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RESEARCH ARTICLE

Redescription of *Hydrobius pauper* (Coleoptera: Hydrophilidae), with a key to the Eurasian species of the genus *Hydrobius*

Переописание *Hydrobius pauper* (Coleoptera: Hydrophilidae) с определительной таблицей евроазиатских видов рода *Hydrobius*

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Abstract. The little-known water scavenger beetle *Hydrobius pauper* Sharp, 1884 has only ever been recorded from Japan. Based on the type series, the species is redescribed and its diagnostic features are clarified. The lectotype of *H. pauper* is designated. This species is compared with other Eurasian representatives of the genus *Hydrobius* Leach, 1815. A key to all Eurasian species of the genus is given.

Резюме. Малоизвестный водолюб *Hydrobius pauper* Sharp, 1884 был указан только с территории Японии. На основании типовой серии сделано переописание этого вида и уточнены его диагностические признаки. Обозначен лектотип *H. pauper*. Приводится сравнение этого вида с другими евроазиатскими представителями рода *Hydrobius* Leach, 1815. Дана определительная таблица всех евроазиатских видов рода.

Key words: water scavenger beetles, taxonomy, Eurasia, Japan, Coleoptera, Hydrophilidae, *Hydrobius*

Ключевые слова: жуки-водолюбы, таксономия, Евразия, Япония, Coleoptera, Hydrophilidae, *Hydrobius*

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Introduction

Today the genus *Hydrobius* Leach, 1815 includes nine species (Hansen, 1999; Short et al., 2017) which are distributed in the Holarctic: seven species in the Palaearctic and three species in the Nearctic (one with Holarctic distribution). In the Palaearctic fauna, nine species of *Hydrobius* have been recorded (Hansen, 1999, 2004; Fikáček et al., 2015), but *H. convexus* Brullé, 1835 and *H. orientalis* Jia & Short, 2009 are now placed in the genus *Limnohydrobius* Reitter , 1909 (Short et al., 2017). *Hydrobius arcticus* Kuwert, 1890 is distributed in Subarctic Eurasia (tundra and forest tundra) from Northern Europe to East Siberia (Fikáček et al., 2015; Fossen et al., 2016). The records of this species from Turkey (İncekara et al., 2005; Mart et al., 2006) and Northern Africa (İncekara, 2007) almost certainly refer to a different species. *Hydrobius fuscipes* (Linnaeus, 1758) is widely distributed in the Holarctic region (Fikáček et al, 2015; Fossen et al., 2016; Ryndevich, 2016). In the paper by Fossen et al. (2016), *H. rottenbergii* Gerhardt, 1872 and *H. subrotundus*

Stephens, 1829, considered previously conspecific with *H. fuscipes*, were treated as distinct species on the basis of molecular and morphological (morphometric, punctation of elytra, male genitalia, etc.) evidence. *Hydrobius rottenbergii* is distributed in Germany, Norway, Sweden, Poland, Latvia, Belarus, Ukraine, and the European part of Russia (Fossen et al., 2016, Ryndevich, 2016, 2017). *Hydrobius subrotundus* is so far known from the United Kingdom, Germany, Norway, Sweden, Finland, and Italy (Fossen et al., 2016). Two species were described from China: *H. pui* Jia, 1995 from Qinghai and *H. punctistriatus* Jia, 1995 from Heilongjiang (Jia, 1995).

Hydrobius pauper Sharp, 1884 was described from Oyama, Honshu Island (Japan). The absence of clear diagnostic features (except the pubescence and punctation of the hind femora) and figures in the original description of the species for a long time did not allow placement of this little-known species. In this contribution, *H. pauper* is redescribed based on the type material, and its diagnostic characters are clarified. Further research on *Hydrobius* taxonomy should involve a combination of morphological, molecular and chromosome studies. There are probably many more species of *Hydrobius* in Eurasia, which follows from preliminary data from a DNA analysis of the authors of this paper and other scientists (Fossen et al., 2016).

Material and methods

The examined type material of *Hydrobius pauper* is deposited in the Natural History Museum, London, U.K. (NHML). In addition, the type material of *H. pui* and *H. punctistriatus* was examined. The species affiliation of most Eurasian *Hydrobius* is confirmed by DNA analysis, with the exception of *H. pauper* and *H. punctistriatus*.

