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CHECKLIST

# An illustrated and annotated checklist of freshwater diatoms (Bacillariophyta) from Livingston, Signy and Beak Island (Maritime Antarctic Region)

**Mieke Sterken[1], Elie Verleyen[1], Vivienne J. Jones[2], Dominic A. Hodgson[3], Wim Vyverman[1], Koen Sabbe[1] & Bart Van de Vijver[4,5,*]**

[1]Ghent University, Protistology and Aquatic Ecology, Krijgslaan 281 S8, BE-9000 Gent, Belgium
[2]University College London, Department of Geography, Pearson Building, Gower Street, London, WC1E 6BT, United Kingdom
[3]British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge, CB3 0ET, United Kingdom
[4]Botanic Garden Meise, Department of Bryophyta, Thallophyta, Nieuwelaan 38, BE-1860 Meise, Belgium
[5]University of Antwerp, Department of Biology, ECOBE, Universiteitsplein 1, BE-2610 Wilrijk, Belgium
*Author for correspondence: bart.vandevijver@botanicgardenmeise.be

**Background and aims** – Non-marine diatom communities in the Antarctic Region are characterized by a typical species composition, dominated by a large number of Antarctic endemic species. Despite recent advances in our knowledge about the diversity and biogeography of non-marine Antarctic diatoms, the flora of many Antarctic localities is still only poorly known, which can result in incorrect conceptions of species' distributions. The present paper provides a taxonomically consistent illustrated checklist of the diatom flora observed in recent and (sub)fossil non-marine sediments of three islands in the proximity of the northern Antarctic Peninsula, namely; Signy Island (South Orkneys), Livingston Island (South Shetlands) and Beak Island (James Ross Island group).
**Methods** – The diatom flora of 66 samples collected from a wide variety of lakes and localities on the three above-mentioned islands has been studied using light and scanning electron microscopy. The biogeographical distribution of the composing taxa has been assessed on the basis of quality-checked distribution data from the recent literature.
**Key results** – One hundred and two diatom taxa, belonging to thirty-four genera, were observed. *Pinnularia* (twelve taxa), *Chamaepinnularia*, *Luticola*, *Planothidium*, *Psammothidium* and *Stauroneis* (seven taxa each), *Nitzschia* (six taxa), *Humidophila* and *Navicula* (five taxa each) proved to be the most species-rich genera. Original morphometric data (including length, width and stria density) and illustrations are presented for all taxa observed. Forty-one species are hitherto only known from the Antarctic region. The exact taxonomic identity of twenty species remains uncertain and requires further study. It is suspected that many of these will also turn out to be restricted to the Antarctic region, suggesting that about half of all taxa observed are probably endemic to the Antarctic.
**Conclusions** – The diatom flora of the three investigated localities comprises a large proportion of typical Antarctic taxa, many of which have only recently been split off from their presumably cosmopolitan relatives.

**Key words** – Diatom taxonomy, biogeography, endemic, Antarctic Peninsula, freshwater.

## INTRODUCTION

Diatoms are one of the most species-rich and widespread algal groups in sub-Antarctic and Antarctic non-marine environments (Jones 1996, Van de Vijver & Beyens 1999). They are commonly used as indicators for monitoring the ecological status of contemporary environments and reconstructing past environmental and climatic conditions, since many of their species have distinct ecological optima and narrow tolerances, and because their silica cell walls are often well-preserved in fossil sediments. In the ice-free regions of Antarctica, where phanerogamic vegetation is often absent, diatoms are therefore of paramount importance for paleo-ecological research (e.g. Jones et al. 2000, Sterken et al. 2012, Verleyen et al. 2003).

Recent revisions of diatom systematics and biodiversity in the Antarctic (e.g. Van de Vijver & Mataloni 2008, Van de Vijver et al. 2010a, 2010b, 2010c, 2011a, 2011b, Kopalová et al. 2011, Zidarova et al. 2012) have shown that in the past many species have been wrongly identified, usually by force-fitting to known European or North-American species (Tyler 1996, see Sabbe et al. 2003 for a detailed discussion of this issue). This practice has had serious repercussions on our understanding of diatom biodiversity and biogeography in the Antarctic, revealing a higher species richness and level of endemism than previously accepted.

This paper presents the results of a detailed taxonomic intercalibration of non-marine diatom materials from three islands in the vicinity of the Antarctic Peninsula, viz. Signy Island (South Orkneys), Livingston Island (South Shetlands) and Beak Island (James Ross Island group). The checklist is based on a re-analysis of samples from Livingston, Signy Island, which have previously been used for the construction of diatom transfer functions (cf. Jones et al. 1993, Jones & Juggins 1995), supplemented with newly collected recent and fossil material from lakes and ponds on Beak Island (NE-Antarctic Peninsula, Sterken et al. 2012).Recently, numerous new studies on the taxonomy of (sub-)Antarctic diatoms have been published, and therefore a re-analysis and intercalibration of these materials was timely. The results of this intercalibration form the basis for several transfer functions (e.g. of nutrients, Sterken 2009) that may be applied in a wider geographical area, especially after intercalibration with new, larger datasets, which will be published elsewhere. All entries are annotated, illustrated and provided with original morphometric data.

## MATERIAL AND METHODS

### Study area

Livingston Island (62°40′S 61°00′W) is the second-largest island of the South Shetland Islands (fig. 1). The island has a maritime Antarctic climate strongly influenced by westerly winds, resulting in higher precipitation rates and milder temperatures than in continental Antarctica (Kopalová & Van de Vijver 2013 and references therein). Livingston's geology consists of Jurassic-Cretaceous shales, sandstones and volcanic rocks (Hobbs 1968). The snow-free ground is usually barren and rocky with sparse vegetation, mainly consisting of lichens and mosses in inland sites, and a more extensive cover of lichens, mosses and two flowering plants in the coastal areas (Jones et al. 1993, Kopalová & Van de Vijver 2013). Samples were obtained from lakes in Byers Peninsula, the largest ice-free area consisting of an inland, upland plateau (between 20 and 193 m a.s.l.) and a low-lying coastal area (Jones et al. 1993). In summer, most of the lakes on Byers Peninsula, situated on the barren central plateau, are ice-free and well-mixed by wind. They are generally nutrient poor, except for the brackish coastal lakes, which are heavily influenced by sea spray and in some cases by large animal populations (Jones et al. 1993, Kopalová & Van de Vijver 2013).

Signy Island (60°43′S 45°38′W) is a low-lying (max. altitude 279 m) island belonging to the South Orkney Islands (fig. 1). Approximately 32% of the island is covered with a thin, climate-sensitive ice-cap (Hodgson & Convey 2005). Similarly to Livingston Island, Signy has a maritime Antarctic climate. The island mainly consists of metamorphic rocks (schists), and the soils are generally more acid than those on Livingston Island (Jones et al. 1993). The ice-free areas

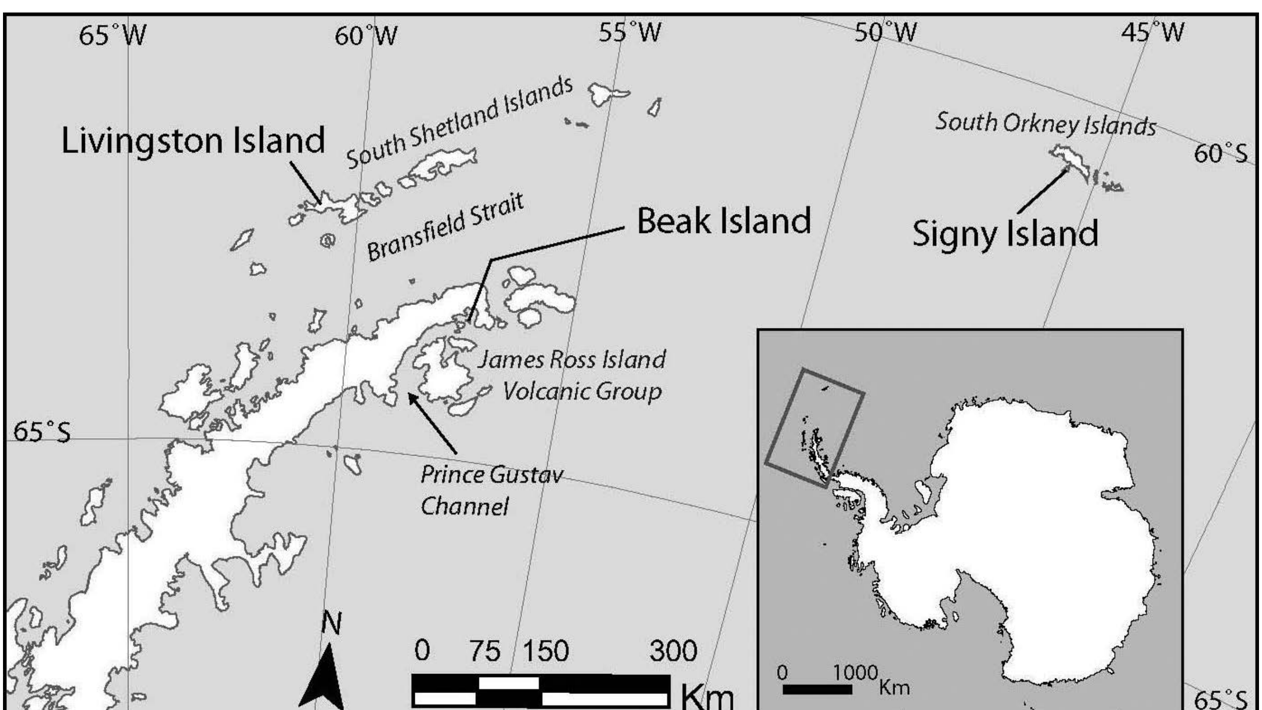



**Figure 1** – Map of the study area, showing Livingston, Signy and Beak Island in the northern tip of the Antarctic Peninsula.

of Signy Island are well vegetated with patches of mosses, lichens, and some flowering plants (Smith 1972), and the catchments of the lakes are generally more densely vegetated than those on Livingston Island (Jones et al. 1993). Signy Island lakes are ice-free and well-mixed in summer, but experience a (several weeks) shorter period of ice cover than those on Livingston Island, due to the lower snow accumulation, which causes a lower albedo at the lake surfaces (Jones et al. 1993). Lakes on Signy Island are generally more nutrient-rich than those on Livingston Island, which is mainly due to the influence of animals (birds, fur seals) in the Signy Island lake catchments (Jones et al. 1993). A detailed description of the geology and vegetation of both Signy and Livingston islands, and the physical, chemical and biological characteristics of the study lakes are given in Jones et al. (1993), Jones & Juggins (1995), Heywood et al. (1979, 1980) and references in these papers. Except for Oppenheim (1994), who described and illustrated several *Achnanthes* (sensu lato, s.l.) species, none of the other limnological and/or diatom studies in these areas have provided diatom illustrations.

Beak Island (63°36′S 57°20′S) is a small, ice-free island located in the northern Prince Gustav Channel, between Eagle Island and the Tabarin Peninsula (fig. 1). The island is assumed to either have a similar continental climate regime as James Ross Island (50 km SW of Beak, with mean monthly temperatures below 0°C (Björck et al. 1996) or a climate in between maritime and continental (Hawes & Brazier 1991), as winter temperatures only occasionally fall below -20°C (data for nearby Seymour Island, Jones & Limbert 1989). James Ross Island is influenced by the rain shadow effect of the mountains of the Antarctic Peninsula (AP), and is probably characterized by yearly maximum precipitation values of 100–200 mm $yr^{-1}$ (Sugden 1982). Beak Island is composed of Miocenic volcanic rocks (James Ross Volcanic Island group; Bibby 1966). The island contains a few lakes and shallow ponds, with small, barren catchments, partly vegetated by moss banks (see Sterken et al. 2012). Details about the lakes and their limnology can be found in Sterken et al. (2012).

**Sampling and microscopic analyses**

For details of sampling and sample preparation of the Livingston and Signy Island materials from lacustrine (recent and (sub)fossil) surface sediments, see Jones & Juggins (1995) and Jones et al. (1993). Detailed information on the Beak Island material (recent and (sub)fossil samples) can be found in Sterken et al. (2012) and Sterken (2009). Samples from Beak Island were oxidized using hydrogen peroxide (Renberg 1990); oxidized materials were mounted in Naphrax. Original light microscope (LM) pictures of all materials were taken with an Olympus DP50 camera on an Olympus CX 41 microscope, and an Axiocam on a Zeiss Axioplan II microscope, at 10x100x magnification. Samples and slides are stored at the Protistology and Aquatic Ecology Lab, Ghent University, Belgium and at UCL, London, UK.

Identifications are based on literature data provided with unambiguous illustrations and/or descriptions, viz. Esposito et al. (2008), Lowe et al. (2014), Kopalová et al. (2009, 2011, 2012), Sabbe et al. (2003), Taylor et al. (2014), Van de Vijver (2008), Van de Vijver & Mataloni (2008), Van de Vijver & Kopalová (2014), Van de Vijver & Zidarova (2011), Van de Vijver et al. (2002, 2004, 2006, 2010b, 2010c, 2011a, 2011b, 2013a, 2013b, 2013c, 2014a, 2014b, 2014c) and Zidarova et al. (2009, 2010, 2012, 2014a, 2014b). When the identity of a taxon could not be determined with 100% certainty, this is indicated using ‘cf.’ or ‘sp.’.

Morphometric data (L= length, W = width, D = diameter, S = stria density, F = fibula density) are given as ranges and number of specimens measured (n). Stria densities (S) were measured alongside the raphe between the central area and the apex.

