FRONTIERS OF BIOGEOGRAPHY
The scientific journal of The International Biogeography Society

Frontiers of Biogeography 18, 2025, e146943 | DOI 10.21425/fob.18.146943

RESEARCH ARTICLE

New oribatid mite (Acari, Oribatida) records in the Antarctic Peninsula region

Habriel Hushtan[1], Kateryna Hushtan[1,2], Pavlo Kovalenko[3,4], Anton Puhovkin[4,5,6], Peter Convey[7,8,9,10], Iryna Kozeretska[4]

1 *State Museum of Natural History of the National Academy of Science of Ukraine, Lviv, 79008, Ukraine*
2 *Separate Structural Department "Lviv Professional College of the Lviv National Environmental University", Lviv, 79000, Ukraine*
3 *State Institution "Institute for Evolutionary Ecology", National Academy of Sciences of Ukraine, Kyiv, 03143, Ukraine*
4 *State Institution National Antarctic Scientific Center, Ministry of Education and Science of Ukraine, Kyiv, 01601, Ukraine*
5 *Department of Experimental Biology, Faculty of Science, Masaryk University, Brno, 62500, Czech Republic*
6 *Institute for Problems of Cryobiology and Cryomedicine, National Academy of Science of Ukraine, Kharkiv, 61016, Ukraine*
7 *British Antarctic Survey, NERC, High Cross, Madingley Road, Cambridge CB3 0ET, UK*
8 *Department of Zoology, University of Johannesburg, Auckland Park 2006, South Africa*
9 *Millennium Institute – Biodiversity of Antarctic and Sub-Antarctic Ecosystems (BASE), Santiago, Chile*
10 *School of Biosciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK*

Corresponding author: Habriel Hushtan (habrielhushtan@gmail.com)

Editor Mark John Costello
Received 16 January 2025 ♦ **Accepted** 9 March 2025 ♦ **Published** 31 March 2025

Abstract

We report new oribatid records from the western Antarctic Peninsula region obtained during the XXVI–XXVIII Ukrainian Antarctic expeditions. Five species (including 2 subspecies) representing five families of oribatid mites were recorded: *Nanhermannia elegantissima*, *Hermanniella dolosa*, *Membranoppia loxolineata*, *Suctobelbella sinuata*, *Alaskozetes antarcticus* subsp. *antarcticus* and *A. a.* subsp. *intermedius*. The single specimen records of *N. elegantissima*, *H. dolosa* and *S. sinuata* are the first for these species in the Antarctic region. *Hermanniella dolosa*, previously recorded only in the Palearctic is likely to represent an anthropogenic introduction or contaminant. The other two species have been recorded from Southern Hemisphere locations, but far from the maritime Antarctic and their status cannot be assessed with confidence. *Membranoppia loxolineata* and the two subspecies of *A. antarcticus* were previously recorded from the maritime Antarctic, and we provide new specific occurrence records of these taxa. Our data expand knowledge of the distribution and biogeography of oribatid mites in the maritime Antarctic. Further research is required to assess the status of the three new species records and if established, any potential to impact the native microarthropod community.

Highlights

- New records for five species of oribatid mites were made in the Antarctic Peninsula region.
- *N. elegantissima*, *H. dolosa* and *S. sinuata* first recorded in the Antarctic region.
- Further survey is required to confirm the status of the first recorded species.
- Data received expands knowledge of the distribution and biogeography of oribatid mites in the maritime Antarctic.
- Increasing anthropogenic activity in the Maritime Antarctic emphasizes the need for robust surveys and ongoing monitoring of key terrestrial locations.

Keywords

Alaskozetes antarcticus, *Hermanniella dolosa*, *Membranoppia loxolineata*, *Nanhermannia elegantissima*, non-native species, *Suctobelbella sinuata*

Introduction

Oribatida is a suborder of mites belonging to the order Sarcoptiformes within the superorder Acariformes of the subclass Acari (Krantz and Walter 2009). The known global diversity of oribatid mites includes more than 11,600 species representing 1,328 genera and 166 families. Of these, around 148 taxa are known from Antarctica (~100 species) and the sub-Antarctic islands (~54 species) (Pugh 1993; Subías 2004, 2021). The oribatid mite diversity of the maritime Antarctic (Antarctic Peninsula region and South Shetland Islands) currently includes 14 species and three subspecies (Wallwork 1973; Usher and Edwards 1986; Block and Starý 1996; Starý and Block 1998; Pugh and Convey 2000; Marshall and Convey 2002). These include *Liochthonius australis* Covarrubias, 1968, *L. mollis* (Hammer, 1958), *Membranoppia loxolineata* (Wallwork, 1965), *Austroppia crozetensis* (Richters, 1908), *Brachioppiella pepitensis* (Hammer, 1962), *B. p.* subsp. *brevipectinata* (Covarrubias, 1968), *Alaskozetes antarcticus* (Michael, 1903), *A. a.* subsp. *intermedius* Wallwork, 1967, *Halozetes belgicae* (Michael, 1903), *H. b.* subsp. *longisetae* Wallwork, 1967, *H. impeditus* Niedbala, 1986, *H. marinus* (Lohmann, 1907), *H. necrophagus* Wallwork, 1967, *Totobates nordenskjoeldi* (Trägårdh, 1907), *Edwardzetes dentifer* Hammer, 1962, *Magellozetes antarcticus* (Michael, 1895) and *M. processus* Hammer, 1962.

