Diatom (Bacillariophyceae) flora of early Holocene freshwater sediments from Skalafjord, Faeroe Islands

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ABSTRACT – Relative abundance data of diatom (Bacillariophyceae) species were generated for sediment core SKPC-01B from the Skalafjord, Faeroe Islands. The record shows distinct temporal changes in species composition. In the lowermost 65 cm of the 230 cm long core a species-rich freshwater diatom assemblage was found. Most of the taxa observed in this section are typical of oligotrophic to dystrophic lakes in northern Europe (Scandinavia, Iceland and Spitsbergen). Above this interval the diatom flora is dominated by marine taxa. The change from a freshwater to a marine flora is inferred to be caused by rising sea-level that took place about 7700–6400 years BP. Drastic changes in the diatom species composition within the transitional core section show that environmental change in the Skalafjord took place in several pulses. The first stage included strong inflow (possibly catastrophic) of marine waters. As a possible trigger of this phenomenon the tsunami released by the Storegga Slide is proposed. Before the final flooding by marine waters, freshwater conditions were re-established within the Skalafjord. These results have important implications for the interpretation of the palaeogeographical development of the Eysturoy area. Hence, it is suggested that the Storegga Slide led to inflow of marine waters at a distinctly lower water level in the area of the Skalafjord than proposed in recent publications and that the inundation of the threshold in the fjord happened after the tsunami. J. Micropalaeontol. 22(2): 183–208, November 2003.

INTRODUCTION
Fossil diatom floras of freshwater and marine origin may be used for reconstructing environmental changes. Freshwater diatom floras from limnic sediments are useful for reconstructions of the climate changes that took place at high latitudes in the Northern Hemisphere since the last deglaciation. Recently, studies of lacustrine sediments from the land areas surrounding the North Sea and Norwegian Sea have been shown to contain a record of past catastrophic events that took place in the area. One such record is a tsunami caused by the Storegga Slide dated at c. 7500 14C years BP (Dawson & Smith, 2000). Diatoms represent one of the best indicators of the impact of this tsunami on the sedimentary record. This phenomenon has been shown to occur in sediment cores from lakes from the Faeroe Islands (Grauert et al., 2001). Abrupt changes in diatom species composition were interpreted as indicators of this catastrophic event. However, the altitude of the sediment section analysed here and its significance for the ocean level at which the Storegga Slide took part is not in agreement with palaeogeographical interpretations given by Bennike et al. (1998) and Grauert et al. (2001).

Although the first publications on freshwater diatoms from the northern part of the North Atlantic are from the nineteenth and twentieth centuries, knowledge of the freshwater diatom flora of the Faeroe Islands is rather poor. Early publications (Lyngbye, 1819; Cleve, 1873, 1896, 1898, 1900; Lagerstedt, 1873; Cleve & Grunow, 1880; Østrup, 1897; Brun, 1901) dealt with the high latitude North Atlantic in general and usually concerned both marine and freshwater floras. Later, Hustedt (1937), Krasske (1938) and Foged (1964, 1974) published results on their studies of the freshwater diatom flora from some North Atlantic islands (for example, the Faeroe Islands and Spitsbergen). Only Hustedt (1937) dealt with diatoms from Iceland, the Faeroe Islands and Spitsbergen. The first report focusing on freshwater diatoms from the Faeroe Islands was by Lyngbye (1819). The next study specifically dealing with the freshwater diatom flora from the Faeroe Islands was published by Østrup (1901). Somewhat later, Østrup (1903) published a report on marine diatoms from this area. Since then, no papers on freshwater diatoms from the Faeroes have been published, to the best of our knowledge.

Recently, an effort was directed towards studies of the marine diatom flora of the North Atlantic and the results were used for studies of climate change following the last deglaciation. The major objective of these studies was to decipher palaeoceanographical changes (Koc & Schrader, 1990; Koc & Jansen, 1992; Schrader et al., 1993a, b; Kohly, 1998; Wachnicka, 1999; Jozkow, 2000; Jiang et al., 2001; Witak et al., 2004). Core SKPC-01B from the Skalafjord, Faeroe Islands has been analysed for diatoms. The Skalafjord penetrates into Eysturoy, the biggest of the Faeroe Islands (Fig. 1). Diatoms are well preserved and dominated by freshwater forms in the lowermost part and marine forms in the upper part. The focus is on the freshwater diatom flora from the lower part of the core. The sediments are of early Holocene age, and the flora is typical of high latitude nutrient-poor (oligotrophic to dystrophic) lakes (e.g. Cleve-Euler, 1951–1955; Lange-Bertalot & Metzeltin, 1996). The position of the freshwater deposits within the section and the weak representation of marine elements suggest that deposition took place before the threshold in the Skalafjord was inundated.

Geological setting
The Faeroe Islands consist of a group of islands in the North Atlantic situated between 61°20’N and 62°24’N and between 6°15’W and 7°41’W (Fig. 1). Geologically, they belong to
the North Atlantic basalt province, and the whole area was influenced by Tertiary volcanism (Boldreel & Andersen, 1995; van Weering et al., 1998). During glacial periods, part of the North Faeroe shelf was exposed subaerially and may have been glaciated (Jørgensen & Rasmussen, 1986). Lakes and bogs are common throughout the islands, and the deposits within them provide Holocene palaeoenvironmental records (Grauert et al., 2001). Skalafjord is 13 km long with a greatest depth of around 70 m. At the entrance of the fjord a sill with a water depth of 25 m is present. The fjord is surrounded by 500–600 m high mountains. Post-glacial sediments in the fjord were deposited in two separate basins and have a maximum thickness of about 20 m (Juul, 1992).

**MATERIAL AND METHODS**

Core SKPC-01B was one of nine sediment cores retrieved from the Faeroe Islands during the September–October 1995 *R/V Skagerak* cruise organized by Göteborg University in collaboration with the Geological Survey of Denmark and Greenland (Fig. 1). Skalafjord is 13 km long with a greatest depth of around 70 m. At the entrance of the fjord a sill with a water depth of 25 m is present. The fjord is surrounded by 500–600 m high mountains. Post-glacial sediments in the fjord were deposited in two separate basins and have a maximum thickness of about 20 m (Juul, 1992).

**Fig. 1.** Location of the core sampled in the Skalafjord, Faeroe Island.

Samples were prepared in the manner of Håkansson & Ross (1984). Samples for diatom analyses were collected at 5 cm intervals. One gram of sediment was dried at 60° for 24 hours. The sediment was treated with 10% HCl to dissolve carbonates and then washed several times with distilled water. The siliceous material was gently boiled in concentrated (37%) H₂O₂ and washed several times with distilled water. The supernatant was decanted off after 20 hours. An aliquot of the shaken suspension was transferred by pipette to an 18 × 18 mm square coverslip. The coverslips were left to dry at room temperature. After evaporation, the coverslips were placed onto labelled slides. Permanent diatom preparations were mounted with Naphrax® (refractive index=1.78) and briefly heated to 200°C. Diatom analyses were performed with a LEICA DMLB light microscope, using ×100/1.25 planapochromatic oil-immersion objective. Scanning electron microscope analysis was performed by means of a Zeiss DSM 940 at 25 kV. In each sample more than 300 valves were counted. Diatoms were counted by the Schrader & Gersonde (1978) method.

