

---

## *Acroloxus* Beck (Pulmonata, Acroloxidae) from Hokkaido — new genus and family of freshwater molluscs for Japan

---

L.A. PROZOROVA

*Institute of Biology and Soil Science of Far Eastern Branch of Russian Academy of Sciences,  
Vladivostok, 690022, RUSSIA; e-mail: lprozorova@mail.ru*

**ABSTRACT.** For the first time for Japan freshwater limpets *Acroloxus orientalis* Kruglov et Starobogatov, 1991 were recorded in the stream of central Hokkaido (Tomakomai city vicinities). Both the genus *Acroloxus* and family Acroloxidae are for the first time found in Japan. External morphology of shell and soft body as well as copulative apparatus are described.

---

Based on soft body morphology and reproductive system structure, *Acroloxus* Beck, 1837 was established to form its own family Acroloxidae having significant anatomical differences from other freshwater limpet taxa [Hubendick, 1962, 1964, 1969; Burch, 1962; Brown, 1967; Starobogatov, 1967]. Distinguishness of acroloxid, ancyloid and bulinid limpets is supported by molecular phylogenetic approach as well [Albrecht et al., 2006; Walther et al., 2006].

*Acroloxus* has an entirely Holarctic distribution. On the basis of the studies of both conchological and anatomical characters it has been demonstrated that Russian acroloxids belong to 18 species, grouped in two subgenera: Holarctic *Acroloxus* s. str. and southern Far East *Amuracroloxus* Kruglov et Starobogatov, 1991 [Kruglov, Starobogatov, 1991; Prozorova, 1996; Prozorova, Starobogatov, 1998; Starobogatov et al., 2004].

Previously, freshwater limpets of the genera *Laevapex* Walker, 1903, *Ferrissia* Walker, 1903 and *Pettancylus* Iredale, 1943 were known to occur in central and southern Japan [Kuroda, 1963; Burch, 1964; Habe, Burch, 1965; Higo, Goto, 1993]. No limpets were previously recorded from fresh waters of northern Japan. In late May 2001 on central Hokkaido in the Bibi River (42.75°N, 141.71°E) small molluscs with cap-shaped shells were collected. Bibi River of the Abira river system is the natural river remained in Yufutsu plain in Tomakomai city, Hokkaido. This is secondary-level stream with slow current and aquatic vegetation. Nine found limpet specimens with shell length less than 4 mm were collected from submerged aquatic plants in the river bed. Below are the description and discussion of their taxonomy.

### Results and discussion

Morphology of the shells, soft body, and copulative apparatus allowed us to assign Hokkaido limpets to the family Acroloxidae. Acroloxids are distinguished from other limpets by having a dextral body [Hubendick, 1962, 1969 and others] and the apex correspondingly directed to the left (Fig. 1, A, B). Besides, acroloxids have three adductor muscles on the dorsal body surface, with two anterior adductors located on both sides and a posterior one on the right side (Fig. 1, C). The posterior adductor of other families of limpets is located in the middle or on the left side of the dorsal body surface. There are also essential differences in the reproductive system structure. The copulative apparatus of acroloxids consists of a praeputium and penis sheath with a massive glandular appendage at its proximal end, and having a lateral inflowing of the vas deferens into a muscular part (Fig. 1, E). The copulative apparatus of *Ferrissia*, *Pettancylus*, *Laevapex*, *Ancylus* Müller, 1774 and other limpets is of a Bulinidae-like or Planorbidae-like structure [Hubendick, 1962, 1964, 1969; Brown, 1967; Starobogatov, 1967].

On the basis of soft body morphology, Hokkaido acroloxids are attributed to the subgenus *Amuracroloxus* of the genus *Acroloxus*. Morphology of Japanese acroloxids corresponds to subgeneric characters given by Kruglov and Starobogatov [1991]. These are as follows: mantle pigmentation on the dorsal body side forms two transverse lines in front of and behind the apex (Fig. 1, C, D); seminal receptacle duct is longer than pro-vagina; penis sheath width is less than that of its glandular appendage and sharply converged to the distal end; sarcobellum is rather developed; velum is visible (Fig. 1, E). All specimens have a horn-shaped protoconch with slight reticular sculpture. Baikalian representatives of the *Acroloxus* except *Acroloxus* sp. have very similar protoconch characters [Shirokaya et al., 2009].

