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Little-known arctic species *Montacuta spitzbergensis* (Bivalvia: Montacutidae) from the north-western Pacific with notes on *Montacuta substriata* and *Tellimya ferruginosa*

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An expanded description of a little-known arctic species Montacuta spitzbergensis *from the Sea of Okhotsk with new data on its morphology, ecology and geographical distribution is given. This is the first record of* M. spitzbergensis *from the north-western Pacific. It differs from other species of* Montacuta *in its large (to 8.4 mm), elongate–ovate, thick shell with wide, slightly curved hinge plate, wide, short, and shallow resilifer, and weakly developed external ligament. This species occurs in the Arctic Ocean (Spitsbergen, Barents, Kara, Laptev and Chukchi Seas) and the Pacific Ocean (Sea of Okhotsk) at depths from 9 to 232 m at a bottom temperature from −1.62°C to +2.50°C. The hinge structure of the type species of the genera* Montacuta *and* Tellimya *is also discussed.*

Keywords: Montacutidae, taxonomy, shell morphology, Arctic Ocean, Sea of Okhotsk

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INTRODUCTION

The study of bivalves collected on the shelf of north-eastern Sakhalin Island (Sea of Okhotsk) revealed *Montacuta spitzbergensis* Knipowitsch, 1901 which was not previously recorded for the Pacific Ocean (Scarlato, 1981; Scarlato & Kafanov, 1988; Higo *et al.*, 1999; Coan *et al.*, 2000; Okutani, 2000).

Montacuta spitzbergensis was described by Knipowitsch (1901) from four specimens found at depths of 9 and 24 m in Spitsbergen fjords. Later, this species was recorded in the Barents, Kara, Laptev and Chukchi Seas (Filatova, 1948, 1957; Gorbunov, 1952; Voronkov, 2004, personal communication). Filatova (1957) speculated that it might also be encountered in the northern Bering Sea. Based on this assumption, Scarlato (1981) and further Kantor & Sysoev (2005) reported *M. spitzbergensis* to be a member of the bivalve fauna of the north-western Pacific Ocean. Nevertheless, this species has not been found in the Pacific Ocean thus far.

Knipowitsch (1901) provided a fairly brief description and five good-quality photographs of *M. spitzbergensis*. Some authors give very brief and contradictory descriptions and rather schematic figures of its shell and hinge (Filatova, 1948; Gorbunov, 1952; Scarlato, 1981). Gorbunov (1952) having examined two dead specimens from the Chukchi Sea and part of the type material of *M. spitzbergensis* suggested that this species is not a member of the genus *Montacuta* Turton, 1822 and possibly is not a montacutid. When reviewing all recent European species of the superfamilies Galeommatoidea and Cyamioidea, Van Aartsen (1996a, b) did not analyse this species because of poor knowledge about it and tentatively placed it in the genus *Montacuta*.

I compared the description and extensive materials of *M. spitzbergensis* from the Russian Arctic Sea and the Sea of Okhotsk with material and descriptions of representatives of various genera of the superfamily Galeommatoidea. By the hinge structure, this species is most similar to *Montacuta substriata* (Montagu, 1808), which is the type species of the genus *Montacuta*. Therefore, *M. spitzbergensis* is herein treated under its old name.

Thus, the purpose of this paper is to give an expanded description of *M. spitzbergensis*, supplemented by new data on its shell morphology and hinge structure, ecology, and geographical distribution. Results of comparisons with the type species of the genera *Montacuta* and *Tellimya* Brown, 1827 are also presented.

MATERIALS AND METHODS

Material studied

The material of *M. spitzbergensis* from Sakhalin Island was collected by the IO RAS expedition (August–October 1949, RV 'Vityaz'), the PRIFO expedition (June–July 2002, RV 'Bukharo') and the EKS expedition (July 2006, RV 'Agat').

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All material of this species was fixed with 4% formaldehyde and stored in 70% ethanol at the IO RAS and IMB.

Also, collection material of the following species was used: *M. spitzbergensis* (ZIN); *M. substriata* (NMW); and *Tellimya ferruginosa* (Montagu, 1808) (NMW).

Shell measurements

Shell length (L), anterior end length (A), height (H) and width (W) were measured for the shell. The ratios of these parameters to shell length (A/L, H/L and W/L, respectively) were determined. Shell measurements were made using an ocular micrometer with an accuracy of 0.1 mm.

Methods used

For scanning electron microscopy, shells were cleaned of traces of soft tissues and periostracum in a high-strength commercial bleach, washed in distilled water, and dried. They were then mounted to aluminium stubs using adhesive tape and coated with gold for examination with a LEO 430.

Abbreviations

The following institutional abbreviations are used in the paper: ECS, Ecological Company of Sakhalin, Yuzhno-Sakhalinsk; IMB, A.V. Zhirmunsky Institute of Marine Biology, Russian Academy of Sciences, Vladivostok; IO RAS, P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow; NMW, National Museums and Galleries of Wales, Cardiff; PRIFO, Pacific Research Institute of Fisheries and Oceanography, Vladivostok; and ZIN, Zoological Institute, Russian Academy of Sciences, St Petersburg.

SYSTEMATICS

Order VENEROIDA Adams & Adams, 1856
Superfamily GALEOMMATOIDEA Gray, 1840
Family MONTACUTIDAE Clark, 1855
Genus *Montacuta* Turton, 1822
Type species (SD, Herrmanssen, 1847): *Ligula substriata* Montagu, 1808

DIAGNOSIS

Shell small (<9 mm), equivalve, unequilateral, ovate to elongate–ovate. Beaks posterior, orthogyrate. Sculpture of growth lines and radial ribs; sometimes radial sculpture absent. Periostracum thin, polished. Hinge plate curved. Right valve with an anterior oblique cardinal tooth and a deep socket of hinge plate anterior to tooth. Left valve with an anterior elongate laminar tooth and a socket of hinge plate under beak and tooth. Posterior teeth absent. Ligament mostly internal, strong, oblique, posterior to beaks. Resilifer elongate–ovate, oblique, posterior to beaks. Adductor muscle scars irregular, elongated. Pallial line wide, without a pallial sinus.

REMARKS

The description of the *Montacuta* hinge differs from author to author. The founder of this genus Turton (1822) wrote that each valve bears two cardinal teeth, while lateral teeth are lacking. Jeffreys (1864) described the hinge of *Montacuta* as having two lateral but not cardinal teeth in each valve. Ockelmann (1965) noted the error of Jeffreys in the description of the hinge as he did not find posterior lateral teeth in the type species *M. substriata*. Also, Tebble (1966) and Van Aartsen (1996b) reported only the presence of a long anterior lateral tooth in the hinge in each valve. However, Bernard (1979) stated that the *Montacuta* hinge has an anterior lamina terminating in a minute cardinal hook in each valve and a weak, sometimes vestigial posterior lamina.

