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〈短報　Short Communication〉

Rediscovery of *Helophorus auriculatus* Sharp, 1884 (Coleoptera, Helophoridae) in Saitama Prefecture, Japan, with ecological notes

Reiya WATANABE[1, *], Yasuyuki IWATA[2] and Atsushi KATO[3]

[1] IDEA Consultants, Inc.,
2–2–2 Hayabuchi, Tsuzuki-ku, Yokohama-shi, Kanagawa 224–0025, Japan
[2] Japan Institute of Insect and Fungal Damage to Cultural Properties,
2–1–8 Shinjuku, Shinjuku-ku, Tokyo 160–0022, Japan
[3] 1–3–306, 845–1 Koshikiya, Ageo-shi, Saitama 362–0064, Japan
*E-mail: watanabe.reiya.sw@alumni.tsukuba.ac.jp

埼玉県におけるセスジガムシ（コウチュウ目，セスジガムシ科）の再発見および生態学的知見

渡辺黎也[1,*]・岩田泰幸[2]・加藤敦史[3]

[1] いであ株式会社国土環境研究所
〒224–0025 神奈川県横浜市都筑区早渕2–2–2
[2] 公益財団法人文化財虫菌害研究所
〒160–0022 東京都新宿区新宿2–1–8
[3] 〒362–0064 埼玉県上尾市小敷谷845–1 第1街区3–306

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Abstract. *Helophorus auriculatus* Sharp, 1884 is an endangered water beetle that inhabits earth ditches and small pools in riverbeds and paddy fields. In Japan, the recent record of *H. auriculatus* has been limited to the Ibaraki Prefecture in 2019 and Tsushima Island, Nagasaki Prefecture in 2020. We rediscovered this species in the Saitama Prefecture, Japan, after 34 years and compared the habitat and adult morphology of this species among different Japanese regions.

Key words: endangered species, Hydrophiloidea, water beetle.

The monogeneric family Helophoridae Fabricius, 1775, comprises a single genus, *Helophorus*, with approximately 190 known species, which have a total body length ranging from 1.9 to 7.5 mm (Angus 1992; Foster *et al.* 2014; Yee & Kehl 2015). Most adults are aquatic and inhabit the edges of medium or small water bodies (Angus 1973). The larvae are not aquatic and normally live in vegetation or soil near the water (Yee & Kehl 2015). Their diet differs with life stage; most adults are saprophagous, feeding on pond detritus, decomposing organic materials, and filamentous algae, whereas most larvae are carnivorous and prey on small invertebrates, such as *Tubifex* worms (Angus 1973; Yee & Kehl 2015). Five *Helophorus* species have been recorded in Japan, of which four species are distributed in the northern part of Japan (i.e., Aomori Prefecture and/or Hokkaido): *Helophorus sibiricus* (Motschulsky, 1860); *H. matsumurai* Nakane, 1965; *H. orientalis* Motschulsky, 1860; and *H. nigricans* Poppius, 1907 (Nakajima *et al.* 2020).

Helophorus auriculatus Sharp, 1884 is a helophorid beetle (total body length of 4.1–6.5 mm) that inhabits earth ditches and small pools in riverbeds and paddy fields (Yoshitomi 2007; Watanabe *et al.* 2020). The adults are active from October to late March and reproduce from autumn to spring. A third-instar larva was found on the shore of a paddy field in March (Watanabe *et al.* 2020). This species is distributed in the Kanto Plain, Nara Prefecture, and on Tsushima Island, Nagasaki Prefecture in Japan, as well as in China and Korea (Koukata 1994; Yoshitomi 2007; Jung

