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On the identity and distribution of *Hebrus nipponicus* HORVÁTH, 1929, with a note on the publication date of *Hebrus* CURTIS (Hemiptera: Hebridae)

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A b s t r a c t : *Hebrus nipponicus* HORVÁTH, 1929 is redescribed and illustrated, chiefly based on the types. A lectotype is designated. Wing dimorphism and variations are described. The wide distribution range extends from Japan to Western Indonesia. First records are published from Thailand, Cambodia, East Malaysia, Brunei, and the Philippines. The correct publication year of *Hebrus* CURTIS is 1833.

K e y w o r d s : Hebridae, *Hebrus nipponicus*, taxonomy, lectotype designation, distribution, variation.

Introduction

The taxonomy of the Hebridae in the Oriental Region is still poorly known, especially concerning *Hebrus* CURTIS, 1833 (see note on publication year at the end of this paper). This paper treats the East and Southeast Asian *Hebrus nipponicus* HORVÁTH, 1929, which is known as a widely distributed species. Originally described from Japan (HORVÁTH 1929), it was soon after recorded and redescribed from Indonesia (LUNDBLAD 1933). Further records were published from West Malaysia, Singapore, and Vietnam (TRAN et al. 2015, ZETTEL & TRAN 2016). My comparison of populations from Southeast Asia with type specimens – reaching back to 2007 – indicated some differences, but after having studied numerous specimens from various regions, I finally came to the conclusion that populations cannot be safely separated by morphological characteristics.

Material and methods

The syntype series was loaned from the Museum in Budapest (MTMB), the remaining material is chiefly from the Natural History Museum Vienna (NHMW), but some specimens from other sources were also examined. Most specimens are dry-mounted (glued on pinned paper boards).

Acronyms of depositories:

CNTN Coll. N. Nieser, Tiel, The Netherlands

CSS Coll. W.D. Shepard, Sacramento, California, U.S.A.

CUL Coll. W.G. Ullrich (now included in the Smithsonian Institution, Washington, U.S.A.)

- CZWColl. Zettel, Vienna, Austria
 MTMB.....Magyar Természettudományi Múzeum (Hungarian Natural History Museum), Budapest, Hungary
 NHMWNatural History Museum, Vienna, Austria
 UBD.....University Brunei Darussalam, Brunei
 ZRCZoological University Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore

Specimens were examined with a Leica Wild M10 binocular microscope. Measurements were taken from the lectotype at magnifications from 50× up to 80× and are given in millimetres. Some variation is given for body length and pronotal width. Measurements refer to the maximum length or width of the respective structure (for details see, e.g., ZETTEL 2006). Measurements of body length and width were taken in dorsal view of the specimens. As tarsomere 1 is very short, a combined length of both tarsomeres is given.

Digital images for Figure 1 were taken with a Leica DFC490 camera attached to a Leica Z16 APO zoom macroscope, using Leica Application Suite v4.12.0. Images were stacked with Zerene Stacker 1.04 64-bit and processed with Adobe Photoshop 7.0. Drawings were carried out with help of a camera lucida attached to a Leica Wild M10 binocular microscope.

Taxonomy

Hebrus nipponicus HORVÁTH, 1929 (Figs. 1-8)

Type specimens examined: **Japan.** Lectotype (brachypterous male, Fig. 1; here designated): "Japonia\ Kanagawa\ Sauter", "nipponicus\ Horv.\ det. Horváth", "TYPUS", "Lectotypus\ Hebrus nipponicus\ Horváth, 1929 Ann. hist.-\ nat. Mus. natl. hung. 26: 314\ des. Herbert Zettel 2022" (MTMB) (Fig. 2). Paralectotypen: 3♂♂, 8♀♀ (brachypterous), with same label data, except "Paralectotypus\ Hebrus nipponicus\ Horváth, 1929 Ann. hist.-\ nat. Mus. natl. hung. 26: 314"; (10 ex. MTMB; 1♂ NHMW); 1♀ (brachypterous) "Japonia\ Okayama\ Sauter", "nipponicus\ Horv.\ det. Horváth", "TYPUS", "Paralectotypus\ Hebrus nipponicus\ Horváth, 1929 Ann. hist.-\ nat. Mus. natl. hung. 26: 314" (MTMB).

