

Communication

A New and Little-Known Species of the Ground Beetle Genus *Nebria* Subgenus *Falcinebria* Ledoux and Roux, 2005 (Coleoptera: Carabidae) from Japan [†]

Kôji Sasakawa

Laboratory of Zoology, Department of Science Education, Faculty of Education, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba-shi, Chiba 263-8522, Japan; ksasa@chiba-u.jp

[†] urn:lsid:zoobank.org:pub:4E06E826-9E62-48EC-91C5-5065F980AF93;
urn:lsid:zoobank.org:act:A36B7EB3-6614-4AB1-AAFF-99FD7B67DEF9.

Abstract: This paper presents additional notes on the carabid genus *Nebria* subgenus *Falcinebria* Ledoux and Roux, 2005 from Japan: a description of a new species *Nebria suzukana* sp. nov. from Mt. Gozaishodake; a new distribution and the southwesternmost collection record of *Nebria furcata* Sasakawa, 2020 from Mt. Uchimiyama; an additional record of *Nebria kobushicola* Sasakawa, 2023 from the Yatsugatake Mountains; and an additional record of an undetermined species from the Iide Mountains that was previously treated as *Nebria taketoi* Habu, 1962, with a note on its habitat. In addition, a key to the known species of *Nebria* (*Falcinebria*) from Honshu is provided.

Keywords: collection record; endophallus; identification key; male genitalia; new species; taxonomy



Citation: Sasakawa, K. A New and Little-Known Species of the Ground Beetle Genus *Nebria* Subgenus *Falcinebria* Ledoux and Roux, 2005 (Coleoptera: Carabidae) from Japan. *Taxonomy* **2023**, *3*, 551–558. <https://doi.org/10.3390/taxonomy3040031>

Academic Editor: Mathias Harzhauser

Received: 6 November 2023

Revised: 7 December 2023

Accepted: 8 December 2023

Published: 12 December 2023



Copyright: © 2023 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Subgenus *Falcinebria* Ledoux and Roux, 2005 is a flightless group belonging to carabid genus *Nebria* Latreille, 1802 that occurs in Japan, Taiwan, and mainland China [1–3]. In Japan, two species, i.e., *N. reflexa* Bates, 1883 and *N. taketoi* Habu, 1962, have been recognized for several decades [4–8], but these species were recently found to be composed of at least 11 and 2 species, respectively, based on comparative morphological analysis of the endophallus, a membranous inner sac everted from the aedeagus of the male genitalia [9–13]. The utility of this male genital morphology in species-level taxonomy has been demonstrated in many *Nebria* taxa [14–18]. There are, however, many localities from which specimens have not been examined (Figure 1; fig. 1 in [10]), and the overall diversity of this group has not been fully elucidated.

This study describes a new species and reports additional records of some little-known species belonging to this subgenus. In addition, a key to the known species from Honshu is provided because all recently described species are distributed in Honshu.