Diatom identifications were based on the works of Podzorski (1985), Krammer & Lange-Bertalot (1986, 1991a, b, 1997, 2000), Sala et al. (1993), Lange-Bertalot & Moser (1994), Lange-Bertalot & Metzeltin (1996), Metzeltin & Witkowski (1996), Witkowski et al. (1996), Metzeltin & Lange-Bertalot (1998), Lange-Bertalot & Genkal (1999), Reichardt (1999), Lange-Bertalot (2001), Krammer (1992, 1997, 2000, 2002) and Háčkansson (1990, 2002) for freshwater taxa and Witkowski et al. (2000) for marine forms. Diatoms were divided into groups according to their ecological requirements after Denys (1992), Hoffman (1994) and Van Dam et al. (1994).
The chronology of core SKPC-01B is based on three radiocarbon AMS 14C analyses (Table 1) from macrofossil shells. The dating was performed at the University of Aarhus, Denmark. Calibrated ages in calendar years were obtained from Stuiver et al. (1998) by means of the Seattle calibration program CALIB version 4.0 (Stuiver & Reimer, 1993). Ages of certain levels in SKPC-01B were estimated through linear interpolation between the AMS 14C dated levels assuming a constant sedimentation rate.

**DISTRIBUTION OF FRESHWATER DIATOMS**

**Abundance and concentration**

The core length studied is 230 cm, and it is characterized by predominantly homogeneous olive-grey clayey mud (Fig. 2). More or less corroded shell fragments were observed along the whole profile. Their quantity distinctly increased at 120–130 cm depth. At 108–118 cm the sediment was distinctly laminated and somewhat darker.

Within the whole sediment profile the diatoms represent two completely different environments. At a depth of 230–165 cm, taxa typical of limnic environments predominated (Fig. 3). Above 165 cm the flora is almost exclusively marine. The sediments representing these two different environments are connected by an apparently transitional section between 180–165 cm. In this part of the sediment profile a transition from limnic to marine conditions is recorded. First, in the section from 180–170 cm, a strong peak in marine diatoms occurs followed by a dominance of freshwater taxa in the sediment interval from 170–165 cm. These abrupt environmental changes took place during the period 7700–6400 years BP.

A total of 166 diatom taxa have been identified. In general, the preservation state was satisfactory but, at some levels, the valves were fragmented. Freshwater diatoms were represented by 121 taxa, brackish-water forms by 16 taxa and marine forms by 28 taxa. The freshwater flora was dominated by benthic species (126 species), while the planktonic flora consisted of 39 species.

In this paper the freshwater diatoms that occurred in the lowermost part of the core are described. Two diatom assemblage zones (DAZ) and several subzones are distinguished (Fig. 3). The first zone (DAZ-1) corresponds to the lower part of the core (230–165 cm). Two subzones were distinguished, DAZ-1a (depth interval 230–195 cm) and DAZ-1b (depth interval 195–165 cm) (Fig. 4). The following criteria were applied to distinguish the diatom assemblage zones:

- changes in the ratio between marine and freshwater taxa;
- habitat characteristics, i.e. planktonic versus benthic forms;
- diatom concentration in number of valves per 1 g of sediment.

**DAZ-1a.** The age of the boundary between subzone DAZ-1a and DAZ-1b sediments was estimated to be about 7700 14C years BP. Diatom zone DAZ-1 is characterized by abundant freshwater taxa and less abundant marine ones (Fig. 3). Diatom valves are usually very well preserved.

In diatom subzone DAZ-1a the proportion of marine taxa was very low. Planktonic forms showed a distinct upward

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**Table 1.** Results of AMS 14C datings for the piston core SKPC-01B retrieved from the Skalafjord, Faeroe Islands

| Depth (cm) | Lab. no. | 14C age (bp) | Reservoir-corrected 14C age (bp) | Calibrated age ± 1σ (bc) |
|-----------|----------|--------------|---------------------------------|-------------------------|
| 50        | AAR-6940 | 3380 ± 55    | 2980 ± 55                       | 1370–1130               |
| 150       | AAR-6941 | 6235 ± 60    | 5835 ± 60                       | 4780–4620               |
| 183       | AAR-6942 | 7465 ± 55    | 7065 ± 55                       | 5990–5840               |

The calibrated ages in calendar years have been obtained from the calibration tables in Stuiver et al. (1998) by means of the 1998 version (4.0) of the Seattle CALIB program (Stuiver & Reimer, 1993).

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**Fig. 2.** Lithology of the core SKPC-01B.
Fig. 3. Distribution and relative abundance the most common freshwater diatom taxa from core SKPC-01B from interval 165–230 cm. Solid area stands for % contents of ecological groups. dotted areas express contents of ecological groups with very low abundance in ‰.

Fig. 4. Percentage diagram of diatom ecological groups core in SKPC-01B. Solid area stands for % contents of particular taxa. dotted areas express contents of taxa with very low abundance in ‰.
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increase within this subzone. The concentration of diatom valves fell from 435 × 10⁴ to 3.5 × 10⁶ per 1 g of sediment. The most abundant taxa include Cyclotella rossii Håkansson (up to 60%), Aulacoseira distans (Ehrenberg) Simonsen (16%), Fragilariella exigua Grunow (12%), Aulacoseira subarctica (O. Müller) Haworth (12%) and Tabellaria flocculosa (Roth) Kützing (7%).

**DAZ-1b.** Diatom assemblage subzone DAZ-1b encompasses the sediment interval 195–165 cm. The age of the transition from subzone DAZ-1b to DAZ-2 was estimated to be about 6400 years BP. The bottom of the zone is marked by a drastic decrease in diatom valve concentration to c. 50 × 10⁴ valves/g (Fig. 3). Freshwater taxa dominate, but in the interval 180–170 cm a peak of marine taxa is recorded. Amongst the predominant species are: *Paralia sulcata* (up to 30%), *Thalassiosira nordenskioeldii* (up to 17%), *Thalassiothrix hantzschii* (up to 9%) and *Odontella aurita* (up to 5%). Among the freshwater forms the following taxa were the most abundant: *C. rossii* (up to 53%), *A. distans* (up to 15%), *A. subarctica* (up to 10%), *Fragilariopsis ulna* (up to 10%) and *T. flocculosa* (up to 10%). With respect to habitat, planktonic forms dominate with 50–80% (Fig. 4). Only in the section rich in marine forms is a peak in benthic forms (up to 40%) seen.

**DISCUSSION**

The development of the Skalafjord since the last deglaciation was studied by Bennike *et al.* (1998; macrofossils in core SKPC-18), Jozkow (2000; diatoms in core SKPC-18) and Wachnicka (1999; diatoms in core DAPC-01).

The diatom record in core SKPC-01B provides excellent documentation of the Holocene development of the Faeroe Islands area – the best record of Early Holocene changes known so far. Well-preserved lacustrine deposits at a similar altitude within the Skalafjord were also studied by Jozkow (2000). However, the upper part of core SKPC-18 studied by Jozkow (2000) apparently did not contain the complete record of the diatom flora.

The sediments of core SKPC-01B show two distinct developmental stages. The first one recorded in the lowermost part of the core, subzone DAZ-1a, encompasses lacustrine sediments with a very low content of marine- and brackish-water diatoms. As the proportion between fully marine taxa and brackish-water ones is similar, it is assumed that no permanent connection existed between the central part of the fjord and the ocean. Apparently, diatoms of a marine origin were transported into the Skalafjord during storms. It appears that relative sea-level was below the threshold.

The species composition recorded in subzone DAZ-1b indicates the existence of a lake with abundant planktonic diatoms dominated by *C. rossii* and *F. ulna* (Fig. 4). Their vertical distributions do not show any dramatic changes, implying rather stable conditions. Sporadic inflow of marine waters did not cause any spectacular changes during this developmental stage. Environmental conditions of diatoms in subzone DAZ-1a indicate oligotrophic to mesotrophic waters (e.g. Lange-Bertalot & Metzeltin, 1996) accompanied by, for example, *A. distans*, *F. exigua* and the *T. flocculosa* complex (Fig. 4). Generally, within DAZ-1a, a continuous distribution of freshwater taxa is observed. Several of these taxa have been recently described (e.g. Lange-Bertalot & Metzeltin, 1996; Krammer, 2000, 2002) or are known only from very few localities. e.g. *Fragilariopsis opaciolutea* Lange-Bertalot, *Stauroneis neohyalina* Lange-Bertalot, *Gomphonema subtile* Ehrenberg, *Pinnularia ovata* Krammer, *Pinnularia platycephala* Krammer and *Pinnularia turbulenta* Krammer.