Beetles were examined using a Nikon SMZ-745T, Nikon SMZ-800 and Leica MZ25 stereomicroscopes. Measurements were taken using an ocular micrometer. Habitus photographs were taken with a Canon EOS 40D digital camera with a Canon MP-E 65 mm objective and were combined using Zerene Stacker 1.04 software (at Zoological Institute, Russian Academy of Sciences, St Petersburg), Nikon D5100 digital camera with attached Nikon 60 mm 1:2.8G macro lens and Meike Macro Extension Tube Set (at Ecological Laboratory, Baranovichi State University, Baranovichi), and with a Leica MZ25 stereomicroscope combined with a Canon digital camera and Eos Utility software and images were stacked using Helicon Focus software (at Sackler Bioimaging Laboratory, NHML, London). The aedeagi were photographed using a Zeiss Axioskop microscope and Helicon Focus software (at Sackler Bioimaging Laboratory, NHML, London). The photographs were edited subsequently in Adobe Photoshop CS5®.

Total body length is measured between anterior margins of eyes and apices of elytra, width is taken as maximum linear distance between outer margins of elytra. Body length is measured in specimens with deflexed head and not inflexed prothorax (i.e. in the natural position).

Taxonomy

Order **Coleoptera**

Family **Hydrophilidae**

Subfamily **Hydrophilinae**

Tribe **Hydrobiusini**

Genus ***Hydrobius*** Leach, 1815

Hydrobius pauper Sharp, 1884

(Figs 1–9, 11, 19, 20)

Hydrobius pauper Sharp, 1884: 452.

Hydrobius pauper: Hansen, 1999: 205, 2004: 53; Fikáček et al., 2015: 49.

Material examined (all in NHML). *Lectotype* (present designation). Male, **Japan**, "*Hydrobius pauper*, Japan, Lewis" [Sharp's writing on the face of the card], "Japan, G. Lewis" [printed label], "Sharp Coll. 1905-313" [printed label], "Lectotype" [purple bordered round printed label], "*Hydrobius pauper* Sharp, lectotype, S.K. Ryndevich & R.B. Angus des., 2020" [white printed label]. *Paralectotypes*. **Japan**: 1 specimen [originally mounted on one card with lectotype], same data as for lectotype, but "Paralectotype" [blue bordered round printed label]; 1 female, "*Hydrobius pauper*, Type D.S., Japan, Lewis" [Sharp's writing on the face of the card], "Type, H.T." [red bordered round printed label], "Japan, G. Lewis", "Sharp Coll. 1905-313" [printed labels], "Paralectotype" [blue bordered round printed label]; 1 male [specimen lacking

the head, mounted upside down on a card and with its wings and elytra spread, and with the aedeagus protruding from the abdomen], "*Hydrobius pauper* Japan Lewis" [Sharp's handwriting on the face of the card] and with "Japan/ G. Lewis" and "Sharp Coll./ 1905-313" [printed labels], "Paralectotype" [blue bordered round printed label]; 1 specimen, *Tochigi Prefecture*, "Oyama" [written in pencil on card back], "Oyama/ 24.v – 26.v.80" [handwritten label], "Japan, G. Lewis/ 1910-320" [printed label], "*pauper*" [Sharp's handwritten label], "Paralectotype" [blue round printed label]. All paralectotypes were labelled "*Hydrobius pauper* Sharp, paralectotype, S.K. Ryndevich & R.B. Angus des., 2020" [white printed label].

Note. Although Sharp (1884) labelled one specimen as holotype, he did not publish any type designation, so all these specimens are in fact syntypes. One male (lectotype) and one unsexed specimen (paralectotype), originally mounted on one card labelled in Sharp's handwriting, are now on separate cards and the aedeagus of the male is mounted on the card with the beetle, in a drop of dimethyl hydantoin formaldehyde resin.

