Geographic distribution of epilithic diatoms (Bacillariophyceae) in Antarctic lakes, South Shetland Islands, Maritime Antarctica Region

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Abstract
Organisms adapt to the environment by establishing themselves in suitable locations. Adaptation to the harsh Antarctic environment is no different. In this work the communities of epilithic diatoms in ice-free areas of water systems of five Antarctic islands are studied. The samples were oxidized, and permanent sheets were later prepared for analysis of the material. They were examined using an optical microscope and mounted on stubs for identification of the taxon in an electron microscope. Fifty-nine species distributed in 28 genera were collected. Only four species were observed in all study areas. Deception Island had unique species in comparison with those on other islands. Knowing the diatom community is a first step in understanding the systems that they inhabit. The polar environment is challenging due to the difficulty of sampling and low diversity and abundance.

Keywords
Aquatic systems, biogeography, conservation, environment, microalgae.

Introduction
Owing to the harsh climatic conditions in Antarctica, microbial organisms dominate most ecosystems. Microscopic algae are the primary producers in most freshwater bodies, such as inland lakes and meltwater streams (Larsen et al. 2014).

Diatoms are among the peripheral organisms of greatest richness and distribution, and tolerate a wide range of environmental conditions, making them suitable bioindicators (Rimet and Bouchez 2012). They can live in a wide variety of habitats, including in extreme conditions such as at the poles (Round et al. 1990). Diatoms represent one of the most common groups of algae in terms of wealth and number of individuals in the Antarctic region (Jones 1996; Sabbe et al. 2003; Van de Vijver and Beyens, 1999). Algae are abundant in the Antarctic meltwater system, with the general trend of decreasing diversity towards the south (Jones 1996). Although the Antarctic diatom community is generally reported to be

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mainly made up of cosmopolitan taxa (Van de Vijver and Beyens 1999), there are several papers that support the importance of endemism, for example, Kopalová (2014), Kopalová et al. (2013), Sabbe et al. (2003), and Spaulding et al. (1997). Moreover, the actual specific richness and the existing endemic taxa are not clear owing to an underestimation of taxa (Kopalová and Van de Vijver 2013; Kopalova et al. 2009). This is demonstrated by the growing publications reporting new species.


The more recent studies have led to the general conclusion that not all the islands of the Antarctic Maritime share similar flora. In addition, the richness of the flora is more limited than that in more temperate or tropical localities (Hamsher et al. 2016). In this context, the aim of the present work was to study the richness, taxonomy and similarity of epilithic diatom communities in lentic systems of the South Shetland Islands.

Methods

Study area. The archipelago of the South Shetlands is part of the Maritime Zone, north of the Antarctic Peninsula. Elephant, King George, Nelson, Robert, Greenwich, Livingston, and Deception islands are the largest of the group. Of these, Elephant Island is farthest to the north, located at 61°10′S, 055°14′W and about 800 km southeast of Cape Horn (South America) and about 265 km from the northern end of the Antarctic Peninsula (Putzke and Pereira 2001).

Sampling design and laboratory methods. During the expedition of the Brazilian Antarctic Program (PRO-ANTAR) in 2012–2017, lentic systems of King George, Halfmoon, Decoration, Elephant, and Nelson islands were sampled (Fig. 1). A total of 78 epilithic diatom samples in ice-free areas of water systems of the five Antarctic islands were collected (Table 1). At each sample site, epilithic material was obtained from pebbles by scraping with brushes. Samples were stored in flasks and fixed with 4% formaldehyde.

Slides preparation and counting. The materials were prepared according to Kelly et al. (1998), and permanent slides were mounted using Naphrax® (Refraction index = 1.74, Brunel Microscopes Ltd, Chippenham, Wiltshire, United Kingdom). Diatoms were identified under light microscopy (LM) with a 100× oil immersion objective, and light photographs were taken with a Leica DM750. Samples selected for scanning electron microscopic (SEM) analysis were filtered through Isopore™ polycarbonate membrane filters (Merck Millipore) with a pore diameter of 3 μm, with additional deionized water. They were mounted on aluminum stubs and sputtered with platinum using a BAL–TEC MED 020 Modular High Vacuum Coating System for 30 s at 100 mA. SEM images were taken using the lower (SE-L) detector signal and an ultra-high-resolution analytical field emission (FE) SEM Hitachi SU–70 (Hitachi High-Technologies Corporation, Tokyo, Japan) operated at 5 kV at a distance of 10 mm. The quantitative analysis was performed with approximately 400 valves for each sample. The specimens examined were deposited in the diatom collection of the Laboratory of Ficology at Universidade Federal de Santa Maria (Table 2). The taxonomy follows the system of Round et al. (1990). Specialized works were used for identification, including Bonaventura et al. (2006), Esposito et al. (2008), Kawecka et al. (1998), Kochman-Kędziora et al. (2018), Kopalová (2012), Kopalová et al. (2011, 2013, 2015, 2018), Van de Vijver and Beyens (1996), Van de Vijver and Kopalová (2014), Van de Vijver and Mataloni (2008), Van de Vijver and Zidarova (2011), Vinocur and Izaguirre (1994), Vinocur and Maidana (2010), Zidarova (2010), Zidarova et al. (2012) and Hamsher et al. (2016).