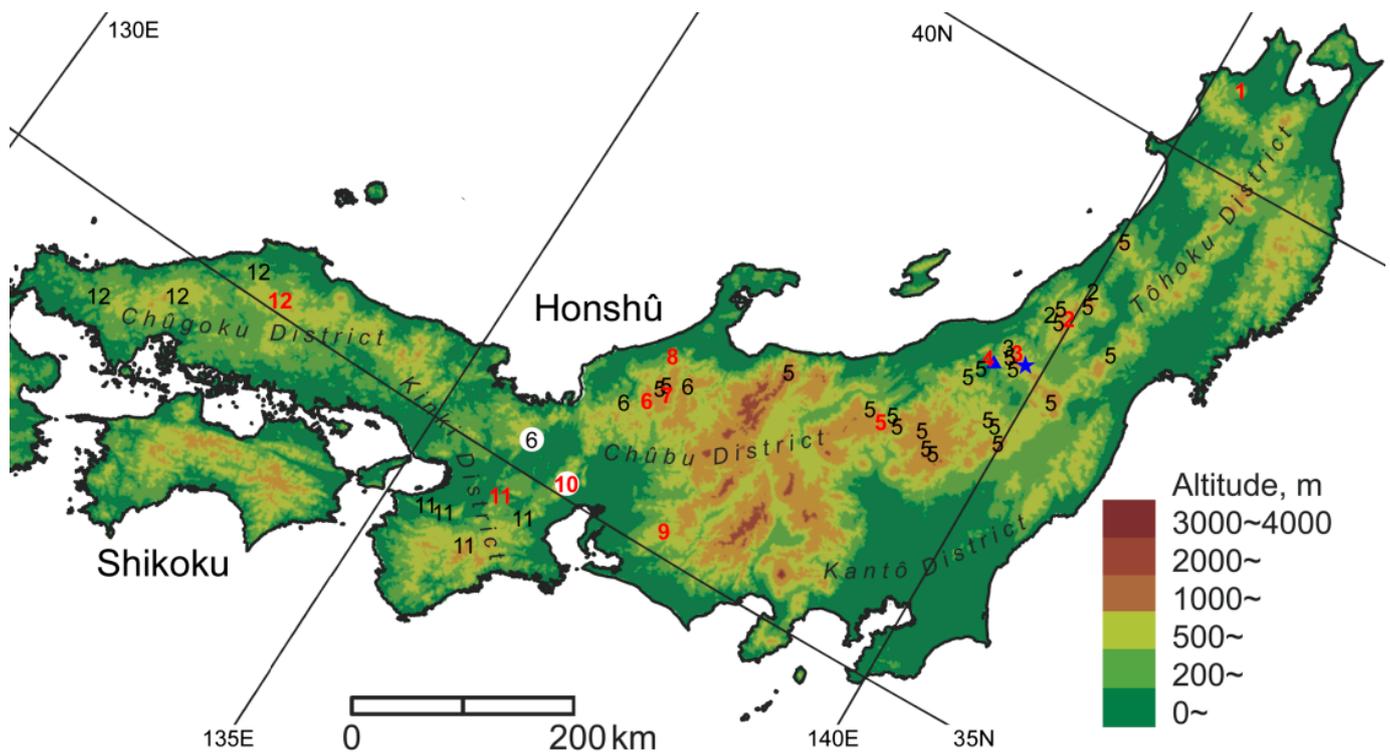


Figure 1. Distribution of species previously treated as *Nebria reflexa* on Honshu, compiled from Sasakawa and Ito (2021 [12], 2023 [13]), Sasakawa (2023) [11], and new records (white circles). Only records with unambiguous species identity (i.e., collection sites of type materials and records based on specimens identified by the endophallus) are presented. 1–*N. reflexa* Bates; 2–*N. sagittata* Sasakawa; 3–*N. iidesana* Sasakawa; 4–*N. kasasugaensis* Sasakawa and Itô; 5–*N. niohozana* Bates; 6–*N. furcata* Sasakawa; 7–*N. pisciformis* Sasakawa; 8–*N. kuragadakensis* Sasakawa; 9–*N. dichotoma* Sasakawa; 10–*N. suzukana* sp. nov.; 11–*N. uenoi* Nakane; 12–*N. chugokuensis* Sasakawa. Red letters denote the type localities of each species. The blue star indicates the locality where the sympatric occurrence of *N. iidesana* and *N. niohozana* was confirmed, and the blue triangle indicates the locality where the sympatric occurrence of *N. kasasugaensis* and *N. niohozana* was confirmed. We note that species previously treated as *N. taketoi*, which include *N. kobushicola* and the undetermined species from the Iide Mountains, are not included; for their distribution, see Sasakawa (2023) [10].

2. Materials and Methods

The endophallus was everted and fully inflated by injecting toothpaste from the base of the aedeagus; it was preserved as a dried specimen. Terminology of endophallus structures followed Sasakawa (2020) [9]. Specimens examined were preserved in the collections of Kashihara City Museum of Insects, Nara, Japan (KCMI), and of the author (KS). Here, the identification key was constructed for males only, because it is currently impossible to identify species based solely on female specimens. Usually, females are identified based on conspecific males from the same collection site.

3. Taxonomy

Nebria (Falcinebria) suzukana sp. nov.

Figures 2A and 3A–F

Nebria reflexa: Narukawa et al., 2016 [19]: 91 (an unsexed specimen from Mt. Gozaishodake).

Type material. Holotype: ♂ (KCMI), Mt. Gozaishodake, the Suzuka Mountains, alt. 700–1100 m, Komono City, Mie Prefecture, Japan, 17. ix. 1977, T. Matsuda leg.

