp and brook periphyton on west part of Mount Desert Island.

Eunotia* cf. *monodon Ehr. Plate 4: Figs. 3,4

Sites 057, 119

Valves 89-123 µm long, 9-10 µm wide; striae 8-9 in 10 µm in the center valve, 10-12 in 10 µm near the apices; punctae 23-25 in 10 µm.

The overall shape of this taxon resembles *E. monodon*. However, the ends are distinctly set off the main body of the valve. Also, valves are slightly curved with widest part at the center and narrowing to the subapical constriction. The measurements fit E. *monodon* in KRAMMER & LANGE-BERTALOT (1991), but one of the specimens was longer (123 µm) than the maximal length (90 µm) reported for *E. monodon* in HUSTEDT (1959) or PATRICK & REIMER (1966). This taxon and the related *E. monodon* did not occur in the same localities, which supports my differentiation between these two taxa. It was observed in samples from Great Meadow and Hunters Brook on east part of Mount Desert Island.

Eunotia* cf. *monodontiforma Lange-Bertalot & Nörpel-Sch. Plate 5: Figs. 5, 6

Sites 003, 057

Valves 46-63 µm long, 12-13 µm wide; striae 10-12 in 10 µm in the center valve, 12-15 in 10 µm near the apices; punctae 24-30 in 10 µm.

This taxon belongs to the *Eunotia monodon* species cluster. Although it fits dimensions of *E. monodon* (including punctae and striae density), the shape of these specimens is distinctly different. *E. monodon* is always slightly concave on the ventral side of the valve, whereas this taxon is almost linear on the ventral side. *E. monodon* also lacks a prominent swelling on the dorsal side of the valve. The newly described *Eunotia areniverma* Furey, Lowe & Johansen (FUREY et al. in review) has shape and measurements similar to my taxon. However, *E. areniverma* is distinctly concave ventrally and its ends are broadly rounded, compared to the slightly cuneate ends of my species. *E. monodontiforma*, described from Venezuela (RUMRICH et al. 2000), also has a very similar shape to my taxon. However, the ends of *E. monodontiforma* are more distinctly set-off from the valve body on the ventral side of the valve. The measurements fit well except for the punctae count (ca. 35 punctae in 10 µm). RUMRICH et al. (2000) show four pictures of *E. monodontiforma*. I suspect that the smallest valve (pl. 21, fig. 4) does not possess the reported punctae count for *E. monodontiforma* (it has ca. 28 punctae in 10 µm), and it belongs to the same group as my taxon. Given these facts I decided to recognize this taxon as a separate species with closest relation to *E. monodontiforma*. This species was observed in samples from Echo Lake and Great Meadow on Mount Desert Island.

Eunotia mucophila (Lange-Bertalot & Nörpel-Schempp) Lange-Bertalot Plate 19: Figs. 1-32

Sites 034, 055, 068, 073, 076, 078, 080, 081, 098

Valves 17.5-52 µm long, 1.5-2 µm wide; striae 21-26 in 10 µm.

This taxon is not very commonly reported in the literature. My populations correspond well to the description of *E. bilunaris* var. *mucophila* Lange-Bertalot & Nörpel in KRAMMER & LANGE-BERTALOT (1991), which has been elevated to species in METZELTIN et al. (2005). LANGE-BERTALOT & METZELTIN (1996) show a population of *E. bilunaris* var. *mucophila* along with a very similar population of *E. naegelii* Migula. Although *E. naegelii* has a very similar morphology to *E. mucophila*, *E. naegelii* is coarsely striated, has thinner ends and has a larger length-breadth ratio (KRAMMER & LANGE-BERTALOT 1991). This taxon was very common on Cape Cod Peninsula, Massachusetts (SIVER et al. 2005). My populations of *E. mucophila* occurred mostly in ponds on Mount Desert Island.

Eunotia muscicola* var. *tridentula (Grun.) Nörpel & Lange-Bertalot Plate 25: Figs. 8-22

Sites 029, 093, 109, 111, 116, 119

Valves 12-21 µm long, 3.5-4 µm wide; striae 16-18 in 10 µm.

The Acadia population of *E. muscicola* var. *tridentula* matches the morphology of other populations in the literature (KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996, LANGE-BERTALOT et al. 1996, FUREY et al. in review). PATRICK (1958) identified this taxon as *E. perpusilla* Grunow, but KRAMMER & LANGE-BERTALOT (1991) disagree with her determination, saying the North American populations actually belong to *E. muscicola* var. *tridentula.* This species was reported from cool, acidic waters of New England States and Montana (PATRICK & REIMER 1966), which is consistent with my observations. This taxon occurred in all habitat types (lakes, brooks, wetlands and wet walls) from all three major parts of Acadia National Park.

Eunotia naegelii Migula ***sensu*** **SIVER** et al. (2000) Plate 21: Figs. 1-9

Sites 032, 073, 080, 081, 107

Valves 85-133 µm long, 1.75-2.5 µm wide in the center valve, 1.25-2 µm wide at the head poles; striae 20-22 in 10 µm.

Eunotia naegelii, reported in the literature, is always slightly arched ventrally (PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996). Also *E. alpina* in HUSTEDT (1959), a later synonym of *E. naegelii*, is ventrally curved. My population of *E. naegelii* generally fits the descriptions (except the density of striae, limit is up to 20 in 10 µm), but completely lacks the arch. SIVER et al. (2005) show two linear specimens of *E. naegelii* from Cape Cod, MA, which have very similar morphology to my population. I suspect both populations (mine and the one from Cape Cod) are a new variety of *E. naegelii*. This taxon was found mostly in lakes on Mount Desert Island.

Eunotia neofallax Nörpel-Sch. & Lange-Bertalot Plate 26: Figs. 1-3

Sites 104, 109, 118

Valves 39-49 µm long, 3.5-4.5 µm wide; striae 11.5-14 in 10 µm in the center valve, up to 16 in 10 µm near the apices.

The morphology and measurements of *E. neofallax* from Acadia National Park fit the description reported in LANGE-BERTALOT et al. (1996). The authors established this taxon based on *E. fallax sensu* Hustedt and *E. fallax sensu* KRAMMER & LANGE-BERTALOT (1991). My population is consistent with the dimensions and illustrations of these morphotypes in both HUSTEDT (1959) and KRAMMER & LANGE-BERTALOT (1991).

This taxon was found in a brook and swamp around Cadillac Mountain, and in a wetland near West Pond on Schoodic Peninsula.

Eunotia nymanniana Grun. ***sensu*** **METZELTIN & LANGE-BERTALOT** (2007) Plate 28: Figs. 30-31

Site 109

Valves 18-27 µm long, 2.25-2.75 µm wide; striae 20-22 in 10 µm.

My populations of *E. nymanniana* Grunow in Van Heurck (1881) match those of *E. steineckei* Petersen (1950) illustrated in KRAMMER & LANGE-BERTALOT (1991) and LANGE-BERTALOT & METZELTIN (1996). However, *E. steineckei* became a later synonym of *E. nymanianna* following the selection of a lectotype for *E. nymanianna* (METZELTIN & LANGE-BERTALOT 2007). Acadia National Park specimens were found in a wetland near West Pond on the Schoodic Peninsula.

Eunotia* cf. *nymanniana Grun. ***sensu*** **KRAMMER & LANGE-BERTALOT** (1991) Plate 28: Figs. 1-18

Sites 016, 032, 055, 058, 073, 080, 081, 087, 094

Valves 13.5-47 µm long, 2.5-3.25 µm wide; striae 15.5-20 in 10 µm.

There is a great deal of confusion associated with *E. nymanniana* in the literature. KRAMMER & LANGE-BERTALOT (1991) show two different populations of *E. nymanniana*, one from Europe (pl. 154, figs. 31-38) and the other one from the Rocky Mountains in Canada (pl. 154, figs. 39-43). The Canadian population is similar to the Acadia National Park population. The authors do not report the measurements for *E.*

nymanniana directly in the text, but consider *E. exigua* var. *compacta sensu* HUSTEDT (1930) from Europe to be a later synonym. In SCHMIDT et al. (1874-1959), the drawings of *E. nymanniana* (pl. 274: fig. 9-18) look like the modern concept of *E. exigua*, while the drawings of *E. exigua* (pl. 297: figs. 87-92) look like *E. nymanniana*. DETONI (1892) restricts the name *E. exigua* to very short forms 10-15 µm long. Later authors expanded the species concept of *E. exigua* to include forms 8-67 µm long (HUSTEDT 1959). Grunow originally showed two specimens in his description of *E. nymanniana*, one which is strongly curved and is identical to the later synonym *E. steineckei* Petersen, and the other which is identical to the long, straight valves placed in *E. exigua* by HUSTEDT (1959). A lectotype for *E. nymanniana* was eventually chosen, and it was the curved (=*E. steineckei*) form. Consequently, *E. exigua* var. *compacta* is not synonymous with *E. nymanniana,* and is a valid taxon distinct from both *E. exigua* and from the Acadia (and Canadian) taxon. The long straight forms with apices not strongly dorsally recurved are consequently without a valid name.

I would conclude that the straight, longer-valved populations in North America attributed to *E. nymanniana* in KRAMMER & LANGE-BERTALOT (1991) represent a new species. This taxon was observed in samples from Mount Desert Island, mostly in ponds (but also in streams, a lake and a wetwall).

Eunotia paludosa Grun. Plate 27: Figs. 34

Site 094

Valve 11 µm long, 2 µm wide; striae 20 in 10 µm.

My specimen is very similar to one of the specimens of *E. paludosa* in KRAMMER & LANGE-BERTALOT (1991; pl. 155, fig. 7). However, HUSTEDT (1959) and PATRICK & REIMER (1996) do not recognize *E. paludosa* Grun. These authors report *E. paludosa* as a synonym of *E. exigua* (Bréb.) Rabh. My specimen does not fit my or other recent concepts of *E. exigua* and I choose to use Grunow's taxon based upon correspondence to the material shown in KRAMMER & LANGE-BERTALOT (1991). *Eunotia paludosa* was found in a brook next to a carriage road on Mount Desert Island.

Eunotia pectinalis (Dillwyn) Rabenhorst Plate 10: Figs. 1-11, Plate 11: Figs 1-16, Plate 12: Figs. 1-17

Sites 016, 018, 023, 032, 034, 055, 068, 073, 076, 078, 080, 087, 098, 109, 115, 117

Valves 20-111 µm long, 4-7 µm wide in the center valve; striae 9-15 in 10 µm in the center valve, 12.5-16 in 10 µm near the apices; punctae 25-29 in 10 µm.

Eunotia pectinalis is a very common and abundant taxon in Acadia National Park. It occurred in one third of the examined samples (mostly in ponds, lakes and streams) from all three sampled parts of Acadia National Park. Although this species is very variable in its shape and dimensions, my populations fit within the broad description of the taxon in the literature (e.g., KRAMMER & LANGE-BERTALOT 1991). Because of that, some authors recognize several varieties. Straight specimens with a little swelling on the ventral side of the valve center are usually considered a true *E. pectinalis* (HUSTEDT 1959, PATRICK & REIMER 1966) – in my population on Plate 10: Fig. 2, 5, 6, Plate 11: Fig. 3, Plate 12: Fig. 3, 6. *E. pectinalis* var. *ventralis* (Ehr.) Hust. is slightly bent ventrally and has a distinct ventral swelling (HUSTEDT 1959, LANGE-BERTALOT & METZELTIN

1996) – Fig. 5 on Plate 12 could belong to this variety. *E. pectinalis* var. *undulata* (Ralfs) Rabenhorst is straight and has two undulations on the dorsal margin of the valve (*sensu* HUSTEDT 1959, PATRICK & REIMER 1966). A typical specimen of this variety is shown on Plate 12: Fig. 14.

The specimen on Plate 12: Fig. 8 is similar to *E. undulata* Grunow from South America in METZELTIN & LANGE-BERTALOT (2007) (non *E. pectinalis* var. *undulata* (Ralfs) Rabh.!). However, the authors discuss a problem with the validity of this name. FUREY (2008) shows a similar population of *E. undulata* to my specimen (Plate 12: Fig. 8) from the Great Smokey Mountains. I had insufficient specimens to confirm whether or not this form merited taxonomic recognition at the species or varietal level. I decided to put all the *E. pectinalis* forms into one taxon because of a large gradient of shape and measurements in my population, and absence of clear discontinuities between the purported varieties.

Eunotia praerupta* var. *bigibba (Kütz.) Grunow Plate 24: Figs. 20-35

Sites 090, 094, 118

Valves 14.5-23 µm long, 5-7 µm wide in the center valve, 6-8 µm wide at undulation; striae 12-15 in 10 µm.

This taxon identical to form illustrated as *Eunotia praerupta* var. *bigibba* (Kütz.) Grunow in KRAMMER & LANGE-BERTALOT (1991). Apparently, Lange-Bertalot is splitting the form corresponding to my population out of this taxon, and erecting the new species *E. subherkiniensis* Lange-Bertalot, but this work is not yet published (FUREY et al. in review). It was found only in small headwater streams in the mountainous part of the east Mount Desert Island (Richardson Brook, brook on a carriage road, brook from the top of Cadillac Mountain).

Eunotia rhomboidea Hust. Plate 29: Figs. 1-20

Sites 018, 055, 068, 076, 080, 087, 104, 107, 109, 117

Valves 16.5-25 µm long, 2.5-4 µm wide; striae 13.5-18 in 10 µm in the center valve, up to 20 in 10 µm near the apices.

The overall valve outline and dimensions of this taxon resemble *E. rhomboidea* as shown in KRAMMER & LANGE-BERTALOT (1991) or LANGE-BERTALOT & METZELTIN (1996). My population of *E. rhomboidea* was found mostly in acidic ponds and streams in all three parts of Acadia National Park. Also GAISER & JOHANSEN (2000) found this species in acidic waters of Carolina Bays in South Carolina, as well as SIVER et al. (2005) on Cape Cod Peninsula, MA. FUREY (2008) also found *E. rhomboidea* in the Great Smoky Mountains. However, she also found a very similar taxon to this one and suggests separating it from *E. rhomboidea sensu stricto*. FUREY et al. (in review) propose a new species name, *Eunotia papilioforma* Furey, Lowe & Johansen, for the latter taxon. Our specimens appear to have the broader apices that would cause their placement to be in *Eunotia rhomboidea*.

Eunotia rhynchocephala Hust. Plate 29: Fig. 28

Site 116

Valve 12.5 µm long, 3.5 µm wide; striae 17 in 10 µm.

This taxon is distinguished from *E. meisteri* by its highly convex, almost flattened dorsal valve margin. Striae density is lower compared to *E. meisteri* as well; sometimes two striae can be bifurcated or widely spaced in the center valve (ANTONIADES et al. 2008). My specimen possesses the distinct flattened "hump" of *E. rhynchocephala*. However, according to KRAMMER & LANGE-BERTALOT (1991) or ANTONIADES et al. (2008), the striae density should not exceed 15 or 14 striae in 10 µm, respectively. I decided to name this specimen *E. rhynchocephala* because of its distinctive shape and the bifurcation of the central striae. This specimen was found in Long Pond on Isle au Haut.

Eunotia richbuttensis Furey, Lowe & Johansen Plate 27: Figs. 19-21

Sites 020, 023, 058

Valves 11-18 µm long, 6.5-7.5 µm wide; striae 10.5-11 in 10 µm in the center valve, up to 12 in 10 µm near the apices.

The valve outline of this species is very distinct. The dorsal valve margin is flattened, as well as the apices. My specimens fit a newly described *E. richbuttensis* (FUREY et al. in review) in its valve shape and striae density. Although my population is at the lower dimension limit of *E. richbuttensis*, I believe it belongs to this species as it matches the appearance of valves in the original description. This taxon was found in Marshall Brook, Fresh Meadow and Cromwell Brook on Mount Desert Island.

Eunotia* cf. *rushforthiana Furey, Lowe & Johansen Plate 31: Figs. 23-26

Sites 018, 109, 117

Valves 25-29 µm long, 3-3.5 µm wide; striae 16-17 in 10 µm.

This taxon closely resembles the recently described *E. rushforthiana* (FUREY et al. in review), especially in outline and valve dimensions. *E. rushforthiana* shares a similar valve outline but has wider valves than *E. trinacria*. However, my populations are more coarsely striated than *E. rushforthiana* (which has 19-20 striae in 10 µm) and lack the "hint of undulation" on the dorsal valve margin. A larger population is needed to decide if this taxon could be placed into *E. rushforthiana*. This species was found in three sites: in Lurvey Brook on Mount Desert Island, in a wetland on Schoodic Peninsula and in Bull Brook on Isle au Haut.

Eunotia satelles (Nörp.-Sch. &Lange-B.) Nörp.-Sch. &Lange-B. Plate 23: Figs. 13-16
Site 116

Valves 9-11.5 µm long, 3.5-4 µm wide in the center valve, 3.5-4.5 µm wide at undulation; striae 15-17 in 10 µm.

This taxon was first attributed to *Eunotia bigibba* var. *pumila* Grunow in Van Heurck 1881 by FOGED (1977), but was subsequently recognized as its own distinct taxon, *E. rhynchocephala* var. *satelles* Nörpel & Lange-Bertalot in LANGE-BERTALOT (1993) (cited originally by this name in KRAMMER & LANGE-BERTALOT 1991!). LANGE-BERTALOT & METZELTIN (1996) later elevated this taxon to species level. My population of *E. satelles* fits the valve outline and dimensions of *E. rhynchocephala* var. *satelles* in KRAMMER & LANGE-BERTALOT (1991). SIVER et al. (2005) found a similar population to *E. satelles* in their study of Cape Cod Peninsula, but identified it as *E. bigibba* Kütz. They indicate a similarity to *E. satelles*, but felt their specimens were too capitate, had larger valves, and lacked shortened striae along the margin, excluding them from that taxon.

However, it seems to me that *E. satelles* is a better fit for both their population and my population. According to FUREY et al. (in review), a new species is being split out of the broadly conceived *E. bigibba,* and will be called *E. subherkiniensis* Lange-Bertalot when published*.* *E. satelles* is distinct from both *E. bigibba* and *E. subherkiniensis.* My specimens occurred only in a sample from Long Pond on Isle au Haut.

Eunotia septena Ehr. Plate 26: Figs. 20-23

Sites 058, 076, 087

Valves with 5-6 pointed undulations and protracted ends, 36-39 µm long, 7-9 µm wide at dorsal depressions near center, 8.5-11 µm wide at undulations near center; striae 14-16 in 10 µm, 18-20 in 10 µm near the apices.

Eunotia hexaglyphis Ehr., the better known name for this taxon (KRAMMER & LANGE-BERTALOT 1991) is a later synonym of *E. septena* (LANGE-BERTALOT & METZELTIN 1996). Our specimens fit this taxon well in all regards. *Eunotia septena* was observed in three samples from northeast part of Mount Desert Island: in Cromwell Brook, Witch Hole Pond and Aunt Betty Pond.

Eunotia serra Ehr. Plate 2: Figs. 1-5

Site 016

Valves with 7-12 undulations on the dorsal side of valve, 47-80 µm long, 10-13 µm wide in center valve, 12.5-15 µm wide at widest point; striae 10-14 in 10 µm, 15-19 in 10 µm near the apices.

This taxon conforms to the valve outline and dimensions reported in the literature. This species occurred in a swamp on the west side of Mount Desert Island.

Eunotia subarcuatoides Alles, Nörpel-Sch. & Lange-Bertalot Plate 22: Figs. 12-14

Sites 018, 023, 040

Valves 13.5-16 µm long, 2.9-3 µm wide; striae 17-19 in 10 µm.

It is always difficult to identify a small population of short *Eunotia* specimens. My population matches the descriptions of *E. subarcuatoides* illustrated in Lange-Bertalot & Metzeltin (1996), Lange-Bertalot et al. (1996) and Furey (2008). It also resembles *E. seminulum* Nörpel-Sch. & Lange-Bertalot (Lange-Bertalot & Metzeltin 1996), but this taxon is more finely striated than *E. subarcuatoides*. *E. subarcuatoides* was found in Lurvey Brook, Fresh Meadow and a wetland next to Schooner Head Road on Mount Desert Island.

Eunotia* cf. *suecica Cleve-Euler. Plate 3: Figs. 8-11

Sites 020, 023, 057

Valves 20-23.5 µm long, 7.5-8 µm in the center, 8-10 µm at widest part; striae 12 in 10 µm.

This form was strongly biundulate in larger valves, with the undulation decreasing in prominence with size reduction. My populations are smaller than any previous reports for *E. suecica*, which have a length of 30-60 µm according to Hustedt (1959). These specimens co-occurred with *E. curtagrunowii*, and certainly bear a resemblance. However, the undulations and wide, reflexed ends separate this form from *E.*

curtagrunowii. FUREY et al. (in review) show biundulate forms that they attribute to *E. curtagrunowii*, but their forms do not have the reflexed apices seen in our populations. Certainly these taxa share a recent common ancestry, but at present I consider the populations as belonging to two different taxa. This species was observed in Marshall Brook, Fresh Meadow and Great Meadow wetlands on Mount Desert Island.

Eunotia* cf. *sylvahercynia Nörpel, Van Sull & Lange-Bertalot Plate 27: Figs. 22-24

Sites 069, 080

Valves 21-25 µm long, 3.75-4.75 µm wide; striae 18.5-20 in 10 µm in the center valve, up to 21 in 10 µm near the apices.

These specimens resemble *E. sylvahercynia* in shape and fit the measurements for this taxon (KRAMMER & LANGE-BERTALOT 1991). However, only specimen on Plate 27: Fig. 24 has the flattened dorsal margin characteristic of *E. sylvahercynia*. The specimens were found in Bubble Pond and Breakneck Ponds on Mount Desert Island.

Eunotia tautoniensis Hust. Plate 6: Figs. 1-5

Sites 018, 117

Valves 115-164 µm long, 6.5-8 µm wide; striae 12-15 in 10 µm in the center valve, 12-17 in 10 µm near the apices; punctae 28-30 in 10 µm.

My population of *E. tautoniensis* matches the typical valve outline and measurements reported for this taxon (PATRICK & REIMER 1966). This species was originally described from Massachusetts. PATRICK & REIMER (1966) also mention distribution of this taxon in New England and the Middle Atlantic States. *Eunotia tautoniensis* was also encountered in study of Carolina Bays (Atlantic Coastal Plain) by

GAISER & JOHANSEN (2000). My observation of this taxon supplements and confirms its distribution in Maine. It was found in two streams, in Lurvey Brook on Mount Desert Island and in Bull Brook on Isle au Haut.

Eunotia* cf. *tenella (Grun.) Hust. Plate 27: Figs. 26-27

Site 008

Valves 21-22 µm long, 2.5-2.75 µm wide; striae 21-22 in 10 µm.

The valve outline of these two specimens resembles *E. tenella*. However, it does not match the dimensions for this taxon. Although several authors (e.g., HUSTEDT 1959, PATRICK & REIMER 1966, and KRAMMER & LANGE-BERTALOT 1991) give differing dimension limits for *E. tenella*, they agree that striae density does not exceed 20 striae in 10 µm. FUREY (2008) reports striae density for her population of *E. tenella* to be 20-22 striae in 10 µm, which corresponds with my observation. However, she discusses this inconsistency and possible resemblance to *E. exigua sensu lato*. My specimens were found in Big Heath wetland on Mount Desert Island.

Eunotia tetraodon Ehr. Plate 1: Figs. 1-4

Sites 001, 016, 076, 116

Valves with four undulations on the dorsal side of valve, 39-54 µm long, 12.5-14.5 µm wide in center valve, 15.5-18 µm wide at widest point; striae not always crossing entire valve, 7-12 in 10 µm on the ventral side, 12-16 in 10 µm on the dorsal side, 12-15 in 10 µm near the apices.

Generally, this taxon does not exceed 50 µm in length (KRAMMER & LANGE-BERTALOT 1991). However, the typical valve outline with four undulations, and striae count fit well the description of the species. *Eunotia tetraodon* was observed in Echo Lake, Heath Swamp, Witch Hole Pond on Mount Desert Island, and in Long Pond on Isle au Haut.

Eunotia trinacria Krasske Plate 31: Figs. 1-22

Sites 018, 093, 109, 111, 117, 119

Valves 10-31 µm long, 2-2.75 µm wide; striae 17-19 in 10 µm.

This population fits the most concepts of *E. trinacria,* with thin valves, narrowly rounded ends, and 17-22 striae in 10 µm (HUSTEDT 1959, PATRICK & REIMER 1966, LANGE-BERTALOT et al. 1996). However, some authors report higher striae density for this taxon or its synonym *E. paludosa* var. *trinacria*. KRAMMER & LANGE-BERTALOT (1991) reported the striae density range to be 19-25(32) striae in 10 µm, while FUREY (2008) gave 21-23 striae in 10 µm. My specimens were found in brooks on Mount Desert Island and in diverse habitats on Schoodic Peninsula.

Eunotia ursamaioris Lange-Bertalot & Nörpel-Sch. Plate 25: Figs. 30-37

Sites 020, 023, 040, 058

Valves 15-27 µm long, 4.5-6 µm wide; striae 13-17 in 10 µm in the center valve, up to 18 in 10 µm near the apices.

Eunotia ursamaioris was in the past called *E. septentrionalis* Oestrup. However, when the type material for *E. septentrionalis* was examined, LANGE-BERTALOT &

GENKAL (1999) found that the most commonly found taxon (shown e.g., in HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996) is not consistent with the type material for *E. septentrionalis*. In their study from Siberia, LANGE-BERTALOT & GENKAL (1999) show populations of both *E. ursamaioris* and *E. septentrionalis* (see also ANTONIADES et al. 2008). *E. ursamaioris* has since been reported in more recent studies (WERUM & LANGE-BERTALOT 2004), but sometimes the incorrect name is still used (FUREY 2008). My population was found in samples from brooks and wetlands on Mount Desert Island.

Eunotia* cf. *varioundulata Nörpel-Sch. & Lange-Bertalot Plate 26: Fig. 16

Site 043

Valve 14.5 µm long, 3 µm wide; striae 23 in 10 µm.

This specimen is similar to *E. varioundulata* in LANGE-BERTALOT et al. (1996), reported as *E. exigua* (Brébisson) Rabenhorst sensu lato (formae *bidens* and *tridentula*) in KRAMMER & LANGE-BERTALOT (1991). However, *E. varioundulata* has an undulated dorsal margin, while my specimen's dorsal valve margin is flat. The strongly dorsally-recurved ends separate the specimen from *E. exigua* and *E. tenella.* This taxon was found in The Bowl on Mount Desert Island.

***Eunotia* sp. 1** Plate 5: Fig. 4

Site 001

Valve 70 µm long, 6.5 µm wide; striae 15-16 in 10 µm in the center valve, 16-17 in 10 µm near the apices; punctae 27-28 in 10 µm.

This specimen does not match any taxon from the literature. Its shape is similar to *Eunotia maior* (W. Smith) Rabenhorst, but this species is generally bigger than my specimen and the striae are coarser (PATRICK & REIMER 1966, ANTONIADES et al. 2008). There is also some similarity with *E. rostellata* Hust., but this species is much smaller than my specimen. Maximal length reported for *E. rostellata* is 30 µm in ANTONIADES et al. (2008), and 46 µm in PATRICK & REIMER (1966). KRAMMER & LANGE-BERTALOT (1991; pl. 159, fig. 6) show a bigger specimen of *E. rostellata*, but its shape and striae count differ from my taxon. This specimen occurred in Echo Lake on Mount Desert Island.

***Eunotia* sp. 2** Plate 17: Figs. 1-9, Plate 18: Figs. 1-10

Sites 008, 018, 081, 109, 116, 117

Valves 33-97 µm long, 3-4 µm wide (mostly 3.5 µm); striae 14.5-17(20) in 10 µm in the center valve, up to 21 in 10 µm near the apices; 12-27:1 length-breadth ratio.