Results

A total of 5598 individuals, belonging to 28 genera and 59 subgeneric level taxa of diatom algae (including sub-species and varieties) (Table 2; Figs 2–5), were recorded in this study. The greatest number of species, sub-species or varieties included in the following numbers was observed in genera Psammothidium L.Bukhtiyarova & Round (8), Nitzschia Hassall (7), Navicula Bory (6) and Planothidium Round & L. Bukhtiyarova (4). These genera are usually well represented in Antarctic diatom survey work (Trobajo et al. 2013; Hamsher et al. 2016; Van de Vijver et al. 2013, 2016, 2018, Van de Vijver 2014). Five species, Chamaeppinularia krookiformis (Krammer) Lange-Bertalot & Krammer, Gymphonema maritimo-antarcticum Van de Vijver, Kopalová, Zidarova & Kociolek, Luticola multicopsis (Van Heurck) Mann, Psammothidium abundans (Manguin) Bukhtiyarova & Round, and Planothidium austral (Manguin) Le Cohu, were observed on all islands. In contrast, 18 species occurred only on Deception Island, nine species on King
Figure 1. Sample points of the islands. **A.** King George. **B.** Nelson. **C.** Deception. **D.** Halfmoon. **E.** Elephant.
George Island, three species on Halfmoon Island, two species on Nelson Island, and one species on Elephant Island.

**Taxonomic composition**

**Achnanthes sp.**
Figures 2(1, 2), 4(1)
Morphometric information: length: 23–34.2 µm; width: 4.7–5.4 µm; striae in 10 µm: 17–22.

**Achnanthidium maritime-antarcticum** Van de Vijver & Kopalová
Figure 2(3, 4)
Morphometric information: length: 12–16 µm; width: 2–3.7 µm; striae in 10 µm: 30–31

**Berkeleya rutilans** (Trentepho ex Roth) Grunow
Figures 2(5–7), 4(2)
Morphometric information: length: 28–36 µm; width: 2.3–3.3 µm; striae in 10 µm: 31–42

**Brachysira aff. minor** (Krasske) Lange-Bertalot in Lange-Bertalot & Moser
Figure 2(7)
Morphometric information: length: 12–16.5 µm; width: 3.5–4.3 µm; striae in 10 µm: impossible to resolve in light microscopy (light microscopy)

**Caloneis australis** Zidarova, Kopalová & Van de Vijver
Figure 2(8)
Morphometric information: length: 16.8–43.1 µm; width: 4–6.2 µm; striae in 10 µm: 21–28

**Chamaepinnularia australomediocris** (Lange-Bertalot & Schmidt) Van de Vijver
Figures 2(9), 4(3)
Morphometric information: length: 8.9–15.5 µm; width: 2–3.7 µm; striae in 10 µm: 20–25

**Chamaepinnularia krookiformis** (Krammer) Lange-Bertalot & Krammer
Figures 2(10), 4(4)
Morphometric information: length: 10.6–22.1 µm; width: 4–5.4 µm; striae in 10 µm: 21–23

Comments: *Chamaepinnularia krookiformis* is commonly found associated abundantly with mosses and small bodies of water near the coast in places with high salinity and nutrients (Zidarova et al. 2016).

**Fragilaria cf. parva** Tuji & Williams
Figures 2(11, 12), 4(5)
Morphometric information: length: 15–52 µm; width: 2.5–4.8 µm; striae in 10 µm: 16–18

**Fragilaria labei** Witkowski et Metzeltin in Metzeltin & Witkowski
Figure 3(13)
Morphometric information: length: 6–12 µm; width: 1.5–2.5 µm; striae in 10 µm: impossible to resolve in light microscopy.