All the discrepancies in the description of the *Montacuta* hinge, as was reasonably noted by Van Aartsen (1996a), are partly due to different interpretations of the hinge teeth in the valves. Very likely, the inconsistency in the description of the hinge is associated with the fact that various species having different structure of the hinge have long been grouped in this genus. Thus, Turton (1822) and Jeffreys (1864) included *Mysella bidentata* (Montagu, 1803) and *T. ferruginosa* (type species of *Tellimya*) in the genus *Montacuta* (Chavan, 1969; Van Aartsen, 1996a, b). Ockelman (1965) and Tebble (1966) placed *T. ferruginosa* in *Montacuta* also.

Taking into consideration the discrepancies in descriptions of the hinge structure of the genus *Montacuta* and the controversy concerning the taxonomic position of some species of this genus, I provide a more detailed description of the hinge in the type species of the genus *Montacuta* (Figure 1).

The right valve of *M. substriata* has an elongate, oblique cardinal tooth, which is directed anteriorly and forms an acute angle with the anterodorsal shell margin (Figure 1A–G). This tooth is widest under the beak and has a knob-like projection (Figure 1E & G). Anterior to the cardinal tooth, the hinge plate widens. Here, between the tooth and the anterodorsal margin, overhanging as a visor, is an elongate socket in the hinge plate. The lateral tooth of the left valve fits into this socket (Figure 1D–F). The shape and relative sizes of the cardinal are fairly variable (Figure 1C & E). The shape and depth of the socket in front of the tooth vary according to the size and shape of the lateral tooth of the left valve.

The left valve bears an anterior long, flattened lateral tooth (Figure 1H–O). It is slightly curved ventrally and subparallel to the anterodorsal shell margin. The tooth shape in the dorsal view varies from rounded triangular to lanceolate (Figure 1K & O). Under the beak and tooth, the hinge plate has an oblique socket corresponding to the cardinal tooth of the right valve (Figure 1J & N).

The resilifer is elongate–ovate, oblique and narrow. It extends from the beak posteriorly, parallel to the posterodorsal margin and somewhat into the shell. Therefore, the hinge plate in the ventral view is noticeably convex in the resilifer area (Figure 1F, J & N).

Montacuta spitzbergensis *Knipowitsch, 1901*
(Figures 2 & 3; Tables 1–3)

Montacuta spitzbergensis Knipowitsch, 1901, p. 519, 520, pl. 19, figures 40–45; Filatova, 1948: p. 437, pl. 60, figures 11al, 11c; Scarlato, 1981, p. 325, pl. 172.

Montacuta (?) spitzbergensis Knipowitsch: Gorbunov, 1952, p. 242, 243, figure 1.

MATERIAL EXAMINED

A total of 172 specimens and 7 separated valves: ZIN 1, 2 specimens, RV 'Krasin', Station 31, Chukchi Sea, 70°41′N

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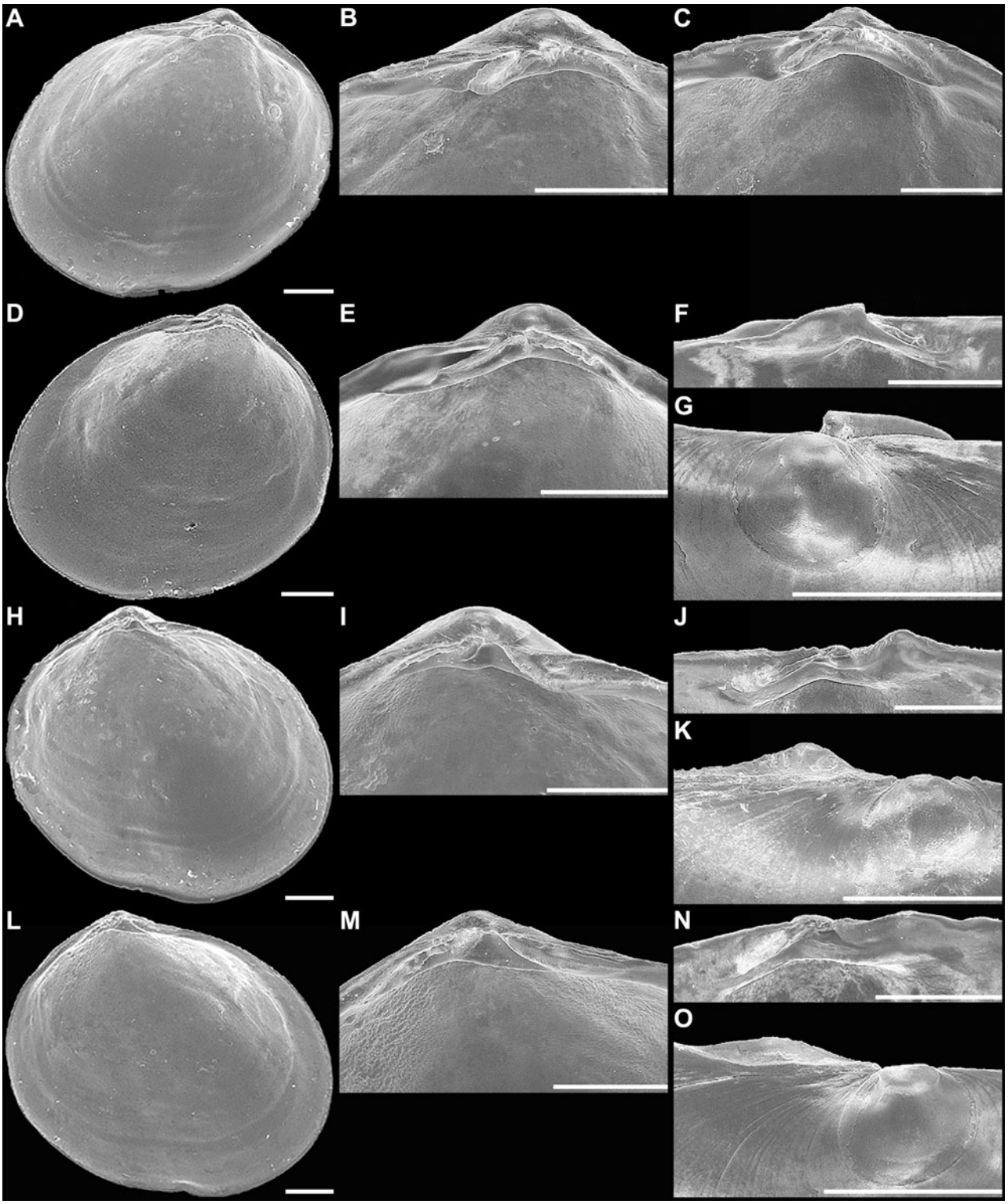

Fig. 1. *Montacuta substriata* (Montagu, 1808) from Maureen Oilfield, North Sea, Scotland, United Kingdom, 58°07.87′N 01°42.11′E, depth 95 m (NMW 2002.020.0026): (A–C) interior view and hinge of the right valve; (D–G) interior view, hinge, ventral view of hinge, and dorsal view of anterior cardinal tooth of the right valve; (H–K) interior view, hinge, ventral view of hinge, and dorsal view of anterior lateral tooth of the left valve; and (L–O) interior view, hinge, ventral view of hinge, and dorsal view of anterior lateral tooth of the left valve. Scale bars: 300 μm.