A d d i t i o n a l s p e c i m e n s e x a m i n e d (all macropterous): **Thailand.** 1♂, Phetchabun Province, 37 km SE of Sila, N of Ban Nam Nao, Ban Pala Noi, 25.XI.1995, leg. H. Zettel (#26) (NHMW); 1♂, 2♀♀, Phetchabun Province, 36 km SE of Sila, N of Ban Nam Nao, Ban Pala Yai, 25.XI.1995, leg. H. Zettel (#27) (NHMW); 6♂♂, 4♀♀, Chaiyaphum Province, Tat Ton National Park, Tat Ton, 27.XI.1995, leg. H. Zettel (#30) (NHMW); 1♀, Chaiyaphum Province, Phu Keio National Park, Nam Prom, 12.III.1994, leg. W.D. Shepard (#1037) (CSS); 1♂, 3♀♀, Udon Thani Province, 5 km E of Udon Thani, 28.XI.1995, leg. H. Zettel (#32) (NHMW); 1♀ Thailand: Khon Kaen Province, Phu Phan Kham National Park, Ban Noon Hua Chang, Huai Sam Caen, 21.XI.1995, leg. H. Zettel (#20a) (NHMW); 3♂♂, 2♀♀, same locality, leg. N. Nieser (#N9523) (CNTN); 1♂, Khon Kaen Province, Khon Kaen University, at electric light, 31.III.1994, leg. W.D. Shepard (NHMW); 14♂♂, 20♀♀, Phang-Nga Province, Phang-Nga Bay, Khao Suan Island, freshwater, 27.XI.2006, leg. H. Zettel (#39) (NHMW); 3♂♂, 1♀, Phang-Nga Province, Khao Suan Island, freshwater reservoir, 27.XI.2006, leg. Yang C.M. (#YCM 344) (ZRC); 6♂♂, 3♀♀, Satun Province, Ko Tarutao National Park, Ko Tarutao Island, 10 m a.s.l., 12.I.1996, leg. P. Schwendinger (NHMW); 1♂, 1♀, Surin Province, Surin, 150 m a.s.l., 5–10.XII.1995, leg. P. Schwendinger (NHMW); 3♂♂, Phitsanulok Province, Tung Salaeng Luang National Park, pond, 4.I.1997, leg. P. Mazzoldi (NHMW). **Vietnam.** 2♂♂, 1♀, Nam Cat Tien National Park, 1–15.V.1994, leg. P. Pacholátko & L. Dembický (NHMW). **Cambodia.** 17♂♂, 15♀♀, Siem Reap, town area, N 13°21'17.8", E103°51'18.6", light trap, 4.I.1998, W.G. Ullrich collection (CUL, NHMW); 54♂♂, 52♀♀, same locality, 5.I.1998, Dr. Wolfgang G. Ullrich collection (CUL, NHMW). **Malaysia** (West). 1♂, 1♀ Perak, Slim River, 1.I.1995 Dr. Wolfgang G. Ullrich collection (CUL, NHMW); 1♀, Pahang, Pulau Tioman, Kang Kong pool, 28.VI.1996, leg. C.M. Yang et al. (#YCM147) (ZRC); 1♂, 3♀♀, Pahang-Johore, Endau Rompin National Park, Salendang, 100 m a.s.l., 28.II.–12.III.1995, leg. M. Štrba & R. Hergovits (NHMW). **Singapore.** 1♀, Lorong Banir, pond 1, 16.VI.1995, leg. H.K. Lua et al. (#NS190) (ZRC); 5♂♂, 4♀♀, Tuas West, marshland, 31.V.2007, leg. H.K. Lua (#LHK466A) (ZRC). **Malaysia** (Borneo). 1♀, Sarawak, Lambir Hills National Park, 25 km S of Miri, pond near headquarter, 24–25.II.1993, leg. H. Zettel (#9c) (NHMW); 1♂, Sarawak, Kelabit Highlands, Bareo – Arur Dalem, stream in rain forest, 1000–1200 m a.s.l., 26.II.–1.III.1993 leg. H. Zettel (#11) (NHMW);); 1♂, 3♀♀, same area, ponds on pastures and paddy fields, 1.III.1993, leg. H. Zettel (#11) (NHMW); 1♂, Sarawak, Kelabit Highlands, 5 km E of Bareo, Pa Ukak, small ponds in agricultural land, 1000 m a.s.l., 27.II.1993, leg. H. Zettel (#12b) (NHMW); 1♂, Sabah, Sandakan near Danau Biantun Kechil along Sungai Kinabatangan, 9.IV.1994, leg. Lua H.K. & Yang C.M. (#LHK 231) (ZRC). **Brunei.** 8♂♂, 8♀♀, Sungai Belait area, marshland, 15 m a.s.l., N 04°32', E 114°32' (GPS), 15.VI.2007, leg. H. Zettel (#6) (NHMW, UBD). **Indonesia.** 4♂♂, 3♀♀, West Sumatra, Talu, Simpangempat, Sukaminanti, VII.1992, leg. W.G. Ullrich (CUL, NHMW). **Philippines.** 1♂, Palawan Province, Palawan Island, 17 km WSW of Puerto Princesa, Tagbuna river, 26.III.1994, leg. H. Zettel (#51) (NHMW); 1♂, 5♀♀, Palawan Province, Palawan Island, 10 km NE of Quezon, Tumarbon Falls, 3–4.IV.1994, leg. H. Zettel (#58) (NHMW, UPLB); 2♂♂, 2♀♀, Palawan Province, Palawan Island, Puerto Princesa, Santa Cruz, km 29 at Northern Highway, Calatoboc Bridge, stream, 14.XI., leg. H. Zettel (#482) (NHMW); 1♂, Palawan Province, Palawan Island, Montible, km 29 at Napsan Road, large river, 30 m, 24.XI., leg. H. Zettel (#493) (NHMW); 1♂, 2♀♀, Palawan Province, Busuanga Island, 13 road-km WNW of Coron, Balulu Falls, 2.II.1999, leg. Zettel (#171) (CZW); 1♀, Samar Island, Northern Samar Province, Veriato, El Amigo, Veriato Falls, 3.III.2003 leg. H. Zettel (#344) (CZW); 1♂, Cebu Island, S of Badian, Matutinao, Kawasan Falls, 20–50 m a.s.l., 12.XI.2003, leg. H. Zettel (#352d) (NHMW); 1♂, Camotes Islands, Poro Island, Tudela, Calmate, small stream, 26.II.2001, leg. H. Zettel (#278) (NHMW); 1♂, Camotes Islands, Pacijan Island, San Francisco, Northern Poblacion, Lake Danao, 27.II.2001, leg. H. Zettel (#281) (NHMW); 1♂, Camiguin Island, Tupsan, Macao Cold Spring, 18.XI.1996, leg. H. Zettel (#99) (NHMW); 1♂, 2♀♀, Mindanao Island, South Cotabato Province, Lake Sebu area, barangay Bakdolong, mountain stream, 4.XI.1993, leg. N. Nieser (#N9366a) (CNTN).

