

Report of *Arrhenia antarctica* from James Ross Island, Antarctica

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Abstract

In antarctic vegetation oases, development of mushrooms depends on moisture availability, substrate characteristics, and air/substrate temperature. In our study, we bring evidence of *Arrhenia antarctica* distribution at James Ross Island, as well as data on the species growth, formation of fruiting bodies, for 2013/2014 austral summer season in particular. This is, to our best knowledge, first record of *Arrhenia antarctica* reported for James Ross Island in a research journal. Available microclimate data suggest that liquid water availability in austral summer season (January, February) combined with high air/moss surface temperature are the most important driving factors. However, occurrence of fruiting bodies is highly irregular between individual austral summer seasons. In some seasons within the 2010-2015 period, no fruiting bodies were observed at all.

Key words: Antarctica, fungal ecology, Macromycetae, pileus size, moss biodiversity

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Introduction

The harsh climatic conditions restrain diversity of macrofungi in antarctic environments and most species are restricted to tundra habitats with permanent vegetation, predominantly bryophytes (Singer and Corte 1964). The most commonly observed bryophilous mushrooms belong to the omphaloid clade, including the genera *Arrhe-*

nia and *Omphalina* (Redhead et al. 2002), with at least five species of *Omphalina* known so far from Antarctica (Bertazzo-Silva et al. 2025a). *Arrhenia antarctica* (Singer) Redhead, Lutzoni, Moncalvo & Vilgalys was the first native macromycete reported from the maritime Antarctica (Singer 1956, as *Omphalina antarctica*

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Singer), the type of description being based on a collection by F. Behn from Deception Island in 1952. The species is relatively frequent at moss-dominated vegetation oases in the maritime subantarctic and antarctic region of the Southern Atlantic (Pegler *et al.* 1980), having been reported from South Sandwich Islands (Convey *et al.* 2000), King George Island (Furmanczyk and Ochyra 1982, Palfner *et al.* 2020), Robert Island and Deception Island (Palfner *et al.* 2020).

Newsham *et al.* (2021) report that *Arrhenia* sp. is poorly adapted to survival in soils at high latitudes and corroborates field observations that basidiocarps are usually restricted to soils on the South Orkney and South Shetland islands (60–62°S), with very occasional records on the western Antarctic Peninsula to 64–67°S (Pegler *et al.* 1980, Newsham pers. obs.). Moreover, recent rDNA-based methods exploiting PCR amplification and cloning revealed *Arrhenia*-like sequences found in soil sampled at Mars Oasis, Alexander Island (Bridge and Nesham 2009). Similarly, fungal biodiversity studies based on DNA metabarcoding reported *Arrhenia* sp. for Keller Peninsula, Admiralty Bay, King George Island (Rosa *et al.* 2021, Garnica *et al.* 2025). The latter study reports two most dominant phyla: Ascomycota (14.6%) and Chytridiomycota (11.8%), followed by Basidiomycota (8.1%) for Fildes Peninsula. A recent study focused on fungal biodiversity of Fildes Peninsula (Kim *et al.*

2025), reports fruiting bodies of macrofungi growing on moss cushions. In terms of autecology, field observations of partial tissue loss in some basidiomata, possibly indicate avian mycophagy – an interaction that requires confirmation but may be ecologically relevant in nutrient-limited polar environments (Palfner *et al.* 2020). *A. antarctica* is typically associated with moss-dominated substrates, particularly *Brachythecium austrosalebrosus*, *Drepanocladus uncinatus*, *Bryum pseudotriquetrum*, *Dicranoweisia grimmiaea*, *Pohlia nutans*, *Polypodium* spp., *Sanionia uncinata*, and *Syntrichia filaris*, but it also occurs with *Deschampsia antarctica* and in mixed patches with the lichen *Leptogium puberulum*, indicating greater ecological plasticity than previously recognised (Bertazzo-Silva and Putzke 2025).

Palfner *et al.* (2020) report that *A. antarctica* is probably the most frequently recorded Antarctic macromycete to date. Recent data on *A. antarctica*, and other macrofungi on their distribution in Antarctica and environmental conditions at their site of occurrence are, however, still too fragmentary to allow general conclusions about tendencies in the development of macrofungal communities in Antarctica (Palfner *et al.* 2020). Therefore, this paper brings the first report of *A. antarctica* on James Ross Island and describes moss and lichen species typical for the site of *A. antarctica* occurrence.