The Skalafjord lake formed after the last deglaciation of the area at c. 10 000 years BP (core SKPC-18; Bennike *et al.*, 1998). The diatom record of the early stages of lake development is recorded by Jozkow (2000). The chronology of core SKPC-18 was established from 14C dating and tephra chronology based on the Saksunarvatn ash (Bennike *et al.*, 1998). Diatom analysis of this core revealed a species composition very similar to that in core SKPC-01B, with *C. rossii* as the dominant species. As core SKPC-01B did not penetrate the Saksunarvatn ash and the uppermost part of the former core is disturbed, these two cores complement each other. Core SKPC-18 provides a record of the early stages of lake development, while core SKPC-01B records the last stage including the transition from lacustrine to marine conditions.

Bennike *et al.* (1998) determined the inundation of the threshold and the change from lacustrine to marine conditions in core SKPC-18 at c. 7800 14C years BP. They also determined the relative sea-level which at that time was c. 25 m below the present sea-level. However, in core SKPC-01B, the transition between lacustrine and marine conditions is dated between 7700 years BP and 6400 years BP. Previously, studies of the benthic foraminiferal fauna of the fjord (Juul, 1992) indicated that the marine transgression occurred around 7500 14C years BP. In addition the diatom species composition prior to the change from lacustrine to marine conditions shows a rise in marine diatoms at 185–180 cm. In the overlying section (180–165 cm) lacustrine taxa with *C. rossii* dominate again, with a distinct decrease in marine forms.

The effect of a tsunami, triggered by the Storegga Slide, has been documented in Norway and Britain (e.g. Dawson *et al.*, 1988; Bondevik *et al.*, 1997). Deposits resulting from this event were recognized by Grauert *et al.* (2001) in Lake Vagur on Suduroy Island, which is located south of Skalafjord. The lithology (redeposited organic material and marine microfossils) marks the tsunami section. The age of the tsunami event was estimated at c. 7200 years BP. In core SKPC–01B the rapid increase in marine taxa between 180 cm and 170 cm (Fig. 3) may signal an inflow of marine waters. As there is no simultaneous change in lithology it appears that this event did not significantly affect sedimentation processes in the lake. Therefore, this event may instead have been caused by a storm surge. The change in diatom flora at 180–170 cm in core SKPC-01B may be evidence of one of the first large-scale inflows of marine waters prior to the inundation of the threshold. It may be assumed that the relative sea-level at that time was a few metres lower than 25 m, as limnic conditions were re-established in the basin after termination of the marine inflow. The beginning of environmental change from lacustrine conditions, which resulted in the establishment of the marine environment, is dated between
7000 $^{14}$C years BP and 6400 $^{14}$C years BP, implying that environmental change took place rather rapidly.

Diatom analysis of subzone DAZ-1b shows that the lake in Skalafjord was affected by a strong inflow (possibly catastrophic) of marine waters. This phenomenon happened somewhat later than 7700 $^{14}$C years BP. However, towards the top of this subzone lacustrine conditions were re-established. The development of the lake in the Skalafjord implies that the Storega Slide led to inflow of marine waters at a distinctly lower water level in the area of Eysturoy and that the inundation of the fjord happened after the tsunami. The lithology of this part of the core indicates that the tsunami impact in this area was relatively weak.

ACKNOWLEDGEMENTS

We wish to express our gratitude to Björn Malmgren, University of Göteborg, Ole Bennike and Antoon Kuijpers, Geological Survey of Denmark and Greenland, Copenhagen, for their critical comments, support and improvement of the text. Special thanks are due to Ditmar Metzeltin and Horst Lange-Bertalot for providing detailed comments on the diatom taxonomy.

APPENDIX A: TAXONOMIC NOTE

Either the dominating or interesting taxa are listed below and the sources of their identification are given. The identification was primarily based on the diatom flora of middle Europe by Krammer & Lange-Bertalot (1986, 1991a, b, 1997). The reason for choosing this was that all the taxa treated in these references are illustrated with relevant LM micrographs. For the complete list of taxa see Appendix B.

Achnanthes holstii Cleve
   Lit.: Krammer & Lange-Bertalot (1991b, p. 33, fig. 18: 14–17)
   Pl. 3, fig. 16

Achnanthes pusilla (Grunow) de Toni
   Syn.: Achnanthes (linearis var.? ) pusilla Grunow in Cleve & Grunow
   Lit.: Krammer & Lange-Bertalot (1991b, p. 67, fig. 37: 9–18)
   Pl. 3, figs 11–13

Amphora inariensis Krammer
   Lit.: Krammer & Lange-Bertalot (1986, p. 310, fig. 96: 18–20)
   Pl. 5, figs 10–12

Amphora veneta Kützing
   Lit.: Krammer & Lange-Bertalot (1986, p. 348, fig. 151: 7–17)
   Pl. 5, figs 8, 9

Aneamastus rostratus (Hustedt) Lange-Bertalot
   Syn.: Navicula tuscula var. rostrata Hustedt; Navicula tusculoides Cleve-Euler
   Lit.: Lange-Bertalot (2001, p. 156, fig. 118: 1–6)
   Pl. 5, fig. 18

Aulacoseira distans (Ehrenberg) Simonsen
   Syn.: Gallionella distans Ehrenberg; Melosira distans (Ehrenberg) Kützing
   Lit.: Krammer & Lange-Bertalot (1991a, p. 32, fig. 29: 1–23, fig. 30: 1–11)
   Pl. 1, figs 6–11

Aulacoseira italic a(Ehrenberg) Simonsen
   Syn.: Gallionella italic a Ehrenberg; Melosira italic a (Ehrenberg) Kützing
   Lit.: Krammer & Lange-Bertalot (1991a, p. 29, fig. 24: 1, 3–6, fig. 25: 1–11)
   Pl. 1, fig. 21

Aulacoseira subarctica (O. Müller) Haworth
   Syn.: Melosira crenulata var. valida Grunow in Van Heurck.
   Melosira italic a var. valida (Grunow) Hustedt. Aulacoseira italic a var. valida (Grunow) Simonsen
   Lit.: Krammer & Lange-Bertalot (1991a, p. 32, fig. 28: 1–11)
   Pl. 1, figs 18–20

Brachysira brebissonii Ross
   Bas.: Navicula apoina var. brachysira Brébisson ex Kützing
   Syn.: Anomoeoneis brachysira (Brébisson ex. Rabenhorst) Grunow in Cleve
   Lit.: Lange-Bertalot & Moser (1994, p. 20, fig. 12: 6, fig. 41: 1–18, fig. 44: 1–10)
   Pl. 12, fig. 9

Brachysira zellensis (Grunow) Round & Mann
   Bas.: Navicula zellensis Grunow
   Syn.: Anomoeoneis zellensis (Grunow) Cleve; Anomoeoneis brachysira var. zellensis (Grunow) Krammer
   Lit.: Lange-Bertalot & Moser (1994, p. 73, fig. 11: 24–28, fig. 12: 5)
   Pl. 12, fig. 10

Caloneis cf. bacillaris (Grunow) Cleve
   Syn.: Staurospira bacillar Grunow; Navicula fasciata Lagerstedt; Caloneis fasciata (Lagerstedt) Cleve; (?)Caloneis bacillaris (Gregory) Cleve
   Lit.: Krammer & Lange-Bertalot (1986, p. 390, fig. 174: 9–20)
   Pl. 10, figs 10, 11

Caloneis pulchra Messikommer
   Lit.: Krammer & Lange-Bertalot (1986, p. 392, fig. 173: 1–4)
   Pl. 10, fig. 14