178°21′E, 34 m, sandy silt, collected by P.V. Ushakov, 2 September 1935; ZIN 2, 1 specimen, RV 'Deryugin', cruise 8, Station 791, Barents Sea, 68°49′N 43°56′E, 52–54 m, sandy silt with pebbles, gravel and shells, collected by L.I. Moskalev, 1 September 1959; ZIN 3, 2 specimens, RV 'Deryugin', cruise 8, Station 765, Barents Sea, 70°18.5′N 58°01.5′E, 165–205 m, silt, collected by L.I. Moskalev, 18 August 1959; ZIN 4, 3 specimens, RV 'Deryugin', cruise 8, Station 768, Barents Sea, 69°56′ 3N 56°25′E, 53 m, silt with gravel, collected by L.I. Moskalev, 12 August 1959; ZIN 5,

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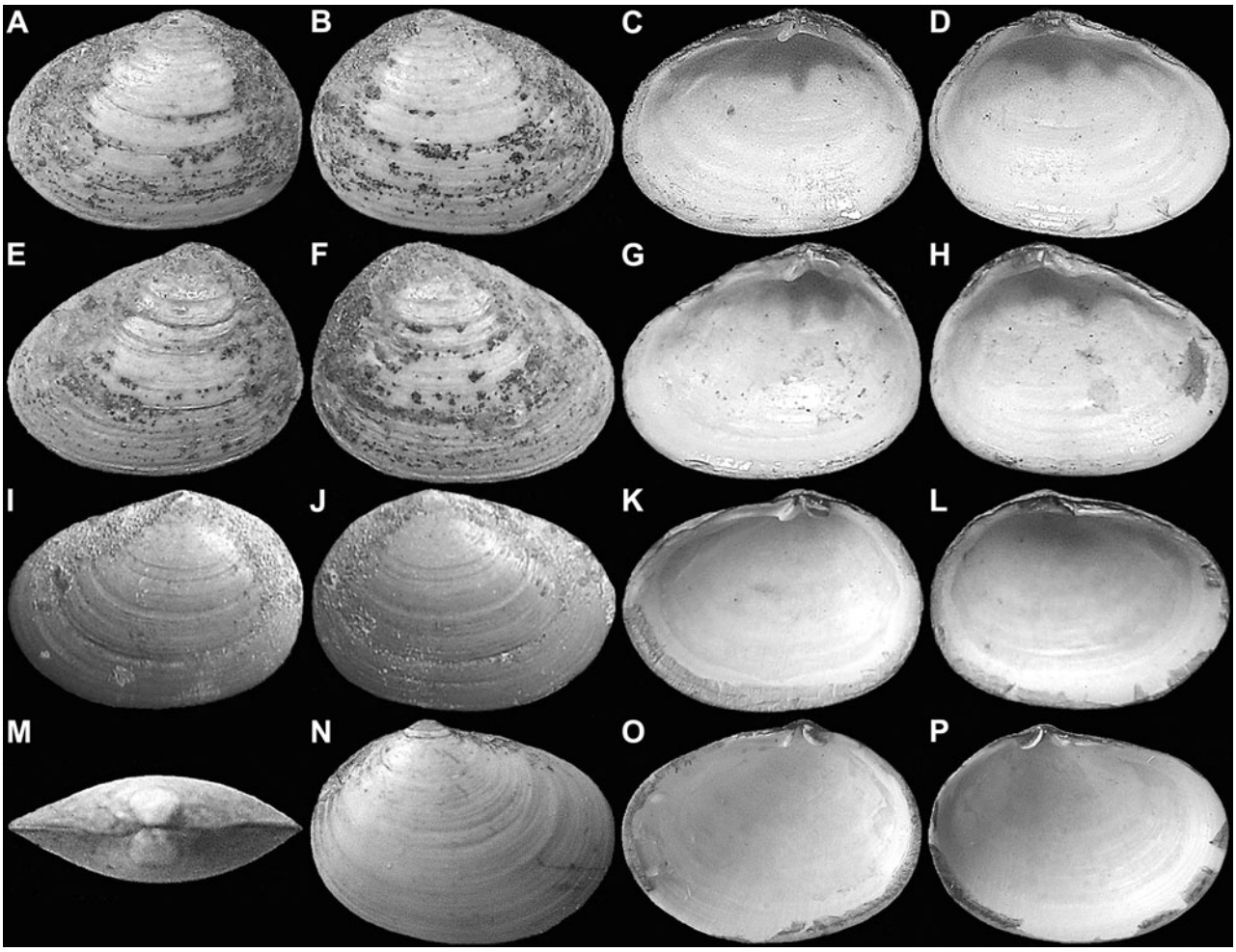

Fig. 2. *Montacuta spitzbergensis* Knipowitsch, 1901. Exterior and interior views of the left and right valves of specimens from: (A–H) Barents Sea, 69°43′ 3N 58°06′E, depth 38 m, shell length 4.7 mm (A–D) and 3.9 mm (E–H) (ZIN 11); (I–L) north-eastern Sakhalin Island, Sea of Okhotsk, 49°29′N 144°25′E, depth 114 m, shell length 6.3 mm. Specimens from the north-eastern Sakhalin Island, 53°45′ 15,2″N 143°373′ 6,5″E, 106 m: (M) dorsal view of both valves, shell length 4.5 mm; (N, O) exterior and interior view of the right valve; and (P) interior view of the left valve, shell length 6.0 mm.

