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Range extensions for moss species on the west side of the Antarctic Peninsula

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Range extensions for moss species on the west side of the Antarctic Peninsula

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ABSTRACT

New distributional data are presented for 12 species of moss collected from the Graham Coast and Danco Coast together with their offshore islands on the west side of the Antarctic Peninsula. *Pohlia wahlenbergii* (F.Weber & D.Mohr) A.L.Andrews is new to the Antarctic Peninsula and the Graham Coast and it is the southernmost station of the species, whereas *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs is new to the Danco Coast. *Schizymenium pusillum* (Hook. & Wilson) A.J.Shaw is recorded for the first time on the Antarctic Peninsula mainland, and *Schistidium rivulare* (Brid.) Podp. is found at its southernmost locality on Cape Pérez on the mainland Graham Coast. *Andreaea regularis* Müll.Hal., *Kiaeria pumila* (Mitt.) Ochyra, *Bucklandiella sudetica* (Funck) Bedn.-Ochyra & Ochyra,

KEY WORDS

Antarctica,
Danco Coast,
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bryophytes,
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distribution,
new records.

MOTS CLÉS
Antarctique,
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signalements nouveaux.

Warnstorfia fontinaliopsis (Müll.Hal.) Ochyra and *Pohlia nutans* (Hedw.) Lindb. are new for Hovgaard Island in the Wilhelm Archipelago, and the latter is additionally recorded for the first time from Point Rasmussen on the mainland Graham Coast. *Bryum pallescens* Schleich. ex Schwägr. is new to Darboux Island, while *Polytrichum juniperinum* Hedw. and *Brachythecium austroglareosum* (Müll. Hal.) Kindb. are new to Lahille Island in the Grandidier Channel. Updated distribution maps for all species in the study areas of the Danco and Graham Coasts and the northern Antarctic Peninsula are presented. The moss floras of the Graham and Danco Coast regions consist currently of 51 and 47 species, respectively.

RÉSUMÉ

Extensions de l'aire de répartition d'espèces de mousses du côté ouest de la péninsule Antarctique.

De nouvelles données de distribution sont présentées pour 12 espèces de mousses collectées sur la côte de Graham et la côte de Danco ainsi que sur les îles au large de la côte ouest de la péninsule Antarctique. *Pohlia wahlenbergii* (F. Weber & D. Mohr) A.L. Andrews est nouvelle dans la péninsule Antarctique et sur la côte de Graham et c'est la station la plus méridionale de l'espèce, tandis que *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs est nouvelle sur la côte de Danco. *Schizymenium pusillum* (Hook. & Wilson) A.J. Shaw est signalée pour la première fois sur le continent de la péninsule Antarctique, et *Schistidium rivulare* (Brid.) Podp. se trouve dans sa localité la plus méridionale au cap Pérez sur la côte continentale de Graham. *Andreaea regularis* Müll.Hal., *Kiaeria pumila* (Mitt.) Ochyra, *Bucklandiella sudetica* (Funck) Bedn.-Ochyra & Ochyra, *Warnstorfia fontinaliopsis* (Müll.Hal.) Ochyra et *Pohlia nutans* (Hedw.) Lindb. sont nouvelles pour l'île Hovgaard dans l'archipel Wilhelm, et la dernière est en outre enregistrée pour la première fois à point Rasmussen sur la côte continentale de Graham. *Bryum pallescens* Schleich. ex Schwägr. est nouvelle pour l'île Darboux, tandis que *Polytrichum juniperinum* Hedw. et *Brachythecium austroglareosum* (Müll.Hal.) Kindb. sont nouvelles sur l'île de Lahille dans le chenal Grandidier. Des cartes de distribution mises à jour pour toutes les espèces dans les zones d'étude des côtes Danco et Graham et du nord de la péninsule Antarctique sont fournies. Les flores de mousses des régions des côtes Graham et Danco se composent actuellement de 51 et 47 espèces, respectivement.

INTRODUCTION

The earliest Antarctic moss collections came from King George Island (62°10'15.64"S, 58°28'44.44"W), the largest island of the South Shetlands archipelago, located about 160 km north of the Trinity Peninsula, the northernmost part of the Antarctic Peninsula. Due to its location, the ships of the first Antarctic explorers reached this island in the years 1819-1831 (Ochyra 1998a; Ochyra *et al.* 2008a) and the earliest herbarium specimens of moss, *Polytrichastrum alpinum* (Hedw.) G.L.Sm. and *Sanionia uncinata* (Hedw.) Loeske, were collected on it by J. Eights, a member of the United States sealing voyage of 1829-1831 (Hedgpeth 1971). In 1839-1843 the British Naval Expedition under the command of Captain James C. Ross circumnavigated the Antarctic continent and on 6 January 1843 reached the small Cockburn Island (64°12'11.3"S, 56°50'33.8"W) in the James Ross Island group, off the eastern coast of Trinity Peninsula, where J. D. Hooker collected five species of moss, two of which were described as new to science (Wilson & Hooker 1847; Müller 1849).

The first mosses on the Antarctic mainland were not collected until 55 years later from the Danco Coast on the west side of the Antarctic Peninsula. Emil Racoviță (1868-1947), the Romanian zoologist and naturalist to the Belgian Antarctic Expedition of 1897-1899, on the ship *Belgica* under the command of A. de Gerlache de Gomery, on 29 January

1898 collected eight species and one variety of moss on Cape Anna (64°35'20.23"S, 62°25'51.09"W), and on 1st February 1898 ten species and two varieties on Beneden Head (64°45'52.6"S, 62°41'47.6"W). In addition, on 12 February 1898 he collected six species and two varieties on rocks at the entrance to Lemaire Channel (65°05'08.5"S, 63°57'35.7"W). In total, 27 species and six varieties of moss were found by the Belgian Antarctic Expedition on the Danco Coast and its offshore islands of the Palmer Archipelago (64°18'22.23"S, 62°18'20.71"W), including 16 species and three varieties new to science (Cardot 1900, 1901).

In the following years the bryological exploration of the West Antarctic Peninsula gradually shifted to the south. During the Third French Antarctic Expedition, led by J.-B. A. E. Charcot in the years 1903-1905, mosses were collected from the two northernmost offshore islands of the Graham Coast, Booth (Wandel) Island (65°5'3.46"S, 63°59'51.10"W) and Hovgaard Island (65°8'12.87"S, 64°5'58.28"W), belonging to the Wilhelm Archipelago. Altogether, 12 species and four varieties were found, of which one species and two varieties were described as new to science (Cardot 1906, 1907).

The Fourth French Antarctic expedition in 1908-1910, also under the command of J.-B. A. E. Charcot, was very fruitful in terms of bryology. It operated mainly on the Graham and Fallières Coasts and occasionally in the South Shetland Islands (King George Island and Deception Island (62°56'36.7"S, 60°32'49.3"W)) and

in the Palmer Archipelago on the Danco Coast. Although its activity resulted only in describing seven species and one variety of mosses new to science (Cardot 1911a, b, 1913), it provided many important distributional data for mosses in the central and southern parts of the West Antarctic Peninsula. This expedition gathered, among others, first mosses on the mainland Graham Coast including Edge Hill (Mont Tranchant (65°14'16.86"S, 64°4'28.74"W)), Cape Tuxen (65°16'11.15"S, 64°7'10.05"W) and Cape Pérez (65°24'20.3"S, 64°05'46.6"W) (for toponymy of this area see Yevchun *et al.* 2021). In addition, some small collections were made on the Berthelot Islands (65°19'53.6"S, 64°08'38.5"W) and Argentine Islands (65°15'01.7"S, 64°15'32.9"W) as well as on Petermann Island (65°10'17.4"S, 64°08'30.4"W). The expedition also operated in Marguerite Bay on the Fallières Coast, shifting the southern limit of moss finds on the West Antarctic Peninsula to Jenny Island at latitude 67°44'S.

In the post-Heroic Age, there was a stagnation in bryological research in the area of the Antarctic Peninsula. In the interwar period, a number of expeditions were active here (Headland 1989), but botanical research was not a major objective. The most important of these was the British Graham Land (*Penola*) Expedition of 1934–1937, whose moss collections were deposited at the Natural History Museum in London (BM). They remained unstudied and were only investigated and published in the Antarctic Moss Floras (Greene *et al.* 1970; Ochrya *et al.* 2008a). In 1939–1941, the United States Antarctic Service Expedition operated in Graham Land, and a modest collection of mosses was published after the World War II (Bartram 1957). During World War II (1943–1945) the British government established a number of small bases in the South Shetland Islands and on the West Antarctic Peninsula under the code name “Operation Tabarin”, and in 1944–1946 I. Mackenzie Lamb made an intensive botanical survey of Deception Island, which is one of the most volcanically active sites in Antarctica (Roberts *et al.* 2017), Hope Bay on the Trinity Peninsula and the Palmer Archipelago. His huge collection included many lichens and mosses.

Intensive survey of the West Antarctic Peninsula started after establishment of the Antarctic Treaty in 1959. Many research stations have been established in the maritime Antarctic and scientific activity centred amongst them. However, floristic field studies in Antarctica face serious logistical obstacles. Ice-free areas are often difficult to access, because on the land side they are usually separated by vast glaciers which are difficult to pass, and on the sea side they are not easy to approach owing to rough sea waves and steep coastal cliffs. This explains the lack of floristic data from many small islands or isolated nunataks. For scientific research in the Graham Land area, “Base F” (65°14'44.79"S, 64°15'26.90"W) was originally set up by the British on the Graham Coast in 1947, subsequently moved in 1953–1954 to Galindez Island, the largest island of the Argentine Islands and in 1977 renamed “Faraday” in honour of Michael Faraday (1791–1867). Based on the Faraday Station, a flora of the bryophytes and vegetation of the Argentine Islands was produced during the 1970s (Lewis Smith & Corner 1973). In 1996, this base was handed over to the Ukraine and was renamed the Vernadsky Research Base after Volodymyr Vernadsky (1863–1945), one of the founders of geochemistry and radiogeology.

This base is an excellent starting point for studies on the moss flora of the Argentine Islands, an archipelago of islands off the Graham Coast, and adjacent areas. They yielded several new regional moss records (Ellis *et al.* 2016a, b, c, 2020a).

Beside the peri-Antarctic archipelagoes of the South Orkney Islands and South Shetland Islands, the northern and central parts of the West Antarctic Peninsula exhibit the greatest diversity of bryophytes in Antarctica. The north-western coast of the Antarctic Peninsula stretching between Cape Herschel (Sterneck) in the north at latitude 64°04'S and Cape Renard in the south at latitude 65°01'S is called the Danco Coast. Its moss flora together with offshore islands consists of 46 species (Ochrya *et al.* 2008a). The central coast of the West Antarctic Peninsula between Cape Renard in the north and Cape Bellue in the south at latitude 66°18'S is called the Graham Coast (Hattersley-Smith 1991) and its moss flora comprises 50 species (Blockeel *et al.* 2006; Ochrya *et al.* 2008a; Parnikoza *et al.* 2012; Ellis *et al.* 2016a, c, 2020a).

In the present account new distributional data for 12 species of moss collected on the mainland and off-lying islands of the Danco Coast and Graham Coast are provided, including one new record for each region. Updated distribution maps for all species in the Antarctic are presented.

MATERIAL AND METHODS

The moss specimens were collected by Ivan Parnikoza and Victoria Ivanets during field work carried out on the XIX, XXI, XXIV, XXV and XXVI Ukrainian Antarctic Expeditions in 2014–2022. Two collections were made on Murray (Bluff) Island and the Pefaur (Ventimiglia) Peninsula in the Graham Passage area (64°24'S, 61°31'W) on the Danco Coast, an area from which no botanical collections had hitherto been made. Most collections come from the Kyiv Peninsula on the mainland Graham Coast and from various offshore islands, including the Argentine Islands and Hovgaard Island in the Wilhelm Archipelago, as well as Darboux Island in Collins Bay and Lahille Island in Grandidier Channel.

Among collecting sites cited in this paper, the distinction between Rasmussen Point (also designated as a cape or an oasis) (65°14'46.32"S, 64°05'05.08"W) and Rasmussen Island (65°15'26.21"S, 64°04'43.65"W) is needed. These are closely spaced sites in the Waddington Bay area immediately north of Cape Tuxen on the Kyiv Peninsula. Originally, the name Cape Rasmussen appeared on a map of the Belgian Antarctic Expedition and was applied to the north-eastern entrance point of Waddington Bay (Lecointe 1900). The name of this feature was initially associated with Knud J. V. Rasmussen (1879–1933), a Danish explorer of the Arctic or Jens E. C. Rasmussen (1841–1893), a Danish painter who visited Greenland and tragically was drowned in the North Atlantic (Hattersley-Smith 1991). However, the eponym of the name of this cape is actually Aage Rasmussen, vice-manager of the Copenhagen shipyard, who was providing practical assistance in preparation for the *Belgica* expedition (Verlinden 2008). Subsequent expeditions found that there was no cape in this area and therefore the name “Rasmussen” was transferred to the nearby island which is now

known as Rasmussen Island and is situated on the north-eastern side of the entrance to Waddington Bay. At the same time, north of this island exists a continental point, on which a British Antarctic Survey refuge hut was established in 1985 and called “Rasmussen Hut”, but sometimes the name “Cape Rasmussen” was used for this point. After 1996, the Ukrainian expeditions continued to name this point Cape Rasmussen, which should be noted during working with samples from that time. The alternative name “Rasmussen Oasis”, which appeared to be more appropriate, was also used for this site. Currently, the National Antarctic Scientific Centre of the Ukraine has proposed the official name Rasmussen Point for this feature (Yevchun *et al.* 2021) and it is also used in the present paper.