## DISCUSSION

A total of 102 diatom taxa (including varieties and undescribed forms) belonging to at least 34 different genera has been observed in recent and (sub)fossil sediments from 66 lakes in these islands. As a result of recent major revisions of the diatom flora of the Maritime Antarctic Region, almost all diatoms found in this study could be identified to species level. Significantly, 41 of these have been described very recently (since 2000) from the Antarctic region. A large number of these taxa were previously force-fitted into European or North-American taxa. Despite this renewed research effort on Antarctic diatom taxonomy there are still many unknown taxa remaining and species complexes that are in urgent need of a revision. This is especially the case for the genera *Gomphonema* and all *Nitzschia* species, at present mostly tentatively identified (hence ‘cf.’). Several species could as yet not be identified and are being described as new species (e.g. *Navicula* sp. 1, B. Van de Vijver, unpubl. res.) whereas of the remainder, several closely resemble (hence ‘cf.’) known species or varieties but display slight but possibly significant differences with the type and/or other populations. Other taxa (e.g. *Pinnularia borealis* s.l., *Fragiliaria capucina* s.l., *Nitzschia paleacea*, *Encyonema minutum*) appear to display a considerable degree of intraspecific variation (noted in other studies), which requires further study. Given the fact that recent diatom studies have revealed extensive semicryptic diversity in many established diatom taxa (e.g. Behnke et al. 2004, Beszteri et al. 2007; see Mann (1999) for a review), each case needs to be carefully studied (at least including morphometry of different populations and SEM analyses, and if at all possible, molecular analyses) to assess its true identity. It is highly likely that in several cases, this will lead to the splitting of the species in several independent (newly to describe) taxa.

The most species-rich genera in our study were *Pinnularia* (twelve taxa) *Chamaepinnularia*, *Luticola*, *Planothidium*, *Psammothidium* and *Stauroneis* (seven taxa each), *Nitzschia* (six taxa), *Humidophila* and *Navicula* (five taxa each). Most taxa were found on Livingston Island (86 taxa) whereas on the more southerly located Beak Island, only 54 taxa were observed. It is generally established that in the Antarctic diatom diversity decreases when moving southwards (Jones 1996). Our results seem to confirm this trend, although it cannot be ruled out that the lower number of taxa on Beak Island is due to the smaller number of lakes on the island. Thirty-four taxa were shared by all three islands while 38 taxa were only found on one island. Of these, Livingston had the largest number of unique taxa (24) and Signy Island the lowest. However, on Signy Island, all unique taxa are shared with the sub-Antarctic Region such as *Staurosirella circula* and *Adlafia bryophila*. These taxa have never been found in previous diatom surveys in the Maritime Antarctic Region (see for instance Kopalová & Van de Vijver 2013, Kopalová et al. 2012, 2013, 2014). On Beak Island, several unique taxa such as *Chamaepinnularia cymatopleura*, *Craticula antarctica* or *Pinnularia splendida* are shared with neighboring James Ross Island or the Antarctic Continent but have never been found in the northern part of the Maritime Antarctic Region. These results suggest that bioregionalism may occur within the Antarctic diatom flora.

## CHECKLIST

***Achnanthes* cf. *muelleri*** Carlson
Fig. 2V–W
**Original description** – Carlson (1913: 23).
**Dimensions** – L: 33.5–37.5 µm; W: 10.0–14.0 µm; S: 10–11 in 10 µm (n = 6).
**Remarks** – Specimens are identical to the smaller specimens illustrated in Van de Vijver et al. (2002: Figs 5–7), all are narrower (10–14 vs. 16–21 µm) than those illustrated in the type description in Carlson (1913). In our specimens, a clear rectangular fascia reaching the valve margin is present, which is not the case in the type illustrations and the larger specimens illustrated in Van de Vijver et al. (2002). This species is similar to *Achnanthes taylorensis* (Kellogg et al. 1980) but has a narrower fascia and a rhombic valve outline (cf. Sabbe et al. 2003: Figs. 1–2 and 74–75) contrary to *A. taylorensis* that has a lanceolate outline.
**Distribution** – Beak Island.

***Achnanthidium australexiguum*** Van de Vijver
Fig. 2X–Y
**Original description** – Taylor et al. (2014: 47).
**Dimensions** – L: 8.0–18.0 µm; W: 5.0–7.5 µm; S: 22–27 in 10 µm (n = 8).
**Remarks** – Our specimens match the description of this recently described species from James Ross Island (Taylor et al. 2014, where it is separated from *Achnanthidium exiguum* (Grunow) Czarn.).
**Distribution** – Beak Island, Livingston Island.

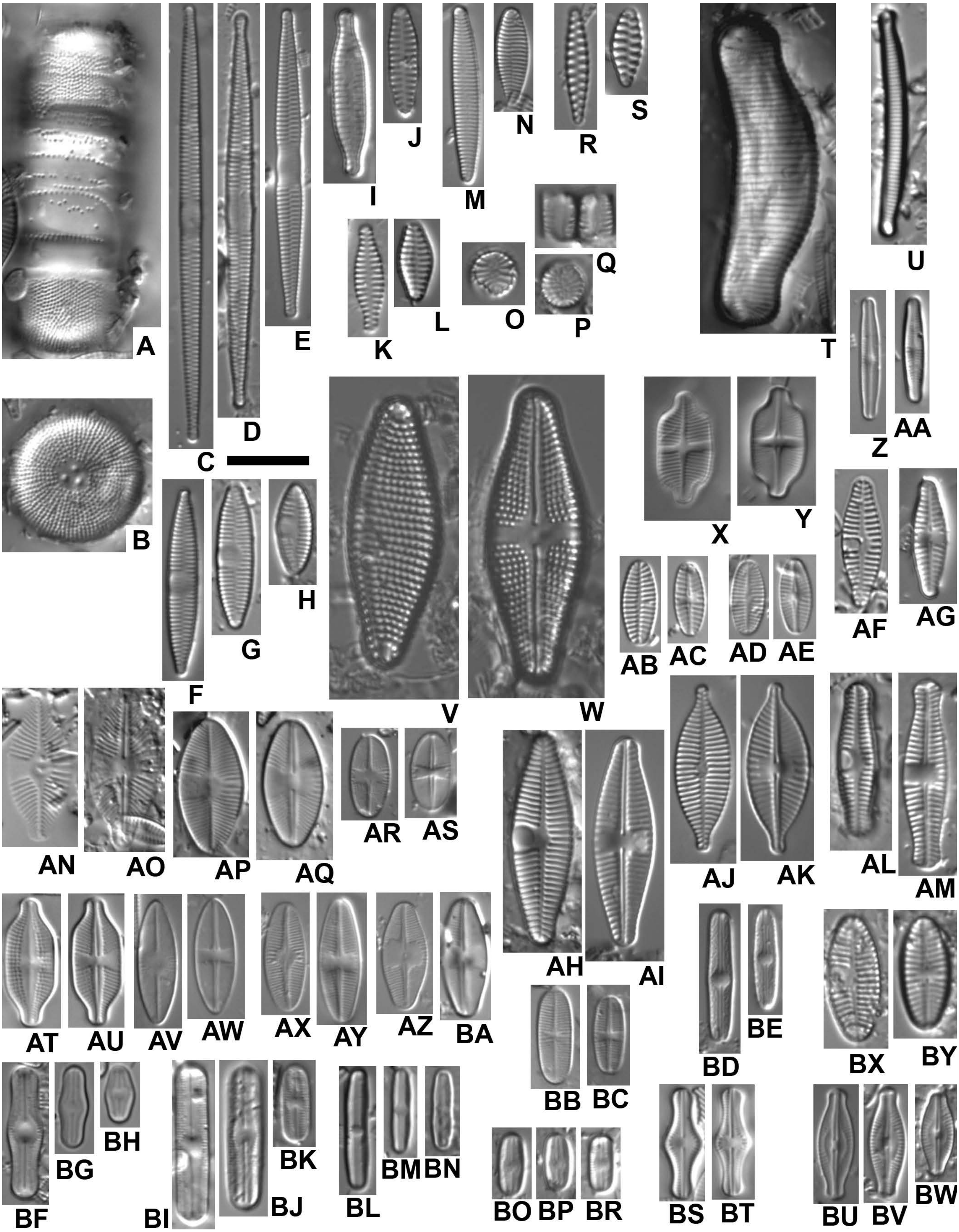
***Achnanthidium maritimo-antarcticum*** Van de Vijver & Kopalová
Fig. 2Z–AA
**Original description** – Van de Vijver & Kopalová (2014: 6).
**Dimensions** – L: 8.5–16.5 µm; W: 2.0–3.0 µm; S: 25–32 in 10 µm (n = 26).
**Remarks** – Our specimens match the description and pictures of *Achnanthidium maritimo-antarcticum* in Van de Vijver & Kopalová (2014) who recently revised all *Achnanthidium* species in the Antarctic Region and concluded that the presumably widespread *A. minutissimum* (Kütz.) Czarn. is not present in the region.
**Distribution** – Livingston Island, Signy Island.

***Adlafia* cf. *bryophila*** (J.B.Petersen) Lange-Bert.
Fig. 3Q–R
**Original description** – *Navicula bryophila* J.B.Petersen (Petersen 1928: 388).
**Dimensions** – L: 13.0–20.0 µm; W: 3.0–5.0 µm; S: 21–30 in 10 µm (n = 6).
**Remarks** – Our specimens match those illustrated in Lange-Bertalot (2001) and Van de Vijver et al. (2002) but have a lower stria density (21–30 vs. 29–36 and 30–38 in 10 µm respectively).
**Distribution** – Signy Island.

***Adlafia submuscora*** Van de Vijver, Kopalová, Zidarova & E.J.Cox
Fig. 3S–T
**Original description** – Van de Vijver et al. (2013b: 191).
**Dimensions** – L: 10.0–12.1 µm; W: 2.5–3.5 µm (n = 4); S: not discernible in LM.
**Remarks** – Our specimens match the description of *Adlafia submuscora*, recently described from James Ross Island (Van de Vijver et al. 2013b).
**Distribution** – Livingston Island, Signy Island.

***Brachysira minor*** (Krasske) Lange-Bert.
Fig. 2BD–BE
**Original description** – *Anomoeoneis minor* Krasske (1939: 377).
**Dimensions** – L: 8.5–16.5 µm; W: 2.5–4.0 µm (n = 7); S: not discernible in LM.
**Remarks** – Our specimens closely match the lectotype specimens from Chile illustrated in Lange-Bertalot et al. (1996)

► **Figure 2** – Light micrographs: A–B, *Orthoseira roeseana* (Rabenh.) O'Meara; C–E, *Fragilaria capucina* Desm. s.l. Morphotype A; F–H, *Fragilaria capucina* Desm. s.l. Morphotype B; I–J, *Staurosira pottiezii* Van de Vijver; K–L, *Staurosira* sp. 1; M–N, *Stauroforma exiguiformis* (Lange-Bert.) Flower, Jones & Round; O–Q, *Staurosira* cf. *circula* Van de Vijver & Beyens; R, *Staurosirella antarctica* Van de Vijver & E.Morales; S, *Staurosirella frigida* Van de Vijver & E.Morales; T, *Eunotia ralitsae* Van de Vijver, M.de Haan & Lange-Bert.; U, *Eunotia pseudopaludosa* Van de Vijver, M.de Haan & Lange-Bert.; V–W, *Achnanthes* cf. *muelleri* Carlson; X–Y, *Achnanthidium australexiguum* Van de Vijver; Z–AA, *Achnanthidium maritimo–antarcticum* Van de Vijver & Kopalová; AB–AC, *Planothidium quadripunctatum* (Oppenheim) Sabbe; AD–AE, *Planothidium renei* (Lange-Bert. & Rol.Schmidt) Van de Vijver; AF–AG, *Planothidium* cf. *frequentissimum* (Lange-Bert.) Round & Bukht.; AH–AI, *Planothidium rostrolanceolatum* Van de Vijver, Kopalová & Zidarova; AJ–AK, *Planothidium australe* (Manguin) Le Cohu; AL–AM, *Planothidium capitatum* (O.Müll.) Van de Vijver et al.; AN–AQ, *Psammothidium germainii* (Manguin) Sabbe; AR–AS, *Psammothidium subatomoides* (Hust.) Bukht. & Round; AT–AU, *Psammothidium manguinii* (Hust.) Van de Vijver; AV–AW, *Psammothidium incognitum* (Krasske) Van de Vijver; AX–AY, *Psammothidium papilio* (D.E.Kellogg et al.) Van de Vijver & Kopalová; AZ–BA, *Psammothidium aretasii* (Manguin) Le Cohu; BB–BC, *Psammothidium abundans* (Manguin) Bukht. & Round; BD–BE, *Brachysira minor* (Krasske) Lange-Bert.; BF–BH, *Humidophila australis* (Van de Vijver & Sabbe) R.Lowe et al.; BI–BK, *Humidophila arcuata* (Heiden) R.Lowe et al.; BL–BN, *Humidophila nienta* (Carter) R.Lowe et al.; BO–BR, *Humidophila inconspicua* (Kopalová & Van de Vijver) R.Lowe et al.; BS–BT, *Humidophila tabellariaeformis* (Krasske) R.Lowe et al.; BU–BW, *Microcostatus naumannii* (Hust.) Lange-Bert. & Genkal; BX–BY, *Planothidium lanceolatum* (Bréb.) Lange-Bert. Scale bar represents 10 µm.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but are slightly smaller and appear to be more finely structured. They are also smaller, have more broadly rounded apices and have slightly more linear-elliptic not rhombic-lanceolate valves than those from Southern Chile illustrated in Lange-Bertalot & Moser (1994: Figs 1–7). The specimens from the Antarctic Peninsula and James Ross Island, illustrated in Lange-Bertalot & Moser (1994: Fig. 8) and Kopalová et al. (2012: Fig. 5O–P), fully match our specimens.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Caloneis* sp. 1**
Fig. 4O–P
**Dimensions** – L: 13.5–27.5 µm; W: 4.0–5.5 µm; S: 20–24 in 10 µm (n = 8).
**Remarks** – Our specimens fall within the range of the description of *Caloneis bacillum* (Grunow) Cleve given by Kelly et al. (2005: L: 15–48 µm; W: 4–9 µm; S: 20–30 per 10 µm) and are also in accordance with *Caloneis bacillum* as described and illustrated in Krammer & Lange-Bertalot (1986: 390, Fig. 173: 9–20), but our larger specimens tend to have a smaller L/W-ratio (2.9–6.2 vs. 3.0–3.8 in our specimens). Variability in valve outline also seems to be larger in Krammer & Lange-Bertalot (1986) with our specimens most closely resembling their more linear forms (Figs 14–16). Van de Vijver et al. (2002) reported this species as *Caloneis* cf. *bacillum* from Ile de la Possession (Crozet Archipelago), but their specimens were generally larger (L: 22–42 µm; W: 4–6 µm; S: 22–26 in 10 µm). The original *C. bacillum* (Grunow) Cleve however is a typical brackish-marine taxon (see for instance Witkowski et al. 2000: pl. 151, Figs 15–17), but many freshwater forms have been incorrectly associated with this name. The taxonomic status of these freshwater forms therefore requires further study. The Maritime Antarctic populations are currently under review (B. Van de Vijver, Botanic Garden Meise, Belgium, unpubl. res.).
**Distribution** – Beak Island, Livingston Island, Signy Island.