Caloneis tenuis (Gregory) Krammer
   Syn.: Pinnularia tenuis Gregory; Pinnularia gracillima Gregory
   Lit.: Krammer & Lange-Bertalot (1986, p. 392, fig. 174: 5–10)
   Pl. 10, fig. 13

Caloneis undulata (Gregory) Krammer
   Syn.: Pinnularia undulata Gregory
   Lit.: Krammer & Lange-Bertalot (1986, p. 394, fig. 175: 1–11)
   Pl. 10, fig. 12

Ceratoneis arcus (Ehrenberg) Kützing var. arcus
   Syn.: Fragilaria arcus var. arcus (Ehrenberg) Cleve; Ceratoneis amphioxys Rabenhorst; Ceratoneis arcus var. amphioxys (Rabenhorst) Brun; Ceratoneis arcus var. linearis
Explanation of Plate 1.

figs 1–5. *Cyclorella rossii* Håkansson. figs 6–11. *Aulacoseira distans* (Ehrenberg) Simonsen. figs 12, 13. *Cyclostephanus invisitatus* (Hohn & Hellerman) Theriot, Stoermer & Håkansson. figs 14, 15. *Cyclorella antiqua* W. Smith. figs 16, 17. *Aulacoseira subarctica* (O. Müller) Haworth. figs 18–20. *Aulacoseira valida* (Grunow) Krammer. fig. 21. *Aulacoseira italic* (Ehrenberg) Simonsen. figs 1–10, 12–14, 16–17, 19–21 LM micrographs (magnification ×1500); figs 11, 15, 18 SEM micrographs (scale bars: 11=5 µm; 15, 18=10 µm).
Explanation of Plate 2.

**fig. 1.** Cyclotella radiosa (Grunow) Lemmermann. **figs 2, 3.** Cyclotella rossi Håkansson. **fig. 4.** Cyclostephanus invisitatus (Hohn & Hellerman) Theriot, Stoermer & Håkansson. **figs 5, 6.** Navicula schmasmannii Hustedt. All SEM micrographs (scale bars: 1, 2=5 µm; 3, 5, 6=2 µm; 4=10 µm).
Explanation of Plate 3.

figs 1–2. Eunotia arcus Ehrenberg. fig. 3. Eunotia boreoalpina Lange-Bertalot & Nörpel-Schempp. figs 4–8. Eunotia incisa Gregory. fig. 9. (?) Eunotia implicata Nörpel-Schempp, Lange-Bertalot & Alles. fig. 10. Achnanthes minutissima sensu auct. nonnull. figs 11–13. Achnanthes pusilla (Grunow) De Toni. figs 14, 15. Achnanthes lanceolata (Brébisson) Grunow. fig. 16. Achnanthes holstii Cleve. fig. 17. Eunotia circumborealis Nörpel-Schempp & Lange-Bertalot. fig. 18. Eunotia media A. Cleve. fig. 19. Eunotia praerupta Ehrenberg. fig. 20. Achnanthes didyma Hustedt. fig. 21. Achnanthes laterostrata Hustedt. fig. 22. Eucocconeis laevis (Østrup) Lange-Bertalot. fig. 23. (?) Achnanthes daonensis Lange-Bertalot.

figs 1–19 LM micrographs (magnification × 1500); figs 20–23 SEM micrographs (scale bars: 20=2 µm; 21, 23=5 µm; 22=10 µm).
Explanation of Plate 4.

figs 1, 2. Cymbella spec. cf. helvetica Kützing. figs 3–5. Cymbella lange-bertalotti Krammer. fig. 6. Cymbella vulgata Krammer. figs 7, 8. Cymbella neoleptoceros var. tenuistriata Krammer. fig. 9. Cymbella pervarians Krammer. figs 10, 11. Cymbella cf. subtruncata Krammer. All LM micrographs (magnification ×1500).
Explanation of Plate 5.

fig. 1. *Cymbella proxima* Reimer. figs 2, 3. *Encyonema silesiacum* (Bleisch) D.G. Mann. fig. 4. *Encyonema procerum* Krammer. figs 5, 6. *Encyonema neogracile* Krammer. fig. 7. *Amphora copulata* (Kützing) Schoeman & Archibald. figs 8, 9. *Amphora veneta* Kützing. figs 10–12. *Amphora inariensis* Krammer. fig. 13. *Diploneis petersenii* Hustedt. figs 14–16. *Diploneis pseudovalis* Hustedt. fig. 17. *Neidium apiculatum* Reimer. fig. 18. *Aneumastus rostratus* Lange-Bertalot. figs 1–12, 14–18 LM micrographs (magnification ×1500); fig. 13 SEM micrograph (scale bar: 10 µm).
Explanation of Plate 6.

figs 1–3. *Cavinula cocconeiformis* (Gregory) D.G. Mann & Stickle. fig. 4. *Eucocconeis flexella* (Kützing) Cleve var. *flexella*. fig. 5. *Eucocconeis alpestris* (Brun) Lange-Bertalot. fig. 6. *Didymosphenia geminata* (Lyngbye) M. Schmidt. Morphotyp *geminata* sensu Metzeltin & Lange-Bertalot (1995). fig. 7. *Craticula cuspidata* (Kützing) D. G. Mann. figs 8–10. *Cocconeis placentula* var. *lineata* (Ehrenberg) Van Heurck. fig. 11. *Placoneis* cf. *elementis* (Grunow). fig. 12. *Surirella amphioxys* W. Smith. figs 1–4, 6–12 LM micrographs (magnification ×1500); fig. 5 SEM micrograph (scale bar: 10 µm).
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Explanation of Plate 7.

figs 1–5. *Meridion circulare* (Greville) Agardh. fig. 6. *Diatoma tenuis* Agardh. figs 7–9. *Diatoma mesodon* (Ehrenberg) Kützing. figs 10–12. *Denticula tenuis* Kützing. figs 13–19. *Diatomella balfouriana* Greville. figs 20–23. *Tabellaria flocculosa* sensu lato (Roth) Kützing. figs 24, 25. *Tabellaria flocculosa* sensu stricto (Roth) Kützing. figs 26–28. *Ceratoneis arcus* (Ehrenberg) Kützing var. arcus. All LM micrographs (magnification ×1500).
Explanation of Plate 8.

figs 1–5, 7. *Fragilaria exigua* Grunow. fig. 6. *Staurosira martyi* (Heribaud) Bukhtiyarova. figs 8, 9. *Fragilaria construens* var. *binodis* fo. *borealis*? Foged. figs 10, 11. *Fragilaria capucina* var. *perminuta* (Grunow) Lange-Bertalot. fig. 12. *Fragilaria capucina* var. *vaucheri* (Kützing) Lange-Bertalot. fig. 13. *Fragilaria capucina* var. *distans* (Grunow) Lange-Bertalot. fig. 14. *Fragilaria alpestris* Krasske. figs 15–17. *Fragilaria opaclineolata* Lange-Bertalot. figs 18–20. *Fragilaria parasitica* (W. Smith) Grunow. fig. 21. *Staurosira construens* (Ehrenberg) Grunow. figs 22–24. *Staurosira pseudoconstruens* (Marciniak) Lange-Bertalot. figs 25–27. *Staurosira* sp. figs 28, 29. *Diadesmis biceps* Arnott. figs 30–33. *Diadesmis perpusilla* (Grunow) Lange-Bertalot. figs 3–24, 26–31 LM micrographs (magnification ×1500); figs 1, 2, 25, 32, 33 SEM micrographs (scale bars: 1=10 µm; 2, 25, 32, 33=5 µm).
Explanation of Plate 9.