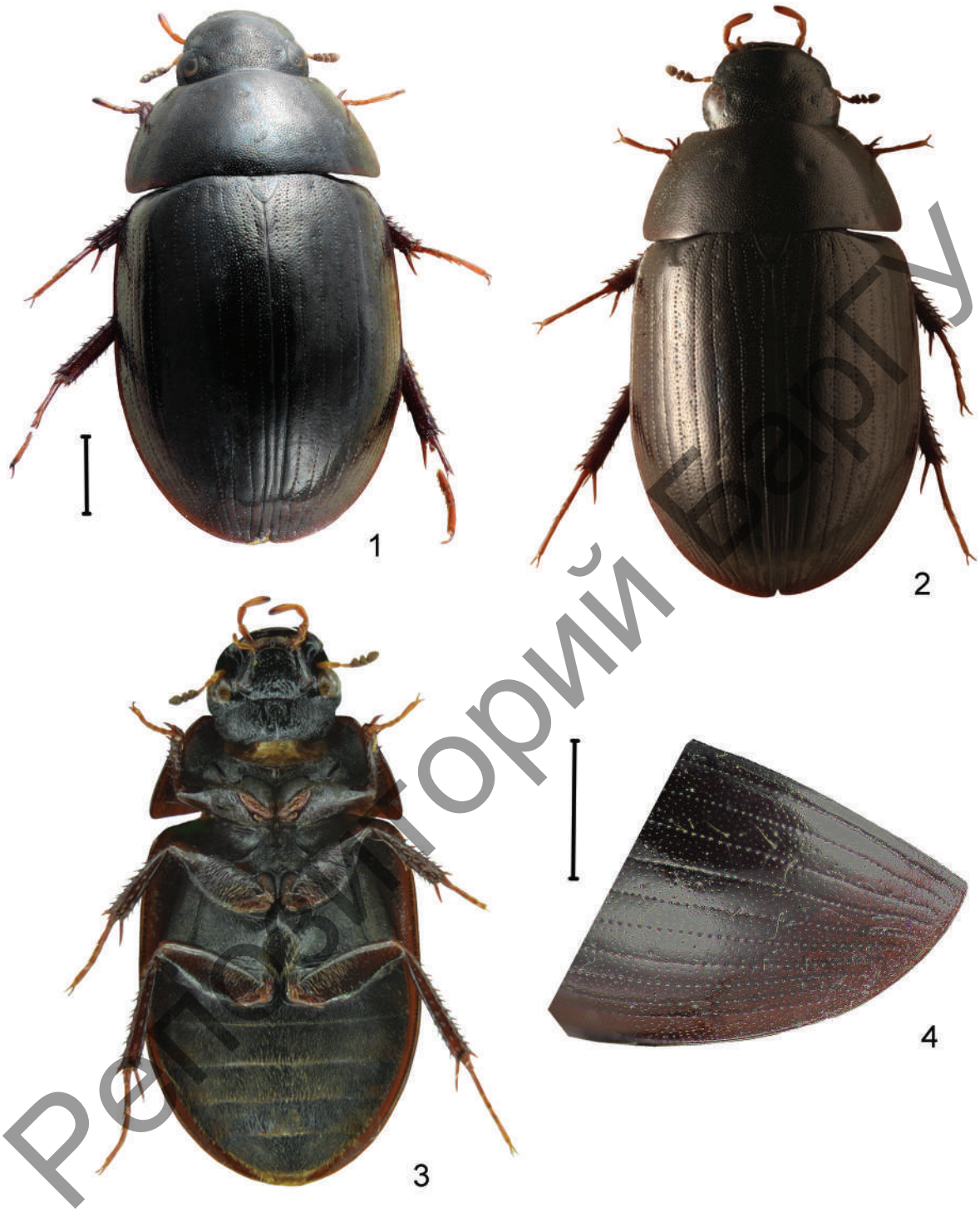
Redescription. Form and colour. Body oval, moderately convex (Figs 1, 2), length 6.5–7.1 mm, width 3.5–3.8 mm. Maximum body width in middle of elytra. Dorsal side black; lateral parts of pronotum and elytra paler, brown or reddish-brown. Maxillary palpomeres and antennae yellowish-brown except for darker club. Last segment sometimes darkened apically. Ventral surface black, metaventral pentagon brown to dark brown, posterior margins of abdominal ventrites paler, brown or reddish-brown. Legs dark brown to yellowish-brown, femora slightly darker, tarsi brownish-yellow (Figs 1–3).

