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Anodontine bivalves of the genus *Kunashiria* Starobogatov from Southern Kurile Islands, with descriptions of two new species

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ABSTRACT. Anodontine bivalves of the genus *Kunashiria* Starobogatov in Zatrawkin, 1983 are reviewed based on a detailed comparison of museum material and newly collected specimens from southern Kurile Islands. Four species of Kurile *Kunashiria* are recognized: *K. japonica* (Clessin in Kuester et Clessin, 1874), *K. haconensis* (Ihering, 1893), *K. **sinanodontoides*** sp. nov., and *K. **iturupica*** sp. nov. The fifth species, *K. iwakawai* (Suzuki, 1939), is recognized from Hokkaido and southern Sakhalin Island. Iturup is identified as the northernmost limit of *Kunashiria* within Kurile Archipelago.

Bivalves of the subfamily Anodontinae from Japan, Sakhalin, and southern Kurile Islands form two distinct groups, the first containing large forms characterized by a moderately developed wing and beak sculpturing, with ventrally unbent ridges that do not reach the posterior ridge. The species-rich Asian genus *Sinanodonta* Modell, 1945 is a member of this group. The second group, which constitutes the focus of this study, is represented primarily by small individuals that closely resemble the European species *Colletopterum piscinale* (Nilsson, 1823) (= *Anodonla piscinalis*). Members of this group are characterized by a weakly developed wing and beak sculpturing that approximates umbones of the western North American species *Anodonta californiensis* Lea, 1852. Also diagnostic of the second group are ridges that are bent ventrally, especially near the posterior ridge, and smoothly rounded before the umbo.

These small members of the Anodontinae were first mentioned in 1874 by Clessin [in Kuester, Clessin, 1838-1876], with description of *Anodonta japonica*. Almost 20 years later, Ihering [1893] described two additional species, *A. kobelti* and *A. haconensis*. Finally, the fourth species of the group was described by Suzuki [1939] as *A. iwakawai*, which was later regarded as either synonym of *Sinanodonta woodiana* Lea, 1834 [Habe, 1977] or member of the genus *Kunashiria* Starobogatov in Zatrawkin, 1983.

Material and methods

The study of the genus *Kunashiria* was based on specimens at the Zoological Institute (ZIN) of the Russian Academy of Sciences, St.-Petersburg, and material collected in the southern Kurile Island (Kunashir, Shikotan, Zelionyi, and Iturup) during the 1994 expedition of the International Kurile Island Project, a biotic survey and inventory of Kurile Archipelago funded jointly by the U.S. National Science Foundation, the Japan Society for the Promotion of Science, and the Far East Branch of the Russian Academy of Sciences.

In examining shell morphology, only specimens of three or four years old were used, because the characteristic variation gradually disappears in older specimens due to allometric growth. Shell characters examined include convexity of valve, position and height of umbones, presence and shape of wing, shell shape, and other features.

Procedural methods follow those established by Logvinenko and Starobogatov [1971], which provide a standard way to draw the frontal valve curvature, and are especially useful in comparing hetero-dimensional shells with valve shape changing significantly during growth. However, it is necessary to point out that this method is ineffective for damaged valves.

The observation of glochidia was performed on both living material and induviduals preserved in 74% alcohol. Shell length, shell height and the length of hook were measured under microscope using an ocular micrometer. The size of glochidia is the mean value.

Results

We compared the published illustrations of the holotypes of *Kunashiria japonica* [Kuester, Clessin, 1838-1876] and *K. haconensis* [Ihering, 1893], which were produced in natural size, with speci-