Valves are mostly 3.5 µm wide and slightly arched. Valve ends are narrowed toward rounded or somewhat capitate ends. The raphe is distinct, but short. The valve outline of this taxon is very constant. It is probably related to *E. bilunaris*, because it fits the measurements and possesses a similar shape. However, my population is very distinct and might represent a cryptic species within *E. bilunaris sensu lato*. This taxon also shares features with *E. naegelii* Migula. However, *E. naegelii* is thinner and has a larger length-breadth ratio (PATRICK & REIMER 1966). *Eunotia* sp. 2 was observed in ponds and streams in all three parts of Acadia National Park.

***Eunotia* sp. 3** Plate 21: Figs. 10, 11

Sites 023, 029

Valves slightly arched, distinctly swollen apically to form capitate ends, 92-131 µm long, 3.5 µm wide in the center valve, 4.25-5 µm wide at the head poles; raphe short, distinct, perpendicular to the striae; striae parallel, 17-17.5 in 10 µm in the center valve, up to 19 in 10 µm near the apices.

This taxon probably belongs to the *E. flexuosa* species complex. Both specimens fit the measurements for *E. flexuosa* (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991), but the arch and capitate ends are more distinct than found in *E. flexuosa*. One specimen (Plate 21: Fig. 10) resembles a drawing of *E. flexuosa* in HUSTEDT (1959), but my population of *E. flexuosa* (Plate 14: Figs. 1-10) is very different from this specimen. The second specimen (Plate 21: Fig. 11) has even more capitate ends which are swollen dorsally on the valve margin. I believe that both specimens belong to the same, probably new species. They were found in samples from Fresh Meadow and Long Pond on Mount Desert Island.

***Eunotia* sp. 4** Nörpel-Sch. & Lange-Bertalot Plate 22: Figs. 6-11

Sites 008, 016, 020, 032, 068, 115, 117

Valves 15.5-33 µm long, 3.5-4.5 µm wide; striae 14-16 in 10 µm in the center valve, up to 17 in 10 µm near the apices.

This taxon probably belongs to the group of species related to *E. bilunaris*. It is usually very difficult to recognize short *Eunotia* specimens. The short specimens often lose the distinctive characteristics visible in larger specimens, such as constrictions near the apices. The specimens shown here (Plate 22: Figs. 6-11) might be a part of a diminutive series of *E. bilunaris,* which was present in this study (Plate 15: Figs. 1-12). Indeed, their measurements fit within the size range for that taxon given by KRAMMER & LANGE-BERTALOT (1991). However, the shape is slightly different from *E. bilunaris*. The apices of *Eunotia* sp. 4 are widely pointed and the raphe is strongly flexed towards the dorsal valve margin. *E. bilunaris* has widely rounded apices, even in the smallest specimens. *E. bilunaris* and *Eunotia* sp. 4 did not co-occur in the samples.

This taxon also resembles *E. boreotenuis,* and it more or less matches the measurements for this taxon (LANGE-BERTALOT & METZELTIN 1996, FUREY 2008). However, the valve shape of my population is different. Valves are distinctly wider and the apices are widely pointed, not protracted as in *E. boreotenuis*. LANGE-BERTALOT & METZELTIN (1996) show two specimens of *E. boreotenuis* from Baffin Island in Canada. Likewise, FUREY (2008) encountered this taxon in the study of the Great Smoky Mountains. However, my population is distinct from all other published accounts of the species.

Eunotia sp. 4 was found in small streams, lakes and wetlands on Mount Desert Island, Schoodic Peninsula and Isle au Haut.

***Eunotia* sp. 5** Plate 23: Figs. 1, 2

Sites 031, 068

Valves 51-95 µm long, 6.5-8.5 µm wide; striae 18-22 in 10 µm in the center valve, 20-24 in 10 µm near the apices.

This species is characterized by its large terminal nodules. This feature and the valve outline are similar to *E. ruzickae* Bílý & Marvan reported in KRAMMER & LANGE-BERTALOT (1991). However, striae density reported for *E. ruzickae* is much lower (13-14 striae in 10 µm), and the valve outline is slightly undulate, so the Acadia populations are surely not conspecific with *E. ruzickae.* This taxon was found in Duck Pond and in Eagle Lake on Mount Desert Island.

***Eunotia* sp. 6** Plate 23: Figs. 8-9

Sites 001, 068

Valves 54-75 µm long, 8.5-9.5 µm wide; striae 10-11 in 10 µm in the center valve, up to 13 in 10 µm near the apices.

This taxon does not conform to any taxon described in the literature. Valves are relatively large, dorsal margin is flat, the beak-like apices are protracted, terminal nodules are small. This taxon was found in Echo Lake and Eagle Lake on Mount Desert Island.

***Eunotia* sp. 7** Plate 24: Figs. 15-19

Sites 003, 058, 073, 115

Valves 21-29 µm long, 5-6.5 µm wide; striae 11-14 in 10 µm in the center valve, up to 16 in 10 µm near the apices.

The valve outline in this taxon is very distinct, with a flattened, slightly undulate dorsal valve and broadly rounded ends. This population does not fit any taxon described in the literature. It was found brooks and ponds on Mount Desert Island and Schoodic Peninsula.

***Eunotia* sp. 8** Plate 26: Figs. 4-7

Sites 117, 119

Valves 25-29 µm long, 7-7.5 µm wide in the center valve, 7.5-8 µm wide at undulation; striae 9.5-10 in 10 µm in the center valve, up to 11 in 10 µm near the apices.

This species does not conform to any description of *Eunotia* species in the literature. The dorsal valve margin is slightly double-undulate. The apices are slightly capitate and broadly rounded. This taxon resembles *E. diodon* Ehr. in its outline (e.g., KRAMMER & LANGE-BERTALOT 1991, LANGE-BERTALOT & METZELTIN 1996), but *Eunotia* sp. 8 is very coarsely striated compared to *E. diodon*. This taxon was found in Hunters Brook on Mount Desert Island and in Bull Brook on Isle au Haut.

***Eunotia* sp. 9** Plate 26: Fig. 8

Site 087

Valve 33 µm long, 5-5.5 µm wide; striae 11.5-12 in 10 µm in the center valve, up to 14.5 in 10 µm near the apices.

This specimen is probably related to *E. pectinalis*. Although the measurements for this taxon fit the description of *E. pectinalis* (e. g., KRAMMER & LANGE-BERTALOT 1991), it differs by possessing slightly arched valves and by an irregular undulation on the dorsal valve margin. This specimen was found in Aunt Betty Pond on Mount Desert Island.

***Eunotia* sp. 10** Plate 26: Fig. 9

Site 087

Valve 27 µm long, 5 µm wide; striae 12 in 10 µm in the center valve, up to 14.5 in 10 µm near the apices.

This nondescript taxon does not fit any species in the literature. However, a larger population is needed before it can be named or placed in a variable taxon. This species was found in Aunt Betty Pond on Mount Desert Island.

***Eunotia* sp. 11** Plate 26: Figs. 10-14

Sites 104, 111, 115

Valves 20-28 µm long, 4.25-5.5 µm wide; striae 13-16 in 10 µm in the center valve, up to 16.5 in 10 µm near the apices.

This taxon is characterized by its oval shape and distinct terminal nodules. Valves are oval and sometimes slightly arched, apices broadly rounded, striae parallel, terminal nodules placed at the very end of the apices. This form does not match any *Eunotia* species described in the literature. It was found in a wetland near the Dorr Mountain on Mount Desert Island and in a pond and on a wet wall on Schoodic Peninsula.

***Eunotia* sp. 12** Plate 26: Fig. 15

Site 031

Valve 30 µm long, 5 µm wide; striae 16 in 10 µm in the center valve, up to 18 in 10 µm near the apices.

This taxon has a very distinctive shape. The valve is arched and the dorsal valve margin is highly convex. The apices are rounded, strongly capitate, and recurved dorsally. It did not match any taxon described in the literature, but unfortunately only a single specimen was seen. If a population of this species could be found, it is likely it could be described as new. This specimen was found in Duck Pond on the west part of Mount Desert Island.

***Eunotia* sp. 13** Plate 27: Figs. 1-18

Sites 016, 076, 080, 081, 087

Valves 23-63 µm long, 3-5 µm wide; striae 17.5-21 in 10 µm in the center valve, up to 22 in 10 µm near the apices.

The valves are almost linear with slightly protracted rounded apices. Striae are parallel in the center, becoming slightly radiate at the apices. Terminal nodules are large and located somewhat distant from the apices. The morphology and dimensions of this taxon do not conform to any *Eunotia* taxon described in the literature. Given the size of the populations found, this will likely be described as new to science in the publication that follows from this thesis. This taxon was found in Heath Swamp and ponds in northwest part of Mount Desert Island.

***Eunotia* sp. 14** Plate 27: Fig. 25

Site 119

Valve 23 µm long, 3 µm wide; striae 17.5 in 10 µm.

The valve outline and measurements of this small *Eunotia* are similar to a number of species, but fit none. More material is needed. This taxon was found in Hunters Brook on Mount Desert Island.

***Eunotia* sp. 15** Plate 29: Figs. 29-44

Sites 037, 043, 068, 069, 080, 107

Valves 16-41 µm long, 2-2.5 µm wide; striae 21-22 in 10 µm.

This taxon has distinctive, very thin linear valves with slightly pointed ends. Terminal nodules are distinct and relatively large given the narrow valve width, and are removed from the valve ends to the ventral side (similar to the configuration in *E. incisa*). Striae are parallel, sometimes slightly radiate at the apices. This population does not fit any taxon in the literature. Its thin, linear valves bear some resemblance to *E. fallax* Cleve-Euler, but this species has much coarser striae and the overall morphology is different. In the study of Cape Cod Peninsula, Massachusetts, SIVER et al. (2005) show a single "narrow form" of *E. incisa* (pl. 26, fig. 12), which is very similar to my taxon (with a similar striae density of 23 striae in 10 µm). However, it seems to have round apices and the terminal nodules are not very distinct. It does not fit *E. incisa* in my opinion. My populations were found in Kebo Brook and in several lakes on Mount Desert Island and likely represent a species new to science.

***Eunotia* sp. 16** Plate 30: Figs. 1-6

Site 018

Valves 44-52 µm long, 2.25-2.75 µm wide; striae 18 in 10 µm, up to 19 in 10 µm near the apices.

This taxon is very distinct in its valve outline. The valves are thin, slightly arched, and sometimes irregularly undulate on both dorsal and ventral valve margins. Apices are rounded and sometimes slightly flexed to the dorsal side. Terminal nodules are small and near the terminus of the apices. Striae are parallel. This taxon does not match any description reported in the literature. My population was found in Lurvey Brook on Mount Desert Island.

***Eunotia* sp. 17** Plate 30: Fig. 11

Site 116

Valve 22 µm long, 3.25 µm wide; striae 17-18 in 10 µm.

The dorsal valve margin of this taxon is distinctly flat. The rounded apices are slightly capitate. Striae are slightly radiate. This taxon probably belongs to a group of species related to *Eunotia tenella*, because of the similar valve size and shape. However, this specimen differs distinctly in its valve outline from *E. tenella*, especially in the flat dorsal valve margin. This taxon was found in Long Pond on Isle au Haut.

Semiorbis hemicyclus (Ehr.) Patrick Plate 33: Figs. 1-6

Sites 043, 055

Valves 24-51 µm long, 4-4.5 µm wide; striae 9-11 in 10 µm in the center valve.

Semiorbis hemicyclus is a very good indicator of acid, cool waters, and is easily distinguished by its typical shape of the valve. In the past, this taxon was placed in different genera, such as *Amphicampa* or *Eunotia* (KRAMMER & LANGE-BERTALOT 1991, Lange-BERTALOT & METZELTIN 1966), but was later recognized as a separate genus (SIVER et al. 2005). My population matches the valve outline and measurements reported in the literature (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991), except for the length. The valves are usually not longer than 40 µm, but SIVER et al. (2005) found specimens up to 45 µm long. My population of *Semiorbis hemicyclus* was even bigger, which extends the length limit for this taxon. This species was observed in samples from The Bowl and Lower Hadlock Pond on east part of Mount Desert Island.

3.1.2 Family: **Peroniaceae**

Peronia* cf. *heribaudi Brun & Peragallo Plate 34: Figs. 28-34

Sites 032, 068, 069, 073

Valves 16-21 µm long, 2.5-3 µm wide, heterovalvar, with raphe shortened more on one valve than the other, sometimes missing at the head pole; striae 22 in 10 µm.

KRAMMER & LANGE-BERTALOT (1991) considered all common *Peronia* species (*P. erinacea* Brébisson & Arnott, *P. heribaudi,* and *P. fibula* (Brébisson & Kützing) Ross) into a single taxon, *Peronia fibula*. I do not agree with this approach, as earlier authors clearly recognized *P. fibula* or its later synonym, *P. erinacea*, as having a clearly broadened, capitate head pole (HUSTEDT 1959). *Peronia heribaudi* has a head pole with diameter similar to the diameter of the widest portion of the central part of the valve, and may be slightly set off by a subterminal constriction. *Peronia intermedium* (H. L. Smith) Patrick has a head pole thinner than the main part of the valve, and is not set off by a constriction. Our specimens of *P. heribaudi* conform to the concept for this taxon held by HUSTEDT (1959) in terms of size and striae density, but valve outline more closely resembles that shown for *P. intermedium* in PATRICK & REIMER (1966). This taxon occurred mostly in lakes or larger ponds (Seal Cove Pond, Eagle Lake, Bubble Pond) on Mount Desert Island.

***Peronia* sp. 1** Plate 34: Figs. 1-27

Sites 032, 068, 069, 073, 076, 080

Frustules in girdle-view are wedge-shaped. Valves are clavate, with an apiculate head pole much narrower than the widest portion of the valve, heterovalvar with respect to the raphe, 22-32 µm long, 2.5-3 µm wide. Raphe on one valve with slits each extending about one third the length of the valve, on the other valve shortened or absent at the head pole, and shortened at the foot pole. Striae parallel, 21-23 in 10 µm.

This morphotype was the most common *Peronia* in Acadia National Park samples. The valve outline is distinctly different than all previously described species. The apiculate head pole resembles that of *P. heribaudi* slightly, but is drawn out to a much finer apex. Given the co-occurrence with my specimens of *P. heribaudi* (in large lakes and ponds on Mount Desert Island), it seems possible that only one species in this genus is present in the park. If that is the case, then the best name would be *Peronia* sp. 1 for all populations, as the majority of forms seen in the park clearly differ from other described species. The *P. heribaudi*-like specimens are all at the small end of the size range, and diatoms frequently become less constricted at the apices and more rounded in outline as they approach their minimum length.

METZELTIN & LANGE-BERTALOT (1998) saw this taxon in material from Venezuela, and called it *Peronia* spec. cf. *fibula* cf. *brasiliensis*. FOGED (1977) saw several morphotypes in samples from Ireland and called them all *P. heribaudi*. In examining the various manuscripts in which *Peronia* is illustrated, I saw no clear evidence that the form with an acuminate head pole intergrades with the other, previously described non-acuminate species.

4. DISCUSSION

In this study, approximately 550 diatom species in 87 genera (Table 3) were found in 45 examined sites. In a study from a nearby Cape Cod Peninsula, MA, SIVER et al. (2005) observed 315 diatom species in 56 mostly acidic and poorly buffered lakes (and ponds). Similarly, 325 diatom taxa were documented from 51 lakes in northeastern Wisconsin (LIPSEY 1988). Species richness of diatoms seems to be much lower in the Cape Cod Peninsula (which is five times larger than ANP) (SIVER & HAMILTON 2005) and in the area of northeastern Wisconsin studied by Lipsey (1988) (which is at least 100 times larger), than the species richness observed in Acadia NP. (However, it is difficult to directly compare the diatom richness of these studies with mine, because I sampled more habitat categories in Acadia NP than the other authors examined. Furthermore, although the sampling intensity might be similar, I sampled all sites and then carefully chose among those sites to maximize habitat diversity actually examined. Despite a possible difference in sampling intensity and strategy, I conclude that the diatom richness in Acadia NP was still very high for such a small geographic area.

The study subsequently focused on the Eunotiophycidae for two reasons – time constraints and *Eunotia* being definitely the most speciose genus in Acadia NP samples. Seventy-seven species and varieties belonging to this genus were observed. The genus *Eunotia* and other genera of Eunotiophycidae seem to be restricted to freshwater (ROUND et al. 1990), preferentially inhabiting oligotrophic or dystrophic waters (PATRICK & REIMER 1966). This corresponds with my observations. Eunotiophycidae were recorded only from the freshwater sites, which were mostly strongly acidic with low conductivity and salinity (Table 1, Table 2). There were no Eunotiophycidae recovered in the barackish habitats, with the exception of a single specimen of *Eunotia* cf. *flexuosa* var. *eurycephala*, which was found in a brackish pond on Schoodic Peninsula (site 114). This occurrence was most likely accidental. The specimen probably had washed into the pond from a freshwater habitat.

There were five freshwater habitat categories to which examined sites were assigned: lakes (6 sites), ponds (15), streams (11), wetlands (5) and wetwalls (3). Most of the Eunotiophycidae species were observed in ponds (58 species), streams (46 species) and lakes (35 species; Table 4). The most species rich locality was Aunt Betty Pond (site 087) on MDI with 20 Eunotiophycidae taxa present. These 20 taxa represent 25 % of total number of Eunotiophycidae (81 taxa) recorded from Acadia NP. Only one third of sites (14 out of 45 examined) contained 10 or more Eunotiophycidae species in the samples. These individual localities belonged to lakes, ponds, streams and wetlands, meaning that each of these habitat categories contained at least one site with elevated species richness of Eunotiophycidae. Similarly, higher species richness was observed in at least one sample from each of the three major parts of Acadia NP, i.e., MDI, Schoodic Peninsula and Isle au Haut,implying that elevated species richness was not restricted to a certain habitat type or geographic area in the park.

Although all of the freshwater localities contained at least some Eunotiophycidae, there were a high number of sites with low numbers of taxa present in the samples. This reality might be caused by the methodology of collecting presence-absence data for individual Eunotiophycidae. In fact, documentation of the Eunotiophycidae was not the original target of the study. Therefore, some *Eunotia* taxa (the recorded ones or even new ones) might have been occasionally overlooked during sample examination. Thus, more occurrences of *Eunotia* species may be recorded, if future examinations focused on the genus. Other genera (and their species) within Eunotiophycidae were so distinct and rare, that very little omission is expected.

It is difficult to separate the influence, caused by sampling methodology or real ecological preferences, on the resulting reported distribution of Eunotiophycidae species within habitat categories. Only seven *Eunotia* species appeared in 10 or more samples (maximum of 16 out of 45 sites; Table 4). *Eunotia pectinalis* and *E. incisa* were the most frequent species, occurring mostly in ponds, sometimes in streams. The other five frequent species (*Eunotia exigua*, *E. flexuosa*, *E. bilunaris*, *E. faba* and *E. rhomboidea*) were present in samples from either standing waters (ponds and lakes), or streams, or both together. There were several, but not many, species restricted to one habitat type, e.g. *Eunotia* cf. *rushforthiana* in streams, *Eunotia* sp.13 in ponds. The other three genera of Eunotiophycidae, *Actinella* sp., *Peronia* spp. and *Semiorbis* sp., were observed solely in ponds and lakes (Table 4). However, most of the Eunotiophycidae were observed in various habitat categories with no distinct preferences. At the same time, many species were not frequent in various samples – almost a third of them were present in only one site. Consequently, decisions about the species habitat preferences are almost impossible to make at this time. With repeated sampling in the park it is possible that clearer distribution patterns and preferences would emerge.

Since this is a taxonomical study, each taxon description includes a discussion of the taxonomy with available literature; an intensive search of the literature was made to find species names. Nevertheless, the identification of Eunotiophycidae taxa was often difficult. One of the difficulties was caused by problematic type material or confusing drawings in the classical literature, which very often includes one or only a few illustrations per species. In the taxonomic section of this study, I discuss problems concerning drawings of *Eunotia exigua* and *E. nymanniana* in SCHMIDT et al. (1874-1959) (see under *Eunotia* cf. *nymanniana*). Similarly, DENICOLA (2000) discusses the broad morphological variability of *Eunotia exigua* and difficulties with recognizing it from similar taxa, such as *E. tenella*. FUREY et al. (in review) clarifies the problems around *E. nymanniana.* (There were two different populations in the type material of this taxon. To add to the confusion, KRAMMER & LANGE-BERTALOT (1991) show two populations of *E. nymanniana*. However, no specimens from these two populations belong to the correct concept of *E. nymanniana*.) A different type of confusion exists around *Eunotia bilunaris*. There are several synonyms of this taxon used in the recent literature (HUSTEDT 1959, PATRICK & REIMER 1966, KRAMMER & LANGE-BERTALOT 1991). This problem stems from the fact that all the synonyms were originally described within a different genus. Furthermore, the publication date of the original work is unclear. (This problem is discussed under *Eunotia bilunaris* in Species Descriptions in this study).

More taxonomic difficulties exist due to the Eunotiophycidae being a widely understudied diatom group, especially in North America, and a revision at the species level is needed (ROUND et al. 1990). PATRICK & REIMER (1966) reported 65 taxa of Eunotiophycidae for the whole continent in 1966. Since that time, several new *Eunotia* species were described. However, 81 Eunotiophycidae taxa were found in Acadia NP alone (approximately one third of them are reported in PATRICK & REIMER 1966). None of the older studies encountered such a high richness of Eunotiophycidae in any North American area. Most studies reported only about 25 taxa of Eunotiophycidae from various parts of the country (HOHN & HELLERMAN 1963, GAISER & JOHANSEN 2000, SIVER et al. 2005). Only in the study of the *Eunotia* flora in Great Smoky Mountains National Park was a comparably high number of species observed (FUREY 2008).

A revised taxonomy of Eunotiophycidae is needed, particularly given the numerous ecological studies of diatoms in North America. KRAMMER & LANGE-BERTALOT (1991), a basic and widely used taxonomical literature, is not a very good source for determination of Eunotiophycidae. This work includes mostly European taxa and was published at a time when species were very broadly circumscribed (i.e., vastly variable measurements including length, width, striae counts, etc.). These broadly defined species included many morphotypes, and the morphological and ecological variability observed was considered just as population or ecophenotypic variation. Now this approach is considered incorrect by most diatom systematists. Scanning electron microscopy in particular has helped demonstrate that many of the species defined by light microscopy in reality represent multiple lineages and species. Despite a change in thinking among systematists, many scientists, especially diatom ecologists, still use KRAMMER & LANGE-BERTALOT (1991) and misidentify or do not recognize newly established taxa. DENICOLA (2000) criticizes this approach and discusses problems especially around *Eunotia exigua*-like taxa (e.g. *E. tenella*, *E. septentrionalis*), which are commonly misidentified in recent studies. This practice of lumping diverse ecologically distinct lineages into a few taxa causes more confusion and lessens our ability to use diatoms as indicators of water quality.

Due to the historic difficulties described above and the ecological importance of Eunotiophycidae, this group needs more attention from scientists. FUREY (2008) studied in detail the genus *Eunotia* in GSM NP and found 55 *Eunotia* taxa in local springs, streams and small wetlands. There were 2 new records for North America and 14 species which will be described as new in FUREY et al. (in review). My study revealed 77 *Eunotia* species and varieties in Acadia NP. Twenty-two *Eunotia* species overlapped with the findings from GSM NP. Seventeen of the Acadia NP *Eunotia* taxa did not conform to any description in the literature. These latter taxa may represent exceptionally variable valves within known species, but more likely represent species new to science. For those unknown taxa with an uncertain identification, further work (such as scanning electron microscopy and consultation with the New Species File at the Academy of Natural Sciences of Philadelphia) is needed before they can be formally described as new species in the literature.

To obtain a complete diatom flora of Acadia NP, all slides from the 119 sampled localities need to be closely examined. Many of the diatom species observed in the samples were represented only by a few valves. Larger populations and new species records would be certainly found if all the samples were studied in detail.

When the complete diatom flora is obtained, the taxa can be used to evaluate water conditions (i.e., eutrophication, anthropogenic acidification, heavy metal pollution), or to reconstruct historical events in the area. This technique is now commonly used in North America (e.g., DIXIT et al. 1999, REAVIE & SMOL 2001, PASSY et al. 2006). In Maine, WANG et al. (2006) developed and tested diatom indicators for wetlands. To develop diatom indicators a detailed synoptic chemistry of waters needs to be analyzed and relative species densities counted in the samples. This allows weighted averaging (WA) to get indicator values for individual species (WANG et al. 2006). Having water chemistry for all sites along with a determination of the abundances of diatom species from those sites within Acadia NP would permit determination of optima and tolerances of diatom species to chemical parameters of interest, such as pH (SIVER & HAMILTON 2005). This work remains to be done, but if completed would have importance to water quality managers throughout the northeastern United States and the Maritime Provinces of Canada. This work is planned for the future.

