Journal of the Marine Biological Association of the United Kingdom, 2018, 98(2), 357–374.
doi:10.1017/S0025315416001387

Three new species of the genus *Hyalopecten* (Bivalvia: Pectinidae) from the abyssal and hadal zones of the North-western Pacific Ocean

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Three new species, Hyalopecten vityazi *sp. nov.,* H. abyssalis *sp. nov. and* H. kurilensis *sp. nov., are described from the abyssal and hadal zones of the North-western Pacific.* Hyalopecten vityazi *was found in the Kuril-Kamchatka and Aleutian trenches at 6090–8100 m depth. It is the most deep-water species of the order Pectinida.* Hyalopecten abyssalis *and* H. kurilensis *were found at the abyssal plain adjacent to the Kuril-Kamchatka and Aleutian trenches at 4550–5045 m depth. To date, 13 species of the genus* Hyalopecten *are known from different regions of the World Ocean. A table with the main differences among all known species in the genus is provided.*

Keywords: *Hyalopecten*, Bivalvia, new species, systematics, abyssal and hadal zones, North-western Pacific

Submitted 1 September 2016; accepted 2 September 2016; first published online 5 October 2016

INTRODUCTION

Many species of the family Pectinidae inhabit the deep waters of the bathyal (200–3000 m) and abyssal (3000–6000 m) zones of the World Ocean (Schein, 1989; Coan *et al.*, 2000; Okutani, 2000; Dijkstra & Kilburn, 2001; Allen, 2008; Dijkstra & Maestrati, 2008; Dijkstra & Marshall, 2008; Huber, 2010; Dijkstra, 2013). Thirty-eight species of this family have been recorded in the deep Atlantic at depths greater than 500 m. Pectinidae, along with Thyasiridae, Cuspidariidae and Verticortiidae, are one of the richest families, in terms of the number of species, among the lamellibranchs in the deep Atlantic (Allen, 2008). However, most of the deep-water pectinids inhabit the bathyal zone. A small number of species of the family Pectinidae, most of them belonging to the genus *Hyalopecten* Verrill, 1897, have been found in the abyssal zone of the World Ocean (Knudsen, 1970; Coan *et al.*, 2000; Okutani, 2000; Allen, 2008; Coan & Valentich-Scott, 2012).

The genus *Hyalopecten* comprises 10 species, of which *Hyalopecten frigidus* (Jensen, 1904), *Hyalopecten neoceanicus* (Dall, 1908), *Hyalopecten profundicola* (Okutani, 1962) and *Hyalopecten pudicus* (Smith, 1885) were recorded in the abyssal zone (Smith, 1885; Dall, 1908; Okutani, 1962, 1975; Knudsen, 1970; Schein, 1989; Dijkstra & Gofas, 2004; Dijkstra *et al.*, 2009; Coan & Valentich-Scott, 2012), and *Hyalopecten hadalis* (Knudsen, 1970) in the hadal zone (depths below 6000 m) (Knudsen, 1970; Dijkstra & Marshall, 2008). Until recently, *H. hadalis* and *Delectopecten vancouverensis* (Whiteaves, 1893) were the only pectinids found in the hadal zone that had been identified to species level (Filatova, 1961; Knudsen, 1970; Belyaev, 1989). Species of the genus *Hyalopecten* have been recorded in many regions of the World Ocean (Schein, 1989; Egorova, 1999; Okutani, 2000; Dijkstra & Marshall, 2008; Coan & Valentich-Scott, 2012). However, most *Hyalopecten* species are very rare in samples and were generally described from a minimal amount of material (1–2 specimens). An exception is *H. frigidus* and *H. pudicus*, which are widespread in the Arctic and Atlantic oceans and off Antarctica, with large number of specimens found in benthic samples and deposited in museum collections (Knudsen, 1970, 1985; Bouchet & Waren, 1979; Schein, 1989; Dell, 1990; Dijkstra & Goud, 2002; Aldea & Troncoso, 2008).

Only one species of *Hyalopecten, H. profundicola*, has so far been recorded in the North-western Pacific. It was found off the shores of Japan at depths of 3150–3450 m (Okutani, 1962, 1975). Probably, this is a rare abyssal species, as in the course of intensive studies of the bathyal, abyssal and hadal zones of the Pacific Ocean Japanese researchers have found only four specimens in a narrow depth range off the shores of Japan. During the period from 1949 to 1990, numerous Russian (more than 20) expeditions explored the deep-water benthic fauna of the Sea of Japan, the Sea of Okhotsk, the Bering Sea and the North-western Pacific, including the abyssal plain and oceanic trenches (Monin, 1983; Belyaev, 1989). Starting in 2010, investigations of the deep-sea fauna of this extensive region have been continued by joint expeditions of Russian and German researchers (Malyutina & Brandt, 2013; Brandt & Malyutina, 2015). As a result of these studies, a rich bottom fauna of the abyssal and hadal zones of the North-western Pacific has been discovered and

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a large number of species of bivalves have been described (Filatova, 1958, 1960, 1971, 1976; Ivanova, 1977; Filatova & Schileyko, 1984, 1985; Krylova, 1993, 1995, 1997; Kamenev, 2014, 2015; Krylova *et al.*, 2015). Representatives of the order Pectinida have also been found in deep-water basins of the Sea of Japan, the Sea of Okhotsk, the Bering Sea, and on the abyssal plains and in oceanic trenches of the North-western Pacific at depths to 8100 m. However, all specimens with the exception of *D. vancouverensis* were not identified to the species level (Filatova, 1961; Belyaev, 1966, 1989; Scarlato, 1981; Kamenev, 2013, 2015).

A thorough examination of the entire extensive material of bivalves collected by different expeditions during the period from 1949 to 2015 in the abyssal and hadal zones of the Sea of Japan, Sea of Okhotsk, Bering Sea and the North-western Pacific has revealed three new species of *Hyalopecten*. Two species were found on the abyssal plain (depth 4550–5045 m) adjacent to the Kuril-Kamchatka and Aleutian trenches and one species was discovered in the hadal zone of the Kuril-Kamchatka and Aleutian trenches (depth 6090–8100 m). To date, the latter species is the most deeply distributed species of the order Pectinida. Therefore, the present paper focuses on the description of the new species on the basis of conchological characters and a detailed comparison with all species of the genus *Hyalopecten*.

MATERIALS AND METHODS

Material studied

The material of *Hyalopecten* species was collected by IO RAS expeditions from the abyssal plain of the Pacific Ocean adjacent to the Kuril-Kamchatka and Aleutian trenches and in the hadal zone of the Kuril-Kamchatka and Aleutian trenches (RV 'Vityaz', cruise no. 2, 7 August–20 October 1949; RV 'Vityaz', cruise no. 14, 2 May–5 July 1953; RV 'Vityaz', cruise no. 20, 28 April–14 June 1955; RV 'Vityaz', cruise no. 39, 7 July–13 September 1966). All material of these species was fixed and stored in 70% ethanol in the IO RAS.

The following were used for comparison purposes: the type material of *Hyalopecten profundicola* (Okutani, 1962) (holotype NMNS Mo 69702), photos of type and other materials of *Hyalopecten neoceanicus* (Dall, 1908) (holotype USNM 110579, photos from USNM website (information provided with the permission of the National Museum of Natural History, Smithsonian Institution, 10th and Constitution Ave. N.W., Washington, DC 20560–0193 (http://www.nmnh.si.edu/)), *Hyalopecten pudicus* (Smith, 1885) (images of holotype (BMNH 1887.2.9.3280) from Marine Bivalve Shells of the British Isles website (Oliver *et al.*, 2010), image numbers: NMW Mo11625–11628), *Hyalopecten frigidus* (Jensen, 1904) (images from Marine Bivalve Shells of the British Isles website (Oliver *et al.*, 2010), image numbers: NMW Mo12784–12786, Mo12827, Mo12830), *Hyalopecten mireilleae* Dijkstra, 1995 (holotype, http://coldb.mnhn.fr/catalognumber/mnhn/im/2000-24350, Muséum national d'Histoire naturelle, Paris (France), Collection: Molluscs (IM), Specimen MNHN-IM-2000-24350), *Hyalopecten undatus* (Verrill & S. Smith in Verrill, 1885) (holotype USNM 44827, photos from USNM website (Information provided with the permission of the National Museum of Natural History, Smithsonian Institution, 10th and Constitution Ave. N.W., Washington, DC 20560–0193 (http://www.nmnh.si.edu/)); type material of different species of the families Propeamussiidae and Pectinidae deposited in CAS, LACM, NMNS, SBNHM.

Shell measurements

Figure 1 shows the shell morphology measurements. Shell length (L), height (H), anterior end length (A), auricles length (AL), anterior auricle length (AAL) and umbonal angle (UA) were measured for shells. The ratios of these parameters to shell length (A/L, H/L, AA/L, AAL/L, respectively) were determined. Shell measurements were made using a caliper and an ocular micrometer with an accuracy of 0.1 mm.

Methods

For scanning electron microscopy, shells were cleaned of traces of soft tissues and periostracum in 50% diluted commercial bleach, washed in distilled water, and dried. They were then mounted onto aluminium stubs using an adhesive tape and coated with carbon for examination with an EVO 40XVP and SIGMA 300VP (Carl Zeiss, Cambridge, UK). Shells of holotypes were only washed in distilled water and dried. Uncoated shells of holotypes were also used for examination with scanning electron microscopes.