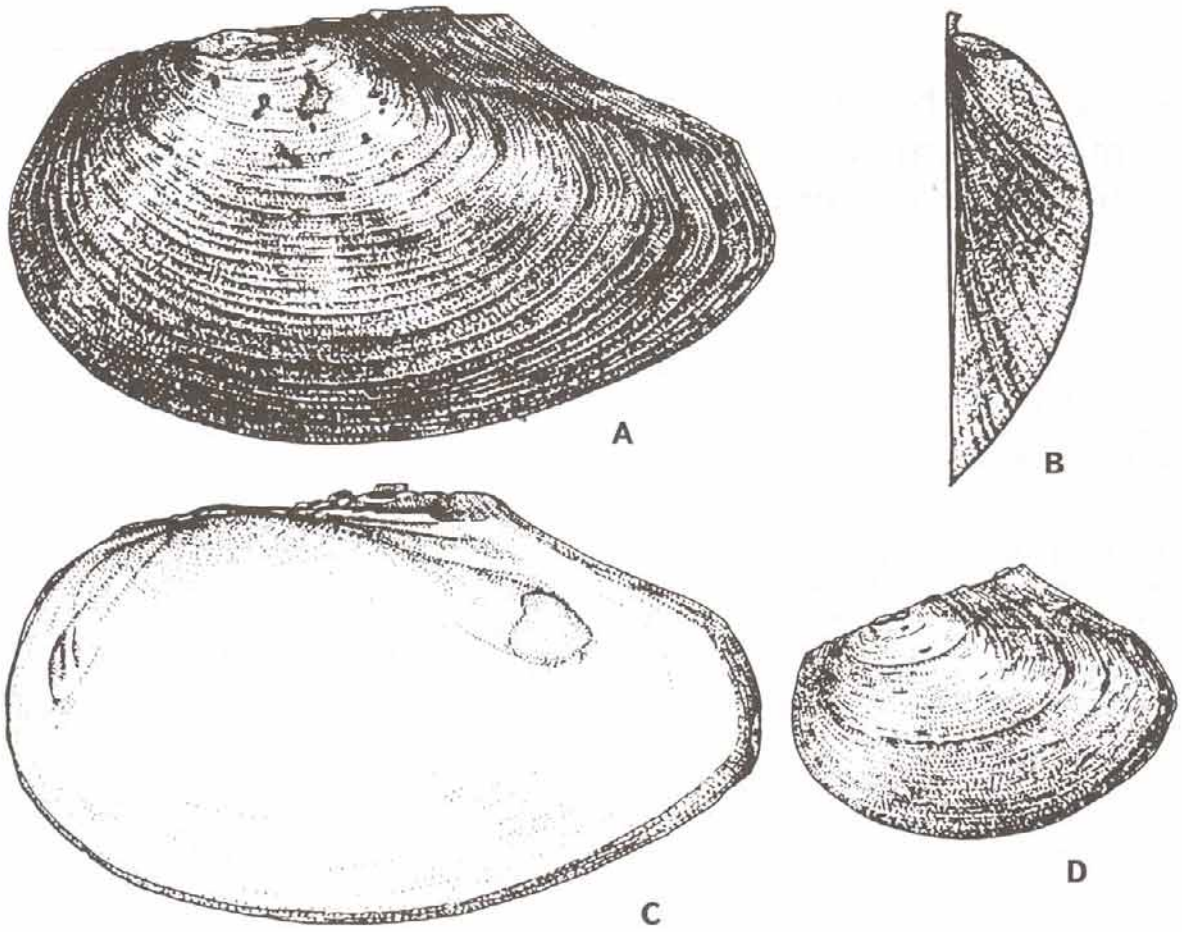

FIG. 1. Shells of *Kunashiria* ***sinanodontoides*** sp. nov.: A, B, C — holotype; D — juvenile paratype.

РИС. 1. Раковины *Kunashiria* ***sinanodontoides*** sp. nov.: A, B, C — голотип; B — паратип, молодая особь.

mens at ZIN in order to check identifications. Using this method of comparison, we identified two of the ZIN specimens as *K. japonica,* one collected from Bolshoye Chibisanskoye Lake of Sakhalin Island (collection No. 6; Zatrawkin, Bogatov, 1987, fig. 27b), the other from Hakodate Prefecture, Hokkaido (collection No. 2). Seven of the ZIN specimens, all collected from Hakone Lake, Japan (collection No. 11), were identified as *K. haconensis.*

Although the study of this material confirmed the distinctiveness of the two species, the ZIN specimens of *K. japonica* and *K. haconensis* are similar in having rather inflated shells and prominent umbones. As the holotype of *K. iwakawai* also shares these features [Suzuki, 1939, fig. VI: 2a, b], we believe that these three species form a natural group. We were unable, however, to identify any of the ZIN specimens as *K. iwakawai* because Suzuki's original description was based on poor quality specimens with important characters not readily distinguishable. Furthermore, the illustrations of large specimens (length, height, and convexity of the holotype are 106, 59.5, and 45.6 mm, respectively) that Suzuki used in his description, were poorly reproduced and printed considerably smaller than natural size, thus making comparisons difficult.