Conchologically examined acroloxid specimens fall into two groups that differ in shell height. Five specimens have cap-shaped shells with height equal to 0.26-0.29 of the length and 0.43-0.48 of the width

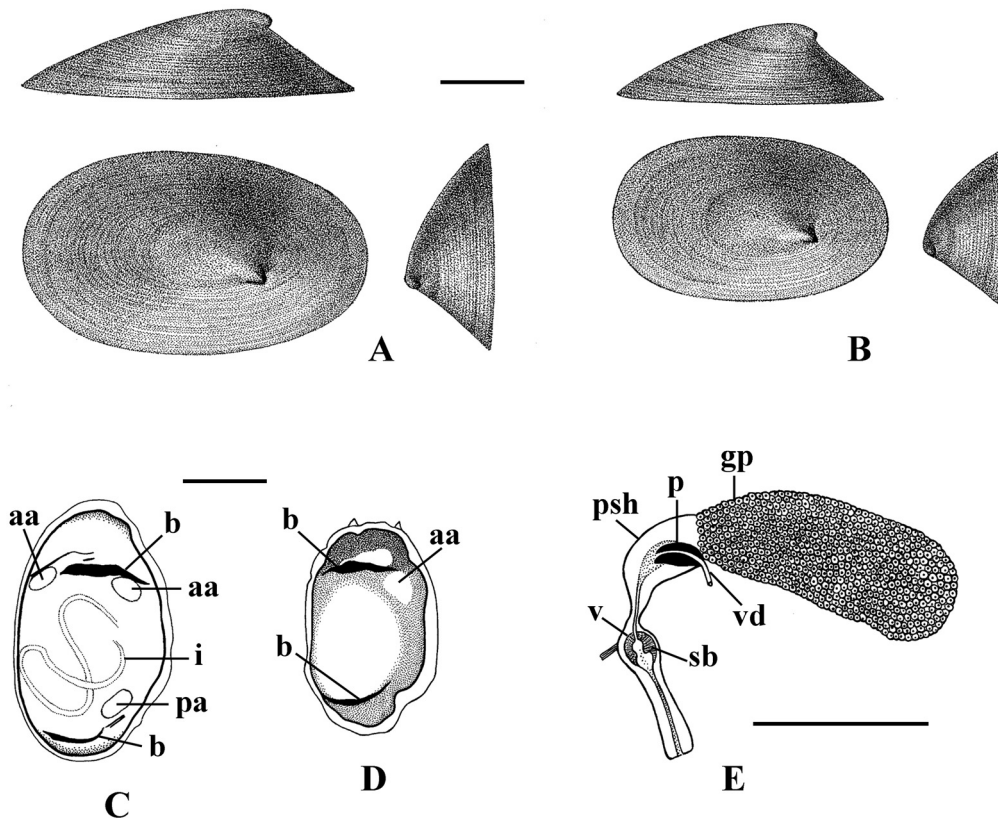


FIG. 1. A — specimen of *Acroloxus orientalis* from Hokkaido with low shell (left, apical and posterior views); B — specimen of *A. orientalis* from Hokkaido with high shell (left, apical and posterior views); C — soft body of low shelled *A. orientalis* from Hokkaido (dorsal view); D — soft body of high shelled *A. orientalis* from Hokkaido (dorsal view); E — copulative apparatus of low shelled specimen of *A. orientalis* from Hokkaido. Scale bars — 1 mm.

Abbreviations: *aa* — anterior adductor, *b* — pigmented bands on the mantle, *gp* — glandular appendage of penis sheath, *i* — visible sections of intestine, *p* — penis, *pa* — posterior adductor, *pr* — prepuhium, *psh* — penis sheath, *sb* — sarcobellum, *v* — velum, *vd* — vas deferens.

РИС. 1. А — экземпляр *Acroloxus orientalis* с Хоккайдо с относительно низкой раковиной (вид слева, сверху и сзади); В — экземпляр *A. orientalis* с Хоккайдо с относительно высокой раковиной (вид слева, сверху и сзади); С — мягкое тело экземпляра *A. orientalis* с Хоккайдо с относительно низкой раковиной (дорсально); D — мягкое тело экземпляра *A. orientalis* с Хоккайдо с относительно высокой раковиной (дорсально); E — копулятивный аппарат экземпляра *A. orientalis* с Хоккайдо с относительно низкой раковиной. Масштабные линейки — 1 мм.

Сокращения: *aa* — передний аддуктор, *b* — пигментированные полосы на мантии, *i* — видимые участки кишечника, *gp* — железистый придаток мешка пениса, *p* — пенис, *pa* — задний аддуктор, *pr* — препуциум, *psh* — мешок пениса, *sb* — саркобеллум, *v* — велум, *vd* — семяпровод.