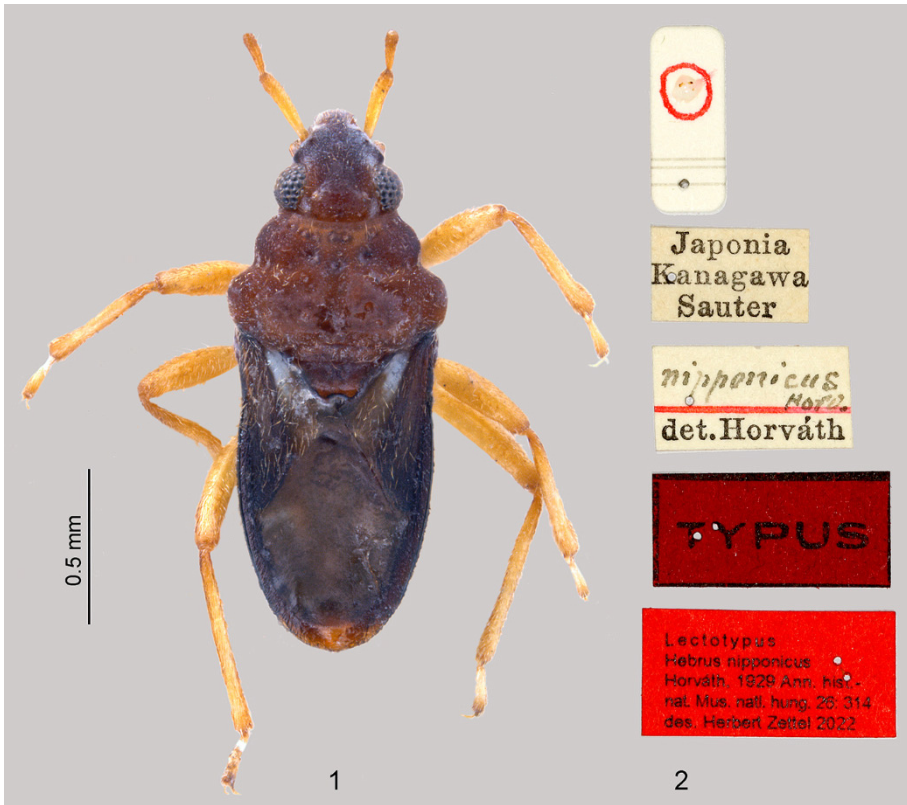
Notes on types: The lectotype (Fig. 1), here designated to fix the species identity, is a male in almost complete condition. Only the distal antennomeres (3–4) are lacking and the pilosity on the dorsal side seems to be rubbed off, as in some paralectotypes. I have dissected the genitalia and glued them with water-soluble dimethyl-hydantoin-formaldehyd resin on a separate label that is pinned with the specimen. One additional paralectotype from Okayama, a brachypterous male, is deposited in the museum of Stockholm (Gunvi Lindberg, pers. comm.); it has not been examined in the course of this study. As it is undissected, it cannot be the specimen from Okayama that has been prepared as a permanent mount and redescribed by LUNDBLAD (1933). The whereabouts of this specimen are unclear, as there are also no permanent mounts of *H. nipponicus* in the museum in Budapest (David Rédei, pers. comm.). Although the forewings of the type specimens almost reach the hind margin of the abdomen, their brachypterous wing condition was recognized after comparison with macropterous specimens from Southeast Asia. The humeri of the pronotum are clearly more weakly developed than in the macropterous morph, and the metanotal elevation is shorter.