Based on these findings, we take the opportunity to re-describe *Kunashiria* with regard to two new species of the genus recently collected from southern Kurile Islands. These new species differ from previously described members of the genus in the shape of shell and weakly developed umbones. Besides these new species, the presence of *K. japonica* and *K. haconensis* on Kunashir, Zelionyi, and Iturup was confirmed, and Iturup is identified as the northernmost limit of *Kunashiria* within Kurile Archipelago. All four species were found in freshwater lakes where they usually inhabit deep channels with slow flow and silt-covered bottoms. None have been collected in large volcanic lakes characterized by a high degree of mineralization. Neither have any been found on Shikotan Island, probably because of the absence of stagnant reservoirs.

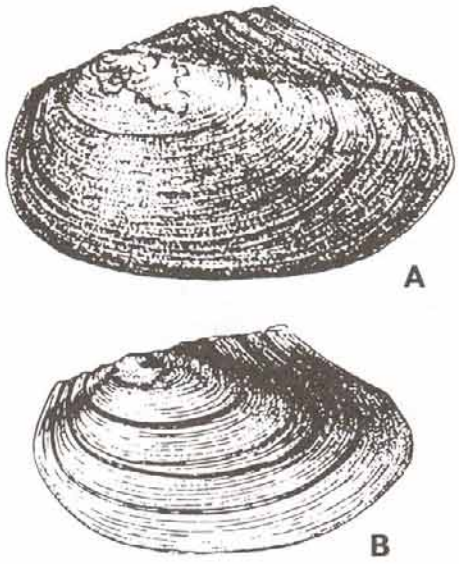

FIG. 2. Shells of juvenile *Kunashiria*, lateral view: A — *K. haconensis* from Slavnaya River, Iturup Island, B — *K. japonica* from Lake Aliger, Kunashir Island.

РИС. 2. Раковины молодых особей *Kunashiria*: А — *K. haconensis* из р. Славная, о. Итуруп; В — *K. japonica* из оз. Алигер, о. Кунашир.

Genus *Kunashiria* Starobogatov in Zatrawkin, 1983

Type species. *Anodonta japonica* Clessin, 1874 in Kuester and Clessin, 1838-1876.

Diagnosis. Shell oval, oval-quadrangular or oval-conic, with weakly developed wing and various degree of convexity. Length of valve 5-26 cm or more. Juvenile shells may be oval-triangular, with conspicuous wing. Beak sculpture usually with ridges, strongly or weakly curved ventrally, smoothly rounded before umbones and broken near posterior ridge. Concavity of ridges may be absent in ventral part or some separate ridges may be more or less concave. Sometimes ridges wavy or broken in middle part. Posteriormost point of valve nearly at middle of shell height or below it.

Kunashiria ***sinanodontoides*** Bogatov, Sayenko et Starobogatov, sp. nov.

(Figs. 1, 3)

Material. Holotype and 13 paratypes from Dobroye Lake, Dobroye Nachalo Bay basin, Iturup Island, Kurile Archipelago (coll. V.V. Bogatov, August 13, 1994; field number IT-94-EMS-09).

Diagnosis. A species of *Kunashiria* differing from all other members of the genus in having a sinanodontoid oval-triangular shell at juvenile stages (Fig. 1D); the juveniles of all congeners have an oval-elongate shell (Fig. 2). The sinanodontoid shape of *K.* ***sinanodontoides*** is characterized by a high wing distinctly bent forward. During growth, inclination of the wing decreases, and the dorsal margin of the valve becomes parallel to the longitudinal axis of the body. The ratio of distance between the umbo and the base of nympha to the convexity of valve of paratypes is 0.71-0.90; umbones and the dorsal margin of wings are 0.25-0.30 and 0.54-0.66 of the shell length from the anterior end of the valve, respectively.