Abbreviations

The following institutional abbreviations are used in the paper: BMNH – The Natural History Museum, London, UK; CAS – California Academy of Sciences, San Francisco; IMB – A.V. Zhirmunsky Institute of Marine Biology, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia; IO RAS – P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia; LACM – Natural History Museum of Los Angeles County, Los Angeles, USA; MIMB – Museum of the Institute of

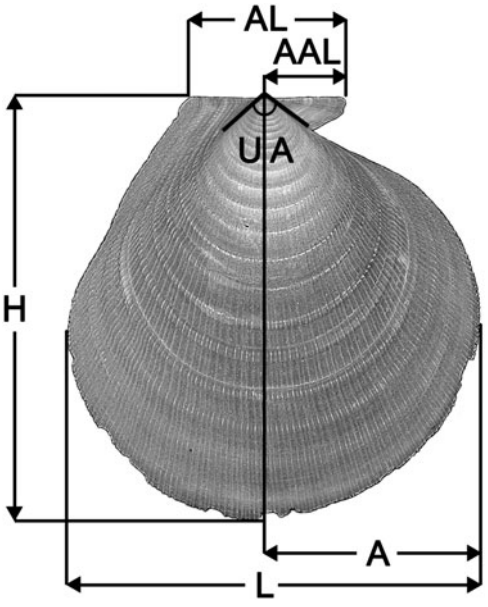

Fig. 1. Placement of shell measurements: L, shell length; H, height; A, anterior end length; AL, auricles length; AAL, anterior auricle length; UA, umbonal angle.

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Marine Biology, Vladivostok, Russia; NMW – National Museums & Galleries of Wales, Cardiff, UK; MNHM – Muséum national d'Histoire naturelle, Paris, France; NMNS – National Museum of Nature and Science, Tsukuba, Japan; SBNHM – Santa Barbara of the Natural History Museum, Santa Barbara, USA; USNM – United States National Museum of Natural History, Smithsonian Institute, Washington, DC, USA; ZIN – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; ZMA – Zoological Museum, University of Amsterdam, Amsterdam, the Netherlands; ZMMU – Zoological Museum of Moscow State University, Moscow, Russia; ZMUC – Zoological Museum, University of Copenhagen, Denmark.

SYSTEMATICS

Order PECTINIDA Gray, 1854
Superfamily PECTINOIDEA Rafinesque, 1815
Family PECTINIDAE Rafinesque, 1815
Subfamily CAMPTONECTINAE Habe, 1977
Genus *Hyalopecten* Verrill, 1897
Type species (by original designation): *Pecten undatus* Verrill & S. Smith in Verrill, 1885

DIAGNOSIS

Shell up to 40 mm in height, oblique, thin, fragile, subequilateral, compressed to inflated, inequivalve, with left valve more convex than right. Valves with commarginal undulations or regular, lamellate ribs and radial ribs or riblets. Auricles unequal, posterior auricles often continuous with disc; anterior auricles distinct. Byssal notch rather deep; ctenolium present.

Hyalopecten vityazi sp. nov.
(Figures 2 & 3, Table 1)

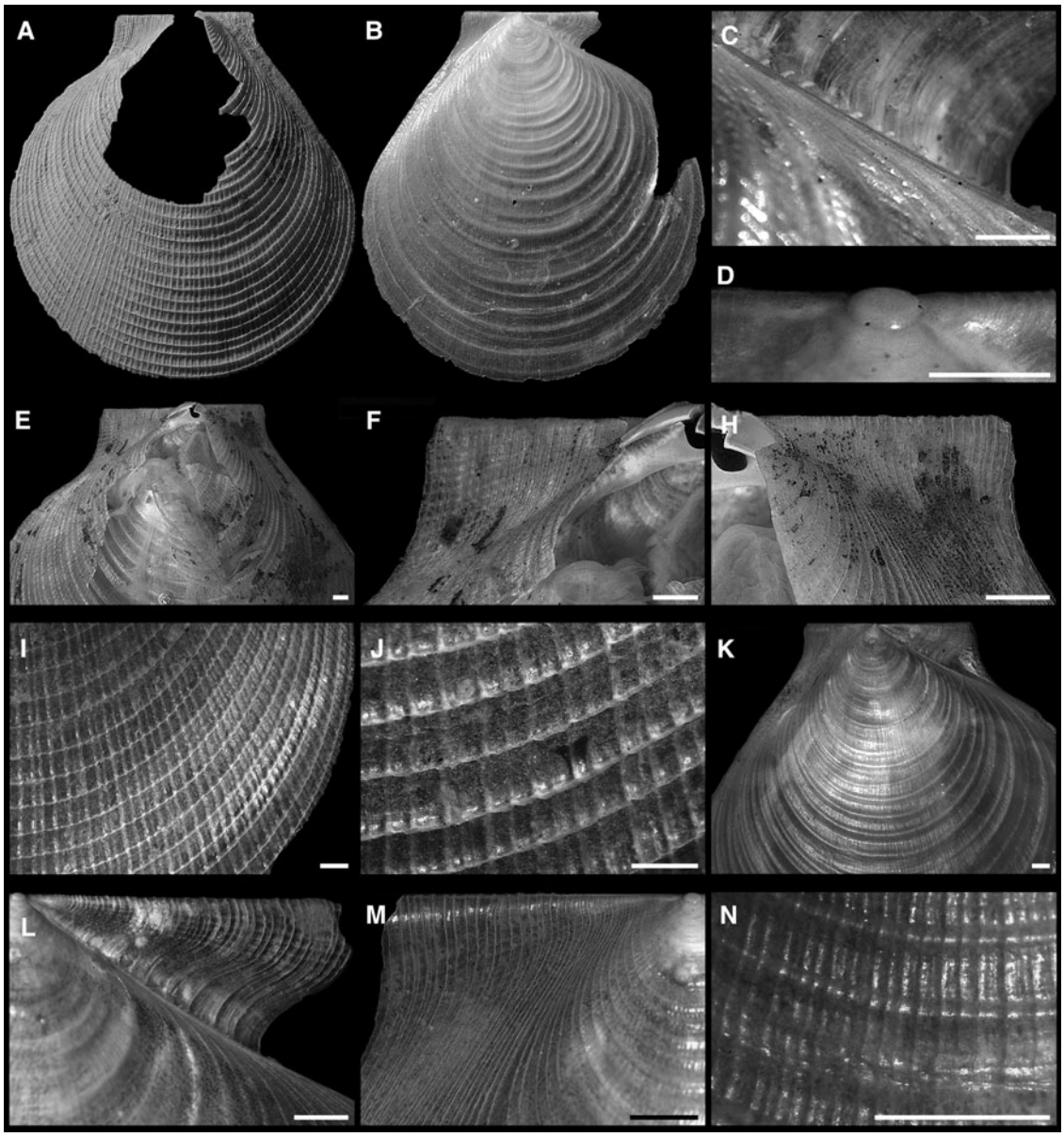

Fig. 2. *Hyalopecten vityazi* sp. nov., holotype (ZMMU Ld-3055), shell length 31.6 mm: (A) exterior view of right valve; (B) exterior view of left valve; (C) ctenolium; (D) prodissoconch; (E–H) auricles of left valve; (I, J) sculpture of left valve; (K–M) auricles of right valve; (N) sculpture of right valve. Scale bars: C–D, 500 μm; E–N, 1 mm.

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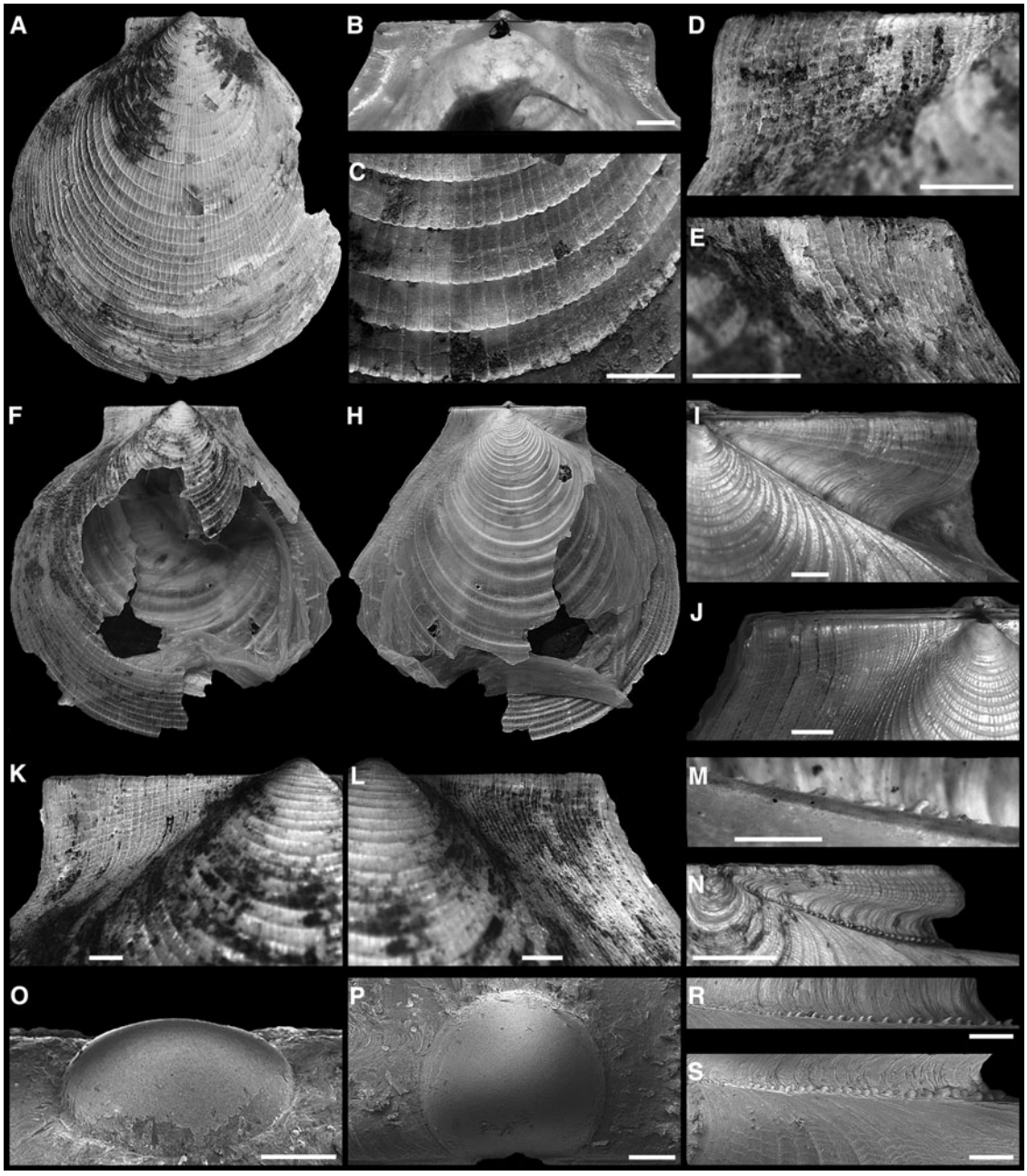

Fig. 3. *Hyalopecten vityazi* sp. nov. A–E: Paratype (ZMMU Ld-3057), Kuril-Kamchatka Trench (44°55.5′N 152°24′E), 8100 m: (A) exterior view of left valve, valve length 27.0 mm; (B) interior view of auricles; (C) sculpture of valve; (D, E) anterior and posterior auricles. (F–M) Paratype (ZMMU Ld-3056), Aleutian Trench (52°25,8′N, 170°53,9′E), 7246 m: (F, H) exterior view of both valves, shell length 33.0 mm; (I, J) anterior and posterior auricles of right valve; (K, L) anterior and posterior auricles of left valve; (M) ctenolium; (N) ctenolium of damaged specimen from Kuril-Kamchatka Trench (46°N, 153°27′E), 7265–7295 m. (O–S) Scanning electron micrographs of fragment of right valve from Kuril-Kamchatka Trench (45°32′N 153°46′E), 6675–6710 m: (O, P) prodissoconch; (R, S): frontal and dorsal views of ctenolium. Scale bars: B–E, I–N, 1 mm; O, P, 100 μm; R, S, 500 μm.