The first studies of oribatids in Antarctica took place at the end of the 19th century and research continues to the present day (Michael 1895; Gwiazdowicz et al. 2022; Pfingstl et al. 2024). The current study reports new records of oribatid mites in parts of the maritime Antarctic, specifically the South Shetland Islands, Graham Coast and Argentine Islands, obtained during the XXVI – XXVIII Ukrainian Antarctic expeditions between 2022 and 2024. Five species (including two subspecies) representing five families of oribatid mites were recorded: *Nanhermannia elegantissima* Hammer, 1958, *Hermanniella dolosa* Grandjean, 1931, *Suctobelbella sinuata* (Hammer, 1982), *M. loxolineata*, *A. antarcticus* subsp. *antarcticus* and *A. a.* subsp. *intermedius*. Given current trends in climate change in the studied region (Convey 2003), studies recording the current state of biodiversity are very important.

Materials and methods

We obtained mite specimens from four regions within the maritime Antarctic: (I) the Argentine Islands and Hovgaard Island (Wilhelm Archipelago); Here, substrates for extraction were obtained from the following islands: Hovgaard (bryophyte mat and carpet subformation of *W. fontinaliopsis*; *Stercorarius maccormicki* nest material, mainly *Sanionia* sp.), Irizar (moss turf subformation of *Bryum* sp.; bryophyte mat and carpet subformation of *Sanionia* sp.), Eight (bryophyte mat and carpet subformation of *Sanionia* sp.; moss turf subformation of *Bryum* sp.), an un-named island within the Barchans (*Prasiola crispa* (Lightfoot) Kützing community with *Sanionia* sp.), Eastern (*L. dominicanus* nest material, mainly *Sanionia* sp.) and Central (*L. dominicanus* nest material, mainly *Sanionia* sp.) of the Three Little Pigs Islands, Uruguay (algal subformation of *P. crispa*), Galindez (moss turf subformation of *Polytrichum strictum*), Skua (*S. maccormicki* nest material, mosses *P. strictum* and *Sanionia* sp.) and Lahille Island (mosses on a rock slope, mainly *Andreaea* sp., with the addition of *Sanionia* sp., *Pohlia* sp., and grass, *Deschampsia antarctica*). (II) Lahille Island (~32 km south of the Ukrainian Akademik Vernadsky Station); (III) Nelson Island (South Shetland Islands) (bryophyte mat and carpet subformation of *Warnstorfia* sp. and *Sanionia* sp.); and (IV) an un-named island (coordinates: -65.400171, -65.302682) within the Pitt Islands (bryophyte mat and carpet subformation of *Sanionia* sp.) (Fig. 1).

Mites were extracted from samples using a Berlese–Tullgren funnel (Walter and Krantz 2009) directly into 96% ethanol. Subsequent examination took place using light microscopy after the return of the extracted samples to the Center "Pedobiology" of the National Academy of Sciences of Ukraine. Oribatid mites were initially separated using an Olympus SZX10 stereomicroscope (Japan). Detailed examination for species identification was then performed under an Olympus BX51 light microscope (Japan) with reference to appropriate taxonomic keys (Wallwork 1965, 1967; Hammer 1982; Balogh and Balogh 1988; Weigmann 2006; Subías et al. 2021). A total of 123 individual oribatid mites were obtained. The taxonomic system follows the Integrated Taxonomic Information System (ITIS 2024).

Results

Five oribatid mite species (including two subspecies) representing five families were identified amongst the specimens collected. Below, we provide a formal list of these species and information about their wider geographical distribution, habitats and other notes of interest.

Family Nanhermanniidae Sellnick, 1928

Nanhermannia elegantissima Hammer, 1958:

Lahille Island, mosses on a rock slope, mainly *Andreaea* sp., with the addition of *Sanionia* sp., *Pohlia* sp., and grass, *D. antarctica* É. Desv., in the north-western part of the island, at -65.522896, -64.417755, on 09.01.2024, 1 adult, Kovalenko P.

***Argentine Islands, Wilhelm archipelago*:** Eight Is., bryophyte mat and carpet subformation of *Sanionia* sp., in the northern part of the island, at -65.225883, -64.210017, on 16.12.2023, 1 adult, Kovalenko P.

Distribution. Neotropical and peri-Antarctic region (Subías 2004).