The voucher collections cited in this account are stored in the bryophyte section of the herbarium in the W. Szafer Institute of Botany, Polish Academy of Sciences in Kraków (KRAM). Moss specimens were identified using traditional microscopic and laboratory techniques. Distributions of all species recorded in the present paper are mapped on detailed large-scaled maps of the Danco and Graham Coasts and include the ‘specimens examined’ records published in *The Illustrated Moss Flora of Antarctica* (Ochyra *et al.* 2008a) supplemented by new records. The standard base maps of the Biology and Ecology Department of the National Antarctic Centre of the Ukraine have been used for completing the distribution maps (Yevchun *et al.* 2021). The maps are on a scale of 1:240 000, Horizontal Datum: WGS84, Projection: UTM Zone 20S, Contours source Scar Add v7.4.

RESULTS

New records for 12 rare species are reported for the moss flora of the Graham Passage area on the Danco Coast, the Kyiv Peninsula and the offshore islands of the Wilhelm Archipelago, as well as the Collins Bay and Grandidier Channel areas of the Graham Coast on the west side of the Antarctic Peninsula. The Danco Coast and Graham Coast floras include at present a total of 47 and 51 species of moss, respectively. Details of the localities and habitat conditions, as well as local distributions, are presented. The distribution of each species in the study areas of the Danco Coast and Graham Coast is mapped in Figures 1–14. In addition, taxonomic and nomenclatural comments are provided with notes on the reviewed Antarctic and world distribution for most species.

Family ANDREAEEACEAE Dumort.

Genus *Andreaea* Hedw.

Andreaea regularis Müll.Hal.

SPECIMENS EXAMINED. — **Antarctica**. West Antarctic Peninsula, Graham Coast, Wilhelm Archipelago, in the north-eastern part of Hovgaard Island, 65°07'14"S, 64°04'05"W, alt. 30 m a.s.l., on rocky cliffs, 20.II.2019, *Parnikoza* & *Ivanets* 12/19 (KRAM[B-258904]); same area, alt. 30 m a.s.l., on exposed rock surface above the moss bank and below the stand of *Hymenoloma crispulum* (Hedw.) Ochyra associated with *Kiaeria pumila* (Mitt.) Ochyra and *Bucklandiella sudetica* (Funck) Bedn.-Ochyra & Ochyra, 12.II.2022, *Parnikoza*

01/22 (KRAM[B-262847]); same area, 65°07'15"S, 64°04'07"W, alt. 30 m a.s.l., in the lower part of the exposed rocky buttress in the company of bryophyte species growing in the immediate vicinity, including *Sanionia georgicouncinata* (Müll.Hal.) Ochyra & Hedenäs, *Polytrichastrum alpinum*, *Kiaeria pumila*, *Pohlia nutans* (Hedw.) Lindb. and *Barbilophozia hatcheri* (A.Evans) Loeske, 12.II.2022, *Parnikoza* 10/22 (KRAM[B-262841]).

REMARKS

Hovgaard Island is the second largest island in the Wilhelm Archipelago situated between Booth Island and Petermann Island off the Graham Coast. Bryologically, the island is very poorly known and the only moss collection consisting of a few specimens was made on it in February 1905 by J. Turquet, a naturalist to the third French Antarctic Expedition of 1903–1905. Cardot (1906, 1907) recognised four species, which according to modern taxonomic concepts represented three species: *Polytrichastrum alpinum*, *Pohlia cruda* (Hedw.) Lindb. and *Bryum pseudotriquetrum* (Hedw.) P.Gaertn., B.Mey. & Scherb. (Ochyra *et al.* 2008a). A recent survey of the island's bryoflora yielded some additional moss and hepatic species, including *Andreaea regularis*. Occurrence of this species on Hovgaard Island was expected since it is frequently collected on the coterminous islands in the Wilhelm Archipelago, although, surprisingly, it is very rare on the mainland Graham Coast where it has so far only been recorded on Cape Tuxen (Fig. 1).

Andreaea regularis is the most widespread and abundant species of the genus *Andreaea* Hedw. in the Antarctic, extending from Leskov Island in the South Sandwich Islands and the orphaned Bouvetøya in the South Atlantic Ocean in the north to George VI South and Charcot Island off Alexander Island in the south, although becoming scattered and localised south of the Antarctic Circle (Ochyra *et al.* 2008a). It is especially abundant on the peri-Antarctic archipelagoes of the South Orkney Islands and the South Shetland Islands, on the Danco Coast, and on the northern part of the Graham Coast on the west side of the Antarctic Peninsula. On the east side of the Antarctic Peninsula it is very rare on Joinville Island and James Ross Island and on the Oscar II Coast and Wilkinson Coast. As the only species of its genus, *A. regularis* has been found in East Antarctica at several sites on the Eights Coast on Ellsworth Land. *Andreaea regularis* is an amphiatlantic subantarctic species which is widely scattered at montane elevations in the western fringes of southern South America from Tierra del Fuego to the Province of Valdivia, in the Falkland Islands and on subantarctic South Georgia, the Prince Edward Islands and Îles Crozet extending northwards to Tristan da Cunha and Bolivia in the Central Andes (Zanten 1971; Ochyra & Hertel 1990; Ochyra *et al.* 2008a).

Family POLYTRICHACEAE Dumort.

Genus *Polytrichum* Hedw.

Polytrichum juniperinum Hedw.

SPECIMEN EXAMINED. — **Antarctica**. West Antarctic Peninsula, Graham Coast, Grandidier Channel, Lahille Island at the north-eastern

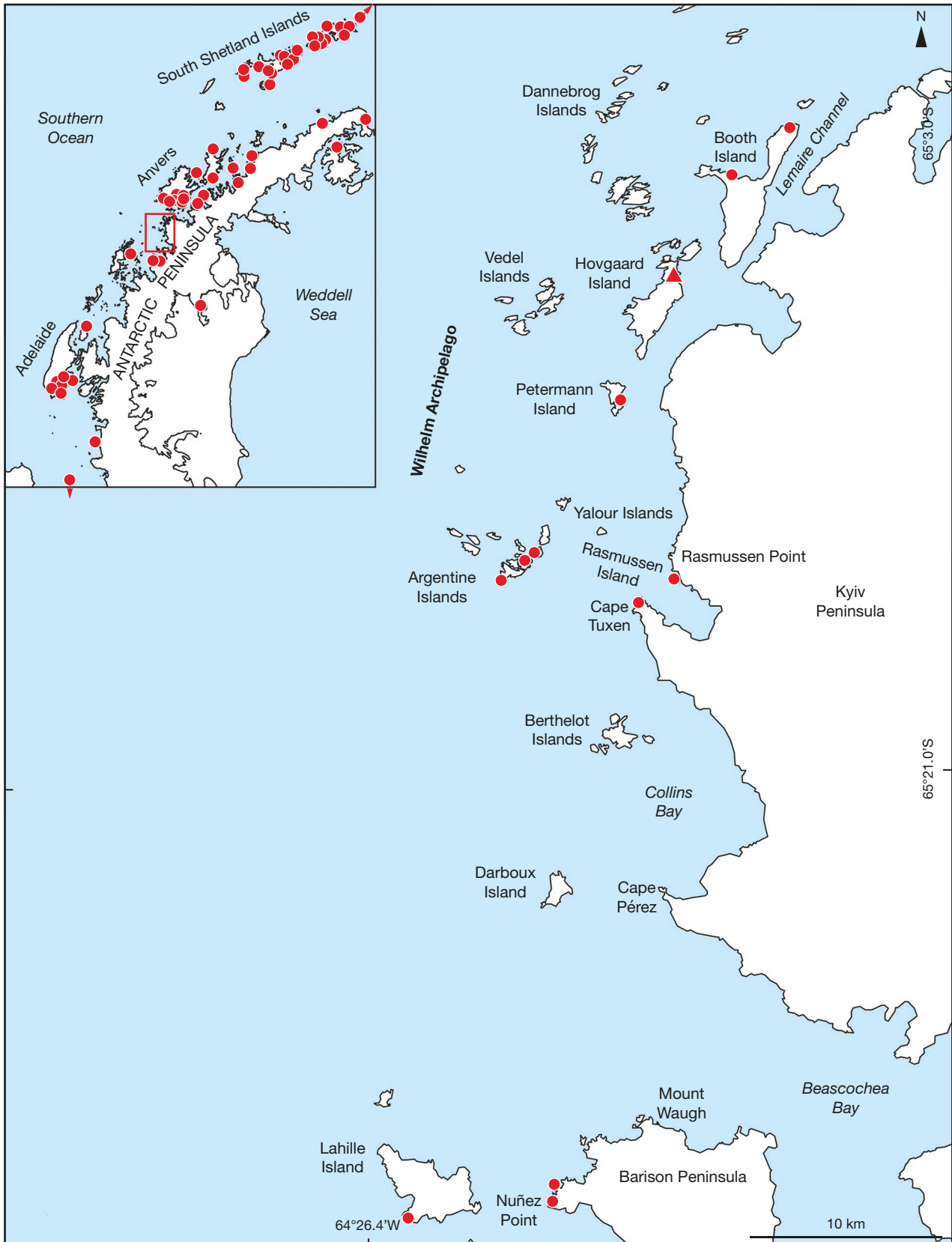


FIG. 1. — Distribution map for *Andreaea regularis* Müll. Hal. in the Graham Coast area and in the northern Antarctic Peninsula region including the South Shetland Islands (inset). The new locality on Hovgaard Island is marked with a triangle.

entrance of Leroux Bay west of Barison Peninsula, 65°33'12.89"S, 64°23'42.14"W, on ground in the bryophyte carpet and mat subformation, 7.II.2020, *Parnikoza* 6B/20 (KRAM[B-259591]).

REMARKS

Polytrichum juniperinum was found on Lahille Island on a unique vegetated point on the island's south-western coast in the bryophyte carpet and mat subformation, with patches of the grass *Deschampsia antarctica* É.Desv. (Poaceae) and cushion-forming *Colobanthus quitensis* (Kunth) Bartl. (Caryophyllaceae), the only two vascular plants that are native to the Antarctic. Like elsewhere in Antarctica, it is a pioneer species growing on soil and humus and colonising communities of the fruticose lichen and moss cushion subformation, often in association with vascular plants (Ochyra *et al.* 2008a). In this locality it is associated with *Brachythecium austroglareosum* (Müll. Hal.) Kindb. and *Pohlia drummondii* (Müll. Hal.) A.L.Andrews.

The present new locality of *Polytrichum juniperinum* on Lahille Island is the southernmost discovery of this species on the Graham Coast. The species was previously known in this region only from Uruguay Island in the Argentine Islands, Cape Tuxen on the mainland Graham Coast and Darboux Island in Collins Bay (Ochyra *et al.* 2008a). Thus, the discovery of this species on Lahille Island shifts the southern limit of its occurrence in the Graham Coast area about 16 km to the south (Fig. 2). In general, *P. juniperinum* reaches its southernmost locality in the Antarctic at latitude 67°58'S on Camp Point in Marguerite Bay on the Fallières Coast.

Family DICRANACEAE Schimp.

Genus *Kiaeria* I.Hagen

Kiaeria pumila (Mitt.) Ochyra

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Wilhelm Archipelago, in the north-eastern part of Hovgaard Island, 65°07'15"S, 64°04'07"W, alt. 30 m a.s.l., on rock surface above the moss bank, 20.II.2019, *Ivanets* 52a/19 (KRAM[B-260628]); *Ivanets* 52b/19 ([B-260629]); same area, in the lower part of the exposed rocky buttress in the company of bryophyte species growing in the immediate vicinity, including *Polytrichastrum alpinum*, *Sanionia georgicouncinata*, *Andreaea regularis*, *Pohlia nutans* and *Barbilophozia hatcheri*, 12.II.2022, *Parnikoza* 13/22 (KRAM[B-262838]); same island, 65°07'14"S, 64°04'08"W, alt. 30 m a.s.l., at the base of the exposed rocky buttress together with *Pohlia nutans* and *Lophozia excisa* (Dicks.) Dumort. growing in the close proximity, 12.II.2022, *Parnikoza* 07/22 (KRAM[B-262844]); same island, 65°07'14"S, 64°04'05"W, alt. 30 m a.s.l., on exposed rock surface above the moss bank associated with *Andreaea regularis*, *Hymenoloma crispulum* and *Bucklandiella sudetica*, 12.II.2022, *Parnikoza* 04/22 (KRAM[B-262848]).

REMARKS

On Hovgaard Island *Kiaeria pumila* was found at three sites close to each other in the vegetated north-facing oasis covered mainly by *Polytrichum strictum* Brid. moss bank in the north-eastern part of this island. Some were collected from rock outcrop surfaces inclined near 40° in lower, wetter and shadowed parts, in association with *Andreaea regularis* and

Sanionia georgicouncinata. In higher, more exposed and sunny parts *Hymenoloma crispulum* and *Bucklandiella sudetica* also occur. Sometimes cushions of *K. pumila* occur on moss carpets dominated by *Brachythecium austrosalebrosum* (Müll. Hall) Kindb., *Pohlia nutans* and *Sanionia georgicouncinata* and together with *Lophozia excisa* and *Barbilophozia hatcheri*, situated in depressions between stands of a moss bank of *Polytrichum strictum* Menzies ex Brid. and *Chorisodontium aciphyllum* (Hook.f. & Wilson) Broth. with small turves of *Pohlia nutans* and *Polytrichastrum alpinum*.

Although *Kiaeria pumila* is a species which is immediately distinct from other Antarctic taxa of dicranalean mosses, it is very likely that it is actually a complex of two closely related species. Unfortunately, almost all Antarctic populations are sterile and fully mature sporophytes have only been found in two specimens from Rasmussen Island on the Graham Coast and sporophyte traits are of critical taxonomic importance in this genus. Antarctic plants of this species represent two distinct morphological types. Mosses belonging to one group have a typical dicranoid aspect with regular strongly falcato-second leaves, which are sometimes even circinate at the stem spices. In contrast, in plants belonging to the second group, the falcation of the leaves is less obvious or absent and the leaves are straight, flexuose and somewhat crisped. Microscopically these two phenotypes are almost inseparable from each other, having identical leaf areolation and prominent, often ventricose and coloured alar cells. In this situation, molecular data can be very helpful in establishing the identity of plants with different leaf shapes and DNA of Antarctic specimens of *K. pumila* urgently needs to be sequenced. In all sites on Hovgaard Island the plants showed a typical dicranoid aspect with regularly strongly falcato-second leaves were collected.