Delectopecten sp.: Belyaev, 1966, p. 116; Belyaev, 1989, p. 216. *Propeamussium* sp.: Belyaev, 1966, p. 116; Belyaev, 1989, p. 216 (for the Aleutian and Kuril-Kamchatka trenches).

TYPE MATERIAL AND LOCALITY

Holotype: damaged specimen. (RV 'Vityaz', cruise 39, station 5609, Kuril-Kamchatka Trench; coordinates: 46°06′N 153°18′E; water depth: 6090–6235 m; Sigsbee trawl) (ZMMU Ld-3055); coll. L.A. Zenkevich, 23 July 1966.

Paratype: slightly damaged left valve. (RV 'Vityaz', cruise 2, station 162, Kuril-Kamchatka Trench; coordinates: 44°55.5′N 152°24′E; water depth: 8100 m, Sigsbee trawl) (ZMMU Ld-3057); coll. L.A. Zenkevich, 10 October 1949.

Paratype: damaged specimen. (RV 'Vityaz', cruise 20, station 3357, Aleutian Trench; coordinates: 52°25.8′N 170°53.9′E; water depth: 7246 m, Sigsbee trawl) (ZMMU Ld-3056); coll. V.P. Petelin, 7 June 1955.

OTHER MATERIAL EXAMINED

Two heavily damaged specimens, one left and one right valves (IO RAS) from holotype locality; one heavily damaged specimen, two heavily damaged right and one heavily damaged left

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Table 1. *Hyalopecten vityazi* sp. nov. shell measurements (mm) and indices.

Depository	L	H	A	AL	AAL	H/L	A/L	AL/L	AAL/AL
Holotype ZMMU Ld-3055	27.0	28.9	15.0	10.9	6.4	1.070	0.556	0.404	0.587
Holotype locality (IO RAS)	–	40.0	–	–	–	–	–	–	–
Holotype locality (IO RAS)	–	31.2	–	14.0	–	–	–	–	–
Paratype, Station 162 ZMMU Ld-3057	31.6	36.1	17.4	11.6	6.3	1.142	0.551	0.367	0.543
Paratype, Station 3357 ZMMU Ld-3056	–	–	–	13.0	7.5	–	–	–	0.577
Paratype locality, Station 3357 (IO RAS)	–	40.0	–	–	–	–	–	–	–
Paratype locality, Station 3357 (IO RAS)	–	–	–	14.0	7.4	–	–	–	0.529
Station 5608 (IO RAS)	–	23.4	–	11.2	–	–	–	–	–
Station 5608 (IO RAS)	–	19.7	–	–	–	–	–	–	–
Station 5617 (IO RAS)	–	–	–	9.1	5.2	–	–	–	0.571
Station 5617 (IO RAS)	20.3	–	–	9.3	–	–	–	0.458	–
Station 5617 (IO RAS)	–	–	–	12.6	7.2	–	–	–	0.571
Station 5617 (IO RAS)	–	–	–	12.8	7.3	–	–	–	0.570

L, shell length; H, height; A, anterior end length; AL, auricles length; AAL, anterior auricle length; "-" – no data.

valves (IO RAS) from paratype locality, Aleutian Trench; two heavily damaged specimens (IO RAS), Kuril-Kamchatka Trench (46°N 153°27′E), 7265–7295 m, Sigsbee trawl, coll. L.A. Zenkevich, 22 July 1966 (RV 'Vityaz', cruise 39, station 5608); four heavily damaged specimens and right valve (IO RAS), Kuril-Kamchatka Trench (45°32′N 153°46′E), 6675–6710 m, Sigsbee trawl, coll. L.A. Zenkevich, 6 August 1966 (RV 'Vityaz', cruise 39, station 5617); two heavily damaged specimens (IO RAS), Aleutian Trench (53°53.2′N 166°55.6′E), 6410–6757 m, Sigsbee trawl, coll. V.P. Petelin, 1 June 1955 (RV 'Vityaz', cruise 20, station 3340); two heavily damaged right and one left valves (IO RAS), Kuril-Kamchatka Trench (48°25′N 156°34′E), 6860 m, Sigsbee trawl, coll. L.A. Zenkevich, 1 June 1953 (RV 'Vityaz', cruise 14, station 2144). Total of 11 heavily damaged specimens and nine heavily damaged valves.

DIAGNOSIS

Shell large (to 40.0 mm in height), thin, slightly higher than longer, inequilateral. Umbonal angle 100°. Auricles small, unequal in length and shape. Right valve disc with well-developed, commarginal undulations and closely spaced, very thin, overlying radial riblets; anterior auricle demarcated from disc, with fine, lamellate, commarginal riblets overlying 4–9 coarse radial ribs; posterior auricle almost continuous with shell disc, with reticulate sculpture. Left valve disc with reticulate sculpture from commarginal, lamellate ridges and thin, more closely spaced, intercalated, radial ribs; anterior and posterior auricles weakly separated from shell disc, with reticulate sculpture. Byssal fasciole broad. Byssal notch moderately deep, rounded. Inactive and active ctenolium well-developed. Prodissoconch very large (length 300–340 μm), D-shaped.

DESCRIPTION

Shell large (to 40.0 mm in height), opaque, thin, fragile, weakly inflated, slightly higher than longer (H/L = 1.070–1.142), inequilateral (beaks slightly posterior to midline, A/L = 0.550–0.556), inequivalve (left valve more convex than right valve). Shell disc tear-shaped. Dorsal shell margin straight. Anterior margin rounded. Posterior margin straight or slightly convex, smoothly transitioning to rounded ventral shell margin. Auricles small (AL/L = 0.367–0.458), anterior auricle slightly larger and longer than posterior (AAL/AL = 0.529–0.587). Umbonal angle 100°.

Right valve disc with well-developed, numerous, rounded, variously high and broad, rather regularly spaced, commarginal undulations and closely spaced, very thin, rounded, overlying radial riblets slightly changing direction in between undulations and separated by interstices broader than riblets. Anterior auricle slightly twisted to the right, sharply demarcated from shell disc by a deep furrow with a long and well-developed ctenolium and a sharp suture (between furrow and shell disc). Surface of auricle with fine, lamellate, commarginal riblets overlying 4–9 coarse, radial ribs on dorsal half of auricle and forming barely visible noduloses at intersections with radial ribs and serration of auricle dorsal margin. Byssal fasciole broad. Byssal notch moderately deep, rounded. Active ctenolium short. Posterior auricle weakly separated and almost continuous with shell disc; sculptured with thin, closely spaced, commarginal, lamellate ribs and very weak, dense, radial riblets.

Left valve disc with reticulate sculpture from rather regularly spaced, numerous, commarginal, lamellate, slightly corrugated ridges with wide interspaces (0.8–0.9 mm) and low, thin, rounded, more closely spaced (0.3–0.4 mm) intercalated, radial ribs. Anterior and posterior auricles weakly separated from shell disc; surface with reticulate sculpture from closely spaced, thin, lamellate, commarginal and rounded, radial ribs.

Prodissoconch very large (length 300–340 μm), smooth, D-shaped, convex, distinct, sharply separated from shell disc.

VARIABILITY

The variability of shell form and proportions of *Hyalopecten vityazi* is difficult to assess, as all the shells and separate valves examined were damaged to a varying degree. Nevertheless, it can be noted that the degree of separation of the posterior auricle from the shell disc varies in this species. In most specimens from the Aleutian Trench, the posterior auricles are not separated and are almost continuous with the shell disc, and the posterior shell margin is straight, as opposed to specimens from the Kuril-Kamchatka Trench, in which the posterior auricles are more separated and the posterior shell margin is slightly convex.

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DISTRIBUTION AND HABITAT (FIGURE 4)

This species was recorded in the Kuril-Kamchatka Trench at a depth from 6090 (46°06′N 153°18′E) to 8100 m (44°55.5′N 152°24′E) (bottom temperature 1.65–2.15°C, salinity 34.7‰ (Belyaev, 1989)); in the Aleutian Trench, at a depth from 6410 (53°53.2′N, 166°55.6′E) to 7246 m (52°25.8′N, 170°53.9′E) (bottom temperature 1.78°C at a depth 6328 m, salinity 34.7‰ (Belyaev, 1989)).