(Fig. 1, A). Four other specimens have higher shells with height equal to 0.30-0.33 of the length and 0.49-0.54 of the width (Fig. 1, B). These are low shelled and high shelled groups correspondingly. Aperture of all specimens is oval elongate and convergent to the back. Anterior and right slopes of the shell are convex, posterior and left are nearly straight. Distance from anterior margin to the apex (in projection to longitudinal axis of aperture) is 0.70-0.74 of the aperture length and the distance from left margin to the apex (in attitudinal projection) is 0.36-0.40 of the aperture width.

On the basis of listed parameters mollusks from

both groups might be identified as *A. orientalis* Kruglov et Starobogatov, 1991. Ecological characters of Japanese acroloxids confirm the species identification as well because *A. orientalis* is known to inhabit the macrophytic vegetation of slow rivers and big lakes.

The species is a rather variable in its shell morphology [Shirokaya et al., 2009]. Typical specimens are characterized by a flattened shell (shell height to width ratio 0.45-0.54), more or less deep undertop concavity, straight posterior slope down undertop concavity, evenly convex right slope, rounded front and back aperture edges [Kruglov, Starobogatov,

1991; Starobogatov et al., 2004]. In some population higher (Baikal) or lower (Primorye, Sakhalin) specimens prevail. *A. orientalis* from Hokkaido more close morphologically to Far East specimens than to Baikalian ones.

*A. orientalis* inhabits Southern Russian Far East including Sakhalin Island on the east [Kruglov, Starobogatov, 1991; Starobogatov et al., 2004]. Recently the species was found in Lake Baikal drainage area [Prozorova, Zasyapkina, 2005] and in shallow bay of eastern Baikal [Shirokaya et al., 2009]. Thus, the range of *A. orientalis* covers the territory from Baikal to Sakhalin and Hokkaido. It is interesting to note, that neither *A. orientalis* nor other acroloxids are known from the Kurile Islands close to Sakhalin and Hokkaido [Prozorova, 1996].

## Acknowledgements

The author expresses her sincere thanks to Yasuhiro Kuwahara (Hokkaido University and Abashiri Fishery Station, Japan) for his kind help in collecting of freshwater mollusks in Hokkaido and Ronald G. Noseworthy (College of Ocean Science, Cheju National University, Korea) for revision English version of the text. Thanks are also due to Tamara A. Eroshenko (Institute of Biology and Soil Science, FEB RAS, Vladivostok) for help in preparing of Figures.

The work was supported by International Kurile Islands Project (US NSF, DEB-9505031), Japan Society for the Promotion of Science (№ BSAR-401) and Russian Science Foundations (FEBRAS № 09-III-A-06-181, RFBR № 09-04-98583-p\_восток\_a).