Material and Methods

The vegetation oases of James Ross Island (Barták *et al.* 2015) were regularly monitored for the occurrence of *A. antarctica* in last decade (2015–2025). Found fruiting bodies were documented by taking photos and measurements of pileus height

and diameter. Sketch of distribution of the fruiting bodies was created for the austral summer 2015 (Fig. 1A), when the occurrence of *A. antarctica* was highest at the Long-Term Research Plot (LTRP).

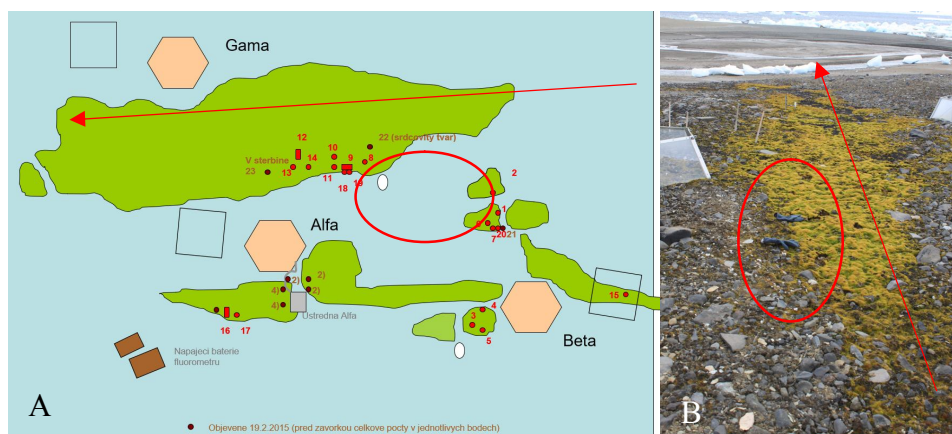


Fig. 1. Distribution of *A. antarctica* fruiting bodies at long-term research plot LTRP where manipulated warming experiment is performed by open-top chambers (OTC, here abbreviated as Alpha, Beta, Gama) approach. The spot with the highest appearance of *A. antarctica* fruiting bodies is indicated by an ellipse (red line) – Fig 1A. Longitudinal axis of the vegetation oasis and a direction of water flow through the moss carpet is indicated by a red arrow – Fig 1B.

Results and Discussion

Fruting bodies of *A. antarctica* were recorded for two localities of the northern part of Ulu peninsula, James Ross Island (Table 1, 2). Majority of fruting bodies was recorded at the LTRP with permanently installed open top chambers (Fig. 1A, B). The highest occurrence of *A. antarctica* fruiting bodies was within moss cushions, *Bryum pseudotriquetrum* in a vast majority of cases. Our observations indicate *A. antarctica* occurrence within a patchy moss carpet close to Mendel station (LTRP) formed of *Bryum pseudotriquetrum*. Similarly to recent study of Bertazzo-Silva et al. (2025b), our results indicate that *A. antarctica* occurs in association with diverse bryophytes with numerous lichen species associated with a moss cushion or raw substrates. Lichens forming the LTRP community reached number of species 44 (Table 3). The authors, studying macrofungi in Antarctica associate *A. antarctica* occurrence mainly with *Sanionia uncinata* (Putzke and Pereira 2012, Palfner et al. 2020, Bertazzo-Silva et al. 2025b). The

occurrence of *A. antarctica* in mixed moss community is less frequent but reported for *S. uncinata* and *Syntrichia* spp. patches nad moss combined with a lichen – *Leptogium puberulum* (Bertazzo-Silva et al. 2025b). In our study, *A. antarctica* grew from a mixed moss cushion (*Hypnum revolutum* and *Bryum pseudotriquetrum*) in the Cape Lachman site. Some individuals were found associated with *Bryum pseudotriquetrum* and *Physconia muscigena*, as well in close neighbourhood of *Dermatocarpon polyphyllizum*, *Xanthoria elegans* and *Nostoc commune* colonies.

At James Ross Island, vegetation oases located at its Northern coast, respectively, occurrence of fruting bodies of *A. antarctica* should be considered infrequent, depending mainly in co-action of two driving factors: (1) availability of liquid water in a moss carpet, and (2) relatively high air/ground temperature in the end of austral summer season (January, February – M. Barták, unpublished data).