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Table 1. List of sites sampled within Acadia National Park including site number and description, date of sampling, UTM coordinates, site category, and water characteristics (pH, temperature, conductivity, salinity). Conductivity was measured in µS; salinity in ppt. Site names in quotation marks were not named in maps, so a temporary name was used for easier orientation. Stars (*) indicate studied samples.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
*001	Echo Lake - Ikes Point, boat launch	June 5, 2008	553062.5	4908285.4	*Lake*	5.0	17.0	55.7	0.0
002	Echo Lake - Ikes Point, stream near a boat launch	June 5, 2008	553084.6	4908257.0	*Stream*	5.5	12.1	146.2	0.1
*003	Echo Lake Beach	June 5, 2008	552925.9	4907094.3	*Lake*	4.8	17.0	54.1	0.0
004	Seawall Pond - outlet to sea	June 5, 2008	555912.0	4899047.9	*Brackish*	4.5	18.4	75.3	0.0
005	Seawall Pond - peaty pond	June 5, 2008	555920.5	4899047.9	*Pond*	4.3	17.2	78.0	0.0
006	"Seawall Pond" II. - west from picnic area along the sea shore	June 5, 2008	555241.1	4898395.0	*Pond*	4.6	17.0	75.8	0.0
007	"Seawall Pond" III. - further south from site 006 adjacent to sea	June 5, 2008	555213.4	4898022.4	*Brackish*	5.6	20.9	13630.0	8.5
*008	Big Heath - wetland (*Sphagnum*) adjacent to Rd 102A	June 5, 2008	554246.3	4898083.4	*Wetland*	4.5	22.6	9.0	0.0
*009	Adams Bridge (Rd 102) - Bass Harbor Marsh (south), stream estuary to sea	June 5, 2008	552635.0	4900223.2	*Brackish*	7.0	15.4	41730.0	26.8
010	Adams Bridge (Rd 102) - culvert brook near the bridge	June 5, 2008	552744.4	4900249.1	*Stream*	5.0	14.3	124.9	0.1
011	Bass Harbor Marsh (north) - gravel-pit pond on Marsh Rd near a cemetery	June 5, 2008	551720.0	4900791.5	*Pond*	5.3	19.8	168.7	0.1
012	Bass Harbor Marsh (north) - boggy area (shaded site) at the end of Marsh Rd access, 200m from gate	June 5, 2008	551717.6	4901249.8	*Wetland*	4.4	14.4	40.2	0.0
013	Bass Harbor Marsh (north) - beaver pond with a large marsh at the end of Marsh Rd access, 300m from gate	June 5, 2008	551867.5	4901141.3	*Pond*	4.6	21.2	38.4	0.0
014	Bass Harbor Marsh (north) - boggy area (sunny site) at the end of Marsh Rd access, 200m from gate	June 5, 2008	551865.4	4901140.7	*Wetland*	4.5	18.7	22.1	0.0
015	Seal Cove Rd. (west) - little pond south of the road	June 5, 2008	548313.1	4903441.6	*Pond*	4.8	21.0	56.4	0.0
*016	"Heath Swamp" - north of Seal Cove Rd	June 5, 2008	549607.2	4903205.8	*Pond*	4.8	19.9	36.9	0.0
017	Heath Brook - on Seal Cove Rd	June 5, 2008	550417.2	4902919.4	*Stream*	4.6	18.1	41.2	0.0
*018	Lurvey Brook - on Seal Cove Rd, scraping from a culvert	June 5, 2008	551254.8	4903044.5	*Stream*	4.5	11.9	27.0	0.0

Table 1. Continued.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
019	Marshall Brook (west branch) - on Seal Cove Rd	June 5, 2008	551891.9	4903626.3	*Stream*	4.8	12.4	44.6	0.0
*020	Marshall Brook (east branch) - on Seal Cove Rd	June 5, 2008	552176.5	4903751.3	*Stream*	5.2	17.2	141.8	0.1
021	Brook to a northeast tidal flat of Somes Sound - Rd 198	June 6, 2008	554976.0	4912592.8	*Stream*	4.8	10.4	18.0	0.0
022	Oldhouse Cove - brackish marsh near the road junction of 3 and 198	June 6, 2008	550626.2	4919018.9	*Brackish*	6.5	16.4	29010.0	21.5
*023	Fresh Meadow - swamp near road connecting Town Hill and Hulls Cove	June 6, 2008	554712.2	4917696.9	*Wetland*	4.8	13.9	138.3	0.1
024	Round Pond (south)	June 6, 2008	549873.4	4910844.1	*Pond*	4.6	18.0	49.1	0.0
025	Pretty Marsh picnic area - spring next to Rd 102	June 6, 2008	547537.0	4908979.0	*Stream*	4.7	10.9	282.1	0.2
026	Long Pond Fire Rd - small wetland, brook to Hogdon pond	June 6, 2008	547800.1	4908844.9	*Wetland*	4.7	12.2	43.7	0.0
027	Long Pond Fire Rd - brook II., east from site #026	June 6, 2008	549325.6	4908985.5	*Stream*	4.5	10.7	22.1	0.0
028	Duck Pond Brook (West MDI) - on Long Pond Fire Rd	June 6, 2008	549557.3	4908827.6	*Stream*	4.7	11.3	19.5	0.0
*029	Long Pond (west) - MDI, Long Pond Fire Rd	June 6, 2008	549839.7	4908696.8	*Lake*	4.8	16.5	36.6	0.0
030	Great Brook - estuary to Long Pond	June 6, 2008	550083.8	4908213.0	*Stream*	4.8	11.2	22.7	0.0
*031	Duck Pond (West MDI)	June 6, 2008	549455.5	4907636.8	*Pond*	4.6	16.1	24.5	0.0
*032	Seal Cove Pond (north) - sampling from a raft	June 6, 2008	548040.8	4906944.0	*Lake*	4.8	17.5	35.9	0.0
033	Brook to Seal Cove Pond (east shore) - south of the Pine Hill	June 6, 2008	548305.5	4906673.0	*Stream*	4.8	10.0	28.7	0.0
*034	Hodgdon Pond (south)	June 6, 2008	548047.2	4907111.5	*Pond*	4.7	18.2	47.0	0.0
035	Small pool between Kebo Mtn & The Whitecap - near a trail coming from the parking place below Kebo Mtn	June 7, 2008	561969.0	4912880.7	*Stream*	4.8	9.4	20.9	0.0
036	Brook between Kebo Mtn & The Whitecap - near a trail coming from the parking place below Kebo Mtn	June 7, 2008	562059.2	4913061.5	*Stream*	4.8	11.1	19.3	0.0
*037	Kebo Brook - below the parking place on Park Loop Rd	June 7, 2008	561996.6	4913670.0	*Stream*	5.0	9.8	22.7	0.0
038	Park Loop Rd - wet wall on the overlook stop northeast from Champlain Mtn	June 7, 2008	564667.4	4912173.9	*Wet wall*	4.9	***NA***	***NA***	***NA***
039	Schooner Head Rd I. - pond I. (Schooner Head across the road)	June 7, 2008	565397.2	4910254.0	*Pond*	5.3	13.6	55.8	0.0
*040	Schooner Head Rd II. - wetland (Cranberry Hill across the road)	June 7, 2008	565217.9	4910777.8	*Wetland*	4.8	13.4	165.3	0.1
041	Schooner Head Rd III. - pond 76	June 7, 2008	565007.6	4911368.6	*Pond*	5.2	20.9	78.2	0.0
042	Bar Harbor, Old Farm Rd - a little pond	June 7, 2008	564120.3	4913549.3	*Pond*	5.5	16.6	824.0	0.5

Table 1. Continued.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
*043	The Bowl (south) - lake	June 7, 2008	564428.1	4909513.8	*Pond*	4.7	18.0	31.4	0.0
044	Small marsh pond south of The Beehive	June 7, 2008	564647.2	4908983.2	*Wetland*	4.9	18.5	42.5	0.0
045	Beaver pond - east of the Beehive Mtn, adjacent to Park Loop Rd	June 7, 2008	565007.3	4909290.1	*Pond*	4.8	13.3	49.3	0.0
046	Small pond west of Halfway Mtn	June 7, 2008	563927.5	4909095.9	*Pond*	4.7	14.2	30.7	0.0
047	Small pond west of Halfway Mtn - outflow	June 7, 2008	563917.8	4909132.2	*Stream*	4.7	14.6	32.7	0.0
048	Otter Creek - a pool, west of Rd 3	June 7, 2008	563200.9	4909312.9	*Stream*	5.6	17.9	108.3	0.1
049	Otter Creek - running water, west of Rd 3	June 7, 2008	563201.3	4909312.3	*Stream*	5.5	18.4	100.5	0.1
*050	Stanley Brook - brackish water (tide influence of Seal Harbor Bay)	June 7, 2008	560515.6	4905074.5	*Brackish*	5.4	14.9	29100.0	22.8
051	Sargent Drive - sewage brook	June 8, 2008	555694.9	4910004.4	*Stream*	5.8	11.3	1246.0	0.8
052	Sargent Drive - brook I. (from Parkman Mtn)	June 8, 2008	555689.0	4909788.0	*Stream*	5.0	11.0	126.4	0.1
053	Sargent Drive - brook II. (from Norumbega Mtn)	June 8, 2008	555416.5	4908340.7	*Stream*	4.5	10.1	22.6	0.0
*054	Upper Hadlock Pond (south)	June 8, 2008	556789.7	4907481.9	*Pond*	4.7	19.6	48.6	0.0
*055	Lower Hadlock Pond (southeast)	June 8, 2008	556855.0	4906475.4	*Pond*	4.7	18.4	46.0	0.0
056	Stanley Brook - freshwater (near Seal Harbor town)	June 8, 2008	560419.9	4905705.9	*Stream*	5.4	10.7	62.9	0.0
*057	Great Meadow (north) - marsh next to Park Loop Rd	June 9, 2008	563220.6	4913194.3	*Wetland*	5.0	22.8	83.8	0.0
*058	Cromwell Brook - on Park Loop Rd	June 9, 2008	563229.8	4913256.3	*Stream*	5.0	22.0	67.8	0.0
059	Sieur de Monts spring - in the Nature center	June 9, 2008	563111.5	4912361.9	*Spring*	5.7	9.0	89.3	0.1
060	Nature center - pond in the garden	June 9, 2008	563115.0	4912490.7	*Pond*	6.1	21.5	149.0	0.1
061	Bear Lake (north)	June 9, 2008	564051.0	4912383.0	*Pond*	5.0	23.3	72.2	0.0
062	Bear Brook - wetland north of Park Loop Rd	June 9, 2008	564059.7	4912414.6	*Wetland*	5.6	21.5	201.7	0.1
063	Newport Cove picnic area - brook north of parking lot	June 9, 2008	564978.4	4909011.5	*Stream*	5.1	17.7	18.1	0.0
*064	Newport Cove picnic area - brackish pond on Sand Beach	June 9, 2008	565250.4	4908805.1	*Brackish*	7.0	20.9	36320.0	25.2
*065	Newport Cove picnic area - wet wall east of Sand Beach	June 9, 2008	565388.6	4908672.4	*Wet wall*	5.2	***NA***	***NA***	***NA***
066	Otter Point (south) - freshwater pools on cliffs	June 9, 2008	564647.5	4906360.5	*Pools on cliffs*	4.3	***NA***	***NA***	***NA***

Table 1. Continued.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
067	Pond on Bubble Brook - next to Eagle Lake	June 9, 2008	560179.7	4911479.7	*Pond*	5.1	22.3	36.3	0.0
*068	Eagle Lake (south)	June 9, 2008	560061.1	4911409.5	*Lake*	4.9	18.0	29.7	0.0
*069	Bubble Pond (north)	June 9, 2008	560505.3	4910955.3	*Pond*	4.9	21.6	29.1	0.0
070	Duck Brook Rd (East MDI) - wetland east of the road	June 10, 2008	560495.4	4914607.5	*Wetland*	5.1	19.5	93.0	0.1
071	New Mills Meadow Pond I. (south one)	June 10, 2008	560691.5	4915210.6	*Pond*	4.9	21.9	65.9	0.0
072	New Mills Meadow Pond II. (north one)	June 10, 2008	560843.0	4915544.0	*Pond*	5.1	23.4	55.7	0.0
*073	Duck Brook (East MDI) - below the carriage road bridge	June 10, 2008	560843.4	4915647.1	*Stream*	5.3	23.2	55.5	0.0
074	Wetland east of Witch Hole Pond	June 10, 2008	560919.4	4916423.0	*Wetland*	4.5	21.9	26.0	0.0
075	Small lake northeast of Witch Hole Pond	June 10, 2008	560609.1	4916802.7	*Pond*	4.4	20.9	34.9	0.0
*076	Witch Hole Pond (north)	June 10, 2008	560513.4	4916763.1	*Pond*	4.9	21.8	22.8	0.0
077	Breakneck Brook - former pond (broken dam), west of Paradise Hill	June 10, 2008	559593.6	4917322.5	*Stream*	5.0	21.9	44.1	0.0
*078	Lake Wood (north)	June 10, 2008	558188.7	4917696.6	*Pond*	4.6	23.0	22.0	0.0
079	Fawn Pond (west)	June 10, 2008	558458.8	4917295.6	*Pond*	4.7	23.5	25.6	0.0
*080	Breakneck Ponds - north one	June 10, 2008	559290.0	4915473.1	*Pond*	4.7	24.7	33.1	0.0
*081	Halfmoon Pond	June 10, 2008	559650.4	4915593.7	*Pond*	4.6	24.6	22.9	0.0
082	Small lake southwest of Witch Hole Pond	June 10, 2008	559870.4	4916211.9	*Pond*	4.6	24.0	25.2	0.0
083	Small lake north of Halfmoon Pond	June 10, 2008	559757.0	4915989.2	*Pond*	4.8	24.9	26.9	0.0
084	Breakneck Ponds - south one	June 10, 2008	559366.9	4915056.0	*Pond*	4.8	23.5	38.4	0.0
085	Small lake north of Eagle Lake - Rd 233	June 11, 2008	559722.1	4914117.7	*Pond*	4.5	21.9	49.9	0.0
086	Eagle Lake (north)	June 11, 2008	559730.3	4913968.8	*Lake*	4.7	20.6	31.3	0.0
*087	Aunt Betty Pond (east)	June 11, 2008	557948.6	4913330.6	*Pond*	5.0	22.7	63.9	0.0
088	Gilmore Meadow (north)	June 11, 2008	558037.3	4912674.2	*Wetland*	4.5	21.5	25.6	0.0
089	"Gilmore Meadow Pond"	June 11, 2008	557984.0	4912658.2	*Pond*	4.8	21.2	27.6	0.0
*090	Richardson Brook - south tributary from Southwest Valley, on a carriage road	June 11, 2008	556784.1	4911575.6	*Stream*	4.8	13.2	20.9	0.0

Table 1. Continued.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
091	Southwest Valley - marsh on a brook (used to be a pond) near a carriage road (west from site #092)	June 11, 2008	556531.7	4911596.1	*Wetland*	4.6	10.1	25.2	0.0
092	Southwest Valley - brook on a carriage road	June 11, 2008	556570.1	4911508.8	*Stream*	4.7	14.0	21.9	0.0
*093	Sargent Brook - on a carriage road	June 11, 2008	556581.8	4910997.6	*Stream*	4.8	15.2	22.7	0.0
*094	Wet wall on carriage road south of Bald Peak	June 11, 2008	557045.0	4908920.2	*Wet wall*	4.6	***NA***	***NA***	***NA***
095	Hadlock Brook (west branch) - under the bridge on a carriage road	June 11, 2008	557236.8	4908995.8	*Stream*	5.1	13.9	29.5	0.0
096	Hadlock Brook (east branch) - waterfall next to the bridge on a carriage road	June 11, 2008	557351.9	4908992.6	*Stream*	4.8	16.9	26.9	0.0
097	The Amphiteater - brook under the bridge on a carriage road	June 11, 2008	558246.8	4908118.0	*Stream*	5.0	14.8	30.6	0.0
*098	Jordan Pond (southwest)	June 11, 2008	559415.5	4907969.4	*Lake*	5.0	21.0	29.6	0.0
099	Penobscot Mtn - small pond north of the mountain	June 11, 2008	558248.3	4909248.4	*Pond*	4.4	22.4	22.4	0.0
100	Little marsh at crossing of Cadillac Mtn South Ridge Trail and Canon Brook Trail	June 12, 2008	561606.9	4909626.0	*Wetland*	4.3	26.2	34.8	0.0
101	Stream parallel with Canon Brook - on Canon Brook Trail	June 12, 2008	561996.5	4909846.6	*Stream*	4.2	15.8	20.0	0.0
102	Canon Brook I. - a wet wall	June 12, 2008	562292.7	4909864.9	*Wet wall*	5.1	***NA***	***NA***	***NA***
103	Canon Brook II. - downstream in a canyon	June 12, 2008	562347.9	4909867.8	*Stream*	4.9	21.9	22.7	0.0
*104	Swamp south of Dorr Mtn - with *Sphagnum* and grasses	June 12, 2008	562870.3	4909980.7	*Wetland*	4.6	25.2	29.6	0.0
105	The Gorge - a brook, site I.	June 12, 2008	563266.4	4910407.0	*Stream*	5.2	24.9	116.2	0.1
106	The Gorge - a pond, site II.	June 12, 2008	563295.9	4910761.9	*Pond*	4.9	23.8	96.6	0.1
*107	The Tarn (west) - lake	June 12, 2008	563258.1	4911533.2	*Pond*	5.1	21.0	112.0	0.1
108	West Schoodic Pond - brackish stratified (subsamples a,b) and freshwater (upstream, subsamples c,d) (**SchP**)	June 12, 2008	574423.0	4910708.0	*Brack./wetl.*	avg. 7.2	15.2	***NA***	***NA***
*109	*Sphagnum* bog further upstream from West Schoodic Pond (**SchP**)	June 12, 2008	574470.0	4910720.0	*Stream*	5.4	11.7	***NA***	***NA***
110	Stream to West Pond Cove (**SchP**)	June 12, 2008	574938.0	4910477.0	*Stream*	5.6	13.6	***NA***	***NA***
*111	Wet wall on Schoodic Scenic Byway between sites #110 and #112 (**SchP**)	June 12, 2008	574750.0	4910300.0	*Wet wall*	***NA***	***NA***	***NA***	***NA***
112	Saline marsh north of Big Moose Island (**SchP**)	June 12, 2008	574958.0	4910308.0	*Brackish*	8.1	20.2	***NA***	***NA***
*113	East Pond - by split of Schoodic Scenic Byway to Schoodic Point - north of the road (**SchP**)	June 12, 2008	575420.0	4909925.0	*Pond*	7.6	20.3	***NA***	***NA***

Table 1. Continued.

Site #	Site description	Date sampled	19T, X UTM	Y UTM	Site category	pH	T [˚C]	Conductivity [µS]	Salinity [ppt]
*114	Pond south of East Pond in Arey Cove - south of Schoodic Scenic Byway split to Schoodic Point (**SchP**)	June 12, 2008	575361.0	4909829.0	*Brackish*	7.0	20.7	***NA***	***NA***
*115	Pond next to Schoodic Scenic Byway by the park exit (**SchP**)	June 12, 2008	576499.0	4912595.0	*Pond*	6.0	20.9	***NA***	***NA***
*116	Long Pond (south, **IAH**) - boat launch	October 3, 2008	531000.7	4875166.2	*Pond*	6.0	16.8	73.5	0.0
*117	Bull Brook (**IAH**)	October 3, 2008	530987.9	4876247.5	*Stream*	4.7	***NA***	50.1	0.0
*118	Cadillac Mtn Summit (**MDI**) - tributary	July 14, 2008	562411.0	4910456.3	*Stream*	5.5	15.3	33.0	0.0
*119	Hunters Brook (**MDI**) - near bridge on Rd 3 over Park Loop Rd	July 15, 2008	562021.6	4906530.3	*Stream*	6.7	17.7	60.0	0.0

Table 2. Ranges and means (with standard deviations) of four measured water characteristics for individual freshwater categories, all freshwater sites and all brackish sites. Number of replicates within each category is indicated in parentheses.

Site category	**pH**	**T [˚C]**	**Conductivity [µS]**	**Salinity [ppt]**
Lakes (7)	4.9 ± 0.1 (7)	18.2 ± 1.8 (7)	39.0 ± 11.2 (7)	0.0 ± 0.0 (7)
Ponds (42)	4.9 ± 0.4 (41)	20.4 ± 3.1 (41)	73.0 ± 126.1 (40)	0.0 ± 0.1 (40)
Streams (40)	5.0 ± 0.4 (40)	14.5 ± 4.2 (39)	57.0 ± 54.1 (38)	0.0 ± 0.1 (38)
Wetlands (16)	4.9 ± 0.6 (16)	18.6 ± 4.9 (16)	65.4 ± 58.9 (15)	0.0 ± 0.0 (15)
Wetwalls (5)	5.0 ± 0.3 (4)	NA	NA	NA
All freshwater sites (110)	4.9 ± 0.4 (108)	17.8 ± 4.6 (103)	63.4 ± 89.2 (100)	0.0 ± 0.1 (100)
Brackish (9)	6.9 ± 0.9 (9)	18.3 ± 2.7 (9)	29,958 ± 10,574 (5)	21.0 ± 7.3 (5)
Range measured (119)	**4.2 - 8.1**	**9.0 - 26.2**	**9.0 - 41,730**	**0.0 - 26.8**

Table 3. List of genera found in the samples from Acadia National Park. Number of taxa found within each genus is in parentheses after the genus name. The genera are listed alphabetically within five phylogenetic groups (classes, subclasses).

Class: COSCINODISCOPHYCEAE (36 taxa in 14 genera)

Actinocyclus (1)	*Hyalodiscus* (1)
Actinoptychus (1)	*Melosira* (1)
Aulacoseira (10)	*Paralia* (2)
Chaetoceros (1)	*Plagiogramma* (1)
Coscinodiscus (2)	*Puncticulata* (1)
Cyclotella (4)	*Thallassiosira* (7)
Discostella (2)	*Urosolenia* (2)

Class: FRAGILARIOPHYCEAE (61 taxa in 17 genera)

Asterionella (1)	*Opephora* (5)
Ctenophora (4)	*Pseudostaurosira* (1)
Diatoma (1)	*Stauroforma* (1)
Distrionella (1)	*Staurosira* (2)
Fragilaria (14)	*Staurosirella* (1)
Fragilariaforma (7)	*Synedra* (5)
Licmophora (2)	*Tabellaria* (10)
Martyana (1)	*Tabularia* (3)
Meridion (2)	

Table 3. Continued.

Class: BACILLARIOPHYCEAE

Eunotiophycidae (81 taxa in 4 genera)

Actinella (1)	*Peronia* (2)
Eunotia (77)	*Semiorbis* (1)

Bacillariophycidae (372 taxa in 52 genera)

Achnanthes (11)	*Decussata* (1)
Achnanthidium (6)	*Denticula* (1)
Amphora (12)	*Diadesmis* (8)
Berkeleya (2)	*Diploneis* (5)
Brachysira (14)	*Encyonema* (18)
Brebissonia (1)	*Entomoneis* (2)
Caloneis (10)	*Eucocconeis* (5)
Capartogramma (1)	*Fallacia* (6)
Cavinula (4)	*Frustulia* (12)
Chamaepinnularia (5)	*Gomphonema* (16)
Cocconeis (12)	*Gyrosigma* (2)
Cosmioneis (1)	*Hantzschia* (1)
Craticula (3)	*Haslea* (1)
Cymbella (2)	*Hippodonta* (1)
Cymbopleura (4)	*Kobayasiella* (3)

Table 3. Continued.

Luticola (3)	*Plagiotropis* (5)
Mastogloia (2)	*Planothidium* (8)
Navicula (27)	*Pleurosigma* (3)
Neidium (19)	*Psammothidium* (9)
Nitzschia (29)	*Rhopalodia* (3)
Oestrupia (1)	*Rossithidium* (2)
Parlibellus (1)	*Sellaphora* (7)
Petroneis (1)	*Stauroneis* (15)
Pinnuavis (1)	*Stenopterobia* (5)
Pinnularia (45)	*Surirella* (12)
Placoneis (2)	*Tryblionella* (2)

Table 4. Distribution of species in various habitat types (L = Lakes, P = Ponds, S = Streams, WL = Wetlands, WW = Wetwalls, B = Brackish). Site total indicates a total number of various sites where was individual species observed.

Species	**L**	**P**	**S**	**WL**	**WW**	**B**	**Site total**
Actinella punctata Lewis	1	3	0	0	0	0	**4**
Eunotia arculus (Grun.) Lange-Bertalot & Nörpel	0	2	0	0	0	0	**2**
Eunotia* cf. *arculus (Grun.) Lange-Bertalot & Nörpel	0	1	0	0	0	0	**1**
Eunotia bidens Ehr.	0	0	1	1	0	0	**2**
Eunotia bidentula W. Smith	0	3	0	0	0	0	**3**
Eunotia bilunaris (Ehr.) Mills	3	5	2	0	0	0	**10**
Eunotia* cf. *bilunaris (Ehr.) Mills	1	2	2	1	0	0	**6**
Eunotia bilunaris* var. *linearis (Okuno) Lange-Bertalot & Nörpel	1	1	0	1	0	0	**3**
Eunotia boomsma Furey, Lowe & Johansen	1	0	1	1	0	0	**3**
Eunotia boreoalpina Lange-Bertalot & Nörpel-Schempp	0	2	1	0	0	0	**3**
Eunotia botellus Moser, Lange-Bertalot & Metzeltin	0	3	0	0	0	0	**3**
Eunotia botuliformis Wild, Nörpel & Lange-Bertalot	0	1	0	0	0	0	**1**
Eunotia chelonia Nörpel-Sch., Metzeltin & Lange-Bertalot	0	1	0	0	0	0	**1**
Eunotia* cf. *circumborealis Nörpel-Sch. & Lange-Bertalot	0	1	0	0	0	0	**1**
Eunotia curtagrunowii Nörpel-Sch. & Lange-Bertalot	0	1	1	2	0	0	**4**
Eunotia diadema Ehr.	2	0	0	0	0	0	**2**
Eunotia elegans Østrup	1	2	0	0	0	0	**3**
Eunotia exigua (Brébisson) Rabenhorst	0	1	8	0	2	0	**11**
Eunotia* cf. *exigua (Brébisson) Rabenhorst	0	0	1	0	0	0	**1**
Eunotia faba Ehr.	4	6	0	0	0	0	**10**
Eunotia flexuosa (Brébisson) Kützing	1	6	3	1	0	0	**11**
Eunotia flexuosa* var. *eurycephala Grunow	0	5	1	0	0	0	**6**
Eunotia* cf. *flexuosa* var. *eurycephala Grunow	0	0	0	0	0	1	**1**
Eunotia* cf. *formica Ehr.	1	0	1	0	0	0	**2**
Eunotia genuflexa Nörpel-Schempp	0	3	3	2	0	0	**8**
Eunotia glacialis Meister	0	2	2	1	0	0	**5**

Table 4. Continued.

Species	L	P	S	WL	WW	B	Site total
Eunotia implicata Nörpel-Sch. & Lange-Bertalot	2	4	1	0	0	0	**7**
Eunotia incisa Gregory	2	9	4	0	0	0	**15**
Eunotia* cf. *incisa Gregory	0	1	0	0	0	0	**1**
Eunotia inflata (Grun.) Nörpel-Sch. & Lange-Bertalot	1	0	2	0	0	0	**3**
Eunotia lapponica Grun.	0	1	0	0	0	0	**1**
Eunotia meisteri Hust.	0	3	1	2	0	0	**6**
Eunotia* cf. *melanogaster Moser, Lange-Bertalot & Metzeltin	1	2	0	0	0	0	**3**
Eunotia microcephala Krasske	0	0	2	0	0	0	**2**
Eunotia monodon Ehr.	1	1	1	0	0	0	**3**
Eunotia* cf. *monodon Ehr.	0	0	1	1	0	0	**2**
Eunotia* cf. *monodontiforma Lange-Bertalot & Nörpel-Sch.	1	0	0	1	0	0	**2**
Eunotia mucophila (Lange-Bertalot & Nörpel-Sch.) Lange-Bertalot	2	6	1	0	0	0	**9**
Eunotia muscicola* var. *tridentula (Grun.) Nörpel & Lange-Bertalot	1	1	3	0	1	0	**6**
Eunotia naegelii Migula ***sensu* Siver** et al. (2000)	1	3	1	0	0	0	**5**
Eunotia neofallax Nörpel-Sch. & Lange-Bertalot	0	0	2	1	0	0	**3**
Eunotia nymanniana Grun. ***sensu* Metzeltin & Lange-Bertalot** (2007)	0	0	1	0	0	0	**1**
Eunotia* cf. *nymanniana Grun. ***sensu* Krammer & Lange-Bertalot** (1991)	1	5	2	0	1	0	**9**
Eunotia paludosa Grun.	0	0	0	0	1	0	**1**
Eunotia pectinalis (Dillwyn) Rabenhorst	3	8	4	1	0	0	**16**
Eunotia praerupta* var. *bigibba (Kütz.) Grunow	0	0	2	0	1	0	**3**
Eunotia rhomboidea Hust.	1	5	3	1	0	0	**10**
Eunotia rhynchocephala Hust.	0	1	0	0	0	0	**1**
Eunotia richbuttensis Furey, Lowe & Johansen	0	0	2	1	0	0	**3**
Eunotia* cf. *rushforthiana Furey, Lowe & Johansen	0	0	3	0	0	0	**3**
Eunotia satelles (Nörpel-Sch. &Lange-B.) Nörpel-Sch. & Lange-Bertalot	0	1	0	0	0	0	**1**
Eunotia septena Ehr.	0	2	1	0	0	0	**3**
Eunotia serra Ehr.	0	1	0	0	0	0	**1**

Table 4. Continued.