6 specimens, RV 'Deryugin', cruise 8, Station 776, Barents Sea, 70°15′N 54°02′E, 125 m, silt, collected by L.I. Moskalev, 20 August 1959; ZIN 6, 10 specimens, RV 'Deryugin', cruise 8, Barents Sea, 70°15′N 54°02′E, 125 m, silt, collected by L.I. Moskalev, 20 August 1959; ZIN 7, 10 specimens, RV 'Deryugin', cruise 8, Station 779, Barents Sea, 69°37.53′N 56°50.5′E, 49 m, silt, collected by L.I. Moskalev, 21 August 1959; ZIN 8, 11 specimens, RV 'Deryugin', cruise 8, Station 780, Barents Sea, 69°55′ 3N 56°58′E, 81 m, sandy silt with pebbles, collected by L.I. Moskalev, 21 August 1959; ZIN 9, 3 specimens, RV 'Deryugin', cruise 8, Station 781, Barents Sea, 70°13.53′N 51°30′E, 110 m, sandy silt with pebbles, collected by L.I. Moskalev, 21 August 1959; ZIN 10, 3 specimens, RV 'Deryugin', cruise 8, Station 781, Barents Sea, 70°13.5′3N 51°30′E, 110 m, sandy silt with pebbles, collected by L.I. Moskalev, 21 August 1959; ZIN 11, 10 specimens, RV 'Deryugin', cruise 8, Station 764, Barents Sea, 69°43′ 3N 58°06′E, 38 m, sandy silt with pebbles, collected by L.I. Moskalev, 17 August 1959; ZIN 12, 7 specimens, RV 'Deryugin', cruise 8, Station 797, Barents Sea, 70°47′N 49°58E′, 125 m, silt with pebbles, collected by L.I. Moskalev, 2 September 1959; ZIN 13, 2 specimens, RV 'Deryugin', cruise 8, Station 802, Barents Sea, 69°58′N 50°25E′, 115 m, sandy silt with pebbles, collected by L.I. Moskalev, 3 September 1959; ZIN 14, 2 valves, RV 'Deryugin', cruise 8, Station 810, Barents Sea, 70°47′N 47°15E′, 150 m, sandy silt with pebbles, collected by L.I. Moskalev, 5 September 1959; ZIN 15, 1 specimen, RV 'Deryugin', cruise 8, Station 812, Barents Sea, 71°04,2′N 48°51′E, 125 m, sandy silt with pebbles, collected by L.I. Moskalev, 5 September 1959; ZIN 16, 2 specimens, RV 'Deryugin', cruise 8, Station 812, Barents Sea, 71°04,2′N 48°51′E, 125 m, sandy silt with pebbles, collected by L.I. Moskalev, 5 September 1959; ZIN 17, 5 specimens, RV 'Deryugin', cruise 8, Station 813, Barents Sea, 71°17,5′N 50°01.5′E, 140 m, sandy silt with pebbles, collected by L.I. Moskalev, 6 September 1959; ZIN 18, 10 specimens, RV 'Deryugin', cruise 8, Station 813, Barents Sea, 71°17,5′N 50°01.5′E, 140 m, sandy silt with pebbles, collected by L.I. Moskalev, 6 September 1959; ZIN 19, 7 specimens, RV 'Deryugin', cruise 8, Station 817, Barents Sea, 71°49′N 49°43.5′E, 125 m, sandy silt, collected by L.I. Moskalev, 7 September 1959; ZIN 20, 3 valves, RV 'Deryugin', cruise 8, Station 817, Barents Sea, 71°49′N 49°43.5′E, 125 m, sandy silt, collected by L.I. Moskalev, 7 September 1959; ZIN 21, 3 specimens, RV 'Deryugin', cruise 8, Station 819, Barents Sea, 71°14′N 45°56′E, 210 m, sandy

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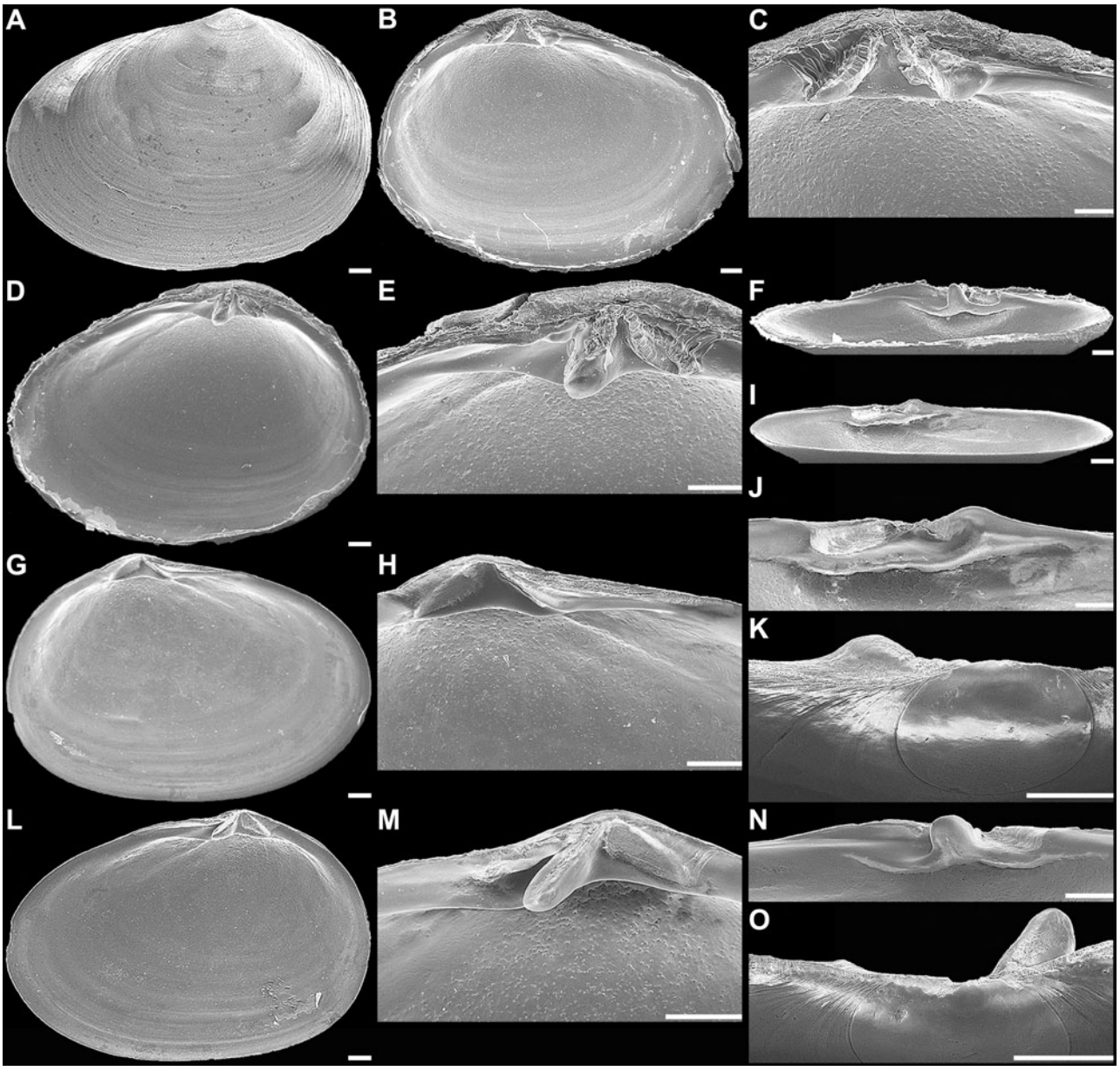