COMPARISONS

Hyalopecten vityazi differs from all species of the genus *Hyalopecten* by its almost regular teardrop-shaped shell but with a slightly produced anterior part, the relatively small length of the auricles, the presence of well-developed undulations only on the right valve and prominent reticulate sculpture on the left valve, and the presence of a large prodissoconch (Figure 5, Table 2). This is the only species of the genus *Hyalopecten* that has undulations and reticulate sculpture on different shell valves. *Hyalopecten mireilleae, Hyalopecten neoceanicus* and *Hyalopecten profundicola* also possess variously expressed reticulate sculpture of the shell. However, these species are readily distinguished from the new species by having reticulate sculpture on both valves, a strongly produced anterior part of the shell, and large auricles. Moreover, *H. mireilleae* and *H. profundicola* lack undulations on both valves, while *H. neoceanicus*, on the contrary, in addition to reticulate sculpture, has undulations on both valves. In terms of shell size, form and proportions, *H. vityazi* is most similar to *Hyalopecten frigidus, Hyalopeten hadalis* and *Hyalopecten pudicus*; however, it markedly differs from them by having no well-developed undulations and by having reticulate sculpture on the left valve, as well as a less distinctly marked and non-pointed posterior auricles, a less deeper byssal notch and a much larger prodissoconch.

ETYMOLOGY

The species name honours the famous RV 'Vityaz', on board of which the first deep-water expedition in 1949 discovered this species at a depth of 8100 m in the Kuril-Kamchatka Trench.

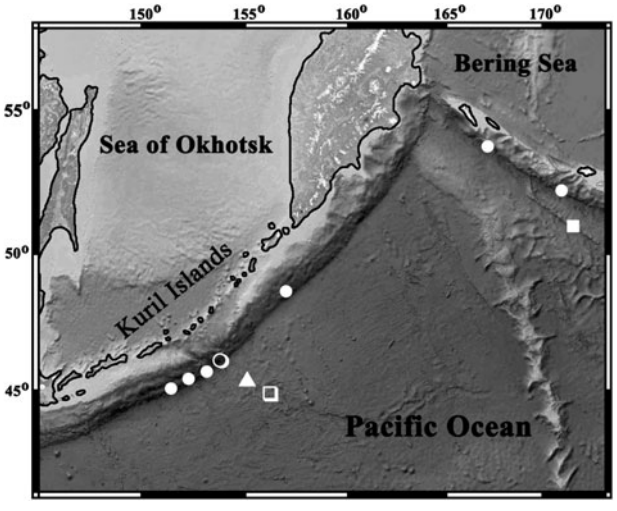

Fig. 4. Distribution of *Hyalopecten* species. ● *Hyalopecten vityazi* (○ type locality), ■ *Hyalopecten abyssalis* (□ type locality), ▲ *Hyalopecten kurilensis*.

REMARKS

Over the whole period of studies (from 1949 to 1966) in the Kuril-Kamchatka Trench with a maximum depth of 9717 m, 26 trawl samples were taken at depths from 6080 to 9530 m, of which 13 samples were collected at depths greater than 8100 m (Belyaev, 1989). *Hyalopecten vityazi* was found in five (38.5%) out of the 13 trawl samples collected at depths only to 8100 m (Belyaev, 1989). In the Aleutian Trench (maximum depth 7822 m) during the period from 1955 to 1969, a total of eight trawl samples were collected in the depth range of 6296–7286 m. *Hyalopecten vityazi* was found in this trench to the maximum depth of study in two samples (25% of the total number of trawl samples) collected in the western part of the trench. Thus, despite the difficulties in sampling *H. vityazi* due to its large, thin and very fragile shell, which is readily broken into small pieces while collecting and washing on the ship's deck, this species was fairly often present in trawl samples at depths to 8100 m. Moreover, several specimens and empty valves were also found in most trawl samples with *H. vityazi* from each of the trenches. It seems likely that this species is fairly common to the hadal fauna of the Kuril-Kamchatka and Aleutian trenches and occurs there in large numbers at depths to 8100 m. Since *H. vityazi* was not found at depths below 8100 m despite the large number of samples from greater depths, it is not improbable that 8000–8500 m depths are the lower limit of its bathymetric distribution, as is the case for many other groups of animals found in the hadal zone (Belyaev, 1989). Unlike *Hyalopecten hadalis*, which was found in a wide depth range (1808–7000 m) from the bathyal to hadal zones (Knudsen, 1970; Dijkstra & Marshall, 2008), *H. vityazi* is probably an endemic hadal species. This species was only found at depth greater than 6000 m despite the large number of samples collected in a wide depth range by various expeditions in the Kuril-Kamchatka and Aleutian trench area, as well as on the adjacent abyssal plain.

In the Kuril-Kamchatka Trench, *H. vityazi* was found along most of its length. However, in the Aleutian Trench, *H. vityazi* was only found at two stations in the western part of the trench adjoining the Kuril-Kamchatka Trench (Figure 4). The Aleutian Trench is one of the world's longest trenches (Jamieson, 2015), extending latitudinally from the Asian to American continents. There may be some barriers in the trench that hamper the eastward distribution of *H. vityazi* towards the coast of North America.

Hyalopecten abyssalis sp. nov.
(Figures 6 & 7, Table 3)

TYPE MATERIAL AND LOCALITY

Holotype: adult specimen (RV 'Vityaz', cruise 14, station 2116, abyssal plain adjacent to Kuril-Kamchatka Trench, North-western Pacific; coordinates: 45°16′N 156°13′E; water depth: 4550–4640 m, Sigsbee trawl) (ZMMU Ld-3058); coll. L.A. Zenkevich, 21 May 1953.

OTHER MATERIAL EXAMINED

Damaged specimen (IO RAS) from holotype locality; damaged left and right valves (IO RAS), abyssal plain adjacent to Aleutian Trench, Pacific Ocean (51°30.1′N 172°04.5′E), 5020 m, Sigsbee trawl, coll. V.P. Petelin, 8 July 1955 (RV 'Vityaz', cruise 20, station 3359).

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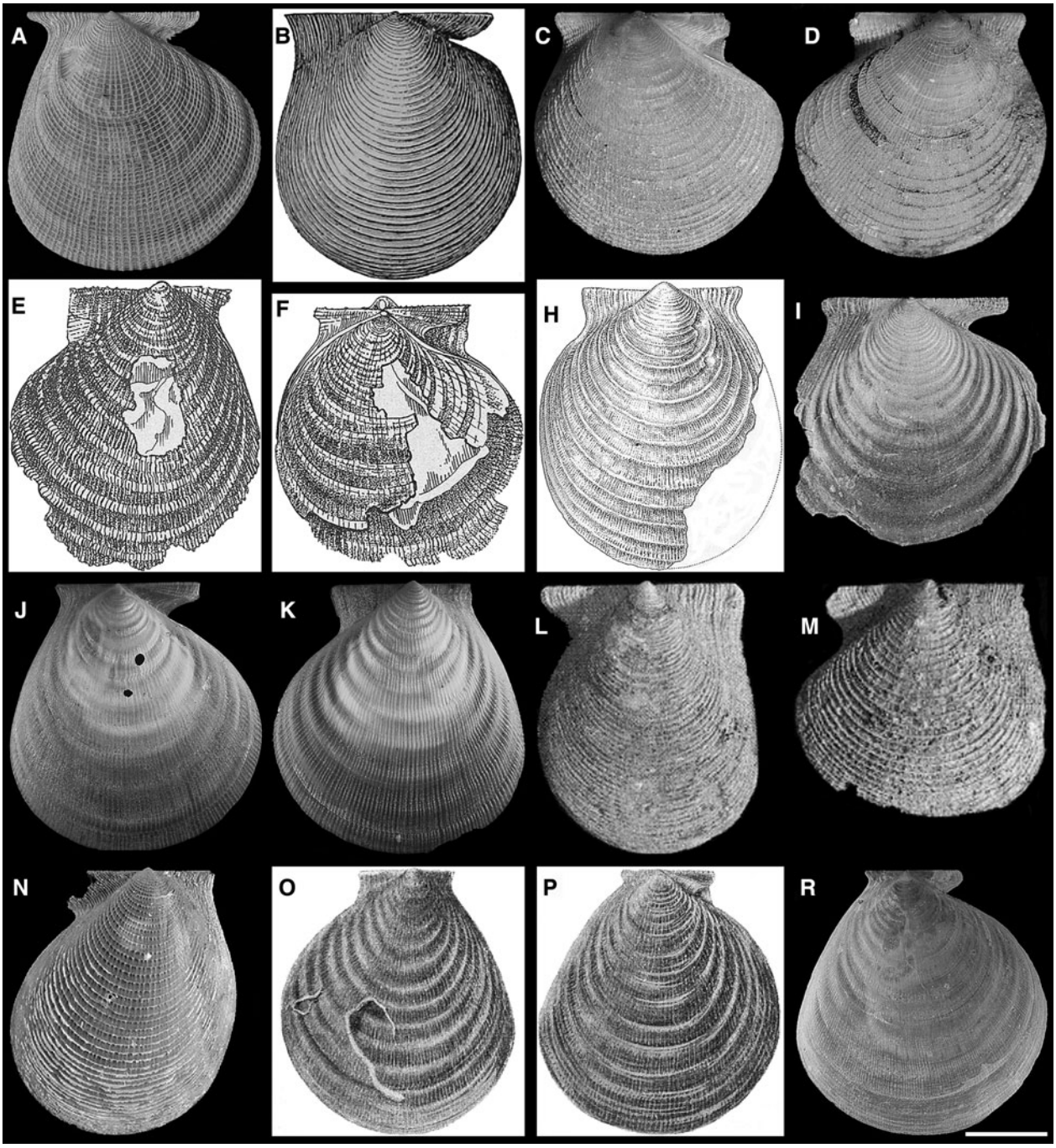

Fig. 5. Species of the genus *Hyalopecten*: (A) *Hyalopecten neoceanicus*, holotype (USNM 110579), right valve, shell length 12.0 mm (Photos from USNM website, 'Information provided with the permission of the National Museum of Natural History, Smithsonian Institution, 10th and Constitution Ave. N.W., Washington, DC 20560–0193 (http://www.nmnh.si.edu/)'); (B) *Hyalopecten strigillatus*, syntype (USNM 94355), right valve, shell height 10.0 mm (from Dall, 1889b); (C, D) *Hyalopecten profundicola*, holotype (NMNS Mo 69702), shell length 4.5 mm; (E, F) *Hyalopecten arntzi*, holotype (ZIN), shell length 10.2 mm (from Egorova, 1999); (H, I) *Hyalopecten hadalis*, holotype (ZMUC BIV-441), shell length 18.2 mm (from Knudsen, 1970); (J, K) *Hyalopecten pudicus*, holotype (BMNH 1887.2.9.3280), shell length 18.5 mm (photos from Marine Bivalve Shells of the British Isles website (Oliver *et al.*, 2010), image numbers: NMW Mo11625, 11628); (L), *Hyalopecten tydemani*, holotype (ZMA Moll. 3.89.009), left valve, shell length 7.5 mm (from Dijkstra, 1990); (M), *Hyalopecten bavayi*, holotype (ZMA Moll. 3.89.008), left valve, shell length 7.0 mm (from Dijkstra, 1990); (N), *Hyalopecten mireilleae*, holotype (MNHN-IM-2000–24350), left valve, shell length 11.0 mm (photos from Muséum national d'Histoire naturelle website http://coldb.mnhn.fr/catalognumber/mnhn/im/2000–24350); (O-R), *Hyalopecten frigidus*: (O, P), lectotype (ZMUC BIV-442) (Dijkstra *et al.*, 2009), shell length 27.0 mm (from Jensen, 1904); (R), paralectotype (ZMUC), right valve (photos from Marine Bivalve Shells of the British Isles website (Oliver *et al.*, 2010), image number NMW Mo12827), scale bar: 10 mm.