figs 1–3. *Gomphonema coronatum* Ehrenberg. figs 4, 5. *Gomphonema subtile* Ehrenberg. fig. 6. *Gomphonema vibrio* Ehrenberg. figs 7, 8. *Gomphonema calcifugum* Lange-Bertalot & Reichardt. figs 9–11. *Gomphonema clavatum* Ehrenberg s. l. fig. 12. *Gomphonema lapponicum* (A. Cleve) Cleve-Euler. fig. 13. *Gomphonema parvulum* Kützing. fig. 14. *Gomphonema sagitta* Schumann. fig. 15. *Gomphonema truncatum* Ehrenberg. All LM micrographs (magnification ×1500).
Explanation of Plate 10.

figs 1–3. *Navicula radiosa* Kützing. figs 4–7. *Navicula angusta* Grunow. fig. 8. *Navicula veneta* Kützing. fig. 9. *Navicula gregaria* Donkin s. l. figs 10, 11. *Caloneis bacillum* s. auct. fig. 12. *Caloneis undulata* (Gregory) Krammer. fig. 13. *Caloneis tenuis* (Gregory) Krammer. fig. 14. *Caloneis pulchra* Messikommer. fig. 15. *Caloneis silicula* (Ehrenberg) Cleve. figs 16–22. *Hippodonta subcostulata* (Hustedt) Lange-Bertalot, Metzeltin & Witkowski. All LM micrographs (magnification × 1500).
Explanation of Plate 11.

fig. 1. *Pinnularia viridis* (Nitzsch) Ehrenberg. fig. 2. *Pinnularia viridiformis* Krammer. fig. 3. *Pinnularia divergens* var. *sublinearis* Cleve. fig. 4. *Pinnularia hemiptera* (Kützing) Rabenhorst. fig. 5. *Pinnularia stomatophora* (Grunow) Cleve. fig. 6. *Pinnularia subcapitata* var. *subrostrata* Krammer. fig. 7. *Pinnularia brandeli* Cleve. fig. 8. *Kobayasiella* sp.. figs 9–12. *Hygropetra balfouriana* (Grunow ex. Cleve) Krammer & Lange-Bertalot. figs 1–7, 9, 10 LM micrographs (magnification ×1500); figs 8, 11, 12 SEM micrographs (scale bars: 8=10 µm; 11, 12=2 µm).
Explanation of Plate 12.

fig. 1. *Frustulia erifuga* Lange-Bertalot & Krammer. fig. 2. *Gyrosigma acuminatum* (Kützing) Rabenhorst. fig. 3. *Frustulia vulgaris* (Thwaites) De Toni. fig. 4. *Stauroneis neohyalina* Lange-Bertalot. figs 5–8. *Brachysira procerata* Lange-Bertalot. fig. 9. *Brachysira brebissonii* Ross. fig. 10. *Brachysira zellensis* (Grunow) Round & Mann. fig. 11. *Epithemia sorex* Kützing. figs 12, 13. *Epithemia adnata* (Kützing) Brébisson. figs 14, 15. *Rhopalodia rupestris* (W. Smith) Krammer. fig. 16. *Rhopalodia gibba* (Ehrenberg) O. Müller var. *gibba*. figs 1–7, 9–16 LM micrographs (magnification × 1500); fig. 8 SEM micrograph (scale bar: 10 µm).
Explanation of Plate 13.

figs 1–5. *Nitzschia angustata* Grunow. fig. 6. *Nitzschia hantzschiana* Rabenhorst. fig. 7. *Nitzschia cf. hantzschiana* Rabenhorst. fig. 8. *Nitzschia denticula* Grunow. figs 9, 10. *Reimeria uniseriata* Sala et al. figs 11, 12. *Reimeria sinuata* (Gregory) Kociolek & Stoermer. fig. 13. *Caloneis* sp. figs 14, 15. *Pinnularia* sp. fig. 16. *Reimeria* sp. fig. 17. *Denticula tenuis* Kützing. figs 1–12 LM micrographs (magnification ×1500); figs 13–17 SEM micrographs (scale bars: 13, 15=20 µm; 14, 16, 17=5 µm).
Holmboe; *Hannaea arcus* (Ehrenberg) *Patrick* in *Patrick* & *Reimer*
Lit.: *Krammer* & *Lange-Bertalot* (1991a, p. 134, fig. 117: 8–13)
Pl. 7, fgs 26–28

*Cricatula cuspida* (Kützing) D.G. Mann
Syn.: *Fraustulia cuspidata* Kützing; *Navicula cuspidata* (Kützing) Kützing;
*Navicula cuspidata var. heribaudii* M. Pergallo in Héribaud
Lit.: *Lange-Bertalot* (2001, p. 111, fig. 221–225)
Pl. 6, fig. 7

*Cyclotella antiqua* W. Smith
Syn.: *Cyclotella operculata var. antiqua* Héribaud
Lit.: *Krammer* & *Lange-Bertalot* (1991a, p. 48, fig. 47: 5–6, fig. 48: 1a–3)
Pl. 1, fgs 12, 13; Pl. 2, fig. 4

*Cyclotella neocistula* Krammer
Lit.: *Krammer* (2002, p. 152, fig. 179: 1–6)
Pl. 4, fgs 3–5

*Cymella pervarians* Krammer
Lit.: *Krammer* (2002, p. 58, fig. 39: 8–18, fig. 41: 1–12, fig. 42: 1–12)
Pl. 4, fig. 9

*Cymella proxima* Reimer
Syn.: *Cocconema cistulum* A. Schmidt; *Cymbella cistula sensu* Grunow in Van Heurck
Lit.: *Krammer* (2002, p. 106, fig. 92: 4–6, fig. 108: 1–6, fig. 109: 1–5, fig. 110: 1–3, fig. 111: 1–3)
Pl. 5, fig. 1

*Cymella cf. subtruncta* Krammer
Lit.: *Krammer* (2002, p. 39, fig. 18: 16–21, fig. 19: 1–21)
Pl. 4, fgs 10, 11

*Cymella vulgata* Krammer
Lit.: *Krammer* (2002, p. 55, fig. 32: 7–13, fig. 36: 1–14, fig. 37: 16–21, fig. 38: 1–18, fig. 39: 1–7)
Pl. 4, fig. 6

*Diadesmis biceps* Arnott
Syn.: *Navicula contenta* Grunow; *Navicula trinodis* W. Smith
Lit.: *Krammer* & *Lange-Bertalot* (1986, p. 219, fig. 75: 1–5)
Pl. 8, fgs 28, 29

*Diadesmis perpusilla* (Grunow) *Lange-Bertalot*
Syn.: *Navicula prepusilla* Grunow; *Navicula gallica var. prepusilla* (Grunow) *Lange-Bertalot*;
*Navicula flotowii* Grunow
Lit.: *Krammer* & *Lange-Bertalot* (1986, p. 220, fig. 75: 12–17)
Pl. 8, fgs 30–33

*Diatomella balfouriana* Greville
Lit.: *Krammer* & *Lange-Bertalot* (1986, p. 436, fig. 205: 4–8)
Pl. 7, fgs 13–19

*Didymosphenia geminata* (Lyngbye) M. Schmidt
Syn.: *Echinella geminata* Lyngbye; *Gomphonema geminatum* (Lyngbye) Agardh
Lit.: *Krammer* & *Lange-Bertalot* (1986, p. 381, fig. 166: 19)
Pl. 7, fig. 6

*Encyonema procerum* Krammer
Lit.: *Krammer* (1997, p. I/95, fig. 32: 9–19)
Pl. 5, fig. 4
Diatoms from Holocene freshwater sediments, Faeroe Islands

*Encyonema silesiacum* (Bleisch) D.G. Mann
Syn.: *Cymbella ventricosa* Agardh; *Cymbella silesiaca* Bleisch in Rabenhorst; *Cymbella minuta* var. *silesiaca* (Bleisch) Reimer in Patrick & Reimer
Lit.: Krammer (1997, p. I/72, fig. 4: 1–18, fig. 7: 6–19, fig. 9: 1–8, fig. 16: 1–11, fig. 17: 5–8)
Pl. 5, figs 2, 3