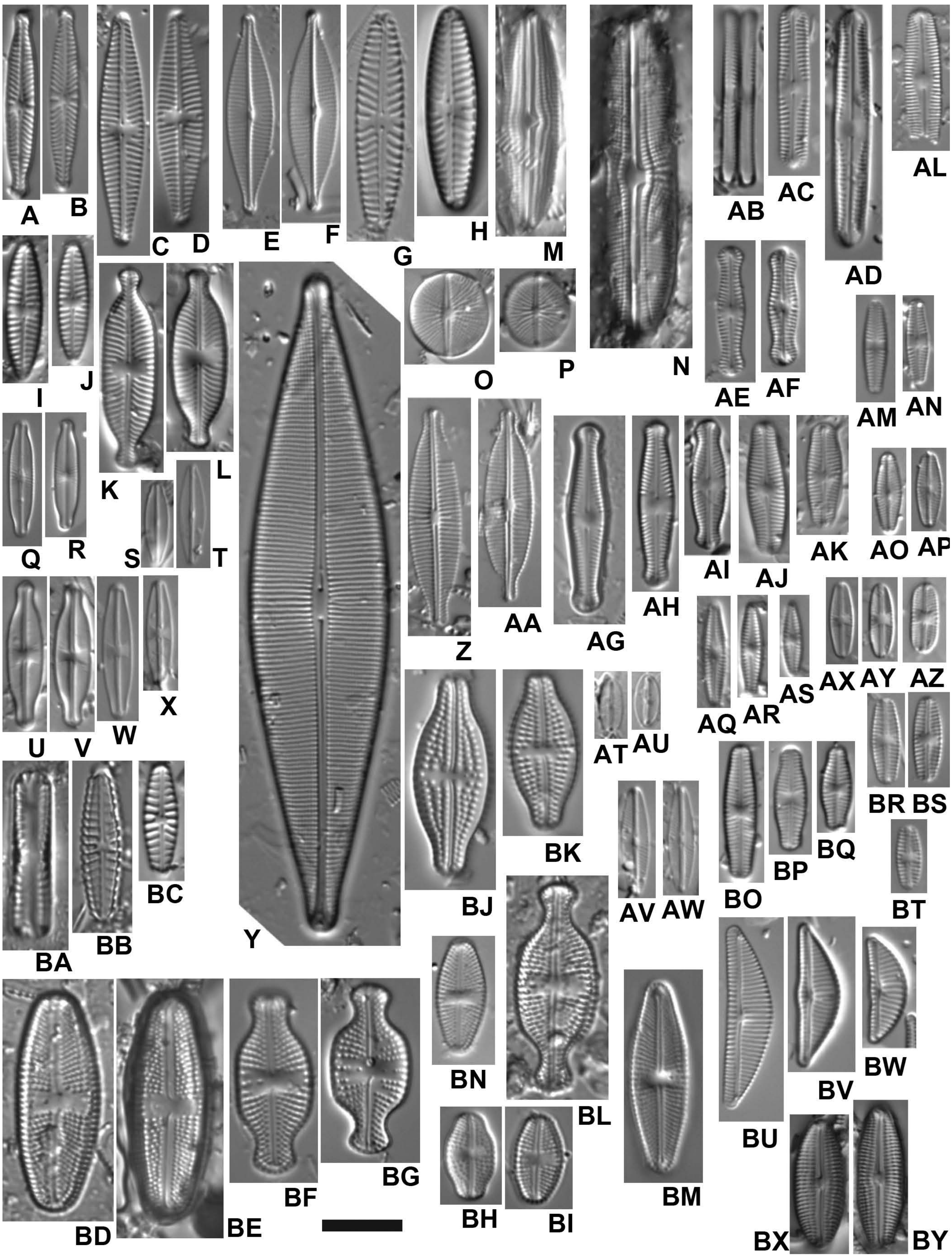
***Cavinula pseudoscutiformis*** (Hust.) D.G.Mann & Stickle
Fig. 3O–P
**Original description** – *Navicula pseudoscutiformis* Hust. (Hustedt 1930: 291).
**Dimensions** – L: 9.5–11.0 µm; W: 8.5–10.0 µm; S: 19–24 in 10 µm (n = 4).
**Remarks** – Our specimens closely match the description of this species given by Riaux-Gobin & Compère (2004). They are morphologically very similar to *C. kerguelensis* Riaux-Gobin & Compère, but this species has a higher stria density (25.4 striae in 10 µm); and less rounded valves (L/W: 1.26 vs. 1.06–1.14 in our specimens) (Riaux-Gobin & Compère 2004). Moreover, *C. kerguelensis* might be brackish-tolerant while *C. pseudoscutiformis* is a freshwater species.
**Distribution** – Signy Island.

***Chamaepinnularia australomediocris*** (Lange-Bert. & Rol. Schmidt) Van de Vijver
Fig. 3AM–AN
**Original description** – *Navicula australomediocris* Lange-Bertalot & Rol.Schmidt (Schmidt et al. 1990: 65).
**Dimensions** – L: 9.0–12.0 µm; W: 2.5–3.0 µm; S: 21–29 in 10 µm (n = 6).
**Remarks** – All observations fully correspond with those illustrated in Schmidt et al. (1990) and Van de Vijver et al. (2002).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Chamaepinnularia cymatopleura*** (W.West & G.S.West) Cavacini
Fig. 3AL
**Original description** – *Navicula cymatopleura* W.West & G.S.West (West & West 1911: 285).
**Dimensions** – L: 18.5 µm; W: 4.5 µm; S: 22 in 10 µm (n = 1).
**Remarks** – Our specimen corresponds to the description and illustrations for this species in Sabbe et al. (2003), Cremer et al. (2004) and Cavacini et al. (2006). This is the first confirmed record of this species outside the Antarctic Continent. Kellogg & Kellogg (2002) listed all observations showing clearly the broad distribution of *C. cymatopleura* on the Continent and its absence in the rest of the Antarctic Region.
**Distribution** – Beak Island.

***Chamaepinnularia gerlachei*** Van de Vijver & Sterken
Fig. 3AB–AD
**Original description** – Van de Vijver et al. (2010c: 432).
**Dimensions** – L: 13.5–30.0 µm; W: 3.5–5.0 µm; S: 15–20 in 10 µm (n = 16).
**Remarks** – *Chamaepinnularia gerlachei* has been recently described from the Maritime Antarctic Region (Van de

► **Figure 3** – Light micrographs: A–B, *Navicula bicephaloides* Van de Vijver & Zidarova; C–D, *Navicula cremeri* Van de Vijver & Zidarova; E–F, *Navicula gregaria* Donkin; G–H, *Navicula* sp. 1 *(N.* cf. *seibigeana*); I–J, *Navicula austroshetlandica* Van de Vijver; K–L, *Placoneis australis* Van de Vijver & Zidarova; M, *Muelleria aequistriata* Van de Vijver & S.A.Spaulding; N, *Muelleria australoatlantica* Van de Vijver & S.A.Spaulding; O–P, *Cavinula pseudoscutiformis* (Hust.) D.G.Mann & Stickle; Q–R, *Adlafia* cf. *bryophila* (J.B.Petersen) Lange-Bert.; S–T, *Adlafia submuscora* Van de Vijver et al.; U–X, *Sellaphora nana* (Hust.) Lange-Bert. et al.; Y, *Craticula subpampeana* Van de Vijver & Sterken; Z–AA, *Craticula antarctica* Van de Vijver & Sabbe; AB–AD, *Chamaepinnularia gerlachei* Van de Vijver & Sterken; AE–AF, *Chamaepinnularia krookii* (Grunow) Lange-Bert. & Krammer; AG–AK, *Chamaepinnularia krookiformis* (Krammer) Lange-Bert. & Krammer; AL, *Chamaepinnularia cymatopleura* (W. & G.S.West) Cavacini; AM–AN, *Chamaepinnularia australomediocris* (Lange-Bert. & Rol.Schmidt) Van de Vijver; AO–AP, *Chamaepinnularia* sp. 1; AQ–AS, *Chamaepinnularia antarctica* Van de Vijver et al.; AT–AU, *Mayamaea* cf. *permitis* (Hust.) Bruder & Medlin; AV–AW, *Chamaepinnularia* sp. 1; AX–AZ, *Eolimna* cf. *minima* (Grunow) Lange-Bert.; BA–BC, *Hippodonta hungarica* (Grunow) Lange–Bertalot, Metzeltin & Witkowski; BD–BE, *Luticola vermeulenii* Van de Vijver; BF–BG, *Luticola muticopsis* (Van Heurck) D.G.Mann; BH–BI, *Luticola muticopsis* f. *reducta* West & West and f. *evoluta* West & West; BJ–BK, *Luticola higleri* Van de Vijver, Van Dam & Beyens; BL, *Luticola katkae* Van de Vijver & Zidarova; BM, *Luticola* cf. *australomutica* Van de Vijver; BN, *Luticola* cf. *cohnii* (Hilse) D.G.Mann; BO–BQ, *Eolimna* cf. *elorantana* (Lange-Bert.) Lange-Bert. & Kulikovskiy; BR–BT, *Sellaphora* cf. *seminulum* (Grunow) D.G.Mann; BU–BW, *Encyonema minutum* (Hilse in Rabenhorst) D.G.Mann; BX–BY, *Muelleria kristinae* Van de Vijver. Scale bar represents 10 µm.


A B C D E F G H M N AB AC AD AL
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BA BB BC BO BP BQ BT
AV AW BL BN BM BU BV BW
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Vijver et al. 2010c) and seems so far widely distributed at all investigated localities in this region (Kopalová et al. 2012, 2013, Kopalová & Van de Vijver 2013).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Chamaepinnularia antarctica*** Van de Vijver, Kopalová, Zidarova & E.J.Cox
Fig. 3AQ–AS
**Original description** – Van de Vijver et al. (2013b: 193).
**Dimensions** – L: 7.5–13.5 µm; W: 2.5–3.0 µm; S: 18–25 in 10 µm (n = 24).
**Remarks** – This species was recently described from Livingston Island (Van de Vijver et al. 2013b) and seems to be widespread though usually quite rare in the Maritime Antarctic Region.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Chamaepinnularia krookii*** (Grunow) Lange-Bert. & Krammer
Fig. 3AE–AF
**Original description** – *Navicula krockii* Grunow (1882: 155).
**Dimensions** – L: 11.5–18.5 µm; W: 3.5–4.0 µm; S: 18–20 in 10 µm (n = 9).
**Remarks** – Our specimens correspond with the pictures of *Chamaepinnularia krookii* (Grunow) Lange-Bertalot & Krammer illustrated in Lange-Bertalot & Genkal (1999), and with the descriptions given for this species in Cavacini et al. (2006), although our specimens tend to be narrower than those in Cavacini et al. (2006: W: 4–7 µm).
**Distribution** –Livingston Island, Signy Island.

***Chamaepinnularia krookiformis*** (Krammer) Lange-Bert. & Krammer
Fig. 3AG–AK
**Original description** – *Pinnularia krookiformis* Krammer (1992: 79–80).
**Dimensions** – L: 12.24–23.4 µm; W: 3.1–5.4 µm; S: 18–28 in 10 µm (n = 23).
**Remarks** – Our specimens correspond to those of this species illustrated in Lange–Bertalot & Genkal (1999) and with the description in Cavacini et al. (2006) but are slightly narrower than those in Cavacini et al. (2006: W: 5–11 µm).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Chamaepinnularia* spp.**
Fig. 3AO–AP & AV–AW
**Dimensions** – L: 8.0–14.0 µm; W: 3.0–4.0 µm; S: 24–32 in 10 µm (n = 20).
**Remarks** – Our specimens resemble *Navicula* (?) sp. 2 in Sabbe et al. (2003) but the specimens illustrated there are narrower (2.6–3.0 µm). They are also similar to *Chamaepinnularia evanida* (Hust.) Lange-Bert. (cf. Krammer & Lange-Bertalot 1986) but are wider, have a slightly larger central area and on average a higher stria density (*N. evanida*: L: 8–10 µm; W: 3 µm; S: 24 in 10 µm, in Hustedt 1942; L: 6–10 µm; W: 2.5–3 µm; S: 24–28 in 10 µm, in Krammer & Lange-Bertalot 1986; L: 7–10 µm; W: 2–3 µm; S: 23–25 per 10 µm, in Van de Vijver et al. 2002). *Chamaepinnularia* sp. 1 also resembles *Chamaepinnularia spec*. in Van de Vijver et al. (2002: pl. 86, Figs 15–22, W: 2–3 µm; S: 23–26 in 10 µm) but these are narrower and generally less finely striated. Wetzel et al. (2013) revised several small *Chamaepinnularia* taxa but none of them entirely match the Antarctic populations. Most likely these Antarctic populations represent more than one new species but detailed SEM investigations will be necessary to clarify their identity.
**Distribution** – Livingston Island, Signy Island.

***Craticula antarctica*** Van de Vijver & Sabbe
Fig. 3Z–AA
**Original description** – Van de Vijver et al. (2010c: 433).
**Dimensions** – L: 23.5–29.5 µm; W: 6.0–7.5 µm; S: 17–20 in 10 µm (n = 9).
**Remarks** – *Craticula antarctica* has been recently described and discussed in Van de Vijver et al. (2010c). The species shows a rather broad geographic distribution on the Antarctic Continent and on some southerly located islands in the Maritime Antarctic Region such as James Ross Island (Kopalová et al. 2013). However, due to confusion with so-called cosmopolitan taxa such as *Craticula molestiformis* (Hust.) Lange-Bert., its precise distribution is currently uncertain.
**Distribution** – Beak Island.

***Craticula subpampeana*** Van de Vijver & Sterken
Fig. 3Y
**Original description** – Van de Vijver et al. (2010c: 435).
**Dimensions** – L: 79.9–102.6 µm; W: 16.9–19.1 µm; S: 15 in 10 µm (n = 3).
**Remarks** – *Craticula subpampeana* was recently described from James Ross Island Van de Vijver et al. (2010c).
**Distribution** – Beak Island, Livingston Island.