Remarks. Previously, within the peri-Antarctic region, this species has been recorded only on the Falkland Islands (Starý and Block 1998; Subías 2004). The current records are the first for this species in Antarctica, and are most likely to represent an anthropogenically-associated record,

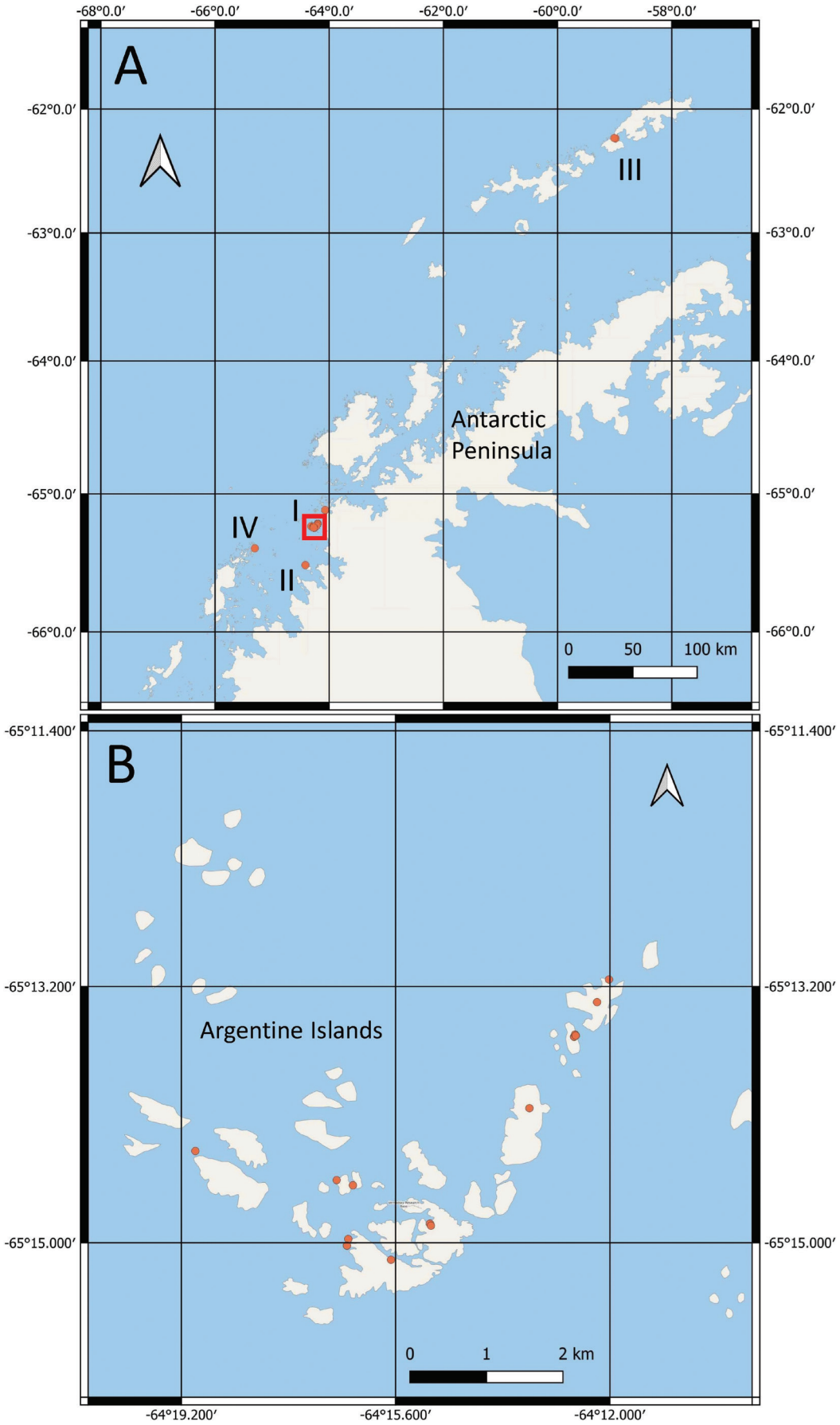

Figure 1. Sampling locations: **A.** General map of all study sites; **B.** Higher resolution view of the Argentine Islands region. Red spots represent sampling locations and red square indicating enlarged map area.

particularly given the long history of the logistic connection between the Falkland Islands and the Argentine Islands dating from the mid-1940s Operation Tabarin followed by continuous station operation to the mid-1990s by the Falkland Islands Dependencies Survey and then British Antarctic Survey and current operation by the Ukrainian Antarctic Programme. This period saw a range of anthropogenic introductions to station vicinities associated with these operations, though most formal records relate to Signy Island (South Orkney Islands), where more detailed terrestrial biological studies took place in that period (see records listed by Leihy et al. (2023), with further interpretation in Hughes et al. (2024)). However, natural dispersal cannot be excluded.