In Antarctica, *Kiaeria pumila* is an infrequent species, although locally it may occur in abundance. It is widely distributed but scattered in the northern and central maritime Antarctic (Fig. 3). It is relatively frequent in the South Orkney Islands and becomes rare and localized southwards in the South Shetland Islands and the Antarctic Peninsula. It is very rare on the Trinity Peninsula and scattered on the Danco Coast and Graham Coast on the west side of the Antarctic Peninsula. In the latter it is known only from six sites, five of which are on the offshore islands, including Hovgaard Island, Petermann Island, Rasmussen Island, Berthelot Islands and the largest island off Takaki Promontory at latitude 65°33'S (the southernmost station of *K. pumila*). On the mainland Graham Coast it has been recorded only once on Cape Pérez. The species is widespread on subantarctic South Georgia (Ochyra *et al.* 2002).

Family GRIMMIACEAE Arn.

Genus *Schistidium* Bruch & Schimp.

Schistidium rivulare (Brid.) Podp.

SPECIMEN EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Cape Pérez, 65°24'27.36"S, 64°05'49.39"W, on rock

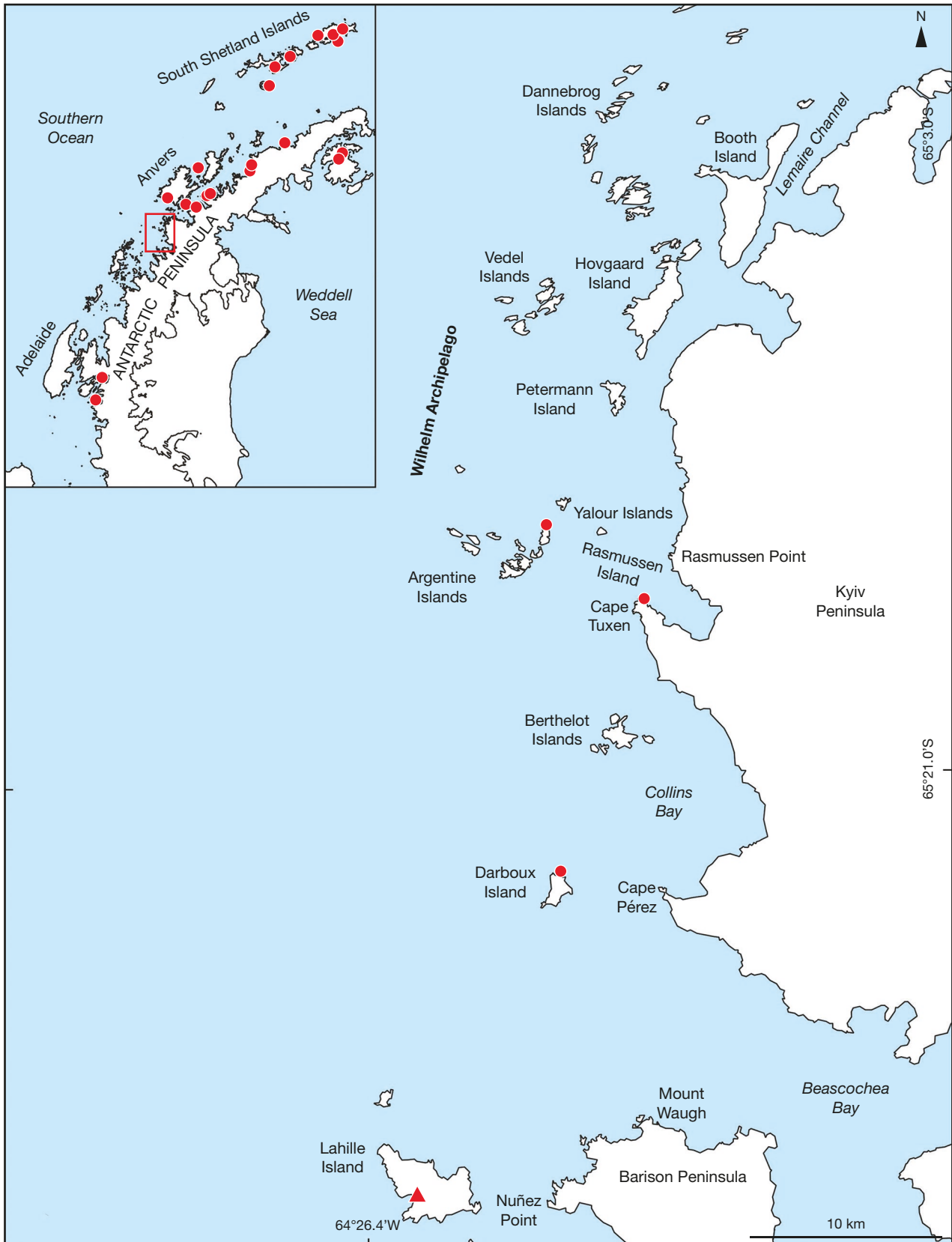


FIG. 2. — Distribution map for *Polytrichum juniperinum* Hedw. in the Graham Coast area and in the northern Antarctic Peninsula region including the South Shetland Islands (**inset**). The new locality on Lahille Island is marked with a **triangle**.

surface in the short moss turf and cushion subformation, 1.III.2019, Parnikoza & Ivanets 298/19 (KRAM[B-257916]).

REMARKS

Schistidium rivulare is a hydrophytic species forming wide patches or turves on wet or damp rocks and in such sites it was found on Cape Pérez on rock surfaces on a vegetated point in the short moss turf and cushion subformation. With this discovery, the southern limit of the geographical range of *S. rivulare* was shifted approximately 16 km southward, from Cape Tuxen to Cape Pérez on the south side of Collins Bay, and is now at latitude 65°24'27.36"S on the mainland Graham Coast (Fig. 4).

Schistidium rivulare is a bipolar species which exhibits a boreal-montane panholarctic but disjunct geographical range in the Northern Hemisphere and penetrating into the Arctic in the north and having intermediate altimontane stations in the tropics, including North and Central Andes in the Neotropics and East and Central African mountains. However, the tropical records of this species need careful taxonomic revision because a re-examination of some specimens named *S. rivulare* revealed that they represented different species. For example, the Peruvian material so-named (Deguchi 1987) actually represents two distinct species, *S. rivulariopsis* (R.S.Williams) Ochyra and *S. deguchianum* Ochyra & Bedn.-Ochyra (Ochyra & Bednarek-Ochyra 2011). The same proved to be true with the Colombian and Kenyan records of *S. rivulare* which are actually *S. rivulariopsis* (Ellis *et al.* 2015, 2016c), and taxonomic re-evaluation made the latter a typical Afro-American disjunct species (*sensu* Ochyra *et al.* 1992; Bednarek-Ochyra *et al.* 1999; Ochyra & Ireland 2004, 2016; Ochyra & Singh 2008; Bednarek-Ochyra & Ochyra 2010, 2012a, b, 2013a; Ochyra & van Rooy 2013).

In the Southern Hemisphere the most problematic is the occurrence of *Schistidium rivulare* in Australia and New Zealand. The record of this species in Australia is based on the conspecificity of *S. flexifolium* (Hampe) Ochyra with *S. rivulare* (Dixon 1926; Bremer 1980), but these species have little in common with each other, except for being aquatics, and are distinct species (Ochyra 2003). Fife (2000) recognised *S. rivulare* in the moss flora of New Zealand but his detailed description and illustrations of the plants clearly show that the New Zealand material in fact represents a different species which exhibits some similarity to southern South American and subantarctic *S. falcatum* (Hook.f. & Wilson) B.Bremer. On the other hand, Fife (2000) distinguished *S. rivulare* subsp. *subflexifolium* (Müll.Hal.) Fife, which is clearly conspecific with *S. flexifolium* (Ochyra 2003). Until detailed taxonomic study of this complex is completed for Australasia, occurrence of *S. rivulare* in this region should be treated with reservation.

Schistidium rivulare does occur in the Western Hemisphere in Tierra del Fuego (Cardot & Brotherus 1923) and on subantarctic South Georgia (Bell 1984) and penetrates to the maritime Antarctic (Ochyra *et al.* 2008a) (Fig. 4). In this biome the species is very rare in the South Sandwich Islands and locally frequent on Signy Island in the South Orkney Islands. It is quite frequent on Livingston Island and very

rare on King George Island in the South Shetland Islands (Ochyra 1998a), although in the latter island it seems to have spread in recent decades and a large population of this species was found in 2018 on Creeping Slopes above Demay Point and in additional streams in the Point Thomas area in Admiralty Bay (Wierzoń, personal observations) where it was not recorded in the very early 1980s (Ochyra, personal observations). Likewise, *S. rivulare* is very rare and localised on the Danco Coast and in the offshore Palmer Archipelago and on the Graham Coast where until recently it was collected only on Petermann Island and Cape Tuxen. The present discovery on Cape Pérez is its southernmost record in the Southern Hemisphere.

Outside the Antarctic and South Georgia, in the austral polar biome *Schistidium rivulare* is known from two subantarctic archipelagoes in the South Indian Ocean, namely Îles Kerguelen (Blockeel *et al.* 2009a) and Îles Crozet (Ellis *et al.* 2020b). Thus, it exhibits an amphiatlantic distribution pattern which is typical of many bryophyte species (e.g. Ochyra & Váňa 1989; Bednarek-Ochyra & Ochyra 1998; Ochyra & Lewis Smith 1998; Ochyra & Zander 2002; Blockeel *et al.* 2007, 2009b; Li *et al.* 2009; Ochyra 2010; Ochyra & Bednarek-Ochyra 2013; Ochyra *et al.* 2015).

Schistidium Bruch & Schimp. is the largest moss genus in the Antarctic, consisting of 13 species, of which *S. rivulare* is the only species occurring outside the Southern Hemisphere. All remaining congeners are austral species and seven of them are Antarctic endemics. Five of these, including *S. steerei* Ochyra (Ochyra 1987), *S. halinae* Ochyra (Ochyra 1998b), *S. lewis-smithii* Ochyra (Ochyra 2003), *S. deceptionense* Ochyra, Bedn.-Ochyra & R.I.L.Sm. (Ochyra *et al.* 2003a) and *S. leptoneurum* Ochyra (Ochyra 2004), are restricted in their occurrence to the maritime Antarctic, whereas the other two, *S. urnulaceum* (Müll.Hal.) B.G.Bell (Ochyra 1990a) and *S. antarctici* (Cardot) L.I.Savicz & Smirnova (Ochyra *et al.* 2008a), are pan-Antarctic species weakly penetrating to subantarctic South Georgia.

Genus *Bucklandiella* Roiv.

Bucklandiella sudetica (Funck) Bedn.-Ochyra & Ochyra

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Wilhelm Archipelago, in the north-eastern part of Hovgaard Island, 65°07'14"S, 64°04'05"W, alt. 30 m a.s.l., on exposed rock surface above the moss bank and below the stand of *Kiaeria pumila* associated with *Hymenoloma crispulum* and *Andreaea regularis*, 25.II.2019, Parnikoza & Ivanets 300/19 (KRAM[B-257918]); same place and conditions, 12.II.2022, Parnikoza 03/22 (KRAM[B-262849]).

REMARKS

Grimmiaceae subfam. Racomitrioideae is represented by two genera in Antarctica which are segregates of the broadly conceived genus *Racomitrium* Brid. (Ochyra *et al.* 2003b; Bednarek-Ochyra *et al.* 2014; Sawicki *et al.* 2015). Of these, *Racomitrium* s.str. contains a single species, *R. lanuginosum*

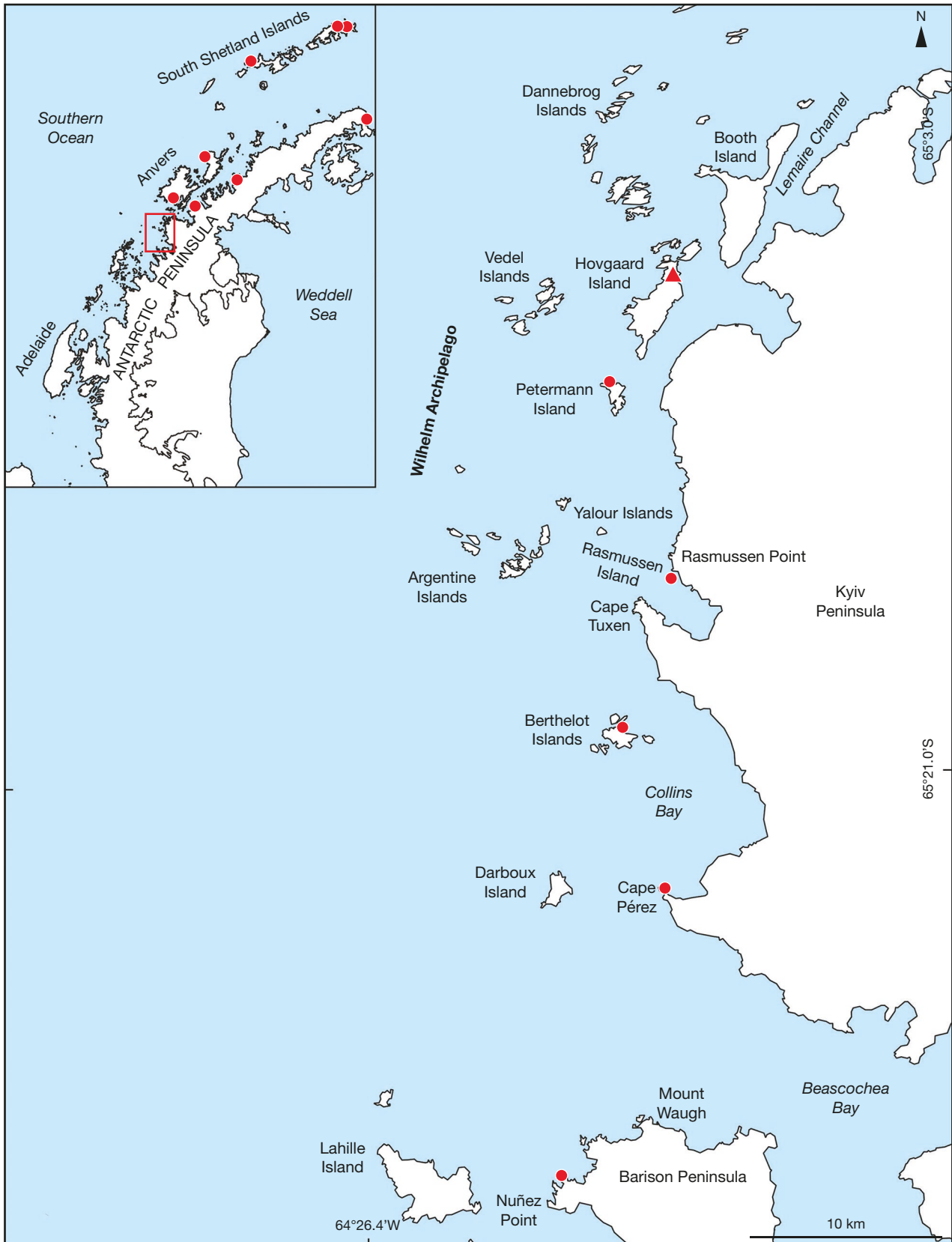


FIG. 3. — Distribution map for *Kiaeria pumila* (Mitt.) Ochyra in the Graham Coast area and in the Antarctic Peninsula region including the South Shetland Islands (inset). The new locality on Hovgaard Island is marked with a triangle.