***Encyonema minutum*** (Hilse) D.G.Mann **s.l.**
Fig. 3BU–BW
**Original description** – *Cymbella minuta* Hilse in Rabenhorst (1862: no. 1261).
**Dimensions** – L: 10.0–23.0 µm; W: 4.5–6.0 µm; S: 14–20 in 10 µm (n = 16).
**Remarks** – Our specimens fit *Encyonema minutum* as described in Krammer (1997) and Kelly et al. (2005), both with respect to valve characteristics and dimensions. This is the first confirmed record in the entire Antarctic Region. A recent taxonomic revision of the cymbelloid diatoms of the Antarctic did not reveal any populations of this taxon so far (B. Van de Vijver, Botanic Garden Meise, Belgium, pers. obs.). Kellogg & Kellogg (2002) list a large number of records for the sub-Antarctic and Maritime Antarctic Region but so far none of them could be confirmed. It is possible that the observed specimens may represent more than one species but since only a few populations were observed, this is too early to say without detailed SEM analysis.
**Distribution** – Livingston Island, Signy Island.

***Eolimna* cf. *elorantana*** (Lange-Bert.) Lange-Bert. & Kulikovskiy
Fig. 3BO–BQ
**Original description** – *Naviculadicta elorantana* Lange-Bert. (Lange-Bertalot & Metzeltin 1996: 84–85).
**Dimensions** – L: 8.0–14.5 µm; W: 3.5–4.5 µm; S: 18–24 in 10 µm (n = 23).

**Remarks** – Our specimens closely resemble *Eolimna* (*Naviculadicta*) *elorantana* as illustrated in Van de Vijver et al. (2002). It is not certain whether some smaller specimens also belong to this taxon as the central area is much smaller. Our longest specimens are longer than those in Van de Vijver et al. (2002). *Eolimna elorantana* also resembles *Sellaphora* (*Naviculadicta*) *seminulum* (Grunow) D.G.Mann (Van de Vijver et al. 2002) but this taxon typically has elliptical valves with non-protracted apices. The true taxonomic identity of the Antarctic populations is as yet not clear and detailed SEM research will be necessary. It is highly likely that they represent a new species.
**Distribution** – Signy Island.

***Eolimna* cf. *minima*** (Grunow) Lange-Bert.
Fig. 3AX–AZ
**Original description** – *Navicula minima* Grunow in Van Heurck (1880–1885: 107).
**Dimensions** – L: 6.5–10.0 µm; W: 2.5–3.5 µm; S: 25–32 in 10 µm (n = 25).
**Remarks** – Our specimens match the description and pictures shown in Van de Vijver et al. (2002) for *Eolimna minima*. However, detailed SEM investigations of all *E. minima* populations from the entire Antarctic Region are necessary together with a better understanding of the exact identity and an acccurate idea of the diversity within this complex.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Eunotia pseudopaludosa*** Van de Vijver, M.de Haan & Lange-Bert.
Fig. 2U
**Original description** – Van de Vijver et al. (2014a: 274).
**Dimensions** – L: 28.5 µm; W: 2.5 µm; S: 19 in 10 µm (n = 1).
**Remarks** – This species was recently split off from *E. paludosa* Grunow (Van de Vijver et al. 2014a) based on populations from Livingston Island. The single specimen we observed here fully matches the description given in Van de Vijver et al. (2014a).
**Distribution** – Livingston Island.

***Eunotia ralitsae*** Van de Vijver, M.de Haan & Lange-Bert.
Fig. 2T
**Original description** – Van de Vijver et al. (2014a: 275).
**Dimensions** – L: 38.5 µm; W: 10.0 µm; S: 14 in 10 µm (n = 1).
**Remarks** – This species was recently split off from *E. praerupta* Ehrenb. (Van de Vijver et al. 2014a) under which name it was often reported from the Maritime Antarctic Region (Kellogg & Kellogg 2002). The single specimen we observed here fully matches the description given in Van de Vijver et al. (2014a).
**Distribution** – Signy Island.

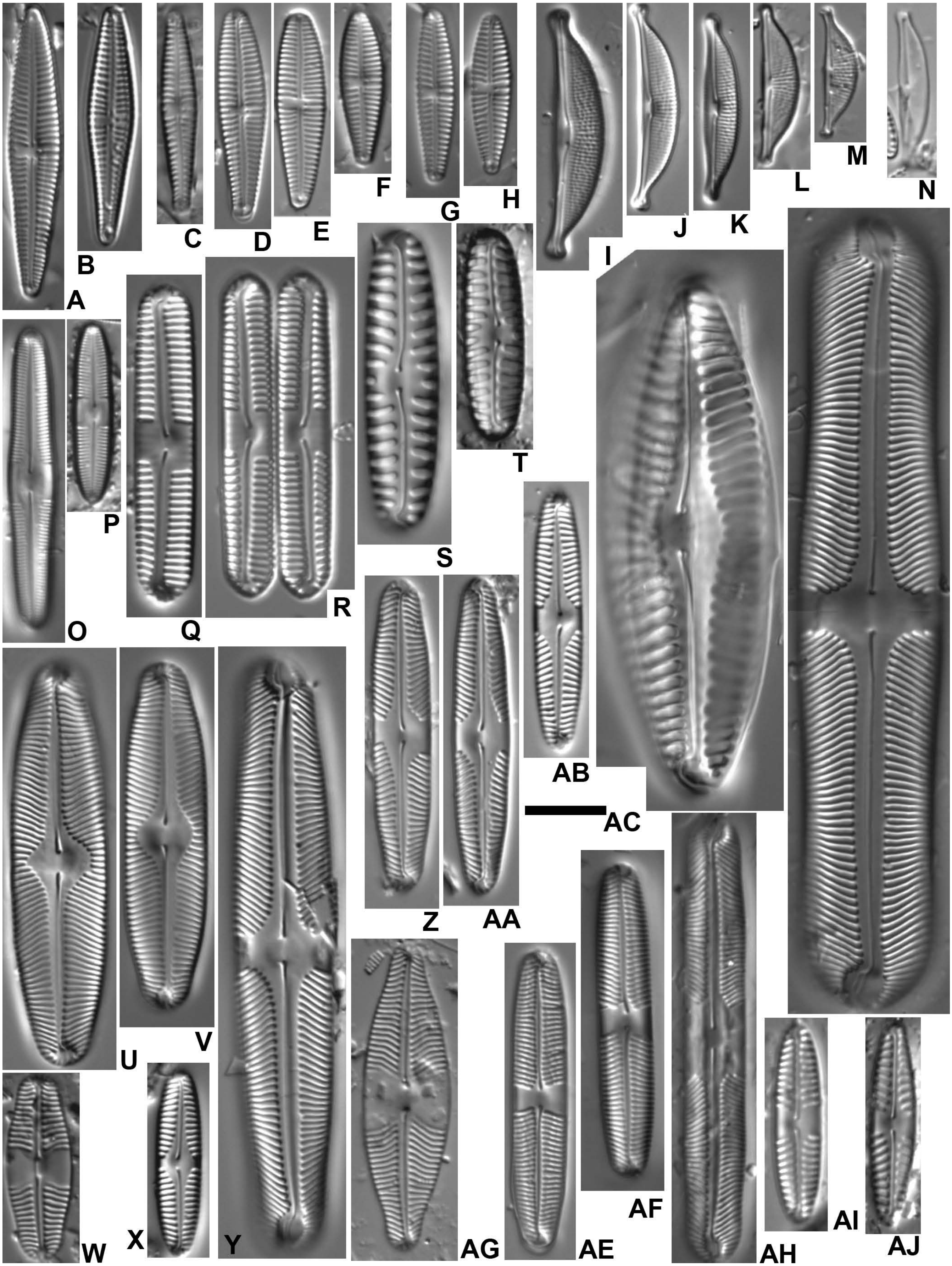
***Fragilaria capucina*** Desm. **s.l.**
**Original description** – *Fragilaria capucina* Desm. (Desmazières 1825: fasc. 10, n° 453).

***Morphotype A***
Fig. 2C–E
**Dimensions** – L: 22.5–54.0 µm; W: 2.0–4.0 µm; L/W ratio: 8.6–19.5; S: 16–19 in 10 µm (n = 14).

***Morphotype B***
Fig. 2F–H
**Dimensions** – L: 13.5–26.0 µm; W: 3.0–4.5 µm; L/W ratio: 3.8–7.1; S: 17–19 in 10 µm (n = 12).
**Remarks** – *Fragilaria capucina* s.l. clearly represents a complex of taxa that are all very similar to each other and at present it is not possible to identify individual taxa at the species level. Morphotype A corresponds well with the description of *Fragilaria capucina* morphotype 2 in Van de Vijver et al. (2002: 44, pl. 7, Figs 19–31) although the longest specimens might even belong to their morphotype 3. Morphotype B on the other hand shows similar characteristics as *F. capucina* morphotype 1 described in Van de Vijver et al. (2002: 41, pl. 7, Figs 1–13). As in Van de Vijver et al. (2002), no difference in stria density was found between the different *F. capucina* morphotypes. It is highly likely that these morphotypes represent new species but due to a lot of confusion regarding the different types within the *F. capucina* s.l. complex, the exact taxonomic identity remains uncertain.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Gomphonema* spp.**
Fig. 4A–H
**Dimensions** – L: 13.5–40.0 µm, W: 4.0–8.0 µm; S: 10–26 in 10 µm (n = 124).
Remarks – It is currently not possible to identify the Maritime Antarctic *Gomphonema* population at the species level. It is highly likely that several separate species are present but detailed morphometric and SEM analysis will be necessary to elucidate variation patterns in this complex (J.P. Kociolek, University of Boulder, USA, pers. comm.). Our specimens belong to the variable species complex around *Gomphonema angustatum* (Kütz.) Rabenh. and varieties (e.g. *G. angustatum var. productum*) and similar species such as *G. micropus* Kütz. (Reichardt 1999), *G. gracile* Ehrenb. and *G. parvulum* Kütz. They are particularly common in the Antarctic (e.g. Wasell & Håkansson 1992, Sabbe et al. 2003). Some valves are very similar to *Gomphonema signyensis* described by Kociolek & Jones (1995) but the variability of this species is currently unsufficiently known to make clear taxonomic decisions.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Halamphora ausloosiana*** Van de Vijver & Kopalová/ ***H. oligotraphenta*** Lange-Bert.
Fig. 4I–N
**Original description** – Van de Vijver et al. (2014b: 379)/ Lange-Bertalot & Metzeltin (1996: 28).
**Dimensions** – L: 20.5–30.5 µm; W: 4.0–5.5 µm; S: 19–28 in 10 µm (n = 18).
**Remarks** – Van de Vijver et al. (2014b) recently revised all *Halamphora* taxa present in the Antarctic Region. Two closely related taxa were observed in the Maritime Antarctic Region, separated from each other by valve width and differences in stria structure. *Halamphora ausloosiana* typically shows biseriate striae whereas *H. oligotraphenta* has uniseriate striae. This feature is however only discernible in SEM. Based on valve width, most observed valves belong to *H. ausloosiana* as all observed *H. oligotraphenta* populations in the Maritime Antarctic Region have a maximum valve width of only 4.5 µm. However, detailed SEM anal-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ysis of all populations will be necessary to unambiguously distinguish between both taxa. The heavily silicified valves (fig. 4N) often found in the populations, have so far not been observed in *H. ausloosiana* (Van de Vijver et al. 2014b).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Hantzschia amphioxys*** (Ehrenb.) Grunow **f. *muelleri*** Ko-bayashi
Fig. 5M
**Original description** – Ko-Bayashi (1963: 62).
**Dimensions** – L: 28.5–53.0 µm; W: 4.5–6.0 µm; S: 22–24 in 10 µm; F: 6–9 in 10 µm (n = 3).
**Remarks** –The *Hantzschia amphioxys* species complex in the Antarctic Region is characterized by a high degree of morphological variability (see for instance Ko-bayashi 1965) and is in need of revision (Sabbe et al. 2003). Recently, Zidarova et al. (2010) described five new *Hantzschia* species and one new variety from Livingston Island. Detailed SEM analysis is necessary to enable a clear separation between the different taxa but due to the extreme paucity of *Hantzschia* valves in our study, it is impossible to perform a good SEM analysis. The specimens observed in our study most likely represent *Hantzschia amphioxys* f. *muelleri*. Zidarova et al. (2010) discuss the taxonomic history of this taxon and its distribution in the Antarctic Region.
**Distribution** – Livingston Island.

***Hantzschia abundans*** Lange-Bert.
Fig. 5N
**Original description** – Lange-Bertalot (1993: 75–76).
**Dimensions** – L: 53.0 µm; W: 9.5 µm; S: 19 in 10 µm (n = 1).
**Remarks** – The single specimen that has been observed corresponds to the description in Lange-Bertalot (1993) and Zidarova et al. (2010). *H. confusa* Van de Vijver & Zidarova, described from Livingston Island, can be distinguished in having coarser striae clearly showing the areolae even in LM (Zidarova et al. 2010) which is not the case in our specimen.
**Distribution** – Livingston Island.

***Hantzschia hyperaustralis*** Van de Vijver & Zidarova
Fig. 5O
**Original description** – Zidarova et al. (2010: 326).
**Dimensions** – L: 76.5–88.5 µm; W: 13.0–13.5 µm; S: 20–23 in 10 µm; F: 5–6 in 10 µm (n = 3).
**Remarks** – Our specimens closely match the description of *H. hyperaustralis*, recently described from Livingston Island (Zidarova et al. 2010). The specimens also bear some resemblance to arctic *H. hyperborea* (Grunow) Lange-Bertalot and can only be separated with 100% certainty using SEM. So far all investigated populations in the Antarctic Region represented *H. hyperaustralis* (Zidarova et al. 2010).
**Distribution** – Beak Island, Livingston Island.

***Hippodonta hungarica*** (Grunow) Lange-Bert., Metzeltin & Witkowski
Fig. 3BA–BC
**Original description** – *Navicula hungarica* Grunow (1860: 539).
**Dimensions** – L: 12.5–29.5µm; W: 4.0–6.5 µm; S: 9–11 in 10 µm (n = 11).
**Remarks** – Our specimens correspond with the descriptions of this species in Lange-Bertalot (2001) and Van de Vijver et al. (2002).
**Distribution** – Livingston Island.