Head. Dorsal surface densely and evenly punctate with moderately coarse punctures of equal size, without microsculpture. Clypeus with dense, moderately coarse punctures. Anterior margin of clypeus with narrow bead. Eyes big, hardly protruding, not emarginate anteriorly, separated by a distance four times as long as width of one eye (Fig. 1). Mentum almost flat, glabrous, about 1.8–2.0 times as wide as long. Antennae with nine antennomeres, scapus about 1.2 times as long as antennomeres 2–5 combined, club not compact. Maxillary palpomere 4 asymmetrical, with more straight inner face, about 1.5–1.6 times as long as palpomere 3.

Thorax. Pronotum and elytra with very rare large punctures (with trichobothria), without microsculpture. Pronotum about 0.3 times as long as elytra, about 2.5 times as wide as long, strongly narrowed anteriorly. Pronotal punctation similar to that on head. In lateral parts of pronotum, large punctures forming ovals; these ovals interrupted by centre of pronotum. Lateral margins of pronotum narrowly rimmed; lateral rims overlapping anterior and posterior corners. Anterior and posterior margins without rim. Prosternum slightly convex medially, without longitudinal carina. Elytra almost parallel-sided medially, with their lateral margins more abruptly rounded to apex. Humeral bulge not distinct. Each elytron with ten punctate striae and a short scutellary stria in base of second elytral interval. Intervals flat; ground punctures on intervals fine (Figs 4, 19, 20); first four to five intervals of female very slightly convex near apex. Large punctures (with trichobothria) in anterior half of elytra situated close to third and fifth elytral striae (Fig. 5). Second interval wider than others, containing 6–8 matted rows of punctation. Remaining intervals with no more than three matted puncture rows. Elytral striae of male weaker apically, reduced to rows of punctures with scarcely any furrows connecting them (Figs 4, 19, 20). Epipleura rather weakly oblique anteriorly, more so posteriorly. Mesoventral elevation low, acute and dentiform (Figs 6, 7). Metaventrite rather strongly but not abruptly raised, with dense punctate pubescence; median pentagonal area about 0.9–1.0 times as long as wide. Femora with sparse and shallow punctures ventrally, pubescent part of metafemora occupying about half (55–60%) of femoral length. Pubescence sparse near posterior edge of metafemora (Figs 8, 9). Tarsi with pale setae ventrally. Protarsomere 5 about as long as protarsomeres 2–4 combined, metatarsomere 5 about as long as metatarsomeres 2 and longer than metatarsomeres 3–4 combined.

Abdomen. With five exposed ventrites, each with dense uniform pubescence; first ventrite not carinate, about as long as second ventrite; fifth ventrite arcuate, not emarginate apically (Fig. 3).

