

## RESEARCH NOTE

# The first freshwater molluscs from Wrangel Island, Arctic Russia

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Arctic; freshwater snails; Physidae.

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**Abstract**

The first finding of a freshwater snail, *Sibirenauta sibiricus* (Westerlund, 1877), in one of the lakes on Wrangel Island (north-eastern Russia) is reported. No freshwater mollusc species have hitherto been known from this island. Specimens from the island are morphologically compared with the type series of the species. How aquatic molluscs may have migrated to the Arctic island is briefly discussed.

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The malacofauna of large islands belonging to the Eurasian sector of the Arctic has been studied since the second half of the 19th century (Stuxberg 1887; Westerlund 1887; Smith 1896). Most publications have been devoted to marine species (e.g., Stuxberg 1887) though freshwater molluscs are also present in the Arctic island fauna. Usually, the freshwater malacofauna of these islands is believed to be extremely poor though some archipelagos may maintain relatively rich communities of snails and bivalves. For instance, at least 19 species occur in the waterbodies of the Solovetskiy Archipelago (Bespalaya et al. 2009); 11 species of molluscs are registered on Vaigach Island (Leško et al. 2008) and so on. As a general rule, the farther an island is from the mainland the fewer species of molluscs it houses. Only three species of pulmonate gastropods were found in the Kolguev Island (Smith 1896), and a single species of fingerclams, *Pisidium conventus* Clessin, 1877, was reported from the Novaya Zemlya Archipelago (Odhner 1923; Sidorov 1925). The northernmost islands seem to lack freshwater malacofauna altogether, as exemplified by the archipelago of Svalbard (Coulson 2007).

The freshwater fauna of Wrangel Island (north-east Russia) was also thought to include no molluscs. Though the island's freshwater habitats are home to several tens of invertebrate species, neither snails nor bivalves have been registered there (Stišov 2004). The aim of this note is to discuss the first finding of freshwater snails on

Wrangel Island and possible routes of aquatic mollusc migration from the mainland to this island.

**Material and methods**

Off the coast of north-eastern Eurasia, Wrangel Island is situated at 71°N and is bounded by the Arctic Ocean, East Siberian Sea and Chukchi Sea. Its total area is about 7600 km<sup>2</sup>. The dominating landscape is Arctic tundra. Aquatic molluscs were collected during a hydrobiological survey of freshwater habitats made by one of us (AN) in 2013. Living snails were found on 19 July 2013 in a nameless lake situated in the Akademiya tundra on the northern edge of the island with these geographical coordinates: 71°28'17.3" N 179°47'12.0" W (Fig. 1). No molluscs were found in other studied habitats of the island.

The lake is nearly 500 m long and 10 m wide. The depth of the lake does not exceed 1 m. The water temperature in the sampling site was +14°C, with a pH of 8.2 and ppm (NaCl) of 84. After collection, specimens were fixed in ethanol. Their taxonomic identification was carried out in the laboratory. Measurements and dissections of the snails were made using standard techniques. Six standard measurements with accuracy to the nearest 0.1 mm were taken from 10 shells (see Supplementary Fig. S1): shell height (SH), shell width (SW), aperture height (AH) and width (AW), spire height (SpH) and body whorl height (BWH). The whorl number was also counted.