Family Hermanniellidae Grandjean, 1934

***Hermanniella dolosa* Grandjean, 1931:**

***Argentine Islands, Wilhelm archipelago*:** Eight Is., moss turf subformation of *Bryum* sp., in the northern part of the island, at -65.225750, -64.209567, on 20.03.2024, 1 adult, Kovalenko P.

Distribution. Palaearctic region (Subías 2004; Hushtan et al. 2021).

Remarks. This taxon is a Palearctic species (Subías 2004) and the current record is the first from the Antarctic region. It is likely to represent an anthropogenically-associated record or a contaminant.

Family Suctobelbidae Jacot, 1938

***Suctobelbella sinuata* (Hammer, 1982):**

***Argentine Islands, Wilhelm archipelago*:** Irizar Is., moss turf subformation of *Bryum* sp., in the northern part of the island, at -65.219167, -64.200250, on 15.03.2024, 1 adult, Kovalenko P.

Distribution. Oriental-tropical (Bali), Hawaii and peri-Antarctic (Amsterdam Island) regions (Subías 2004).

Remarks. Within the peri-Antarctic region, this species has previously been recorded only on Amsterdam Island in the Indian Ocean (Subías 2004), which is considered a temperate or even subtropical island. While this specimen is the first record of this species from an Antarctic region, it is also most likely to be anthropogenic in origin.

Family Oppiidae Sellnick, 1937

***Membranoppia loxolineata* (Wallwork, 1965) (previously known as *Globoppia loxolineata*):**

Lahille Island, mosses on a rock slope, mainly *Andreaea* sp., with the addition of *Sanionia* sp., *Pohlia* sp., and the grass, *D. antarctica*, in the north-western part of the island, at -65.522896, -64.417755, on 09.01.2024, 1 adult, Kovalenko P.

***Argentine Islands, Wilhelm archipelago*:** Skua Island, short moss turf and cushion subformation of *Andreaea* sp., in the northern part of the island, at -65.251983, -64.261283, on 03.03.2024, 1 adult, Kovalenko P.; un-named island in the Barchan Islands, *Prasiola crispa* (Lightfoot) Kützing community with *Sanionia* sp., in the north-western part of the island, at -65.239250, -64.316067, on 03.03.2024, 1 adult, Kovalenko P.; Galindez Is., Stella Ridge (western part of the island), moss turf subformation of *Polytrichum strictum* Brid., at -65.247750, -64.250367, on 24.03.2024, 2 adults, Kovalenko P.; Galindez Is., Stella Ridge (western part of the island), moss turf subformation of *Pohlia* sp., at -65.248000, -64.250100, on 24.03.2024, 2 adults, Kovalenko P.

Distribution. Maritime Antarctic region (Wallwork 1965; Covarubias 1968; Convey and Smith 1997).

Remarks. Our study provides new occurrence records for this species from the Argentine Islands, Wilhelm Archipelago and Lahille Island. It has previously been recorded from the South Orkney Islands (Lynch Island), South Shetland Islands (Livingston Island, Greenwich Island, Nelson Island, King George Island, Ardley Island, Deception Island), the north-west Antarctic Peninsula and offshore Islands (Base General B. O'Higgins, Anvers Island, Green Island, Darboux Island, Fauré Islands) and islands in Marguerite Bay (Wallwork 1965; Covarubias 1968; Usher and Edwards 1986; Convey and Smith 1997).

Family Ameronothridae Vitzthum, 1943

***Alaskozetes antarcticus* subsp. *antarcticus* (Michael, 1903):**

***South Shetland Islands*:** Two localities on the northern part of Nelson Island: bryophyte mat and carpet subformation of *Warnstorfia* sp. and *Sanionia* sp., at -62.238834, -58.986192, on 13.02.2023, 1 female, 1 male, Puhovkin A.; *L. dominicanus* nest matherial: mosses *Bryum* sp. and *Sanionia* sp., at -62.235455, -59.007684, on 18.01.2024, 1 female, Puhovkin A.

***Argentine Islands, Wilhelm archipelago*:** Irizar Is., bryophyte mat and carpet subformation of *Sanionia* sp., in the central part of the island, at -65.221825, -64.203597, on 16.12.2023, 4 adults, Kovalenko P.; Hovgaard Is., bryophyte mat and carpet subformation of *Warnstorfia fontinaliopsis* (Müll. Hal.) Ochyra, -65.120500, -64.068167, 14.03.2024, 1 tritonymph, Kovalenko P.; Hovgaard Is, *S. maccormicki* nest material, mainly *Sanionia* sp., in the eastern part of the island, at -65.119490, -64.071674, on 12.02.2022, 1 tritonymph, Kovalenko P.