Glochidium of new species is smaller than that of all other members of the genus (Tables 1, 2).

Table 1. Conchological characteristics of glochidia of *Kunashiria haconensis* (in μm).

	Kunashir Island		Zelionyi Island
	Bezymiannoye Lake	Lagunnoye Lake	Kamenskoye Lake
H, height	293.8	287.5	293.8
L, length	293.8	287.5	287.5
l, length of hook	93.8	87.5	93.8
HL, length of hinge line	227.5	215.6	215.6

Table 2. Conchological characteristics of glochidia of *Kunashiria japonica* (in μm).

	Kunashir Island, Aliger Lake	after Antonova, Starobogatov, 1988
H, height	281.3	254.4
L, length	275.0	249.3
l, length of hook	93.8	89.1
HL, length of hinge line	206.3	178.1

Dimensions of shells (in cm). Holotype: length 9.85, height 5.87, convexity of valve 3.81. Paratypes (13 specimens): length 12.56, 12.20, 10.10, 9.75, 9.41, 9.10, 9.08, 9.04, 7.68, 6.23, 5.61, 5.24, 4.98; height 6.96, 6.93, 6.20, 5.85, 5.65, 5.34, 5.24, 5.20, 4.70, 4.24, 3.92, 3.78, 3.53; convexity of valve 4.40, 4.20, 3.37, 3.55, 3.54, 3.38, 3.15, 2.93, 2.68, 1.95, 1.95, 1.62, 1,53.

Dimensions of glochidium (in μm). Length 276.6; height 279.7; length of hook 93.8; length of hinge line 206.6.

Description. Shell oval, weakly convex, thin-walled but solid. Anterior margin wide and rounded, passing into dorsal margin with obtuse angle. Dorsal margin almost parallel to longitudinal axis of body. Posterior margin elongated in wide bill. Ventral margin moderately curved. Umbones almost flat, weakly corroded, at 0.29 of shell length from anterior end of valve. Distance between umbo and base of nympha/convexity of valve ratio 0.77. Beak sculptured with curved ridges, closest ridges to umbo double-looped ventrally. Shell with short, conspicuous wing. Top of wing at 0.65 of shell length from anterior end of valve. Most projected point of shell surface opposite to middle of shell