**Fragilariopsis aff. humboldtianorum** Witkowski, Metzeltin & Lange-Bertalot in Metzeltin & Witkowski
Figures 2(14), 4(6)
Morphometric information: length: 10.2–38.5 µm; width: 3–4.2 µm; striae in 10 µm: 25–32

**Gomphonema maritimo-antarcticum** Van de Vijver, Kopalová, Zidarova & Kociolek
Figure 2(15, 16)
Morphometric information: length: 20.1–50 µm; width: 4.3–7.1 µm; striae in 10 µm: 10–15

Comments: *Gomphonema maritimo-antarcticum* is a very common diatom in lakes and lagoons (Zidarova et al. 2016).

**Halamphora acutiuscula** (Kützing) Levkov
Figures 2(17, 18), 4(7)
Morphometric information: length: 24–32 µm; width: 3.9–4.7 µm; striae in 10 µm: 25–35

**Halamphora exigua** (Gregory) Levkov
Figure 2(19)
Morphometric information: length: 15–32 µm; width: 2.6–4 µm; striae in 10 µm: 15–18

**Halamphora oligotraphenta** (Lange-Bertalot) Levkov
Figure 2(20)
Morphometric information: length: 16–31 µm; width: 3.3–5 µm; striae in 10 µm: 25–30

**Hantzschia hyperaustralis** Zidarova & Van de Vijver
Figures 2(21), 4(8)
Morphometric information: length: 67–122 µm; width: 11–16 µm; striae in 10 µm: 50–60

**Hantzschia virgata** (Roper) Grunow in Cleve & Grunow
Figure 2(22)
Morphometric information: length: 110–140 µm; width: 7–9 µm; striae in 10 µm: 15–20

**Humidophila deceptionensis** Kopalová Zidarova & Van de Vijver
Figure 2(23)
Morphometric information: length: 8–12 µm; width: 2–4 µm; striae in 10 µm: 27–32.6

**Humidophila keiliorum** Kopalová
Figures 2(24), 4(9)
Morphometric information: length: 7.7–25.1 µm; width: 3–5 µm; striae in 10 µm: 25–33

**Table 1.** Geographic coordinates from the sampling sites in the South Shetland Islands, Antarctica Maritime Region.

<table>
<thead>
<tr>
<th>Island</th>
<th>Geographic coordinates</th>
<th>Altitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>King George</td>
<td>62°05′07″S, 058°23′39″W</td>
<td>34</td>
</tr>
<tr>
<td>Elephant</td>
<td>61°13′19″S, 055°21′19″W</td>
<td>30</td>
</tr>
<tr>
<td>Nelson</td>
<td>62°14′45″S, 059°00′15.5″W</td>
<td>38</td>
</tr>
<tr>
<td>Deception</td>
<td>62°58′41″S, 060°42′08″W</td>
<td>55</td>
</tr>
<tr>
<td>Halfmoon</td>
<td>62°35′41″S, 059°55′10″W</td>
<td>25</td>
</tr>
</tbody>
</table>