Eight Is., bryophyte mat and carpet subformation of *Sanionia* sp., in the northern part of the island, at -65.225883, -64.210017, on 16.12.2023, 1 male, 3 females, 9 adults, Kovalenko P.; Eight Is., bryophyte mat and carpet subformation of *Sanionia* sp., in the northern part of the island, at -65.225617, -64.209750, on 20.03.2024, 2 juveniles (stage not identified in more

detail), 7 nymphs (stage not identified in more detail), 6 deutonymphs, 2 tritonymphs, 1 larva, 2 protonymphs, Kovalenko P.; Eight Is., moss turf subformation of *Bryum* sp., in the northern part of the island, at -65.225750, -64.209567, on 20.03.2024, 1 protonymph, 2 females, 1 male, 3 deutonymphs, Kovalenko P.; Uruguay Is., alga subformation of *P. crispa*, in the central part of the island, at -65.234233, -64.222533, on 10.02.2024, 2 adults,1 nymph (stage not identified in more detail), Kovalenko P.; Skua Is., Finger Point (western part of the island), *S. maccormicki* nest material, mosses *P. strictum* and *Sanionia* sp., at -65.250328, -64.273618, on 15.02.2022, 7 nymphs (stage not identified in more detail), 4 tritonymphs, 5 deutonymphs, 9 males, 8 females Kovalenko P.; a rock near the west coast of Skua Island, *L. dominicanus* nest material: mosses *Sanionia* sp. and *W. fontinaliopsis*, at -65.249551, -64.273254, on 10.02.2022, 1 nymph, Parnikoza I.; Central Pig Is. of the Three Little Pigs Islands, *L. dominicanus* nest material, mainly *Sanionia* sp., northern part of the island, at -65.242667, -64.276500, on 10.02.2022, 1 deutonymph and 1 male, Kovalenko P.; Eastern Pig Is. of the Three Little Pigs Islands, *L. dominicanus* nest material, mainly *Sanionia* sp., southern part of the islands, at -65.243270, -64.271954, on 10.02.2022, 1 male, Kovalenko P.

***Pitt Islands*:** Un-named island (one of a group of small islets located in the triangle between Trundle Is., Vaugondy Is., and Jingle Is.) in the Pitt Islands, bryophyte mat and carpet subformation of *Sanionia* sp., northern part of the island, at -65.400171, -65.302682, on 17.12.2023, 8 adults, 1 tritonymph, Kovalenko P.

Distribution. Maritime and sub-Antarctic region, Beaucheune Island (Falkland Islands) (Pugh 1993; Subías 2004).

***Alaskozetes antarcticus* subsp. *intermedius* Wallwork, 1967:**

***Argentine Islands, Wilhelm archipelago*:** Skua Is., Finger Point (western part of the island), *S. maccormicki* nest material, mainly *Sanionia* sp., at -65.250328, -64.273618, on 15.02.2022, 1 male, Kovalenko P.

Distribution. Maritime Antarctic, sub-Antarctic region and Falkland Islands (Starý and Block 1998; Subías 2004).

Remarks. Although this subspecies has previously been reported in the region of the Antarctic Peninsula (Block and Starý 1996), this is the first record from the Argentine Islands.

Discussion

In an era of climate change, which is widely predicted to lead to changes in species distributions including the colonization and establishment of species currently not present within given regions, the collection of robust baseline biodiversity data and ongoing monitoring of key locations are of fundamental importance. This is particularly the case in the Antarctic region, considered to be vulnerable to biological invasions and where, as yet, there have been relatively fewer instances of non-native species establishment (Hughes et al. 2015, 2024; Convey and Peck 2019). At present, no non-native species of oribatid mites are known to be established in the maritime or continental Antarctic regions (Hughes et al. 2015). However, some members of the group are known to have extremely well-developed tolerance to cold, desiccation and salinity stresses, with some species specifically occurring in littoral and supralittoral habitats and tolerating long-term submersion in seawater, while some can be dispersed by birds (Block and Convey 1995; Marshall and Convey 2002; Majka et al. 2007; Gwiazdowicz et al. 2022; Grewling et al. 2023).

The three 'new records' presented here of species not previously known from the Antarctic are all single specimens from different islands, and all appear most plausibly to represent either contaminants or association with anthropogenic activity. However, it is impossible to exclude natural dispersal events. Nevertheless, we emphasize that further detailed and targeted survey work is now required focusing on the specific collection locations from which specimens were noted here (cf. Hughes et al. 2017), in order to confirm the status of these species. If presence were to be confirmed, it would be important to assess local population size and distribution and confirm life cycle completion, as well as document the ecophysiological potential of the species, although the latter would require significant numbers of living individuals. The occurrence of one of these species, *N. elegantissima*, could potentially be explained by the long-standing operational and logistic (and, more recently, tourism) connection between the Falkland Islands (where it is known to occur; Starý and Block 1998; Subías 2004) and the operational Faraday research station established in the Argentine Islands in the mid-1940s. The record of *S. sinuata*, otherwise primarily a tropical or subtropical species (Hawaii, Bali) appears most plausibly to be an anthropogenically associated event. Although Subías (2004) lists the species from Amsterdam Island in the Indian Ocean, an island that is included in listings of 'peri-Antarctic' islands (Selkirk 2007), this island (like Tristan da Cunha in the Atlantic Ocean) lies at a subtropical latitude and experiences a warm temperate climate. None of the species' occurrence locations have a plausible link with the western Antarctic Peninsula region. *H. dolosa*, native to the Palaearctic region (Subías 2004; Hushtan et al. 2021), seems most likely to be a contaminant.