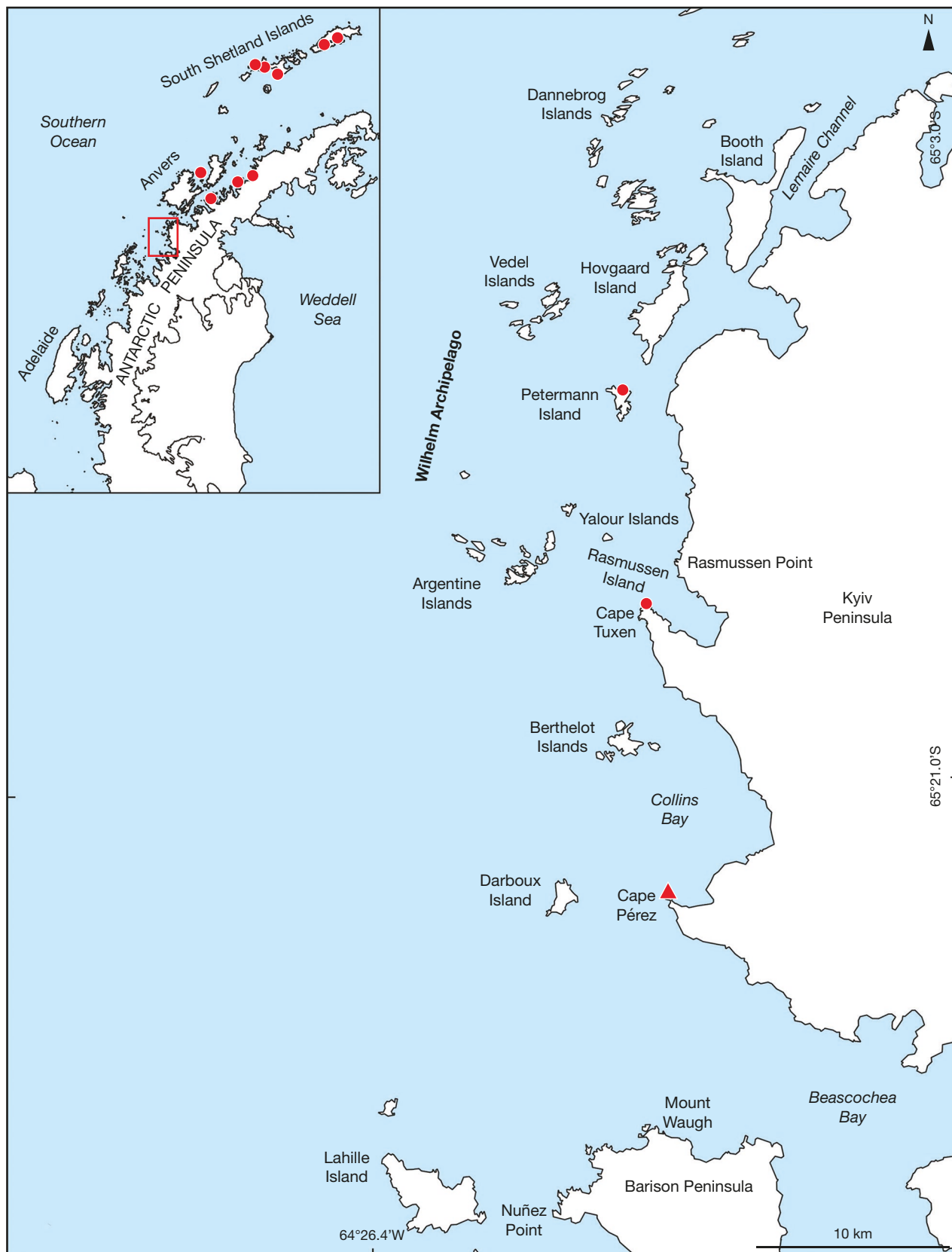


FIG. 4. — Distribution map for *Schistidium rivulare* (Brid.) Podp. in the Graham Coast area and in the Antarctic Peninsula region including the South Shetland Islands (**inset**). The new southernmost locality on Cape Pérez is marked with a **triangle**.

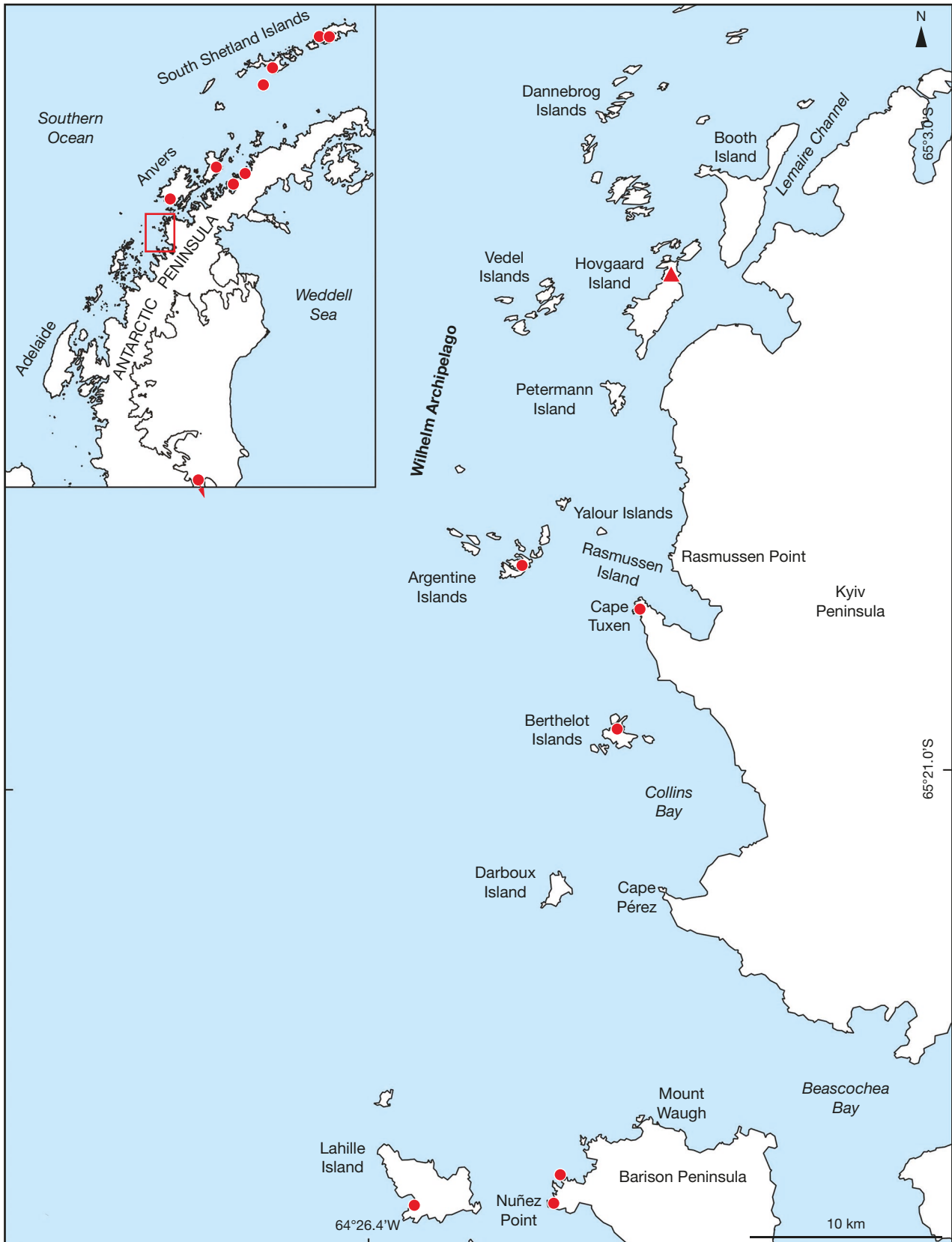


FIG. 5. — Distribution map for *Bucklandiella sudetica* (Funck) Bedn.-Ochyra & Ochyra in the Graham Coast area and in the northern Antarctic Peninsula region including the South Shetland Islands (**inset**). The new locality on Hovgaard Island is marked with a **triangle**.

(Hedw.) Brid., which is exceedingly rare and so far recorded only from heated ground on the volcanic Deception Island (Lewis Smith 2005a, b; Ochyra *et al.* 2008b). In contrast, *Bucklandiella* Roiv. consists of no fewer than five species which are not prominent constituents of the moss flora in this biome, both in terms of frequency and cover (Ochyra *et al.* 2008a; Ellis *et al.* 2013a, 2017). Of all the species of this genus, *B. sudetica* is the most widely distributed, but generally infrequent and only quite abundant in places. One such area is the Graham Coast, where it is known from several sites on Galindez Island in the Argentine Islands, on Cape Tuxen, in the Berthelot Islands, Lahille Island and on the Barison Peninsula and its offshore island where it reaches its southernmost occurrence on the west side of the Antarctic Peninsula (Ochyra *et al.* 2008a). The discovery of the species on Hovgaard Island is thus a remarkable extension of its geographical range in this region to the northern part of the Wilhelm Archipelago (Fig. 5). Additionally, *B. sudetica* is scattered in the Danco Coast including the Palmer Archipelago and frequent in the South Orkney Islands and in the South Shetland Islands, and occasional in the South Sandwich Islands. It was also once recorded on the east side of the Antarctic Peninsula on the Wilkins Coast at latitude 69°32'S, its southernmost locality in the Southern Hemisphere (Ochyra *et al.* 2008a).

Bucklandiella sudetica is a bipolar species lacking any intermediate altimontane outposts in the tropical mountains. In the Southern Hemisphere it is a temperate oreophyte having a strongly disjunct panholantarctic geographical range, known from all continental landmasses including southern South America (Frisvoll 1986; Ochyra *et al.* 2015), South Africa (Bednarek-Ochyra 2018), SE Australia and Tasmania (Frisvoll 1986; Ellis *et al.* 2011a; Bednarek-Ochyra & Ochyra 2013b) and New Zealand (Ellis *et al.* 2011b). In addition, it penetrates into the austral polar regions, including subantarctic islands of South Georgia (Bell 1974), Marion Island (Ellis *et al.* 2014) and Heard Island (Ellis *et al.* 2013a) and the maritime Antarctic and Tristan da Cunha in the south-cool-temperate zone in the South Atlantic Ocean (Ellis *et al.* 2019).

Family BRYACEAE Rchb.
Genus *Schizymenium* Harv.

Schizymenium pusillum (Hook. & Wilson) A.J. Shaw

SPECIMEN EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Rasmussen Point, 65°14'49.70"S, 64°05'6.76"W, in fissures of rocks in the short moss turf and cushion subformation, 9.II.2016, *Parnikoza 21a/16* (KRAM[B-260625]).

REMARKS

A new locality of *Schizymenium pusillum* on Rasmussen Point is apparently the first discovery of this species on the mainland Antarctic Peninsula. Hitherto, it was collected only on the offshore islands of the Antarctic Peninsula, including Andrée Island in Charlotte Bay on the Danco Coast and Galindez Island in the Argentine Islands and Rasmussen Island off the Graham Coast (Clarke & Lightowlers 1983). It is one of

the rarest species of moss in the Antarctic and is only known elsewhere in the biome from a single record on Livingston Island in the South Shetland Islands (Sancho *et al.* 1999) (Fig. 6). Like elsewhere, *S. pusillum* was collected in a sheltered site in crevices of volcanic rock, growing together with *Andreaea regularis*, *Batramia patens* Brid. and *Pohlia nutans*. In the Antarctic, *S. pusillum* appears to have optimum occurrence on Galindez Island, the largest island in the Argentine Islands where it grows in profusion at several sites, although it is locally abundant on Andrée Island (Ochyra *et al.* 2008a).

Schizymenium pusillum is a South American subantarctic species having its main centre of occurrence on South Georgia (Clarke 1973 as *Mielichhoferia austrogeorgica* Müll.Hal.). In continental South America it is rare at altimontane station in the North and Central Andes of Venezuela, Colombia, Peru and Bolivia (Churchill *et al.* 2000) and from the Serra dos Órgãos National Park in the state of Rio de Janeiro in south-eastern Brazil (Ochyra *et al.* 2008a), a well-known outpost of many southern cool-adapted moss species (Herzog 1925; Sehnem 1955).