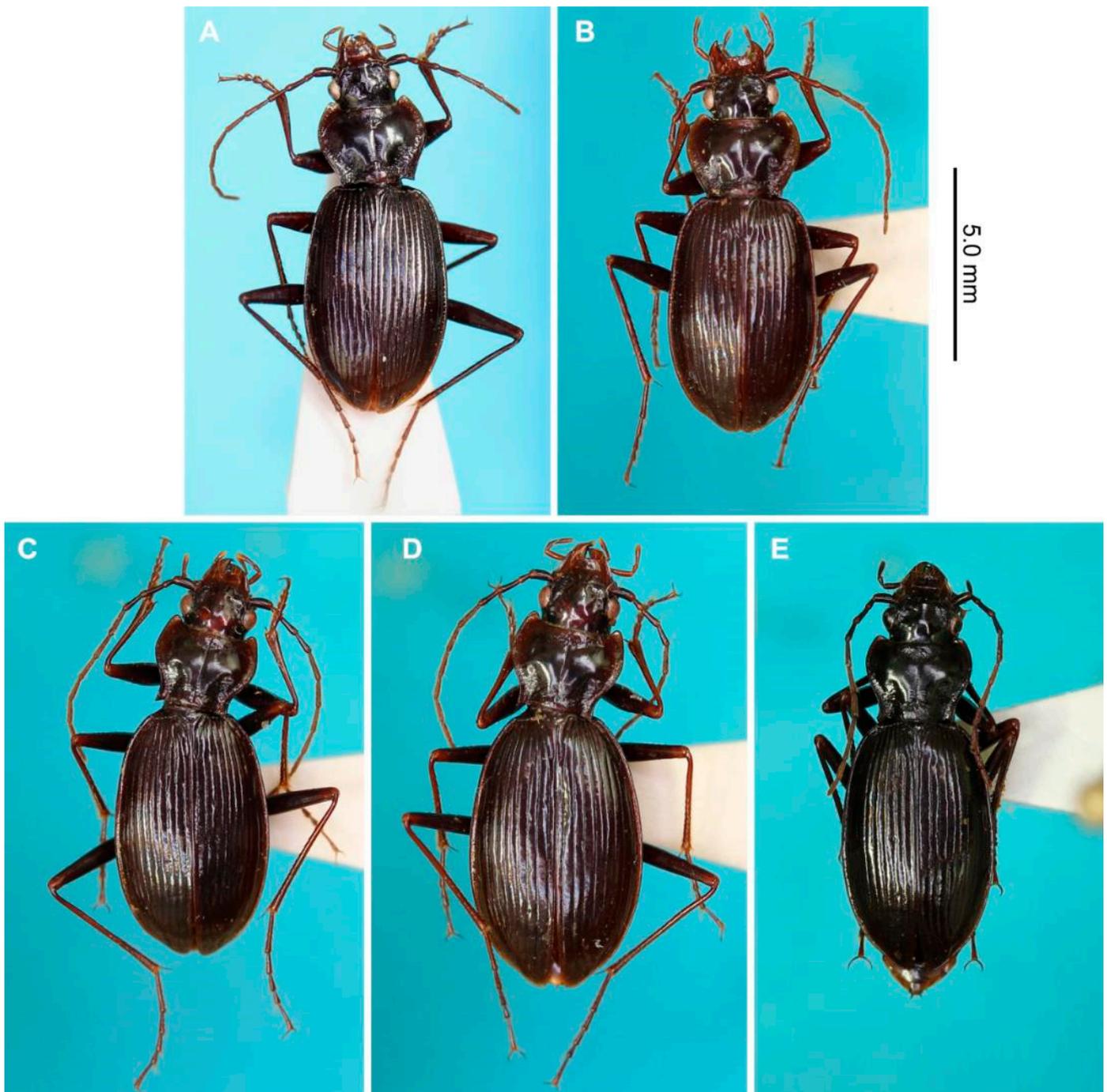


Figure 2. Habitus dorsal view of *Nebria* spp. (A) *N. suzukana* sp. nov. holotype male from Mt. Gozaishodake; (B) *N. furcata* male from Mt. Uchimiya; (C) *N. kobushicola* male from the Yatsugatake Mountains; (D) *N. kobushicola* female from the Yatsugatake Mountains; (E) a female of undetermined species from Mt. Iidehonzan.

Diagnosis. In external and endophallus structures, this new species is similar to *Nebria furcata* Sasakawa, 2000; *Nebria pisciformis* Sasakawa, 2000; and *Nebria kuragadakensis* Sasakawa, 2000; but is distinguished by a small dorsobasal lobe and large, semi-ellipsoid lateroapical lobes on the endophallus.