DIAGNOSIS

Shell large (to 36.3 mm in height), thick, shell height and length almost equal, subequilateral. Umbonal angle 95°. Auricles small, unequal in length and shape. Right and left valve discs with well-developed, regular, commarginal undulations and well-developed, overlying radial ribs. Anterior auricle of right valve demarcated from disc, sculptured with fine, lamellate, closely spaced, commarginal riblets overlying three coarse radial ribs; posterior auricle continuous with shell disc, sculptured with thin, closely spaced,

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Table 2. Main differentiating characters of *Hyalopecten* species.

Species	Maximum shell height and length, mm	Shell	Umbonal angle	Left valve sculpture	Right valve sculpture	Auricles	Auricles sculpture	Byssal notch	Prodissoconch length, µm	References
Hyalopecten arntzi	H = 10.9; L = 10.2; H/L = 1.069	Semi-transparent, inequilateral (A/L = 0.559), weakly inflated, very thin	105°	About 13 commarginal undulations and thin, closely spaced, radial ribs	Similar with left valve	Large (AL/L = 0.569); anterior auricles longer (AAL/AL = 0.603); posterior auricles pointed, separated from shell disc	Thin, closely spaced commarginal ribs and radial riblets; anterior right auricle with a few distinct, radial and fine, commarginal, lamellate ribs	Deep, rounded	No data	Egorova (1999)
Hyalopecten bavay	H = 6.8; L = 7.0; H/L = 0.971	Semi-transparent, slightly inequilateral, weakly inflated	90°	Commarginal, closely spaced lamellate ribs and very fine, interstitial, radial riblets	Similar with left valve	Large, equal in length; posterior auricles continuous with shell disc	Thin, closely spaced, commarginal lamellate riblets	Moderately deep, rounded	No data	(Dijkstra, 1990; Dijkstra & Maestrati, 2008)
Hyalopecten frigidus	L = 27.0; H = 30.0	Opaque, slightly inequilateral, weakly inflated	110°	Regular, commarginal undulations and fine, closely spaced radial riblets	Similar with left valve; radial riblets weakly discernible	Small, subequal in length; posterior auricles slightly separated from shell disc	Thin, closely spaced commarginal ribs; anterior right auricle with fine radial and commarginal ribs	Moderately deep, sharp	220	(Jensen, 1904; Bouchet & Waren, 1979; Dijkstra *et al.*, 2009; Oliver *et al.*, 2010)
Hyalopecten hadalis	H = 20.9; L = 18.2; H/L = 1.149	Semi-transparent, equilateral, weakly inflated	100°	Regular, commarginal undulations and fine, closely spaced radial ribs	Similar with left valve; less expressed than in left valve	Large (AL/L = 0.588–0.677), subequal in length; posterior auricles slightly separated from shell disc	Thin, lamellate, commarginal ribs; anterior right auricle with 4–5 distinct, radial and thin, commarginal, lamellate ribs	Deep, rounded	208–230	(Knudsen, 1970; Dijkstra & Marshall, 2008)
Hyalopecten mireilleae	H = 13,4; L = 11.0; H/L = 1.218–1163	Elongate dorso-ventrally, semi-transparent, inequilateral, inflated	90°	Regular, commarginal, lamellate ribs and fine, radial, interstitial riblets	Similar with left valve	Large, anterior auricle longer; posterior auricles continuous with shell disc	Thin, closely spaced, commarginal riblets	Moderately deep, sharp	200	(Dijkstra, 1995)
Hyalopecten neoceanicus	H = 14.0; L = 13.0; H/L = 1.077	Semi-transparent, inequilateral, inflated, brownish white	95°	4–6 wide, round undulations; about 60 narrow radial ribs with wide interspaces and overlying, commarginal, lamellate ribs	Similar with left valve	Large (AL/L = 0.642), subequal in length, sharply pointed, separated from shell disc,	Posterior auricles with closely spaced commarginal ribs and faint radial striae; anterior right auricle with 4 overlying, distinct, radial ribs; anterior left auricle with commarginal ribs	Deep, sharp	No data	(Dall, 1908; Grau, 1959; Knudsen, 1970; Coan *et al.*, 2000; Coan & Valentich-Scott, 2012)

Hyalopecten profundicola	H = 5.6; L = 5.3; H/L = 1.057	Opaque, inequilateral, inflated, yellowish	105°	Regular, commarginal, lamellate ribs and intercalated, more closely spaced, rounded, radial riblets	Similar with left valve	Large (AL/L = 0.667), anterior auricle longer, pointed, separated from shell disc	Commarginal, lamellate ribs and fine, radial riblets; anterior right auricle with commarginal, lamellate ribs	Moderate deep, broadly rounded	No data	(Okutani, 1962, 1975, 2000)
Hyalopecten pudicus	H = 28.0; L = 27.0; H/L = 1.037–1.143	Dirty white, semi-transparent, slightly inequilateral, inflated	105°	To 25 well-developed, regular undulations and overlying, thin, rounded, more closely spaced, radial ribs	Similar with left valve	Moderate (AL/L = 0.489), subequal in length; posterior auricles slightly pointed, slightly separated from shell disc	Posterior auricles with thin, commarginal, lamellae and fine, rounded, radial riblets; anterior right auricle with 3–4 distinct, radial ribs and closely spaced, overlying, commarginal riblets	Deep, sharp	180–218	(Smith, 1885; Verrill, 1885, 1897; Verrill & Bush, 1898; Knudsen, 1970; Schein, 1989; Dijkstra & Goud, 2002; Dijkstra & Gofas, 2004)
Hyalopecten strigillatus	H = 10.0	Opaque, equilateral, inflated	120°	Closely spaced commarginal, lamellate ribs	Similar with left valve	Large; anterior auricle longer, pointed; posterior auricles continuous with shell disc	Closely spaced commarginal, lamellate ribs	Deep, sharp	No data	(Dall, 1889a, b)
Hyalopecten tydemani	H = 9.1; L = 7.5; H/L = 1.138–1.354	Elongate dorso-ventrally, opaque, subequilateral,	85°	Closely spaced commarginal, lamellate ribs	Similar with left valve	Very large, subequal in length; posterior auricles continuous with shell disc	Closely spaced commarginal, lamellate ribs	Deep, sharp	No data	(Dijkstra, 1990; Dijkstra & Maestrati, 2008)
Hyalopecten vityazi	H = 40.0; L = 31.6; H/L = 1.070–1.142	Opaque, inequilateral (A/L = 0.550–0.556), weakly inflated	100°	Regular, commarginal, lamellate, slightly corrugated ridges and intercalated, low, rounded, more closely spaced, radial ribs.	Well-developed, numerous, variously high and broad, commarginal undulations and overlying, very thin, rounded, radial riblets	Small (AL/L = 0.367–0.458), anterior auricle longer (AAL/AL = 0.529–0.587); posterior auricles weakly separated from shell disc	Anterior right auricle with 4–9 distinct radial ribs and closely spaced, overlying, fine, lamellate, commarginal riblets; posterior right auricle with thin, closely spaced, commarginal, lamellate ribs and very weak, dense, radial riblets; anterior and posterior left auricles with closely spaced, thin, lamellate, commarginal and rounded, radial ribs.	Moderately deep, rounded	300–340	

Continued

Table 2. Continued

Species	Maximum shell height and length, mm	Shell	Umbonal angle	Left valve sculpture	Right valve sculpture	Auricles	Auricles sculpture	Byssal notch	Prodissoconch length, μm	References
Hyalopecten abyssalis	H = 36.3; L = 34.8; H/L = 1.043	Opaque, thick, hard, subequilateral (A/L = 0.511), weakly inflated	95°	Well-developed, regular, rounded, wide, commarginal undulations and overlying, widely spaced, thin, well-developed, rounded, radial ribs	Similar with left valve	Small (AL/L = 0.388), anterior auricle slightly longer (AAL/AL = 0.511); posterior auricles continuous with shell disc	Anterior right auricle with fine, lamellate, closely spaced, commarginal riblets overlying 3 coarse radial ribs; anterior left auricle with widely spaced, lamellate, commarginal and closer spaced, round, radial ribs; posterior auricles with thin, closely spaced, lamellate, commarginal and weak, round, radial ribs	Deep, sharp	245	
Hyalopecten kurilensis	H = 9.7; L = 9.4; H/L = 1.032	Opaque, thick, hard, inequilateral (A/L = 0.521), inflated	105°	Wide, commarginal undulations (5 in right and 6 in left valve) sculptured with about 40 widely spaced, well-developed, rounded, radial ribs and overlying, more closely spaced, commarginal, thin, lamellate, riblets	Similar with left valve	Large (AL/L = 0.596), anterior auricle longer (AAL/AL = 0.571); posterior auricles weakly separated from shell disc	Anterior right auricle with 4 distinct radial ribs and overlying, coarse, closely spaced, commarginal, lamellate ribs; anterior left auricle with closely spaced, lamellate, commarginal ribs and a few weak, wide, radial ribs; posterior auricles with widely spaced, commarginal, thin, lamellate ribs	Moderately deep, broadly rounded	260	

L, shell length; H, height; A, anterior end length; AL, auricles length; AAL, anterior auricle length.