Genus *Pohlia* Hedw.

Pohlia wahlenbergii
(F. Weber & D. Mohr) A.L. Andrews

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Wilhelm Archipelago, Argentine Islands, Galindez Island, Dongon Tower, 65°14'50.14"S, 64°14'40.24"W, in the tall moss turf subformation, 15.III.2014, *Parnikoza 172/14* (KRAM[B-257790]); same locality, in the tall moss turf subformation, 24.II.2016, *Parnikoza 281/16* (KRAM[B-257899]).

REMARKS

Sparse material of *Pohlia wahlenbergii* was collected twice from the same locality in 2014 and 2016 in a site occupied by the tall moss turf subformation in which it was associated with *Polytrichum strictum*, *Polytrichastrum alpinum*, *Chorisodontium aciphyllum*, *Andreaea regularis*, *Pohlia nutans*, *Barbilophozia hatcheri*, *Cephaloziella varians* (Gottsche) Steph. and *Lophozia cf. groenlandica* (Nees) Macoun.

Pohlia wahlenbergii is one of the rarest species of moss in the Antarctic and, interestingly, it has not yet been recorded from the mainland of the Antarctic. It was found only on the two islands in the South Shetland Islands archipelago (Ochyra *et al.* 2008a) (Fig. 7). The rarity of this species in the maritime Antarctic is surprising given its frequent occurrence on subantarctic South Georgia (Clarke 1973). It is very rare on King George Island (Ochyra 1998a), although in recent decades it appears to have spread on the island and in 2018 the species was found at some additional stations on newly formed moraines on recently deglaciated terrain (Wierzoń, personal observations). It is more frequent on the volcanic Deception Island but it usually grows as an admixture in tufts of other moss species in geothermal habitats (Lewis Smith 2005a, b). The present discovery of *P. wahlenbergii* on Galindez Island in the Argentine Islands represents a significant exten-

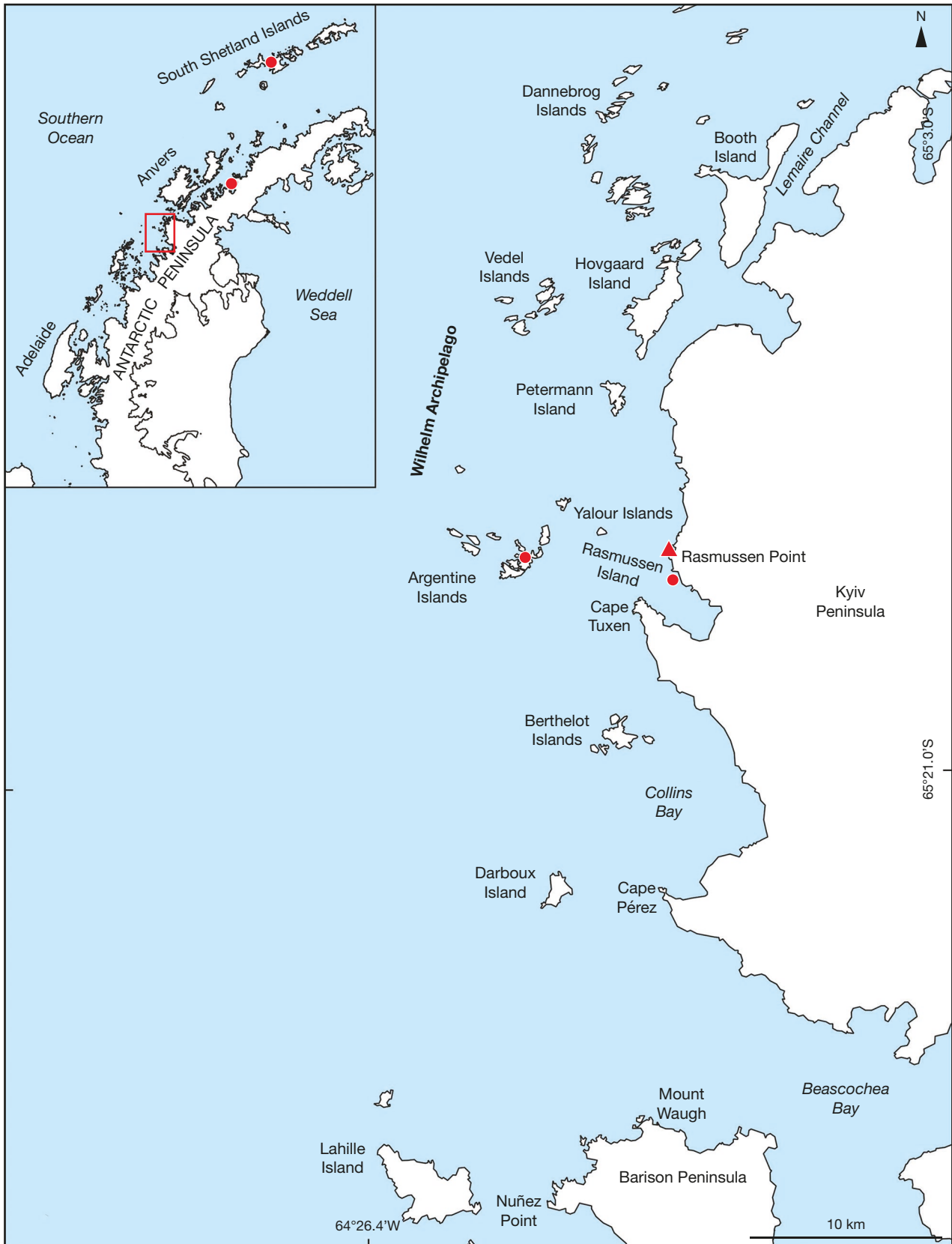


FIG. 6. — Distribution map for *Schizymenium pusillum* (Hook. & Wilson) A.J.Shaw in the Graham Coast region and in the Antarctic Peninsula including the South Shetland Islands (*inset*). The new locality on Rasmussen Point is marked with a **triangle**.

sion of its geographical range to the Graham Coast region and the shifting of the southern limit of its range to latitude 65°14'50.14"S approximately 250 kilometres south of the population recorded on Deception Island (Fig. 7).

Pohlia wahlenbergii is a bipolar species with some intermediate altimontane stations in the American Cordillera from southern Mexico to Bolivia. Interestingly, it is unknown from the Palaeotropics except for one unspecified record from Mauritius in the South Indian Ocean (O'Shea 2003). In the south-temperate zone in the Southern Hemisphere it has a panholantarctic geographical range from Patagonia through the Southern Ocean islands to southern Australia and New Zealand (Ochyra *et al.* 2008a).

Pohlia nutans (Hedw.) Lindb.

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Wilhelm Archipelago, in the north-eastern part of Hovgaard Island, 65°07'14"S, 64°04'08"W, alt. 30 m a.s.l., forming small turves at the base of the exposed rocky buttress near the stand of *Kiaeria pumila*, associated with *Lophozia excisa*, 12.II.2022, *Parnikoza* 06/22 (KRAM[B-262845]); same site, 65°07'15"S, 64°04'07"W, alt. 30 m a.s.l., in the lower part of the exposed rocky buttress in the company of bryophyte species growing in the immediate vicinity, including *Polytrichastrum alpinum*, *Sanionia georgicouncinata*, *Andreaea regularis*, *Kiaeria pumila* and *Barbilophozia hatcheri*, 12.II.2022, *Parnikoza* 14/22 (KRAM[B-262837]); same site, 65°07'14"S, 64°04'05"W, alt. 30 m a.s.l., forming large turves on the moss bank, 12.II.2022, *Parnikoza* 15/22 (KRAM[B-262851]); Graham Coast, Rasmussen Point, on western slope, 65°14'52.00"S, 64°4'60.00"W, alt. 25 m a.s.l., in wet place in moss carpet formation associated with *Andreaea regularis*, 07.III.2019, *Parnikoza* 53a/19 (KRAM[B-248849]); same area, north-west of the hut, 65°14'50"S, 64°05'08"W, alt. 30 m a.s.l., on the moss bank, 16.II.2022, *Parnikoza* 16/22 (KRAM[B-262852]).

REMARKS

The discovery of *Pohlia nutans* on Hovgaard Island is no surprise as it is one of the most common species of moss on the western side of the Antarctic Peninsula, especially in the Danco Coast and Graham Coast regions. On the Graham Coast, it is known on whole region from Booth Island in the north to the Biscoe Islands in the south (Fig. 8) (Ellis *et al.* 2020a). It is similarly common on the Fallières Coast, especially on the northern part of Marguerite Bay.

Towards the south it becomes a rare species, known from single sites on Charcot Island and Alexander Island, reaching its southernmost location in the Antarctic Peninsula on the Rymill Coast on the eastern coast of George VI Sound. It is widely distributed, though scattered on the eastern side of the Antarctic Peninsula, ranging from Joinville Island to the Wilkins Coast. In continental Antarctica *P. nutans* is rare in Victoria Land, Queen Mary Land and Ellsworth Land (Ochyra *et al.* 2008a).

Genus *Bryum* Hedw.

Bryum pallescens Schleich. ex Schwägr.

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, Waddington Bay, Rasmussen Island, 65°15'30.17"S,

64°04'44.32"W, in microhabitats on north-facing rocks in the short moss turf and cushion subformation, 3.III.2021, *Parnikoza* 17/21 (KRAM[B-258909]); Collins Bay, Darboux Island, 65°23'42.80"S, 64°12'53.73"W, in the bryophyte and lichen assemblages of the short moss turf and cushion subformation on north-facing rocks, 25.II.2020, *Parnikoza* 17/20 (KRAM[B-258889]).

REMARKS

Bryum pallescens was found in the communities dominated by fruticose lichens and bryophytes with predominantly short cushion and turf growth-form that represent a short moss turf and cushion subformation. The species was found to grow on humus and debris in crevices and cracks of rock outcrops, cliffs and ledges which are typical for its microhabitats in the Antarctic.

Beside *B. pseudotriquetrum* and *B. archangelicum* Bruch & Schimp., it is the third most widespread species of the genus in the maritime Antarctic (Fig. 9), although generally it is infrequent and only in a few areas does it occurs in great profusion. Its Antarctic geographical range extends from Bellingshausen Island, the southernmost island of the South Sandwich Islands in the north to Alamode Island in the Terra Firma Islands archipelago in southern Marguerite Bay on the Fallières Coast at latitude 68°43'S. It occurs only on the west side of the Antarctic Peninsula from the Davis Coast, where is known only from a single station, through the Danco, Graham and Loubet Coasts where it is widely distributed but scattered to the Fallières Coast (Ochyra *et al.* 2008a). In the Graham Coast region *B. pallescens* is known only from two locations on the mainland, including the coast of Lemaire Channel and Cape Tuxen, and it has been recorded from three sites in the Wilhelm Archipelago, namely Booth (Wandel) Island, Black Island in the Argentine Islands and Green Island in the Berthelot Islands archipelago in Collins Bay. The present records from Rasmussen Island and Darboux Island are noteworthy because they much extend its geographical range in the Graham Coast region (Fig. 9).

Family AMBLYSTEGIACEAE Kindb.

Genus *Warnstorfia* Loeske

Warnstorfia sarmentosa (Wahlenb.) Hedenäs

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Danco Coast, Graham Passage region, Pefaur Peninsula, Santos Peak Point, 64°24'29.66"S, 61°31'05.92"W, in wet site in the bryophyte carpet and mat subformation, 30.I.2020, *Parnikoza* 2/20 (KRAM[B-258874]); Graham Coast, Barison Peninsula, Waugh Mountain, 65°31'08.72"S, 64°04'56.21"W, sparsely on the moist ground in the bryophyte carpet and mat subformation, 25.II.2020, *Parnikoza* 14/20 (KRAM[B-258886]).