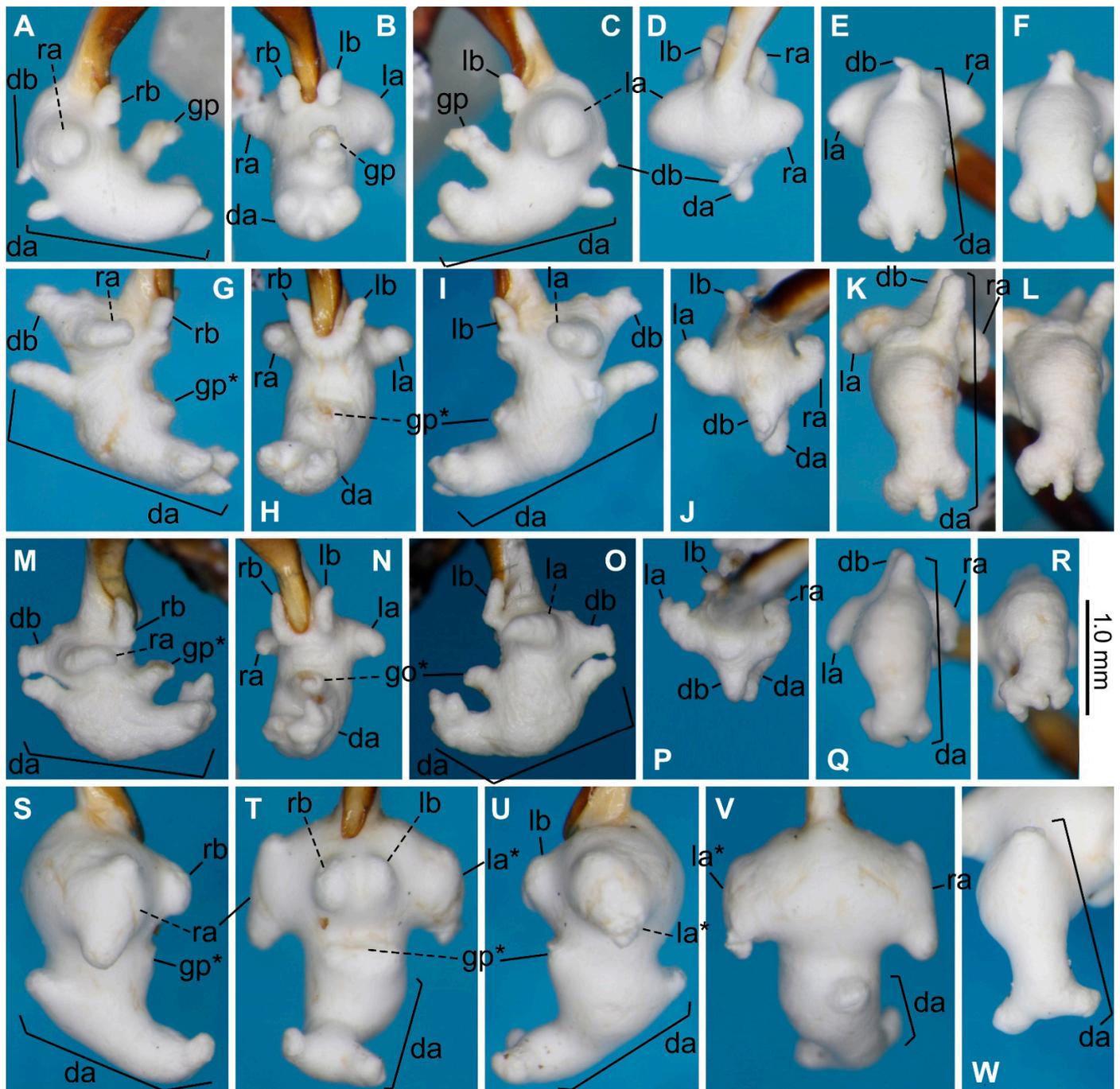


Figure 3. Endophallus of *Nebria* spp. (A–F) *N. suzukana* sp. nov. holotype from Mt. Gozaishodake; (G–L) *N. furcata* from Mt. Uchimiya; (M–R) *N. furcata* holotype from Arashiguchi; (S–W) *N. kobushicola* from the Yatsugatake Mountains. Right lateral view (A,G,M,S), ventral view (B,H,N,T), left lateral view (C,I,O,U), anterior view (D,J,P), dorsal view of anterior half (V), dorsal view of dorsoapical lobe (E,K,Q,W), and dorsal view of dorsoapical lobe apical part (F,L,R). Abbreviations: da—dorsoapical lobe; db—dorsobasal lobe; gp—gonopore protrusion; la—left lateroapical lobe; lb—left laterobasal lobe; ra—right lateroapical lobe; rb—right laterobasal lobe. Asterisk indicates that the gonopore protrusion or lobes are not fully everted.