Description of lectotype: Body length, 1.70; maximum head width, 0.42; head with antennal tubercles, 0.32; minimum distance of eyes, 0.21; pronotum width, 0.71; pronotum length, 0.39; combined length of mesoscutellum and metanotal elevation, 0.19; abdomen width, 0.63; length of abdomen behind apex of metanotum, 0.85; length of antennomeres 1–2 (3 and 4 broken off), 0.25, 0.15. Length of leg segments: profemur, 0.42; protibia, 0.46; protarsus, 0.16; mesofemur, 0.42; mesotibia, 0.43; mesotarsus, 0.15; metafemur, 0.51; metatibia, 0.61; metatarsus, 0.18.

Colour. Dark brown to black. Posterior and lateral parts of head, prothorax, mesoscutellum, and metanotal elevation reddish to chestnut-brown. Ventral side of head yellow. Forewing blackish brown; medial (posterior) cell of corium with posteriorly narrowed white mark, behind brownish white; lateral (anterior) cell of corium brownish white; membrane with three small, indistinct whitish spots. Antennomeres 1 and 2, and legs yellow.

Pilosity. Pilosity of dorsal side chiefly rubbed off. Head, pronotum, mesoscutellum and metanotal elevation with dispersed whitish scales. Head with a few short, suberect, dark setae (Fig. 4). Mesoscutellum and metanotal elevation with slightly longer, oblique, dorsocaudally directed setae. Corium with relatively short, appressed, golden pilosity; setae along veins slightly longer and subdecumbent. Sides of abdomen with thin, whitish, appressed pilosity; ventrally in addition with dispersed, short, erect setae. Femora bearing some relatively long setae on flexor side, especially on profemur. Pro- and mesotibia with apical area densely beset with setae.