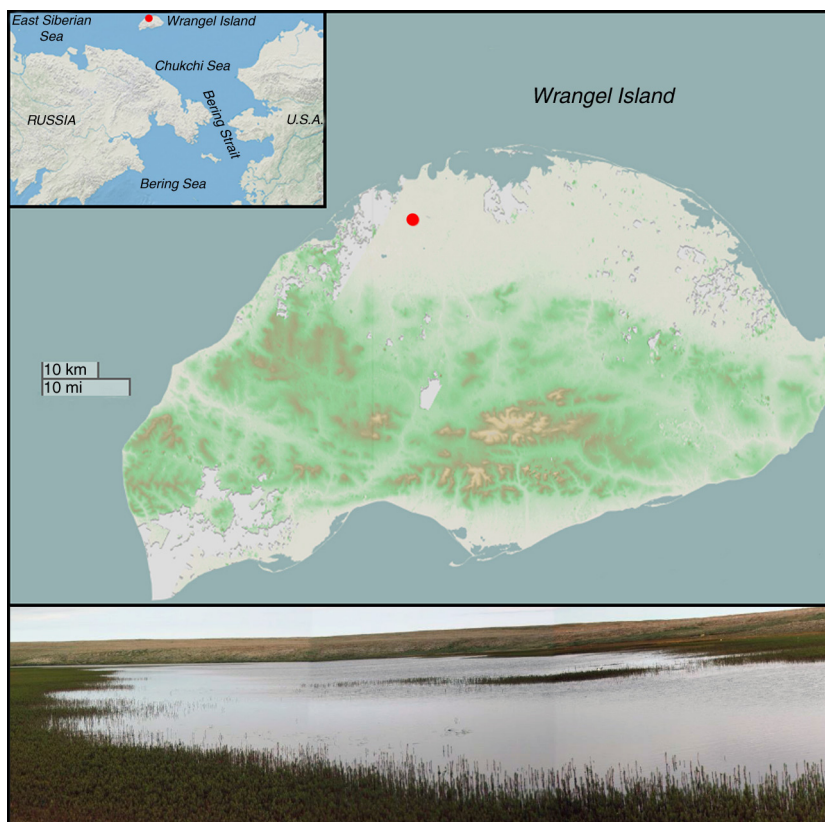


Fig. 1 Map of Wrangel Island with the location of the lake studied marked by the red dot.

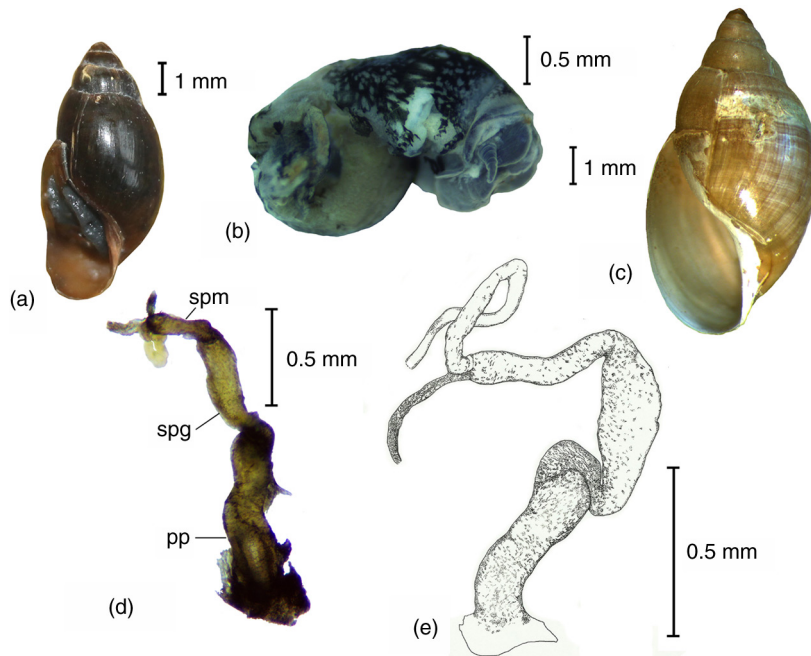
## Results and discussion

The abundance of gastropods and other benthic invertebrates in the studied water body was very low. In total, merely 13 specimens of snails were collected. All the gastropods collected in the lake belong to the same species: *Sibirenauta sibiricus* (Westerlund 1877), from the pulmonate family Physidae Fitzinger, 1833. This identification was confirmed by comparing our specimens with the lectotype of *S. sibiricus* designated by Vinarski et al. (2013). The type locality of *S. sibiricus* (Jenissei, Sopotch-naya Korga, 71°40'N, Taimyr Peninsula) is situated in the northern part of Middle Siberia, and its range covers the northern parts of Middle and East Siberia as well as the Chukotka Peninsula and Alaska (Starobogatov & Budnikova 1976; Taylor 2003; Vinarski et al. 2013). Almost all the snails we collected on Wrangel Island were juvenile. The largest shell reaches only 7.7 mm in height, which is less than the height of the holotype shell, 8.8 mm (Fig. 2, Table 1). The morphology of the copulatory organ of the studied specimens corresponds with the morphological description of the genus *Sibirenauta* Starobogatov et Streleckaja, 1967 published elsewhere (Starobogatov & Streleckaja 1967; Starobogatov & Budnikova 1976; Taylor 2003). The preputium is oblong

and relatively narrow; the penis sheath is bipartite, divided into glandular and muscular parts (see Fig. 2c), which differentiates *Sibirenauta* from representatives of the conchologically similar genus *Aplexa* Fleming, 1820, which is characterized by a unipartite penis sheath (Taylor 2003).