Fig. 3. *Montacuta spitzbergensis* Knipowitsch, 1901: (A) exterior view of the left valve without periostracum (north-eastern Sakhalin Island, Sea of Okhotsk, 49°30′N 144°29′E, depth 126 m); (B & C) interior view and hinge of the left valve with periostracum and ligament (north-eastern Sakhalin Island, 49°45′N 144°16′E, depth 112 m); (D–F) interior view, hinge, and ventral view of the right valve with periostracum and ligament (north-eastern Sakhalin Island, 49°45′N 144°16′E, depth 112 m); (G–K) interior view, hinge, ventral view of the hinge, and dorsal view of anterior lateral tooth of the left valve without periostracum and ligament (north-eastern Sakhalin Island, 49°30′N 144°29′E, depth 126 m); and (L–O) interior view, hinge, ventral view of the hinge, and dorsal view of anterior cardinal tooth of the right valve without periostracum and ligament (north-eastern Sakhalin Island, 49°30′N 144°29′E, depth 126 m). Scale bars: 300 μm.

Table 1. *Montacuta spitzbergensis* from the Barents Sea, Arctic ocean (ZIN 7, 11, 18, 19, 28). Summary statistics of the shell measurements (mm) and indices (N = 40).

Statistics	L	H	W	A	H/L	W/L	A/L
Mean	3.72	2.75	1.31	2.16	0.740	0.349	0.579
SE	0.12	0.08	0.05	0.08	0.003	0.003	0.004
SD	0.76	0.53	0.31	0.49	0.021	0.022	0.026
Minimum	2.3	1.7	0.8	1.2	0.692	0.308	0.536
Maximum	5.0	3.7	1.8	3.1	0.784	0.395	0.646

N, number of specimens measured; L, shell length; H, shell height; W, shell weight; A, shell anterior end length; SE, standard error; SD, standard deviation.

silt, collected by Yu.I. Galkin, 7 September 1959; ZIN 22, 1 specimen, RV 'Deryugin', cruise 8, Station 819, Barents Sea, 71°14′N 45°56E′, 210 m, sandy silt, collected by Yu.I. Galkin, 7 September 1959; ZIN 23, 3 specimens and 2 valves, RV 'Deryugin', cruise 8, Station 820, Barents Sea, 70°53′N 45°57′E, 147 m, sandy silt, collected by L.I. Moskalev, 8 September 1959; ZIN 24, 3 specimens, RV 'Deryugin', cruise 8, Station 820, Barents Sea, 70°53′N 45°57′E, 147 m, sandy silt, collected by L.I. Moskalev, 8 September 1959; ZIN 25, 2 specimens, RV 'Deryugin', cruise 8, Station 821, Barents Sea, 69°00′N 43°04′E, 64 m, silted sand, collected by L.I. Moskalev, 13 September 1959; ZIN 26, 1 specimen, RV 'Deryugin', cruise 8, Station 824, Barents

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Table 2. *Montacuta spitzbergensis* from the Sea of Okhotsk, Pacific Ocean. Summary statistics of the shell measurements (mm) and indices (N = 36).

Statistics	L	H	W	A	H/L	W/L	A/L
Mean	4.94	3.67	1.82	3.13	0.746	0.360	0.631
SE	0.17	0.12	0.07	0.12	0.005	0.005	0.006
SD	1.02	0.72	0.43	0.72	0.031	0.031	0.035
Minimum	2.2	1.7	1.0	1.3	0.689	0.300	0.537
Maximum	7.0	5.1	2.6	4.4	0.821	0.426	0.680

N, number of specimens measured; L, shell length; H, shell height; W, shell weight; A, shell anterior end length; SE, standard error; SD, standard deviation.

Sea, 70°01′N 41°17′E, 105 m, sand with shells, collected by L.I. Moskalev, 18 September 1959; ZIN 27, 1 specimen, RV 'Deryugin', cruise 8, Station 825, Barents Sea, 70°13.8′N 41°16′E, 105 m, sandy silt, collected by Yu. I. Galkin, 19 September 1959; ZIN 28, 5 specimens, RV 'Deryugin', cruise 8, Station 764, Barents Sea, 69°43′N 58°06′E, 38 m, sandy silt with pebbles and shells, collected by Yu.I. Galkin, 17 August 1959; ZIN 29, 2 specimens, RV 'Diana', Station 403a, Barents Sea, 69°01′N 43°02′E, 65 m, silt, collected by L.I. Moskalev, 7 July 1958; ZIN 30, 1 specimen, RV 'Diana', Station 707, Barents Sea, 70°19′N 50°26′E, 95 m, silt, collected by L.I. Moskalev, 2 August 1958; ZIN 31, 1 specimen, RV 'Diana', station 702a, Barents Sea, 69°00′N 44°00′E, 63 m, silted sand, collected by L.I. Moskalev, 30 August 1958; ZIN 32, 4 specimens, RV 'Dalnie Zelenci', Station 5, Barents Sea, 70°05′N 51°51′E, 103 m, silt with gravel, collected by Panteleeva, 15 July 1993; ZIN 33, 1 specimen, RV 'Dalnie Zelenci', Station 30, Barents Sea, 69°31.75′N 51°59,65′E, 48 m, silted sand, collected by Panteleeva, 24 July 1993; ZIN 34, 3 specimens, RV 'Dalnie Zelenci', Station 8, Barents Sea, 70°10.5′N 54°29.8′E, 134 m, silt, collected by Panteleeva, 16 July 1993; IO RAS, 6 specimens, RV 'Vityaz', Sakhalin Island, Sea of Okhotsk, 54°31,2′N 143°52,5′E, 181–268 m, 14 September 1949; IMB, 1 specimen, RV 'Agat', Sakhalin Island, Sea of Okhotsk, 53°45′ 07,1″N 143°37′ 3,9″E, 105 m, silted sand with pebbles, collected by G.M. Kamenev, 6 July 2006; IMB, 2 specimens, RV 'Agat', Sakhalin Island, Sea of Okhotsk, 53°45′ 15,2″N 143°37′ 36,5″E, 106 m, silted sand with pebbles, collected by G.M. Kamenev, 5 July 2006; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 51°30′N 143°59′E, 102 m, silted sand, collected by V.A. Nadtochy, 10 July 2002; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 51°30′N 144°09′E, 145 m, sand, collected by V.A. Nadtochy, 10 July 2002; IMB, 2 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 50°30′N 144°03′E, 109 m, silt, collected by V.A. Nadtochy, 9 July 2002; IMB, 3 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 50°30′N 144°14′E, 140 m, silt, collected by V.A. Nadtochy, 9 July 2002; IMB, 2 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 50°30′N 144°30′E, 189 m, silt, collected by V.A. Nadtochy, 9 July 2002; IMB, 2 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 50°N 144°15′E, 123 m, silt, collected by V.A. Nadtochy, 27 June 2002; IMB, 4 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 50°N 144°26′E, 139 m, silt, collected by V.A. Nadtochy, 8 July 2002; IMB, 2 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°45′N 144°16′E, 112 m, silt, collected by V.A. Nadtochy, 30 June 2002; IMB, 6 specimens, RV