Description. External structures: Body length, measured from mandible apices to elytral end, of a male is 9.86 mm ($n = 1$). Other structures are the same as those shared by species previously regarded as *Nebria reflexa*, which were described by Sasakawa (2020) [9].

Male genitalia: Ventral surface of aedeagal apex not concave. Dorsobasal lobe simple in shape; the apex directed dorsoanteriorly. Dorsomedian lobe absent. Dorsoapical lobe with the basal part protruding dorsally and the protrusion simple in shape; the apical portion directed ventrally, with the apical margin divided into three projections, which are almost equal in size. Right and left laterobasal lobes simple in shape; the apices directed anteriorly. Right lateroapical lobe semi-ellipsoid, directed laterally. Left lateroapical lobe roughly semi-ellipsoid, but the apex narrowed and bent posteriorly. Gonopore protrusion directed ventroanteriorly. Relative sizes of lobe and protrusions are as follows: dorsobasal lobe < basal protrusion of dorsoapical lobe \leq apical projections of dorsoapical lobes \approx right and left laterobasal lobes < gonopore protrusion < right lateroapical lobe < left lateroapical lobe.

Female. Unknown.

Etymology. The name refers to the Suzuka Mountains, where the type specimen was collected.

***Nebria (Falcinebria) furcata* Sasakawa, 2020**

Figures 2B and 3G–R

Nebria (Falcinebria) reflexa: Yoshimatsu et al., 2016 [8]: 38.

Nebria (Falcinebria) furcata Sasakawa, 2020 [9]: 49 (original description), type locality: “Arashiguchi, Kamiuchinami, Ôno-shi, Fukui Prefecture, Japan.”

Materials examined. 5♂, 3♀(KCM), Mt. Uchimiyama, the Hira Mountains, Otsu City, Shiga Prefecture, Japan, T. Matsuda leg. (5♂, 2♀, alt. 1000 m, 12. viii. 1983; 1♀, alt. 900 m, 22. vi. 2002).

Notes. The identification was based on comparison with the holotype (Figure 3M–R; figs. 11 and 27 in [9]) and a paratype (fig. 28 in [9]) of *N. furcata*. As all known records were around the Hakusan Mountains, the present report represents the southwesternmost collection record. Considering the continuity of the habitat, *N. furcata* is probably widely distributed in the mountainous area between the Hakusan Mountains and the present collection site as well as mountainous areas around the present collection site.

***Nebria (Falcinebria) kobushicola* Sasakawa, 2023**

Figure 2C,D and Figure 3S–W

Nebria taketoi: Nakane, 1974 [6]: 15.

Nebria (Falcinebria) kobushicola Sasakawa, 2023 [10]: 191 (original description), type locality: “Mount Kobushigatake, Chichibu-shi Saitama Prefecture.”

Materials examined. 5♂, 6♀(KCM), the Yatsugatake Mountains, alt. 2200 m, Nagano Prefecture, Japan, 12–14. viii. 1975, T. Matsuda leg.

Notes. Although this species is known only from Mt. Kobushigatake and the Yatsugatake Mountains, the record from the latter locality is based only on one male from Akadakekousen at an altitude of 2240 m. After publication of the original description of this species [10], specimens registered as *N. reflexa* in the KCM collection were found to be *N. kobushicola*. The present report includes the first record of females from the Yatsugatake Mountains.

Nebria (Falcinebria) sp.

Figure 2E

Nebria (Falcinebria) taketoi: Yoshitake et al., 2011 [7]: 34 (part).

Nebria (Falcinebria) sp.: Sasakawa, 2023 [10]: 187

Materials examined. 9♀(KS), Mt. Iidehonzan, the Iide Mountains (snowy gorges near the summit, alt. 1800–2000 m), 21. vii. 1976, K. Terada leg.