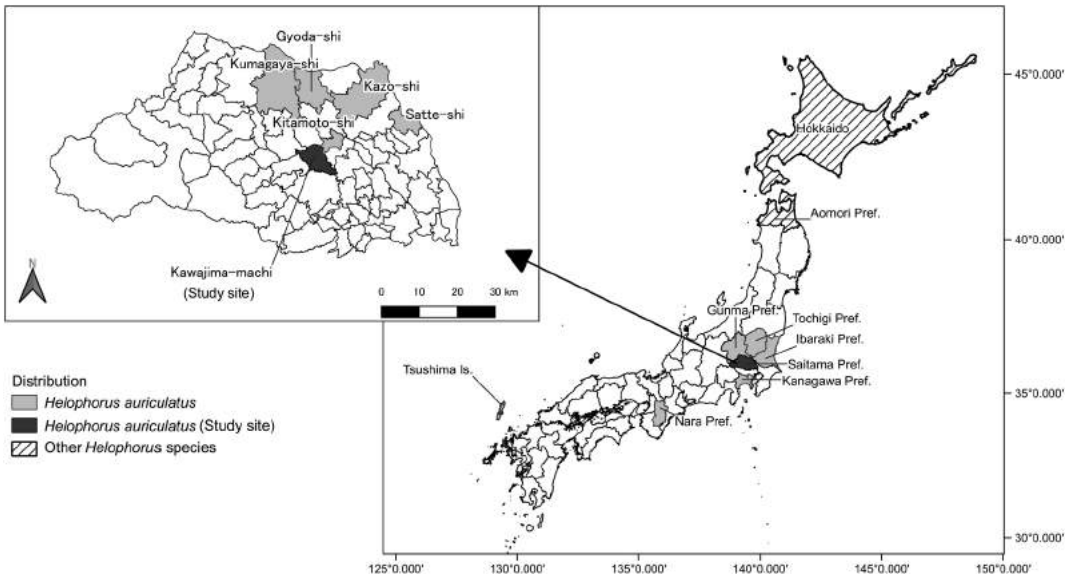

Fig. 1. Map of the distribution of Japanese *Helophorus* species and the location of the study site.

et al. 2016). In Japan, the record of *H. auriculatus* was recently limited to the Ibaraki Prefecture in 2019 (Watanabe *et al.* 2020) and Tsushima Island in 2020 (Watanabe & Ohba 2021). This species is included in the Red List of Japan as endangered (Ministry of the Environment of Japan 2020). Recent records of this species are lacking, probably due to the loss of their natural habitats due to human activities, such as river improvements and farmland consolidation (Satô 1993; Watanabe *et al.* 2020). In Saitama Prefecture, the habitat of *H. auriculatus* had been recorded as including Gyoda-shi, Kazo-shi, Kitamoto-shi, Kumagaya-shi, and Satte-shi in the 1970s–1980s (Yajima 1974; Watanabe 1983; Abe & Sasai 1986; Kino & Hasegawa 1993; Yoshikoshi *et al.* 1998; Nature Conservation and Greenery Division, Department of Environment 2018). Although this species has been recorded in Honjo-shi (Nagashima 1994) and Yokoze-machi (Ohkuma 2004), it is pointed out in the Saitama Red Data Book: Animal Edition 2018 (4th Edition) that these records are in fact misidentifications (Nature Conservation and Greenery Division, Department of Environment 2018). Therefore, no reliable record of this species in Saitama Prefecture after the 1990s can be confirmed.

We discovered habitats of *H. auriculatus* in Saitama Prefecture for the first time since 1987 (Fig. 1). We collected the adults from two ponds (ponds A and B) in Kawajima-machi, Hiki-gun, Saitama Prefecture, Japan (Table 1; Fig. 2). The elevation of the study site was 10 m. We did not provide details regarding the exact locations of the ponds in the interest of conservation of *H. auriculatus*. The direct distance between the two ponds was approximately 800 m, and both were surrounded by *Miscanthus sinensis* Andersson and *Phragmites australis* (Cav.) Trin. ex Steud. The last author first found two (one male and one female) and four (one male and three females) adults in pond A on November 12 and 23, 2021. We also conducted additional sampling for approximately 1 h at pond A and 15 min at pond B on December 12, 2021, for more detailed observations. We whipped the mud and dead plant material near the shore using a D-framed net (30 cm width, 1 mm mesh); alternatively kicking, and floating *H. auriculatus* adults were captured by net or hand. This collection method is more effective than random sweeping using a net in the open habitat, as *H. auriculatus* adults cannot swim well and struggle slowly until they grab onto the substrate on the water surface (movie: Watanabe 2022a). In total, we collected 33 and 3 adults from ponds A and B, respectively. In pond A, we found most individuals near the well sunlit shore within a distance of 1.0 m, but not on the shaded shore. In pond B, where the shore was shaded by trees (*Salix chaenomeloides* Kimura) and the bottom was covered with fallen leaves,

Table 1. Description of study sites.

	Pond A	Pond B
Area (m^2)	8501.6	1741.6
Maximum water depth (cm)	85.3	50.1
Water temperature (°C)*	11.4 ± 0.7	11.2 ± 0.6
Bottom substrate	Mud	Dead leaf on mud

*The water temperature is the mean ± SD measured at three points 1 m away from the shore on December 12, 2021.