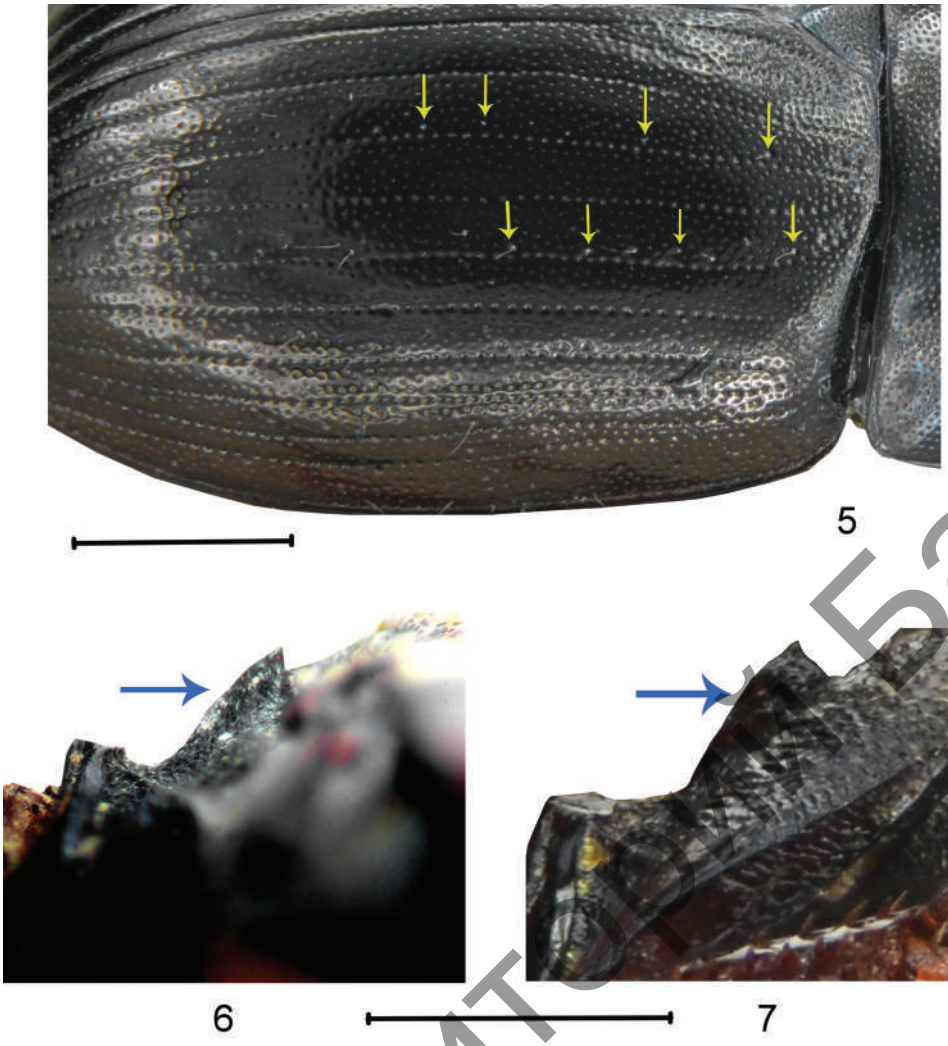
Male genitalia (Fig. 11). Phallobase symmetrical, about 1.3 times as long as paramere. Parameres narrow in apical half; their outer margin almost straight, slightly concave inward, widely rounded



Figs 1–4. *Hydrobius pauper*. **1**, lectotype, male, habitus in dorsal view; **2**, paralectotype, female, habitus in dorsal view; **3**, paralectotype, female, habitus in ventral view; **4**, lectotype, apex of elytra. Scale bars: 1 mm.

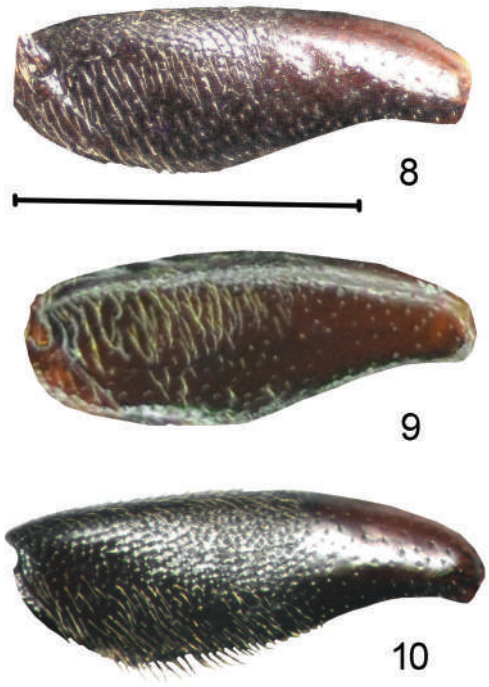
at apex. Median lobe wide, with widely spaced apodemes; gonopore large, situated subapically.

Comparison. *Hydrobius pauper* is most similar in habitus to *H. pui* but has a less convex body. *Hydrobius pui* also differs from *H. pauper* in having the parameres shorter, widest and more robust in apical half, distinctly curved inwards and rounded at apex (Fig. 18).



Figs 5–7. *Hydrobius pauper*. **5**, right elytron in lateral view (yellow arrows indicate large punctures with trichobothria); **6**, **7**, mesoventral elevation in lateral view (indicated by blue arrow). Female (5, 7) and male (6) paralectotypes. Scale bar: 1 mm.