REMARKS

Warnstorfia sarmentosa is a hydrophyte which in the Antarctic is one of the most important constituents of the communities of bryophyte carpet and mat subformation which occupy a wide range of wet and often flushed habitats. The species is

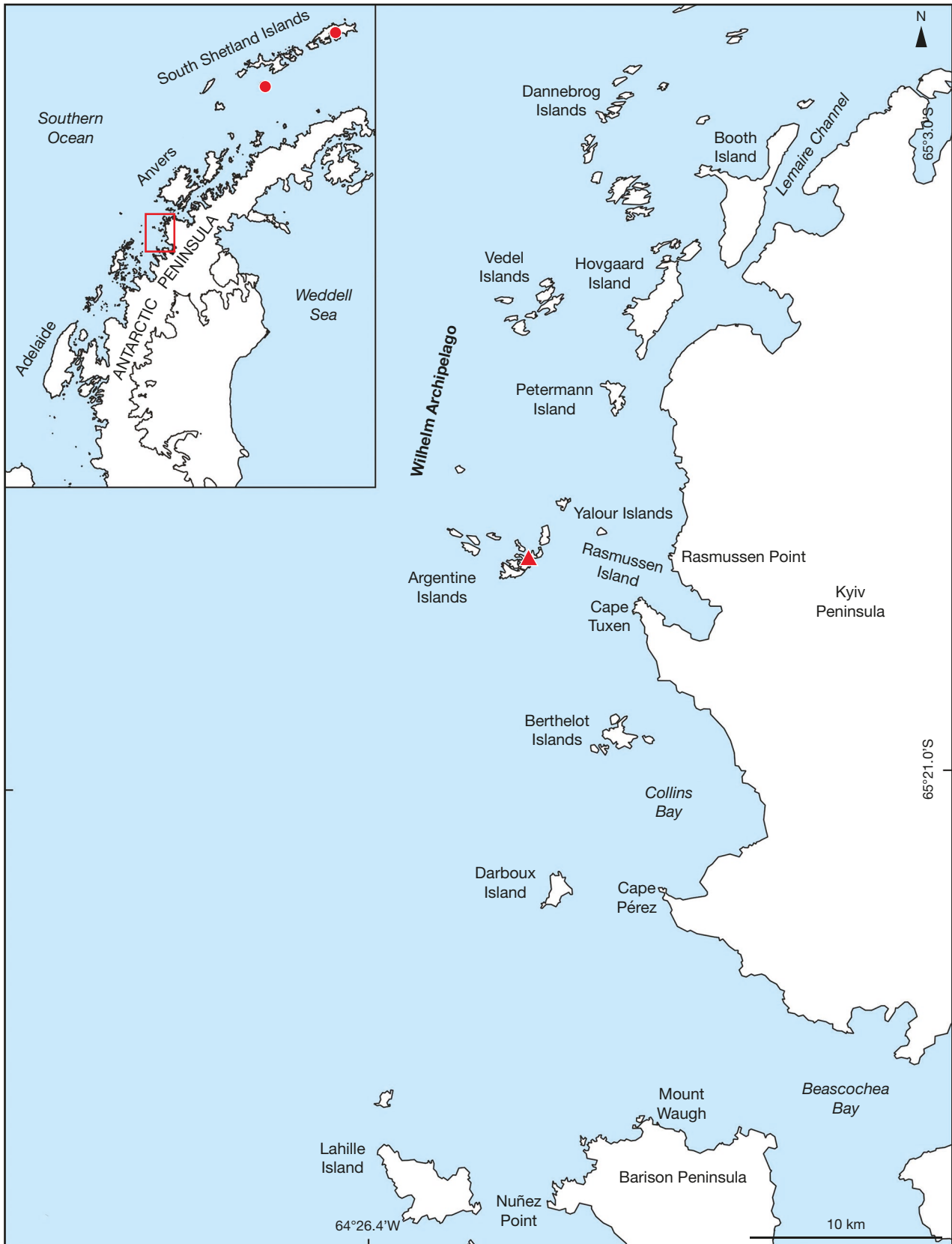


FIG. 7. — Distribution map for *Pohlia wahlenbergii* (F.Weber & D.Mohr) A.L.Andrews in the Graham Coast region and in the Antarctic Peninsula including the South Shetland Islands (*inset*). The new locality on Galindez Island is marked with a **triangle**.

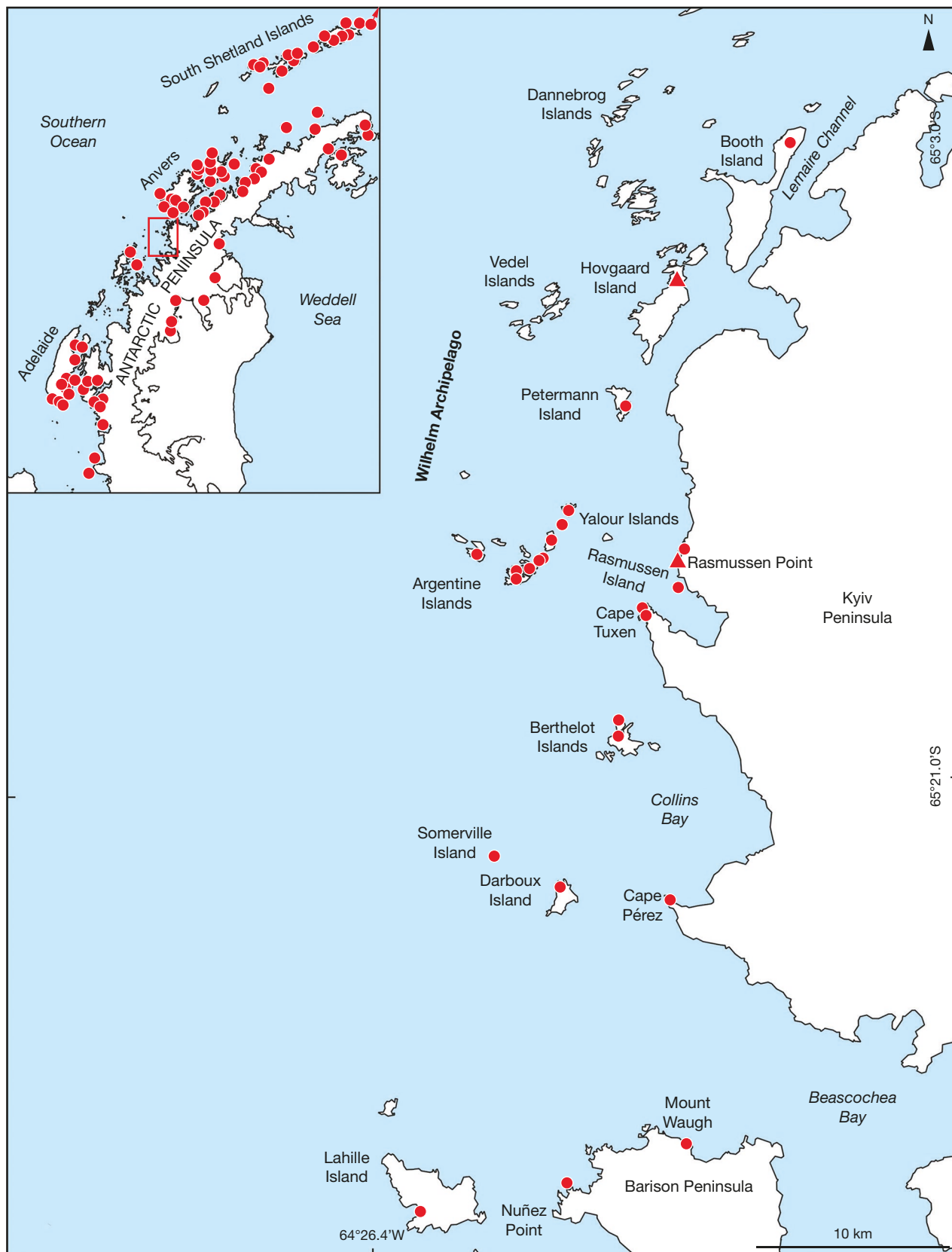


FIG. 8. — Distribution map for *Pohlia nutans* (Hedw.) Lindb. in the Graham Coast area and in the Antarctic Peninsula region including the South Shetland Islands (inset). The new localities on Hovgaard Island and Rasmussen Point are marked with **triangles**.

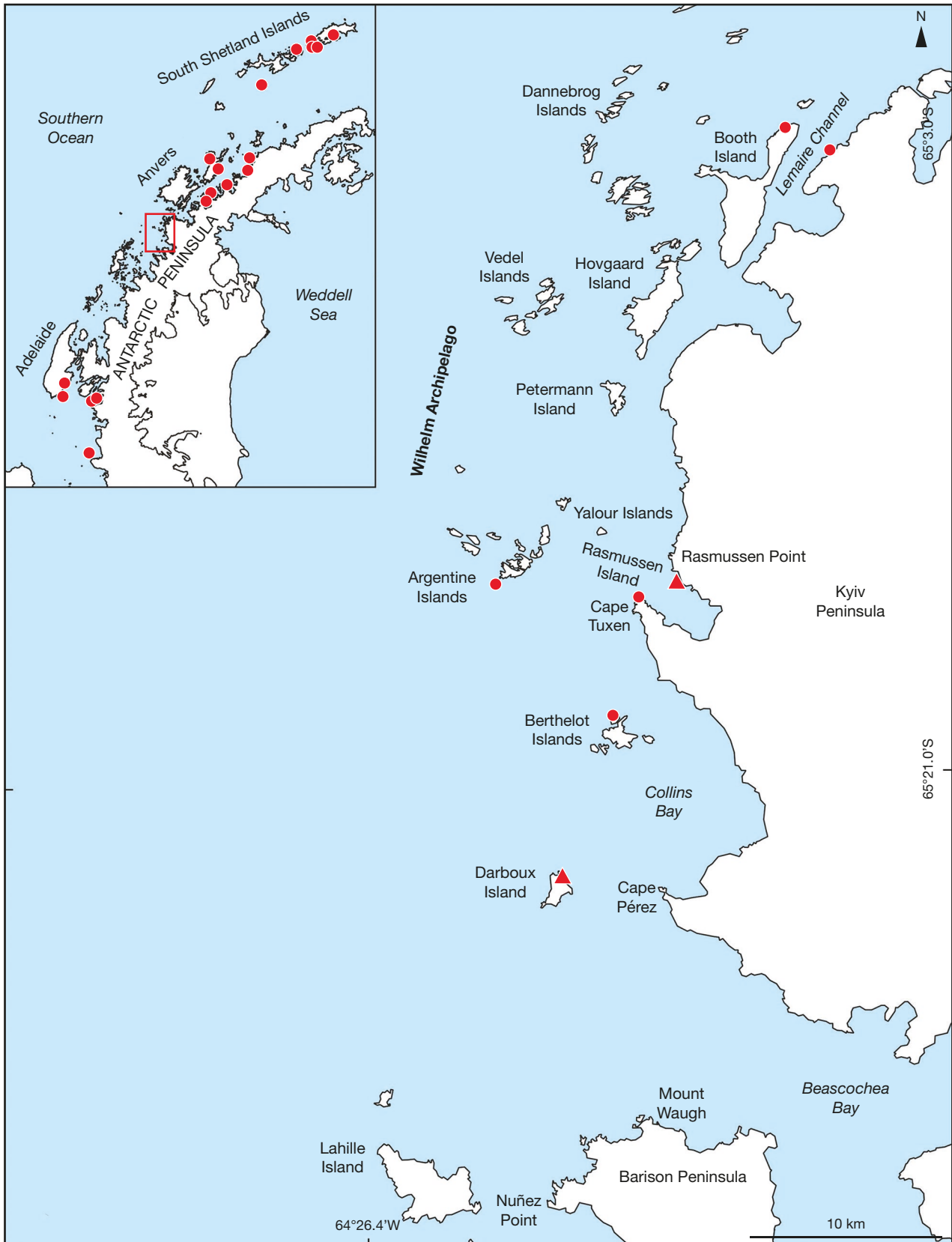


FIG. 9. — Distribution map for *Bryum pallescens* Schleich. ex Schwägr. in the Graham Coast region and in the northern Antarctic Peninsula including the South Shetland Islands (**inset**). The new localities on Rasmussen Island and Darboux Island are marked with **triangles**.

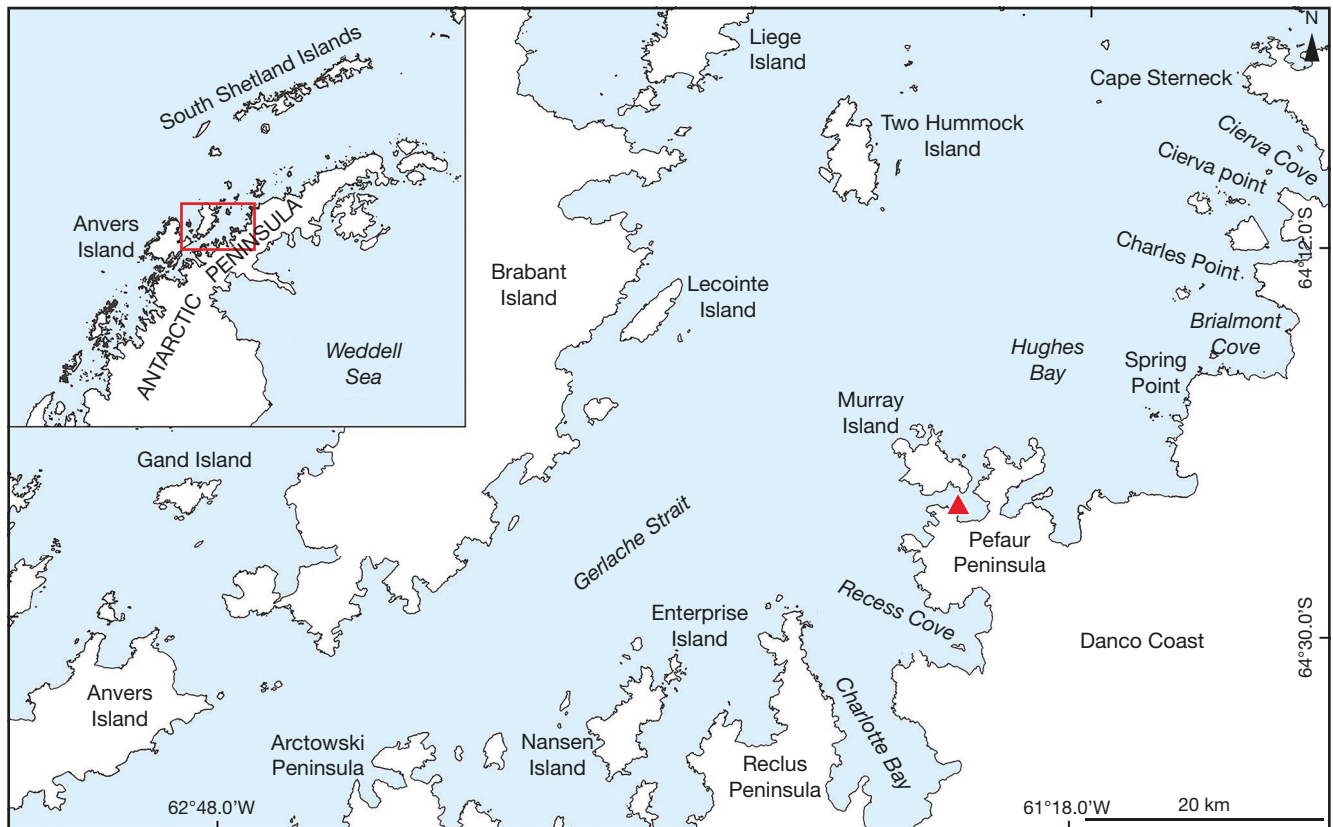


FIG. 10. — Distribution map for *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs in the Danco Coast region. The position of this region in the Antarctic Peninsula is framed on the map (inset). The new locality on the Pefaur Peninsula is marked with a triangle.

primarily widespread and locally common and abundant in the two peri-Antarctic archipelagoes of the South Orkney Islands and South Shetland Islands in the northern maritime Antarctic (Lewis Smith 1972; Ochyra 1998a; Kopalová *et al.* 2014). In the Antarctic Peninsula region its frequency and abundance is rapidly decreasing. On the west side of the northern part of Antarctic Peninsula it was only once collected on the Davis Coast and also a single record is known from James Ross Island on the east side of Antarctic Peninsula (Ochyra *et al.* 2008a). Surprisingly, *W. sarmentosa* has not so far been recorded from the mainland Danco Coast or its offshore islands and only after a fairly wide gap in the range it appears disjunctively on the Graham Coast. For many years it was known only from Lahille Island (Ochyra *et al.* 2008a) at its southernmost locality, where it was rediscovered in 2020. However, it has recently been recorded from Booth (Wandel) Island and on Rasmussen Point on the mainland Graham Coast (Ellis *et al.* 2020a).