Fig. 2. Habitats of *Helophorus auriculatus* in Kawajima-machi, Saitama Pref., Japan. (a), (b) pond A; (c), (d) pond B.

we only collected three adults. The specimens were deposited in the Ehime University Museum (two males and two females, dried specimens), Saitama Museum of Natural History (one male and one female, dried specimens during the proceedings), and in our collection.

We examined the geographic variation among the populations of Saitama Prefecture, Ibaraki Prefecture, and Tsushima Islands based on external morphology, such as the pattern of grooves on the pronotum; the shape of the suprapleural areas of the prothorax; the arrangement of the raised black tubercles on interstices 3, 5, and 7; and the shape of the aedeagus (Fig. 3). For this study, we observed the samples under a stereoscopic microscope (NIKON SMZ645; Nikon, Tokyo, Japan). Careful microscopic examination revealed no morphological differences between the three populations. We measured several body lengths of eight specimens from Saitama Prefecture and compared them with the six samples from the Ibaraki Prefecture using the Wilcoxon rank-sum test (Table 2). We performed statistical analysis using the exactRankTests package in R version 4.1.0 (Hothorn 2021; R Core Team 2021).

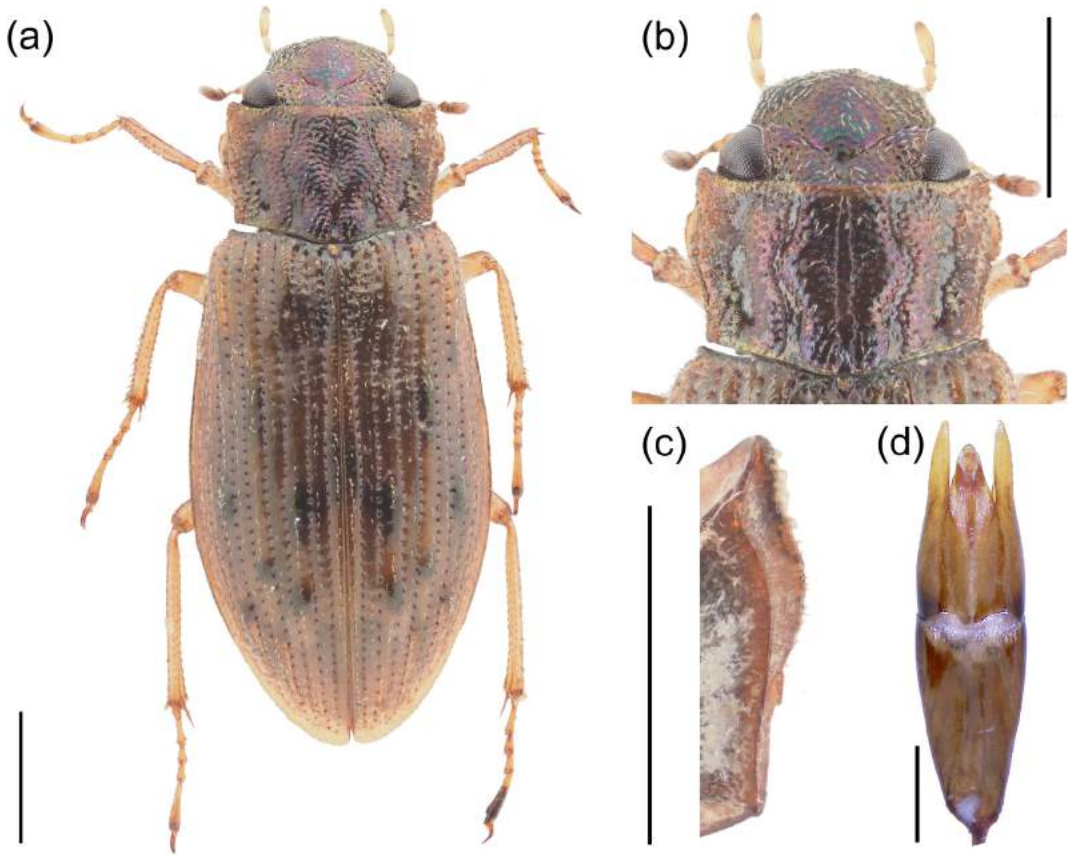

Fig. 3. Habitus of *Helophorus auriculatus* from Kawajima-machi, Saitama Pref., Japan: (a) dorsal habitus of male, (b) pronotum, and (c) lateral portion of prothorax from below to show the suprapleural area, and (d) aedeagus.