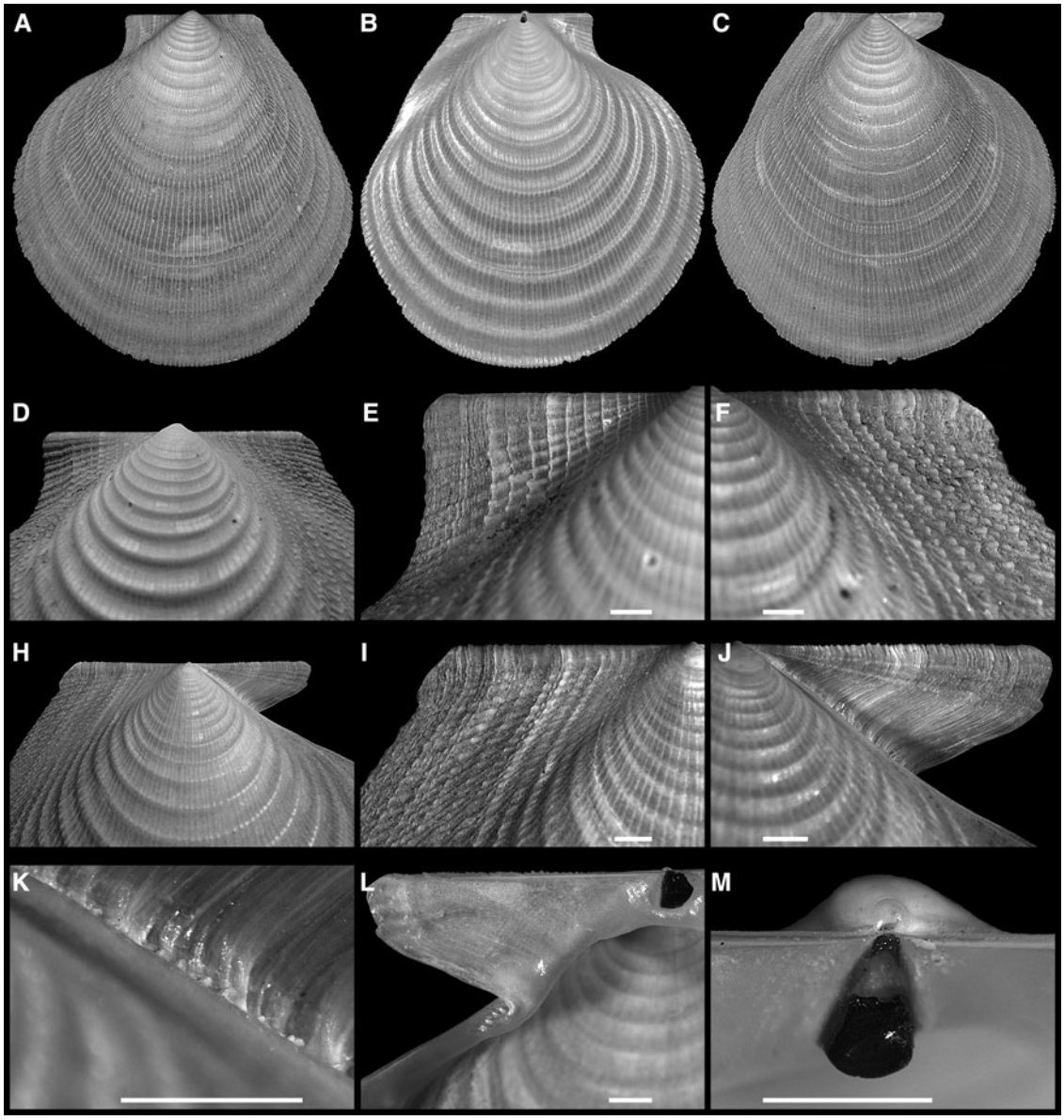

Fig. 6. *Hyalopecten abyssalis* sp. nov., holotype (ZMMU Ld-3058), shell length 34.8 mm: (A–C) exterior view of both valves and interior view of left valve; (D–F) auricles of left valve; (H–J) auricles of right valve; (K, L) ctenolium; (M) ligament. Scale bars: 1 mm.

commarginal, lamellate ribs overlying rounded, radial riblets. Anterior auricle of left valve distinct from disc, with reticulate sculpture from widely spaced, lamellate, commarginal ribs and closer spaced, round, radial ribs; posterior auricle continuous with disc, sculptured with thin, closely spaced, lamellate, commarginal ribs and weak, round, radial ribs with noduloses at intersections. Byssal fasciole broad. Byssal notch deep, sharp. Inactive and active ctenolium well-developed. Prodissoconch large (length 245 μm), circular-shaped.

DESCRIPTION

Shell large (to 36.3 mm in height), opaque, thick, hard, weakly inflated, shell height and length almost equal (H/L = 1.043), subequilateral (beaks slightly posterior to midline, A/L = 0.511), inequivalve (left valve more convex than right valve). Shell disc subcircular. Dorsal shell margin straight. Anterior shell margin rounded. Posterior shell margin slightly convex, smoothly transitioning to rounded ventral shell margin. Auricles small (AL/L = 0.388), anterior auricle slightly larger and longer than posterior (AAL/AL = 0.511). Umbonal angle 95°.

Right and left valve discs with well-developed, regular, rounded, wide, commarginal undulations (distance between tops of undulations in disc centre 3.0–3.3 mm), becoming higher and broader towards ventral shell margin, and widely spaced, thin, well-developed, rounded, overlying radial ribs (interstices broader than ribs, 0.3–0.4 mm in disc centre), with numerous inserted radial riblets at ventral shell margin. Towards anterior and posterior shell margins undulations transforming into narrow ridges with noduloses at intersections with radial ribs.

Anterior auricle of right valve sharply demarcated from shell disc by a deep furrow with a long and strong ctenolium and a sharp suture (between furrow and shell disc). Surface of auricle with fine, lamellate, closely spaced, commarginal riblets overlying three coarse radial ribs on

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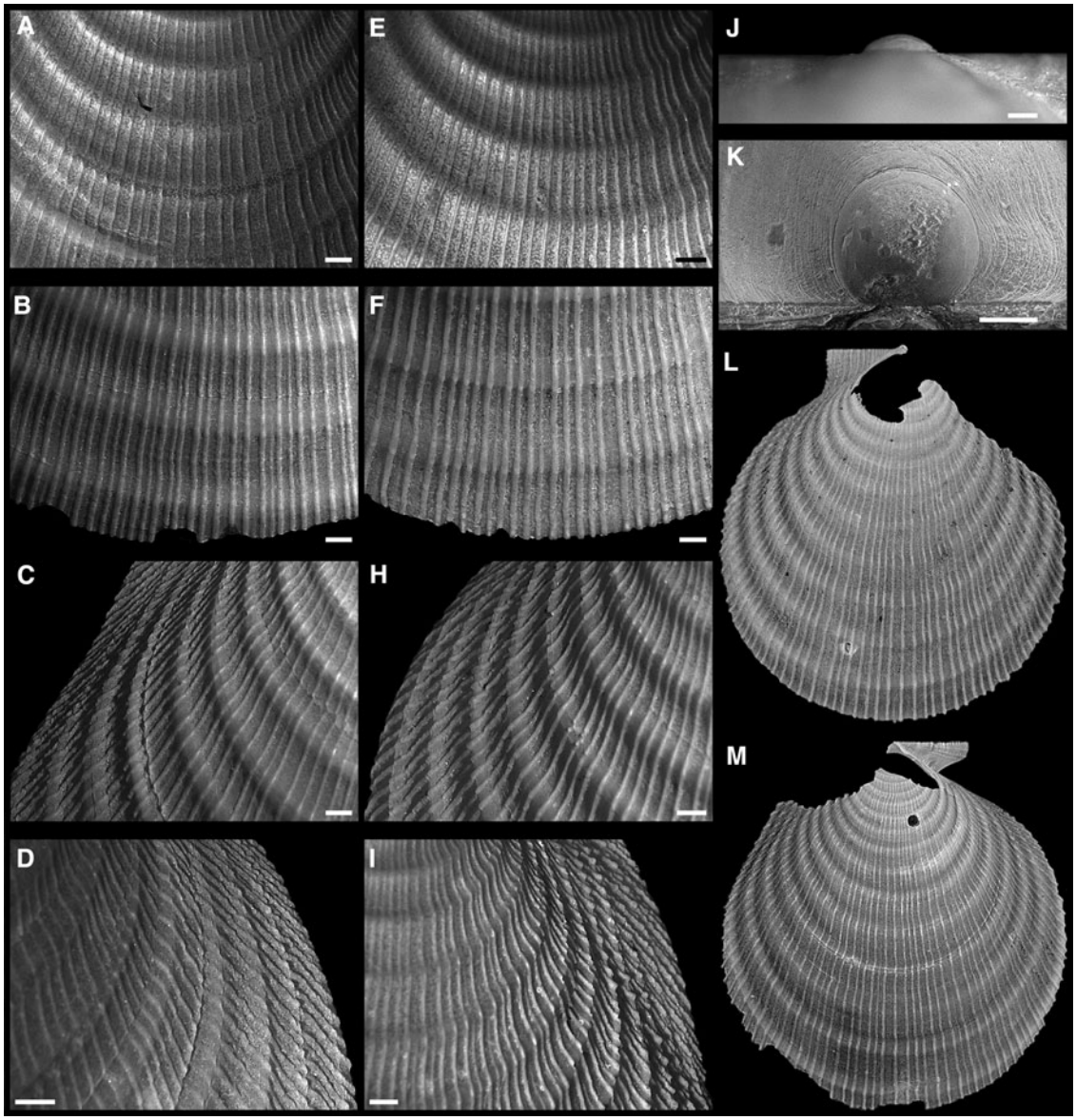

Fig. 7. *Hyalopecten abyssalis* sp. nov. (A–K) holotype (ZMMU Ld-3058): (A–D) sculpture of central, ventral, posterior, and anterior parts of right valve; (E–I) sculpture of central, ventral, posterior, and anterior parts of left valve; (J, K) prodissoconch. (L–M) Damaged left and right valves (IO RAS), abyssal plain adjacent to Aleutian Trench, Pacific Ocean (51°30.1′N 172°04.5′E), 5020 m, shell length 33.5 mm. Scale bars: A–I, 1 mm; J, K, 100 μm.

dorsal half of auricle and forming serration of auricle dorsal margin. Byssal fasciole broad. Byssal notch deep, sharp. Active ctenolium short, strong. Posterior auricle continuous with shell disc; sculptured with thin, closely spaced, commarginal, lamellate ribs overlying rounded, radial riblets and forming small noduloses at intersections with radial riblets.