Hydrobius pauper differs from many congeners (except *H. pui* and *H. arcticus*) in its elytra almost parallel-sided medially, with their lateral margins more abruptly rounded to apex (Figs 19, 20). *Hydrobius arcticus* also has almost parallel lateral margins of the elytra in middle portion, but they are more smoothly rounded to apex (Figs 25, 26) and the mesoventral elevation is small and blunt, not dentiform. *Hydrobius punctistriatus*, *H. fuscipes* and *H. subrotundus* have slightly rounded lateral margins of the elytra, which are smoothly rounded to apex (Figs 21–24). Lateral margins of the elytra of *H. rottenbergii* are slightly rounded medially and more abruptly rounded to apex (Fig. 27). *Hydrobius fuscipes*, *H. subrotundus*, *H. punctistriatus* and *H. rottenbergii* have deeper apical section of the elytral striae (Figs 21–24, 27) and metafemora with coarser punctation and with pubescence unlike *H. pauper* (Fig. 10). In addition, *H. fuscipes*, *H. punctistriatus* and *H. subrotundus* have the large punctures (with trichobothria) in the anterior half of the elytra situated in the intervals between the second and third, and between the fourth and fifth punctured striae unlike *H. pauper*, which has these large punctures in the anterior half of the elytra situated close to the third and fifth elytral striae. *Hydrobius rottenbergii*, *H. punctistriatus*, *H. fuscipes* and *H. subrotundus* also have the metafemora with the hairline reaching the posterior edge and the pubescent part occupying about 66–71% of femoral length (Fig. 10) unlike *H. pauper*, which has the pubescent part of metafemora occupying 55–60% of femoral length (Figs 8, 9). *Hydrobius punctistriatus* also differs from *H. pauper* in its larger size (7.8–8.5 mm).



Figs 8–10. *Hydrobius* spp., metafemur. **8**, **9**, *H. pauper* (8, lectotype, male; 9, paralectotype, female); **10**, *H. fuscipes* (Hokkaido, Japan, Sharp's collection). Scale bar: 1 mm.

The parameres and median lobe of *H. pauper* and *H. punctistriatus* appear very similar. *Hydrobius pauper* has the parameres almost straight along the interior edge (Fig. 11), and *H. punctistriatus* has the parameres with slightly concave interior edge at gonopore level (Fig. 15). The genitalia of *H. fuscipes* and *H. subrotundus* (Figs 12–14) and *H. pauper* (Fig. 11) are also very similar, although the median lobe of *H. pauper* is slightly wider at the base. It is possible that the slight differences in paramere shape of *H. pauper*, *H. fuscipes*, *H. punctistriatus* and *H. subrotundus* are a result of clearing the soft tissue. As opposed to this, the differences between *H. pauper, H. arcticus*, *H. rottenbergii* and *H. pui* in male genitalia are more distinct (Figs 11, 16–18). The last three species have median lobe narrower and parameres wider and more robust in apical half, distinctly curved and rounded at apex.