Table 2. Measurements of *Helophorus auriculatus* adults (Mean ± SD [minimum–maximum] in millimeters) in three regions of Japan.

Parameter	Saitama (n = 8)	Tsushima (n = 1)	Ibaraki (n = 6)
Total body length	6.28 ± 0.60 (5.40–6.86)	6.44	6.15 ± 0.30 (5.76–6.61)
Width of head including eyes	1.48 ± 0.10 (1.32–1.62)	1.50	1.51 ± 0.09 (1.37–1.63)
Pronotum length	1.21 ± 0.15 (1.00–1.38)	1.24	1.16 ± 0.08 (1.03–1.29)
Pronotum width	2.04 ± 0.23 (1.75–2.37)	2.10	2.10 ± 0.10 (1.96–2.26)
Elytra length	4.45 ± 0.44 (3.74–4.88)	4.58	4.40 ± 0.32 (3.94–4.91)
Elytra width	2.77 ± 0.31 (2.33–3.12)	2.72	2.79 ± 0.17 (2.56–3.08)

The data on Tsushima Island and Ibaraki Prefecture were obtained from Watanabe & Ohba (2021).

Morphological measurement was performed using photographs taken with a scale using ImageJ software (Abràmoff *et al.* 2004). We found that the length of all body parts did not significantly differ between the specimens from the Saitama and Ibaraki Prefectures (Wilcoxon rank sum test, $p>0.05$). The measurements of a specimen from Tsushima Island were within the range of specimens collected from Saitama and Ibaraki Prefectures for all parts (Table 2).

We reared 19 adults in a plastic container (16 cm width, 18 cm depth, 9.5 cm height) at the laboratory from December 12 to 25, 2021. The cage was maintained at 15°C under a 10 : 14 h light : dark cycle. The container

included a bank of mud (arakida soil) and water to a depth of 3 cm. We used dead stems of Poaceae collected from the survey sites as perches. For the rearing method, we followed the methodology of Minoshima & Watanabe (2020) and Watanabe *et al.* (2020). Adults fed flake fish food (TetraMin, Spectrum Brands, Tokyo) and organic materials on the water surface; to feed, the adults also scraped the surface of the dead Poaceae stems using their mandibles (movie: Watanabe 2022b). In total, we found four egg cases on the mud bank, indicating that the reproductive season at the study site is the same as that in Ibaraki Prefecture reported by Watanabe *et al.* (2020).

The habitats of *H. auriculatus* in Saitama Prefecture were similar to those in Ibaraki Prefecture (Watanabe *et al.* 2020) and on Tsushima Island (Watanabe & Ohba 2021) in three aspects: loose slopes of mud, sunny, and constantly flooded even in winter. Such environments are suitable for *H. auriculatus* to complete their life cycle: loose slopes of mud for oviposition and larval growth, and a water body flooded even in winter for adults. However, pond B is unlikely to be a suitable habitat for *H. auriculatus* due to shaded by trees and the bottom was covered with fallen leaves. Therefore, it is likely that *H. auriculatus* in pond B flew from neighboring habitats. Many ponds fitting suitable environmental conditions exist in the vicinity of the study sites, and further study is necessary to confirm the distribution and habitat use of *H. auriculatus* in this region.

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References

Abe T, Sasai A (1986) Coleoptera in Ishitojuku, Kitamoto-shi. *Yosegaki-Journal of Entomology of Saitama Japan*, **48**: 691–713 (in Japanese).

Abràmoff MD, Magalhães PJ, Ram SJ (2004) Image processing with imageJ. *Biophotonics International*, **11**: 36–41.

Angus RB (1973) The habitats, life histories and immature stages of *Helophorus* F. (Coleoptera: Hydrophilidae). *Transactions of the Entomological Society of London*, **125**: 1–26.

Angus RB (1992) Insecta Coleoptera Hydrophilidae Helophorinae. In: Schwoerbel J, Zwick P (eds) *Süßwasserfauna von Mitteleuropa*, 144. Gustav Fischer Verlag, Stuttgart, Jena, New York.

Foster GN, Bilton DT, Friday LE (2014) *Keys to Adults of the Water Beetles of Britain and Ireland (Part 2)*. Royal Entomological Society, St Albans.

Hothorn T (2021) Package 'exactRankTests.' URL: https://cran.r-project.org/web/packages/exactRankTests/exactRankTests.pdf (Accessed 6 Jul 2022)

Jung S, Min H, Hwang H, Seo Y, Bae Y, Paek W (2016) Diversity of aquatic insects of Taean area in south Korea, with notes on species-specific distribution. *Korean Journal of Environment and Ecology*, **30**: 58–70.