Comments: *Chamaepinnularia krookiformis* is commonly found associated abundantly with mosses and small bodies of water near the coast in places with high salinity and nutrients (Zidarova et al. 2016).
Table 2. List of the epilithic diatoms collected during the austral summer season from 2012 to 2017, with catalog numbers of voucher specimens. Islands: King George (KG), Elephant (E), Nelson (N), Deception (D), and Halfmoon (H) islands.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Island</th>
<th>Catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achnanthidium maritime-antarcticum Van de Vijver &amp; Kopalová</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Berkeleyella ruftilis (Trentepohl ex Roth) Grunow</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Brachysira aff. minor (Krasse) Lange-Bertalot &amp; G. Moser</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Caloneis australis Zidarova, Kopalová &amp; Van de Vijver</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Chamaepinnularia australomediocriis (Lange-Bertalot &amp; Rol.Schmidt) Van de Vijver</td>
<td>KG</td>
<td>X</td>
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<tr>
<td>Chamaepinnularia krokophorai (Krammer) Lange-Bertalot &amp; Krammer in Lange-Bertalot &amp; Genkal</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Fragilaria cf. parva Tuji &amp; Williams</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Fragilaria labiei Witkowski et Metzeltin in Metzeltin &amp; Witkowski</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Fragilariosps humboldtianorum Witkowski, Metzeltin et Lange-Bertalot in Metzeltin &amp; Witkowski</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Gymnosphaera maritimo-antarcticum Van de Vijver, Kopalová, Zidarova &amp; Kociolek</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Halanaphora acutiuscula (Kützing) Z. Levkow</td>
<td>KG</td>
<td>X</td>
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<tr>
<td>Halanaphora exigus (Gregory) Z. Levkow</td>
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<tr>
<td>Halanaphora oligotraphenta (Lange-Bertalot) Luvkov</td>
<td>KG</td>
<td>X</td>
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<tr>
<td>Hantzschia hyperaustralis Van de Vijver &amp; Zidarova</td>
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<td>X</td>
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<tr>
<td>Hantzschia virgate (Roger) Grunow</td>
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</tr>
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<td>Humidophila delectionensis Kopalová Zidarova &amp; Van de Vijver</td>
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<td>Humidophila kelliorum Kopalová</td>
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<tr>
<td>Humidophila voltageosikii Kopalová Zidarova &amp; Van de Vijver</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Luticola multicapsis (Van Heurck) Mann</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Melosira moniliformis (O.F. Muller) Agardh</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Navicula australoshetlandica Van de Vijver</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Navicula cremeri Van de Vijver &amp; Zidarova</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Navicula cryptotenella Lange-Bertalot</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Navicula gregaria Donkin</td>
<td>KG</td>
<td>X</td>
</tr>
<tr>
<td>Navicula perminuta Grunow</td>
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<td>Navicula venatiiformis Van de Vijver &amp; Beyens in Van de Vijver, Frenot &amp; Beyens</td>
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<td>Nitzschia annelwillemsiana Hamsher, Kopalová, Kociolek, Zidarova &amp; Van de Vijver</td>
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<td>Nitzschia archibaldii Lange-Bertalot</td>
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<td>Nitzschia berigii Cleve-Euler</td>
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<td>Nitzschia homburgiensis Lange-Bertalot</td>
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<td>X</td>
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<td>Nitzschia kleintei Hamsher, Kopalová, Kociolek, Zidarova &amp; Van de Vijver</td>
<td>KG</td>
<td>X</td>
</tr>
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<td>Nitzschia paleacea Grunow</td>
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<td>Pinnularia australomicrostauron Zidarova, Kopalová &amp; Van de Vijver</td>
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<td>Placoseis australis Van de Vijver &amp; Zidarova</td>
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<td>Psammothidium subatomoides (Hustedt) Bukhtiyarova &amp; Round</td>
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<td>Sellaphora antarctica Zidarova, Kopalová &amp; Van de Vijver</td>
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<td>Sellaphora nana (Hustedt) Lange-Bertalot, Cavacini, Tagliaventi &amp; Alfinito</td>
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<td>Sieminska zeta (Cleve) Metzeltin &amp; Lange-Bertalot</td>
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<td>Stauerosirella frigida Van de Vijver &amp; E. Morales</td>
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<tr>
<td>Thalassiosira gracilis var. expecto G. Fryxell &amp; Hasle</td>
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</table>
Humidophila vojtajarosikii Kopalová Zidarova & Van de Vijver
Figures 2(25), 4(10)
Morphometric information: length: 6–15 μm; width: 2.2–3.6 μm; striae in 10 μm: 27–32

Luticola multicopsis (Van Heurek) Mann
Figures 2(26), 4(11)
Morphometric information: length: 20–30.1 μm; width: 8.3–10 μm; striae in 10 μm: 15–17
Melosira moniliformis C.Agardh
Figures 2(27), 4(12)
Morphometric information: diameter (μm): 8–12 × 20–25

Navicula australoshetlandica Van de Vijver
Figure 2(28)
Morphometric information: length: 15–25 μm; width: 4–5 μm; striae in 10 μm: 12–15

Navicula cremeri Van de Vijver & Zidarova
Figures 2(29), 4(13)
Morphometric information: length: 27–33 μm; width: 5.2–7 μm; striae in 10 μm: 14–15

Navicula cryptotenella Lange-Bertalot
Figures 2(20), 4(14)
Morphometric information: length: 39–51.2 μm; width: 5.8–7.3 μm; striae in 10 μm: 16–20

Navicula gregaria Donkin
Figure 2(31)
Morphometric information: length: 20–41.3 μm; width: 5.4–10 μm; striae in 10 μm: 20–30

