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A critical analysis of the type of *Navicula skuae* with the description of a new *Navicula* species (Naviculaceae, Bacillariophyta) from the Antarctic Region.

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Abstract

During a study of the limno-terrestrial diatoms on King George Island (South Shetland Islands), an unknown *Navicula* taxon was observed. Detailed morphological analysis based on both light and scanning electron microscopy observations revealed a unique set of morphological features, that were not observed in any *Navicula* taxon known so far. Despite an extensive literature search, it was not possible to identify this taxon and therefore it is described as a new species: *Navicula massalskiana* sp. nov. At present, the new species has only been observed from its type locality, acid soils influenced by penguin excrements, close to the seashore in the Admiralty Bay Region (King George Island). *Navicula massalskiana* shows a high similarity with two other Antarctic species: *Navicula skuae* and *Navicula shackletonii*. The taxonomic situation of these two taxa is investigated. The type material of *Navicula skuae* was reinvestigated and compared with the published morphological description of *N. shackletonii*. Based on this comparison, both taxa are clearly conspecific making *N. skuae* a later synonym of *Navicula shackletonii*.

Keywords: King George Island, Maritime Antarctic Region, morphology, SEM, soil diatom, taxonomy

Introduction

The (sub-)Antarctic diatom flora is characterized by a high proportion of endemic species, many of which described in recent years as the result of elaborate taxonomic revisions (i.e. Van de Vijver *et al.* 2010, 2011a,b, 2014a,b,c, 2015, Kopalová *et al.* 2009, 2011, 2015, Zidarova *et al.* 2010, 2012, 2014a,b, 2016a). In 2016, Zidarova *et al.* summarized all taxonomic revision in the publication of the first monograph on the non-marine diatoms from the Maritime Antarctic Region (Zidarova *et al.* 2016b). Despite these efforts, there are still gaps in our knowledge on the Antarctic non-marine diatoms. The present paper aims in providing additional data on the Antarctic diatom biodiversity with the description of a new *Navicula* taxon.

The genus *Navicula* Bory (1822: 128) was originally described by Bory de St. Vincent. Over the years, the former catch-all genus was revised and split in a large number of newly erected and re-established genera such as *Geissleria* Lange-Bertalot & Metzeltin (1996: 63), *Diadesmis* Kützing (1844: 109) and *Luticola* D.G.Mann in Round *et al.* (1990: 670). Additionally, the initial, very broad, species concept was modified several times during the second half of the 20th century (Patrick 1959, Cox 1979, Round *et al.* 1990). As a result, the current definition of *Navicula sensu stricto* is based on the neotypus generis *Navicula tripunctata* (O.F.Müller 1786: 52) Bory (1822: 128) and restricted to members of the former section Lineolatae Cleve (1895: 10) (Cox 1979).

The genus *Navicula* is broadly distributed worldwide and often forms dominant and highly diverse populations in rivers and lakes in temperate and tropical regions (Werum & Lange-Bertalot 2004). Kellogg & Kellogg (2002) listed 238 taxa belonging to the *Navicula* s.l. in their bibliography of Antarctic and Sub-Antarctic diatom publication. This number, however, does not reflect the real diversity of the genus *Navicula* s.s. In 2011, Van de Vijver *et al.* revised this list and concluded that only a small fraction of the *Navicula* records actually belonged to the genus *Navicula* s.s. Based on the analysis of hundreds of samples they reported only 14 *Navicula* species of which 5 were described as new (Van de Vijver *et al.* 2011a). Later observations led to the description of additional new species such as *Navicula romanedwardii* Zidarova, Kopalová & Van de Vijver (in Zidarova *et al.* 2016a 48), formerly identified as *Navicula* cf. *seibigiana* Lange-Bertalot (1993: 137) (Van de Vijver *et al.* 2011a). Among all Antarctic *Navicula* taxa only three species: *Navicula gregaria* Donkin (1861: 10), *N. longicephala* Hustedt (1944: 277) and *N. rhynchocephala* Kützing (1844: 152) are cosmopolitan (Kellogg & Kellogg 2002, Van de Vijver *et al.* 2011a). The other taxa have a very restricted distribution, often limited to only a very particular region (Van de Vijver *et al.* 2011a, Zidarova *et al.* 2016b). A clear regional endemism was observed in all genera, separating different parts of the Antarctic and Sub-Antarctic regions (e.g. Van de Vijver *et al.* 2004, 2011a, Kopalová *et al.* 2009, 2011, 2015, Zidarova *et al.* 2016b, Kociolek *et al.* 2017). All studies on the genus *Navicula* in this area revealed that the species diversity in the non-marine *Navicula* s.s. is quite low, especially when compared to other genera. The highest species diversity is observed in the genera, that prefer unstable, aerial conditions, such as the genera *Luticola* D.G.Mann in Round *et al.* (1990: 670), *Muelleria* (Frenguelli 1924: 256) Frenguelli (1945: 172), *Hantzschia* Grunow (1877: 174) and *Humidophila* Lowe *et al.* (2014: 352). These genera are all typically observed in wet soils, moist terrestrial mosses and similar subaerial habitats (Van de Vijver & Mataloni 2008, Van de Vijver *et al.* 2010).