Notes. This undetermined species, hereafter referred to as “Iide population” or “Iide specimen”, was previously regarded as *N. taketoi*. Among populations previously treated as *N. taketoi*, the Iide population shows a disjunct distribution > 200 km distant from the other populations (fig. 1 in [10]) and is probably an undescribed species. For the Iide

population, only two female specimens in the collection of the National Agriculture and Food Research Organization (Ibaraki, Japan) are known. After the publication of Sasakawa (2023) [10], Dr. K. Terada, who collected the lide specimens, provided the author with more detailed information on the lide specimens, which was not described in the collection label. According to this information, a total of 16 females, the 2 females described above plus 14 other females, were collected from sides of snowy gorges near the summit of Mt. Iidehonzan (alt. 2105 m). This information on the habitat will be useful not only for the collection of additional lide specimens but also in the search for new populations from outside the known localities.

4. Key to the Known Species of *Nebria* (*Falcinebria*) from Honshu (for Males)

1. Pronotum strongly cordate; hind angles acute angles (Figure 2C–E; figs. 3E–H in Sasakawa, 2023 [10]). Elytra widest almost at the middle, with anterior and lateral margins smoothly connected, forming an arc (Figure 2C–E; figs. 3A–D in Sasakawa, 2023 [10]). Sternite IV–VI with two to six setae on each ventrolateral side.....2
 - Pronotum less cordate, hind angles square to somewhat acute (Figure 2A,B; figs. 5–16 in Sasakawa, 2020 [9]). Elytra widest slightly behind the middle, with anterior and lateral margins less smoothly connected (Figure 2A,B; figs. 5–16 in Sasakawa, 2020 [9]). Sternite IV–VI with one to three (usually two) setae on each ventrolateral side.....3
2. Pronotum anterior angles more produced (Figure 2C,D; fig. 3G,H in Sasakawa, 2023 [10]). Laterobasal lobes semi-spherical, directed ventrally; lateroapical lobes T-shaped from a dorsal view (Figure 3S–W; fig. 5 in Sasakawa, 2023 [10]). The Yatsugatake and Okuchichibu mountains.....*N. kobushicola* Sasakawa
 - Pronotum anterior angles less produced (fig. 3E,F in Sasakawa, 2023 [10]). Laterobasal lobes semi-ellipsoid, directed ventrobasally; lateroapical lobes broadly rounded at apex, directed laterally (fig. 4 in Sasakawa, 2023 [10]). The northern Hida Mountains*N. taketoi* Habu
3. Ventral surface of aedeagal apex deeply concave (fig. 35a in Sasakawa, 2020 [9]). Lateroapical lobes bifurcated at the base, with the larger apex further bifurcated; dorsoapical lobe large, arc-shaped from lateral views, with posterior and anterior ends simple; ventrobasal swelling large, semispherical from a lateral view (figs. 34 and 35 in Sasakawa, 2020 [9]). The Chûgoku Mountains.....*N. chugokuensis* Sasakawa
 - Ventral surface of aedeagal apex not concave (e.g., fig. 35a in Sasakawa, 2020 [9]).....4
4. Dorsobasal lobe present (e.g., Figure 3A–R).....5
 - Dorsobasal lobe absent (e.g., Figure 3S; fig. 35a in Sasakawa, 2020 [9]).....9
5. Left lateroapical lobe bifurcated at the base; right lateroapical lobe not bifurcated; laterobasal lobes larger than right lateroapical lobe; right lateroapical lobe cylindrical; dorsomedian lobe present (fig. 33 in Sasakawa, 2020 [9]; figs. 2–5 in Sasakawa, 2023 [11]). Mountainous areas of the Kii Peninsula.....*N. uenoi* Nakane
 - Neither right nor left lateroapical lobes bifurcated; dorsomedian lobe absent (e.g., Figure 3A–R).....6
6. Dorsobasal lobe smaller than laterobasal lobes; right lateroapical lobe semi-spherical, larger than dorsobasal lobe (Figure 3A–F). The Suzuka Mountains.....*N. suzukana* sp. nov.
 - Dorsobasal lobe larger than laterobasal lobes; right lateroapical lobe bent ventrally, smaller than dorsobasal lobe (e.g., Figure 3G–R).....7