Navicula perminuta Østrup
Figures 2(32, 33), 4(17)
Morphometric information: length: 4.6–12 μm; width: 1.3–2 μm; striae in 10 μm: 9–11

**Navicula venetiformis** Van de Vijver & Beyens in Van de Vijver, Frenot & Beyens

Figures 2(34), 4(15)

Morphometric information: length: 14.8–22 μm; width: 8.7–9.5 μm; striae in 10 μm: 16–19

**Nitzschia annewillemsiana** Hamsher, Kopalová, Kociolek, Zidarova & Van de Vijver

Figures 2(35, 36), 4(16)

Morphometric information: length: 9–21 μm; width: 3–4 μm; striae in 10 μm: 24–27

**Nitzschia archibaldii** Lange-Bertalot

Figure 2(37)

Morphometric information: length: 14–39.5 μm; width: 2.1–2.8 μm; striae in 10 μm: impossible to resolve in light microscopy.

**Nitzschia bergii** Cleve-Euler

Figure 2(38)

Morphometric information: length: 61.1–72 μm; width: 2.9–3.4 μm; striae in 10 μm: impossible to resolve in light microscopy.
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**Nitzschia gracilis** Hantzsch
Figures 2(39), 4(18)
Morphometric information: length: 13.8–73.5 μm; width: 2–3 μm; striae in 10 μm: 15–20

**Nitzschia homburgiensis** Lange-Bertalot
Figures 2(40), 5(1)
Morphometric information: length: 17.5–38.2 μm; width: 4–5.7 μm; striae in 10 μm: 10–15

**Nitzschia kleinteichiana** Hamsher, Kopalová, Koci olek, Zidarova & Van de Vijver
Figures 2(41, 42), 5(2)
Morphometric information: length: 12.5–25.9 μm; width: 2.3 μm; striae in 10 μm: 10–13

**Nitzschia paleacea** Grunow
Figures 2(43), 5(3)
Morphometric information: length: 16–40.6 μm; width: 1.4–3 μm; striae in 10 μm: 15–20

**Pinnularia australomicrostauron** Zidarova, Kopalová & Van de Vijver
Figure 3(44, 45)
Morphometric information: length: 28–87.5 μm; width: 8–15; striae in 10 μm: 12–15
**Pinnularia microstauron** (Ehrenberg) Cleve
Figure 3(46)
Morphometric information: length: 33.4–60.2 μm; width: 2.9–3.9 μm; striae in 10 μm: 15–17

**Pinnularia subantarctica var. elongata** (Manguin)
Van de Vijver & Le cohu
Figure 3(47)
Morphometric information: length: 25.7–59.3 μm; width: 5–8.1 μm; striae in 10 μm: 13–15

**Pinnunavis elegans** (W. Smith) Okuno
Figure 3(48)
Morphometric information: length: 36.3–57 μm; width: 12–13.6 μm; striae in 10 μm: 13–14

**Placoneis australis** Van de Vijver & Zidarova
Figures 3(49), 5(4)
Morphometric information: length: 21–31.1 μm; width: 5.9–8; striae in 10 μm: 15–20

**Planothidium australis** (Manguin) Le Cohu
Figure 3(50, 51)
Morphometric information: length: 21–32 μm; width: 6–8; striae in 10 μm: 15–20

**Planothidium capitatum** (O. Muller) Van de Vijver, Kopalová, Wetzel & Ector
Figures 3(52), 5(5)
Morphometric information: length: 15–22 μm; width: 4.3–5 μm; striae in 10 μm: 14–15

**Planothidium rostrolanceolatum** Van de Vijver, Kopalová & Zidarova
Figures 3(55, 56), 5(6)
Morphometric information: length: 15.2–23 μm; width: 6–8 μm; striae in 10 μm: 13–15

**Planothidium sp.**
Figure 3(53, 54)
Morphometric information: length: 5–14.5 μm; width: 3.8–5.5 μm; striae in 10 μm: 12–15

**Psammothidium incognitum** (Krasske) Van de Vijver
Figures 3(60), 5(9)
Morphometric information: length: 10–16.7 μm; width: 5–6 μm; striae in 10 μm: impossible to resolve in light microscopy.