*Eunotia arcus* Ehrenberg
Syn.: *Himantidium arcus* Ehrenberg pro parte
Lit.: Krammer & Lange-Bertalot (1991a, p. 184, fig. 147)
Pl. 2, figs 1, 2

*Eunotia circumborealis* Nörpel-Schempp & Lange-Bertalot
Syn.: *Eunotia septentrionalis* var. *bidens* Hustedt sensu Simonsen; (?)*Eunotia scandinavica* f. *angusta* (Fontell) Cleve-Euler; *Eunotia pectinalis* var. *undulata* sensu Krasske
Lit.: Krammer & Lange-Bertalot (1991a, p. 197, fig. 143: 16–23)
Pl. 2, fig. 17

*Eunotia implicata* Nörpel-Schempp, Lange-Bertalot & Alles
Syn.: *Eunotia impressa* var. *angusta* Grunow in Van Heurck; *Eunotia impressa* var. *angusta* f. *vix impressa* Grunow in Van Heurck; *Eunotia pectinalis* var. *minor* f. *impressa* (Ehrenberg) Hustedt; *Eunotia impressa* Ehrenberg sensu Cleve-Euler; *Eunotia impressa* Ehrenberg; *Himantidium minus* Kützing; *Himantidium pectinale* var. *minus* (Kützing) Grunow; *Eunotia pectinalis* var. *minor* (Kützing) Rabenhorst sensu Grunow
Lit.: Krammer & Lange-Bertalot (1991a, p. 197, fig. 143: 1–9A)
Pl. 2, fig. 9

*Eunotia media* A. Cleve
Syn.: *Eunotia parallela* var. *parallela* Ehrenberg; *Eunotia crassa* Pantocsek & Greguss; *Eunotia pseudoparallela* Cleve-Euler;
*Eunotia parallela* var. *pseudoparallela* Cleve-Euler
Lit.: Krammer & Lange-Bertalot (1991a, p. 209, fig. 152: 4–7)
Pl. 2, fig. 18

*Eunotia praerupta* Ehrenberg
Syn.: *Himantidium praeruptum* Ehrenberg
Lit.: Krammer & Lange-Bertalot (1991a, p. 186, fig. 148: 1–17, fig. 149: 1–7, fig. 150: 1–7)
Pl. 2, fig. 19

*Fragilaria alpestris* Krasske
Syn.: (?) *Fragilaria capucina* var. *amphicephala* (Kützing) Lange-Bertalot
Lit.: Krammer & Lange-Bertalot (1991a, p. 141, fig. 111: 25–28)
Pl. 8, fig. 14

*Fragilaria exigua* Grunow in Cleve & Moller
Syn.: *Fragilaria virescens* var. *exigua* Grunow in Van Heurck; *Fragilaria exigua* (W. Smith) Lemmermann; *Triceratium exiguum* W. Smith; *Fragilaria construens* f. *exigua* (W. Smith) Hustedt
Lit.: Krammer & Lange-Bertalot (1991a, p. 137, fig. 126: 11–18)
Pl. 8, figs 1–5, 7

*Fragilaria construens* var. *binodis* fo. *borealis* Foged
Lit.: Foged (1974, p. 56, fig. 3: 6), Krammer & Lange-Bertalot (1991a, p. 164, fig. 130: 18, 197)
Foged (1974) described *F. construens* v. *binodis* fo. *borealis* in a sample from an outflow of a small lake near Thingvellir in Iceland. He established a new forma based on faintly concave margins and coarsely punctate striae. Krammer & Lange-Bertalot included this taxon with a question mark in *Fragilaria robusta* (Fusey) Manguin. The species, to a certain extent, resembles *Fragilaria pseudoconstruens* Marciniak, however, it differs with respect to valve shape, the sternum and the striaion pattern.
Pl. 8, figs 8, 9

*Fragilaria opacolineata* Lange-Bertalot
Lit.: Lange-Bertalot & Metzeltin (1996, p. 132, 340, fig. 7: 36–41B, fig. 111: 2–3)
Pl. 8, figs 15–17

*Fragilaria parasitica* (W. Smith) Grunow
Syn.: *Synedra parasitica* (W. Smith) Grunow in Van Heurck
Lit.: Krammer & Lange-Bertalot (1991a, p. 133, fig. 130: 1–8)
Pl. 8, figs 18–20

*Frustulia vulgaris* (Thwaites) De Toni
Syn.: *Schizonema vulgare* Thwaites
Lit.: Krammer & Lange-Bertalot (1986, p. 260, fig. 97: 1–6)
Pl. 12, fig. 3

*Frustulia erifuga* Lange-Bertalot & Krammer
Syn.: *Colletonema viridulum* Brébisson ex Kützing; *Schizonema viridulum* (Brébisson) Rabenhorst; *Vanheurickia viridula* (Brébisson) Brébisson; *Frustulia viridula* (Brébisson) De Toni; *Frustulia rhomboides* var. *viridula* (Brébisson) Cleve; *Frustulia rhomboides* var. *viridula* f. *hustedtii* Germain
Lit.: Lange-Bertalot (2001, p. 167, fig. 131: 9–10, fig. 132: 1–6, fig. 140: 1–2)
Pl. 12, fig. 1

*Gomphonema acuminatum* Ehrenberg var. *acuminatum*
Syn.: *Gomphonema brebissonii* Kützing
Lit.: Krammer & Lange-Bertalot (1986, p. 365, fig. 160: 1–12)

*Gomphonema cf. affine* Kützing
Syn.: *Gomphonema lanceolatum* sensu Hustedt (et al.) non Ehrenberg nec Agardh. (?)*Gomphonema magnificum* Gandhi
Lit.: Krammer & Lange-Bertalot (1986, p. 366, fig. 161: 1–3)

*Gomphonema calcifugum* Lange-Bertalot & Reichardt
Syn.: *Gomphonema olivaceum* var. *minutissimum* Hustedt
Lit.: Hustedt (1930, p. 378, fig. 720), Lange-Bertalot & Genkal (1999, p. 53)
Pl. 9, figs 7, 8

*Gomphonema clavatum* Ehrenberg
Syn.: *Gomphonema longiceps* Ehrenberg; *Gomphonema mustela* Ehrenberg; *Gomphonema monianum* Schumann; *Gomphonema subclavatum* Grunow; *Gomphonema commutatum* Grunow; *Gomphonema (commutatum var.) mexicanum* Grunow; *Gomphocymbella obliqua* (Grunow) O. Müller
Lit.: Krammer & Lange-Bertalot (1986, p. 367, fig. 163: 1–12)
Pl. 9, figs 9–11
Navicula angusta Grunow
Syn.: Gomphonema truncatum Ehrenberg; Gomphonema constrictum Ehrenberg; Gomphonema turgidum Ehrenberg
Lit.: Krammer & Lange-Bertalot (1986, p. 369, fig. 159: 11–18)

Gomphonema coronatum Ehrenberg
Syn.: Gomphonema acuminatum var. coronatum (Ehrenberg) W. Smith
Lit.: Reichardt (1999, p. 43, fig. 49: 1–5, fig. 7–11, fig. 50: 1–8, fig. 51: 1–8)
Pl. 9, figs 1–3

Gomphonema sagitta Schumann
Syn.: Gomphonema subtile Ehrenberg; Gomphonema minusculum Krasske
Lit.: Krammer & Lange-Bertalot (1986, p. 369, fig. 162: 10–13)
Pl. 9, fig. 14