***Humidophila arcuata*** (Heiden) R.Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová
Fig. 2BI–BK
**Original description** – *Navicula arcuata* Heiden (Heiden & Kolbe 1928: 628).
**Dimensions** – L: 8.0–27.0 µm; W: 3.0–5.0 µm; S: 25–31 in 10 µm (n = 10).
**Remarks** – Our specimens are somewhat narrower than those mentioned in Van de Vijver et al. (2002) (4–5.5 µm vs. 3.0–5.0 µm) but the overall shape and stria structure match. Kopalová et al. (2012) mention valve dimensions for the *H. arcuata* populations of James Ross Island that overlap with our specimens.
**Distribution** – Beak Island, Livingston Island.

***Humidophila australis*** (Van de Vijver & Sabbe) R.Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová
Fig. 2BF–BH
**Original description** – *Diadesmis australis* Van de Vijver & Sabbe (Van de Vijver et al. 2010c: 438).
**Dimensions** – L: 6.0–16.5 µm; W: 2.0–4.5 µm; S: not discernible in LM (n = 25).
**Remarks** – *Humidophila australis* was recently described from the Maritime Antarctic Region as *Diadesmis australis* Van de Vijver, Sabbe (Van de Vijver et al. 2010c). Almost all *Diadesmis* taxa (apart from the generitype *D. confervacea* Kütz.) were transferred by Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová (Lowe et al. 2014) to the new genus *Humidophila*.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Humidophila inconspicua*** (Kopalová & Van de Vijver) R.Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová
Fig. 2BO–BR
**Original description** – *Diadesmis inconspicua* Kopalová & Van de Vijver (Kopalová et al. 2009: 115).

◄ **Figure 4** – Light micrographs: A–H, *Gomphonema* spp.; I–N, *Halamphora ausloosiana* Van de Vijver & Kopalová/*H. oligotraphenta* Lange-Bert.; O–P, *Caloneis* sp. 1; Q–R, *Pinnularia gemella* Van de Vijver; S–T, *Pinnularia borealis* s.l. Ehrenb.; U–V, *Pinnularia australomicrostauron* Zidarova, Kopalová & Van de Vijver; W, *Pinnularia australoglobiceps* Zidarova, Kopalová & Van de Vijver; X, *Pinnularia* sp. (not in text); Y, *Pinnularia sergiplaiana* Zidarova, Kopalová & Van de Vijver; Z–AB, *Pinnularia microstauroides* Zidarova, Kopalová & Van de Vijver; AC, *Pinnularia splendida* Hust.; AD, *Pinnularia australodivergens* Zidarova, Kopalová & Van de Vijver; AE–AF, *Pinnularia subantarctica* var. *elongata* (Manguin) Van de Vijver & Le Cohu; AG, *Pinnularia austroshetlandica* (Carlson) Zidarova, Kopalová & Van de Vijver; AH, *Pinnularia* sp. (not in text); AI, *Pinnularia australoschoenfelderi* Zidarova, Kopalová & Van de Vijver; AJ, *Pinnularia magnifica* Zidarova, Kopalová & Van de Vijver. Scale bar represents 10 µm.

**Dimensions** – L: 6.0–8.0 µm; W: 2.0–3.5 µm; S: not discernible in LM (n = 19).
**Remarks** – This species was recently described from seepage areas on James Ross Island as *Diadesmis inconspicua* Kopalová & Van de Vijver (Kopalová et al. 2009) and later transferred to the genus *Humidophila* (Lowe et al. 2014).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Humidophila nienta*** (Carter) R.Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová
Fig. 2BL–BN
**Original description** – *Navicula nienta* Carter (1966: 464).
**Dimensions** – L: 8.5–15.0 µm; W: 2.0–2.5 µm; S: not discernible in LM (n = 10).
**Remarks** – There has been confusion in the past regarding this taxon as it was described in 1966 by Carter from Tristan da Cunha as *Navicula nienta* Carter and by Le Cohu & Van de Vijver in 2002 as *Diadesmis langebertalotii* Le Cohu & Van de Vijver from the sub-Antarctic islands in the southern Indian Ocean. Almost all records from the Antarctic Region concern the latter taxon but recent taxonomic research (Lowe et al. 2014) confirmed the conspecificity of both taxa giving *N. nienta* (transferred to *Humidophila*) priority. Our specimens closely match the description and illustrations for *Humidophila nienta*.
**Distribution** – Livingston Island, Signy Island.

***Humidophila tabellariaeformis*** (Krasske) R.Lowe, Kociolek, J.R.Johans., Van de Vijver, Lange-Bert. & Kopalová
Fig. 2BS–BT
**Original description** – *Navicula tabellariaeformis* Krasske (1939: 384).
**Dimensions** – L: 10.5–13.5 µm; W: 4.5–5.0 µm; S: 24–28 in 10 µm (n = 7).
**Remarks** – Our specimens agree well with the description of the type of this species in Lange-Bertalot et al. (1996), although they are slightly smaller and narrower (L: 14–17 µm and W: 5.5–6 µm in Lange-Bertalot et al. 1996).
**Distribution** – Livingston Island.

***Luticola* cf. *australomutica*** Van de Vijver
Fig. 3BM
**Original description** – Van de Vijver & Mataloni (2008: 458).
**Dimensions** – L: 24.0 µm; W: 7.0 µm; S: 21 in 10 µm (n = 1).
**Remarks** – This single specimen closely resembles *Luticola australomutica* (Van de Vijver & Mataloni 2008) but appears to have smaller areolae and a less transapically elongated central area. Since only one specimen has been observed, it is almost impossible to make a clear identification.
**Distribution** – Signy Island.

***Luticola* cf. *cohnii*** (Hilse) D.G.Mann
Fig. 3BN
**Original description** – *Stauroneis cohnii* Hilse in Rabenhorst (1860: 83).
**Dimensions** – L: 10.0–21.0 µm; W: 6.0–7.0 µm; S: 14–21 in 10 µm (n = 8).
**Remarks** – Our specimens closely match the description of the type of *L. cohnii* given in Van de Vijver et al. (2011a) and Levkov et al. (2013). Detailed studies of larger populations will be necessary to assess the morphological variability of the Antarctic specimens.
**Distribution** – Livingston Island, Signy Island.

***Luticola higleri*** Van de Vijver, Van Dam & Beyens
Fig. 3BJ–BK
**Original description** – Van de Vijver et al. (2006: 78).
**Dimensions** – L: 15.5–29.0 µm; W: 7.0–11.0 µm; S: 12–16 in 10 µm (n = 10).
**Remarks** – Our specimens match the description of *Luticola higleri* (Van de Vijver et al. 2006) described from nearby King George Island (South Shetland Islands). This taxon is widespread in the Maritime Antarctic Region but absent from the Antarctic Continent and the sub-Antarctic Region (Van de Vijver et al. 2006).
**Distribution** – Beak Island, Livingston Island.

***Luticola katkae*** Van de Vijver & Zidarova
Fig. 3BL
**Original description** – Van de Vijver et al. (2011a: 143).
**Dimensions** – L: 26–29 µm; W: 10.0–11.0 µm; S: 16–17 in 10 µm (n = 2).
**Remarks** – The species was recently described from Livingston Island, separating the typical capitate specimens from those of the more broadly rounded *L. muticopsis*. One of the distinct features of *L. katkae* is the presence of a clear, irregularly shaped raised axial sternum, visible in LM as an irregular thickening in the axial area.
**Distribution** – Livingston Island.

***Luticola muticopsis*** (Van Heurck) D.G.Mann
Fig. 3BF–BG
**Original description** – *Navicula muticopsis* Van Heurck (1909: 12).
**Dimensions** – L: 15.5–29.5 µm; W: 7.5–11.0 µm; S: 12–19 in 10 µm (n = 17).
**Remarks** – The species complex around the Antarctic endemic species *L. muticopsis* has been revised by Van de Vijver & Mataloni (2008) who studied the type material of this taxon. Our specimens closely resemble the description of the type of *Luticola muticopsis* (Van de Vijver & Mataloni 2008) and *L. muticopsis* sensu Sabbe et al. (2003). The more capitate specimens, originally included within *L. muticopsis*, belong to *L. katkae* Van de Vijver & Zidarova. Our specimens differ from the recently described *Luticola truncata* (Kopalová et al. 2009) by the presence of a typically convex and one straight margin on a single valve, and the slightly more deflected central and terminal raphe endings.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Luticola muticopsis* f. *reducta*** W.West & G.S.West and **f. *evoluta*** W.West & G.S.West
Fig. 3BH–BI
**Original description** – West & West (1911: 284).
**Dimensions** – L: 11.0–16.0 µm; W: 6.5–6.5 µm; S: 18–21 in 10 µm (n = 3).
**Remarks** – These small *Luticola* specimens match the smaller *L. muticopsis* forms depicted in Van de Vijver & Mataloni

(2008: Figs 78–89). They lack the typical rostrate-capitate apices and are more elliptic to elliptic-lanceolate with subrostrate ends. In the past, these forms were identified as *L. muticopsis* f. *reducta* and f. *evoluta* (West & West 1911, Ko-Bayashi 1965). Until more populations from other Antarctic locations are investigated, it remains doubtful whether these forms only represent smaller forms of *L. muticopsis sensu stricto* or whether they should be described as one or more independent taxa (Van de Vijver & Mataloni 2008).
**Distribution** – Livingston Island, Signy Island.

***Luticola vermeulenii*** Van de Vijver
Fig. 3BD–BE
**Original description** – Van de Vijver et al. (2011a: 145).
**Dimensions** – L: 25–29 µm; W: 9–10 µm; S: 16 in 10 µm (n = 2).
**Remarks** – For a long time, this species was identified as *L. cohnii* (Hilse) D.G.Mann. Recently however, the type of the latter was investigated and the Antarctic populations were split off as *L. vermeulenii*, based on a population from nearby King George Island (Van de Vijver et al. 2011a). Later on, the species appeared to be widespread in the entire Maritime Antarctic Region, although confusion might arise with the recently described *L. vandevijveri* Kopalová, Zidarova & Levkov (Levkov et al. 2013). Our specimens are similar to the type population of *L. vermeulenii* (Van de Vijver et al. 2011a).
**Distribution** – Beak Island.

***Mayamaea* cf. *permitis*** (Hust.) Bruder & Medlin
Fig. 3AT–AU
**Original description** – *Navicula permitis* Hust. (Hustedt 1945: 919).
**Dimensions** – L: 6.0–7.0 µm; W: 2.5–3.0 µm; S: ± 34 in 10 µm (n = 4).
**Remarks** – Our specimens are similar to this species given by Lange-Bertalot (2001: 136, 444) except for a small difference in width (3–4 µm in Lange-Bertalot 2001). As SEM is needed to differentiate this species from *M. lacunolaciniata* (Lange-Bert. & Bonik) Lange-Bert. (see Lange-Bertalot 2001), we refrain from making a positive identification. A recent analysis of all *Mayamaea* populations from the Maritime Antarctic Region revealed the presence of several distinct species that are currently under revision and that will most likely be described as new species (B. Van de Vijver, Botanic Garden Meise, Belgium, unpubl. res.).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Microcostatus naumannii*** (Hust.) Lange-Bert. & Genkal
Fig. 2BU–BW
**Original description** – *Navicula naumanii* Hust. (Hustedt 1942: 115).
**Dimensions** – L: 9.5–14.0 µm; W: 4.0–4.5 µm; S: 22–26 in 10 µm (n = 8).
**Remarks** – Recently all Antarctic *M. naumannii* populations, including one from Livingston Island, have been screened and compared with the type material (Van de Vijver et al. 2010a). The results did not show any significant differences, although the Antarctic populations seemed to show a larger morphometric range, as is also shown by the specimens observed in this study. Our specimens differ slightly from the holotype of *M. naumannii* illustrated in Simonsen (1987) and Van de Vijver et al. (2010a) in the shape of the axial and central areas, which are respectively less elongate and wider than the holotype, but the differences are so minor that they do not justify the separation of the Antarctic populations as a new species.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Muelleria aequistriata*** Van de Vijver & S.A.Spaulding
Fig. 3M
**Original description** – Van de Vijver et al. (2010b: 24).
**Dimensions** – L: 28.0 µm; W: 8.0 µm; S: 20 in 10 µm (n = 1).
**Remarks** – Our specimens fall within the morphological range of the recently described *Muelleria aequistriata* (Van de Vijver et al. 2010b).
**Distribution** – Livingston Island.

***Muelleria australoatlantica*** Van de Vijver & S.A.Spaulding
Fig. 3N
**Original description** – Van de Vijver et al. (2010b: 26).
**Dimensions** – L: 40.0–41.0 µm; W: 8.5–9.5 µm; S: 18–19 in 10 µm (n = 2).
**Remarks** – Our specimens match the recently described *Muelleria australoatlantica* (Van de Vijver et al. 2010b).
**Distribution** – Livingston Island.

***Muelleria kristinae*** Van de Vijver
Fig. 3BX–BY
**Original description** – Van de Vijver et al. (2010b: 27).
**Dimensions** – L: 14.0–21.0 µm; W: 4.0–5.0 µm; S: 13–15 in 10 µm (n = 24).
**Remarks** – This species was recently described based on material collected from nearby Deception Island (Van de Vijver et al. 2010b) and our specimens entirely match the description and figures given therein.
**Distribution** – Livingston Island.

***Navicula austroshetlandica*** Van de Vijver
Fig. 3I–J
**Original description** – Van de Vijver et al. (2011b: 287).
**Dimensions** – L: 14.0–21.0 µm; W: 4.0–5.0 µm; S: 13–15 in 10 µm (n = 24).
**Remarks** – This species was recently described based on material collected from nearby King George Island (Van de Vijver et al. 2011b). The species was frequently reported under different names (e.g. *Navicula* sp. 1 by Jones et al. 1993) and proved to be quite widespread in the Maritime Antarctic Region (Kopalová et al. 2012, 2013, Kopalová & Van de Vijver 2013).
**Distribution** – Livingston Island.