In this paper, a new *Navicula* species, *Navicula massalskiana* sp. nov., is described from the Maritime Antarctic Region (King George Island, South Shetland Islands) based on its unique morphological features, revealed following detailed scanning electron microscopy (SEM) observations. The new species shows some resemblance to several other *Navicula* species from the Antarctic Region making a detailed comparison with these species necessary. There is however a confusion on the correct identity of two of these species, *Navicula skuae*

Alfinito & Cavacini (2000: 2) and *Navicula shackletonii* West & G.S. West (1911: 286). Earlier reports on the diversity of the genus *Navicula* in the Antarctic Region (Sabbe *et al.* 2003, Van de Vijver *et al.* 2011a, 2012) stated that both taxa should be considered conspecific although these statements were never based on a revision of the original material. In the present study, the type material of *Navicula skuae* was retrieved allowing a critical observation of its morphological features. These observations were compared with the published morphological features of *N. shackletonii* in Van de Vijver et al. (2012, figs 63–81).

Material and methods

Site description

King George Island (61°54’ to 62°16’S/57°35’ to 59°02’W) is the largest island of the South Shetland Archipelago, situated approximately 120 km north of the Antarctic Peninsula. Most of the island is covered by a permanent ice cover with ice-free areas limited to less than 5% of the total surface (Sierakowski *et al.* 2017). The climate of King George Island is transitional between the cold and harsh climate of the Antarctic continent and the milder sub-Antarctic Region and depends mainly on the sea-ice extent in the Antarctic Peninsula Region (Kejna *et al.* 2013). A high variability of weather conditions throughout the year is the result of the dynamical changes of the atmospheric circulation in this region (Kejna 1999, Rakusa–Suszczewski 2002, Angiel & Dąbski 2012). Admiralty Bay (62°01’21”S, 58°15”05”W) is protected as an Antarctic Specially Managed Area, including the Antarctic Specially Protected Area No. 128 (ASPA 128), which encompasses almost the entire western shore. The small cape, called Patelnia Point (62°13'55"S, 58°28'45"W), is located close to the south border of ASPA 128. This area is part of the Windy Glacier forefield. The glacier is still retreating, and lost therefore, as a consequence contact with the shore (Pudełko *et al.* 2018).

Patelnia Point, located south of the glacier, is an ice-free area and a breeding place for chinstrap penguins (*Pygoscelis antarcticus* Forster, 1781). The vegetation is rather diverse. The rocks are overgrown with ornithocoprophilous communities of epilithic lichens whereas the soil is covered by small tufts of the grass *Deschampsia antarctica* É.Desv. in Gay (1854: 338), nitrophilous algae and various mosses. The penguin rookeries are devoid of vegetation cover due to large guano deposits (Olech *et al.* 2011).

Sample collection and preparation

The unknown *Navicula* species was observed in two samples from Patelnia Point:

Q17.2009 (Windy Glacier Forefield, King George Island, leg. *M. Olech*, 2 January 2009; soil; GPS: 62˚14'6.67"S/ 58˚28'14.02"W),

Q18.2009 (Windy Glacier Forefield, King George Island, leg. *M. Olech*, 2 January 2009; soil; GPS: 62˚14'7.9"S/ 58˚28'13.01"W).

Both samples were collected from an area strongly influenced by penguins, close to the sea shore. The surface soil layer was scraped off and placed in labelled plastic bags. Subsamples were prepared for diatom analysis following the method used by Kawecka (1980, 2012). Cleaned diatom valves are obtained by boiling a small part of the sample (5–10 g) in a mixture of concentrated sulfuric acid and chromic acid. After digestion and centrifugation (5 times 5 minutes at 2500 rpm) the resulting cleaned material was diluted using distilled water. One drop of cleaned diatom material was mounted as permanent slide using the synthetic resin Pleurax (refractive index 1.75). Diatoms were identified using a Carl Zeiss Axio Imager A2 light microscope (LM) equipped with a Differential Interference Contrast (Nomarski) optics and the Zeiss AxioCam HR camera. For scanning electron microscopy analyses of the samples from King George Island, part of the cleaned diatom material was filtered through a 5-µm Isopore™ polycarbonate membrane filter (Merck Millipore), air-dried, attached to aluminum stubs and sputter-coated with a 20 nm gold layer using the Turbo-Pumped Sputter Coater Quorum Q 150OT ES . Diatoms were studied in a Hitachi SU 8010 microscope at 5 kV at the Podkarpackie Innovative Research Center of Environment (PIRCE), University of Rzeszow (Poland). For the new taxon, the number of specimens measured at random on the type slide is indicated (n=20).