Anterior auricle of left valve distinct from disc; anterior auricle margin passing vertically down. Surface of auricle with reticulate sculpture from widely spaced, lamellate, commarginal ribs and closer spaced, round, radial ribs sometimes with small noduloses at intersections. Posterior auricle continuous with disc, sculptured with thin, closely spaced, lamellate, commarginal ribs and weak, round, radial ribs with noduloses at intersections.

Prodissoconch large (length 245 μm), smooth, circular-shaped, convex, distinct, sharply separated from shell disc.

DISTRIBUTION AND HABITAT (FIGURE 4)

This species was recorded at the abyssal plain adjacent to the Kuril-Kamchatka and Aleutian trenches (North-western Pacific) at 4550–5020 m depth.

COMPARISONS

Hyalopecten abyssalis is most close in the shape, proportions and sculpture of the shell to *Hyalopecten arntzi, Hyalopecten frigidus, Hyalopecten hadalis* and *Hyalopecten pudicus*. However, it differs from them in having the shell almost rounded, markedly less elongate dorso-ventrally, posterior auricles continuous with the shell disc, and a sharp byssal notch (Figure 5, Table 2). Furthermore, *H. abyssalis* differs from *H. arntzi, H. hadalis* and *H. pudicus* in much smaller relative length of the auricles; and from *H. frigidus* with relatively small auricles, in having a more well-developed radial

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Table 3. *Hyalopecten abyssalis* sp. nov. shell measurements (mm) and indices.

Depository	L	H	A	AL	AAL	H/L	A/L	AL/L	AAL/AL
Holotype ZMMU Ld-3058	34.8	36.3	17.8	13.5	6.9	1.043	0.511	0.388	0.511

L, shell length; H, height; A, anterior end length; AL, auricles length; AAL, anterior auricle length.

sculpture on both valves. This species is distinguished from *Hyalopecten vityazi*, which has a similar shape of the shell and small auricles, by the presence of commarginal undulations and the lack of reticulate sculpture on the left valve, by its posterior auricles continuous with the shell disc, a sharp and deeper byssal notch, and a smaller and circular-shaped prodissoconch.

ETYMOLOGY

The species epithet 'abyssalis' refers to the abyssal plain of the Pacific Ocean where the species was discovered.

REMARKS

Despite the large number of samples collected beginning in 1949 by many Russian expeditions at the abyssal plain of the North-western Pacific, *Hyalopecten abyssalis* and fragments of its shells were only found at two stations at the 4550–5020 m depth. This species may be assigned to the category of 'rare' species, forming very sparse populations at the abyssal plain of the North-western Pacific. A great part of the species of the abyssal fauna is represented in samples of various deep-sea expeditions by only very few specimens and many of the species were described from 1–2 specimens (Knudsen, 1970; Okutani & Kawamura, 2002; Ellingsen *et al.*, 2007; Allen, 2008; Kamenev, 2015). On the other hand, it is not improbable that *H. abyssalis*, like many species of the genus *Hyalopecten*, prefers smaller depths in the bathyal and upper-abyssal zones of the North-western Pacific. Therefore, it can supposed that further thorough investigations at depths less than 4500–5000 m may uncover this species in larger numbers in the northern Pacific.

Hyalopecten kurilensis sp. nov.
(Figures 8 & 9, Table 4)

TYPE MATERIAL AND LOCALITY

Holotype: one adult specimen (RV 'Vityaz', cruise 39, station 5623, abyssal plain adjacent to Kuril-Kamchatka Trench, North-western Pacific; coordinates: 45°26′N 154°59′E; water depth: 4995–5045 m, Galathea trawl) (ZMMU Ld-3059); coll. L.A. Zenkevich, 19 August 1966.

OTHER MATERIAL EXAMINED

Damaged specimen (IO RAS) from holotype locality.

DIAGNOSIS

Shell small (to 9.7 mm in height), thick, slightly higher than longer, inequilateral. Umbonal angle 105°. Auricles large, unequal in size and shape. Right and left valve discs with 5–6 wide, commarginal undulations and reticulate sculpture from about 40 widely spaced, well-developed, radial ribs and more closed, commarginal, lamellate, overlying riblets. Anterior auricle of right valve demarcated from disc; sculptured with four distinct radial ribs and coarse, closely spaced, commarginal, overlying, lamellate ribs. Anterior auricle of left valve separated from disc by a shallow sulcus; sculptured with closely spaced, lamellate, commarginal ribs and a few, weak, wide radial ribs. Posterior auricles weakly separated and continuous with disc; sculptured with widely spaced, commarginal, lamellate ribs. Byssal fasciole broad. Byssal notch moderately deep, broadly rounded. Active and inactive ctenolium well-developed. Prodissoconch large (length 260 μm), D-shaped.

DESCRIPTION

Shell small (to 9.7 mm in height), opaque, thick, hard, inflated, slightly higher than longer (H/L = 1.032), inequilateral (beaks slightly posterior to midline, A/L = 0.521), inequivalve (left valve more convex than right valve). Shell disc oblique, slightly drawn out anteriorly. Dorsal shell margin straight. Anterior shell margin rounded. Posterior shell margin slightly convex, smoothly transitioning to rounded ventral shell margin. Auricles large (AL/L = 0.596), anterior auricle larger and longer than posterior (AAL/AL = 0.571). Umbonal angle 105°.

Right and left valve discs with wide, commarginal undulations (five in right and six in left valve) strongly smoothed near beak and almost indiscernible. Undulations in form of broad steps with a rounded edge widening (up to 1.7–1.8 mm) towards ventral shell margin. Valve discs with reticulate sculpture from about 40 widely spaced, well-developed, rounded, radial ribs (interstices broader than ribs, 0.2–0.5 mm in disc centre) and more closely spaced, commarginal, thin, lamellate, overlying riblets (with interspaces 0.2–0.3 mm) becoming denser in lower part of undulations.

Anterior auricle of right valve slightly twisted to the right, sharply demarcated from shell disc by a sharp, thin suture and a long, strong ctenolium. Surface of auricle with four distinct radial ribs on dorsal half of auricle and coarse, closely spaced, commarginal, overlying, lamellate ribs forming serration of auricle dorsal margin. Byssal fasciole broad. Byssal notch moderately deep, broadly rounded. Active ctenolium short. Anterior auricle of left valve separated from disc by a shallow sulcus; anterior auricle margin extending vertically down. Surface of auricle with closely spaced, lamellate, commarginal ribs, forming indistinct serration of auricle dorsal margin, and a few indistinct, weak, wide radial ribs. Posterior auricle of right and left valves weakly separated from shell disc; dorsal and posterior auricle margins producing a rounded acute angle; sculptured with widely spaced, commarginal, thin, lamellate ribs, forming indistinct serration of auricle dorsal margin.

Prodissoconch large (length 260 μm), smooth, D-shaped, convex, distinct, sharply separated from shell disc.

DISTRIBUTION AND HABITAT (FIGURE 4)

This species was recorded at the abyssal plain adjacent to the Kuril-Kamchatka Trench (North-western Pacific) at 4995–5045 m depth.

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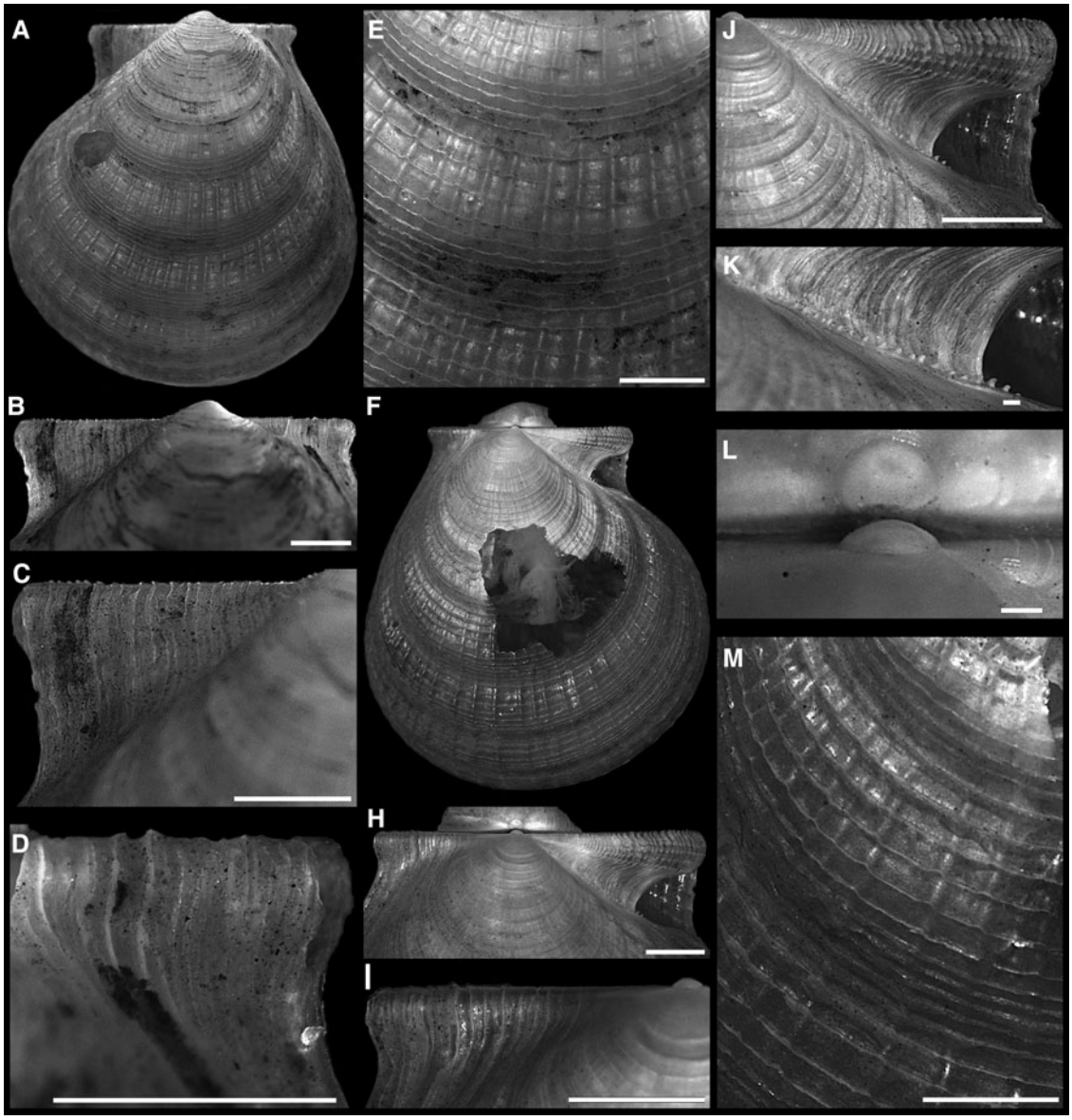