***Navicula bicephaloides*** Van de Vijver & Zidarova
Fig. 3A–B
**Original description** – Van de Vijver et al. (2011b: 292).
**Dimensions** – L: 20.5–24.0 µm; W: 3.5–4.5 µm; S: 14–17 in 10 µm (n = 8).
**Remarks** – This species was initially reported from the Antarctic as *N. bicephala* Hust. Van de Vijver et al. (2011b) separated the populations from the Maritime Antarctic Region as *N. bicephaloides*. Our specimens clearly match the de-

scription in Van de Vijver et al. (2011b) and not *N. bicephala* as discussed in Van de Vijver et al. (2002).
**Distribution** – Livingston Island, Signy Island.

***Navicula* sp. 1 (*N.* cf. *seibigeana*)**
Fig. 3G–H
**Dimensions** – L: 25.0–31.5 µm; W: 6.5–7.0 µm; S: 10–11 in 10 µm (n = 4).
**Remarks** – This species was previously erroneously identified as either *N. cincta* (see Kellogg & Kellogg (2002) for references) or *N. seibigeana* (Van de Vijver et al. 2011b). Both taxa however present sufficient morphological differences to justify its recognition as a separate taxon (B. Van de Vijver, Botanic Garden Meise, Belgium, unpubl. res.).
**Distribution** – Beak Island.

***Navicula gregaria*** Donkin
Fig. 3E–F
**Original description** – Donkin (1861: 10).
**Dimensions** – L: 23.5–28.0 µm; W: 6.0–7.0 µm; S: 17–20 in 10 µm (n = 10).
**Remarks** – Our specimens fully match the descriptions given in Lange-Bertalot (2001) for *N. gregaria*. We note, however, that there was much less variability in the size of our specimens and in the outline of the protracted ends, being subcapitate only, and not rostrate. On an intraspecific level our specimens correspond best with the description and illustrations provided for '*Navicula gregaria* B' in Cox (1987), a widespread form with nearly similar dimensions (i.e. L: 18–26 µm; W: 5–6 µm; S: 18–22 per 10 µm; Cox 1987), which could be conspecific with *Navicula gregalis* Cholnoky 1963 (Cox 1987). Our observations match the data provided by Van de Vijver et al. (2011b).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Navicula cremeri*** Van de Vijver & Zidarova
Fig. 3C–D
**Original description** – Van de Vijver et al. (2011b: 289).
**Dimensions** – L: 26.0–31.0 µm; W: 4.5–6.5 µm; S: 13–16 in 10 µm (n = 16).
**Remarks** – This taxon was recently described by Van de Vijver et al. (2011b) from James Ross Island and bears a resemblance to the South African species *N. libonensis* Schoeman as described by Lange-Bertalot (2001).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Nitzschia* cf. *gracilis*** Hantzsch
Fig. 5AD–AF
**Original description** – Hantzsch (1860: 40).
**Dimensions** – L: 26.0–43.0 µm; W: 2.5–3.5 µm; S: indistinct in LM; F: 14–19 in 10 µm (n = 15).
**Remarks** – Our specimens resemble *Nitzschia gracilis* Hantzsch (cf. Krammer & Lange-Bertalot 1988, Van de Vijver et al. 2002). The valves in our study are slightly smaller and have narrower and longer apices than those illustrated in Van de Vijver et al. (2002). It is however unclear whether all populations in the Maritime Antarctic Region belong to *N. gracilis* or in fact represent one or more separate species. A revision on all *Nitzschia* species in the South Shetland Islands and James Ross Island is ongoing (K. Kopalová, Charles University in Prague, Czech Republic, unpubl. res.).
**Distribution** – Beak Island, Livingston Island, Signy Island.

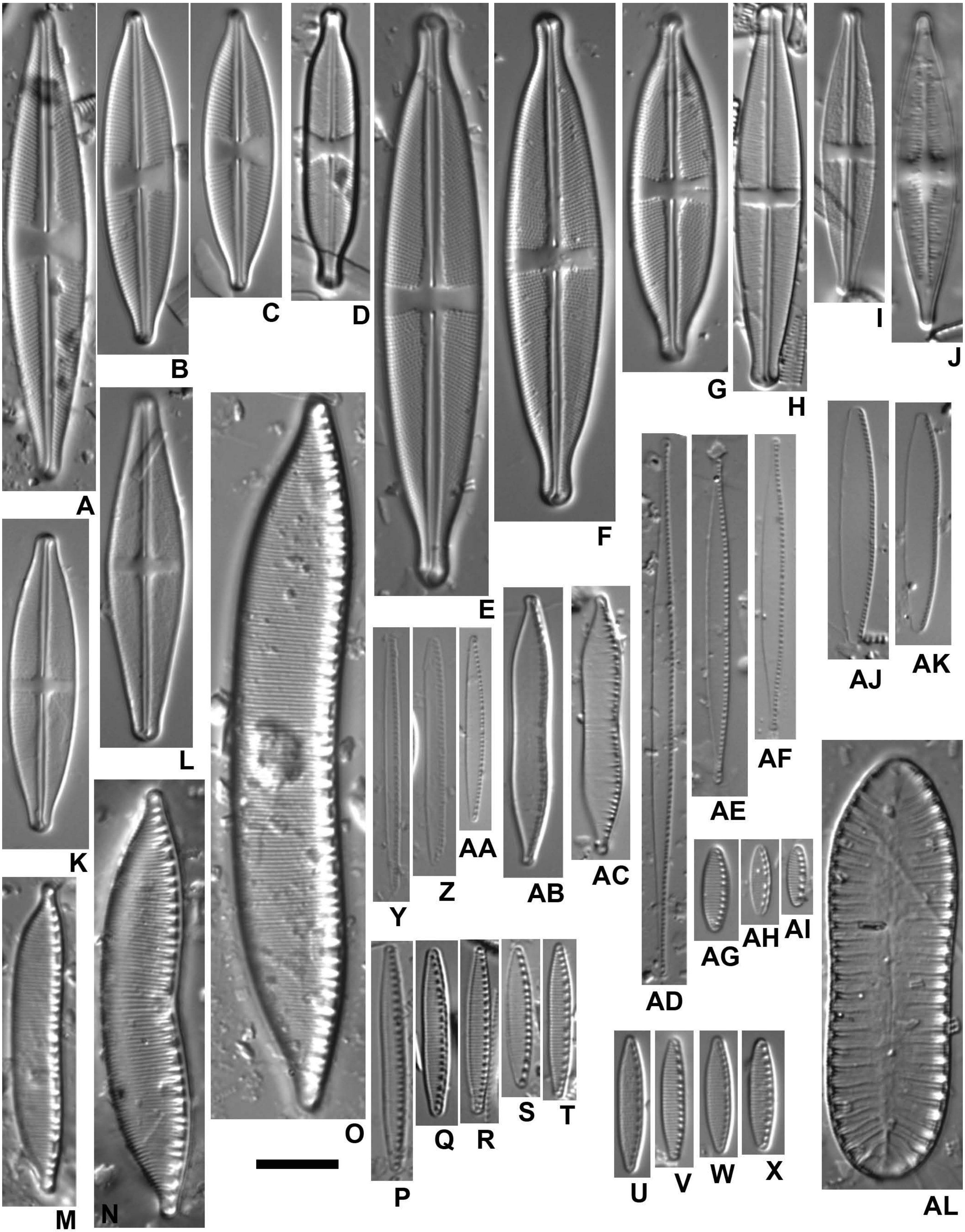
***Nitzschia homburgiensis*** Lange-Bert.
Fig. 5AB–AC
**Original description** – Lange-Bertalot (1978: 650–651).
**Dimensions** – L: 29.5–37.5 µm; W: 4.0–5.0 µm; S: 32–36 in 10 µm; F: 10–16 in 10 µm (n = 12).
**Remarks** – Our specimens correspond with *Nitzschia homburgiensis* Lange-Bertalot as illustrated in Krammer & Lange-Bertalot (1988).
**Distribution** – Beak Island, Livingston Island.

***Nitzschia paleacea*** Grunow
Fig. 5Y–AA
**Original description** – *Nitzschia paleacea* Grunow (Van Heurck 1880–1885: pl. 68, Figs 9–10).
**Dimensions** – L: 18.0–41.5 µm; W: 1.5–3.5 µm; S: ± 27 in 10 µm, usually indistinct in LM; F: 14–18 in 10 µm.
**Remarks** – Our specimens correspond to those illustrated in Krammer & Lange-Bertalot (1988).
**Distribution** – Beak Island, Livingston Island.

***Nitzschia* cf. *perminuta*** (Grunow) Peragallo
Fig. 5P–X
**Original description** – *Nitzschia frustulum* var. *perminuta* Grunow (Van Heurck 1880–1885: pl. 68, Fig. 31).
**Dimensions** – L: 11.5–28.0 µm; W: 2.0–3.5 µm; S: 21–32 in 10 µm; F: 5–10 in 10 µm (n = 84).
**Remarks** – *Nitzschia* cf. *perminuta* represents a complex of at least three separate taxa that await formal description (K. Kopalová, Charles University in Prague, Czech Republic, unpubl. res.). In the past, they have been reported from the Antarctic under various names such as *N. acidoclinata* Lange-Bert., *N. frustulum* or *N. perminuta* (including varieties) (Kellogg & Kellogg 2002). All populations in the Maritime Antarctic Region should be revised in order to know the exact taxonomic identity of these taxa and their distribution in the region.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Nitzschia* sp. 1**
Fig. 5AJ–AK
**Dimensions** – L: 26.5–30.5 µm; W: 4.0–4.5 µm; S: not discernible in LM; F: 18–23 in 10 µm (n = 15).
**Remarks** – Our specimens are slightly wider and have less produced apices than those illustrated in Van de Vijver et al. (2002). *Nitzschia communis* Rabenhorst in Van de Vijver et al. (2002) has a similar morphology, but lower stria and fibula densities and longer valves. This species is currently under

► **Figure 5** – Light micrographs: A–C, *Stauroneis latistauros* Van de Vijver & Lange-Bert.; D, *Stauroneis husvikensis* Van de Vijver & Lange Bert.; E–G, *Stauroneis acidojarensis* Zidarova, Kopalová & Van de Vijver; H–J, *Stauroneis delicata* Zidarova, Kopalová & Van de Vijver; K, *Stauroneis* sp. 1; L, *Stauroneis* sp. 2; M, *Hantzschia amphioxys* f. *muelleri* Ko-bayashi; N, *Hantzschia abundans* Lange-Bert.; O, *Hantzschia hyperaustralis* Van de Vijver & Zidarova; P–X, *Nitzschia* cf. *perminuta* (Grunow) Peragallo; Y–AA, *Nitzschia paleacea* Grunow; AB–AC, *Nitzschia homburgiensis* Lange-Bert.; AD–AF, *Nitzschia* cf. *gracilis* Hantzsch; AG–AI, *Nitzschia soratensis* E.Morales & Vis; AJ–AK, *Nitzschia* sp1; AL, *Surirella australovisurgis* Van de Vijver et al. Scale bar represents 10 µm.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revision and will be published as a new species (K. Kopalová, Charles University in Prague, Czech Republic, unpubl. res.).
**Distribution** – Livingston Island.

***Nitzschia soratensis*** E.Morales & Vis
Fig. 5AG–AI
**Original description** – Morales & Vis (2007: 128).
**Dimensions** – L: 7.5–19.5 µm; W: 2.5–3.5 µm; S: 25–32 in 10 µm; F: 9.0–14.7 in 10 µm (n = 20).
**Remarks** – This species was recently described by Morales & Vis (2007) from Bolivia. For a long time, it was identified and reported in the Antarctic Region as *N. inconspicua* Grunow but detailed SEM research indicated that all populations in the Maritime Antarctic Region belonged to *N. soratensis*. Trobajo et al. (2013) discussed its morphology and it is clear that our specimens showed more resemblance to *N. soratensis* than to *N. inconspicua.*
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Orthoseira roeseana*** (Rabenh.) O'Meara
Fig. 2A–B
**Original description** – *Melosira roeseana* Rabenh. (Rabenhorst 1853: 13).
**Dimensions** – D: 15.5–30.5 µm (n = 4).
**Remarks** – *Orthoseira roeseana* specimens from the sub-Antarctic Iles Crozet have a valve diameter of 10–45 µm and a mantle depth of 5–10 µm (Van de Vijver et al. 2002). Linking spines were not observed in our specimens, but might have been broken due to preparation.
**Distribution** – Beak Island, Livingston Island.

***Pinnularia australodivergens*** Zidarova, Kopalová & Van de Vijver
Fig. 4AD
**Original description** – Zidarova et al. (2012: 25).
**Dimensions** – L: 94.5–111.5 µm; W: 17.5–20.5 µm; S: 10 in 10 µm (n = 3).
**Remarks** – Our specimens closely resemble this taxon, recently described from Livingston Island by Zidarova et al. (2012), although some seem to be slightly wider (width of 14–19 µm given in Zidarova et al. 2012).
**Distribution** – Livingston Island, Signy Island.

***Pinnularia australoglobiceps*** Zidarova, Kopalová & Van de Vijver
Fig. 4W
**Original description** – Zidarova et al. (2012: 29).
**Dimensions** – L: 23.5–25.0 µm; W: 8.5–9.0 µm; S: 13–14 in 10 µm (n = 2).
**Remarks** – This species was recently described from Livingston Island (Zidarova et al. 2012) and our specimens match the description, although they belong to the smallest valves in the cell cycle as the given length for the species is 25–38 µm (Zidarova et al. 2012).
**Distribution** – Livingston Island.

***Pinnularia australomicrostauron*** Zidarova, Kopalová & Van de Vijver
Fig. 4U–V
**Original description** – Zidarova et al. (2012: 22).
**Dimensions** – L: 37.0–55.5 µm; W: 8.0–12.5 µm; S: 11 in 10 µm (n = 11).
**Remarks** – This species was described by Zidarova et al. (2012) from Livingston Island and groups all populations formerly identified as *P. microstauron* (Ehrenb.) Cleve. All specimens however had a sturdier valve outline, a higher stria density and a larger separation between the proximal raphe endings, justifying its separation from *P. microstauron*. Our specimens correspond entirely with the morphology and dimensions of the type of *P. australomicrostauron* (Zidarova et al. 2012).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Pinnularia australoschoenfelderi*** Zidarova, Kopalová & Van de Vijver
Fig. 4AI
**Original description** – Zidarova et al. (2012: 18).
**Dimensions** – L: 25.5 µm; W: 6.0 µm; S: 11–13 in 10 µm (n = 1).
**Remarks** – This species was described by Zidarova et al. (2012) from Livingston Island and was most likely previously reported as *P. obscura* Krasske. All populations of *P. obscura* however need to be revised in order to know its distribution in the Maritime Antarctic Region.
**Distribution** – Livingston Island.