For comparison, a subsample of the type material of *Navicula skuae* Alfinito & Cavacini collected by Bruno Fumanti on 25 December 1989 and deposited in RO Herbarium Generale (Rome, Italy) has been retrieved to analyse the morphological differences between *Navicula skuae* and the new taxon. The morphology of *Navicula skuae* was compared with the observations published in Van de Vijver *et al.* (2012) who studied the type slide of *N. shackletonii*, obtained from the Natural History Museum (BM collection, London, UK). For scanning electron microscopy (SEM), part of the diluted suspension of *N. skuae* was filtered through polycarbonate membrane filters (pore diameter 5 µm), pieces of which were fixed on aluminum stubs after air-drying. The stubs were sputter-coated with 20 nm of Pt and studied in a JEOL JSM-7100F at 2 kV (Meise Botanic Garden, Belgium).

Diatom terminology follows Cox *et al.* (1979, 1999), Round *et al.* (1990) and Van de Vijver *et al.* (2011). The new species was compared with similar taxa from the Antarctic Region (West & West 1911, Alfinito & Cavacini 2000, Van de Vijver *et al.* 2011a, 2012).

Results

Class Bacillariophyceae Haeckel (emend. Medlin & Kaczmarska 2004)

Subclass Bacillariophycidae D.G.Mann (Round *et al.* 1990)

Order Naviculales Bessey (1907)

Family Naviculaceae Kützing (1844)

Genus *Navicula* Bory (1822)

***Navicula massalskiana* sp. nov. (Figs 1–27 & 41–46)**

LM observations (Figs 1–27) :— Frustules rectangular in the girdle view. Valves narrowly lanceolate with weakly convex margins, slightly tapering towards the apices. Apices bluntly rounded, slightly cuneate (Figs 2–10) in smaller valves. Larger valves showing more elongated, sub-rostrate to rostrate apices. Valve dimensions (n=25): valve length 13.5–34.0 µm, width 3.0–5.5 µm. Axial area narrow, linear. Central area broad, forming a rectangular, usually asymmetric fascia. Shortened striae bordering the central area lacking. Raphe filiform, straight. Central raphe endings extending beyond the last striae bordering the central area, simple to weakly expanded. Terminal raphe endings clearly hooked. Transapical striae radiate to almost parallel on both sides of the central area, becoming parallel and even slightly convergent towards the apices, 16–20 in 10 µm. In girdle view, a regular striation pattern visible on the mantle continuing from apex to apex (Fig. 1).

SEM observations (Figs 41–46) :—External raphe branches straight to weakly curved (Figs 41, 42). Central raphe endings simple, to weakly expanded, straight (Fig.43). Terminal raphe fissures unilaterally hooked, continuing onto the valve mantle (Fig. 41, arrow). Striae typically composed of short, almost rounded lineolae near the central area, becoming more elongated towards the apices (usually 5 in 1µm). Few short, small slits present at both apices near the end of terminal raphe endings (Fig. 45, arrows). Striae continuing without interruption onto the valve mantle (Figs 45–46). At the central area, 2–4 shortened striae present, but restricted to the valve mantle (Fig. 45). Girdle composed of several open copulae, each perforated by at least one, often two rows of perforations (Fig. 46). Internally, areolae occluded by individual hymenes (Fig. 44). Raphe situated lateral of a raised sternum, only near the central area, raphe located on top of the sternum. Central raphe endings terminating onto an elongated central nodule. Terminal raphe endings terminating onto small helictoglossa.

Type:— Maritime Antarctic Region, South Shetland Islands: King George Island, Sample Q18.2009, leg. *M. Olech*, GPS: 62˚14'7.9"S/ 58˚28'13.01"W, coll. date 2 January 2009, slide BR-XXXX! (holotype, Meise Botanic Garden, Belgium), slide PLP-XXXX! (isotype University of Antwerp, Belgium), slide Q17.2009! (isotype University of Rzeszow, Poland)

Etymology:— The species is named after Prof. Andrzej Massalski (Jan Kochanowski University, Kielce, Poland) in honor of his important contributions to the research of Antarctic algae.

Ecology, distribution and associated diatom flora:— At present, *Navicula massalskiana* has only been confirmed from King George Island, where it was found in two soil samples collected from Patelnia Point (Windy Glacier Forefield), the area strongly influenced by the penguin rookery at the sea shore. The soil was acid (pH = 4.4) with very high conductivity values (705–3525 µS ×cm-1). A larger population was observed in sample Q18.2009 with a relative abundance exceeding 18 % of the entire diatom community. The sample was further dominated by *Luticola* cf. *truncata* Kopalová & Van de Vijver in Kopalová *et al.* (2009: 118) and various other *Luticola* and *Pinnularia* Ehrenberg (1843: 45) taxa.