Table 3. Differentiating characters of *Montacuta* spp.

Characters	*Montacuta spitzbergensis*	*Montacuta substriata*	*Montacuta goudi*	*Montacuta echinocardiophila*	*Montacuta semiradiata neozelanica*
Shall shape	Elongate–ovate	Ovate	Ovate	Ovate to elongate–ovate	Elongate–ovate
Valves	Thick, solid	Thin, fragile, sometimes translucent	Thin, fragile, translucent	Thin, fragile, translucent	Thin, fragile
Shell length (mm)	8.4	3.2	3.5	2.7	2.7
Sculpture	Fine, dense and a few, strong, wide spaced growth lines	Fine growth lines and delicate radial riblets	Fine growth lines	Fine growth lines and wide spaced radial riblets in central part of valves	Few, irregular growth lines with low, spare, irregular, lachrymoid radial riblets
Prodissoconch	Very large (700–920 μm), elongate–ovate	Small (130–150 μm), ovate	ND	ND	ND
Ligament	Mostly internal, connected by a thin layer of fibres with weakly developed external ligament	Internal	Internal	Internal	Internal
Hinge plate	Wide, slightly curved	Narrow, strongly curved	Very narrow, strongly curved	Narrow, strongly curved	Narrow, strongly curved
Resilifer	Wide, shot, shallow	Narrow, long, deep	Narrow, shot	ND	Narrow, long, deep
Teeth	Strong	Strong	Very week, barely noticeable	Strong	Strong

ND, no data available.

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'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°45′N 144°23′E, 127 m, silt, collected by V.A. Nadtochy, 30 June 2002; IMB, 3 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°45′N 144°35′E, 155 m, silt, collected by V.A. Nadtochy, 30 June 2002; IMB, 4 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°30′N 144°29′E, 126 m, sandy silt, collected by V.A. Nadtochy, 1 July 2002; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°30′N 144°40′E, 150 m, silt, collected by V.A. Nadtochy, 1 July 2002; IMB, 3 specimens, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°29′N 144°25′E, 114 m, silt, collected by V.A. Nadtochy, 1 July 2002; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°15′N 144°47′E, 140 m, silt with gravel, collected by V.A. Nadtochy, 2 July 2002; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 49°15′N 144°59′E, 232 m, silted sand with pebbles, collected by V.A. Nadtochy, 2 July 2002; IMB, 1 specimen, RV 'Bukharo', Sakhalin Island, Sea of Okhotsk, 48°10′N 145°02′E, 132 m, silted sand with pebbles, collected by V.A. Nadtochy, 3 July 2002.

DIAGNOSIS

Shell small (to 8.4 mm), thick, equivalve, unequilateral, elongate–ovate. Beaks posterior, orthogyrate. Sculpture of fine and strong growth lines. Periostracum thin, polished. Hinge plate wide, slightly curved. Right valve with an anterior strong, oblique cardinal tooth and a deep socket of hinge plate anterior to tooth, bounded by a visor-shaped protection of anterodorsal shell margin and tooth. Left valve with an anterior, strong, long, laminar tooth and a socket of hinge plate under beak. Ligament mostly internal, strong, oblique, elongate–ovate, connected by a thin layer fibres with a very thin, short, weakly developed external ligament. Resilifer wide, short, oblique, ovate–elongate. Adductor muscle scars irregular, elongated; anterior scar situated along anterodorsal shell margin, higher than posterior. Prodissoconch very large (length from 700 to 920 μm), distinctly marked, regularly elongate–ovate.

DESCRIPTION

Exterior shell morphology: shell small (to 8.4 mm), elongate–ovate (H/L = 0.689–0.821), equivalve, moderately inflated (W/L = 0.300–0.426), strongly unequilateral, thick, solid. Sculpture of fine, dense and a few strong, widely spaced growth lines. Periostracum thin, polished, light grey or pinkish-brown, often with ferruginous deposit, covering beaks and dorsal shell margin. Beaks low, rounded, orthogyrate, posterior to midline (A/L = 0.536–0.678). Anterior shell end elongate, slightly narrowed, rounded. Posterior shell end slightly expanded, rounded, sometimes slightly splayed and angular. Anterodorsal shell margin almost straight, with a small obtuse angle, gently sloping ventrally and then smoothly transitioning to anterior margin. Anterodorsal shell margin of right valve with a large visor-shaped projection anterior to beak, thus producing in the dorsal view a noticeable bend of coalescence line of valves. Anterior margin rounded, smoothly transitioning to ventral margin. Ventral margin smoothly rounded. Posterodorsal slightly convex, gently sloping ventrally, smoothly transitioning to posterior margin. Posterior margin slightly curved, smoothly transitioning to ventral margin. Ligament mostly internal, strong, elongate–ovate, connected by a thin layer fibres with a very thin, short, weakly developed external ligament. Prodissoconch very large (length from 700 to 920 μm), distinctly marked, regularly elongate–ovate.

Interior shell morphology: hinge plate wide, slightly curved, most concave under beaks. Hinge with anterior cardinal tooth in right valve and lateral tooth in left valve. Cardinal tooth of right valve strong, short, oblique, high, directed anteroventrally. Between anterior tooth and over handing visor-shape projection of anterodorsal margin is a deep socket in the hinge plate matched by lateral tooth of left valve. Lateral tooth of left valve strong, long, angular, rounded triangular in dorsal view, laminar, with a thickened posterior edge, slightly curved ventrally, extending along anterodorsal shell margin. Under the beak is an oblique, anteriorly directed socket matched by cardinal of right valve.