Considerable increases in both national operator and tourism activity have taken place in the maritime Antarctic region in the latter part of the 20th and early 21st centuries (Tin et al. 2009; Convey and Peck 2019; Chwedorzewska et al. 2020). Any human presence in this region carries a risk of movement of both non-native and native species (Chown et al. 2012; Hughes et al. 2020), although confirmed species establishment events known to date can virtually all be most plausibly linked with national operations (Siegert et al. 2023; Hughes et al. 2024). Ongoing

baseline survey and monitoring of Antarctic terrestrial biota, both in locations of high visitor pressure and in less visited and protected locations, are required to detect changes and design management actions. Detailed and common-sense biosecurity guidelines already exist (COMNAP and SCAR 2019) and must be rigorously and consistently applied by all operators and visitors.

M. loxolineata and *A. antarcticus* are species known to occur in the Maritime Antarctic region (Wallwork 1965, 1967; Pugh 1993; Subías 2004). The records of the former presented here are the first formal records for Lahille Island and the Argentine Islands. While relatively few studies have specifically recorded the smaller species of Oppiidae, *M. loxolineata* has been recorded as far south as Marguerite Bay (Usher and Edwards 1986; Convey and Smith 1997). *Alaskozetes antarcticus*, the largest micro-arthropod in Antarctica, is widespread and abundant throughout the Maritime Antarctic (Antarctic Peninsula and Scotia Arc archipelagoes) and extends into the sub-Antarctic. While our survey recorded two of the described sub-species of *A. antarcticus*, their presence in exactly the same substrates and locations can raise questions about the biological validity of this distinction, which has not as yet been addressed in molecular phylogenetic studies.

Conclusions

The specimens obtained in this study represent five species (including two subspecies) and families of oribatid mites. Single specimens of *Nanhermannia elegantissima*, *Hermanniella dolosa* and *Suctobelbella sinuata* provide the first records of these species in the Antarctic region, although they do not confirm establishment and seem most plausibly related to contamination (*H. dolosa*) or, possibly, historical logistic or other anthropogenic links leading to inadvertent introduction (*S. sinuata*, *N. elegantissima*). Further survey is required to confirm their status. Increasing national operator and tourism activity in the Maritime Antarctic emphasizes the need for robust surveys and ongoing monitoring of key terrestrial locations.

Acknowledgements

We are grateful to Dr. Ivan Parnikoza, State Institution National Antarctic Scientific Center, Kyiv, Ukraine for providing samples.

Author contributions

H.H.: conceptualization, identification of mites, interpretation, writing; K.H.: preparation of mite specimens for identification, writing; P.K.: sample collection, visualization; A.P.: sample collection; P.C.: interpretation and writing; I.K.: coordination of research. All authors contributed to the writing and editing of the manuscript.

Funding

The current study was performed in the framework of the Ukrainian State Special-Purpose Research Program in Antarctica for 2011–2025. P.K. takes part in a scientific research project of the National Academy of Sciences of Ukraine “Ecological indication of biotopes conditions using model biota representatives under anthropogenic transformation of ecosystems”. P.C. is supported by NERC core funding to the BAS ‘Biodiversity, Evolution and Adaptation’ Team.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

Balogh J, Balogh P (1988) Oribatid Mites of the Neotropical Region I. In: Balogh J, Mahunka S (Eds) The Soil Mites of the World. Akad. Kiadó, Budapest, vol. 2, 335 pp.

Block W, Convey P (1995) The biology, life-cycle and ecophysiology of the Antarctic mite *Alaskozetes antarcticus*. Journal of Zoology 236: 431–449. https://doi.org/10.1111/j.1469-7998.1995.tb02723.x

Block W, Starý J (1996) Oribatid mites (Acari: Oribatida) of the maritime Antarctic and Antarctic Peninsula. Journal of Natural History 30: 1059–1067. https://doi.org/10.1080/00222939600770561 [Correction in: 30: 1875–1876]

Chown SL, Huiskes AHL, Gremmen NJM, Lee JE, Terauds A, Crosbie K, Frenot Y, Hughes KA, Imura S, Kiefer K, Lebouvier M, Raymond B, Tsujimoto M, Ware C, Van de Vijver B, Bergstrom DM (2012) Continent-wide risk assessment for the establishment of nonindigenous species in Antarctica. Proceedings of the National Academy of Science USA 109: 4938–4943. https://doi.org/10.1073/pnas.1119787109

Chwedorzewska KJ, Korczak-Abshire M, Znój A (2020) Is Antarctica under threat of alien species invasion? Global Change Biology 26: 1942–1943. https://doi.org/10.1111/gcb.15013

COMNAP, SCAR (2019) Review and update of the “Checklists for supply chain managers of National Antarctic Programs for the reduction in risk of transfer of non-native species”. Working Paper 50. Antarctic Treaty Consultative Meeting XLII, Prague, Czech Republic, 1–11 July 2019.