The critical analysis of the type of *Navicula skuae*.

The type material of *Navicula skuae* was used for comparison with the new species from King George Island. The need to use the type material was due to the fact that the pictures presented in Alfinito & Cavacini (2000) do not show all the morphological features in detail.

Navicula skuae **Alfinito & Cavacini (Figs 28–40 & 47–52)**

LM morphology (Figs 28–40) :— In girdle view, frustules slightly concave in the middle part with a regular striation pattern visible on the mantle continuing from apex to apex (Fig. 40). Valves lanceolate with rostrate to subcapitate apices (Figs 28–39). Valve dimensions (n=20): valve length 18.0–37.5 µm, width 3.5–5.0 µm. Axial area narrow, linear. Central area broad, forming an asymmetric fascia, bordered by 3–4 shortened striae. Raphe filiform, straight. Central raphe endings extending beyond the last striae bordering the central area, simple to weakly expanded. Terminal raphe endings clearly hooked. Transapical striae almost parallel becoming slightly convergent towards the apices, 12–14 in 10 µm, in some valves striae are more radiate (Figs 33, 37).

SEM morphology (Figs 47–52) :— External raphe branches straight. Central raphe endings simple, to weakly expanded, straight. Terminal raphe fissures unilaterally hooked, continuing onto the valve mantle (Figs 47–48, 52). Striae composed of apically elongated lineolae, usually 5–6 in 1 µm. Lineolae less apically elongated in striae located next to the central area (Fig. 48). One (occasionally two) short slits present at both poles near the end of terminal raphe fissures (Figs 51–52, arrows). Striae continuing without interruption onto the valve mantle (Figs 51–52). At the central area few shortened striae present, but restricted to the valve mantle (Fig. 51). In the girdle view small, slit-like perforations present on the most abvalvar copula (Figs 51-52). Internally, striae located in shallow grooves, bordered by raised virgae. Hymenes covering the areolae not observed (Figs 49, 50). Central raphe endings terminating onto an elongated central nodule. Terminal raphe endings terminating onto small helictoglossa (Fig. 50).

Discussion

One of the features of the genus *Navicula* is the lack of perforations on the girdle bands (Round *et al.* 1990). Cox (1979, 1999) studied in detail the morphology of some members of the genus *Navicula* (including the typus generis *Navicula tripunctata*) and confirmed the lack of perforations of the copulae. *Navicula massalskiana*, on the contrary, clearly shows several rows of small perforations on its copulae, which might exclude the species from being a member of the genus *Navicula*. Nevertheless, all other morphological features such as the structure of the raphe and the lineolate character of the areolae, confirm that *N. massalskiana* should be best placed within the genus *Navicula* (sect. *Naviculae lineolatae* sensu Cleve 1895). Therefore, we believe that the taxonomic position of the new species in *Navicula* is justified although more research of other populations could shed more light on this systematical problem.

Comparison of *Navicula massalskiana* with other Antarctic *Navicula* species

The revision of the genus *Navicula* s.s. based on hundreds of samples from the (sub-)Antarctic Region (Van de Vijver *et al.* 2011a) resulted in the description of several new species (Van de Vijver *et al.* 2011a, Zidarova *et al.* 2016a). Nevertheless, the results of the present study show that unknown taxa are still present in the Antarctic Region. The newly described species can be separated from similar taxa based on its specific combination of morphological features with respect to: valve outline, striae density, shape of areolae and perforations on the girdle bands. Several *Navicula* species from the Antarctic Realm show some resemblance to the new species such as *Navicula australoshetlandica* Van de Vijver in Van de Vijver *et al.* (2011a: 287) and *Navicula conveyi* Van de Vijver in Van de Vijver *et al.* (2011a: 290). The most similar, however, is *Navicula shackletonii* G.S.West & W.West (Table 1).