Fig. 8. *Hyalopecten kurilensis* sp. nov., holotype (ZMMU Ld-3059), shell length 9.4 mm: (A) exterior view of left valve; (B–D) auricles of left valve; (E) sculpture of left valve; (F) exterior view of right valve; (H–J) auricles of right valve; (K) ctenolium; (L) prodissoconch of both valves; (M) sculpture of right valve. Scale bars: B–E, H–J, M, 1 mm; K, L, 100 μm.

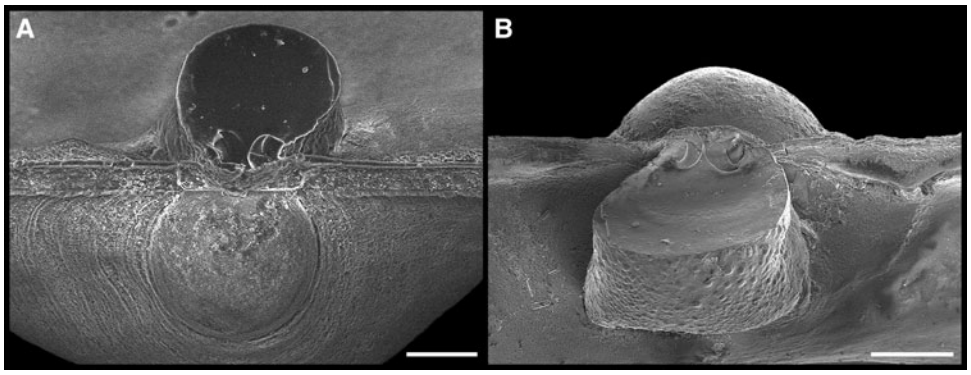

Fig. 9. *Hyalopecten kurilensis* sp. nov., holotype (ZMMU Ld-3059): (A, B) scanning electron micrographs of prodissoconch and ligament of left valve. Scale bars: 100 μm.

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Table 4. *Hyalopecten kurilensis* sp. nov. shell measurements (mm) and indices.

Depository	L	H	A	AL	AAL	H/L	A/L	AL/L	AAL/AL
Holotype ZMMU Ld-3059	9.4	9.7	4.9	5.6	3.2	1.032	0.521	0.596	0.571

L, shell length; H, height; A, anterior end length; AL, auricles length; AAL, anterior auricle length.

COMPARISONS

Hyalopecten kurilensis is most close to *Hyalopecten arntzi, Hyalopecten neoceanicus* and *Hyalopecten profundicola* in terms of the dimensions, shape and proportions of the shell, as well as the presence of cancellate sculpture (Figure 5, Table 2). However, unlike *H. arntzi, H. kurilensis* has a thick, inflated and opaque shell with much fewer and much wider commarginal undulations, a much smaller number of wider and more widely spaced radial ribs, and well expressed widely spaced lamellate, commarginal ribs. *Hyalopecten kurilensis* is distinguished from *H. neoceanicus* by having a less drawn-out anterior part of the shell, the beaks less displaced posteriorly, non-pointed and smaller auricles, a rounded byssal notch, and fewer rounded and more widely spaced radial ribs. *Hyalopecten kurilensis* differs from *H. profundicola* in having a shell less drawn-out anteriorly, less posteriorly displaced beaks, shorter auricles, commarginal undulations, and fewer wider and more widely spaced radial ribs.

ETYMOLOGY

The specific name 'kurilensis' derives from the name of the Kuril Islands, at the latitude of which it was found at the abyssal plain of the Pacific Ocean.

REMARKS

As was the case with *Hyalopecten abyssalis*, despite the relatively large number of benthic samples collected at the abyssal plain of the North-western Pacific, *Hyalopecten kurilensis* was only found at one station. Like *H. abyssalis* and *Hyalopecten profundicola*, this species may also fall under the category of 'rare' species, forming sparse populations on the abyssal plain of the North-western Pacific.

DISCUSSION

To date, four species of the genus *Hyalopecten* have been recorded in the abyssal and hadal zones of a relatively small region of the North-western Pacific Ocean (from Japan to the Commander and Aleutian Islands). This is almost half (44.4%) of all species of the genus *Hyalopecten* discovered in the abyssal and hadal zones of the World Ocean. The relatively high species richness of deep-water *Hyalopecten* species in this region of the North-western Pacific is not a unique phenomenon and reflects high species richness of both the entire abyssal and hadal fauna of the region and individual taxonomic groups (Zenkevich *et al.*, 1955; Belyaev, 1989; Downey & Janussen, 2015; Elsner *et al.*, 2015; Mironov *et al.*, 2015). Examination of the materials collected by just one KuramBio expedition on the abyssal plain (4861–5787 m) adjacent to the Kuril-Kamchatka Trench has revealed 55 species of bivalves belonging to 21 families (Kamenev, 2015), which is much more diverse at the family level than the Atlantic deep-water bivalve fauna (Allen, 2008). The high species richness of the abyssal and hadal faunas in the Kuril-Kamchatka Trench region may be connected with the fact that the region is one of the Pacific's most productive areas where favourable conditions are created for the feeding of bottom animals (Filatova, 1960, 1968; Sokolova, 1976, 1981; Belyaev & Mironov, 1977; Belyaev, 1989). Remarkably, although different types of sampling gear were used (Agassiz trawl, epibenthic sledge, boxcorer, multicorer) to sample benthic animals in the same region of the abyssal plain where *Hyalopecten abyssalis* and *Hyalopecten kurilensis* were collected, the KuramBio expedition did not find any members of the genus *Hyalopecten* (Kamenev, 2015). It can therefore be supposed that further studies of the abyssal zone of the North-western Pacific will markedly increase the species richness of the benthic fauna of this region by finding 'rare' species such as *Hyalopecten* species.

Filatova (1961) and Belyaev (1966) have shown that, along with other bivalves, representatives of the order Pectinida also inhabit the hadal zone of the World Ocean. *Delectopecten vancouverenis* was found in Java (6820–6850 m) and Japan (6156–6207 m) trenches (Filatova, 1961; Belyaev, 1966). Following preliminary identification by Z.A. Filatova of bivalve materials collected by RV 'Vityaz' expeditions in different oceanic trenches during 1949–1966, Belyaev (1966) reported that, presumably, various species of the order Pectinida were found at 6410–8100 m depths in the Aleutian, Kuril-Kamchatka, Bougainville and New Hebrides trenches of the Pacific Ocean. Later, Knudsen (1970) described *H. hadalis* from the Kermadec Trench, and Filatova (1974) found *Hyalopecten* sp. resembling *H. hadalis* in the South Sandwich (5600–5670 m) and South Orkney (5450–5480 m) trenches of South Atlantic. Furthermore, Vinogradova (1974) reported on the finding of pectinids in the Romanche Trench fault. Thus, various species of the family Pectinidae are widespread in the hadal zone of the World Ocean and further investigation of both existing and new material from oceanic trenches will contribute to the knowledge of the hadal fauna of the Pectinidae.

ACKNOWLEDGEMENTS

I am very grateful to Drs A. V. Gebruk, E. M. Krylova, T. N. Molodtsova and all collaborators of Laboratory of Ocean Bottom Fauna (IO RAS), as well as to Drs H. Saito (NMNS), L. T. Groves (LACM), E. Kools (CAS), P. Valentich-Scott (SBNHM) for arrangement of my work with the bivalve mollusc collections and great help during this work; to Drs E. M. Krylova, T. N. Molodtsova and A. S. Maiorova (IMB) for photographing some specimens of *H. vityazi*; to Drs E. M. Krylova, P. Valentich-Scott, K. A. Lutaenko (IMB), J. Goud (National Museum of Natural History, Leiden), B. A. Marshal (Museum of New Zealand Te Papa Tongarewa, Wellington) for sending copies of scientific papers necessary for this work; to Ms T. N. Koznova (IMB) for help with translating the manuscript into English;

https://doi.org/10.1017/S0025315416001387 Published online by Cambridge University Press

to Dr A. V. Gebruk and an anonymous reviewer for comments on the manuscript.

FINANCIAL SUPPORT

This research was supported by the Russian Foundation for Basic Research (grant no. 14-04-00872-a).

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https://doi.org/10.1017/S0025315416001387 Published online by Cambridge University Press