Kino N, Hasegawa Y (1993) Coleoptera colleted in Ishitojuku, Kitamoto-shi. *Yosegaki-Journal of Entomology of Saitama Japan*, **68**: 1487–1491 (in Japanese).

Koukata S (1994) Record of Helophorus auriculatus from Nara Prefecture, Japan. *Gekkan-Mushi*, **286**: 13 (in Japanese).

Ministry of the Environment of Japan (2020) Red List of Japan. URL: https://www.env.go.jp/press/files/jp/114457.pdf (Accessed 28 Jan 2022)

Minoshima YN, Watanabe R (2020) Morphology of immature stages of *Helophorus* (*Gephelophorus*) *auriculatus* (Coleoptera, Helophoridae). *Acta Entomologica Musei Nationalis Pragae*, **60**: 319–332.

Nagashima T (1994) Coleoptera in Kodama-machi. *Kodama-choshi Shizen-hen*, 463–483. Daiichi-hoki Shuppan Co., Ltd., Tokyo (in Japanese).

Nakajima J, Hayashi M, Ishida K, Kitano T, Yoshitomi H (2020) *Aquatic Coleoptera and Hemiptera of Japan*. Bun-ichi Sogo Shuppan, Tokyo (in Japanese).

Nature Conservation and Greenery Division, Department of Environment SPG (2018) *Saitama Red Data Book: Animal Edition 2018* (4th Ed.). Kanto Tosho Co., Ltd., Saitama (in Japanese).

Ohkuma M (2004) Fauna in Terasaka-tanada, Yokoze-machi, Saitama Prefecture. *Saitama-Dobutsuken-Tuushin*, **47**: 1–4 (in Japanese).

R Core Team (2021) R: A language and environment for statistical computing. R Foudation for Statistical Computing, Vienna, Austria.

Satô M (1993) *Helophorus auriculatus*. In: Asahina S (ed) *50 Species of Declining Japanese Insects*, 183. Tsukiji Shokan Publishing, Tokyo (in Japanese).

Watanabe N (1983) A new species of the genus Helophorus Fabricius (Coleoptera, Hydrophilidae) from Japan, with notes on the Japanese species. *Proceedings of the Japanese Society of Systematic Zoology*, **25**: 43–47.

Watanabe R (2022a) Swimming and walking behaviour of *Helophorus auriculatus* adults. Movie Archives of Animal Behavior Data No.: momo220103ha01b (http://movspec.mus-nh.city.osaka.jp/ethol/myvideo/showdetail.php?movieid＝momo220103ha01b) (Accessed 28 Jan 2022)

Watanabe R (2022b) Feeding behaviour of *Helophorus auriculatus* adults. Movie Archives of Animal Behavior Data No.: momo220103ha02b (http://movspec.mus-nh.city.osaka.jp/ethol/myvideo/showdetail.php?movieid＝momo220103ha02b) (Accessed 28 Jan 2022)

Watanabe R, Matsushima R, Yoda G (2020) Life history of the endangered Japanese aquatic beetle *Helophorus auriculatus* (Coleoptera: Helophoridae) and implications for its conservation. *Journal of Insect Conservation*, **24**: 603–611.

Watanabe R, Ohba S (2021) Rediscovery of *Helophorus auriculatus* Sharp, 1884 (Coleoptera, Helophoridae) from Tsushima Island and comparison of its habitat, morphology and mitochondrial COI among another Japanese population. *Elytra, New Series*, **11**: 295–300.

Yajima T (1974) Coleoptera fauna in Tone-gawa river bed (I). *Saitama-seibutsu*, **14**: 11–13 (in Japanese).

Yee DA, Kehl S (2015) Chapter 39 Order Coleoptera. In: Thorp JH, Covich AP (eds) *Thorp and Covich's Freshwater Invertebrates, Volume I: Ecology and General Biology*, 1003–1042. Academic Press, Boston.

Yoshikoshi H, Oda H, Takeuchi T, Nishiyama A, Kobori F, Nagahata N, Makibayashi I (1998) Coleoptera of Saitama Prefecture. *Saitamaken Kontyûshi III (Insects of Saitama Prefecture III)*, 93–340. Saitama Kontyû Danwakai (Entomological Society of Saitama, Japan), Ômiya (in Japanese).

Yoshitomi H (2007) An Explanation of the Japanese Helophoridae. *The Nature and Insects*, **42**: 17–20 (in Japanese).

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