Hippodonta subcostulata (Hustedt) Lange-Bertalot, Metzeltin & Witkowski
Valves linear-lanceolate, with obtusely rounded apices, 14–20 µm long, 2.75–3.3 µm broad. Raphe straight with relatively distinct, somewhat expanded external central endings and straight terminal endings. Axial area very narrow, barely distinguishable, central area in a form of relatively broad fascia reaching the valve margins. Transapical striae relatively robust in the middle radiate, towards apices becoming convergent, 13–14 in 10 µm. The valve outline and the shape of central area of this taxon resembles Hippodonta costulata (Grunow) Lange-Bertalot, Metzeltin & Witkowski
Pl. 10, figs 16–22

Hygropetra balfouriana (Grunow ex Cleve) Krammer & Lange-Bertalot
Bas.: Pinnularia balfouriana Grunow ex Cleve
Lit.: Krammer (2000, p. 207, fig. 216: 1–9, fig. 15: 15–19)
Pl. 11, figs 9–12

Navicula angusta Grunow
Syn.: Navicula cari var. angusta Grunow in Van Heurck; Navicula cincta var. angusta (Grunow) Cleve; Navicula cincta var. linearis Østrup; Navicula pseudocari Krasske; Navicula lobelliae Jørgensen
Lit.: Krammer & Lange-Bertalot (1986, p. 97, fig. 28: 1–5)
Pl. 10, figs 4–7

Navicula gregaria Donkin
Syn.: Navicula cryptcephala Kützing; Navicula gregalis Cholonky; Navicula gorlandica Grunow sensu Hustedt; Navicula phylepta Kützing sensu Brockmann and sensu Hendey
Lit.: Krammer & Lange-Bertalot (1986, p. 116, fig. 38: 10–15)
Pl. 10, fig. 9

Navicula veneta Kützing
Syn.: Navicula cryptcephala var. veneta (Kützing) Rabenhorst; Navicula cryptcephala var. subsalina Hustedt; Navicula lanceolata Schumann
Lit.: Krammer & Lange-Bertalot (1986, p. 104, fig. 32: 1–4)
Pl. 10, fig. 8

Neidium apiculatum Reimer
Lit.: Krammer & Lange-Bertalot (1986, p. 250, fig. 100: 9)
Pl. 5, fig. 17

Nitzschia angustata (W. Smith) Grunow in Cleve & Grunow
Syn.: Tryblionella angustata W. Smith
Lit.: Krammer & Lange-Bertalot (1997, p. 48, fig. 36: 1–5)
Pl. 13, figs 1–5

Nitzschia denticula Grunow
Syn.: Denticula kuetzingii Grunow; Denticula obtusa W. Smith; Denticula inflata W. Smith; Denticula decipiens Arnott
Lit.: Krammer & Lange-Bertalot (1991a, p. 143, fig. 94: 3, 4, fig. 99: 11–23, fig. 100: 1–14, 18–22)
Pl. 13, fig. 8

Nitzschia hantzschiana Rabenhorst
Syn.: Nitzschia perpusilla Rabenhorst; Nitzschia frustulum var. glacialis Grunow in Van Heurck; Nitzschia frustulum f. subserians Grunow in Van Heurck
Lit.: Krammer & Lange-Bertalot (1997, p. 101, fig. 73: 9–18)
Pl. 13, figs 6, 7

Pinnularia brandeli Cleve
Lit.: Lange-Bertalot & Metzeltin (1996, p. 206, fig. 44: 1–6)
Pl. 11, fig. 7

Pinnularia divergens var. sublinearis Cleve
Syn.: Pinnularia divergens f. linearis Fontell; Pinnularia divergens var. fontellii Cleve-Euler; Pinnularia divergens var. elliptica sensu Krammer
Lit.: Krammer (2000, p. 62, fig. 30: 1–7, fig. 31: 1–8, fig. 32: 9)
Pl. 11, fig. 3

Pinnularia hemiptera (Kützing) Rabenhorst
Syn.: Pinnularia acuminata W. Smith; Navicula instabilis A. Schmidt; Navicula hybrida Peragallo et Héribaud; Pinnularia debilis (Pantocsek) Cleve-Euler
Lit.: Krammer & Lange-Bertalot (1986, p. 410, fig. 182: 1–3)
Pl. 11, fig. 4

Pinnularia neomajor Krammer
Syn.: Navicula major ex. rec Grunow in A. Schmidt; (?) Frustulia major Kützing; Navicula major Kützing; Pinnularia major sensu Cleve
Lit.: Krammer (2000, p. 165, fig. 6: 1–4, fig. 62: 1–5, fig. 63: 1)

Pinnularia ovata Krammer
Syn.: Navicula divergens var. elliptica Grunow; Pinnularia divergens var. elliptica (Grunow) Cleve; Pinnularia episcopalis sensu Hustedt
Lit.: Krammer (2000, p. 64, fig. 35: 5–8, fig. 36: 1–5, fig. 37: 1–4)

Pinnularia platyccephala (Ehrenberg) Cleve
Bas.: Stauroptera platyccephala Ehrenberg
Syn.: Pinnularia platystoma Hustedt
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Lit.: Krammer (2000, p. 68, fig. 2: 1, fig. 39: 6, fig. 44: 1–7)

Rhopalodia gibba (Ehrenberg) O. Müller var. gibba
Syn.: Navicula gibba Ehrenberg; Epithemia gibba (Ehrenberg) Kützing; Epithemia ventricosa Kützing; Rhopalodia ventricosa (Kützing) O. Müller; Rhopalodia gibba var. ventricosa (Kützing) Pergallo
Lit.: Krammer & Lange-Bertalot (1997, p. 159, fig. 110: 1, fig. 111: 1–13)
Pl. 13, figs 9, 10

Rhopalodia rupestris (W. Smith) Krammer
Syn.: Navicula rupestris (W. Smith) O. Müller; Rhopalodia rupestris (W. Smith) Krammer
Lit.: Krammer & Lange-Bertalot (1997, p. 165, fig. 115: 1–8)
Pl. 12, figs 14, 15

Stauroneis neohyalina Lange-Bertalot & Krammer
Syn.: Stauroneis anceps var. siberica Grunow in Cleve & Grunow
Lit.: Lange-Bertalot & Metzelin (1996, p. 104, fig. 35: 7–10)
Pl. 12, fig. 4

Staurosira construens Ehrenberg
Syn.: Fragilaria construens (Ehrenberg) Grunow
Lit.: Krammer & Lange-Bertalot (1991a, p. 153, fig. 132: 1–34, fig. 129: 21–27, fig. 131: 5–6), Krammer & Lange-Bertalot (2000, p. 584)
Pl. 8, fig. 21

Staurosira martyi (Héribaud) Lange-Bertalot
Bas.: Opephora martyi Héribaud
Syn.: Fragilaria martyi (Héribaud) Lange-Bertalot; Martynia martyi (Héribaud) Round in Round et al. (1990)
Lit.: Krammer & Lange-Bertalot (1991a, p. 160, fig. 133: 28–31), Witkowski et al. (1996). Krammer & Lange-Bertalot (2000, p. 586)
Pl. 8, fig. 6

Staurosira pseudoconstruens (Marciniak) Lange-Bertalot
Bas.: Fragilaria pseudoconstruens Marciniak
Pl. 8, figs 22–24
Lit.: Krammer & Lange-Bertalot (1991a, p. 163, fig. 130: 25–30), Krammer & Lange-Bertalot (2000, p. 587)

Surirella amphioxys W. Smith
Syn.: Surirella moelleriana Grunow ex Moller; Surirella moelleriana sensu Germain
Lit.: Krammer & Lange-Bertalot (1986, p. 819, fig. 138: 1–5, fig. 39: 1–8)
Pl. 6, fig. 12

Tabellaria flocculosa sensu lato (Roth) Kützing
Syn.: Diatoma fenestratum Lyngbye
Lit.: Krammer & Lange-Bertalot (1991, p. 106, fig. 105: 1–4, fig. 107: 8)
Pl. 7, figs 20–23