Fig. 2. Round-shaped pileus of *A. antarctica* as recorded for young and old individuals at the long-term research plot (LTRP) located close to J. G. Mendel station (James Ross Island, Antarctica). Bars represent 1 cm length.

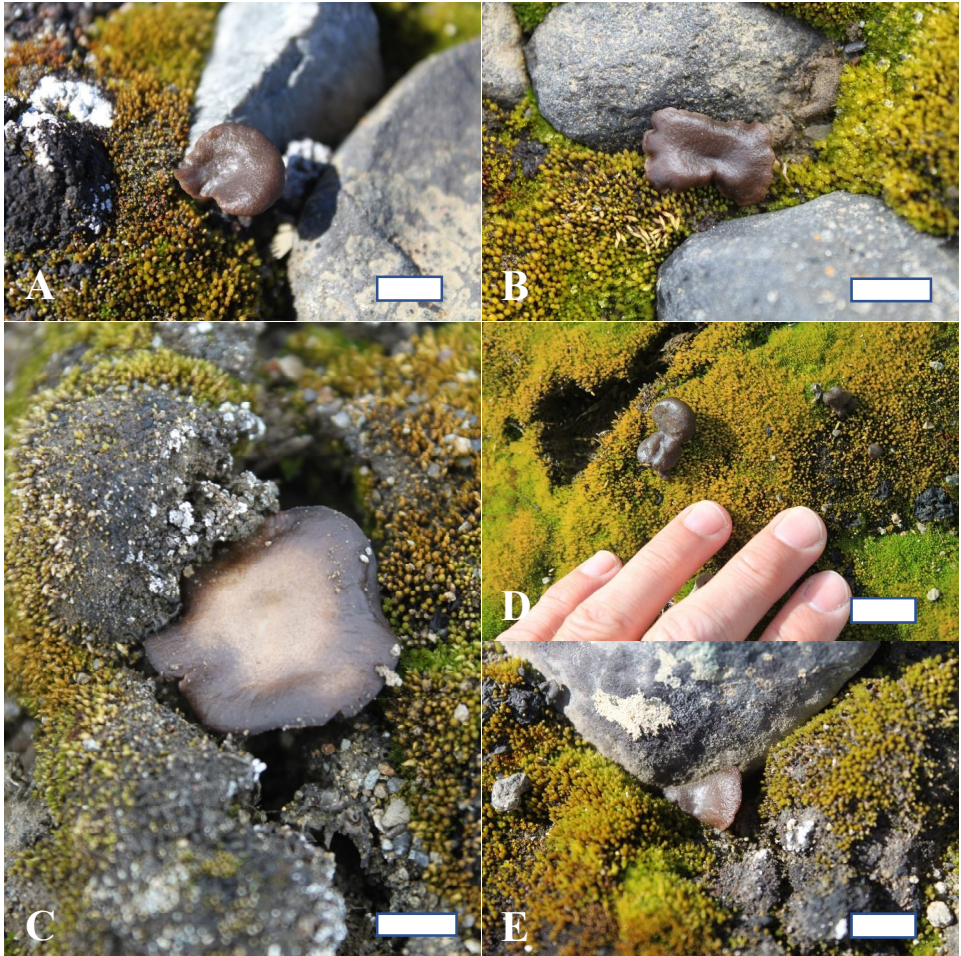


Fig. 3. Differently-shaped pileus of *A. antarctica* found at the long-term research plot (LTRP). Bars represent 1 cm length.

	Locality 1	Locality 2	Locality 3	Locality 4
	LTRP (OTC site)	LTRP (stream bank)	Cape Lachman	San José Pass
No. of fruiting bodies	37	16	3	1

Table 1. Number of *A. antarctica* fruiting bodies found in Jan-Feb 2015 at the long-term research plot located close to Mendel station, James Ross Island.

	Pileus diameter (mm)	Fruting body height (mm)
Locality 1	21 ± 1.8	8 ± 0.7
Locality 2	18 ± 1.6	7 ± 0.4

Table 2. Biometrical parametrs of *A. antarctica* fruiting bodies found in Jan-Feb 2015 at the long-term research plot located close to Mendel station, James Ross Island. Round-shape pileus in a mature state are presented (mean of at least 8 replicates ± standard deviations). Fruiting body height denotes the height of pileus margin above ground level.