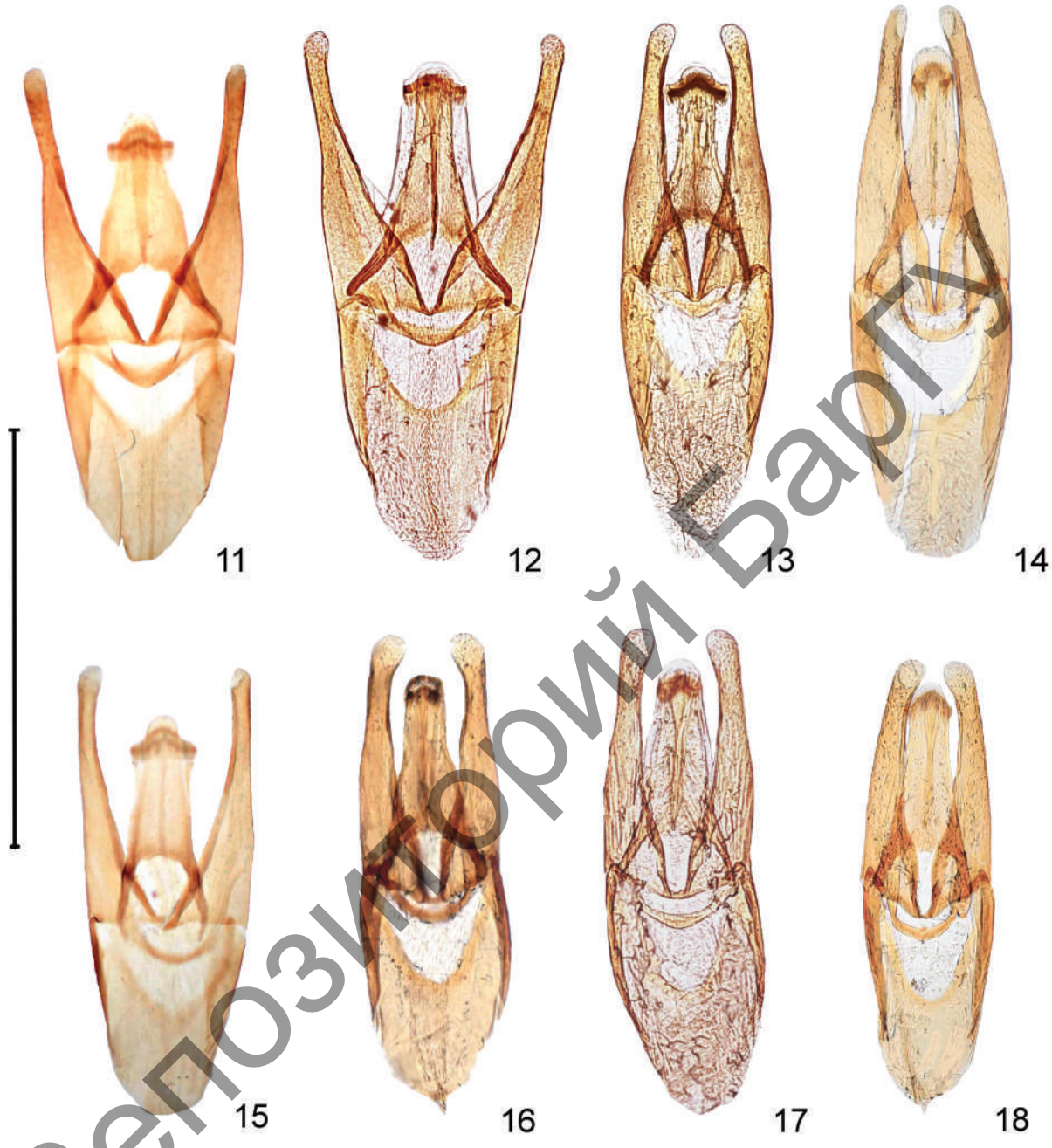
Distribution. Japan (Honshu, ?Hokkaido). The record of this species from Hokkaido (Minoshima & Hayashi, 2011, 2012) based on the preimaginal stages requires confirmation.

Bionomics. Most likely, like other species of the genus, *H. pauper* is a water beetle.

Remarks. Shatrovskiy (1989), Hebauer (1995), Hansen (1999, 2004), Ryndevich (2016) and Fikáček et al. (2015) recorded only *H. fuscipes* for the Russian Far East fauna. According to Fikáček et al. (2015) and Nakajima et al. (2020), the genus *Hydrobius* in Japanese fauna includes only *H. pauper*. Sharp (1884) recorded *H. fuscipes* from Japan based on one specimen from Horubetsu, Yezo (Hokkaido), which served as the basis for its inclusion in the earlier catalogues (Hansen, 1999, 2004). This single specimen labelled "Horobetsu, 19.VIII.–20.VIII.80" [printed label], "Japan G. Lewis 1910 – 380" [printed label] is in Sharp's collection (NHML) and is shown to be *H. fuscipes* by the coarse apical section of the elytral striae and the punctation of the metafemora (Fig. 10); the presence of *H. fuscipes* on Hokkaido is confirmed by recent material taken there by Fenglong Jia (Guangdong, China). Currently, *H. pauper* is known only from Honshu, the main island of Japan (Hansen, 1999), where it is the sole recorded species. The record of *H. pauper* by Uéno et al. (1985) from Japan judging by the photo most likely refers to *H. fuscipes*. All instars of the larva of *Hydrobius* were described (as *H. pauper*) from South Hokkaido (Minoshima & Hayashi, 2011, 2012) but their species affiliation requires confirmation. At present there is no information published of any *Hydrobius* from Honshu since Sharp's description of *H. pauper*. *Hydrobius fuscipes* occurs in the Kuril Islands (Russian Far East) so its presence in northern Japan is not unexpected.