Structures. Head short; sides between anterior margin of the small eyes and the small, almost rounded antennal tubercles straightly diverging. Preocular tubercle slightly protruding (Fig. 3). Anteclypeus without swelling. Bucculum posteriorly higher than anteriorly, with three small, circular depressions; process very stout, straight, apex very broadly rounded, almost truncated (Fig. 4). Pronotum with very shallow medial furrow, with deep grooves along anterior and posterior margins and around humeri, otherwise only with large, dispersed, shallow grooves. Metanotal elevation trapezoidal, posterior margin with a small concavity between a pair of short blunt teeth (Fig. 5). Brachypterous; forewing ending before apex of abdomen, but distance only about as large as tibia width. Legs short; tarsi rather short. Femora enlarged. Metafemur hardly curved; metatibia straight.



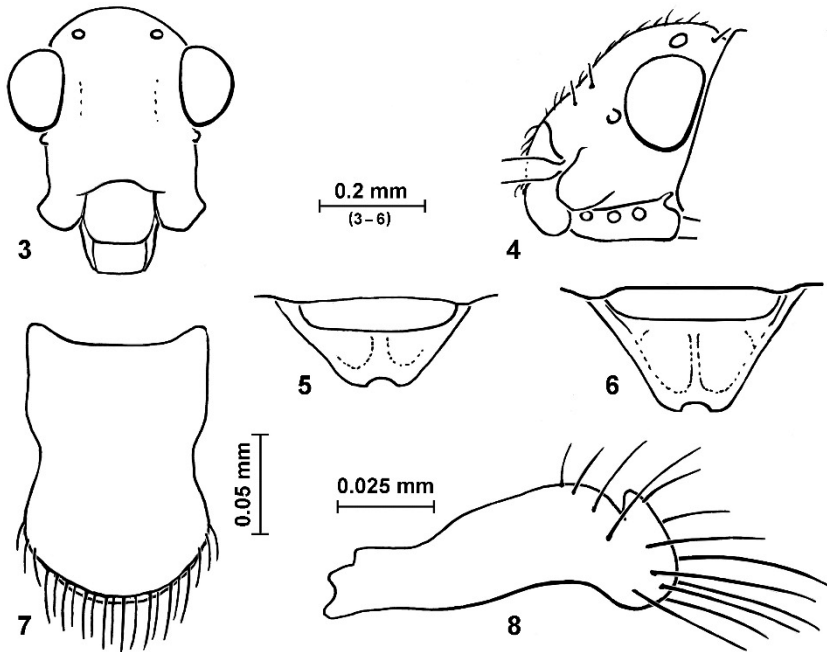
Figs 1-2: Lectotype of *Hebrus nipponicus*, brachypterous male. (1) Habitus, dorsal view. (2) Paper card with genitalia and labels (not on scale).

Abdomen slender-ovate, posteriorly regularly rounded.

Genitalia of male. Segment 8 slender, without special modifications. Pygophore small, short, ovate, with inconspicuous pilosity. Proctiger (Fig. 7) short, its sides distinctly concave; distal part roundish, inconspicuously pilose. Paramere (Fig. 8) very small, weakly sclerotised, hook-shaped, with narrow, acute, dorsally directed apex, with few moderately long setae.

Additional notes on brachypterous paralectotypes: Body length ca. 1.7 mm (♂♂), ca. 1.8–1.9 mm (♀♀). Pronotum width 0.65–0.71 mm (♂♂), 0.67–0.89 mm (♀♀).