## References

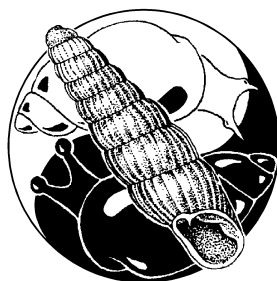
- Albrecht C., Shirokaya A.A., Prozorova L.A., Ellis B.K., Wilke T. 2007. Evolution and biogeography of ancient freshwater pulmonate gastropods: the limpet family Acroloxiidae (Hygrophila). *Abstracts of World Congress of Malacology, Antwerp, Belgium, 15-20 July 2007*. Antwerp: Universiteit Antwerpen: 3-4.
- Brown D.S. 1967. The anatomy and relationships of a South African *Ferrissia* (Basommatophora: Ancyliidae). *Malacologia*, 6(1-2): 155-174.
- Burch J. B. 1962. Cytotaxonomic studies of freshwater limpets (Gastropoda: Basommatophora). 1. The European Lake limpet, *Acroloxus lacustris*. *Malacologia*, 1(1): 55-72.
- Burch J. B. 1964. A new species of freshwater limpet, genus *Gundlachia*, from Japan. *Occasional Papers of the Museum of Zoology, University of Michigan*, 637: 1-7.
- Habe T., Burch J. B. 1965. A new species of freshwater limpet, genus *Ferrissia*, from Japan. *Venus, Japanese Journal of Malacology*, 24(1): 1-7.
- Higo S., Goto Y. 1993. *A systematic list of the molluscan shells of the Japanese islands and the adjacent area*. Osaka: Yuko, 693 pp. [In Japanese].
- Hubendick B. 1962. Studies on *Acroloxus* (Mollusca, Basommatophora). *Meddelanden från Göteborgs Musei, Zoologiska Avdelning*, 133: 1-68.
- Hubendick B. 1964. Studies on Ancyliidae. The subgroups. *Meddelanden från Göteborgs Musei, Zoologiska Avdelning*, 137: 1-72.
- Hubendick B. 1969. A note on *Acroloxus coloradensis* (Henderson). *Journal de Conchyliologie*, 7(3): 109-118.
- Kruglov N. D. & Starobogatov Ya. I. 1991. Generic composition of the family Acroloxiidae (Gastropoda, Pulmonata) and the species of the genus *Acroloxus* found in the USSR. *Zoologicheskij Zhurnal*, 70(2): 66-80 [In Russian].
- Kuroda T. 1963. *A catalogue of the non-marine mollusks of Japan, including the Okinawa and Ogasawara Islands*. Tokyo: Malacological Society of Japan, 77 pp.
- Prozorova L.A. 1996. On the species composition of the Acroloxiidae (Gastropoda, Pulmonata) family in the Russian Far East. *Zoologicheskij Zhurnal*, 75(4): 494-498 [In Russian].
- Prozorova L.A., Starobogatov Ya. I. 1998. New species of the genus *Acroloxus* Beck (Pulmonata, Acroloxiidae) from the Kolhyma River basin. *Rutshenica*, 8(1): 39-42 [In Russian].
- Prozorova L.A., Zasyapkina M.O. 2005. Freshwater molluscs of the Khilok River (Selenga R, watershed, Transbaikalia). *Vladimir Ya. Levanidov's Biennial Memorial Meetings*, 3: 295-301 [In Russian].
- Shirokaya A.A., Prozorova L.A., Sitnikova T.Y., Matfonov D.V., Albrecht C. 2009. Limpets of the genus *Acroloxus* (Gastropoda: Pulmonata: Acroloxiidae) in Lake Baikal: taxonomy, shell morphology, distribution, origin. *Abstracts of the International Symposium 'Speciation in Ancient Lakes', SIAL 5, Ohrid, September 7-11, 2009. Review — HBI Ohrid*, 42: 107-109.
- Starobogatov Ya. I. 1967. On the systematization of freshwater pulmonate mollusks. *Trudy Zoologicheskogo Instituta [Molluscs and their significance in biocenosis and faunogenesis]*, 52: 28-304 [In Russian].
- Starobogatov Ya. I., Prozorova L.A., Bogatov V.V., Sayenko E.M. 2004. Molluscs. *Key to freshwater invertebrates of Russia and adjacent lands*. Vol. 6. *Molluscs, Polychaetes, Nemertean*. SPb.: Nauka: 10-491 [In Russian].
- Walther A.C., Lee T., Burch J.B., Foighil Y.D. 2006. *Acroloxus lacustris* is not ancyliid: A case of misidentification involving the cryptic invader *Ferrissia fragilis* (Mollusca: Pulmonata: Hygrophila). *Molecular Phylogenetics and Evolution*, 39: 271-275.

●  
*Acroloxus* Beck (Pulmonata, Acroloxidae) на Хоккайдо — новый род и семейство пресноводных моллюсков для Японии

Л. А. ПРОЗОРОВА

Биолого-почвенный институт ДВО РАН, пр. 100 лет Владивостоку, 159, Владивосток, 690022, РОССИЯ, e-mail: lprozorova@mail.ru

**РЕЗЮМЕ.** Впервые для Японии в малой реке южного побережья центрального Хоккайдо (окрестности г. Томакомай) отмечены пресноводные моллюски *Acroloxus orientalis* Kruglov et Starobogatov, 1991, что является также первой находкой рода *Acroloxus* и семейства Acroloxidae в целом. Приводятся сведения по внешней морфологии раковины, мягкого тела и строению копулятивного аппарата данных моллюсков.



This paper is published on a CD-ROM to comply with the Article 8.6 of the International Code of Zoological Nomenclature. The copies of the CD-ROM were mailed on the date mentioned on the front page to: Department of biological literature of the Library on Natural Sciences of Russian Ac. Sci., Library of Zoological Institution of Russian Ac. Sci., Malacology library of Muséum National d'Histoire Naturelle (Paris, France), Malacology library of the Natural History Museum (London, UK), Library of the National Museum of Natural History, Smithsonian Institution (Washington, DC, USA); Thomson Reuters (publishers of Zoological Record).

Эта статья опубликована на CD-ROM, что соответствует требованиям статьи 8.6 Международного Кодекса Зоологической номенклатуры. Копии CD-ROM разосланы в день, указанный на первой странице в следующие библиотеки: Библиотеку биологической литературы РАН (Москва), которая является отделом Библиотеки по естественным наукам Российской академии наук (БЕН РАН); библиотеку Зоологического института РАН; малакологическую библиотеку Muséum National d'Histoire Naturelle (Париж, Франция); малакологическую библиотеку Natural History Museum (London, UK), библиотеку National Museum of Natural History, Smithsonian Institution (Washington, DC, USA); Thomson Reuters (издатели Zoological Record).