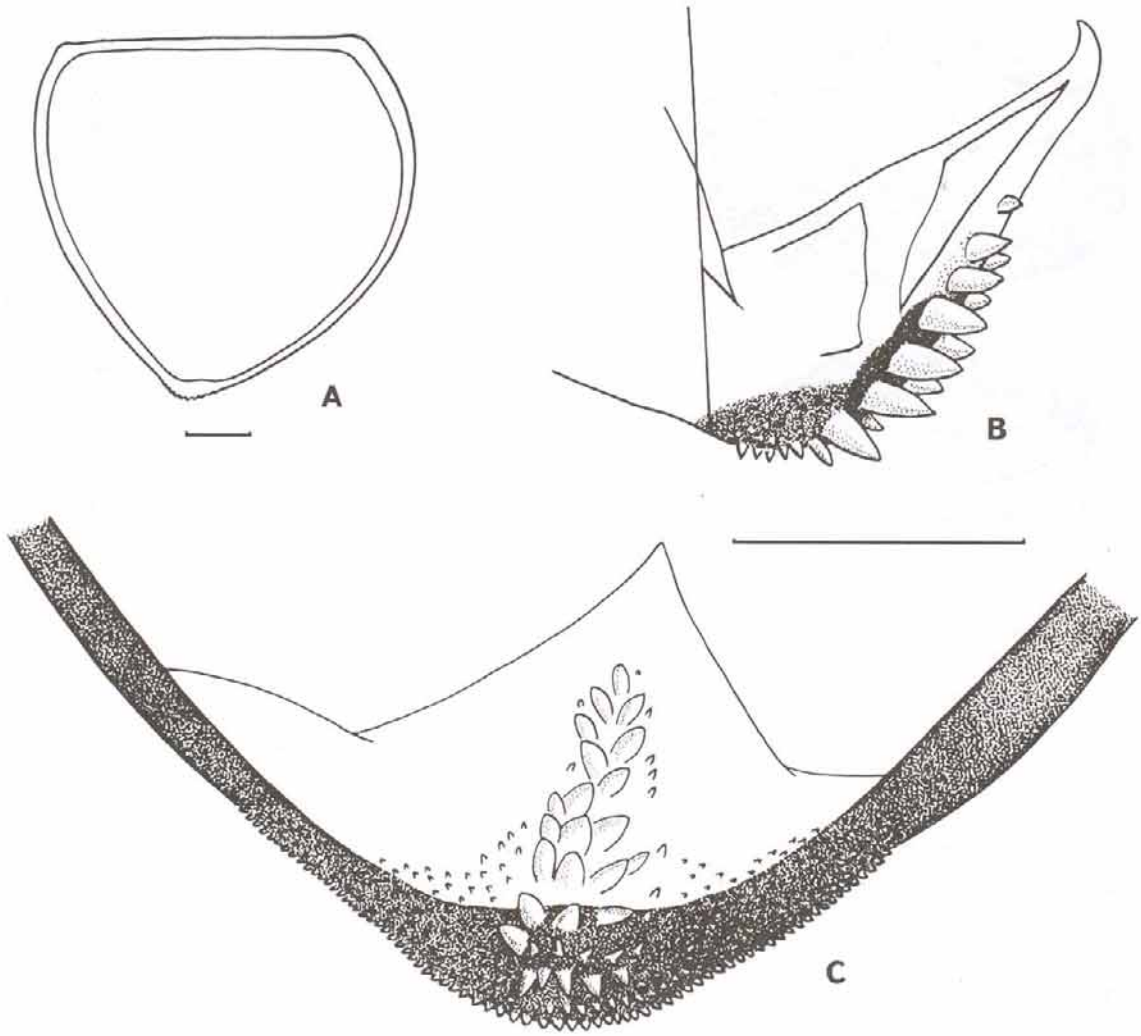

FIG. 3. Glochidium of *Kunashiria* ***sinanodontoides*** sp. nov.: A — glochidium, lateral view; B — hook, lateral view; C — hook, frontal view. Scale bar — 50 μm.

РИС. 3. Глохидий *Kunashiria* ***sinanodontoides*** sp. nov.: A — общий вид; B — крючок, вид сбоку, C — крючок, вид спереди. Масштабная линейка — 50 μm.

height. Periostracum yellowish-brown, with green hue. Hinge area not developed. Adductor scars poorly visible. Interior surface of valve blue, with wide oily spots near umbo. Posteriormost point of valve lying slighly ventral to middle of shell height.

[**Диагноз.** Раковина овальная, слабо выпуклая, тонкостенная, прочная. Передний край широкий, закругленный, через тупой уголок переходит в спрямленный спинной край, который почти параллелен продольной оси тела. Задний край вытянут в широкий клюв. Брюшной край слабо выгнутый. Макушки покатые, слегка корродированные, сдвинуты к переднему краю раковины на 0,29 ее длины. Отношение расстояния между макушкой и основанием нимфы к выпуклости раковины 0,77. Макушечная скульптура представлена выгнутыми валиками, близлежащие к макушке валики вогнуты на вентральном участке. Крыло невысокое, хорошо заметное. Его вершина лежит от переднего края раковины на 0,65 ее длины. Наиболее выступающая точка боковой поверхности створки лежит против середины ее высоты. Периостракум желто-коричневый с зеленоватым оттенком. Замочная площадка не выражена. Мускульные отпечатки едва заметны. Перламутр голубой, в примакушечной части с широкими масляные пятнами. Самая задняя точка раковины лежит чуть ниже середины ее высоты.]

Distribution. Known only from Dobroye Lake, Iturup Island, Kurile Archipelago.

Etymology. The name *sinanodontoides* is given for the shape of the shell of juvenile specimens.

Kunashiria ***iturupica*** Bogatov, Sayenko et Starobogatov, sp. nov.