Based on valve outline *Navicula massalskiana* can be confused with *Navicula conveyi* and *Navicula australoshetlandica* (Van de Vijver *et al.* 2011a). However, they can be easily differentiated from *N. massalskiana* by their different stria density, even visible in LM. Both taxa have a lower stria density in 10 µm (13–15 in *N. conveyi* and 12–15 in *N. australoshetlandica*) in comparison to *N. massalskiana* (16–20) (Table 1). Moreover, both taxa possess a different central area. In *Navicula massalskiana* the asymmetrical central area is broad, reaching the valve face/mantle junction, lacking shortened striae on the valve face. The asymmetry of the central area is caused by the uneven arrangement of the striae relative to the apical axis. The central areas of *Navicula australoshetlandica* and *Navicula conveyi* are much smaller, elliptical to rectangular, always bordered by a few shortened striae (Van de Vijver *et al.* 2011a). Finally, *Navicula australoshetlandica* was described from freshwater habitats (Van de Vijver *et al.* 2011a), but can also develop on wet soils and on mosses and around small melt-water basins in the Maritime Antarctic Region (Zidarova *et al.* 2016b). The (sub-)Antarctic species *Navicula conveyi* was described in very wet, red soil under a moss cover on Ile de la Possession, and, so far, is known only from this island in the southern Indian Ocean (Van de Vijver *et al.* 2011a).

Navicula shackletonii described by West & West (1911) and *Navicula massalskiana* have a comparable valve outline (especially in larger valves) and overlapping valve dimensions, although in *Navicula massalskiana* smaller valves are commonly observed (length 13.5–34 µm vs. 20.0–38.0 in *Navicula shackletonii*).. Additionally, *Navicula shackletonii* has rostrate to capitate apices throughout its size range, while only some valves of *Navicula massalskiana* have rostate apices. Both taxa can be easily distinguished from each other by striae density: *Navicula shackletonii* has 12–14 striae in 10 µm, whereas *N. massalskiana* has 16–20 in 10 µm. Also, some of the features observed under SEM differ these two species. These features include: shape of lineolae, the number of slits near the valve apices and perforations on the girdle bads. Finally, considering also the ecological differences and Antarctic distribution between *Navicula massalskiana* and *Navicula shackletonii*, the latter one is an endemic taxon, reported only from the Antarctic Continent (Van de Vijver *et al.* 2012).

During the taxonomic revision of Antarctic species described in West & West (1911), Van de Vijver *et al.* (2012) briefly commented on the possible conspecificity between *Navicula skuae* and *Navicula shackletonii*. Several years prior to the analysis of the type of *N. shackletonii*, Sabbe et al. (2003) already suggested this conspecificity but called for a better analysis of the type material of both taxa. Van de Vijver et al. (2012) analysed the type slide of *N. shackletonii* and in the present study, the material of *N. skuae* was finally retrieved and restudied. Alfinito & Cavacini (2000) already made the comparison when they described *N. skuae*, although they based this comparison on the line drawings in West & West (1911). They indicate three distinctive features for *N. skuae*: (1) central and distal raphe endings, (2) stria density, (3) shape of the frustules in girdle view. According to Alfinito & Cavacini (2000) *"The raphe central endings, may be slightly deflected in the same direction (Pl. XXVI fig. 140) and the raphe terminal endings that in all drawings are clearly straight and not strongly hooked."* This argument was already verified by Van de Vijver *et al.* (2012) and the latter concluded that in the type material of *Navicula shackletonii* only valves with hooked terminal raphe endings could be observed and that the drawings in West & West (1911) were misleading. Secondly, Alfinito & Cavacini (2000) reported a lower stria density for *N. shackletonii*: "*about half of those of N. skuae."* In the original description, *N. shackletonii* has 10–12 striae in 10 µm (West & West 1911). But both Sabbe *et al.* (2003) and Van de Vijver *et al.* (2012) observed a higher density of 12–14 in 10 µm. In addition, both papers recounted the number of striae on the plates presented by Alfinito & Cavacini (2000) and reported not 16–20 striae in 10 µm as in Alfinito & Cavacini (2000) for *N. skuae*, but only 14–15. Our observations of the type material of *N. skuae* confirm this lower stria density.

Finally, Alfinito & Cavacini (2000) reported that the shape of the frustules of *N. skuae* in girdle view was not rectangular as in the original drawings of *N. shackletonii*, but slightly concave in the middle part. Van de Vijver *et al.* (2012) illustrated an entire frustule of *N. shackletonii* in girdle view (p. 158, Fig. 76), showing slightly concave margins, identical to the frustules of *N. skuae.* The results of our SEM analysis of the type material of *N. skuae* (Fig. 51) confirmed that both *N. skuae* and *N. shackletonii* have slightly concave valve margins in girdle view.

Navicula shackletonii was originally described from Cape Royds (Ross Island), whereas *N. skuae* was observed on algal mats in Skua Lake (Northern Victoria Land, Antarctic Continent). Both localities are situated in the Ross Sea Region, approximately 300 kilometers apart from each other. Given the very reduced diatom diversity on the Antarctic Continent (Jones 1996, Van de Vijver *et al.* 2012), it seems unlikely that two species bearing such a high similarity would occur separately in this region.

Therefore, based on the previous observations in Sabbe *et al.* (2003), Van de Vijver *et al.* (2012) and our analysis of all the distinguishing features of *Navicula skuae* presented by Alfinito & Cavacini (2000) we have to conclude that *N. skuae* should definitely be considered as a younger synonym of *N. shackletonii*.