Tabellaria flocculosa sensu stricto (Roth) Kützing
Syn.: Conferva flocculosa Roth
Lit.: Krammer & Lange-Bertalot (1997, p. 108, fig. 106: 1–3, fig. 107: 7, 11, 12)
Pl. 7, figs 24, 25

APPENDIX B: SPECIES LIST

Freshwater species
Achnanthes daonensis Lange-Bertalot
Achnanthes didyma Hustedt
Achnanthes holstii Cleve
Achnanthes lanceolata (Brébisson) Grunow
Achnanthes laterostrata Hustedt
Achnanthes pusilla (Grunow) de Toni
Amphora copulata (Kützing) Schoeman
Amphora inariensis Krammer
Amphora veneta Kützing
Aneanastus rostratus (Hustedt) Lange-Bertalot
Aulacoseira distans (Ehrenberg) Simonsen
Aulacoseira italica (Ehrenberg) Simonsen
Aulacoseira subarctica (O. Müller) Haworth
Aulacoseira valida (Grunow) Krammer
Brachysira breve (Ross)
Brachysira procea Lange-Bertalot & Moser
Brachysira zellensis (Grunow) Round & D.G. Mann
Caloneis cf. bacillum (Grunow) Cleve
Caloneis pulchra Messikomer
Caloneis silicula (Ehrenberg) Cleve
Caloneis tenuis (Gregory) Krammer
Caloneis undulata (Gregory) Krammer
Caviniula cocconeiformis (Gregory) D.G. Mann & Stickler
Ceratoneis arcus (Ehrenberg) Kützing var. arcus
Cocconeis placenta var. lineata (Ehrenberg) Van Heurck
Craticula cuspidata (Kützing) D.G. Mann
Cyclostephanos invisitatus (Hohn & Hellerman) Theriot, Stoerner & Hákansson
Cyclotella antiqua W. Smith
Cyclostephanos radiosa (Gregory) Lemmermann
Cyclotella ocellata Pantocsek
Cyclotella antiqua var. arcus (Ehrenberg) V. Kützing
Ceratoneis arcus (Hohn & Hellerman) Theriot, Stoerner & Hákansson
Cyclostephanos invisitatus Craticula cuspidata (Kützing) D.G. Mann
Cavinula cocconeiformis (Gregory) D.G. Mann
Caloneis undulata (Gregory) Krammer
Caloneis tenuis (Gregory) Krammer

Fragilaria capucina Krasske
Fragilaria capucina var. perminuta (Grunow) Lange-Bertalot
Fragilaria capucina var. vaucheri (Kützing) Lange-Bertalot
Fragilaria construens var. binodis fo. borealis (Ehrenberg) V. Kützing
Fragilaria exigua Grunow in Cleve & Moeller
Fragilaria opacolinea Lange-Bertalot
Frustrula eriatica Lange-Bertalot & Krammer
Frustrula vulgaris (Thwaites) De Toni
Gomphonema acuminatum Ehrenberg var. acuminatum
Gomphonema calcifugum Lange-Bertalot & Reichardt
Gomphonema capitatum Ehrenberg
Gomphonema cf. affinis Kützing
Gomphonema clavatum Ehrenberg

Gomphonema coronatum Ehrenberg
Gomphonema lapponicum (Cleve) Cleve-Euler
Gomphonema parvulum Kützing
Gomphonema sagitta Schumann
Gomphonema truncatum Ehrenberg
Gomphonema virbio Ehrenberg
Gomphonema subtile Ehrenberg

Gyrosigma acuminatum (Kützing) Rabenhorst
Hippodonta subcostulata (Hustedt) Lange-Bertalot, Metzeltin & Witkowski
Hygropetra balfouriana (Grunow ex Cleve) Krammer & Lange-Bertalot
Meridion circulare (Greville) Agardh
Navicula angusta Grunow
Navicula gregaria Donkin
Navicula radiosa Kützing
Navicula schmasmannii Hustedt
Navicula veneta Kützing
Neidium apiculatum Reimer
Nitzschia angustata (W. Smith) Grunow in Cleve & Grunow
Nitzschia denticula Grunow
Nitzschia hantshchiana Rabenhorst
Pinnularia brandeli Cleve
Pinnularia cf. viridis (Nitzsch) Ehrenberg
Pinnularia divergens var. sublinearis Cleve
Pinnularia hemiptera (Kützing) Rabenhorst
Pinnularia neomajor Krammer
Pinnularia ovata Krammer
Pinnularia platyccephala (Ehrenberg) Cleve
Pinnularia rupestris Hantzsch in Rabenhorst
Pinnularia stomatophora Grunow
Pinnularia subcapitata var. subrostrata Krammer
Pinnularia turbulenta (Cleve-Euler) Krammer
Pinnularia viridiiformis Krammer
Placoneis cf. clementis Grunow
Reimeria simuata (Gregory) Kociolek & Stoemer
Reimeria uniseriata (Gregory) Kociolek & Stoemer
Rhopalodia rupestris (W. Smith) Krammer
Stauroneis neohyalina Lange-Bertalot & Krammer
Stauronemia construens Ehrenberg
Stauronemia martyi (Héribus) Lange-Bertalot
Stauronemia parasitica (W. Smith) Grunow
Stauronemia pseudoconstruens (Marciniak) Lange-Bertalot
Surirella amphioxys W. Smith
Tabelaria flocculosa (Roth) Kützing

Brackish-water species
Achnanthes brevipes Agardh var. brevipes
Campylosdiscus clypeus Ehrenberg
Cocconeis scutellum Ehrenberg var. scutellum
Cocconeis speciosa Gregory
Diploneis litoralis (Donkin) Cleve var. litoralis
Diploneis smithii (Brébisson) Cleve var. smithii
Diploneis stromii Hustedt
Fallacia forcipata (De Toni) Stickler & D.G. Mann
Grammatophora oceaniaca (Ehrenberg 1854 pro parte) Grunow
Nitzschia coarctata Grunow
Pleurosigma normanni Ralfs
Rhabdonema arcuatum (Agardh) Kützing var. arcuatum

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Rhabdonema minutum Kützing
Rhopalodia gibba (Ehrenberg) O. Müller var. gibba
Synedra tabulata (Agardh) Kützing var. tabulata
Thalassiosira eccentrica (Ehrenberg) Cleve

Marine species
Actinocyclus senarius (Ehrenberg) Ehrenberg
Amphora marina W. Smith
Bacteriosira batyomphala (Cleve) Syvertsen & Hasle
Caloneis undulata (Gregory) Krammer
Coconees costata Gregory var. costata
Coconees guttata Hustedt
Coconees pinnata Gregory ex Greville
Coconees pseudomarginata Gregory
Dimeregramma fulsum (Gregory) Ralfs in Pritchard
Diploneis bombus Ehrenberg
Diploneis notabilis (Greig) Cleve
Diploneis vacillans (A. Schmidt) Cleve var.
Diploneis bombus (Greville) Cleve
Ehrenberg
Diploneis bombus (Ehrenberg) Cleve

Lyrella lyra (Ehrenberg) Karayeva
Lyrella islandica (Ehrenberg) Grunow
Lyrella lyra (Ehrenberg) Karayeva

Mercia striatula Håkansson
Paralia sulcata (Ehrenberg) Cleve
Plagiogramma staurophorum (Gregory) Heiberg
Rhizosolenia hebatae Bailey
Rhicosphenia marina (W. Smith) M. Schmidt
Rhopalodia acuminata Krammer
Thalassionema nitzchioides Grunow
Thalassiosira decipiens (Grunow) Jørgensen
Thalassiosira nordenskioldii Cleve
Trachyneis aspera (Ehrenberg) Cleve

Manuscript received 10 January 2003
Manuscript accepted 17 July 2003

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