**Psammothidium papilio** (Kellogg, Stuiver, Kellogg & Denton) Kopalová & Van de Vijver
Figures 3(63, 64), 5(10)
Morphometric information: length: 7.6–14 μm; width: 3.7–5.2 μm; striae in 10 μm: impossible to resolve in light microscopy

**Psammothidium rostrogermainii** Van de Vijver, kopalová & Zidarova
Figures 3(65), 5(11)
Morphometric information: length: 7.5–22 μm; width: 5.1–8.5 μm; striae in 10 μm: 17–22

**Psammothidium sp.**
Figure 3(61, 62)
Morphometric information: length: 4.2–8.5 μm; width: 3–3.5 μm; striae in 10 μm: impossible to resolve in light microscopy

**Psammothidium subatomoides** (Hustedt) Bukhtiyarova et Round
Figure 3(66)
Morphometric information: length: 6.9–9 μm; width: 4.2–6 μm; striae in 10 μm: impossible to resolve in light microscopy

**Pseudogomphonema kamtschaticum** (Grunow) Medlin in Medlin & Round
Figures 3(67-68), 5(12)
Morphometric information: length: 11.2–36.5 μm; width: 2–2.4 μm; striae in 10 μm: 11–13

**Sellaphora antarctica** Zidarova, Kopalová & Van de Vijver
Figures 3(69), 5(13)
Morphometric information: length: 7–17.2 μm; width: 2.2–3.5 μm; striae in 10 μm: 18–22

**Sellaphora nana** (Hustedt) Lange-Bertalot, Cavacini, Tagliaventi & Allinoto
Figure 3(70)
Morphometric information: length: 8–20.2 μm; width: 3–6 μm; striae in 10 μm: impossible to resolve in light microscopy

**Sieminskia zeta** (Cleve) Metzeltin & Lange-Bertalot
Figure 3(71)
Morphometric information: length: 32.1–45.8 μm; width: 10.1–12.3 μm; striae in 10 μm: 24–26

**Stauroneis latistauros** Van de Vijver & Lange-Bertalot
Figure 3(72)
Morphometric information: length: 26.9–49.4 μm; width: 6.8–10 μm; striae in 10 μm: 20–25
Stauronella indubitabilis Lange-Bertalot & Genkal
Figures 3(73), 5(14)
Morphometric information: length: 36.2–40.7 μm; width: 2.5–3.1 μm; striae in 10 μm: impossible to resolve in light microscopy

Staurorosirella frigida Van de Vijver & E. Morales
Figures 3(74, 75), 5(15)
Morphometric information: length: 10–15.3 μm; width: 2.8–4.5 μm; striae in 10 μm: 9–10

Thalassiosira gracilis var. expecta Fryxell & Hasle
Figure 3(76)
Morphometric information: diameter (μm): 5.9–14.1; areolae in 10 μm valve: 16–18

Discussion
The species richness observed in this study was much lower than that observed by Kopalová et al. (2013), who found 123 species of diatoms on James Ross Island. However, the number of samplings and sample stations in their study was greater. The most abundant species in that study was Fragilariopsis capucina, Luticola muticaensis, Nitzschia gracilis, N. homburgiensis, and Psammothidium papillo. Lobo et al. (1998) observed 25 species of epilithic diatoms in a survey of two lakes on King George Island, with a sampling number similar to the numbers presented here. In the lakes observed by Lobo et al. (1998), Gomphonema angustatum and Fragilariopsis capucina were also present. The southern tip of the American continent is the most likely source of diatom dispersion.

When analyzing the diatom species in a transect of Patagonia to Antarctica, Maidana et al. (2005) observed a decrease in specific richness with the increase of latitude, confirming the theory of insular biogeography. This area–species relationship is another basic principle of island biogeography, in that the number of species found in an area increases with the size of the island (Morin 2005). The number of species on an island is also a consequence of the dynamic balance and interrelationship between rates of colonization and extinction on the island, and it is presumed that in a larger area there would be more interference from such processes.

Deception Island is an active volcano located on a rift along the Bransfield Strait. It is a horseshoe-shaped island belonging to the South Shetland Islands, a mountainous archipelago located in the southern Atlantic Ocean within the Maritime Antarctica biogeographical region (Smith 2005). The volcanic characteristics may be a factor in the selection of unique species because 18 species occurred only on Deception Island. Deception Island had the greatest number of unique species, with nine.

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Authors’ Contributions
JFS, MAP, and ABP conceived and designed the project. JFS, RPA, and ABP collected the samples. RRA and EPS carried out the preparation of the material for identification. JFS identified all samples and registered microscopy images. ALS built the maps. All authors wrote and corrected the text.

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