Resilifer wide, short, oblique, ovate–elongate, shallow, with a tapering and sharpened lower end, posterior to beaks. Adductor scars distinct, elongate–ovate, unequal; anterior scar situated along anterodorsal shell margin, higher than posterior. Pallial line distinct, wide. Shell interior white, smooth.

VARIABILITY

Shell shape and proportions are variable (Figure 2; Tables 1 & 2). The shell shape varies from ovate–triangular to almost regularly elongate–ovate. The position of the beaks is also variable. In comparison with specimens from the Sea of Okhotsk, *M. spitzbergensis* from the Barents Sea has less posteriorly placed beaks (Tables 1 & 2). Specimens from the Sea of Okhotsk generally attain markedly larger shell size. However, the greatest shell length (over 8 mm) was found for specimens from the Chuckchi Sea (A. Yu. Voronkov, personal communication). Other morphological characteristics of the shell and hinge structure of *M. spitzbergensis* from the most distant localities of its range show no marked variation.

Width and bend of the hinge plate, as well as the sizes, shape and position of teeth in both valves vary little. Sometimes, the hinge plate markedly widens in the teeth area, and the cardinal tooth of the right valve is almost vertical (Figure 3D & E). The lateral tooth of the left valve varies from thin, laminar, subparallel to the anterodorsal shell margin (Figure 3G & H) to thick, elongate–triangular, anteroventrally directed (Figure 3B & C).

COMPARISON

Montucata spitzbergensis differs considerably from other species of this genus in its elongate–ovate, thick shell with a wide, slightly curved hinge plate; wide, short, and shallow resilifer; weakly developed external ligament (Table 3).

In shell shape *M. spitzbergensis* is similar to *Montacuta echinocardiophila* Habe, 1964 and *Montacuta semiradiata neozelanica* (Dell, 1956). However, in contrast to *M. echinocardiophila* and *M. semiradiata neozelanica*, this species further has no radial sculpture of the shell (Dell, 1956; Habe, 1964, 1977, 1981; Ponder, 1968; Okutani, 2000).

DISTRIBUTION AND HABITAT

Arctic Ocean: Spitsbergen, Barents, Kara, Laptev and Chukchi Seas (Knipowitsch, 1901; Filatova, 1948, 1957; Gorbunov, 1952; Voronkov, 2004, personal communication); Pacific Ocean: north-eastern Sakhalin Island, Sea of Okhotsk (from 48°10N′ 145°02′E to 54°31,2′N 143°52,5′E) (Figure 4).

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Fig. 4. Distribution of *Montacuta spitzbergensis* (■) in the north-western Pacific.

Montacuta spitzbergensis was recorded off Spitsbergen at depths from 9 m (Hornsund, 76°57′N 15°50′E) to 24 m (Storfjord, 77°28′N 20°57′E) on silt with gravel at a bottom temperature +2.50°C (Hornsund) (Knipowitsch, 1901). In the Barents Sea, it was obtained from 38 m (69°43′N 58°06′E) to 210 m (71°14N 45°56′E) on silt, silted sand, and sand sometimes with some admixture of gravel, pebbles, and shells at a bottom temperature from −1.62°C (70°10,5′N 54°29,8′E, depth 134 m) to −0.11°C (69°31,75′N 52°59,65′E, depth 48 m); in the Laptev Sea—from 21 m (73°50.84′N 120°18.07′E) to 192 m (77°41.05′N 105°39.02′E) on silt sometimes with pebbles at a bottom temperature from −1.10°C (77°08.08N 110°16.06E, depth 50 m) to −0.80°C (77°41.05′N 105°39.02′E, depth 192 m); in the Chukchi Sea—from 14 m (66°46.46′N 174°23.1′W) to 52 m (68°16′N 170°00′W) on silt, sandy silt, and silted sand sometimes with gravel and pebbles at a bottom temperature from +1.66°C (66°54.5′N 169°54.4′W, depth 44 m) to +2.36°C (68°16′N 170°00′W, depth 52 m) (Voronkov, personal communication); in the Sea of Okhotsk—from 102 m (51°30′N 143°59′E) to 232 m (49°15′N 144°59′E) on silt, silted sand, and sand sometimes with some admixture of gravel and pebbles.

REMARKS

The host of *M. spitzbergensis* is not known. In all the investigated samples, this species was found in sediments. Perhaps, during sample collection and washing, the molluscs accidentally fell down or were thrown off the host.

Herrmann (2006) recorded *Montacuta* sp. for the coastal slope (5 m to 30 m) in Kongfjorden (Spitsbergen) at 5, 20, and 30 m depths. Probably, this is *M. spitzbergensis*.

Knipowitsch (1901) described *M. spitzbergensis* from four specimens found at Station 30 (3 specimens, Storfjord, Krausshafen) and Station 13 (1 specimen, Hornsund, Goësbay). Gorbunov (1952) examined the type material in the ZIN collection and found only two dry, badly damaged specimens from Station 30. Scarlato (1981) reported *M. spitzbergensis* to be absent from the ZIN collection, though it is in the ZIN where the materials collected by expeditions on the RV 'Krasin' (1935) and RV 'Deryugin' (1959) are deposited. During my brief visit to the ZIN, I was unable to find the type material in the collection of this species. It is not inconceivable that following a more thorough study of the extensive bivalve collection of the ZIN the type material of *M. spitzbergensis* will be found.

Scarlato (1981) stated that *M. spitzbergensis* occurs in the Barents, Kara, Laptev and East Siberian Seas, making reference to a work of Filatova (1957). Kantor & Sysoev (2005), citing the monograph by Scarlato (1981), also reported this species to be distributed in all Russian Arctic Seas. However, Filatova (1957) noted that *M. spitzbergensis* may occur in the Laptev and East Siberian Seas, but it was not actually recorded there. In reality, *M. spitzbergensis* was found in the Laptev Sea much later (Voronkov, 2004), and it is not yet known in the East Siberian Sea.

Describing *M. spitzbergensis*, Knipowitsch (1901) stated that the right valve has two teeth: one is oblique, projecting, and placed in the middle and the other is anterior, weak, laminar and lateral. Very likely, Knipowitsch (1901) confused the lateral tooth with the visor-shaped projecting part of the anterodorsal shell margin in front of the beak, under which is a deep socket of the hinge plate.