Species	L	P	S	WL	WW	B	Site total
Eunotia subarcuatoides Alles, Nörpel-Sch. & Lange-Bertalot	0	0	1	2	0	0	**3**
Eunotia* cf. *suecica Cleve-Euler.	0	0	1	2	0	0	**3**
Eunotia* cf. *sylvahercynia Nörpel, Van Sull & Lange-Bertalot	0	2	0	0	0	0	**2**
Eunotia tautoniensis Hust.	0	0	2	0	0	0	**2**
Eunotia* cf. *tenella (Grun.) Hust.	0	0	0	1	0	0	**1**
Eunotia tetraodon Ehr.	1	3	0	0	0	0	**4**
Eunotia trinacria Krasske	0	0	5	0	1	0	**6**
Eunotia ursamaioris Lange-Bertalot & Nörpel-Sch.	0	0	2	2	0	0	**4**
Eunotia* cf. *varioundulata Nörpel-Sch. & Lange-Bertalot	0	1	0	0	0	0	**1**
***Eunotia* sp. 1**	1	0	0	0	0	0	**1**
***Eunotia* sp. 2**	0	2	3	1	0	0	**6**
***Eunotia* sp. 3**	1	0	0	1	0	0	**2**
***Eunotia* sp. 4**	2	2	2	1	0	0	**7**
***Eunotia* sp. 5**	1	1	0	0	0	0	**2**
***Eunotia* sp. 6**	2	0	0	0	0	0	**2**
***Eunotia* sp. 7**	1	1	2	0	0	0	**4**
***Eunotia* sp. 8**	0	0	2	0	0	0	**2**
***Eunotia* sp. 9**	0	1	0	0	0	0	**1**
***Eunotia* sp. 10**	0	1	0	0	0	0	**1**
***Eunotia* sp. 11**	0	1	0	1	1	0	**3**
***Eunotia* sp. 12**	0	1	0	0	0	0	**1**
***Eunotia* sp. 13**	0	5	0	0	0	0	**5**
***Eunotia* sp. 14**	0	0	1	0	0	0	**1**
***Eunotia* sp. 15**	1	4	1	0	0	0	**6**
***Eunotia* sp. 16**	0	0	1	0	0	0	**1**
***Eunotia* sp. 17**	0	1	0	0	0	0	**1**
Peronia* cf. *heribaudi Brun & Peragallo	2	1	1	0	0	0	**4**
***Peronia* sp. 1**	2	3	1	0	0	0	**6**
Semiorbis hemicyclus (Ehr.) Patrick	0	2	0	0	0	0	**2**

Table 5. Richness of Eunotiophycidae in Acadia National Park studied sites. Total indicates a number of **various** *Eunotia* (*E.*), *Actinella* (*A.*), *Semiorbis* (*S.*) and *Peronia* (*P.*) species in each site or habitat type.

Site category	Site name	Site number	*E.*	*A.*	*S.*	*P.*	Total
Lake	Echo Lake	001	4	0	0	0	4
	Echo Lake Beach	003	7	0	0	0	7
	Long Pond - MDI	029	6	0	0	0	6
	Seal Cove Pond	032	8	0	0	2	10
	Eagle Lake	068	14	1	0	2	17
	Jordan Pond	098	3	0	0	0	3
	total in Lakes		**32**	**1**	**0**	**2**	**35**
Pond	"Heath Swamp"	016	12	1	0	0	13
	Duck Pond (West MDI)	031	4	0	0	0	4
	Hodgdon Pond	034	4	0	0	0	4
	The Bowl	043	3	0	1	0	4
	Upper Hadlock Pond	054	4	0	0	0	4
	Lower Hadlock Pond	055	8	0	1	0	9
	Bubble Pond	069	2	0	0	2	4
	Witch Hole Pond	076	11	1	0	1	13
	Lake Wood	078	6	0	0	0	6
	Breakneck Ponds – the north one	080	12	0	0	1	13
	Halfmoon Pond	081	12	1	0	0	13
	Aunt Betty Pond	087	20	0	0	0	20
	The Tarn	107	7	0	0	0	7
	Pond near the park exit (SchP)	115	9	0	0	0	9
	Long Pond (south, IAH)	116	13	0	0	0	13
	total in Ponds		**54**	**1**	**1**	**2**	**58**
Stream	Lurvey Brook	018	14	0	0	0	14
	Marshall Brook	020	9	0	0	0	9
	Kebo Brook	037	2	0	0	0	2
	Cromwell Brook	058	12	0	0	0	12
	Duck Brook (East MDI)	073	9	0	0	2	11
	Richardson Brook	090	2	0	0	0	2
	Sargent Brook	093	4	0	0	0	4
	Bog near West Sch. Pond (SchP)	109	12	0	0	0	12
	Bull Brook (IAH)	117	11	0	0	0	11

Table 5. Continued.

Site category	Site name	Site number	*E.*	*A.*	*S.*	*P.*	Total
Stream	Cadillac Mtn Summit	118	3	0	0	0	3
	Hunters Brook	119	9	0	0	0	9
	total in Streams		**46**	**0**	**0**	**2**	**48**
Wetland	Big Heath - wetland	008	3	0	0	0	3
	Fresh Meadow	023	10	0	0	0	10
	Schooner Head Rd II. – wetland	040	5	0	0	0	5
	Great Meadow	057	6	0	0	0	6
	Swamp south of Dorr Mtn	104	5	0	0	0	5
	total in Wetlands		**23**	**0**	**0**	**0**	**23**
Wetwall	Wetwall east of Sand Beach	065	0	0	0	0	0
	Wetwall south of Bald Peak	094	4	0	0	0	4
	Wetwall on Scenic Byway (SchP)	111	4	0	0	0	4
	total in Wetwalls		**7**	**0**	**0**	**0**	**7**
Brackish	Adams Bridge - estuary to sea	009	0	0	0	0	0
	Stanley Brook - brackish water	050	0	0	0	0	0
	Brackish pond on Sand Beach	064	0	0	0	0	0
	East Pond (SchP)	113	0	0	0	0	0
	Pond south of East Pond (SchP)	114	1	0	0	0	1
	total in Brackish sites		**1**	**0**	**0**	**0**	**1**

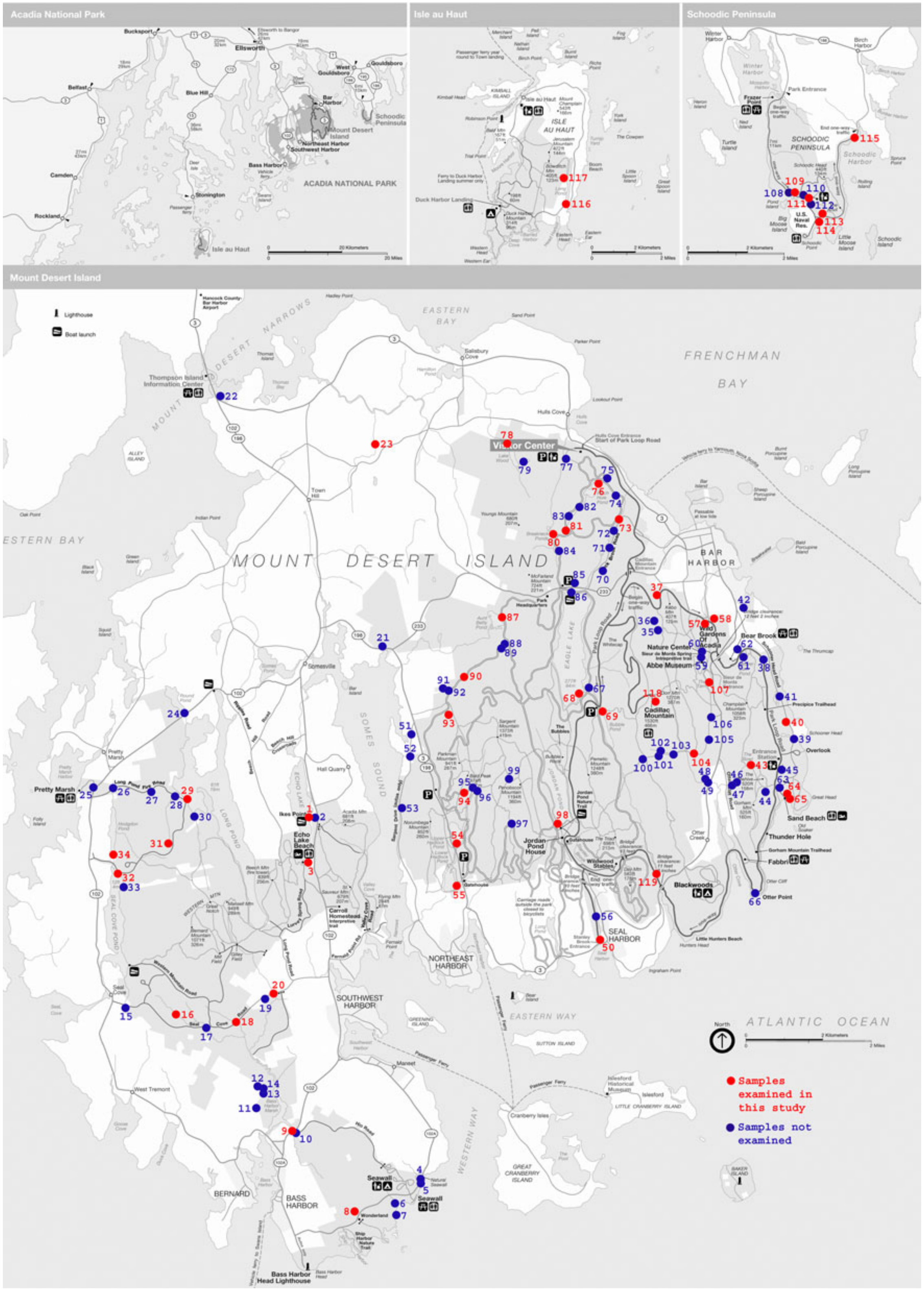

Figure 1. A map of Acadia National Park indicating 119 sites sampled (modified from http://www.nps.gov/acad/planyourvisit/upload/ACADmap2005.pdf).

<u>Plate 1</u>:

Scale bar = 10 µm

Figs. 1 – 4. ***Eunotia tetraodon*** Ehr.

Figs. 5 – 6. ***Eunotia diadema*** Ehr.

Figs. 1 – 4. Sites 001, 016, 076, 116

Figs. 5 – 6. Sites 003, 068

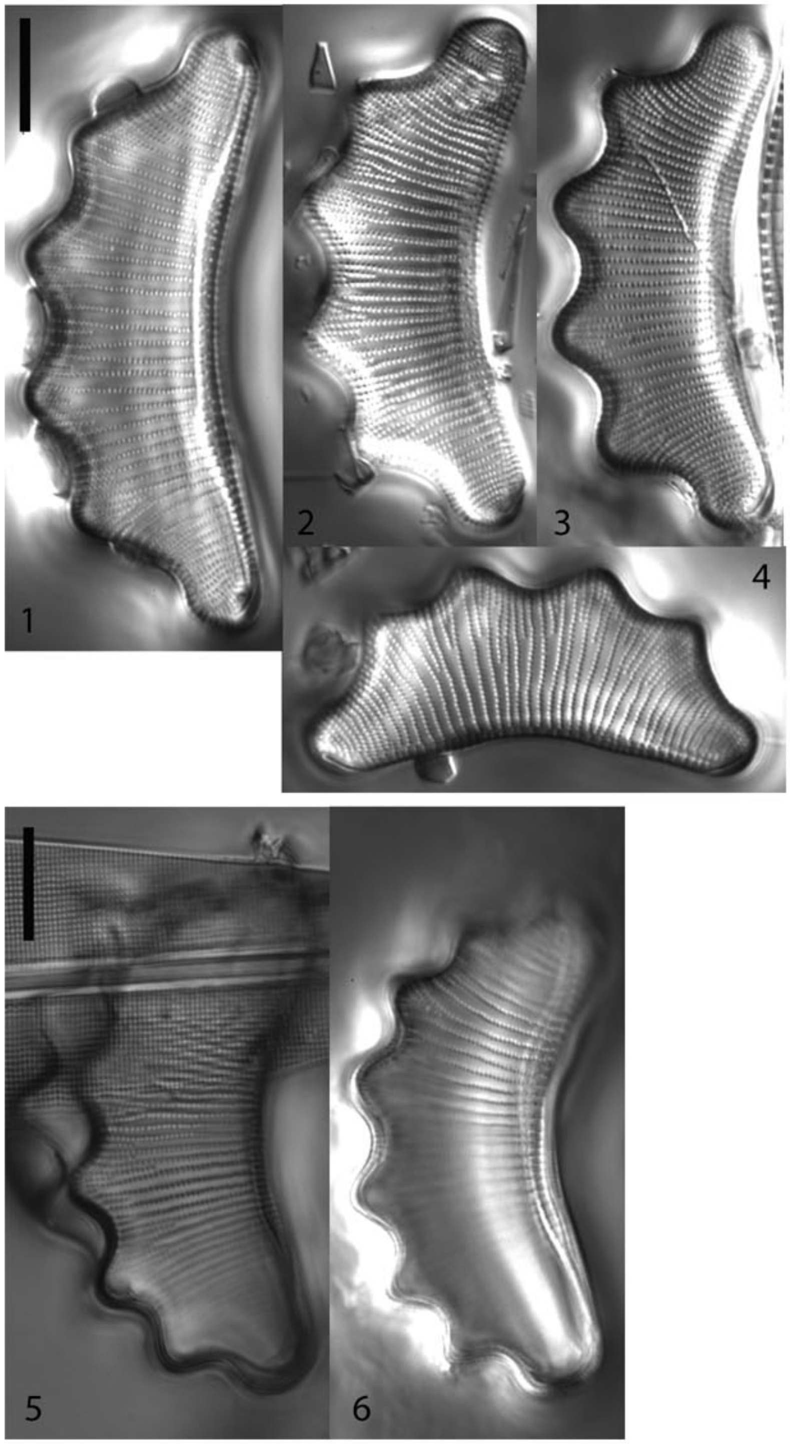
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Plate 2:

Scale bar = 10 µm

Figs. 1 – 5. ***Eunotia serra*** Ehr.

Figs. 1 – 5. Site 016

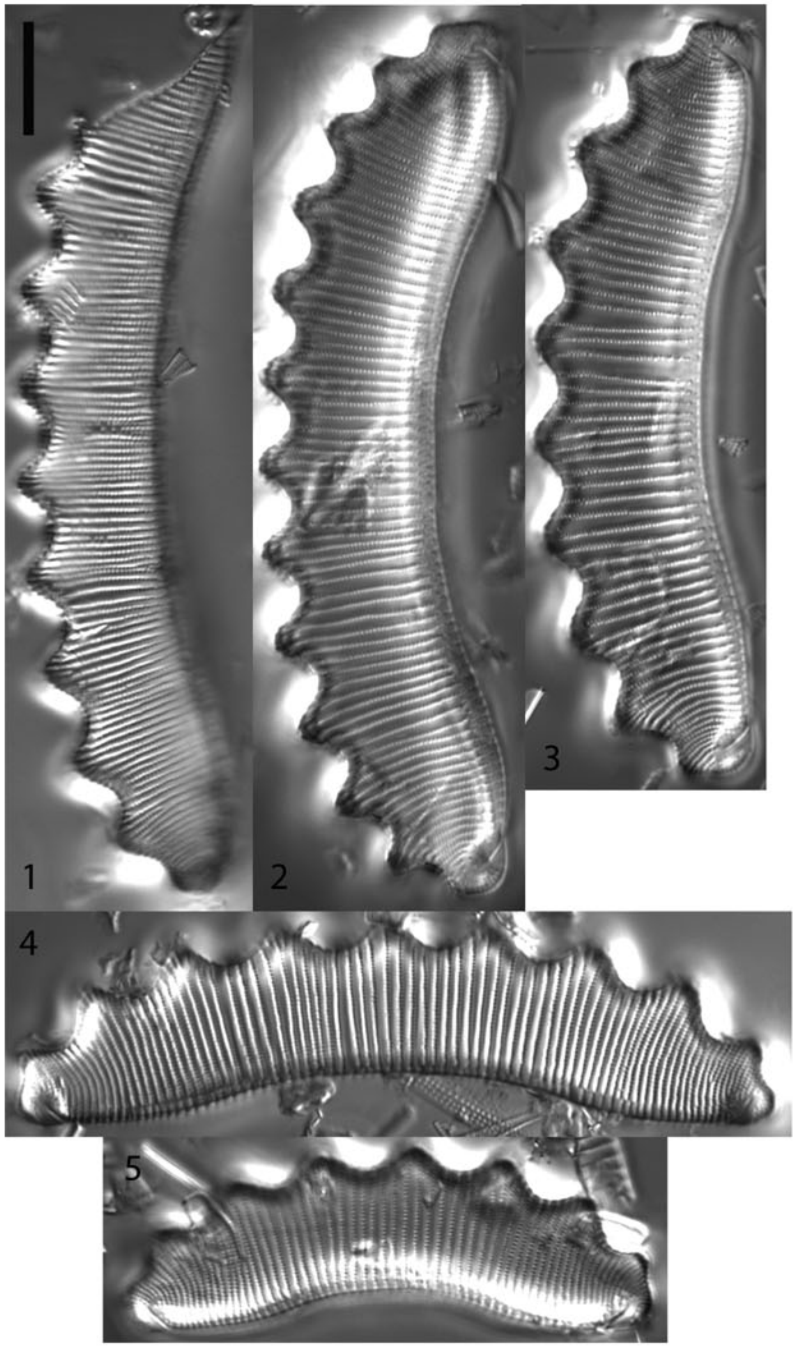
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Plate 3:

Scale bar = 10 µm

Figs. 1 - 2. ***Eunotia inflata*** (Grun.) Nörpel-Sch. Lange-Bertalot

Figs. 3 - 7. ***Eunotia curtagrunowii*** Nörpel-Sch. Lange-Bertalot

Figs. 8 - 11. ***Eunotia* cf. *suecica*** Cleve-Euler.

Figs. 12 – 14. ***Eunotia bidens*** Ehr.

Figs. 1 - 5. Sites 020, 029

Figs. 3 - 7. Sites 020, 023, 057, 087

Figs. 8 - 11. Sites 020, 023, 057

Figs. 12 - 14. Sites 057, 058

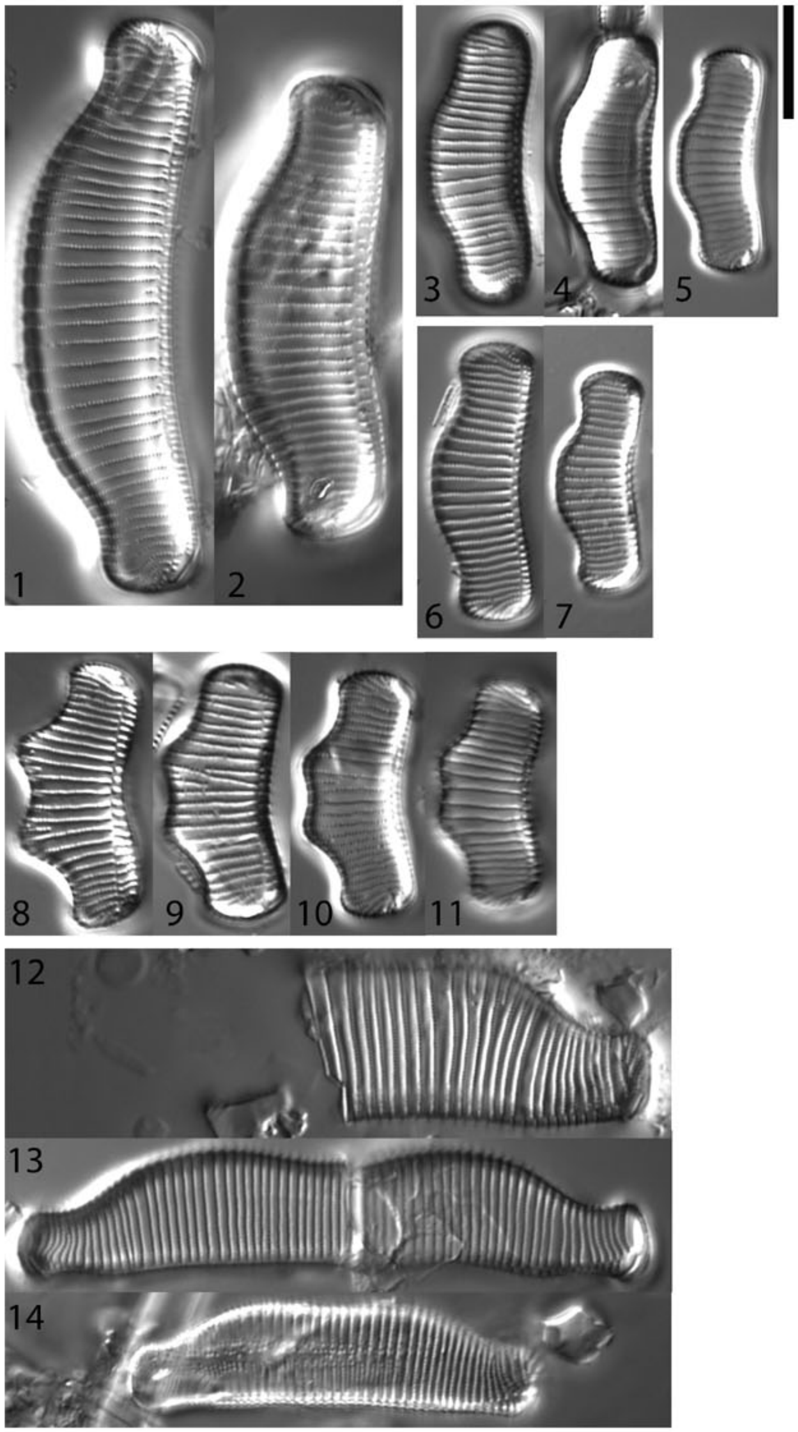
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Plate 4:

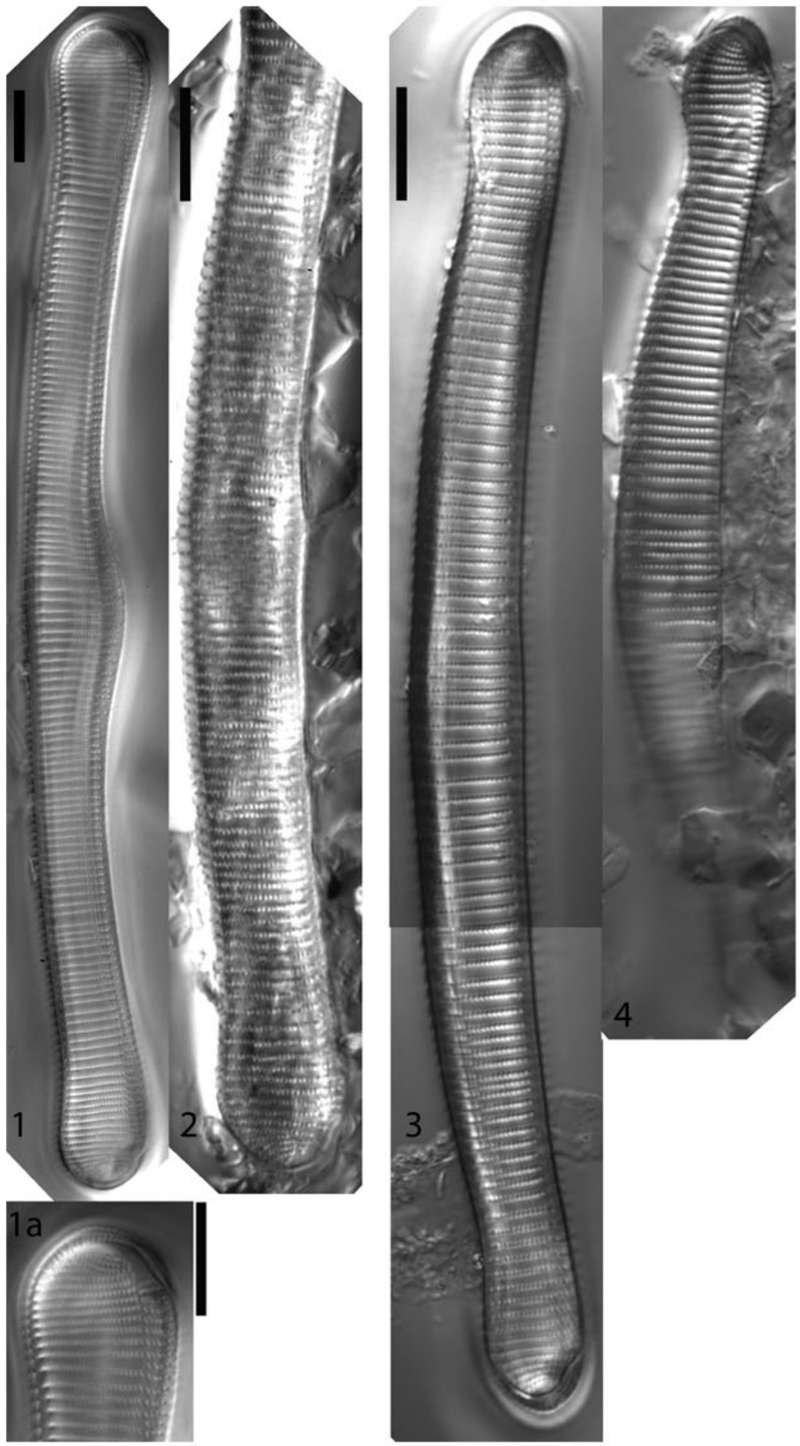
Scale bar = 10 µm

Figs. 1 - 2. ***Eunotia* cf. *formica*** Ehr.

Figs. 3 - 4. ***Eunotia* cf. *monodon*** Ehr.

Figs. 1 - 2. Sites 003, 058

Figs. 3 - 4. Sites 057, 119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<u>Plate 5</u>:

Scale bar = 10 µm

Figs. 1 - 3. ***Eunotia monodon*** Ehr.

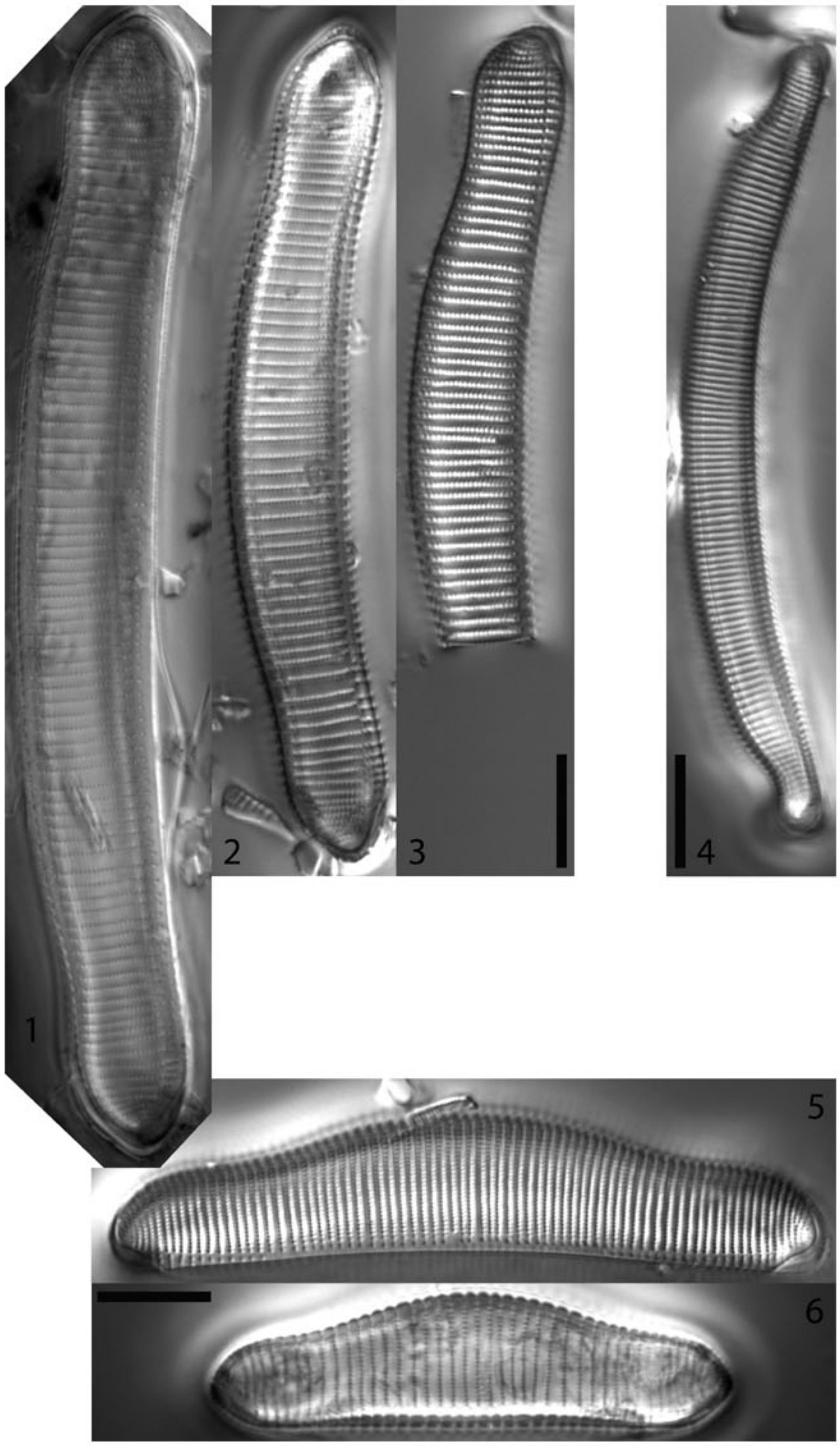
Figs. 4. ***Eunotia*** **sp. 1**

Figs. 5 - 6. ***Eunotia*** **cf.** ***monodontiforma*** Lange-Bertalot & Nörpel-Sch.