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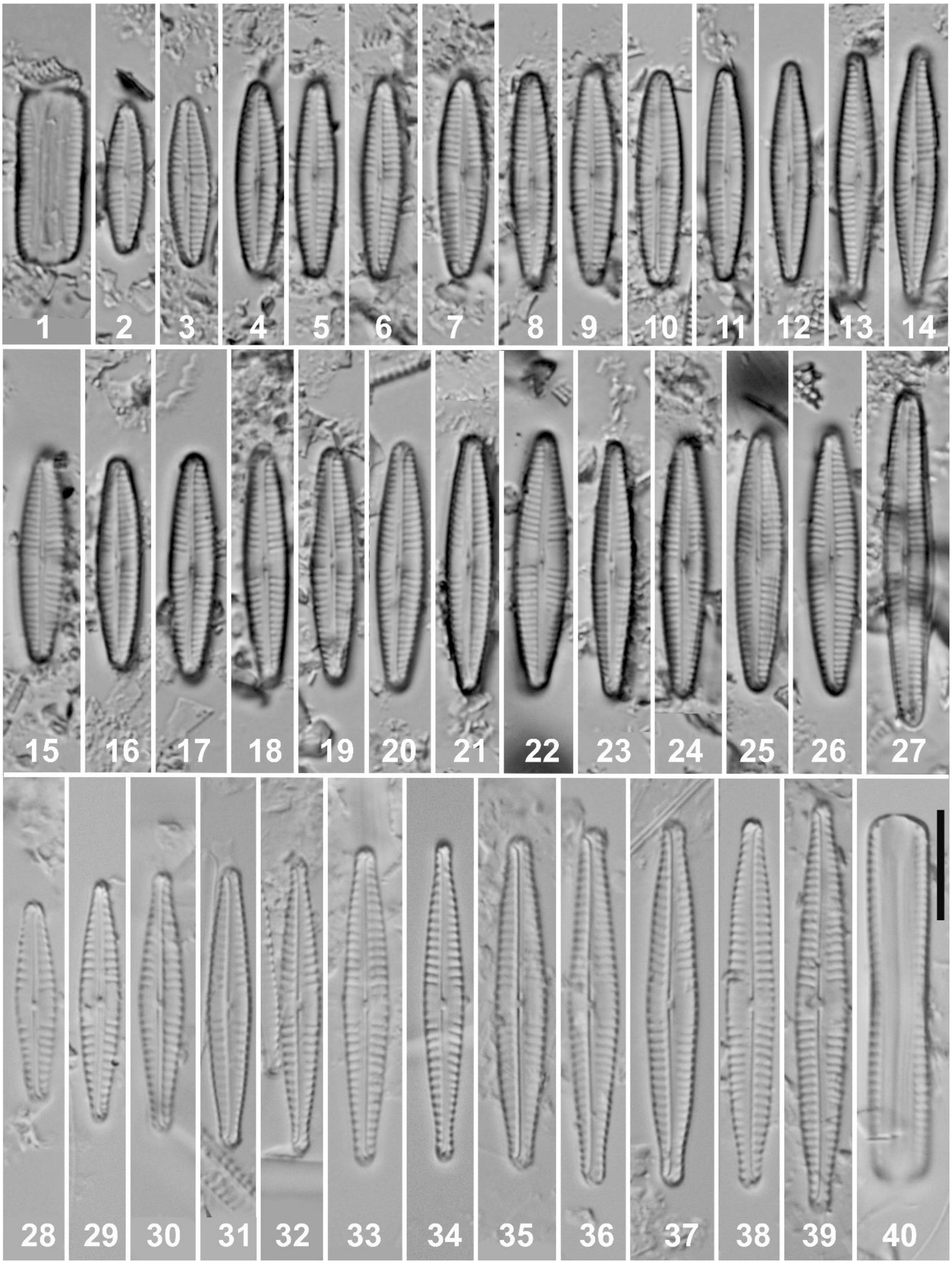
FIGURES 1–40. LM pictures of *Navicula massalskiana* sp. nov. (1–27) and *Navicula skuae* (28–40). Scale bare represents 10 µm.

FIGURES 41–46. *Navicula massalskiana* sp. nov. SEM images: (41–42) external view of entire valve, (43) detailed view of the central area, (44) internal view with areolae occluded by hymenes, (45) detailed view of small slits located close to the terminal raphe fissures, (46) valve in girdle view with small, round perforation on each girdle band. Scale bars represent 5 µm, except for 43 and 46, where scale bare is 3 µm.