The macrozoobenthos community of the lake included, in addition to *S. sibiricus*, *Mesostoma* sp. (Turbellaria), *Branchinecta paludosa* (O.F. Müller 1788) (Branchiopoda), *Psectrocladius* sp. (Chironomidae), and several species of water mites (Hydrachnidia). Three species of planctonic crustaceans were also found: *Heterocope borealis* (Fischer 1851), *Diaptomus glacialis* Lilljeborg, 1881, and *Eurycercus* cf. *glacialis* Lilljeborg, 1887.

Two possibilities may explain the fact that *Sibirenauta* has not previously been documented from the island water bodies. The first one is that this species is extremely rare, so preceding researchers overlooked it. The second possibility is that the snails are rather recent arrivals to Wrangel Island, and we observed the first step of colonization of this land by molluscs. Though it is almost impossible to choose one hypothesis over another on the basis of our limited data, how snails may have migrated to the island is worth considering.



**Fig. 2** (a) An intact specimen of *Sibirenauta* from Wrangel Island. (b) Soft body of a snail withdrawn from its shell. (c) Shell of the lectotype of *S. sibiricus*. (d)–(e) The copulatory organ of *Sibirenauta* from Wrangel Island (photographs and drawing). The following terms are abbreviated: preputium (pp); glandular portion of penis sheath (spg); muscular portion of penis sheath (spm).

The first hypothesis implies that *Sibirenauta* is an old inhabitant of the island. The island is thought to have become separated from the mainland by 12 000 years BP (Vartanyan et al. 1993). The snails found by us could be remnants of the native mainland fauna, alongside such animals as Arctic fox (*Vulpes lagopus*) and two species of lemmings (*Dicrostonyx vinogradovi* and *Lemmus sibiricus*). The snail's absence in the species lists (Stišov 2004) would be explained by its small population or by relatively low research efforts made by a previous investigator, or both.

**Table 1** Morphometric characteristics of shells of *Sibirenauta sibiricus* from Wrangel Island: shell height (SH), shell width (SW), aperture height (AH) and width (AW), spire height (SpH) and body whorl height (BWH). See Supplementary Fig. S1 for an explanation of the measurements

Character or index	Values (means $\pm$ standard deviation)
Whorls number	4.00–5.00 (4.44 $\pm$ 0.21)
SH (mm)	5.3–7.7 (6.6 $\pm$ 0.7)
SW (mm)	2.9–3.9 (3.4 $\pm$ 0.3)
SpH (mm)	2.2–3.3 (2.8 $\pm$ 0.4)
BWH (mm)	4.2–6.0 (5.2 $\pm$ 0.5)
AH (mm)	3.3–4.8 (4.0 $\pm$ 0.4)
AW (mm)	1.5–2.4 (2.0 $\pm$ 0.3)
SW/SH	0.49–0.55 (0.51 $\pm$ 0.02)
SpH/SH	0.38–0.57 (0.43 $\pm$ 0.03)
BWH/SH	0.76–0.81 (0.79 $\pm$ 0.02)
AH/SH	0.53–0.66 (0.61 $\pm$ 0.04)
AW/AH	0.46–0.63 (0.51 $\pm$ 0.06)

The other hypothesis supposes that some mechanism of distant dispersal of snails over sea must be proposed. The Long Strait, which is about 140 km wide, separates Wrangel Island from Asia. Though rare, cases of birds carrying pulmonate snails on long voyages—exceeding 1000 km—to remote oceanic islands are known (Gittenberger et al. 2006; Kappes & Haase 2012). Water birds are the only appropriate vectors to transport snails from the mainland, and freshwater snails migrating in this way is well established (Malone 1965; Boag 1986; Wesselingh et al. 1999). A few large species of waterfowl are known to migrate to Wrangel Island from the mainland and to nest here. Snow goose (*Anser caerulescens*) and brant goose (*Branta bernicla*) are among these species (Stišov 2004), and we suspect that they could be responsible for the snail's arrival to the island. One may assume that air-breathing should facilitate this way of dispersal for physids, which, like other aquatic pulmonate snails, can withstand desiccation and full absence of water.

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