***Pinnularia austroshetlandica* (**Carlson) Zidarova, Kopalová & Van de Vijver
Fig. 4AG
**Original description** – *Navicula austroshetlandica* Carlson (1913: 16).
**Dimensions** – L: 38.5 µm; W: 11.0 µm; S: 14 in 10 µm (n = 1).
**Remarks** – This species has been known for a long time as *P. kolbei* Manguin described from the sub-Antarctic Iles Kerguelen (Bourrelly & Manguin 1954). The name was later changed into *P. parakolbei* Fukushima, Ko-Bayashi & Yoshitake (Fukushima et al. 2001). Recently, Zidarova et al. (2012) revised the taxonomic history of this taxon and recognized the original epitheton given for this taxon by Carlson in 1913. Our single specimen fits in the series depicted in Zidarova et al. (2012).
**Distribution** – Livingston Island.

***Pinnularia borealis*** Ehrenb. **s.l.**
Fig. 4S–T
**Original description** – Ehrenberg (1843: 420).
**Dimensions** – L: 27.0–41.0 µm; W: 7.5–10.5 µm; S: 5–6 in 10 µm (n = 4).
**Remarks** – *Pinnularia borealis* s.l. represents a complex of species, often described as varieties or formas (Krammer 2000). Souffreau et al. (2013) analysed several strains of *P. borealis* s.l. and concluded that considerable cryptic diversity was present in this complex. Currently, the Antarctic populations are under review. Van de Vijver & Zidarova (2011) discussed all *Pinnularia* species belonging to the section Distantes. Our specimens could not be identified as one of the new species described in the latter publication but seem to belong to another species in the *P. borealis* s.l. complex.
**Distribution** – Beak Island, Livingston Island.

***Pinnularia gemella*** Van de Vijver
Fig. 4Q–R
**Original description** – Van de Vijver et al. (2009: 432).
**Dimensions** – L: 40.0–58.0 µm; W: 7.0–8.5 µm; S: 10–11 in 10 µm (n = 5).
**Remarks** – Our specimens are similar to *P. gemella* Van de Vijver, recently described from Livingston Island (Van de Vijver et al. 2009). This species can easily been recognized since its frustules are often sideways connected to each other by spines.
**Distribution** – Livingston Island.

***Pinnularia magnifica*** Zidarova, Kopalová & Van de Vijver
Fig. 4AJ
**Original description** – Zidarova et al. (2012: 18).
**Dimensions** – L: 25.1 µm; W: 5.8 µm; S: 9 in 10 µm (n = 1).
**Remarks** – This species was described by Zidarova et al. (2012) from Livingston Island and like *P. australoschoenfelderi* Zidarova et al. has most likely previously been reported as *P. obscura* Krasske. All populations of *P. obscura* however need to be revised to know the distribution of this species in the Maritime Antarctic Region
**Distribution** – Livingston Island.

***Pinnularia microstauroides*** Zidarova, Kopalová & Van de Vijver
Fig. 4Z–AB
**Original description** – Zidarova et al. (2012: 20).
**Dimensions** – L: 33.0–54.0 µm; W: 6.5–10.0 µm; S: 12–15 in 10 µm (n = 14).
**Remarks** – This species was separated in 2012 by Zidarova et al. from the presumably cosmopolitan *P. microstauron* based on a narrower valve width (10–12.4 µm in *P. microstauron*), lower stria density (9–10 in 10 µm in *P. microstauron*) and less undulating valve margins in the latter (as often seen in *P. microstauroides*). Our specimens match the description and pictures in Zidarova et al. (2012) of *P. microstauroides*, described from Livingston Island.
**Distribution** – Livingston Island, Signy Island.

***Pinnularia sergiplaiana*** Zidarova, Kopalová & Van de Vijver
Fig. 4Y
**Original description** – Zidarova et al. (2012: 26).
**Dimensions** – L: 75.0 µm; W: 12.5 µm; S: 11 in 10 µm (n = 1).
**Remarks** – This species was described in 2012 by Zidarova et al. from Livingston Island.
**Distribution** – Livingston Island.

***Pinnularia splendida*** Hust.
Fig. 4AC
**Original description** – *Pinnularia splendida* Hust. (Schmidt 1934: pl. 391, Figs 5–6).
**Dimensions** – L: 65.0–90.5 µm; W: 20.0–23.0 µm; S: 4–5 in 10 µm (n = 2).
**Remarks** – Our specimens match the morphology and illustrations given for this species in Krammer (2000). The species was also observed on neighbouring James Ross Island (Kopalová et al. 2014) but never on more northerly located islands in the Maritime Antarctic Region (B. Van de Vijver, Botanic Garden Meise, Belgium, pers. obs.).
**Distribution** – Beak Island.

***Pinnularia subantarctica*** (Manguin) Van de Vijver & Le Cohu **var. *elongata*** (Manguin) Van de Vijver & Le Cohu
Fig. 4AE–AF
**Original description** – *Pinnularia microstauron* var. *elongata* Manguin in Bourrelly & Manguin (1954: 36).
**Dimensions** – L: 28.5–40.0 µm; W: 6.0–7.0 µm; S: 14–16 in 10 µm (n = 8).
**Remarks** – Our specimens match the description and pictures in Van de Vijver et al. (2002).
**Distribution** – Livingston Island, Signy Island.

***Placoneis australis*** Van de Vijver & Zidarova
Fig. 3K–L
**Original description** – Zidarova et al. (2009: 301).
**Dimensions** – L: 22.5–25.0 µm; W: 6.5–8.0 µm; S: 14–15 in 10 µm (n = 5).
**Remarks** – Our specimens are similar to *P. australis*, recently described from James Ross Island (Zidarova et al. 2009). Several populations from the southern Atlantic Ocean islands have been investigated and all belonged to *P. australis*, including a population from Livingston Island.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Planothidium australe*** (Manguin) Le Cohu
Fig. 2AJ–AK
**Original description** – *Achnanthes delicatula* var. *australis* Manguin (Bourrelly & Manguin 1954: 20).
**Dimensions** – L: 15.0–26.0 µm; W: 5.5–8.5 µm; S: 13–18 in 10 µm (n = 13).
**Remarks** – This taxon was split off by Manguin based on observations made on populations from the sub-Antarctic Iles Kerguelen (Bourrelly & Manguin 1954). Later on, it was raised to species level by Le Cohu (2005). Our specimens match the description given in Bourrelly & Manguin (1954). The taxon is widespread in coastal areas of the Maritime Antarctic Region (Kopalová & Van de Vijver 2013, Kopalová et al. 2013).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Planothidium capitatum*** (O.Müll.) Van de Vijver et al.
Fig. 2AL-AM
**Original description** – *Achnanthes lanceolata* (Bréb.) Lange-Bert. var. *capitata* O.Müll. (Müller 1909: 8).
**Dimensions** – L: 17.5–24.0 µm; W: 4.0–5.5 µm; S: 14–17 in 10 µm (n = 12).
**Remarks** – The taxon closely resembles *Planothidium haynaldii* (Schaarschm.) Lange-Bert. & Genkal illustrated in Patrick & Reimer (1966: pl. 18: 20–21) but differs in having an asymmetrical central area on the raphe valve. Recently, Wetzel et al. (2014) analysed the type material of *P. haynaldii* and concluded that the Antarctic populations were certainly not conspecific and belonged to *Achnanthes lanceolata* var. *capitata* O. Müll. and raised the variety to the specific level in the genus *Planothidium* as *P. capitatum*. *Achnanthes semifasciata* (Østrup) Foged sensu Foged (1974) has an asymmetrical central area but the original description in Østrup (1918) shows a more rhombical species. More information

regarding the taxonomic history and morphology of this taxon can be found in Wetzel et al. (2014).
**Distribution** – Beak Island, Livingston Island.

***Planothidium* cf. *frequentissimum*** (Lange-Bert.) Round & Bukht.
Fig. 2AF–AG
**Original description** – *Achnanthes lanceolata* var. *frequentissima* Lange-Bert. (Lange-Bertalot 1993: 4).
**Dimensions** – L: 12.5–18.0 µm; W: 4.5–6.0 µm; S: 13–17 in 10 µm (n = 14).
**Remarks** – Our specimens generally match the description of this taxon in Krammer & Lange-Bertalot (1991, *Achnanthes lanceolata* var. *frequentissima* Lange-Bertalot) and are characterized by a typical "double arched" cavum in the centre of the valve. However, most specimens have a more elongate valve outline and more produced, almost rostrate apices compared to those illustrated in Krammer & Lange-Bertalot (1991); only a few smaller valves were more elliptical. The morphological variability in this taxon needs to be further investigated and its place within *P. frequentissimum* needs to be confirmed once the type of the latter is thoroughly investigated.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Planothidium lanceolatum*** (Bréb.) Lange-Bert.
Fig. 2BX–BY
**Original description** – *Achnanthidium lanceolatum* Bréb. ex Kütz. (Kützing 1846: 247).
**Dimensions** – L: 14.0–29.0 µm; W: 5.5–7.0 µm; S: 13–16 in 10 µm (n = 3).
**Remarks** – Van de Vijver et al. (2013c) described a new species, *P. rostrolanceolatum* Van de Vijver et al., split off from *P. lanceolatum* s.s., grouping almost all *P. lanceolatum* s.l. populations from the Maritime Antarctic Region. The illustrations in Oppenheim (1994, as *Achnanthes lanceolata* (Bréb.) Grunow) agree with our specimens, both in valve morphology and dimensions. In our material, there is apparently a clear biogeographic distinction between both mentioned species with *P. lanceolatum* s.s. only present on Signy Island and *P. rostrolanceolatum* only found on Livingston Island.
**Distribution** – Signy Island.

***Planothidium quadripunctatum*** (Oppenheim) Sabbe
Fig. 2AB–AC
**Original description** – *Achnanthes quadripunctata* Oppenheim (1994: 1742).
**Dimensions** – L: 7.5–9.0 µm; W: 2.5–4.5 µm; S: 15–21 in 10 µm (n = 15).
**Remarks** – Our specimens correspond well to those described in Oppenheim (1994), Van de Vijver et al. (2002) and Sabbe et al. (2003). It is often difficult to distinguish this species from *Planothidium renei* (see below), which has a higher stria density (> 20 in 10 µm) and a different ultrastructure (terminal raphe endings deflected in the same direction in *P. quadripunctatum* and in opposite directions in *P. renei*, and the striae are composed of 3–4 instead of 2 transapical rows of areolae in the latter). Preliminary SEM investigations have shown that some populations which were assigned to *P. quadripunctatum* on the basis of valve dimensions displayed ultrastructural features typical of *P. renei*. There also appears to be an overlap in stria densities in some populations. Further SEM and morphometric analyses are needed to resolve the relationship between these two species.
**Distribution** – Beak Island, Signy Island.

***Planothidium renei*** (Lange-Bert. & Rol.Schmidt) Van de Vijver
Fig. 2AD–AE
**Original description** – *Achnanthes renei* Lange-Bert. & Rol. Schmidt (Schmidt et al. 1990: 64–65).
**Dimensions** –L: 7.0–10.0 µm; W: 3.5–4.5 µm; S: 17–27 in 10 µm (n = 91).
**Remarks** – Our specimens closely resemble *P. renei* as described in Schmidt et al. (1990), but stria densities were significantly more variable in our specimens (cf. 20–22 per 10 µm in Schmidt et al. 1990). Oppenheim (1994) and Van de Vijver et al. (2002) mention a slightly higher stria density (24–28 and 20–24 in 10 µm resp.). All populations of *P. renei* in the Maritime Antarctic Region are currently under revision (B. Van de Vijver, Botanic Garden Meise, Belgium, unpubl. res.).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Planothidium rostrolanceolatum*** Van de Vijver, Kopalová & Zidarova
Fig. 2AH–AI
**Original description** – Van de Vijver et al. (2013c: 109).
**Dimensions** – L: 17.5–23.5 µm; W: 6.0–7.5 µm; S: 14–16 in 10 µm (n = 12).
**Remarks** – Van de Vijver et al. (2013a) revised several Antarctic populations of *Achnanthes lanceolata* s.l. (Bréb. ex Kütz.) Grunow and separated two newly described species from *P. lanceolatum* s.s. All investigated populations in the Maritime Antarctic Region were grouped under *P. rostrolanceolatum* and our specimens match entirely the morphological and morphometric features described in Van de Vijver et al. (2013c).
**Distribution** – Livingston Island.

***Psammothidium abundans*** (Manguin) Bukht. & Round
Fig. 2BB–BC
**Original description** – *Achnanthes abundans* Manguin in Bourrelly & Manguin (1954: 19).
**Dimensions** – L: 8.0–13.0 µm; W: 3.0–4.5 µm; S: 25–32 in 10 µm (n = 30).
**Remarks** – Our specimens generally agree well with the extensive descriptions given by Bukhtiyarova & Round (1996), Sabbe et al. (2003) and Van de Vijver et al. (2008, including the type material) but our specimens tend to be smaller and narrower. Further details on this species can be found in Bourrelly & Manguin (1954), Le Cohu & Maillard (1983) and Oppenheim (1994). This species was erroneously identified as *Achnanthes mollis* Krasske in Jones & Juggins (1995).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Psammothidium aretasii*** (Manguin) Le Cohu
Fig. 2AZ–BA
**Original description** – *Achnanthes aretasii* Manguin (Bourrelly & Manguin 1954: 19).

**Dimensions** – L: 13.5–15.0 µm; W: 5.5–6.0 µm; S: 26–31 in 10 µm (n = 3).
**Remarks** – Our specimens resemble those shown in Bourrelly & Manguin (1954) and Le Cohu (2005). This species was originally described from the sub-Antarctic Iles Kerguelen in the southern Indian Ocean.
**Distribution** – Livingston Island.