Warnstorfia sarmentosa is recorded for the first time from the Danco Coast where it was found on Pefaur Peninsula on the mainland Antarctic Peninsula (Fig. 10). This locality nicely bridges the two centres of its occurrence on the west side of the Antarctic Peninsula. The species was also collected on Waugh Mountain on the Barison Peninsula at latitude 64°04'56.208"S and it is the southernmost occurrence of *W. sarmentosa* on the mainland Antarctic Peninsula (Fig. 11).

Warnstorfia sarmentosa is a bipolar species having an arctic-boreal-alpine panholarctic distribution in the Northern Hemisphere with some intermediate occurrences in the northern and central South American Cordillera (Ochyra *et al.* 2008a), in the East African mountains (Ochyra 1990b) and in New Guinea (Ochyra *et al.* 1991). In the south-cool-temperate regions in the Western Hemisphere *W. sarmentosa* occurs in Patagonia, Tierra del Fuego and in the Falkland Islands (Ochyra & Matteri 2001) and extends to the northern maritime Antarctic, whereas in the Eastern Hemisphere it is known from south-eastern Australia and New Zealand (Karczmaz 1971).

Warnstorfia fontinaliopsis (Müll.Hal.) Ochyra

SPECIMENS EXAMINED. — **Antarctica.** West Antarctic Peninsula, Danco Coast, Graham Passage region, Murray (Bluff) Island, 64°23'41.35"S, 61°29'47.72"W, abundant on wet rock on a vegetated point in the bryophyte carpet and mat subformation, 30.I.2020, *Parnikoza* 3/20 (KRAM[B-258875]); Graham Coast, Hovgaard Island, north-eastern oasis, 65°7'15.00"S, 64°4'7.00"W, in the depression on moss bank 12.II.2022, *Parnikoza* 08/22 (KRAM[B-262843]); Barison Peninsula, Waugh Mountain, 65°30'42.53"S, 64°05'00.49"W, on wet rocks in the bryophyte carpet and mat subformation, 25.II.2020, *Parnikoza* 15/20 (KRAM[B-258887]).

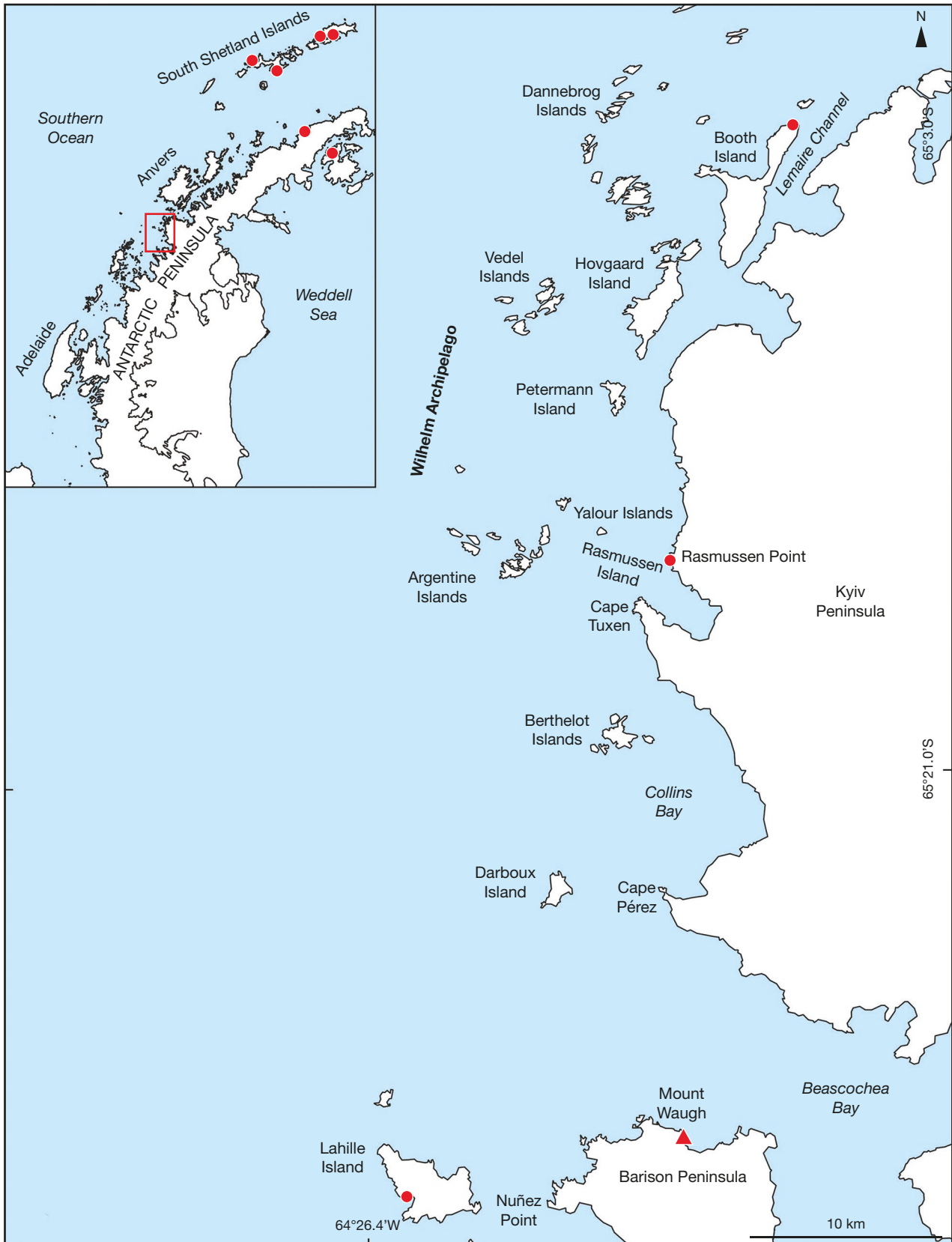


FIG. 11. — Distribution map for *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs in the Graham Coast region and in the Antarctic Peninsula including the South Shetland Islands (**inset**). The new locality on Barison Peninsula is marked with a **triangle**.

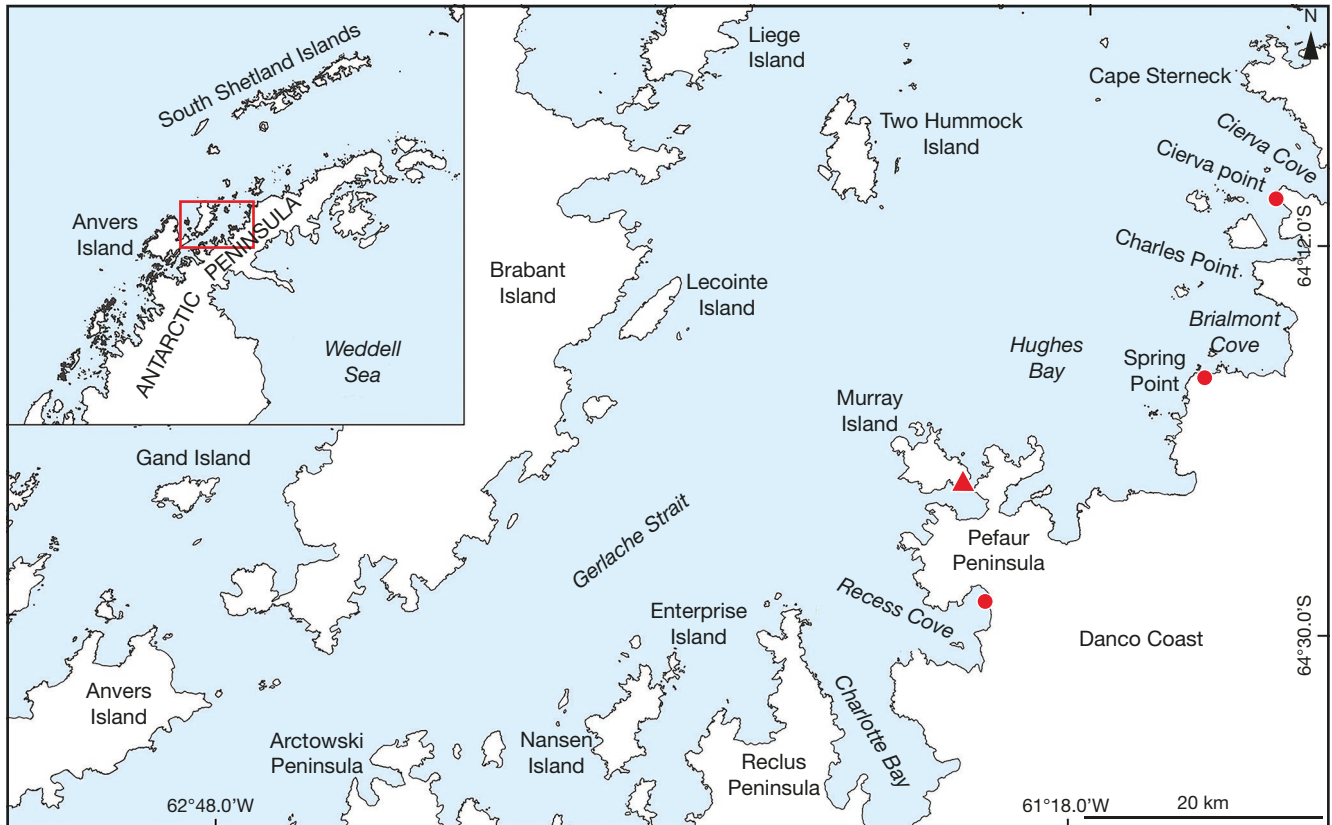


FIG. 12. — Distribution map for *Warnstorfia fontinaliopsis* (Müll.Hal.) Ochyra in the Danco Coast region. The position of this region in the Antarctic Peninsula is framed on the map (inset). The new locality on Murray (Bluff) Island is marked with a triangle.

REMARKS

Warnstorfia fontinaliopsis is a hydrophytic moss usually growing in abundance in constantly wet or moist habitats including dripping rock faces, wet soil and humus in crevices, depressions and cracks on barren rocks, margins of streams and melt water channels, pools and lakes, as well as swamps on level or gently sloping ground. It is one of the principal components in the bryophyte carpet and mat subformation, most often growing together with *Sanionia georgicouncinata* (Müll.Hal.) Ochyra & Hedenäs (Ochyra *et al.* 2008a; Loisel *et al.* 2017).

Warnstorfia fontinaliopsis is a widespread species and its more or less continuous range extends from the South Orkney Islands to the Graham Coast on the west side of Antarctic Peninsula, with two highly isolated stations on the Fallières Coast in the northern part of Marguerite Bay where it reaches its southernmost locality on the Line Islands east of Adelaide Island at latitude 67°55'S. It is common and most abundant in the South Orkney Islands and in the South Shetland Islands as well as in the Palmer Archipelago off the Danco Coast, particularly on the southern coast of Anvers Islands and its offshore islands. On the mainland northern Antarctic Peninsula *W. fontinaliopsis* is widely scattered and localised (Figs 12; 13). It is known merely from a single station on the Davis Coast and from seven localities on the Danco Coast, of which only three are situated on the mainland and four on islands lying off the coast, including the site recorded for the

first time in the present account on Murray Island (Fig. 12). The species is relatively less abundant on the Graham Coast where it is known from 13 localities (Fig. 13). Of these, only four are located on the mainland including Rasmussen Point, Cape Tuxen, Takaki Promontory and Waugh Mountain on Barison Peninsula. The latter is a newly recorded station and is the southernmost known locality of this species on the mainland Antarctic Peninsula. The remaining locations of *W. fontinaliopsis* are from the off-lying islands including Booth (Wandel) Island, the Argentine Islands (Uruguay Island, Corner Islands, Galindez Island, Black Island), Green Island in the Berthelot Islands group, Lahille Island, Hook Island in the Biscoe Islands group and Fish Island (Fig. 13).