Colour similar as in lectotype, but in few specimens head completely dark, and pronotum with dark mark. Antennomeres 3 and 4 brownish. Spots on membrane in some specimens more distinct than in lectotype. Pilosity on dorsum of head, if still existing, denser and slightly longer (or as long as) pilosity on metanotal elevation; pilosity on pronotum distinctly shorter and subdecumbent, consequently inconspicuous. Length of antennomeres 1–4 of a randomly selected paralectotype (male): 0.25, 0.14, 0.25, 0.41 mm. Posterior depression of bucculum in few specimens reniform. Females slightly stouter than males, posterior margin of abdomen evenly rounded. Femora of females not thickened.



Figs 3-8: Morphological details of *Hebrus nipponicus*, lectotype (except 6). (3) Head, frontal view. (4) Head, lateral view. (5) Mesoscutellum and metanotal elevation of brachypterous morph. (6) Same of macropterous morph (specimen from Philippines). (7) Proctiger, dorsal view. (8) Left paramere, lateral view.

Notes on macropterous morph: Size. Body length ca. 1.7–1.9 mm (♂♂), ca. 1.8–2.0 mm (♀♀). Pronotum width ca. 0.73–0.86 mm (♂♂), ca. 0.78–0.94 mm (♀♀).

Colour very variable. Most common are dark specimens, but few specimens even with more expanded reddish brown colouration than in types. Setae on dorsum of head variable, either shorter or longer than setae on metanotal elevation. Buccula process in many specimens more slender than in types. Pronotum with strongly developed humeri and slightly coarser puncturation. Metanotal elevation longer than in brachypterous morph (Fig. 6); forewing reaching apex of abdomen; corium with very variable pilosity; from sparse, rather short, almost decumbent to dense and suberect. Femora of males not so strongly enlarged as in types. See also notes on different populations below.

Comparative notes and discussion: *Hebrus nipponicus* is a small species with a wide, bluntly ending buccula process, a short, moderately incised metanotal elevation, conspicuous, dorsocaudally directed setae on mesoscutellum and metanotal elevation, and relatively long setae on femora. The male possesses very small genitalia; especially an extremely small, yellowish paramere ending in a small apical hook; its proctiger shows a small, roundish distal part that is well separated from the base by concave sides.

When studying only few specimens from Japan, the Philippines, Sumatra, and Thailand, one might think that the material consists of several different species. Differences can be

found in size, colour, length of setae on head, slightly erect or decumbent setae on corium, width of buccula process, and width of femora (in males). However, for the following reasons, *H. nipponicus* is presently regarded as a single, variable and widely distributed species: First of all, the genitalia of males are almost identical. Secondly, some external characters, most of all pilosity, also show some variability within populations. Thirdly, in contrast to many other *Hebrus* species, *H. nipponicus* lives in astatic habitats like ponds, puddles, and water reservoirs and was also collected at light traps, which indicates good dispersal abilities. However, it cannot be completely excluded that *H. nipponicus* s.l. is a complex of closely-related species. Based on morphology, I can recognize the following four, more or less separable populations, although not every single individual expressed all typical characteristics.

1) The type series from Japan differs from Southeast Asian populations (forms 2–4) by almost appressed pilosity of the corium and wider femora of males. Only brachypterous specimens could be studied, whereas all studied specimens from Southeast Asia and the Malay Archipelago are macropterous. Japanese specimens illustrated by MITAMURA et al. (2017) are brachypterous, too. It is well known (e. g., ZETTEL 2006) that morphology of pronotum and metanotal elevation changes with the development of wings / wing muscles. In brachypterous specimens, as in the Japanese specimens of *H. nipponicus*, the pronotum is generally narrower and the metanotal elevation shorter. Whether brachyptery also influences the width of femora cannot be answered at present (no data available), nor whether wing development could be genetically fixed in certain populations. A similar hypothesis in the case of *H. lacustris* ZETTEL 2006 (see ZETTEL 2006) must be rejected after having studied more material (unpublished).

2) Specimens from Thailand, Vietnam and Cambodia are comparatively small (pronotum width of males 0.67–0.80 mm, of females 0.67–0.84 mm), rather dark coloured, and with mostly decumbent setae on corium. As in the Japanese specimens, the buccula process is rather broad. The pilosity of the head is variable, but more frequently short.