(Fig. 4)

Material. Holotype and 2 paratypes from Kui-

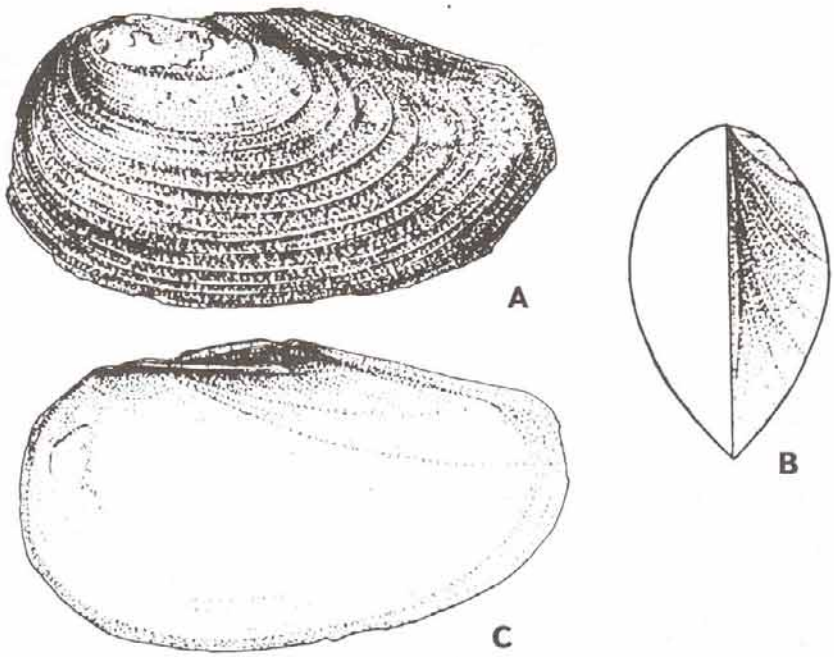

FIG. 4. Shell of holotype of *Kunashiria* ***iturupica*** sp. nov.: A, C — lateral view; B — anterior view.

РИС. 4. Раковина голотипа *Kunashiria* ***iturupica*** sp. nov.: A, C — вид сбоку; B — вид спереди.

byshevskoye Lake, Iturup Island, Kurile Archipelago (coll. V.V. Bogatov, August 22, 1994; field number IT-94-EMS-57); 1 paratype from Serebryanoye Lake, Kunashir Island, Kurile Archipelago (coll. V.V. Bogatov, August 1, 1994; field number KV-94-EMS-12).

Diagnosis. A species of *Kunashiria* differing from all other members of the genus in having an oval-conic shell with umbones projecting forward and strongly shifted to the anterior margin of valve. It differs from *K. japonica* and *K. haconensis* in having a more convex shell (Fig. 5). The ratio of the distance between the umbo and the base of nympha to the convexity of the valve in paratypes is 0.76-0.79; umbones and the dorsal margin of wings are at 0.23-0.24 and 0.54-0.57 of the shell length from the anterior end of valve, respectively. The ventral margin of valve in adults is sometimes unbent. The ligament of juveniles is closed by margins of the valves, whereas margins of adult shells are usually broken off and the ligament is open.

Glochidia of the new species differ in shape from those of all other members of the genus; the H/L ratio is 1.0-1.02 for *K. haconensis*, 1.02 for *K. japonica*, 1.01 for *K.* ***sinanodontoides***, and 1.1 for glochida of the new species (Tables 1, 2).

Dimensions of shells (in cm). Holotype: length 7.12, height 4.10, convexity of valve 2.68. Paratypes (3 specimens); length 8.60, 7.91, 6.67; height 5.35, 4.75, 3.39; convexity of valve 3.17, 2.91, 2.63.

Dimensions of glochidium (in μm). Length 281.0, height 295.5, length of hook 97.9, length of hinge line 215.6.

Description. Shell oval, conic, weakly convex, thin-walled, solid. Anterior margin wide, visibly unbent in middle area. Dorsal margin short, not developed anterior to umbones, parallel to longitudinal axis of body behind umbones. Posterior margin elongated in bill curved dorsally at end. Ventral margin curved. Umbones sloping, markedly projecting above shell margin, at 0.24 of shell length from anterior end of valve. Distance between umbo and base of nympha/convexity of valve ratio 0.78. Wing weakly developed. Dorsal margin of wing at 0.56 of shell length from anterior end of valve. Most projecting point of shell surface at middle of shell height. Periostracum yellowish-brown, with green hue. Hinge area short, bent posteriorly. Adductor scars poorly visible. Interior surface of valve blue, with pink iridescence and wide oily spots near umbones. Posteriormost point of valve slightly ventral to middle of shell height.