Warnstorfia fontinaliopsis is a critical taxon which needs careful taxonomic studies with use of molecular analyses based on sequencing DNA. Hedenäs (2011) considered this species to be conspecific with the Holarctic *W. pseudostraminea* (Müll. Hal.) Tuom. & T.J.Kop. on the basis of examination of the very limited Antarctic material from King George Island. Definitive taxonomic conclusions should be based upon the investigation of the material from the whole geographical range of *W. fontinaliopsis* in the Southern Hemisphere. At present it is considered as a subantarctic-antarctic species having a disjunct circumpolar range with maximum occurrence on subantarctic South Georgia and in the northern maritime Antarctic with a limited penetration to the cool-temperate

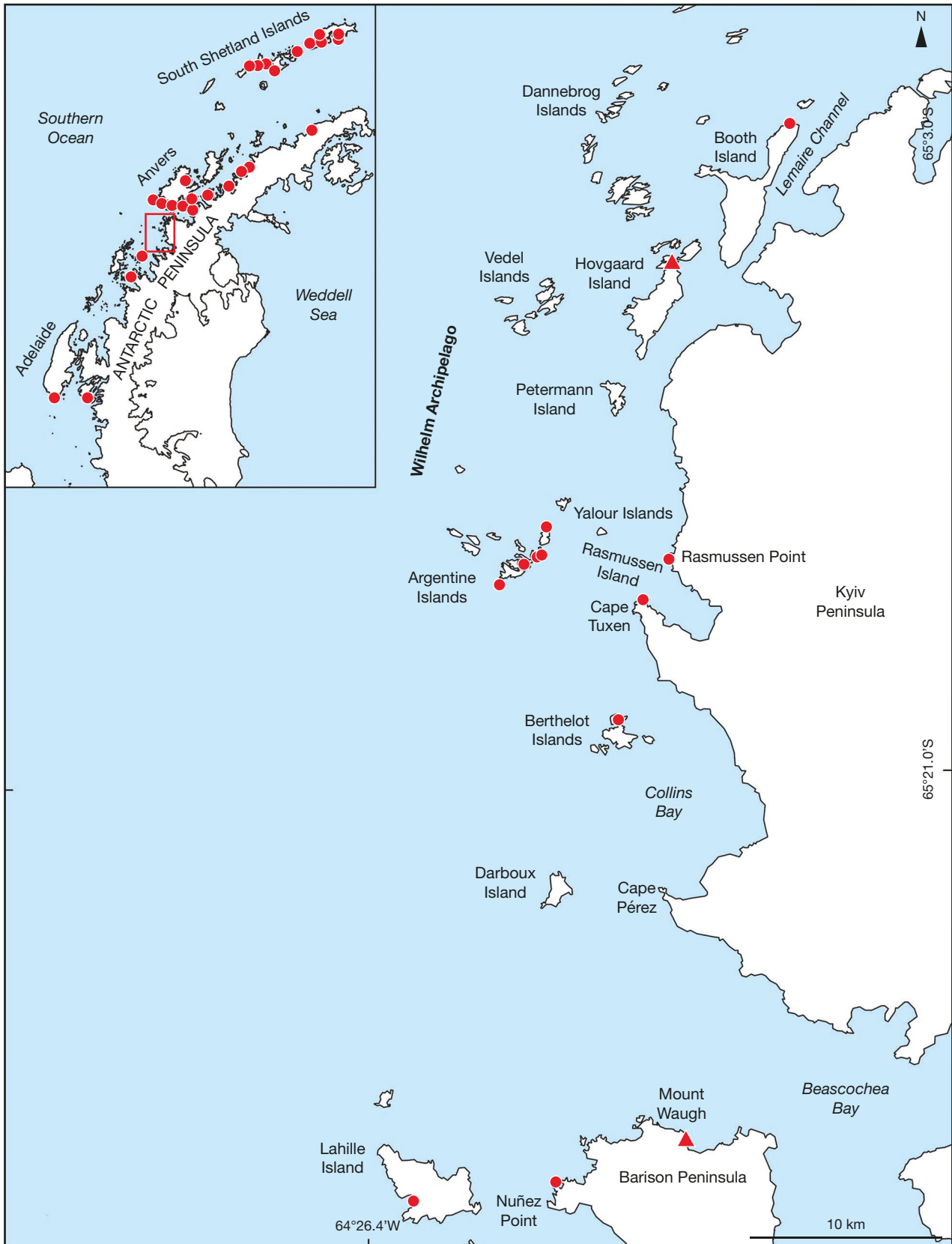


FIG. 13. — Distribution map for *Warnstorfia fontinaliopsis* (Müll.Hal.) Ochyra in the Graham Coast region and in the Antarctic Peninsula including the South Shetland Islands (**inset**). The new localities on Hovgaard Island and Barison Peninsula are marked with **triangles**.

zone in Tierra del Fuego (Ochyra & Matteri 2001; Ochyra *et al.* 2002). It occurs in the Prince Edward Islands and Îles Kerguelen in the Kerguelen biogeographical province in the Subantarctic (Ochyra *et al.* 2002) and in the South Island of New Zealand (Ochyra *et al.* 2008a), the Auckland Islands and Campbell Island in the south-cool-temperate zone south of New Zealand (Ellis *et al.* 2010). The taxonomic clarification needs also the reassessment of the status of *W. pseudostraminea* itself because *Hypnum pseudostramineum* Müll.Hal., the basionym of this name, has not hitherto been lectotypified or thoroughly taxonomically assessed. Until these issues are resolved, the taxonomic status of *W. fontinaliopsis* outlined in studies from the Southern Hemisphere (Ochyra & Matteri 2001; Ochyra *et al.* 2008a) is retained.

Family BRACHYTHECIACEAE Schimp.
Genus *Brachythecium* Schimp.

Brachythecium austroglareosum (Müll.Hal.) Kindb.

SPECIMEN EXAMINED. — **Antarctica.** West Antarctic Peninsula, Graham Coast, on a unique vegetated point on the western coast of Lahille Island at the north-eastern entrance of Leroux Bay west of Barison Peninsula, 65°33'12.89"S, 64°23'42.14"W, on ground in the bryophyte carpet and mat subformation, 7.II.2020, *Parnikoza* 6/20 (KRAM[B-258878]).

REMARKS

Brachythecium austroglareosum was found on soil in a stand of the community dominated by bryophytes, including *Polypodium juniperinum* and *Pohlia drummondii*, in which both native vascular plants, *Deschampsia antarctica* and *Colobanthus quitensis*, also had a considerable share. This community covered moist rocks and rock ledges which are typical habitats for it in the Antarctic.

Brachythecium austroglareosum is relatively rare species in the Antarctic, occurring mainly on the west side of Antarctic Peninsula, although once it was recorded from the Foyt Coast on the east side of Antarctic Peninsula just on the Antarctic Circle (Ochyra *et al.* 2008a). Surprisingly, the species is exceedingly rare in the peri-Antarctic archipelagoes of the South Orkney Islands, where it was only once collected on Signy Island, and the South Shetland Islands, where it was once found on Livingston Island and on two locations on the volcanic Deception Island. It appears to have maximum occurrence at higher latitudes on the Danco and Graham Coasts, where it is scattered both on the mainland Antarctic Peninsula and its offshore islands, decreasing in frequency towards the south (Fig. 14). On the Graham Coast *B. austroglareosum* is known mainly to occur in the offshore islands in Lemaire Channel (Booth Island), Penola Strait (Uruguay Island and Galindez Island in the Argentine Islands) and at the south-western entrance of Grandidier Channel (Hook Island). On the mainland it was only once recorded on Cape Pérez. As is the case with many species, *B. austroglareosum* occurs disjunctively in the northern Marguerite Bay on the Fallières Coast where it was collected on three islands, reaching

its southernmost location on Jenny Island off Cape Alexandra on Adelaide Island at latitude 67°44'S.

DISCUSSION

In the 175 years that have elapsed since the publication of the first moss species collected from the Antarctic (Eights 1833) until the first complete descriptive moss flora of Antarctica (Ochyra *et al.* 2008a), covering the area south of the 60th parallel and including the South Sandwich Islands archipelago and the highly isolated Bouvetøya in the South Atlantic Ocean, 308 taxa of these plants have been recorded or described as new to science from this biome. As a result of critical taxonomic studies of all available historical collections of Antarctic mosses, this number was reduced to 113 taxa, including 111 species and two varieties. From then until 2021 some additional species of moss were reported or described as new from the Antarctic including, chronologically, *Bucklandiella striatipila* (Cardot) Bedn.-Ochyra & Ochyra (Ellis *et al.* 2013a), *Ditrichum hookeri* (Müll.Hal.) Hampe (Ellis *et al.* 2013b), *Bryoerythrophyllum rubrum* (Jur. ex Geh.) P.C.Chen and *B. antarcticum* (L.I.Savicz & Smirnova) P.Sollman (Sollman 2015), *Bartramia subsymmetrica* Cardot (Câmara *et al.* 2019) and *Bryum bhatariense* W.U.Rehman, K.Gupta & Bast (Rehman *et al.* 2021). However, *Bryoerythrophyllum antarcticum* and *Bryum bhatariense* both need their taxonomic status re-assessed.

Apart from the aforementioned novelties which have increased the biodiversity of the whole biome, numerous distributional records have been published which have resulted in the considerably richer moss flora of various regions and smaller areas, including archipelagoes, individual islands, oases or ice-free areas on the mainland Antarctic. An example is King George Island, the largest island of the South Shetland Islands archipelago, which also has the richest moss flora in the entire Antarctic with 65 species (Ochyra 1998a). This number has increased to 70 species, with five more species discovered since 2009 (Li *et al.* 2009; Ellis *et al.* 2012, 2016b; Wierzgoń *et al.* 2018). The moss flora of Dronning Maud Land currently includes 13 species after discovery of *Grimmia plagiopodia* Hedw. and *Hennediella antarctica* (Ångstr.) Ochyra & Matteri in the Schirmacher Oasis (Kurbatova & Ochyra 2012).

In this paper, twelve species are reported from the two large stretches of the west side of the Antarctic Peninsula, the Danco Coast and the Graham Coast. For each, one species is reported for the first time, *Warnstorfia sarmentosa* for the Danco Coast and *Pohlia wahlenbergii* for the Graham Coast. The latter find is the first record for the entire Antarctic Peninsula and also the southernmost record of this species. The moss floras of the Danco Coast and the Graham Coast regions consist currently of 47 and 51 species, respectively. For these two regions the great shortage of distributional data is still evident, especially from sites which are difficult to access. The species richness of the Argentine Island region is noteworthy and deserves support for its recognition as an Antarctic Specially Protected Area (Parnikoza *et al.* 2020). Besides these

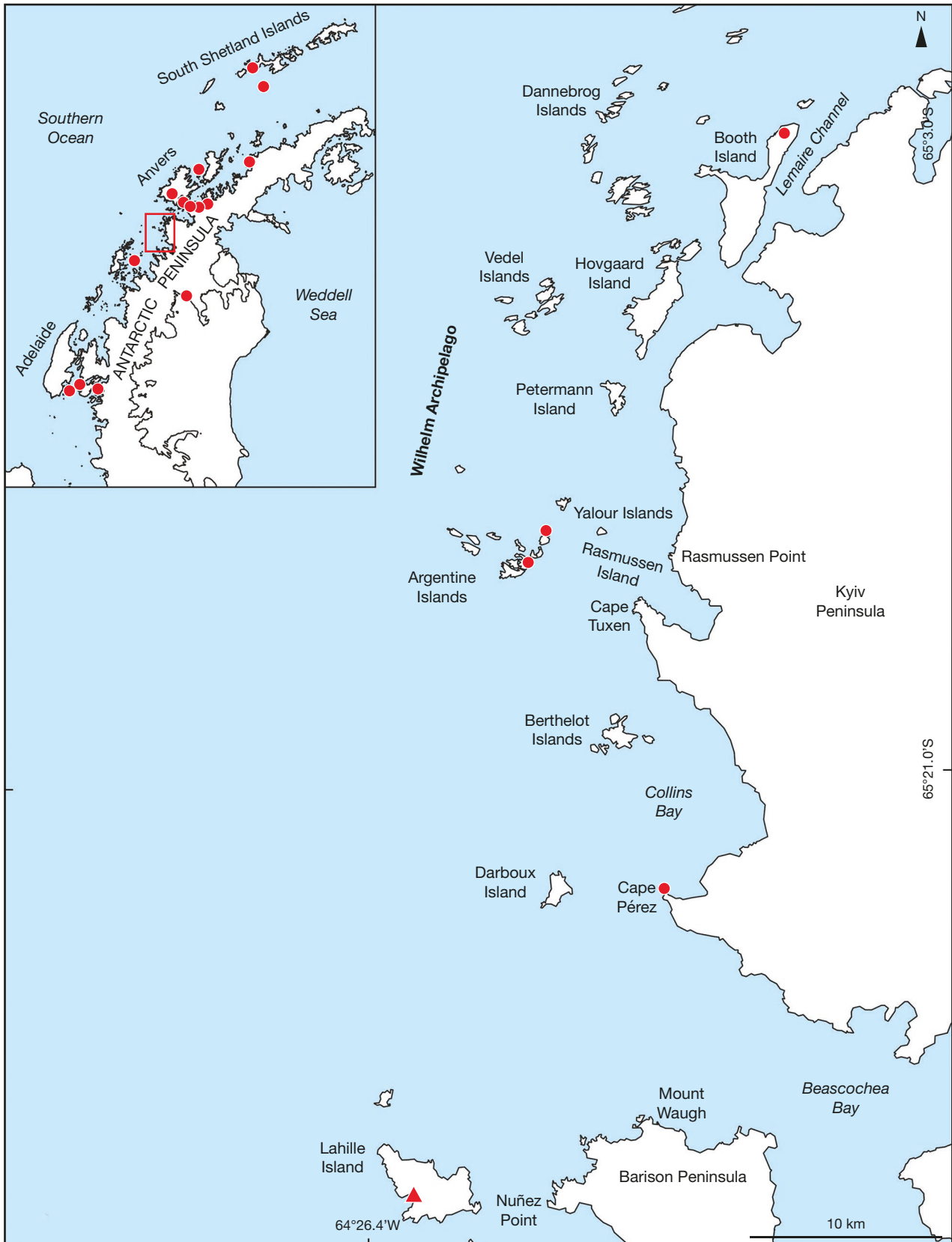


FIG. 14. — Distribution map for *Brachythecium austroglareosum* (Müll.Hal.) Kindb. in the Graham Coast region and in the northern Antarctic Peninsula including the South Shetland Islands (inset). The new locality on Lahille Island is marked with a **triangle**.

new records *Schizymerium pusillum* is recorded for the first time on the mainland Antarctic Peninsula and *Schistidium rivulare* is a new find to the mainland Graham Coast and at the same time its southernmost record.

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