Figs. 1 - 3. Sites 016, 018, 029

Figs. 4. Site 001

Figs. 5 - 6. Sites 003, 057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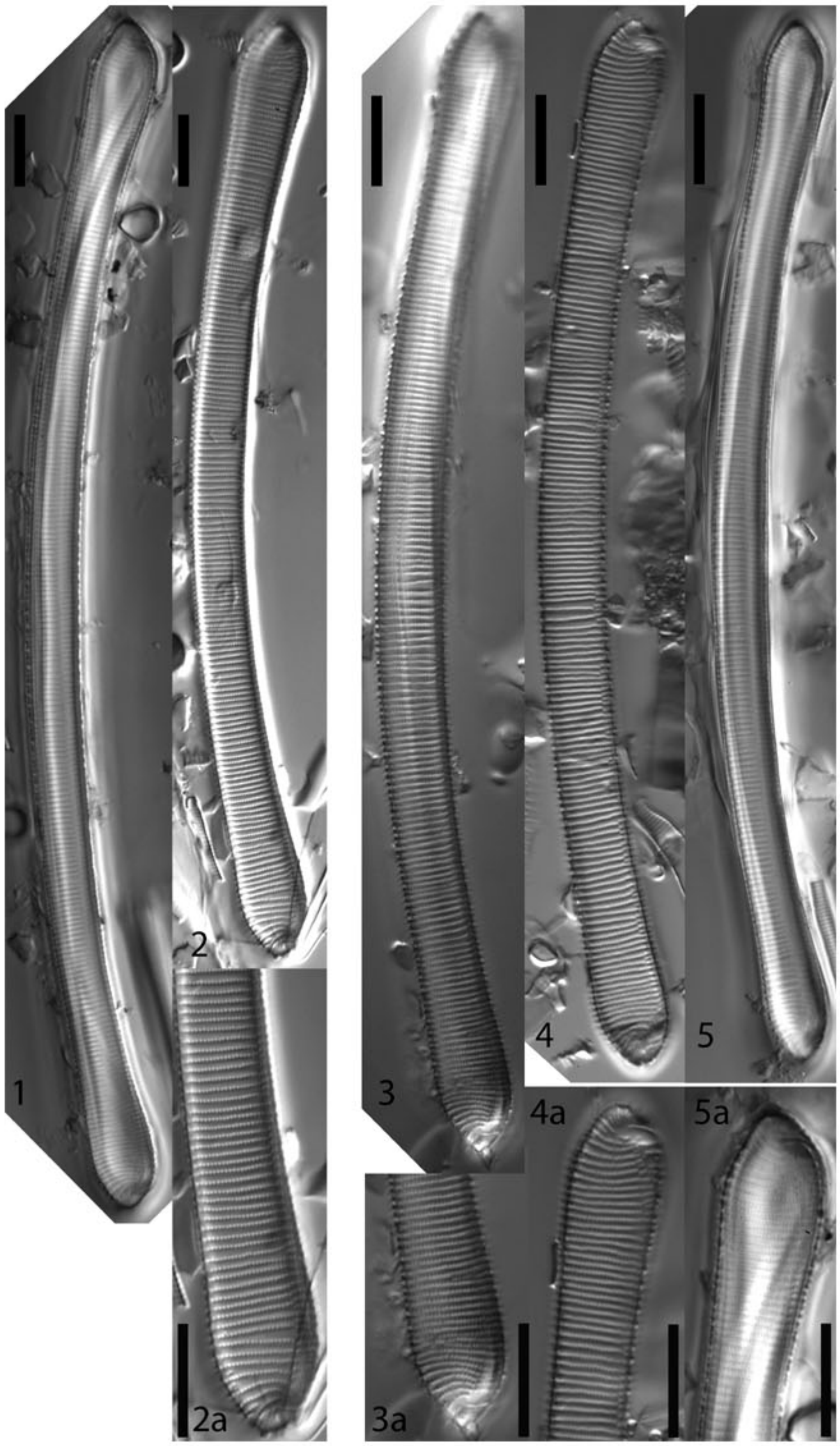
<u>Plate 6</u>:

Scale bar = 10 µm

Figs. 1 - 5. ***Eunotia tautoniensis*** Hust.

Figs. 1 - 5. Sites 018, 117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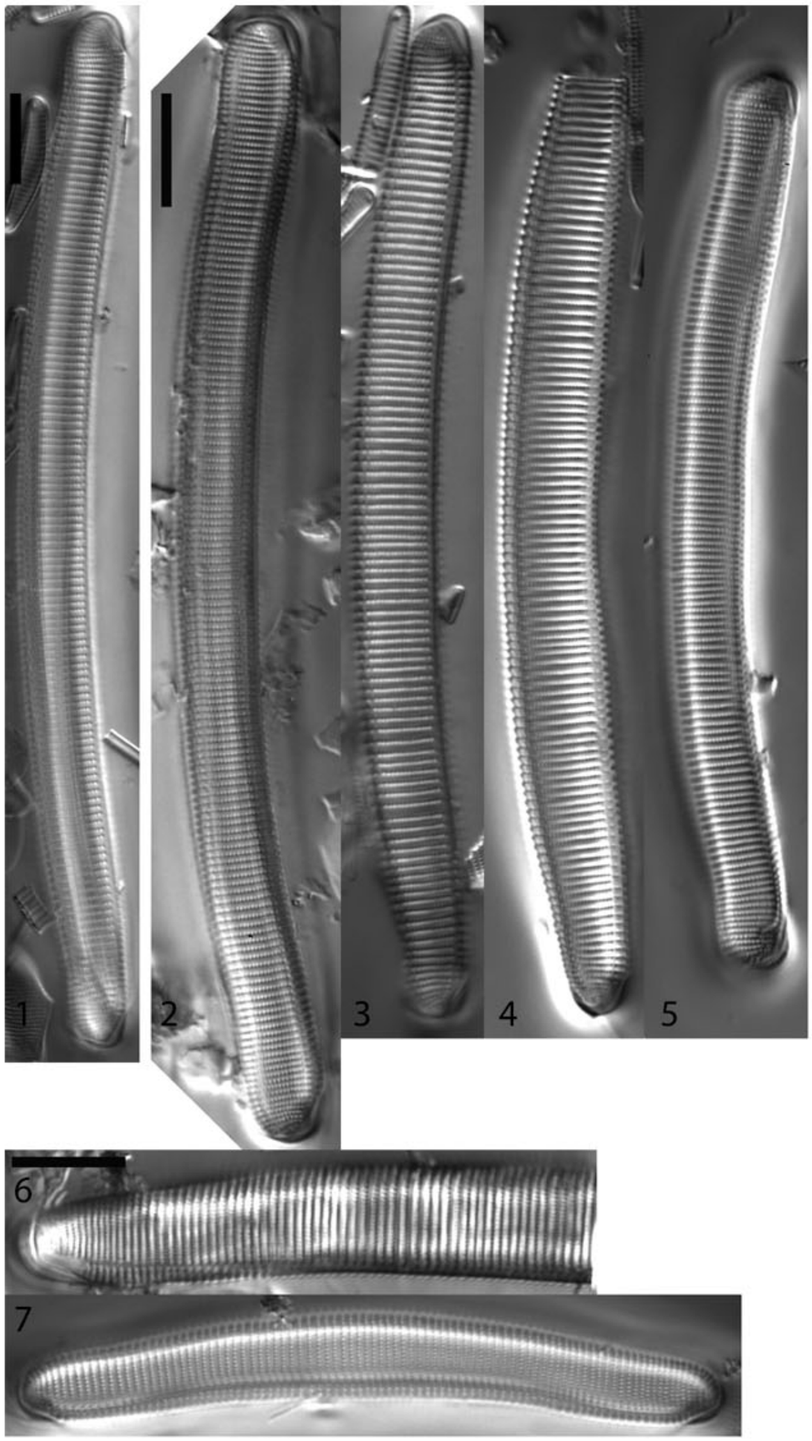
<u>Plate 7</u>:

Scale bar = 10 µm

Figs. 1 - 7. ***Eunotia glacialis*** Meister

Figs. 1 - 7. Sites 055, 087, 104, 109, 117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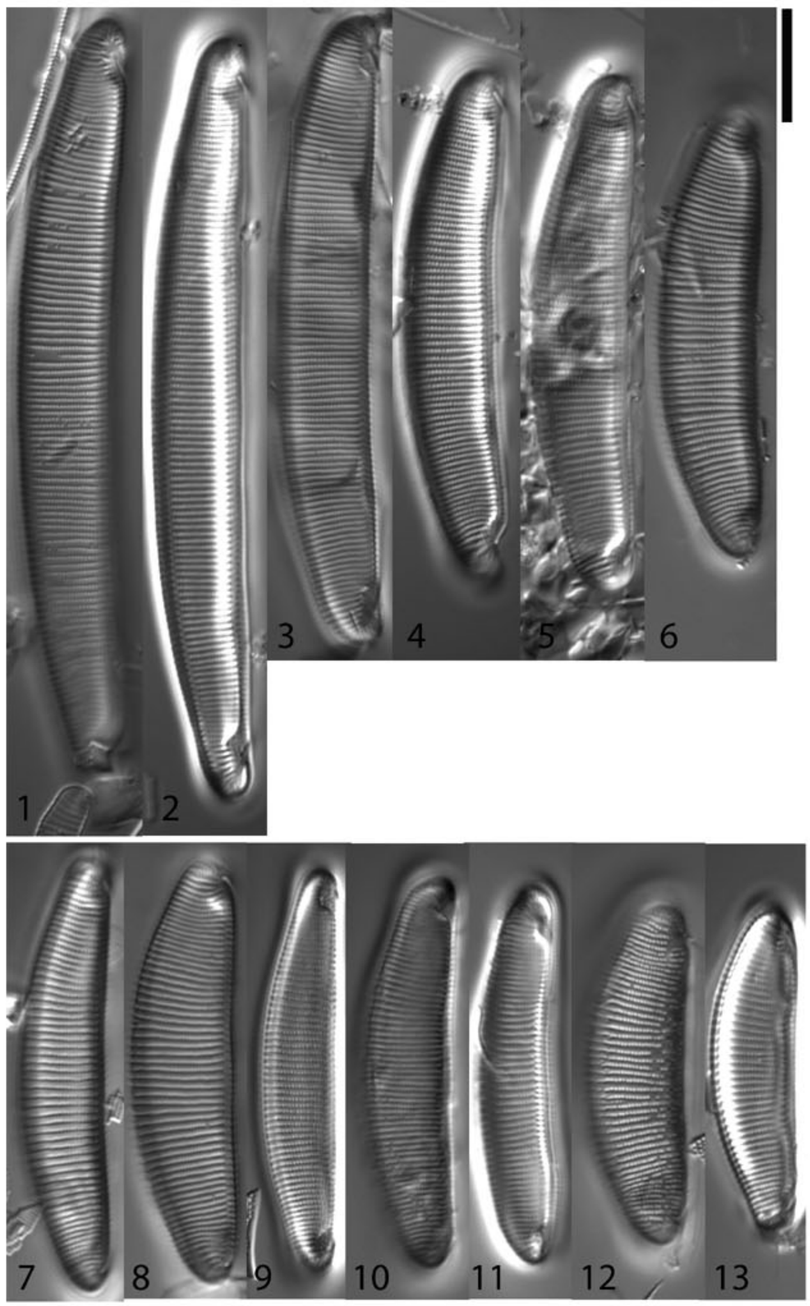
<u>Plate 8</u>:

Scale bar = 10 µm

Figs. 1 - 13. ***Eunotia faba*** Ehr.

Figs. 1 - 13. Sites 001, 003, 029, 054, 068, 076, 080, 087, 107, 116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<u>Plate 9</u>:

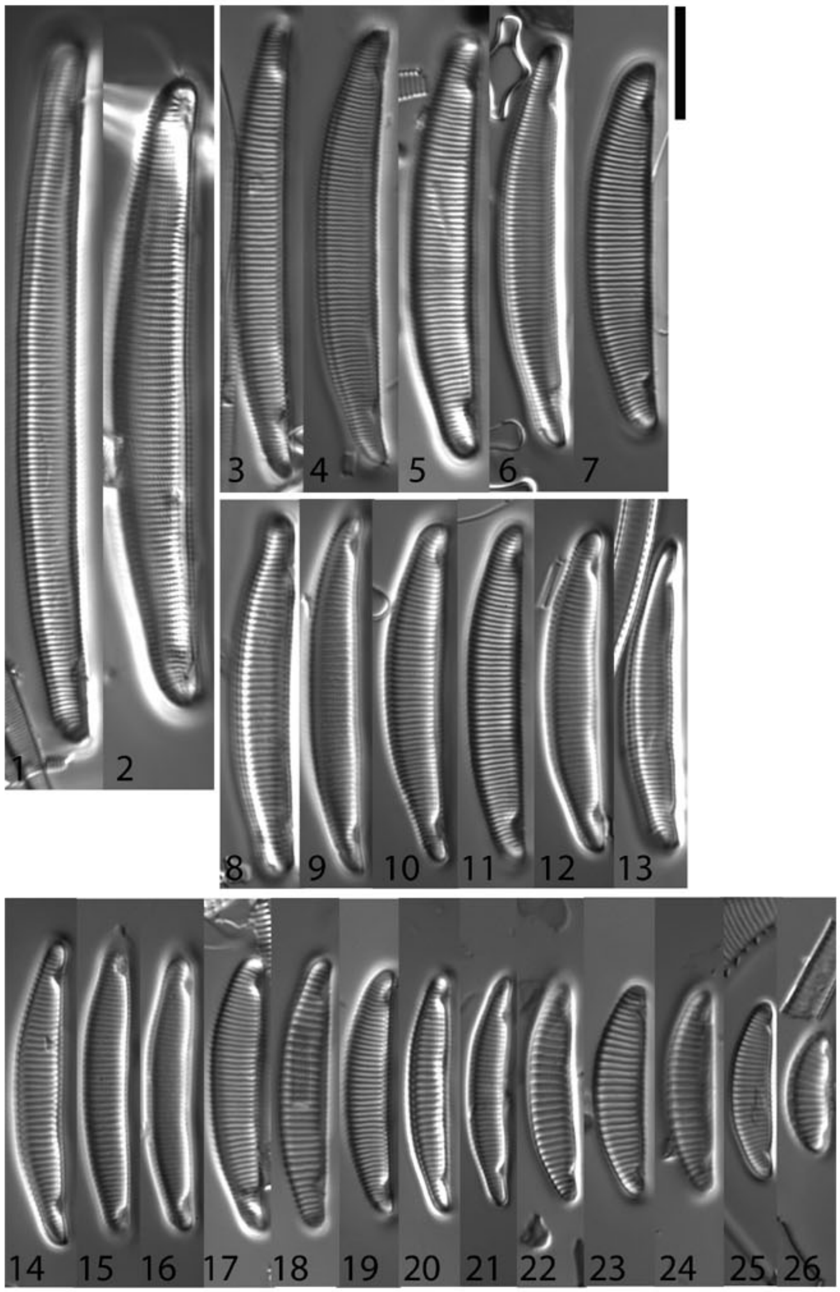
Scale bar = 10 µm

Figs. 1 - 2. ***Eunotia* cf. *incisa*** Gregory

Figs. 3 - 26. ***Eunotia incisa*** Gregory

Figs. 1 - 2. Site 054

Figs. 3 - 26. Sites 016, 018, 032, 054, 073, 076, 078, 080, 081, 087, 093, 115, 119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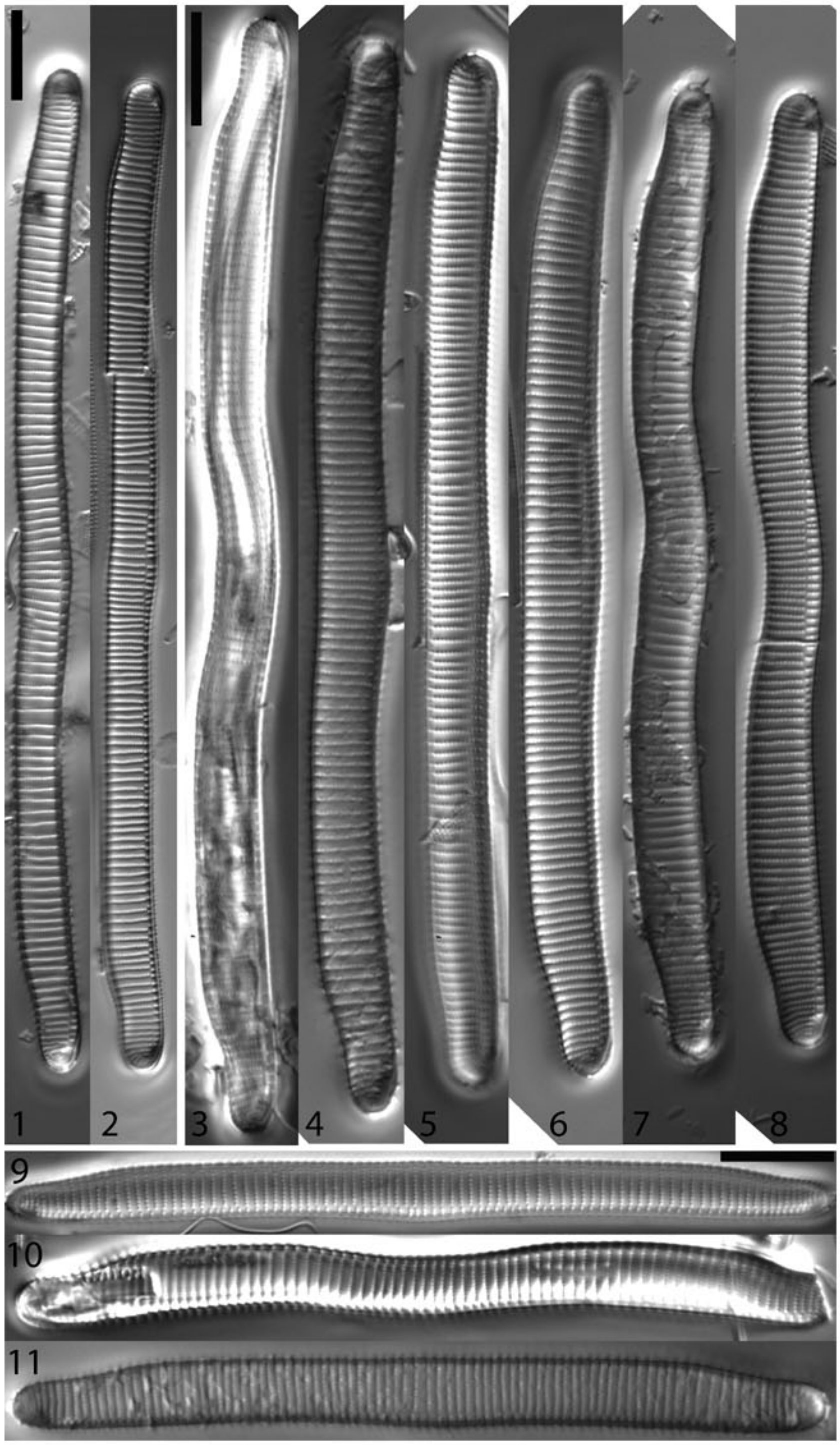
<u>Plate 10</u>:

Scale bar = 10 µm

Figs. 1 - 11. ***Eunotia pectinalis*** (Dillwyn) Rabenhorst

Figs. 1 - 11. Sites 016, 018, 023, 032, 055, 068, 073, 076, 078, 080, 087, 109, 115, 117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<u>Plate 11</u>:

Scale bar = 10 µm

Figs. 1 - 16. ***Eunotia pectinalis*** (Dillwyn) Rabenhorst

Figs. 1 - 16. Sites 016, 018, 023, 032, 055, 068, 073, 076, 078, 080, 087, 109, 115, 117

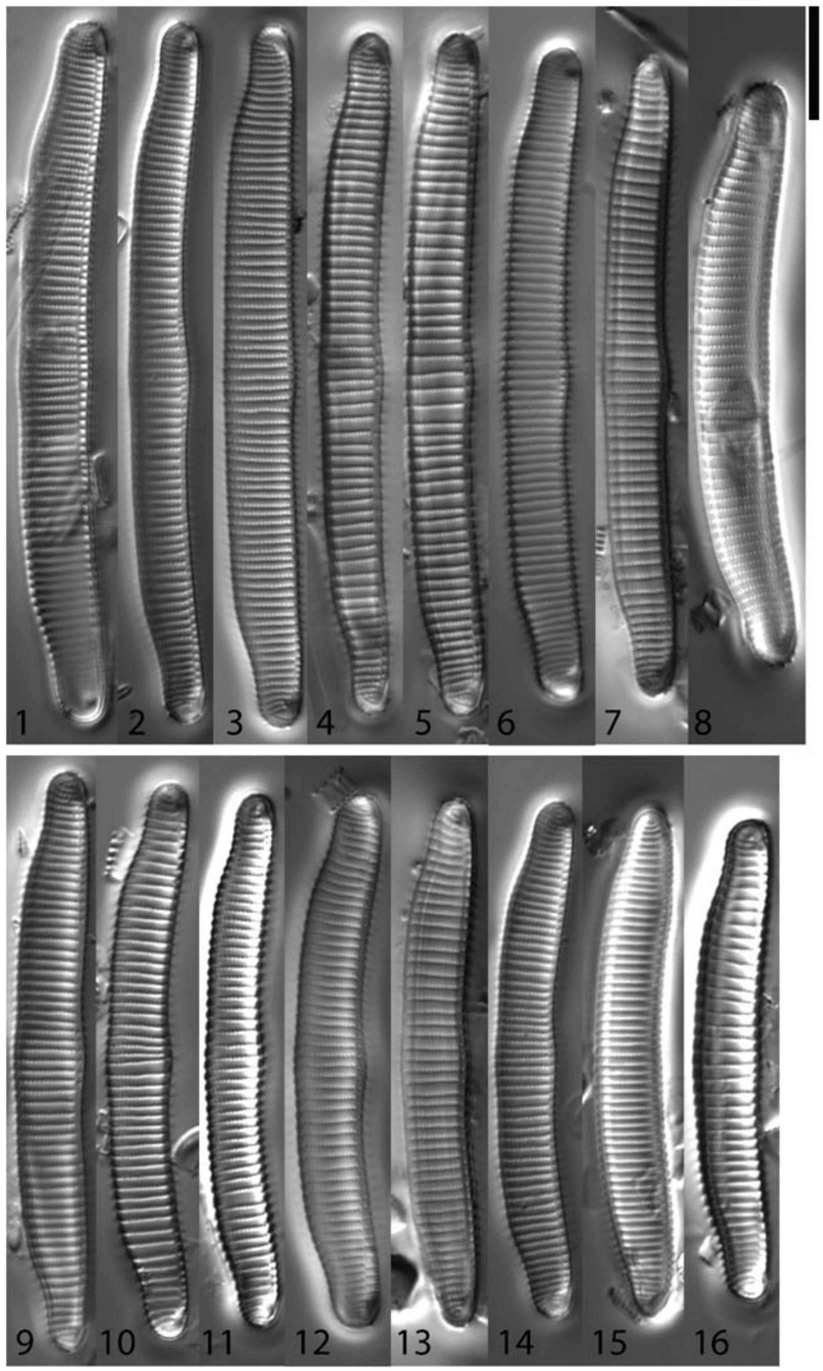
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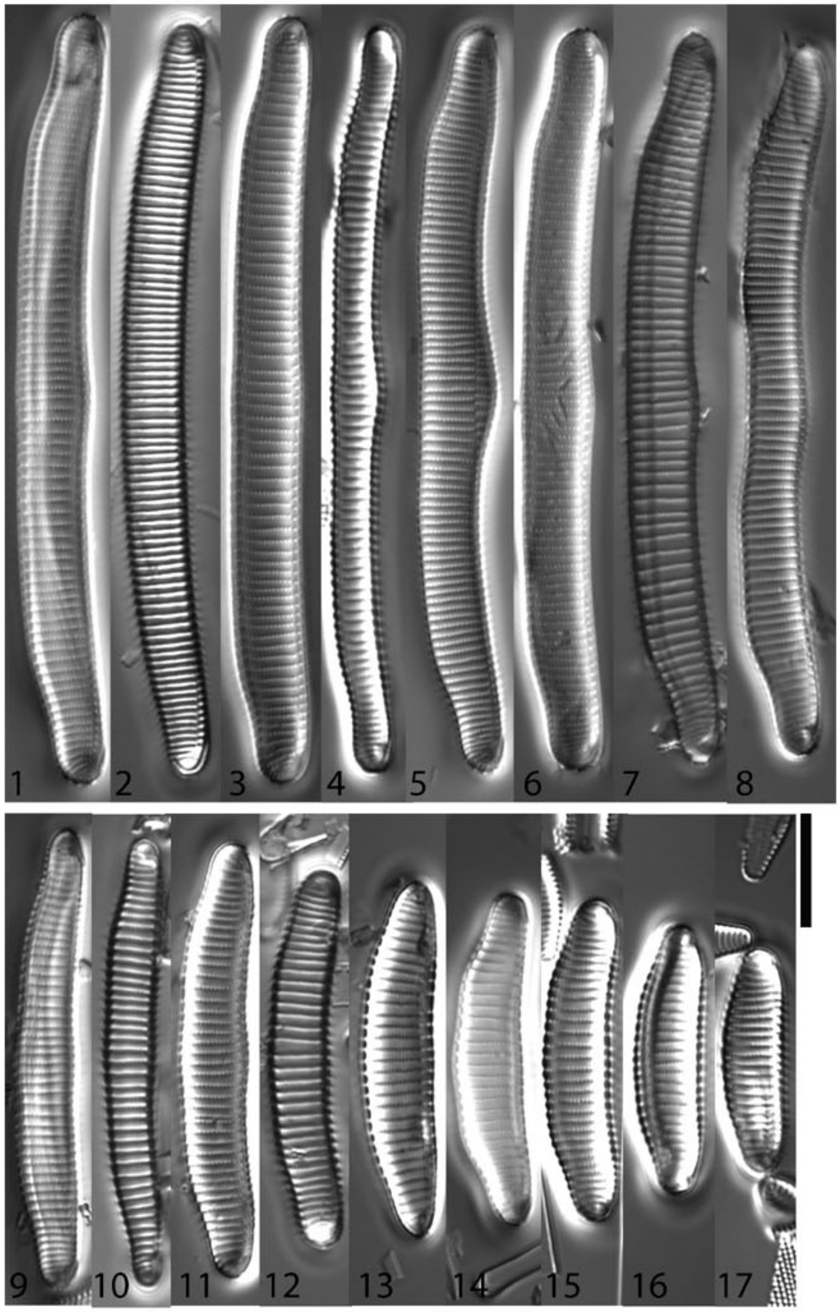
Plate 12:

Scale bar = 10 µm

Figs. 1 - 17. ***Eunotia pectinalis*** (Dillwyn) Rabenhorst

Figs. 1 - 17. Sites 016, 018, 023, 032, 055, 068, 073, 076, 078, 080, 087, 109, 115, 117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<u>Plate 13</u>:

Scale bar = 10 µm

Figs. 1 - 7. ***Eunotia flexuosa*** **var.** ***eurycephala*** Grunow

Fig. 8. ***Eunotia*** **cf.** ***flexuosa*** **var.** ***eurycephala*** Grunow

Figs. 1 - 7. Sites 016, 058, 076, 078, 080, 081

Fig. 8. Site 114

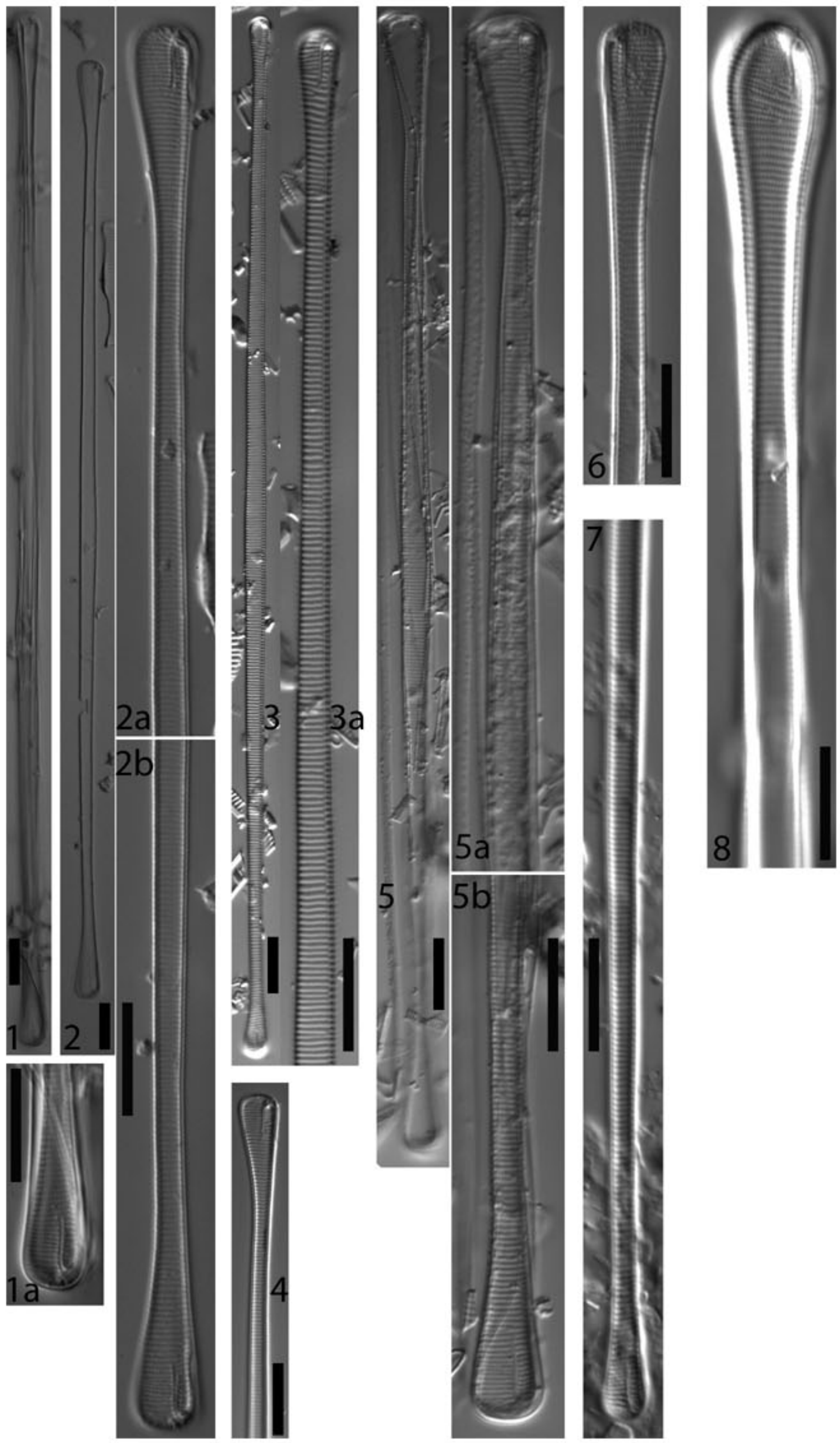

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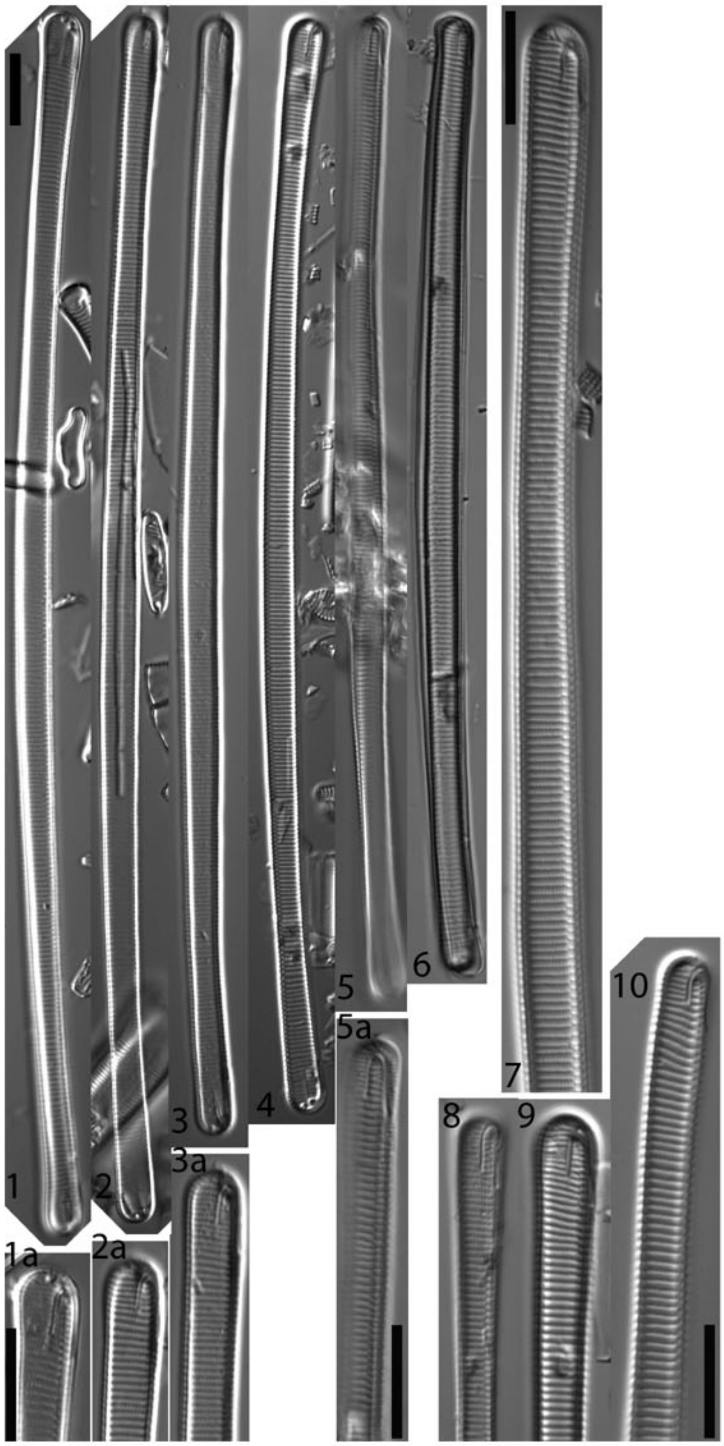
Plate 14:

Scale bar = 10 μm

Figs. 1 - 10. ***Eunotia flexuosa*** (Brébisson) Kützing

Figs. 1 - 10. Sites 018, 023, 068, 073, 076, 078, 081, 109, 115, 116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<u>Plate 15</u>:

Scale bar = 10 µm

Figs. 1 - 12. ***Eunotia bilunaris*** (Ehr.) Mills

Figs. 1 - 12. Sites 003, 020, 032, 054, 055, 058, 068, 081, 087, 116

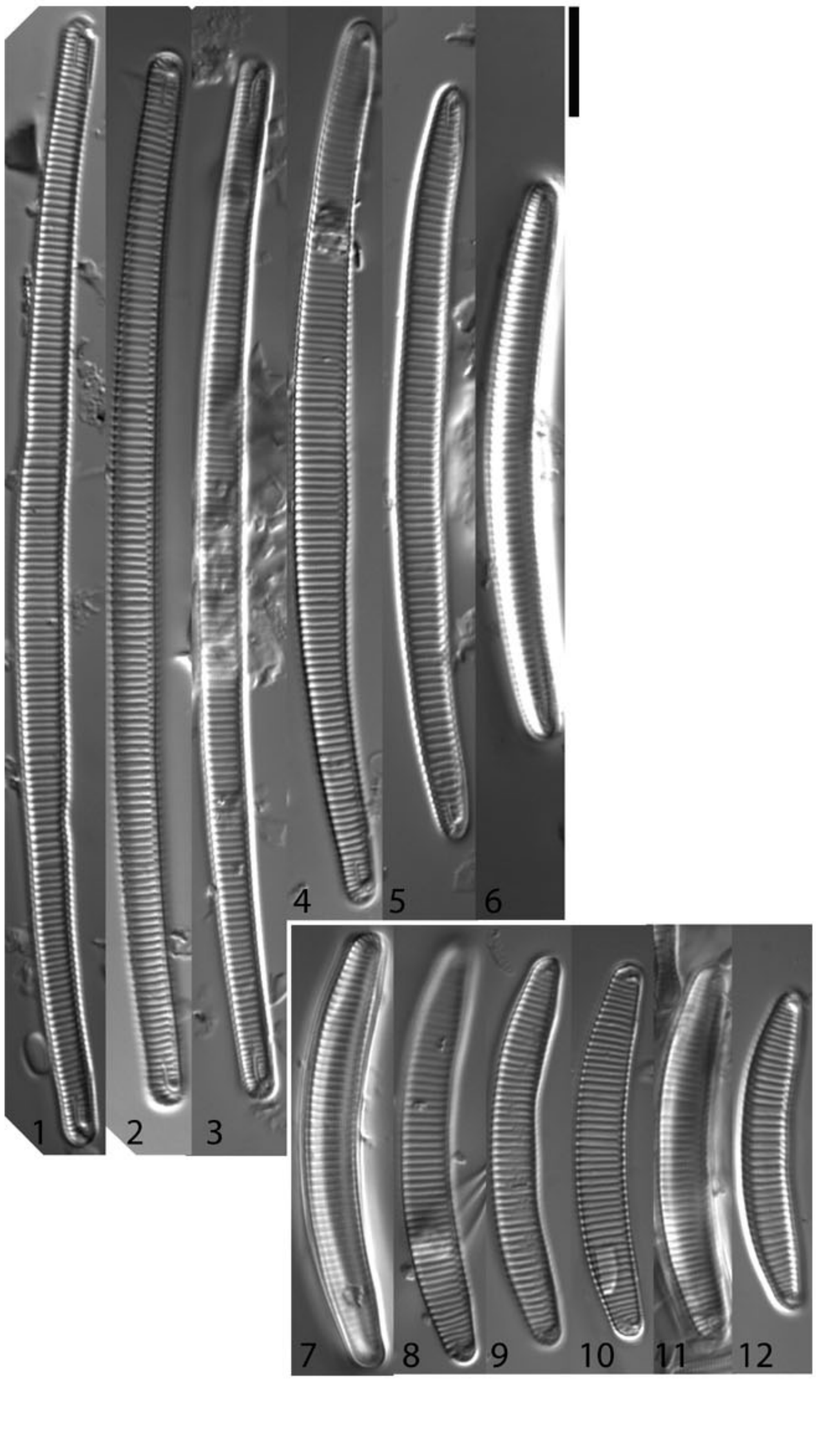
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Plate 16:

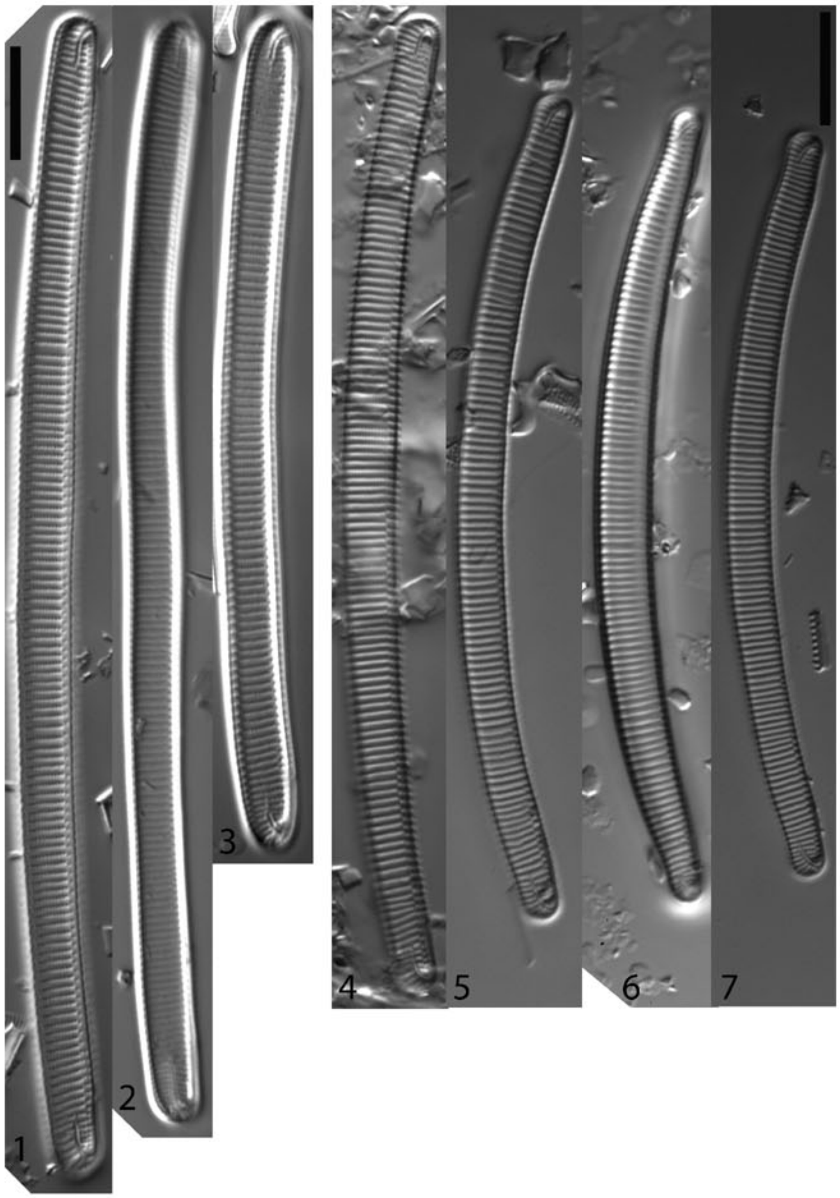
Scale bar = 10 µm

Figs. 1 - 3. ***Eunotia bilunaris* var. *linearis*** (Okuno) Lange-Bertalot & Nörpel

Figs. 4 - 7. ***Eunotia* cf. *bilunaris*** (Ehr.) Mills

Figs. 1 - 3. Sites 032, 104, 116

Figs. 4 - 7. Sites 018, 040, 055, 058, 068, 087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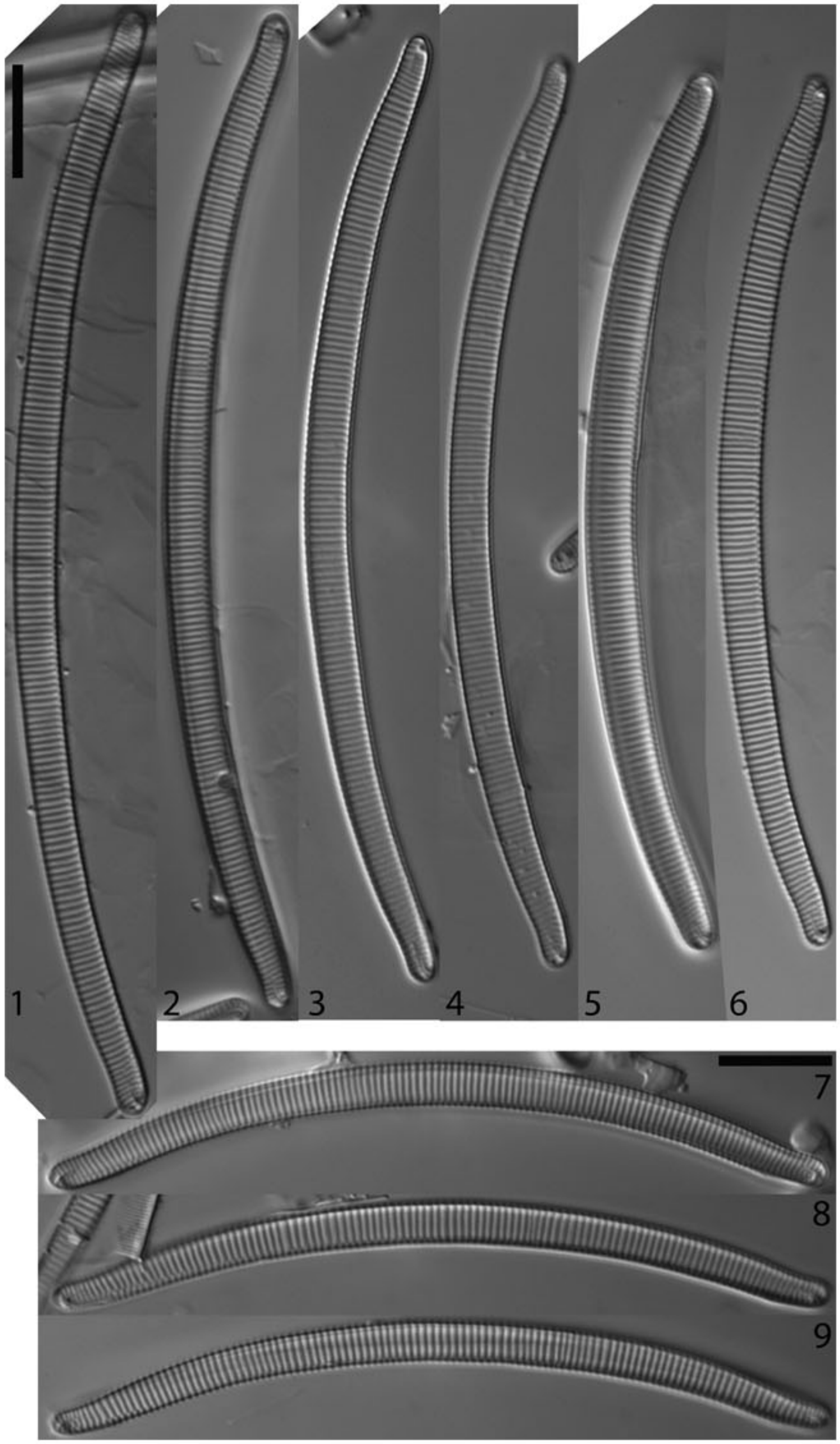
<u>Plate 17</u>:

Scale bar = 10 µm

Figs. 1 - 9. *Eunotia* sp. 2

Figs. 1 - 9. Sites 008, 018, 081, 109, 116, 117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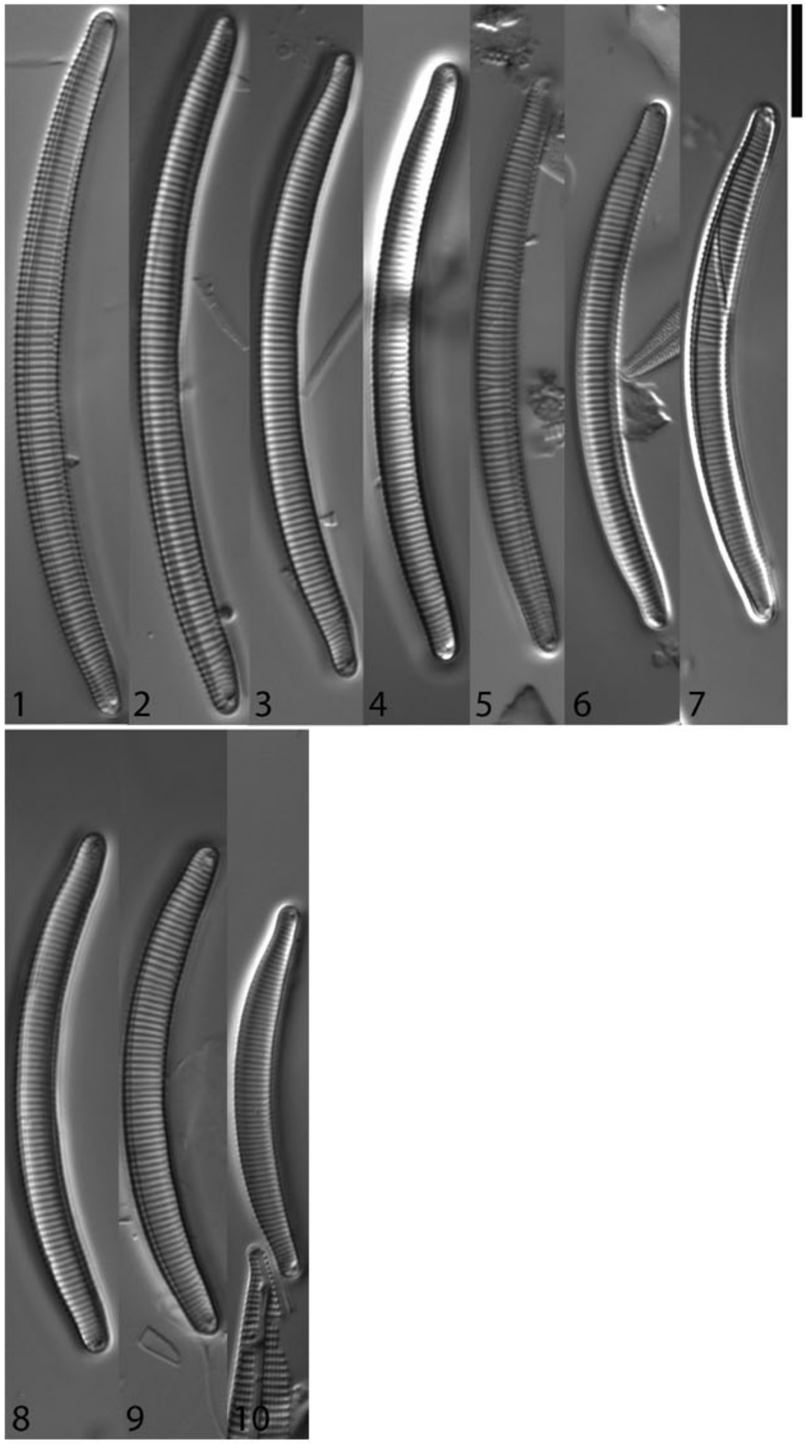
<u>Plate 18</u>:

Scale bar = 10 μm

Figs. 1 - 10. ***Eunotia*** **sp. 2**

Figs. 1 - 10. Sites 008, 018, 081, 109, 116, 117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<u>Plate 19</u>:

Scale bar = 10 µm

Figs. 1 - 32. ***Eunotia mucophila*** (Lange-Bertalot & Nörpel-Schempp) Lange-Bertalot

Figs. 1 - 32. Sites 055, 068, 073, 076, 078, 080, 081

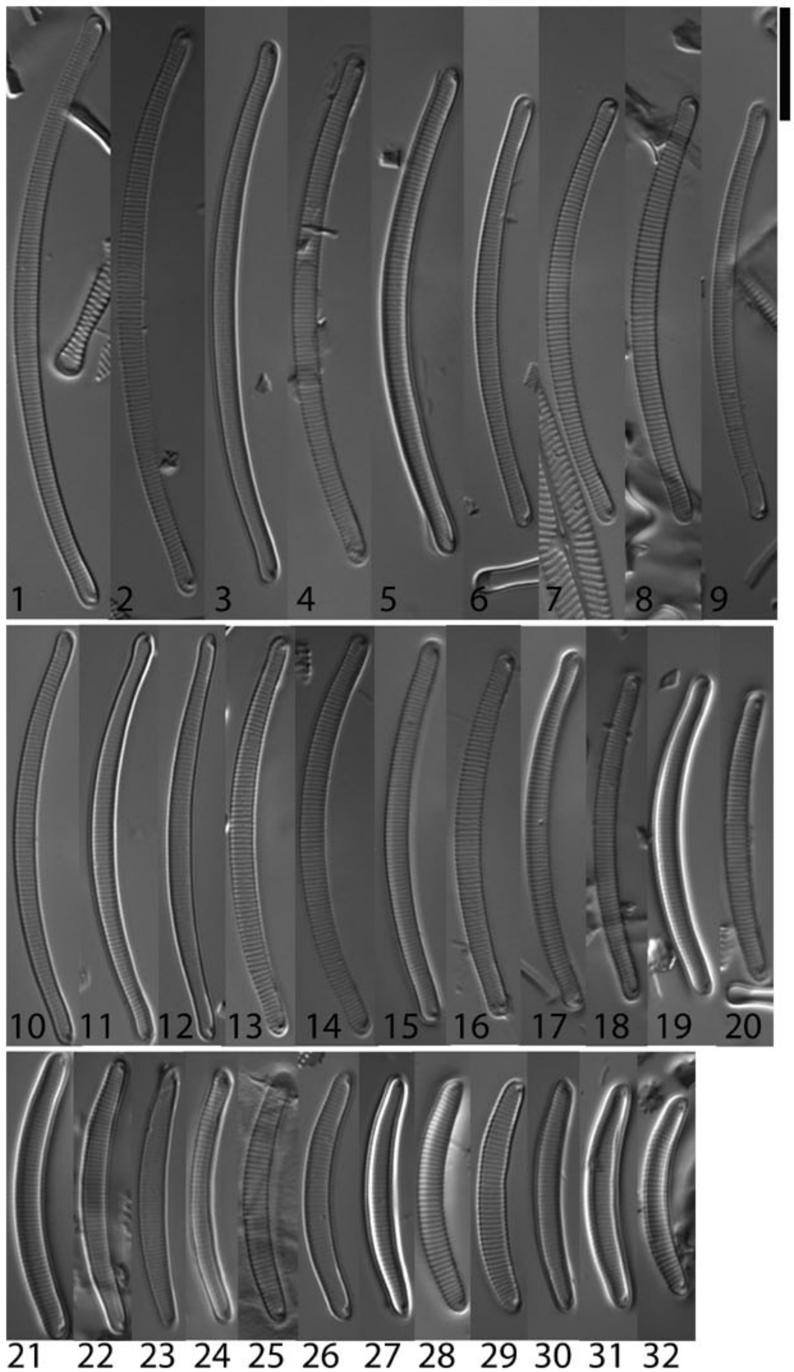

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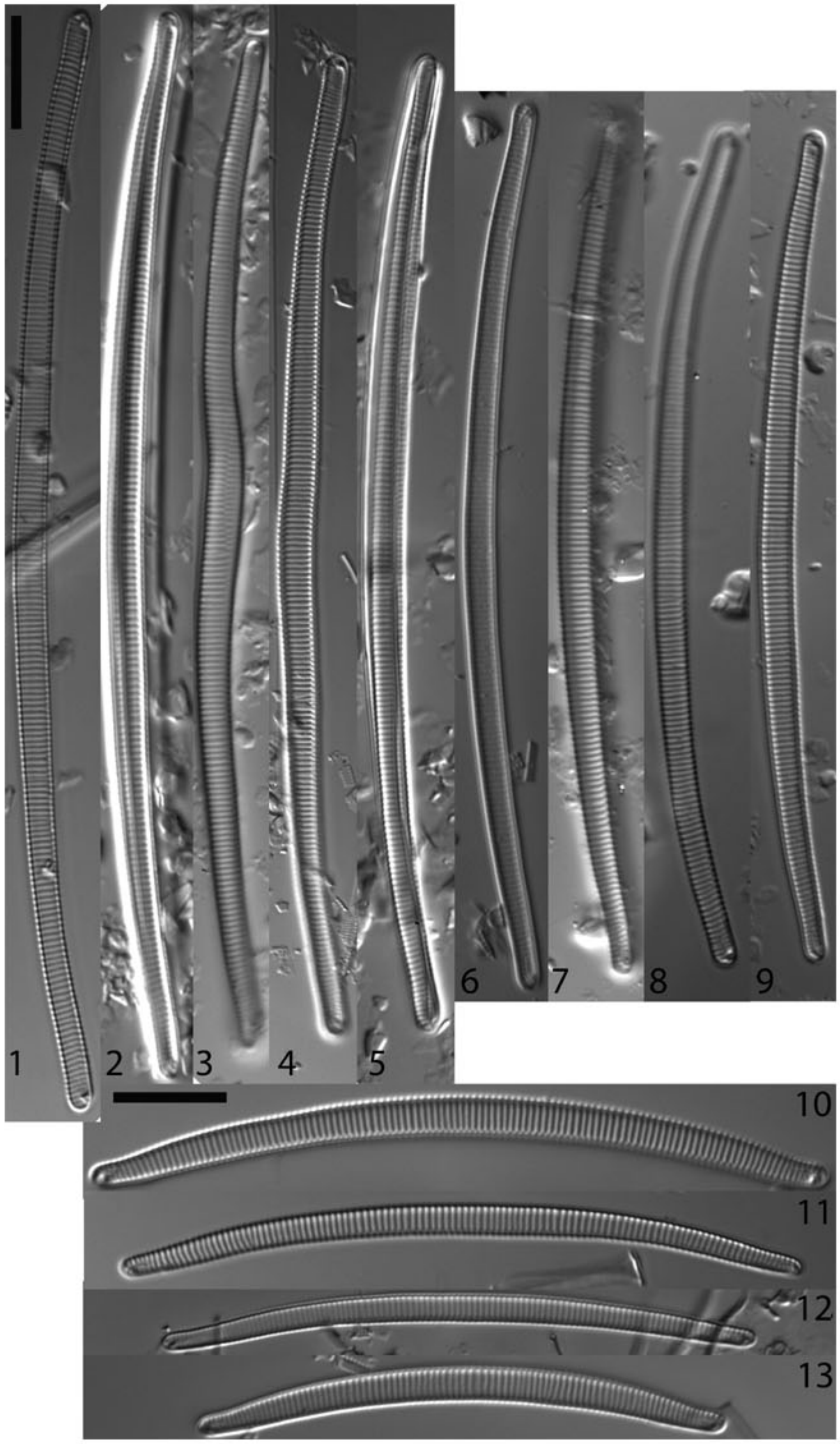
Plate 20:

Scale bar = 10 µm

Figs. 1 - 13. ***Eunotia genuflexa*** Nörpel-Schempp

Figs. 1 - 13. Sites 020, 023, 040, 058, 073, 087, 115, 117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<u>Plate 21</u>:

Scale bar = 10 µm

Figs. 1 - 9. ***Eunotia naegelii*** Migula ***sensu*** **Siver** et al. (2000)

Figs. 10 - 11. ***Eunotia*** **sp. 3**

Figs. 1 - 9. Sites 032, 073, 080, 081, 107

Figs. 10 - 11. Sites 023, 029


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<u>Plate 22</u>:

Scale bar = 10 µm

Figs. 1 - 5. ***Eunotia laponica*** Grun.