7. Left lateroapical lobe not bifurcated; dorsoapical lobe with the apical margin divided into three projections from a dorsal view of apical part (Figure 3G–R). Mountainous area around the Hakusan Mountains, and Mt. Uchimiyama of the Hira Mountains*N. furcata* Sasakawa
- Left lateroapical lobe bifurcated at the base; the apical margin of dorsoapical lobe not divided or only ambiguously divided (e.g., figs. 29 and 30 in Sasakawa, 2020 [9]).....8
8. Left lateroapical lobe with the sublobe at the apical side larger than sublobe at the basal side (fig. 30 in Sasakawa, 2020 [9]). Mt. Kuragadake.....*N. kuragadakensis* Sasakawa
- Left lateroapical lobe with the sublobe at the apical side smaller than sublobe at the basal side (fig. 29 in Sasakawa, 2020 [9]). Ôshirakawa-dani, a valley east of the Hakusan Mountains.....*N. pisciformis* Sasakawa
9. Neither right nor left lateroapical lobes bifurcated (e.g., figs. 2B–E, 3 and 4 in Sasakawa and Itô, 2021 [12]).....10
- Right and/or left lateroapical lobes bifurcated (e.g., figs. 17 and 31 in Sasakawa, 2020 [9]).....12
10. Dorsoapical lobe with apex simple, not bifurcated; right lateroapical lobe directed laterally, with apex widely rounded (figs. 2B–E in Sasakawa and Itô, 2021 [12]). Mt. Kasasugayama and adjacent mountainous area.....*N. kasasugaensis* Sasakawa and Itô
- Dorsoapical lobe with apex bifurcated (e.g., figs. 3 and 4 in Sasakawa and Itô, 2021 [12]).....11
11. Right lateroapical lobe with apex bent anteriorly; the basal protrusion of dorsoapical lobe with the length longer than twice the width at the base; the left apex of dorsoapical lobe more than twice the size of the right apex from dorsal view (fig. 3 in Sasakawa and Itô, 2021 [12]). The Asahi Mountains and the adjacent Mt. Gassan*N. sagittata* Sasakawa
- Right lateroapical lobe with apex wide, not bent from dorsal view; the basal protrusion of dorsoapical lobe with the length shorter than 1.5 times the width at the base; the right and left apices of dorsoapical lobe almost similar in size (fig. 4 in Sasakawa and Itô, 2021 [12]). The Iide Mountains.....*N. iidesana* Sasakawa
12. Left lateroapical lobe bifurcated at the base; right lateroapical lobe not bifurcated; laterobasal lobes smaller than right lateroapical lobe; right lateroapical lobe semi-spherical, except for the apical protrusion, which is bent in a basal direction; dorsomedian lobe present. Body length < 9.1 mm (fig. 17 in Sasakawa, 2020 [9]). Mt. Iwakisan*N. reflexa* Bates
- Both right and left lateroapical lobes bifurcated in a T or Y shape. Body length > 9.4 mm (figs. 22 and 31 in Sasakawa, 2020 [9]).....13
13. Dorsoapical lobe with apex bifurcated in a Y shape; laterobasal lobes spherical, larger than lateroapical lobes (figs. 31 and 32 in Sasakawa, 2020 [9]). Mt. Takanosuyama.....*N. dichotoma* Sasakawa
- Dorsoapical lobe with apex not bifurcated; laterobasal lobes cylindrical, smaller than lateroapical lobes (figs. 22–26 in Sasakawa, 2020 [9]). Mountainous areas mainly on and near the Sea of Japan side, ranging from Mt. Chôkaisen in the north to the Hakusan Mountains in the west.....*N. niohozana* Bates

Funding: This study was partly supported by JSPS KAKENHI (no. 22K06386).

Data Availability Statement: The data presented in this study are available through the voucher specimens indicated in type material and materials examined sections.