Convey P, Peck LS (2019) Antarctic environmental change and biological responses. Science Advances 11: eaaz0888. https://doi.org/10.1126/sciadv.aaz0888

Convey P, Smith RIL (1997) The terrestrial arthropod fauna and its habitats in northern Marguerite Bay and Alexander Island, maritime Antarctic. Antarctic Science 9: 12–26. https://doi.org/10.1017/S0954102097000035

Convey P (2003) Maritime antarctic climate change: signals from terrestrial biology. Antarctic Research Series 79: 145–158. https://doi.org/10.1029/AR079p0145

Covarrubias R (1968) Some observations on Antarctic Oribatei (Acarina). *Liochthonius australis* sp. n., and two *Oppia* ssp. n. Acarologia 10: 313–356.

Grewling Ł, Laniecki R, Jastrzębski N, Borkowska J, Marek Z, Kondrat K, Nowak Z, Zacharysiewicz M, Małecka M, Valle B, Messyasz B, Zawierucha K (2023) Dispersal of pollen and invertebrates by wind in contrasting Arctic habitats of Svalbard. Polish Polar Research 45: 43–65. https://doi.org/10.24425/ppr.2023.146740

Gwiazdowicz DJ, Niedbala W, Skarzynski D, Zawieja B (2022) Occurrence of mites (Acari) and springtails (Collembola) in bird nests on King George Island (South Shetland Islands, Antarctica). Polar Biology 45: 1035–1044. https://doi.org/10.1007/s00300-022-03052-1

Hammer M (1982) On a collection of oribatid mites from Bali (Indonesia). Entomologia Scandinavica 13: 445–464. https://doi.org/10.1163/187631282X00291

Hughes KA, Pertierra LR, Molina-Montenegro MA, Convey P (2015) Biological invasions in terrestrial Antarctica: what is the current status and can we respond? Biodiversity and Conservation 24: 1031–1055. https://doi.org/10.1007/s10531-015-0896-6

Hughes KA, Greenslade P, Convey P (2017) The fate of the non-native collembolon, *Hypogastrura viatica*, at the southern extent of its introduced range in Antarctica. Polar Biology 40: 2127–2131. https://doi.org/10.1007/s00300-017-2121-4

Hughes KA, Pescott O, Peyton J, Adriaens T, Cottier-Cook E, Key G, Rabitsch W, Tricarico E, Barnes DKA, Baxter N, Belchier M, Blake D, Convey P, Dawson W, Frohlich D, Gardiner L, González-Moreno P, James R, Malumphy C, Martin S, Martinou AF, Minchin D, Monaco A, Moore N, Morley S, Ross F, Shanklin J, Smith K, Turvey K, Vaughan D, Vaux A, Werenkraut V, Winfield I, Roy H (2020) Invasive non-native species likely to threaten biodiversity and ecosystems in the Antarctic Peninsula region. Global Change Biology 26: 2702–2716. https://doi.org/10.1111/gcb.14938

Hughes KA, Convey P, Lee JR (2024) Status assessment of non-native terrestrial species in Antarctica. Submitted to Neobiota, October 2024.

Hushtan HH, Hushtan KV, Glotov SV (2021) Checklist of oribatid mites (Acari, Oribatida) of the Transcarpathian lowland, Ukraine. Persian Journal of Acarology 10: 371–402.

ITIS [Alexander S, Hodson A, Mitchell D, Nicolson D, Orrell T, Perez-Gelabert D] (2024) The Integrated Taxonomic Information System (version 2024-07-23). In: Bánki O, Roskov Y, Döring M, Ower G, Hernández Robles DR, Plata Corredor CA, Stjernegaard Jeppesen T, Örn A, Vandepitte L, Pape T, Hobern D, Garnett S, Little H, DeWalt RE, Ma K, Miller J, Orrell T, Aalbu R, Abbott J, et al. Catalogue of Life (Version 2024-08-29). Catalogue of Life, Amsterdam, Netherlands. https://doi.org/10.48580/dgdwl-4ky

Krantz GW, Walter DE [Eds] (2009) A Manual of Acarology. 3rd Edition. Texas Tech. University Press, Lubbock, 807 pp.