Gorbunov (1952) was sure that *M. spitzbergensis* is not a *Montacuta* species. However, comparison of *M. spitzbergensis* with members of different genera of the superfamily Leptonacea showed that this species is most similar in shell morphology to type species of the genera *Montacuta* and *Tellimya*. The hinge of *M. spitzbergensis* is very similar to the hinge of *M. substriata*. The shape and position of the lateral tooth in the left valve are identical in these species (Figures 1H–O & 3G–K). Unlike *M. substriata*, the tooth in the right valve of *M. spitzbergensis* is wider, more rounded in cross-section, thickened ventrally, and separated from the lower margin of the hinge plate (Figures 1A–G, 3A–F & 3L–O). The position of the resilifer is largely similar in these species. It is situated on the hinge plate, which in *M. spitzbergensis* is wider and less turned inside the shell at the place where the resilifer lies. In contrast to *M. substriata*, the resilifer of *M. spitzbergensis* is shorter, shallower and wider.

In my view, the differences in the hinge structure between these species are not sufficient for the referral of *M. spitzbergensis* to some other genus within the Montacutidae. Therefore, I consider *M. spitzbergensis* to be a distinct species of the genus *Montacuta*. It is possible that these differences are in part due to the different sizes and thickness of the shell in these species. The shell of *M. spitzbergensis* is much larger and thicker. Probably, that is why its hinge plate is wider and thicker, the ligament is larger and thicker, and the cardinal tooth is stronger. The relationship between degree of development of hinge and shell thickness in montacutids was noted by Ockelmann (1965).

By the shell shape and proportions, *M. spitzbergensis* is most similar to *T. ferruginosa* (Figures 2 & 5). However, the hinge of *T. ferruginosa* differs from the hinge of both *M. spitzbergensis* and *M. substriata*. In contrast to *M. spitzbegensis* and *M. substriata*, *T. ferruginosa* lacks the hinge plate under the beak, its wide and spoon-shaped resilifer is situated on the inner shell surface behind the beaks instead of being on

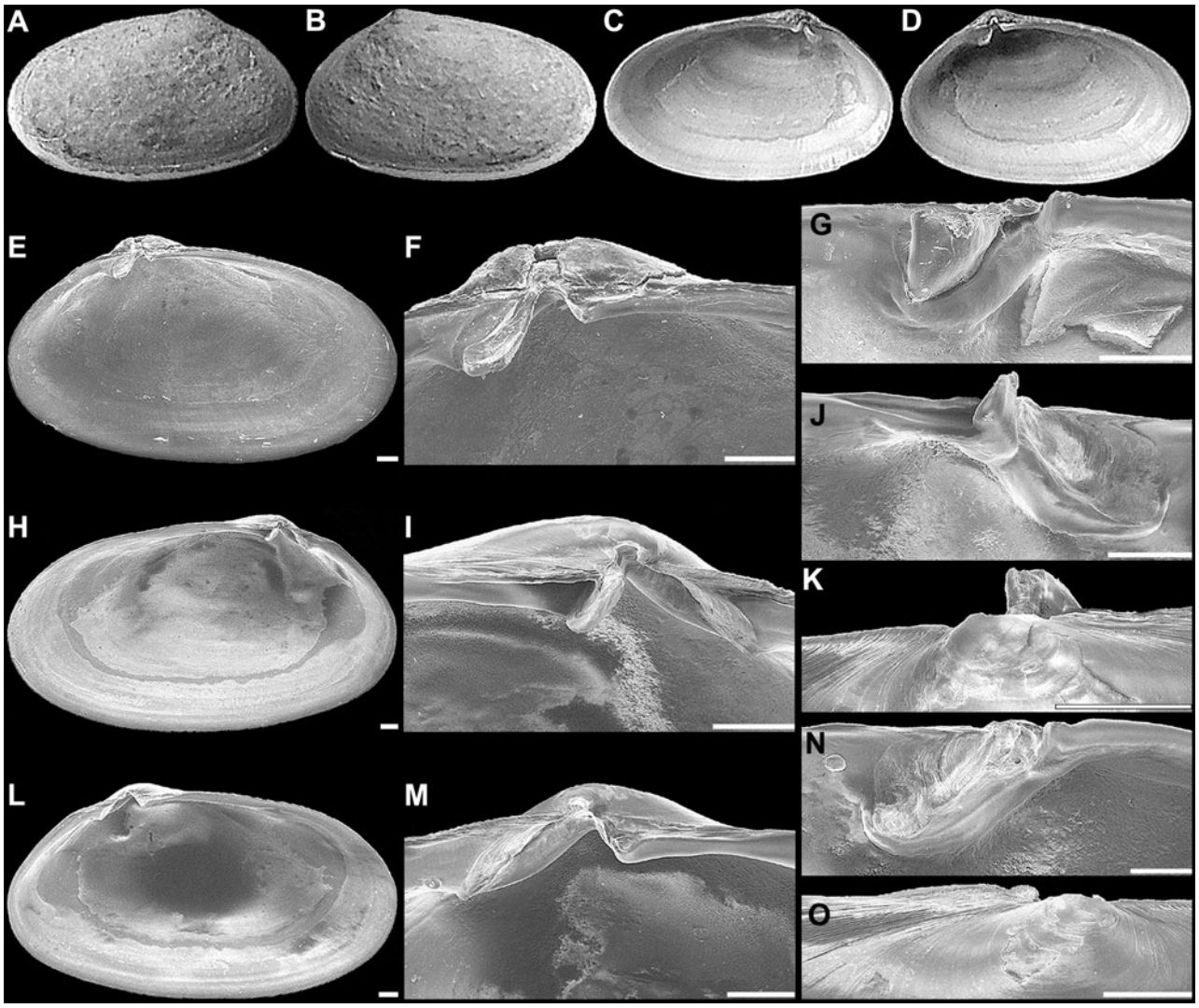

Fig. 5. *Tellimya ferruginosa* (Montagu, 1808) from Oxwich Bay, Gower, West Glamorgan (NMW 1980.188–8): (A–D) exterior and interior views of the left and right valves, shell length 7.2 mm; (E–G) interior view, hinge, and ventral view of hinge of left valve with periostracum and ligament; (H–K) interior view, hinge, ventral view of hinge, and dorsal view of anterior cardinal tooth of right valve without periostracum and ligament; and (L–O) interior view, hinge, ventral view of hinge, and dorsal view of anterior lateral tooth of left valve without periostracum and ligament. Scale bars: 300 μm.

the hinge plate; the anterior lateral tooth is very long, thin, narrow, curved like a V-groove; the anterior cardinal tooth fits into the space under the beak between the ligament and lateral tooth of the left valve instead of the socket of the hinge plate.

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