FIGURES 47–52. *Navicula skuae* (later synonym of *Navicula shackletonii*): (47–48) external view of entire valve, (49) internal view with central raphe endings and shape of areolae, (50) internal view of entire valve, (51-52) valves in girdle view. Scale bars represent 5 µm, except for 49 and 52, where scale bare is 3 µm.

TABLE 1. Comparison of the *Navicula massalskiana* sp. nov. with similar Antarctic *Navicula* taxa.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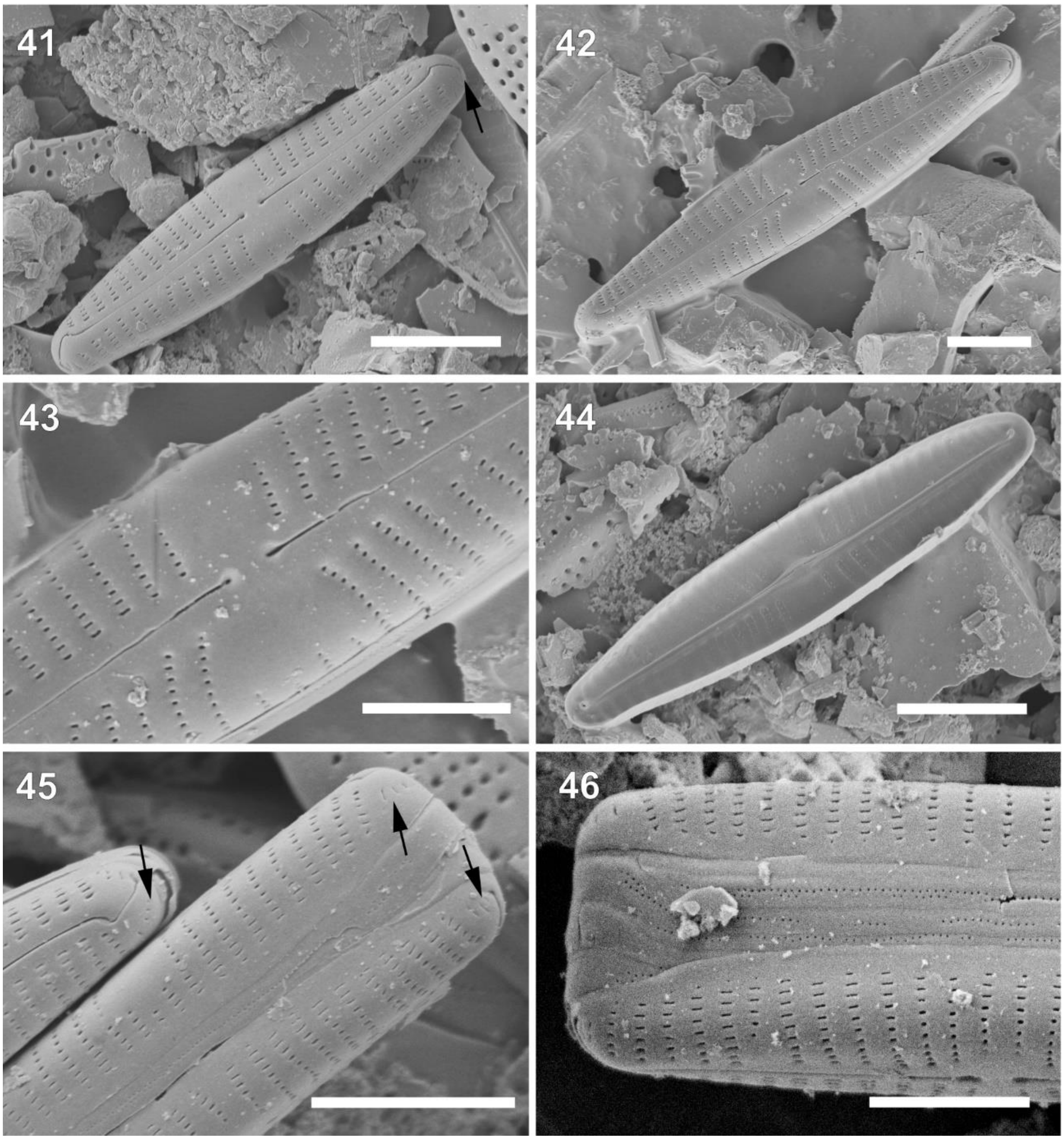
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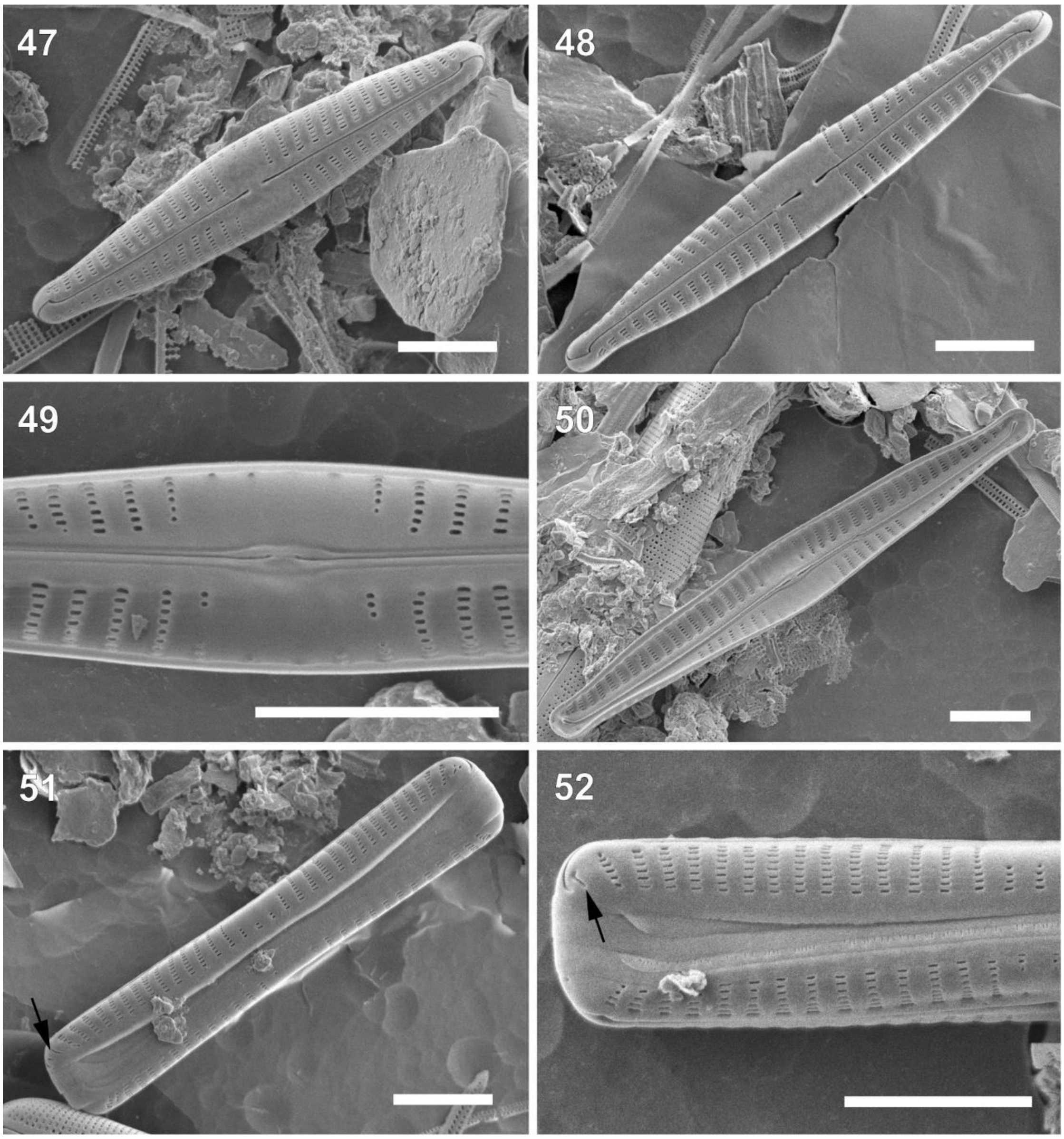
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	length (µm)	width (µm)	striae (in 10 µm)	valve shape	central area	perforation on the girdle bands	distribution
Navicula massalskiana	13.5–34.0	3.0–5.5	16–20	valves lanceolate, tapered towards the apices; smaller valves bluntly rounded in apices	broad, rectangular with no striae on the valve face and few shortened striae on the mantle	two rows of rounded perforations visible on each girdle band	King George Island (Maritime Antarctic Region)
Navicula shackletonii	18–38	3.5–5.8	12–14	lanceolate with rostrate to capitate apices	rectangular, borderer by 2–3 shortened striae	small, slit-like perforations present on the most abvalvar copula	Antarctic Continent
Navicula conveyi	23–29	4.8–5.8	13–15	valves narrowly elliptical to narrowly lanceolate, with produced, cuneate-subrostrate to subrostrate apices	elliptical to rectangular, often slightly asymmetrical, bordered by two to three shortened striae	?	Ile de la Possession, Crozet Archipelago, (sub-Antarctica)
Navicula australoshetlandica	15.0–23.5	3.9–5.0	12–15	valves linear for most of its length with bluntly rounded, slightly cuneate apices; lower valves more elliptical	elliptical to rectangular, usually asymmetric, bordered by two shortened striae	no perforations	northeastern Antarctic Peninsula (Beak Island), the South Shetland Islands and South Georgia