3) As a third form I summarize populations from West Malaysia, Singapore, Sumatra, Borneo, and the Palawan archipelago in the southwestern Philippines. The specimens are on average larger (pronotum width of males 0.77–0.86 mm, of females 0.82–0.94 mm), possess a slightly narrower buccula process, slightly more acute teeth of the metanotal elevation, and a conspicuously long, dense, and suberect pilosity on the corium; proctiger and paramere are slightly more reduced than in males from Indochina. Transitions exist to the forms 2 and 4. Specimens from Sumatra are chestnut-brown and resemble specimens from Japan in colour.

4) Specimens from the other Philippine Islands, from where material was available (Samar, Cebu, Poro, Pacijan, Camiguin, Mindanao), are more distinguished from the remaining populations. Like the former (3), they are relatively large (pronotum width of males 0.77–0.84 mm, of females 0.88–0.92 mm), and possess an even denser suberect pilosity on corium and a relatively slender buccula process. Specimens (especially males) appear slender, their heads bear a dense and rather long pilosity and are more slender than in all other populations.

No specimens were studied from the temperate Asian mainland (Korea) and from Taiwan (recorded by ANDERSEN 1995).

D i s t r i b u t i o n : Japan (Honshu Island) (HORVÁTH 1929); Indonesia (Sumatra, Java) (LUNDBLAD 1933); Korea and Taiwan (ANDERSEN 1995); Singapore and Peninsula

Malaysia (TRAN et al. 2015); Vietnam (Song Be) (ZETTEL & TRAN 2016); first records for Thailand (Phitsanulok, Phetchabun, Chaiyaphum, Udon Thani, Khon Kaen, Satun, Surin), Cambodia (Siem Reap), East Malaysia (Sarawak, Sabah), Brunei, and the Philippines (Palawan, Busuanga, Samar, Cebu, Poro, Pacijan, Camiguin, Mindanao). – The record from Russian Far East presented by KANYUKOVA (1988) and followed by ANDERSEN (1995) was falsified by KANYUKOVA (1997).

H a b i t a t s : *Hebrus nipponicus* inhabits the edges of a large variety of aquatic habitats in temperate and tropical climates, including ponds, puddles, artificial freshwater reservoirs, marshland, and streams.

The publication year of the taxon *Hebrus* CURTIS

Whereas most taxonomic publications refer to *Hebrus* CURTIS, 1833 (e.g., KANYUKOVA 1997, ANDERSEN 1995, CHEN et al. 2005, ZETTEL 2006, 2022, KMENT et al. 2016), more recently the year 1831 was cited in widely used online sources like The Integrated Taxonomic Information System, Catalogue of Life, Interim Register of Marine and Nonmarine Genera, and Wikipedia (English edition). To clarify the situation, I studied the old works by John CURTIS (1831, 1833, 1836) and present the following results.

CURTIS (1831, column 199) lists "1123 *Hebrus*, Curt." and a single, presumed new species, "1 *Walkerii* Curt.". Both are not described. Because the species *H. walkerii* is not available, Article 12.2.5 of ICZN (1999) is not applicable. Accordingly, *Hebrus* CURTIS, 1831 is a nomen nudum and also not available.

CURTIS (1833: p. 198–199) provides a description of *Hebrus* and includes *pusilla* FALLÉN, 1807 (= *Walkerii* CURTIS).

CURTIS (1836, column 229) lists "1123 *Hebrus*, Curt." and "1 *pusillus* Fall."

Accordingly, *Hebrus* CURTIS, 1833 is correct.

Acknowledgements

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Zusammenfassung

Hebrus nipponicus HORVÁTH, 1929 wird – hauptsächlich auf Basis der Typenserie – wiederbeschrieben und abgebildet. Ein Lectotypus wird festgelegt. Auf den Flügeldimorphismus und die innerartliche Variabilität weiterer Merkmale wird eingegangen. Die weite Verbreitung von *H. nipponicus* reicht von Japan bis ins westliche Indonesien. Erstnachweise werden aus Thailand, Kambodscha, Ostmalaysien, Brunei und den Philippinen erbracht. Das Publikationsjahr von *Hebrus* CURTIS ist 1833.

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