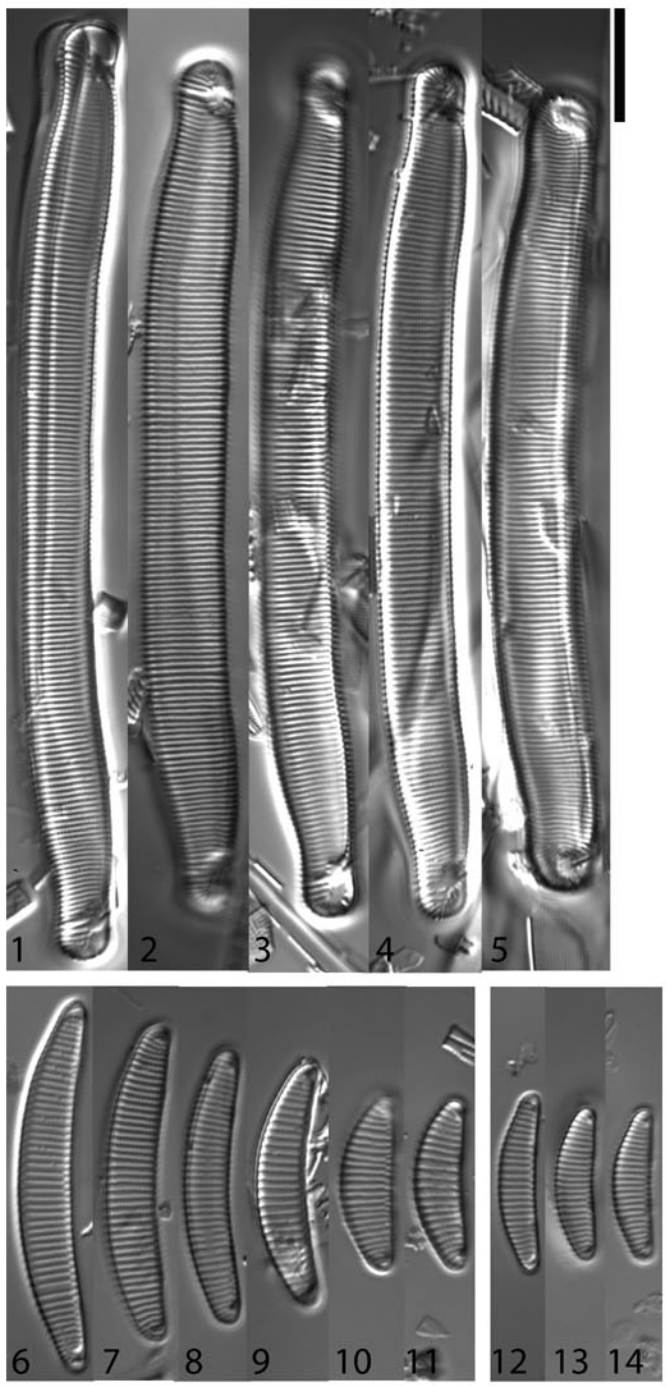
Figs. 6 - 11. ***Eunotia* sp. 4**

Figs. 12 - 14. ***Eunotia subarcuatoides*** Alles, Nörpel-Sch. & Lange-Bertalot

Figs. 1 - 5. Site 031

Figs. 6 - 11. Sites 008, 016, 020, 032, 068, 115, 117

Figs. 12 - 14. Sites 018, 023, 040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<u>Plate 23</u>:

Scale bar = 10 µm

Figs. 1 - 2. ***Eunotia* sp. 5**

Figs. 3 - 7. ***Eunotia botellus*** Moser, Lange-Bertalot & Metzeltin

Figs. 8 - 9. ***Eunotia* sp. 6**

Figs. 10 - 12. ***Eunotia boomsma*** Furey, Lowe & Johansen

Figs. 13 - 16. ***Eunotia satelles*** (Nörp.-Sch. &Lange-B.) Nörp.-Sch. &Lange-B.

Figs. 1 - 2. Sites 031, 068

Figs. 3 - 7. Sites 043, 081, 087

Figs. 8 - 9. Sites 001, 068

Figs. 10 - 12. Sites 020, 029, 057

Figs. 13 - 16. Site 116

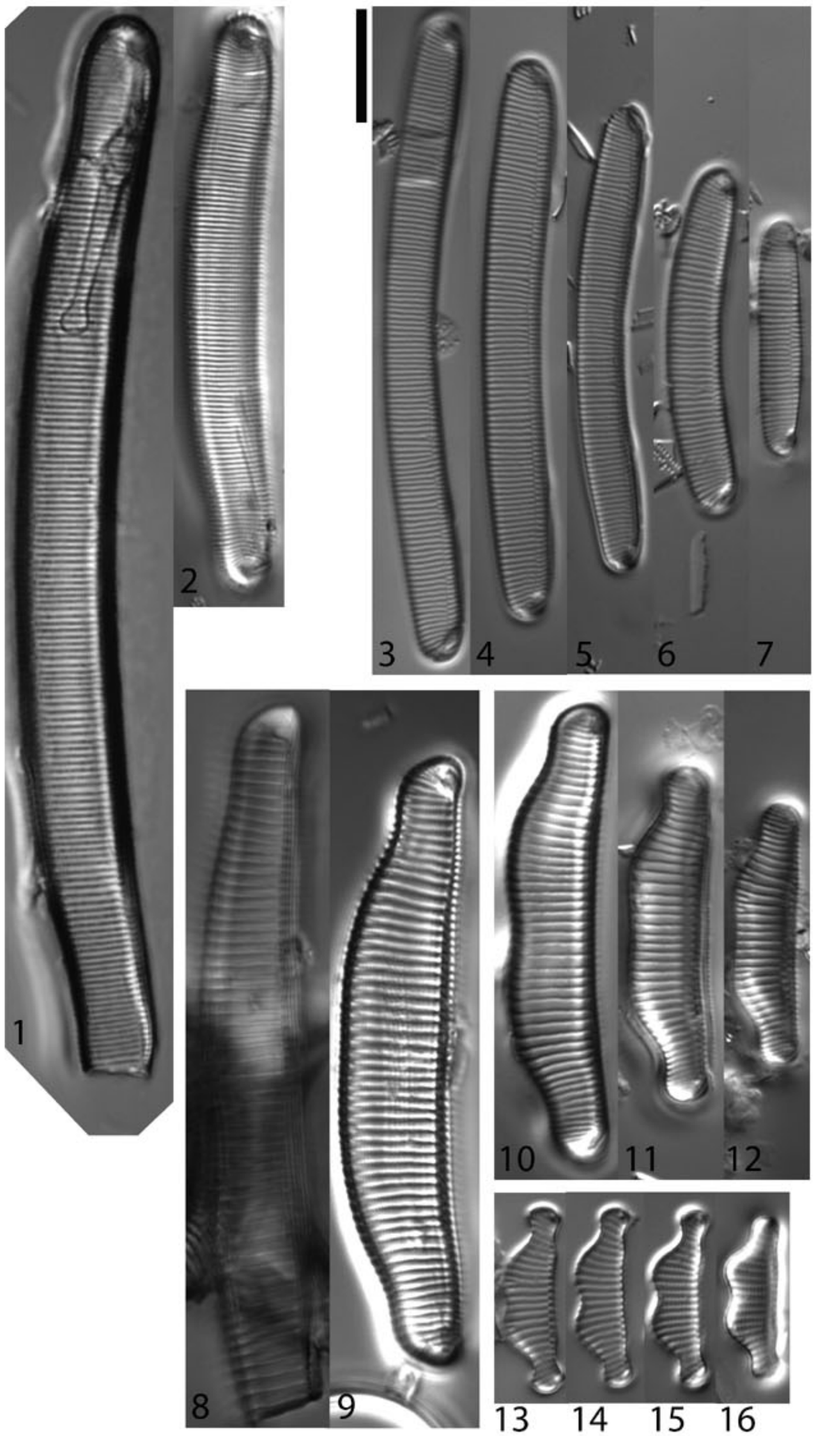
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Plate 24:

Scale bar = 10 µm

Fig. 1. ***Eunotia* cf. *circumborealis*** Nörpel-Sch. & Lange-Bertalot

Figs. 2 - 14. ***Eunotia implicata*** Nörpel-Sch. & Lange-Bertalot

Figs. 15 - 19. ***Eunotia* sp. 7**

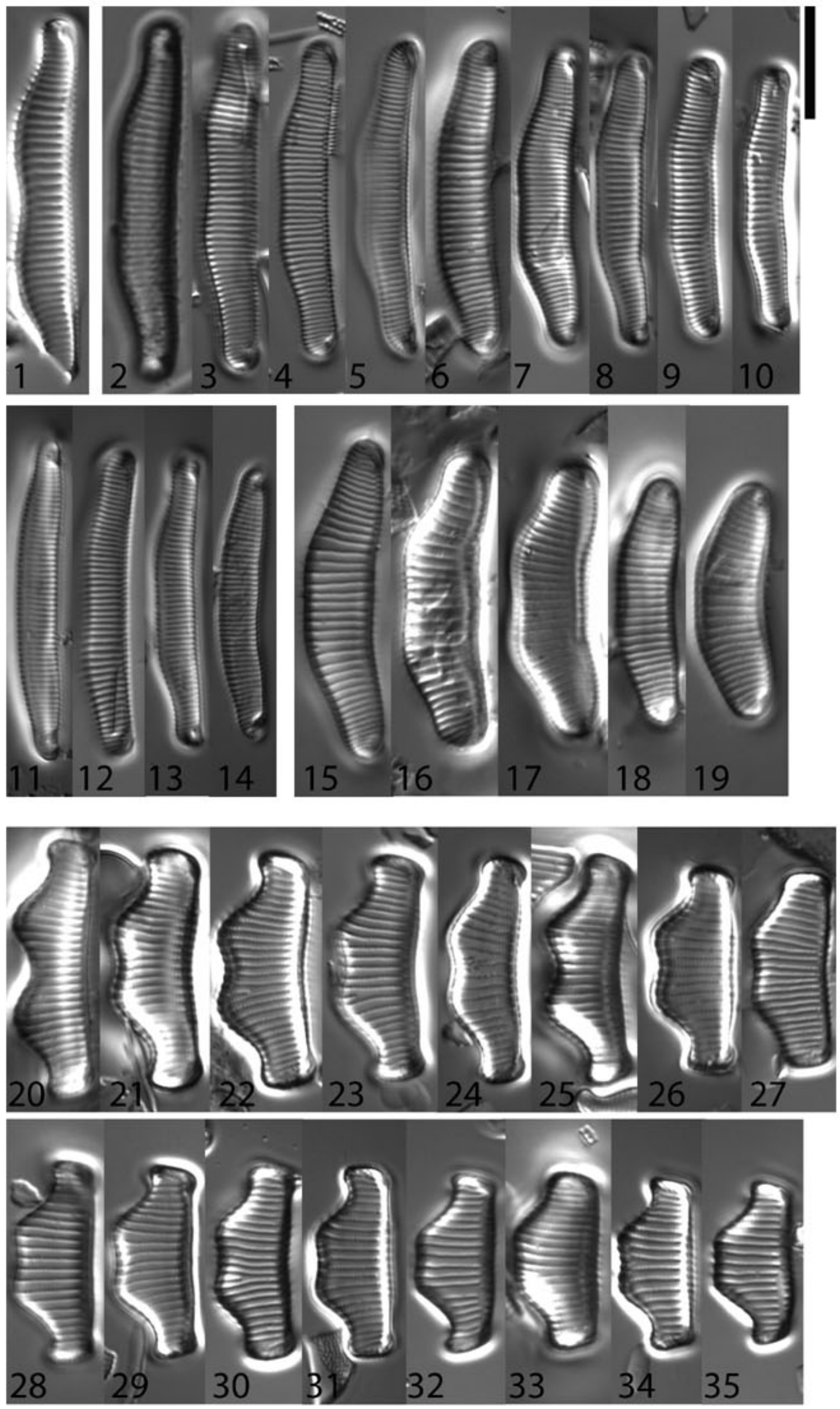
Figs. 20 - 35. ***Eunotia praerupta* var. *bigibba*** (Kütz.) Grunow

Fig. 1. Site 116

Figs. 2 - 14. Sites 016, 032, 068, 073, 080, 087, 115

Figs. 15 - 19. Sites 003, 058, 073, 115

Figs. 20 - 35. Sites 090, 094, 118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<u>Plate 25</u>:

Scale bar = 10 µm

Figs. 1 - 7. ***Eunotia bidentula*** W. Smith

Figs. 8 - 22. ***Eunotia muscicola*** **var.** ***tridentula*** (Grun.) Nörpel & Lange-Bertalot

Figs. 23 - 29. ***Eunotia microcephala*** Krasske

Figs. 30 - 37. ***Eunotia ursamaioris*** Lange-Bertalot & Nörpel-Sch.

Figs. 1 - 7. Sites 031, 076, 107

Figs. 8 - 22. Sites 029, 093, 109, 111, 116, 119

Figs. 23 - 29. Sites 018, 109

Figs. 30 - 37. Sites 020, 023, 040, 058

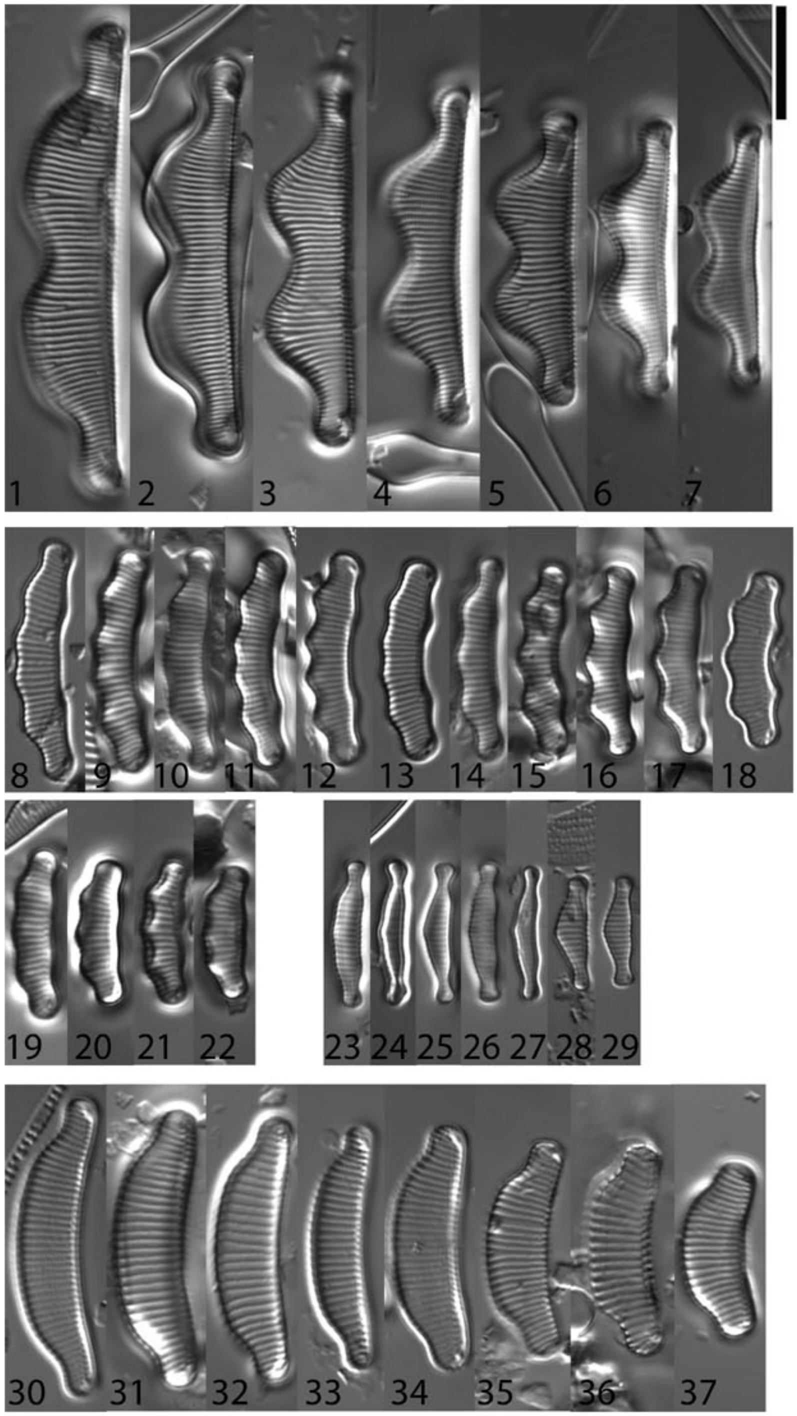
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Plate 26:

Scale bar = 10 µm

Figs. 1 - 3. ***Eunotia neofallax*** Nörpel-Sch. & Lange-Bertalot

Figs. 4 - 7. ***Eunotia* sp. 8**

Fig. 8. ***Eunotia* sp. 9**

Fig. 9. ***Eunotia* sp. 10**

Figs. 10 – 14. ***Eunotia* sp. 11**

Fig. 15. ***Eunotia* sp. 12**

Fig. 16. ***Eunotia* cf. *varioundulata*** Nörpel-Sch. & Lange-Bertalot

Fig. 17. ***Eunotia* cf. *exigua*** (Brébisson) Rabenhorst

Figs. 18 - 19. ***Eunotia botuliformis*** Wild, Nörpel & Lange-Bertalot

Figs. 20 - 23. ***Eunotia septena*** Ehr.

Figs. 1 - 3. Sites 104, 109, 118

Figs. 4 - 7. Sites 117, 119

Fig. 8. Site 087

Fig. 9. Site 087

Figs. 10 - 14. Sites 104, 111, 115

Fig. 15. Site 031

Fig. 16. Site 043

Fig. 17. Site 119

Figs. 18 - 19. Site 087

Figs. 20-23. Sites 058, 076, 087

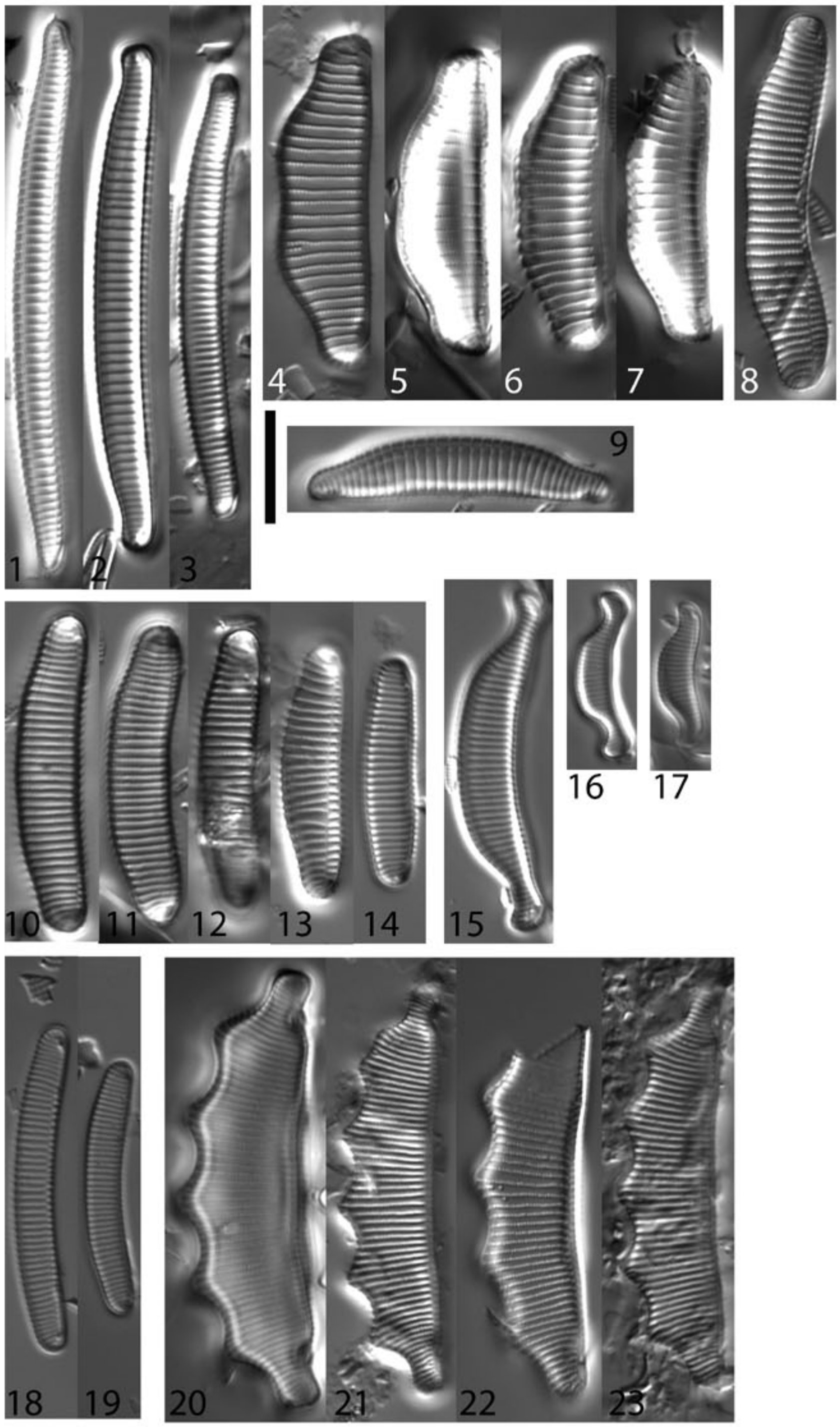

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Plate 27:

Scale bar = 10 µm

Figs. 1 - 18. ***Eunotia* sp. 13**

Figs. 19 - 21. ***Eunotia richbuttensis*** Furey, Lowe & Johansen

Figs. 22 - 24. ***Eunotia* cf. *sylvahercynia*** Nörpel, Van Sull & Lange-Bertalot

Fig. 25. ***Eunotia* sp. 14**

Figs. 26 - 27. ***Eunotia* cf. *tenella*** (Grun.) Hust.

Figs. 28 - 30. ***Eunotia* cf. *melanogaster*** Moser, Lange-Bertalot & Metzeltin

Figs. 31 - 33. ***Eunotia chelonia*** Nörpel-Sch., Metzeltin & Lange-Bertalot

Fig. 34. ***Eunotia paludosa*** Grun.