***Psammothidium germainii*** (Manguin) Sabbe
Fig. 2AN–AQ
**Original description** – *Achnanthes germainii* Manguin (Bourrelly & Manguin 1954: 20).
**Dimensions** – Morphotype 1: L: 11.0–21.0 µm; W: 6.5–9.0 µm; S: 17–19 in 10 µm (n=6), Morphotype 2: L: 13.0–18.5 µm; W: 5.5–9.0 µm; S: 21–28 in 10 µm (n = 13).
**Remarks** – *Psammothidium germainii* most likely represents a complex of species and is currently under revision (B. Van de Vijver, Botanic Garden Meise, Belgium, unpubl. res.). In our material, two morphotypes can be distinguished: Morphotype 1 (fig. 2AN–AO) has more or less rostrate apices and corresponds to the type specimens of this species shown in Bourelly & Manguin (1954). Similar forms were found in Oppenheim (1994) and Sabbe et al. (2003, except for their higher stria density of 20–21 in 10 µm). Morphotype 2 (fig. 2AP–AQ) is more elliptic-lanceolate, lacks the rostrate apices and appears to have higher stria densities. Similar forms were illustrated by Van de Vijver et al. (2002) from Crozet.
**Distribution** – Livingston Island.

***Psammothidium incognitum*** (Krasske) Van de Vijver
Fig. 2AV–AW
**Original description** – *Achnanthes incognita* Krasske (1939: 370).
**Dimensions** – L: 10.5–15.5 µm; W: 4.5–5.5 µm; S: 29–35 in 10 µm (n = 15).
**Remarks** – Our specimens agree with those illustrated in Van de Vijver et al. (2002). *Psammothidium incognitum* (as *Achnanthes incognita* Krasske 1939) was previously reported from Signy Island (Moss Lake, Khyber Lakes) by Oppenheim (1994). The species closely resembles *P. stauroneioides* (Manguin) Bukht. in shape, size and stria density, but differs in the shape of the central area on the rapheless valve, which is large and distinctly rhombic in the latter, not small and circular (cf. Van de Vijver et al. 2002 and Sabbe et al. 2003), and possibly also the absence of an external terminal pore in the axial area of the rapheless valve (Oppenheim 1994; note that this pore is also not always present in *P. stauroneioides*, cf. Van de Vijver et al. 2002).
**Distribution** – Livingston Island, Signy Island.

***Psammothidium manguinii*** (Hust.) Van de Vijver
Fig. 2AT–AU
**Original description** – *Achnanthes manguinii* Hust. (Hustedt 1952: 383).
**Dimensions** – L: 13.0–15.0 µm; W: 6.0–6.5 µm; S: 20–24 in 10 µm (n = 3).
**Remarks** – Our specimens are on average smaller and have a higher stria density than those illustrated in Oppenheim [1994; L: 15–22 µm, W: 6–9 µm, S: 15–20 per 10 µm (n = 5)] but correspond well with the description of this species given by Bourrelly & Manguin (1954) and Van de Vijver et al. (2002).
**Distribution** – Livingston Island, Signy Island.

***Psammothidium papilio*** (D.E.Kellogg, Stuiver, T.B.Kellogg & Denton) Van de Vijver & Kopalová
Fig. 2AX–AY
**Original description** – *Navicula papilio* D.E.Kellogg, Stuiver, T.B.Kellogg & Denton (Kellogg et al. 1980: 183–184).
**Dimensions** – L: 8.5–15.5 µm; W: 3.5–6.0 µm; S: 24–33 in 10 µm (n = 33).
**Remarks** – This widespread species is more commonly known under its former name *Psammothidium* (*Achnanthes*) *metakryophilum* (Rol.Schmidt & Lange-Bert.) Sabbe until its correct identity was established in Kopalová et al. (2012). Our specimens match those illustrated in Sabbe et al. (2003), Cremer et al. (2004) and Kopalová et al. (2012) but have a broader range in stria density. A detailed description of this species, comparison with similar species and notes on synonymy and biogeography are given in Kopalová et al. (2012).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Psammothidium subatomoides*** (Hust.) Bukht. & Round
Fig. 2AR–AS
**Original description** – *Navicula subatomoides* Hust. (Schmidt 1936: pl. 404).
**Dimensions** – L: 7.5–10.5 µm; W: 4.5– 5.5 µm; S: 29–41 in 10 µm (n = 15).
**Remarks** – Our specimens agree with those illustrated in Bukhtiyarova & Round (1996). Oppenheim (1994) found this species (as *Achnanthes subatomoides* (Hust.) Lange-Bert. & Archibald) in Heywood Lake (Signy Island).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Sellaphora nana*** (Hust.) Lange-Bert., Cavacini, Tagliaventi & Alfinito
Fig. 3U–X
**Original description** – *Stauroneis nana* Hust. (Hustedt 1957: 259).
**Dimensions** – L: 17.0–19.0 µm; W: 4.0–4.5 µm; S: 28–33 in 10 µm (n = 6).
**Remarks** – Recently, Van de Vijver et al. (2013b) revised the *S. nana* populations in the Maritime Antarctic Region. Apart from differences in valve outline, no other morphological differences could be found suggesting that all populations belonged to the same species. Our specimens match several of the populations depicted in Van de Vijver et al. (2013b).
**Distribution** – Livingston Island, Signy Island.

***Sellaphora* cf. *seminulum*** (Grunow) D.G.Mann
Fig. 3BR–BT
**Original description** – *Navicula seminulum* Grunow (1860: 552).
**Dimensions** – L: 6.0–13.5 µm; W: 2.5–4.0 µm; S: 17–23 in 10 µm (n = 32).
**Remarks** – Our specimens agree with the description of this taxon in Van de Vijver et al. (2002, as *Naviculadicta seminulum* (Grunow) Lange-Bert.). Their exact identity should however be confirmed by SEM images of the poroids and internal central raphe endings (Mann 1989). Moreover, a thor-

ough revision is currently made of the entire *S. seminulum* complex as it is very likely that currently under this name, a large number of separate (new?) taxa is included (C.Wetzel, Centre Gabriel Lippmann, Luxembourg, pers. comm.).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Stauroforma exiguiformis*** (Lange-Bert.) Flower, Jones & Round
Fig. 2M–N
**Original description** – *Fragilaria exiguiformis* Lange-Bert. (Lange-Bertalot 1993: 45–46).
**Dimensions** – L: 9.0–22.0 µm; W: 3.0–4.5 µm; S: 19–23 in 10 µm (n = 15).
**Remarks** – Flower et al. (1996) described the genus *Stauroforma* and included two taxa within this genus *S. exiguiformis* and *S. inermis* Flower et al. It is however almost impossible to distinguish both taxa in LM since the separation is based on the presence of an apical porefield and the absence of marginal spines in *S. inermis*. Le Cohu (1999) and Van de Vijver et al. (2002) concluded however that both taxa should be considered as synonyms as intermediate valves between both valves were observed. Further research is necessary to assess whether we are dealing with two different species or not.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Stauroneis acidojarensis*** Zidarova, Kopalová & Van de Vijver
Fig. 5E–G
**Original description** – Zidarova et al. (2014a: 197).
**Dimensions** – L: 40.5–71.5 µm; W: 10.0–13.0 µm; S: 20–25 in 10 µm (n = 20).
**Remarks** – This species was recently described from Livingston Island (Zidarova et al. 2014a) and was previously reported from Antarctica as *Stauroneis* aff. *acidoclinata* in Van de Vijver et al. (2004).
**Distribution** – Livingston Island, Signy Island.

***Stauroneis delicata*** Zidarova, Kopalová & Van de Vijver
Fig. 5H–J
**Original description** – Zidarova et al. (2014a: 202).
**Dimensions** – L: 21.5–52.0 µm; W: 5.5–8.5 µm; S: 21–26 per 10 µm (n = 8).
**Remarks** – This species was recently described from Livingston Island (Zidarova et al. 2014a, cf. also as *Stauroneis subgracilior* 'Peninsula' Van de Vijver et al. (2004: pl. 69). However, our specimens have a lower stria density (24–27 in 10 µm in Zidarova et al. 2014a). Heavily silicified resting stages have been found in some populations, consistent with the observations in Zidarova et al. (2014a).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Stauroneis husvikensis*** Van de Vijver & Lange Bert.
Fig. 5D
**Original description** – Van de Vijver et al. (2004: 41).
**Dimensions** – L: 35.0 µm; W: 6.5 µm; S: 24 in 10 µm (n = 1).
**Remarks** – The valve morphology of our single specimen matches the description of *S. husvikensis* from Husvik, South Georgia in Van de Vijver et al. (2004).
**Distribution** – Livingston Island.

***Stauroneis latistauros*** Van de Vijver & Lange-Bert.
Fig. 5A–C
**Original description** – Van de Vijver et al. (2004: 48).
**Dimensions** – L: 31.0–58.5 µm; W: 7.5–10.0 µm; S: 18–22 in 10 µm (n = 16).
**Remarks** – Our specimens match the description of *Stauroneis latistauros* in Van de Vijver et al. (2004) and Sabbe et al. (2003, as *S. anceps* Ehrenberg; note that these have a higher stria density, viz. 22.5–25.5 in 10 µm).
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Stauroneis* sp. 1**
Fig. 5K
**Dimensions** – L: 36.5 µm; W: 8.0 µm; S: 23 in 10 µm (n = 1).
**Remarks** – This specimen possibly belongs to *S. delicata* Zidarova et al., but is provisionally separated on the basis of its narrower and very rectangular stauros. More valves need to be studied to clarify its taxonomical position.
**Distribution** – Signy Island.

***Stauroneis* sp. 2**
Fig. 5L
**Dimensions** – L: 41.5–43.0 µm; W: 9.0–10.0 µm; S: about 25 in 10 µm, indistinct.
**Remarks** – The valves of this taxon show a more rhombic outline and a narrower stauros than *S. delicata* Zidarova et al. Detailed SEM research of the entire population will be necessary to clarify its taxonomical position. It is possible that *Stauroneis* sp. 1 and sp. 2 are conspecific.
**Distribution** – Signy Island.

***Staurosira* cf. *circula*** Van de Vijver & Beyens
Fig. 2O–Q
**Original description** – Van de Vijver & Beyens (2002: 325).
**Dimensions** – L: 5.5–6.5 µm; W: 5.5–7.0 µm; S: ± 18 in 10 µm (n = 11).
**Remarks** – In LM, our specimens resemble *Staurosira circula* (Van de Vijver et al. 2002) and *Nanofrustulum shiloi* (Lee, Reimer & McEnery) Round, Hallsteinsen & Paasche (cf. Sabbe et al. 2003). Small representatives of *Staurosira* and related genera are notoriously difficult to identify and require SEM to confirm their identity. *Staurosira circula* was originally described from sub-Antarctic islands in the southern Indian Ocean (Van de Vijver et al. 2002) whereas *Nanofrustulum* has never been found in the Antarctic Region (B. Van de Vijver, Botanic Garden Meise, Belgium, pers. comm.).
**Distribution** – Signy Island.

***Staurosira pottiezii*** Van de Vijver
Fig. 2I–J
**Original description** – Van de Vijver et al. (2014c: 257).
**Dimensions** – 12.5–21.0 µm; W: 2.5–4.0(–4.5) µm; S: 12–14 in 10 µm (n = 15).
**Remarks** – Van de Vijver et al. (2014c) recently reviewed the small-celled fragilarioids in the Maritime Antarctic Region. The valves identified as *S. alpestris* (Krasske) Van de Vijver & Beyens illustrated in Van de Vijver et al. (2002) from the sub-Antarctic islands in the southern Indian Ocean do not belong to *S. pottiezii* as they have larger valve dimensions (valve width > 4.5 µm). The specimen from Signy Is-

land with a valve width of 4.4 µm might belong to *S. alpestris* sensu Van de Vijver et al. (2002) but since only one valve was recorded, it is impossible to confirm this identification.
**Distribution** – Beak Island, Livingston Island, Signy Island.

***Staurosira* sp. 1**
Fig. 2K–L
**Dimensions** – L: 8.5–13.5 µm; W: 4.0–4.5 µm; S: 13–14 in 10 µm (n = 7).
**Remarks** – Our specimens differ from *Staurosira venter* (Ehrenb.) Cleve & Möller depicted in Van de Vijver et al. (2002) based on valve shape (not elliptical or lanceolate but more rhombic with produced, rounded apices) and lower stria density (cf. 20 in 10 µm in Van de Vijver et al. 2002). It is possible that these valves actually represent the smallest specimens in the life cycle of *S. pottiezii* Van de Vijver but further SEM research will be necessary to confirm this identification. This taxon should also be compared with *Staurosira aventralis* in Rumrich et al. (2000).
**Distribution** – Livingston Island, Signy Island.

***Staurosirella antarctica*** Van de Vijver & E.Morales
Fig. 2R
**Original description** – Van de Vijver et al. (2014c: 261).
**Dimensions** – L: 14.5 µm; W: 3.0 µm; S: 9 in 10 µm (n = 1).
**Remarks** – Van de Vijver et al. (2014c) recently reviewed the small-celled fragilariods in the Maritime Antarctic Region. These results showed that two *Staurosirella* species, both described as new, were present, separated in LM by their distinct valve outline and valve dimensions. The most narrow, heteropolar valves, such as the specimen depicted here, belong to *S. antarctica*.
**Distribution** – Livingston Island.

***Staurosirella frigida*** Van de Vijver & E.Morales
Fig. 2S
**Original description** – Van de Vijver et al. (2014c: 261).
**Dimensions** – L: 9.0–12.5 µm; W: 3.5–4.5 µm; S: 8–10 in 10 µm (n = 4).
**Remarks** – According to Van de Vijver et al. (2014c), our specimens belong to *S. frigida*, separated from *S. antarctica* by the less heteropolar valve outline, and larger valve width. Our specimens are however somewhat narrower than those in the protologue in Van de Vijver et al. (2014c).
**Distribution** – Beak Island, Signy Island.

***Surirella australovisurgis*** Van de Vijver, Cocquyt, Kopalová & Zidarova
Fig. 5AL
**Original description** – Van de Vijver et al. (2013a: 101).
**Dimensions** – L: 41.6–51.9 µm; W: 15.4–17.0 µm; S: 22–26 in 10 µm (n = 4).
**Remarks** – *Surirella australovisurgis* was recently described from Livingston Island and represents so far the only freshwater *Surirella* taxon in the Maritime Antarctic Region (Van de Vijver et al. 2013a).
**Distribution** – Livingston Island, Signy Island.

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