[**Диагноз.** Раковина овально-коническая, слабо выпуклая, тонкостенная, прочная. Передний край широкий, заметно спрямленный в средней части. Спинной край короткий, перед макушками не выражен, за макушками параллелен продольной оси тела. Задний край вытянут в клюв, слегка завернутый в концевой части вверх. Брюшной край слабо выгнутый. Макушки покатые, заметно оттянуты за край створки, сдвинуты к переднему краю раковины на 0,24 ее длины. Отношение расстояния между макушкой и основанием нимфы к выпуклости раковины 0,78. Крыло слабо заметное. Его вершина лежит от переднего края раковины на 0,56 ее длины. Наиболее выступающая точка боковой поверхности створки лежит против середины ее высоты. Периостракум желто-коричневый с зеленоватым оттенком. Замочная

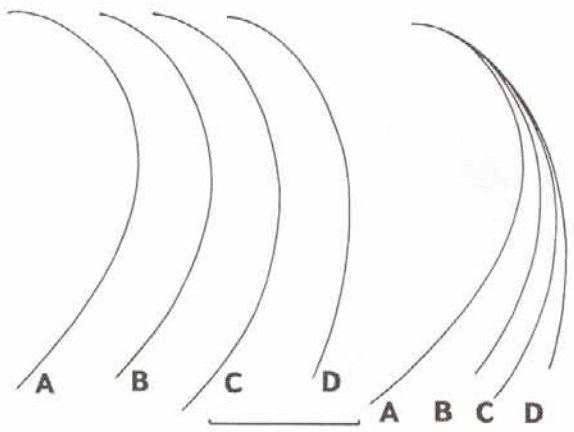

FIG. 5. Contours of frontal section of valves of *Kunashiria* species: A — *K. japonica;* B — *K. haconensis,* C — *K.* ***iturupica*** sp. nov.; D — *K.* ***sinanodontoides*** sp. nov. Scale bar — 1 cm.

РИС 5. Контуры фронтального сечения створок *Kunashiria:* A — *K. japonica;* B — *K. haconensis,* C — *K.* ***iturupica*** sp. nov.; D — *K.* ***sinanodontoides*** sp. nov. Масштабная линейка — 1 см.

площадка короткая, наклонена назад. Мускульные отпечатки едва выражены. Перламутр голубой с розовым отливом, в примакушечной части с широкими масляными пятнами. Самая задняя точка раковины лежит чуть ниже середины ее высоты.]

Distribution. Kunashir and Iturup Islands, Kurile Archipelago.

Etymology. The name *iturupica* is given after Iturup Island.

Acknowledgements

This work was partly supported by the Biological Sciences Directorate (Biotic Surveys and Inventories Program) and the International Program Division of the U.S. National Science Foundation, grant No. DEB-9400821, Theodore W. Pietsch, principal investigator. The work was also supported by the Russian Foundation for Basic Research, grant No. 98-04-49595a. We thank Brian K. Vrbain and T.W. Pietsch, both of the University of Washington, for editorial assistance; and T.A. Yaroshenko and A. Beldy for providing the illustrations.

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Беззубки рода *Kunashiria* Starobogatov южных Курильских островов, с описанием двух новых видов

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На основе детального сравнения уже имевшегося и вновь собранного на южных Курильских островах материала проведена ревизия рода *Kunashiria* Starobogatov in Zatrawkin, 1983. На Курильских островах были выявлены четыре вида *Kunashiria: K. japonica* (Clessin in Kuester et Clessin, 1874), *K. haconensis* (Ihering, 1893), *K.* ***sinanodontoides*** sp. nov. и *A.* ***iturupica*** sp. nov. Пятый вид — *K. iwakawai* (Suzuki, 1939) — обнаружен в коллекционных сборах с о. Хоккайдо и юга Сахалина. Итуруп был определен как самая северная граница для рода *Kunashiria* в пределах Курильских островов.