Figs. 1 - 18. Sites 016, 076, 080, 081, 087

Figs. 19 - 21. Sites 020, 023, 058

Figs. 22 - 24. Sites 069, 080

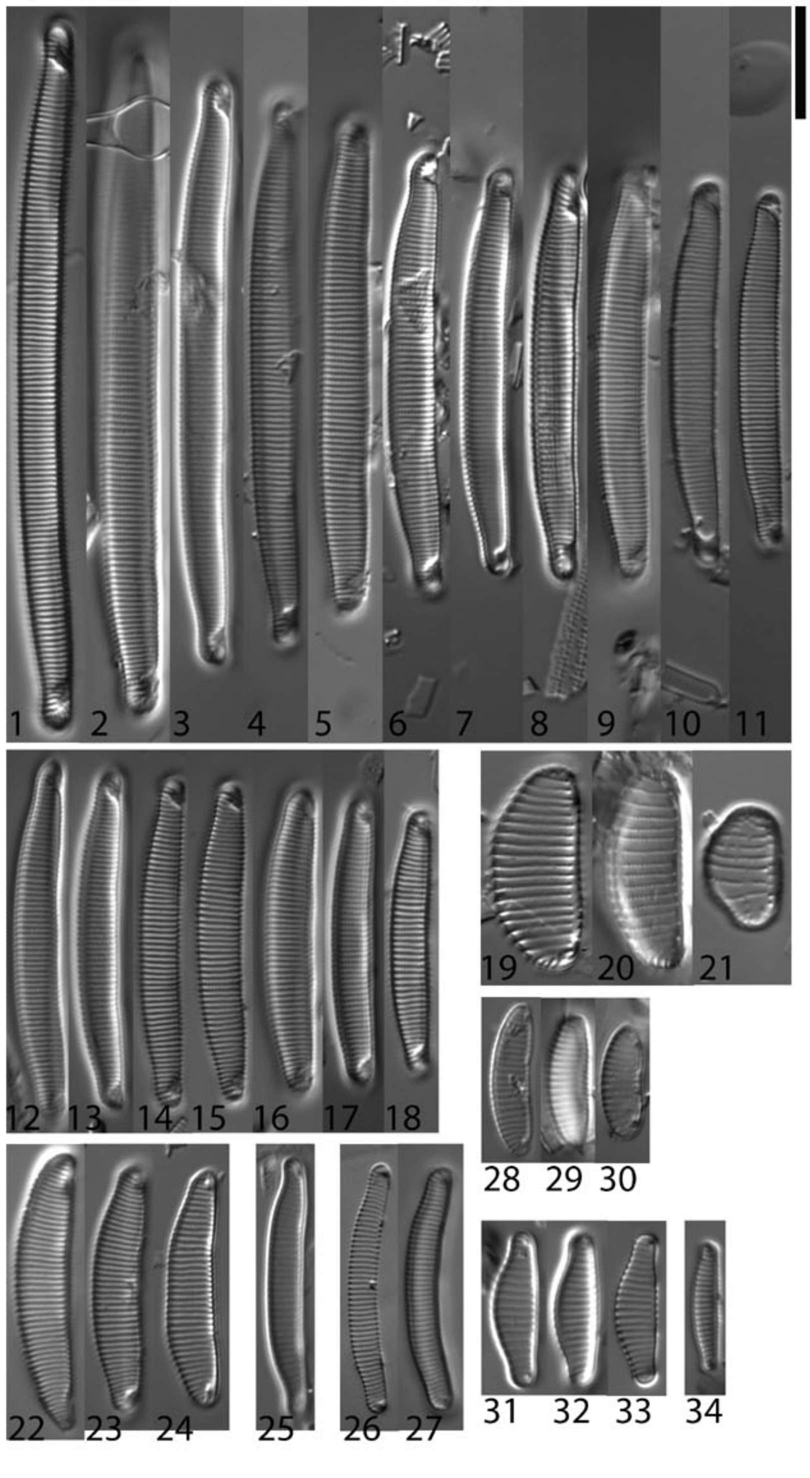
Fig. 25. Site 119

Figs. 26 - 27. Site 008

Figs. 28 - 30. Sites 068, 078, 087

Figs. 31 - 33. Site 116

Fig. 34. Site 094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<u>Plate 28</u>:

Scale bar = 10 µm

Figs. 1 - 18. ***Eunotia* cf. *nymanniana*** Grun. ***sensu*** **KRAMMER & LANGE-BERTALOT** (1991)

Figs. 19 - 24. ***Eunotia arculus*** (Grun.) Lange-Bertalot & Nörpel

Figs. 25 - 29. ***Eunotia elegans*** Østrup

Figs. 30 - 31. ***Eunotia nymanniana*** Grun. ***sensu*** **METZELTIN & LANGE-BERTALOT** (2007)

Figs. 32 - 33. ***Eunotia* cf. *arculus*** (Grun.) Lange-Bertalot & Nörpel

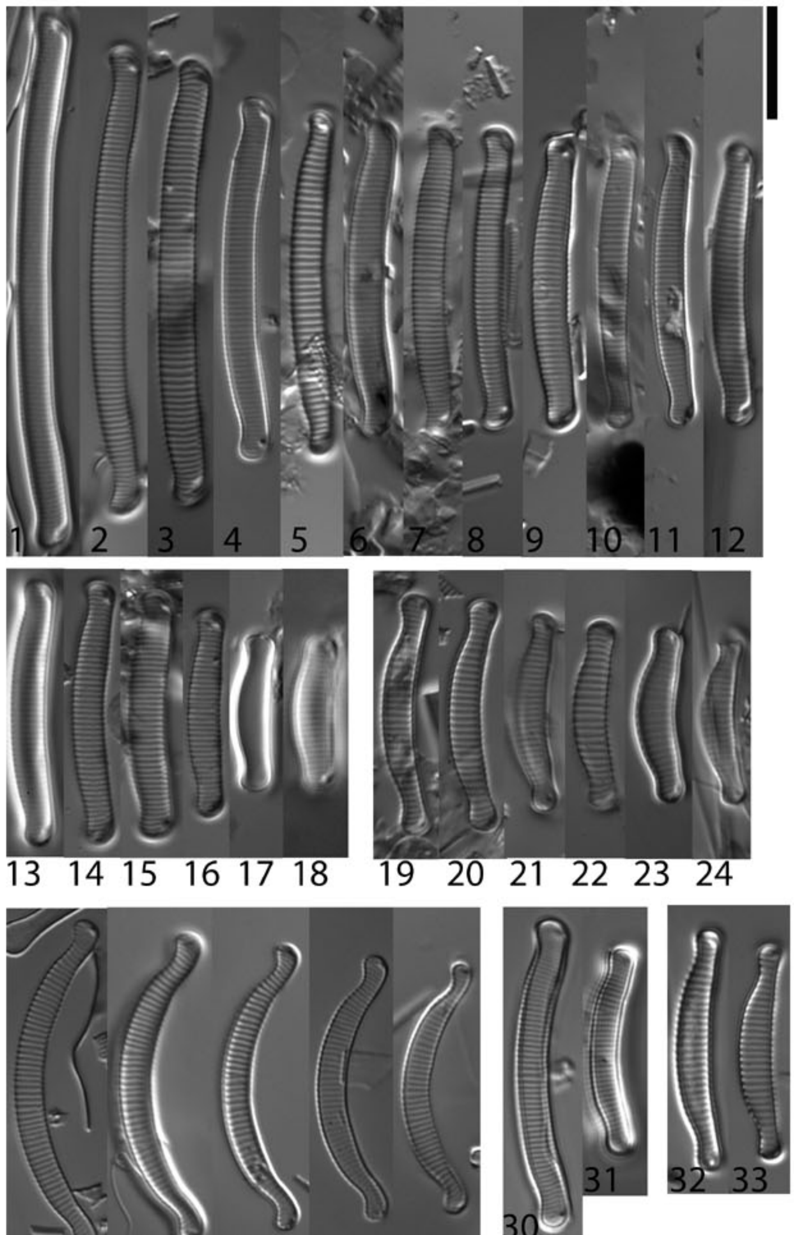
Figs. 1 - 18. Sites 016, 032, 055, 058, 073, 080, 081, 087, 094

Figs. 19 - 24. Sites 081, 087

Figs. 25 - 29. Sites 003, 016, 087

Figs. 30 - 31. Site 109

Figs. 32 - 33. Site 116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<u>Plate 29</u>:

Scale bar = 10 µm

Figs. 1 - 20. ***Eunotia rhomboidea*** Hust.

Figs. 21 - 27. ***Eunotia meisteri*** Hust.

Fig. 28. ***Eunotia rhynchocephala*** Hust.

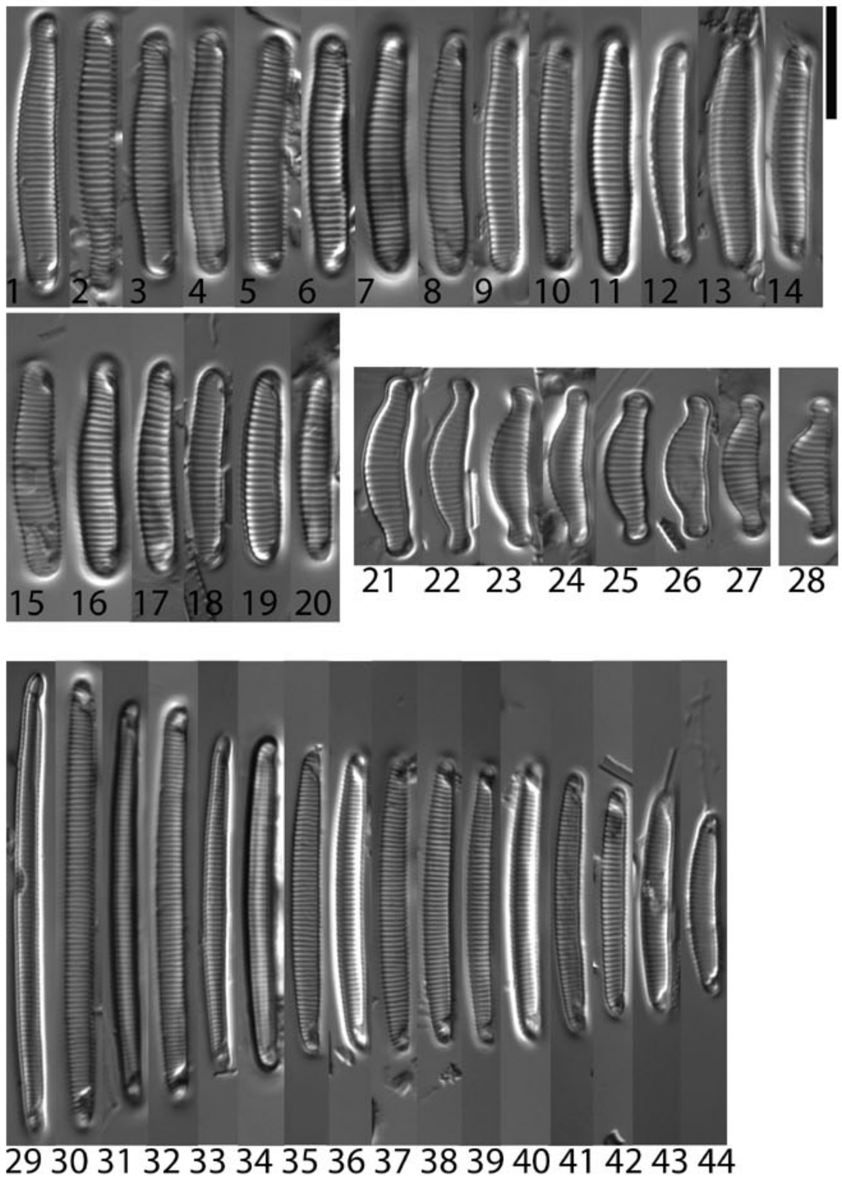
Figs. 29 - 44. ***Eunotia* sp. 15**

Figs. 1 - 20. Sites 018, 055, 068, 076, 080, 087, 104, 107, 109, 117

Figs. 21 - 27. Sites 016, 023, 040, 055, 058, 107

Fig. 28. Site 116

Figs. 29 - 44. Sites 037, 043, 068, 069, 080, 107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29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

Plate 30:

Scale bar = 10 µm

Figs. 1 - 6. ***Eunotia* sp. 16**

Figs. 7 - 10. ***Eunotia boreoalpina*** Lange-Bertalot & Norpel-Schempp

Fig. 11. ***Eunotia* sp. 17**

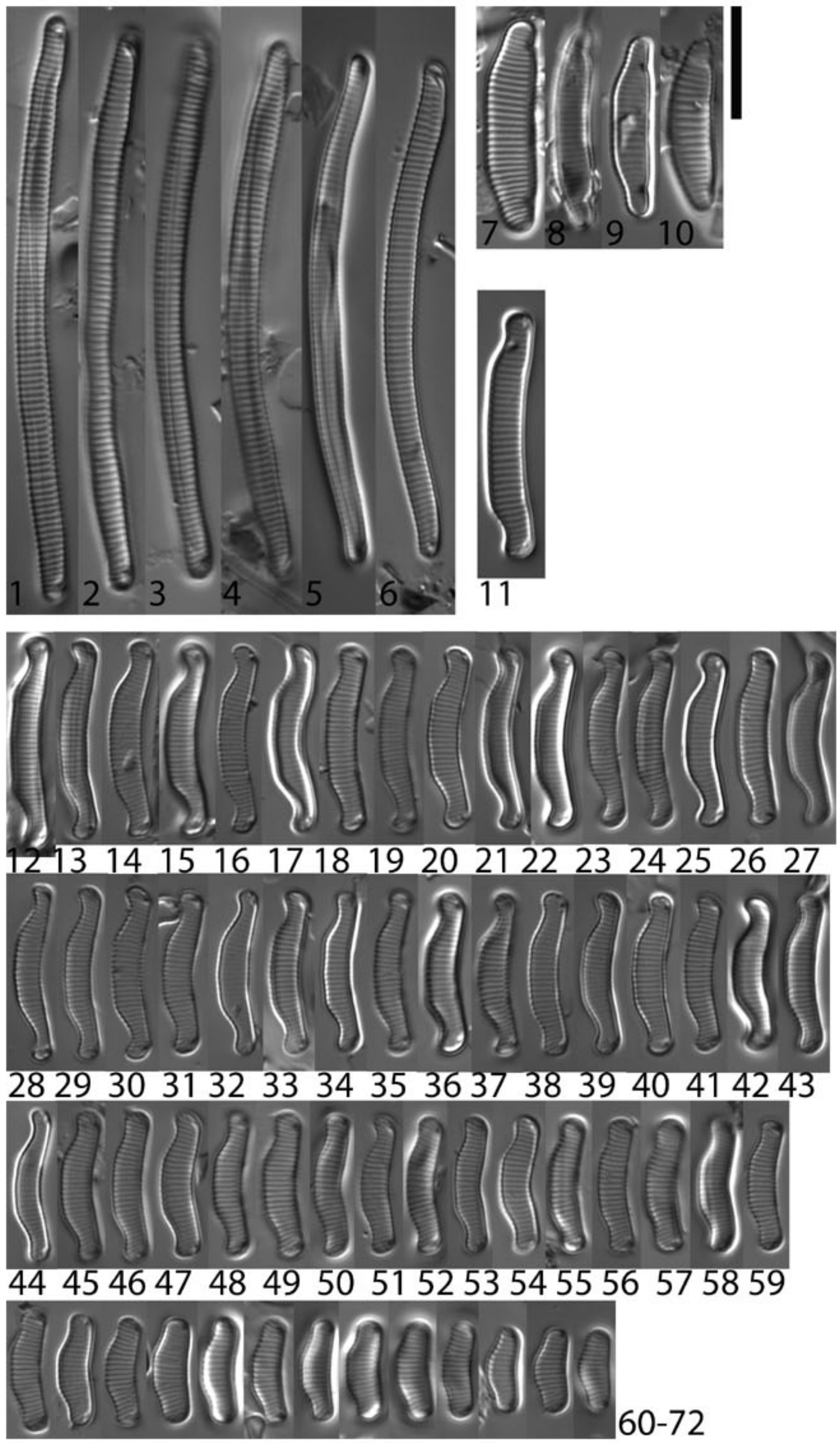
Figs. 12 - 72. ***Eunotia exigua*** (Brébisson) Rabenhorst

Figs. 1 - 6. Site 018

Figs. 7 - 10. Sites 018, 109

Fig. 11. Site 116

Figs. 12 - 72. Sites 018, 037, 081, 093, 094, 109, 111, 117, 118, 119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60-72

<u>Plate 31</u>:

Scale bar = 10 µm

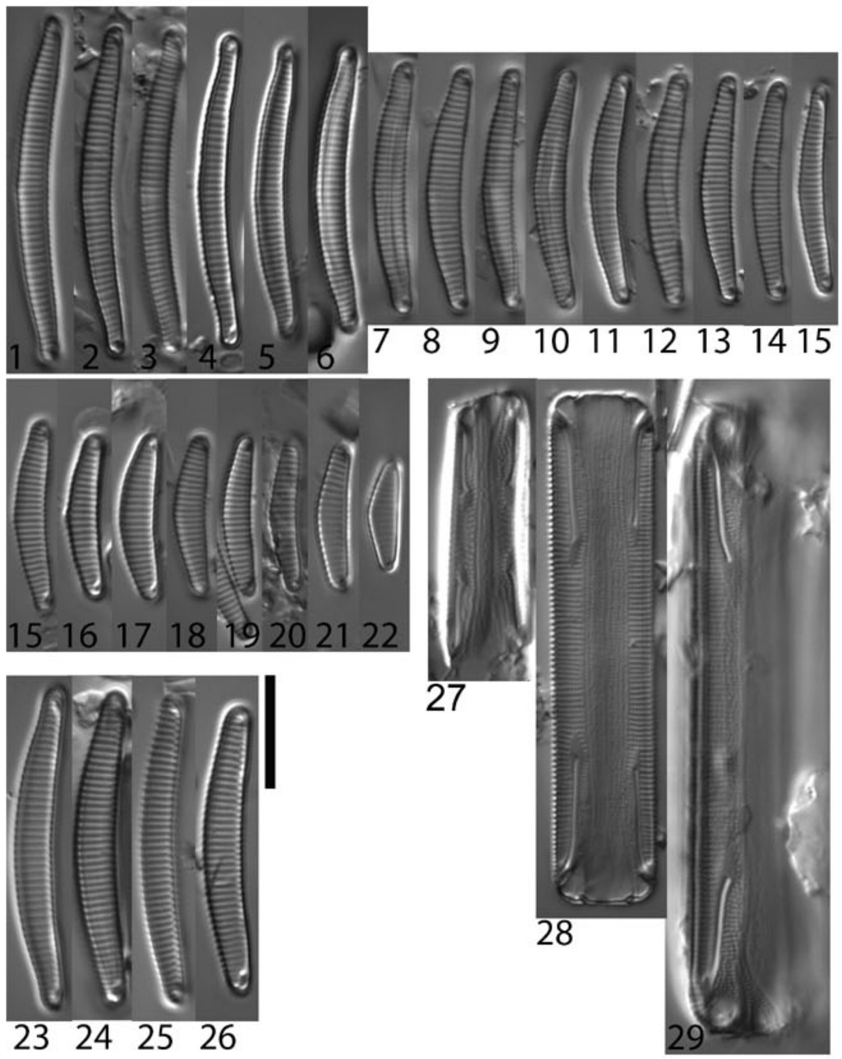
Figs. 1 - 22. ***Eunotia trinacria*** Krasske

Figs. 23 - 26. ***Eunotia* cf. *rushforthiana*** Furey, Lowe & Johansen

Figs. 27 - 29. ***Eunotia* sp. -** girdle views

Figs. 1-22. Sites 018, 093, 109, 111, 117, 119

Figs. 23-26. Site 018, 109, 117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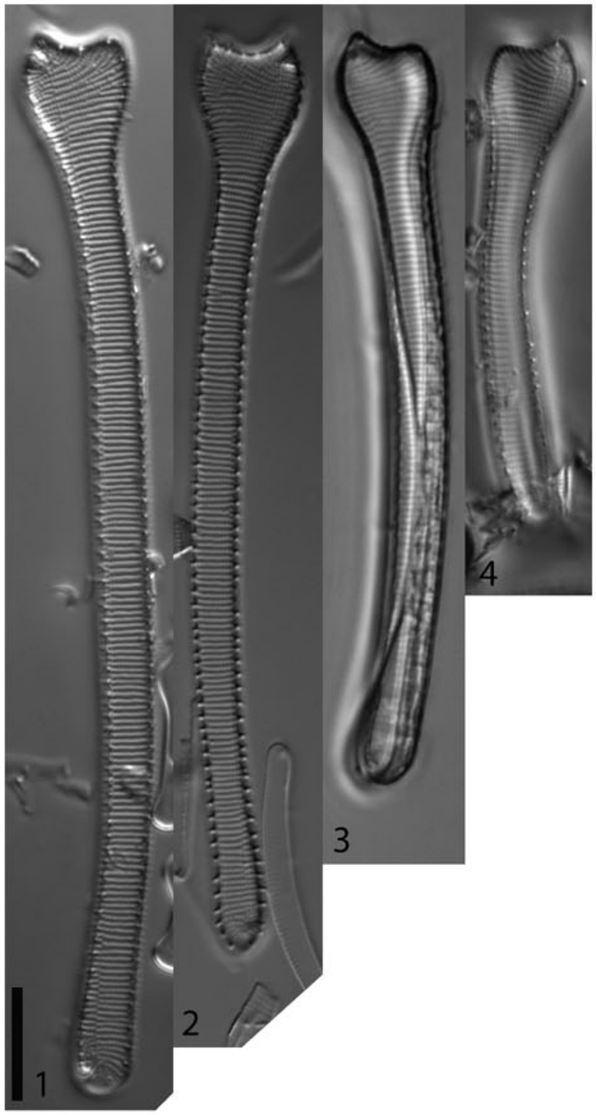
<u>Plate 32</u>:

Scale bar = 10 µm

Figs. 1 - 4. ***Actinella punctata*** Lewis

Figs. 1 - 4. Sites 016, 068, 076, 081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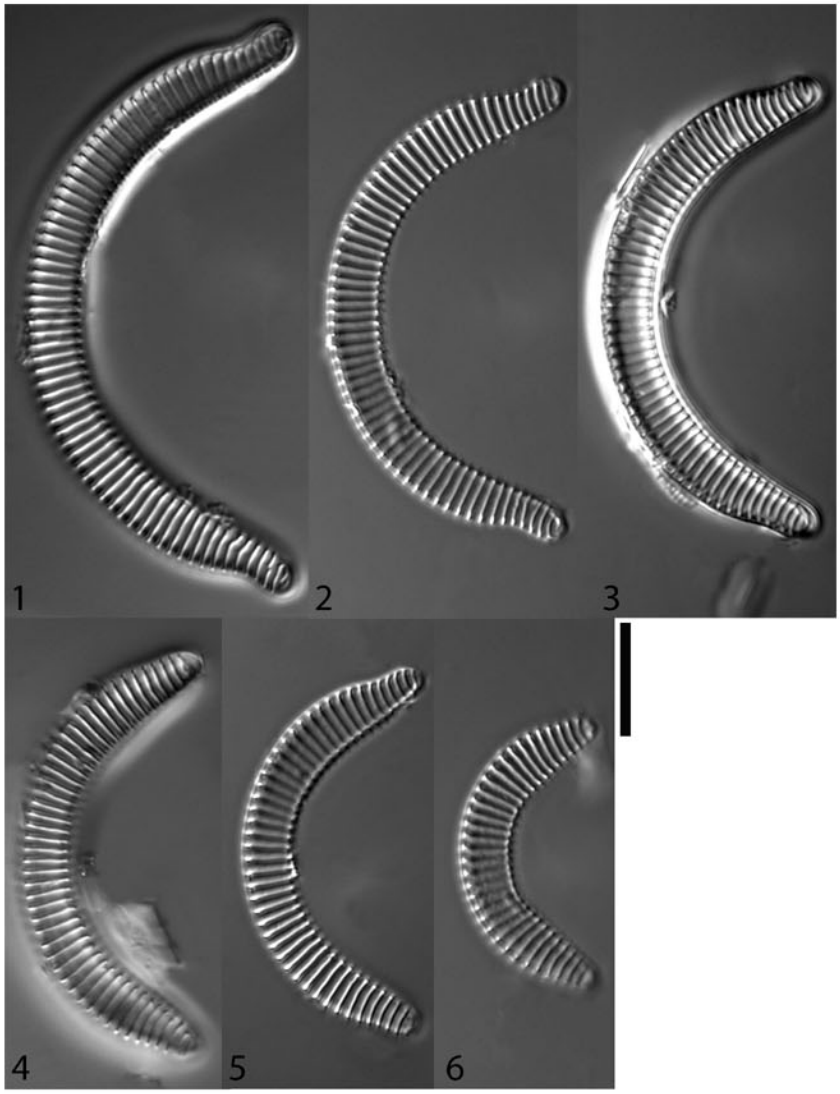
<u>Plate 33</u>:

Scale bar = 10 µm

Figs. 1 - 6. ***Semiorbis hemicyclus*** (Ehr.)

Figs. 1 - 6. Sites 043, 055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<u>Plate 34</u>:

Scale bar = 10 µm

Figs. 1 – 27. ***Peronia* sp. 1**

Figs. 1 – 10. “raphe-valves” (with two long raphe slits)

Figs. 11 – 19. “rapheless-valves” (raphe slit on the head pole is reduced)

Figs. 20 – 24. “raphe-valves” (with shorter head pole raphe)

Figs. 25 – 26. girdle view

Fig. 27. spines on the valve margin

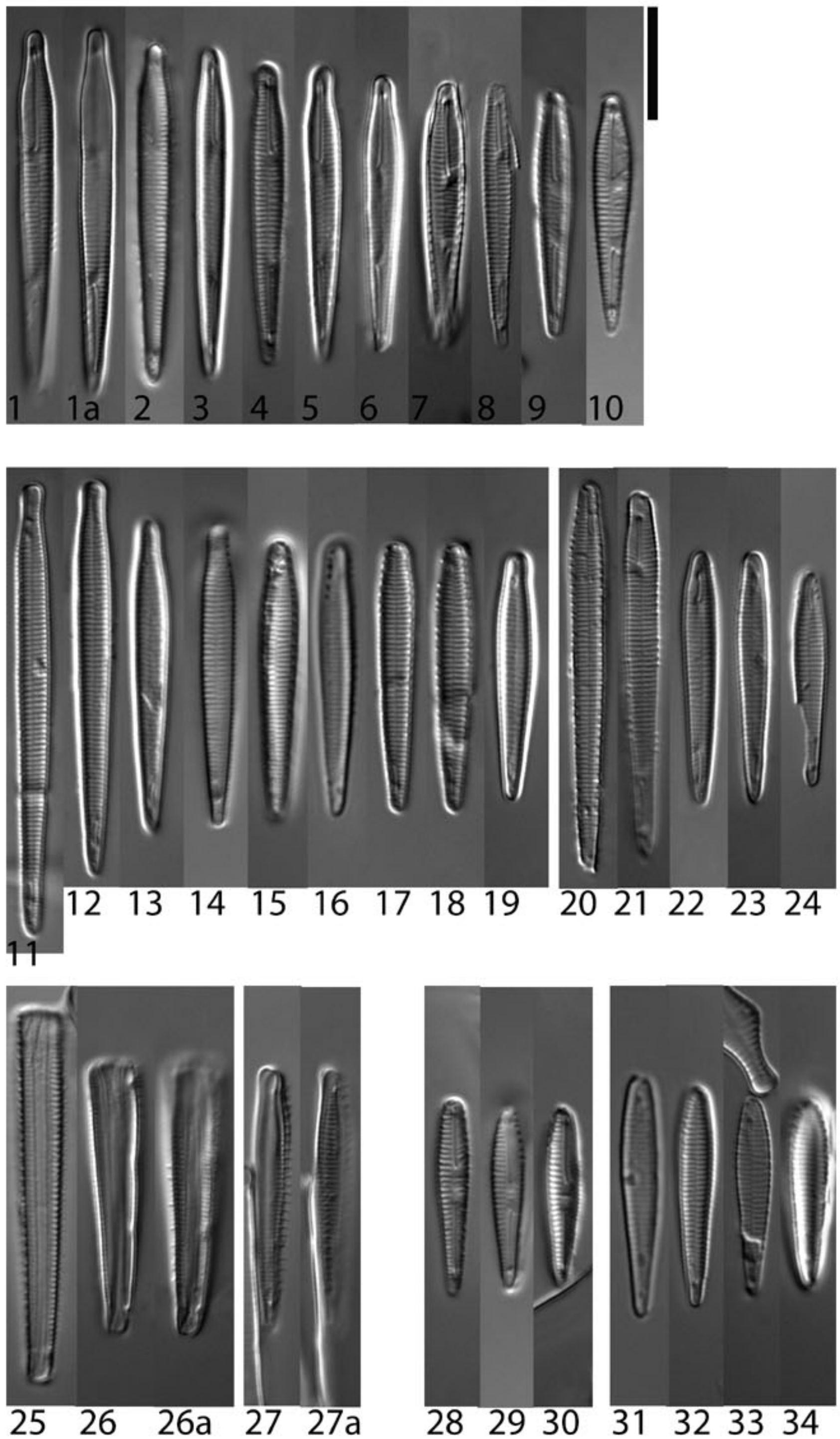
Figs. 28 – 34. ***Peronia heribaudi*** Brun & Peragallo

Figs. 28 – 30. “raphe-valves” (with two long raphe slits)

Figs. 31 – 34. “rapheless-valves” (raphe slit on the head pole is reduced)

Figs. 1 – 27. Sites 032, 068, 069, 073, 076, 080

Figs. 28 – 34. Sites 032, 068, 069, 073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