Acknowledgments: The author thanks K. Terada (Hiroshima, Japan) for offering important specimens and H. Ikeda (KCMi) for the loan of specimens under his care.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Ledoux, G.; Roux, P. *Nebria* (Coleoptera, Nebriidae) *Faune Mondiale*; Société Linnéenne de Lyon: Bossuet, Lyon, 2005; 976p.
2. Huber, C. Tribe Nebriini Laporte, 1834 (except genus *Leistus*). In *Catalogue of Palaearctic Coleoptera. Vol. 1. Archostemata–Myxophaga–Adephaga. Revised and Updated Edition*; Löbl, I., Löbl, D., Eds.; Brill: Leiden, The Netherlands, 2017; pp. 31–60.
3. Farkač, J.; Janata, M. Tribe Nebriini Laporte, 1834. In *Catalogue of Palaearctic Coleoptera. Vol. 1. Archostemata–Myxophaga–Adephaga*; Löbl, I., Smetana, A., Eds.; Apollo Books: Stenstrup, Denmark, 2003; pp. 79–96.
4. Uéno, S. The Coleoptera of Japan (6). *Shin Konchū* **1953**, *6*, 55–60. (In Japanese)
5. Nakane, T. The Family Carabidae. In *Iconographia Insectorum Japonicorum, Colore Naturali Editi Vol. 2 (Coleoptera)*; Nakane, T., Ohbayashi, K., Nomura, S., Kurosawa, Y., Eds.; Hokuryukan: Tokyo, Japan, 1963; pp. 3–54. (In Japanese)
6. Nakane, T. The beetles of Japan (5). *Nat. Insects* **1974**, *9*, 13–18. (In Japanese)
7. Yoshitake, H.; Kurihara, T.; Yoshimatsu, S.; Nakatani, Y.; Yasuda, K. A list of carabid specimens (Insecta: Coleoptera) collected by the late Dr. Akinobu Habu preserved in the Insect Museum of the National Institute for Agro-Environmental Sciences. *Bull. Natl. Inst. Agric. Sci. Ser. C* **2011**, *28*, 1–327. (In Japanese)
8. Yoshimatsu, S.; Ito, N.; Nakatani, Y.; Yoshitake, H. A list of ground beetles (Insecta: Coleoptera: Caraboidea) in Dr. Kazuo Tanaka Collection preserved in the Insect Museum of Institute for Agro-Environmental Sciences, NARO. *Bull. NARO Agro-Environ. Sci.* **2018**, *39*, 15–191. (In Japanese)
9. Sasakawa, K. Taxonomic studies of the ground beetle subgenus *Falcinebria* Ledoux & Roux, 2005 (Coleoptera, Carabidae, *Nebria*) from Honshū, Japan. *ZooKeys* **2020**, *902*, 37–60. [PubMed]
10. Sasakawa, K. Taxonomic study of the alpine carabid beetle *Nebria* (*Falcinebria*) *taketo* Habu, 1962 (Coleoptera, Carabidae). *Alp. Entomol.* **2023**, *7*, 185–194. [CrossRef]
11. Sasakawa, K. New distribution records of *Nebria uenoi* Nakane, 1963 (Insecta: Coleoptera: Carabidae). *Bull. Biogeogr. Soc. Jpn.* **2023**, *78*, in press. (In Japanese)
12. Sasakawa, K.; Itō, H. A new species and distribution record of the ground beetle subgenus *Falcinebria* Ledoux & Roux, 2005 (Coleoptera: Carabidae: *Nebria*) from central Honshu, Japan. *Biogeography* **2021**, *23*, 30–32.
13. Sasakawa, K.; Itō, H. New records and sympatric occurrence of *Nebria niohozana* Bates, 1883 and *Nebria kasasugaensis* Sasakawa & Itō, 2021 (Coleoptera: Carabidae). *Biogeography* **2023**, *25*, 1–3.
14. Dudko, R.Y.; Shilenkov, V.G. A review of the Palaearctic species of the subgenus *Catonebria* Shilenkov (Coleoptera, Carabidae, *Nebria*). 1. *Nebria mellyi* Gebler group. *Bull. Inst. R. Sci. Nat. Belg. Entomol.* **2001**, *71*, 63–82.
15. Dudko, R.Y.; Matalin, A.V. New and little known species of the genus *Nebria* (Coleoptera, Carabidae) from Altai. *Entomol. Rev.* **2002**, *82*, 1077–1083.
16. Huber, C.; Szallies, A.; Baur, H.; Giachino, P.M. *Nebria* (*Nebriola*) *gosteliae* sp. nov. from the Penninian Alps near Biella, Piemonte, Italy (Coleoptera: Carabidae, Nebriinae). *Contrib. Nat. Hist.* **2010**, *15*, 9–27.
17. Huber, C.; Schnitter, P.H. *Nebria* (*Pseudonebriola*) *tsambagarav* sp. nov., a new alpine species from the Mongolian Altai (Coleoptera, Carabidae). *Alp. Entomol.* **2020**, *4*, 29–38. [CrossRef]
18. Schat, J.; Weng, Y.M.; Dudko, R.Y.; Kavanaugh, D.H.; Luo, L.; Schoville, S.D. Evidence for niche conservatism in alpine beetles under a climate-driven species pump model. *J. Biogeogr.* **2022**, *49*, 364–377. [CrossRef]
19. Narukawa, N.; Yokozeki, H.; Tanaka, K.; Ozaki, M.; Kannou, K.; Inagaki, M. Coleoptera of the Suzuka Mountains. In *Insects of the Suzuka Mountains*; Narukawa, N., Ed.; Miekonchūdanwakai: Mie, Japan, 2016; pp. 81–218. (In Japanese)

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.