Leihy RI, Peake L, Clarke DA, Chown SL, McGeoch MA (2023) Introduced and invasive alien species of Antarctica and the Southern Ocean Islands. Scientific Data 10: 200. https://doi.org/10.1038/s41597-023-02113-2

Majka CG, Behan-Pelletier V, Bajerlein D, Bloszyk J, Krantz GW, Lucas Z, O'Connor B, Smith IM (2007) New records of mites (Arachnida: Acari) from Sable Island, Nova Scotia, Canada. The Canadian Entomologist 139: 690–699. https://doi.org/10.4039/n06-103

Marshall DJ, Convey P (2002) Latitudinal variation in habitat specificity of ameronothrid mites (Oribatida). Experimental and Applied Acarology 34: 21–35. https://doi.org/10.1023/B:APPA.0000044437.17333.82

Michael AD (1895) Über die auf Süd-Georgien von der deutschen Station 1882–83 gesammelten Oribatiden. Jahrb. Hamburg wiss. Anstalt, Hamburg 12(69): 71–72.

Pfingstl T, Hiruta SF, Shimano S (2024) Mitochondrial metagenomics reveal the independent colonization of the world's coasts by intertidal oribatid mites (Acari, Oribatida, Ameronothroidea). Scientific Reports 14: 11634. https://doi.org/10.1038/s41598-024-59423-7

Pugh PJA (1993) A synonymic catalogue of the Acari from Antarctica, the sub-Antarctic Islands and the Southern Ocean. Journal of Natural History 27: 323–421. https://doi.org/10.1080/00222939300770171

Pugh PJA, Convey P (2000) Scotia Arc Acari: antiquity and origin. Zoological Journal of the Linnaean Society 130: 309–328. https://doi.org/10.1111/j.1096-3642.2000.tb01633.x

Selkirk PM (2007) The nature and importance of the sub-Antarctic. Papers and Proceedings of the Royal Society of Tasmania 141: 1–6. https://doi.org/10.26749/rstpp.141.1.1

Siegert M, Bentley M, Atkinson A, Bracegirdle T, Convey P, Davies B, Downie R, Hogg AE, Holmes C, Hughes K, Meredith M, Ross N, Rumble J, Wilkinson J (2023) Antarctic extreme events. Frontiers in Environmental Science 11: 1229283. https://doi.org/10.3389/fenvs.2023.1229283

Starý J, Block W (1998) Distribution and biogeography of oribatid mites (Acari: Oribatida) in Antarctica, the sub-Antarctic islands and nearby land areas. Journal of Natural History 32: 861–894. https://doi.org/10.1080/00222939800770451

Subías LS (2004) Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del mundo (exceptofósiles) (19ª actualización). Graellsia, 60 (número extraordinario), 3–305. http://bba.bioucm.es/cont/docs/RO_1.pdf [Accessed in January 2024, 545 pp.] [in Spanish]

Subías LS, Shtanchaeva UYa, Arillo A (2021) Listado de los ácaros oribátidos (Acariformes, Oribatida) de las diferentes regiones biogeográficas del mundo (Ilustrado) Parte 6: Antárticos y subantárticos (10a actualización). (Originally published in Monografías electrónicas Sociedad Entomológica Aragonesa, 4: 805 pp. [(2012), this version in July 2021, 58 pp., online capture] [in Spanish]

Tin T, Fleming Z, Hughes KA, Ainley D, Convey P, Moreno C, Pfeiffer S, Scott J, Snape I (2009) Impacts of local human activities on the Antarctic environment: a review. Antarctic Science 21: 3–33. https://doi.org/10.1017/S0954102009001722

Usher MB, Edwards M (1986) The selection of conservation areas in Antarctica: An example using the arthropod fauna of Antarctic Islands. Environmental Conservation 13: 115–122. https://doi.org/10.1017/S0376892900036705

Wallwork JA (1965) The Cryptostigmata (Acari) of Antarctica with special reference to the Antarctic Peninsula and South Shetland Islands. Pacific Insects 7: 453–468.

Wallwork JA (1967) Cryptostigmata (oribatid mites). In Gressit JL (Ed.) Entomology of Antarctica. Antarctic Research Series 10: 105–122. https://doi.org/10.1029/AR010p0105

Wallwork JA (1973) Zoogeography of some terrestrial microarthropods in Antarctica. Biological Reviews 48: 233–259. https://doi.org/10.1111/j.1469-185X.1973.tb00981.x

Walter DE, Krantz GW (2009) Collecting, rearing, and preparing specimens. In: Krantz GW, Walter DE (Eds) A Manual of Acarology, 3rd Edn., Texas Tech University Press, Lubbock, 83–96.

Weigmann G (2006) Hornmilben (Oribatida). Die Tierwelt Deutschlands, 76. Teil. Goecke & Evers, Keltern, 520 pp.