Key to the Eurasian species of *Hydrobius*

1. Mesoventral elevation very small and blunt, not high, acute and dentiform (Fig. 15 in Fossen et al., 2016). Male genitalia with parameres robust, inturned apically (Fig. 16). 5.8–6.4 mm. Subarctic Eurasia ..... *H. arcticus*
– Mesoventral elevation prominent, acute and dentiform (Fig. 14 in Fossen et al., 2016; Figs 3–25 in Ryndevich, 2016) 2
2. Mesoventral elevation low (Figs 6, 7). Large punctures (with trichobothria) in anterior half of elytra situated within or close to the 3rd and 5th elytral striae (Fig. 5). 3



Figs 11–18. *Hydrobius* spp., aedeagus, dorsal view. **11**, *H. pauper* (lectotype); **12**, **13**, *H. fuscipes* (England, Great Britain); **14**, *H. subrotundus* (Scotland, Great Britain); **15**, *H. punctistriatus* (Heilongjiang, China); **16**, *H. arcticus* (Sweden); **17**, *H. rottenbergii* (Sweden); **18**, *H. pui* (Sichuan, China). Scale bar: 1 mm.

– Mesoventral elevation high (Figs 11–25 in Ryndevich, 2016). Large punctures (with trichobothria) in anterior half of elytra situated in the intervals between the 2nd and 3rd, and between the 4th and 5th striae (Fig. 1 in Ryndevich, 2016) 5

3. Pubescent part of metafemora occupying about half (55–60%) of femoral length (Figs 8, 9). Aedeagus with parameres slender and scarcely inturned apically (Fig.11). 6.5–7.1 mm. Japan..... *H. pauper*

– Pubescent part of metafemora occupying more than 65% of femoral length (Fig. 10). Aedeagus with parameres robust, inturned apically (Figs 17, 18) 4

4. Lateral margins of elytra in middle portion almost

Figs 19–24. *Hydrobius* spp., elytra. **19**, **20**, *H. pauper* (19, lectotype, male; 20, paralectotype, female); **21**, *H. subrotundus* (England, Great Britain); **22**, **23**, *H. fuscipes* (22, Kunashir Island, Russia; 23, Japan, Sharp's collection); **24**, *H. punctistriatus* (holotype, Heilongjiang, China). Scale bar: 1 mm.

parallel (Figs 28, 29). 5.9–6.7 mm. China: Qinghai, Sichuan ..... *H. pui*

– Lateral margins of elytra in middle portion slightly rounded (Fig. 27). 6.2–7.8 mm. Europe .... *H. rottenbergii*

5. Aedeagus larger (Fig. 12–14), more than 0.2 times as long as elytron 6

– Aedeagus smaller (Fig. 15), less than 0.18 times as long as elytron. 7.8–8.5 mm. China: Heilongjiang ..... *H. punctistriatus*

6. Aedeagus in lateral view with parameres only slightly curved towards apex (Fig. 10 C in Fossen et al., 2016). Legs of most specimens pale, yellowish, but occasionally darker. Body usually more elongate (Figs 22, 23). 6.5–7.7 mm. Eurasia and North America ..... *H. fuscipes*

– Parameres in lateral view more curved towards apex (Fig. 10 D in Fossen et al., 2016). Legs dark. Body generally more robust (Fig. 21). 6.7–7.5 mm. Europe ..... *H. subrotundus*

Figs 25–29. *Hydrobius* spp., elytra. **25**, **26**, *H. arcticus* (25, Karelia, Russia; 26, Sweden); **27**, *H. rottenbergii* (Sweden); **28**, **29**, *H. pui* (Sichuan, China). Scale bar: 1 mm.

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