Microclimate in the period of the highest abundance

In spite of the fact air temperature (2 m) shows generally increasing trend, both yearly mean and the mean for austral summer season air temperature itself does not seem to be a driving factor of the occurrence of *A. antarctica* fruiting bodies. The highest occurrence was recorded for January–February 2015, while in the following austral summer seasons (2016–2024), very limited or no occurrence was witnessed. The period of the highest occurrence was when the mean austral summer temperature was lowest in last decade. Therefore, it seems that moisture and liquid water availability in a moss layer is a limiting factor of

A. antarctica fruiting bodies development in the vegetaion oases at the norther coast of James Ross Island. Indeed, weekly means of air RH measured 1 cm above the moss surface ranged between 75–95% in the austral summer season with the highest *A. antarctica* occurrence (November 2014 – February 2015). However, air temperature close to ground might be one of interacting factors, since peak weekly mean air temperature was recorded for the last week in February 2015, when *A. antractica* showed pronounced growth. Unfortunately, due to missing data, growth rate (increment in coleus diameter).

Concluding remarks

Ongoing warming of Antarctic terrestrial habitats has brought increased number of records of agaricoid basidiomata-forming macrofungi from several locations in Maritime Antarctica. Recent study of Kim et al. (2026) summarized them and revised taxonomy of Antarctic macrofungi including *Arrhenia antarctica* using ITS and LSU sequences, and phylogenetic analysis. The approach is highly desirable since the five taxa of *Arrhenia* reported

for Antactica (Bertazzo-Silva and Putzke 2025) have been identified yet mostly by morphological markers (Horak 1966, 1982; Gumińska et al. 1994, Gyusheva and Chipnev 1999, Putzke et al. 2012, Palfner et al. 2020). Therefore, the study of Kim et al. (2026) provides a useful framework for future research into Antarctic macrofungi diversity, ecological roles, adaptive mechanisms, and their potential for biotechnologies (Singh et al. 2026).

1	<i>Acarospora badiofusca</i>
2	<i>Arrhenia</i> sp. - <i>macromycetes</i>
3	<i>Arthonia neglectula</i> , on <i>Lepraria</i>
4	<i>Aspicilia</i> aff. <i>aquatica</i>
5	<i>Bryum argenteum</i>
6	<i>Bryum pseudotriquetrum</i>
7	<i>Buellia latemarginata</i>
8	<i>Buellia</i> sp.
9	<i>Caloplaca johnstonii</i>
10	<i>Caloplaca johnstonii</i>
11	<i>Caloplaca tirolensis</i>
12	<i>Candelariella aurella</i>
13	<i>Carbonea vorticosa</i>
14	<i>Catillaria contristans</i>
15	<i>Cladonia pocillum</i>
16	<i>Collema tenax</i>
17	<i>Dermatocarpon polyphyllizum</i>
18	<i>Gyalidea antarctica</i>
19	<i>Huea cerussata</i>
20	<i>Lecanora crenulata</i>
21	<i>Lecanora dispersa</i>
22	<i>Lecanora mons-nivis</i>
23	<i>Lecanora parmelinoides</i>
24	<i>Lecidella demissum</i>
25	<i>Lecidella stigmatea</i>
26	<i>Lecidoma demissum</i>
27	<i>Lepraria</i> sp.
28	<i>Leptogium menziesii</i>
29	<i>Leptogium puberulum</i>
30	<i>Muellerella pygmea</i> – lichenicolous fungus
31	<i>Nostoc commune</i>
32	<i>Nostoc</i> sp.
33	<i>Peltigera didactyla</i>
34	<i>Phaeorrhiza nimbosa</i>
35	<i>Physconia muscigena</i>
36	<i>Placopsis</i> sp.
37	<i>Placynthium asperellum</i>
38	<i>Placynthium lachneoides</i>
39	<i>Placynthium lachneoides</i>
40	<i>Rhizocarpon geminatum</i>
41	<i>Rinodina olivaceobrunnea</i>
42	<i>Rinodina peloleuca</i>
43	<i>Staurothelle</i> aff. <i>frustulenta</i>
44	<i>Xanthoria elegans</i>

Table 3. List of lichen species found for a long-term research plot (LTRP) situated near Mendel station (Northern coast of James Ross Island, Antarctica).

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