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A review of *Agnoshydrus* Biström, Nilsson & Wewalka, 1997 (Coleoptera: Dytiscidae: Hyphydrini), with descriptions of two new species from Thailand

RYOHEI OKADA[1,2]
[1]*Thailand National History Museum, National Science Museum, Pathum Thani, 12120 Thailand*
[2]*Coleopterological Society of Japan. National Museum of Nature and Science, Tsukuba, 3050005 Japan*
wasserinsekt@kub.biglobe.ne.jp; *https://orcid.org/0000-0002-8488-0660*

Abstract

The genus *Agnoshydrus* Biström, Nilsson & Wewalka, 1997 is reviewed and two new species are described from Thailand: *A. thailandicus* **sp. nov.** (Ubon Ratchathani, Chiang Mai, Nong Khai provinces) and *A. wewalkai* **sp. nov.** (Nan Province). *Agnoshydrus schillhammeri* Wewalka, 1999 is recorded from Cambodia for the first time. A key to species and a distribution map of all known *Agnoshydrus* species are provided.

Key words: Coleoptera, Dytiscidae, Hydroporinae, Hyphydrini, new species, first record, Southeast Asia

Introduction

Agnoshydrus Biström, Nilsson & Wewalka, 1997 is a member of the tribe Hyphydrini of the subfamily Hydroporinae. The genus comprises small and globular diving beetles with a length up to 2.7 mm (Biström *et al*. 1997). Among the Hyphydrini, this genus is characterized by the following characters: body shape globular; dorsal surface covered by fine, dense, and evenly distributed punctures; base of metatrochanters completely exposed; median lobe of aedeagus apically not bifurcate (Wewalka & Wang 2007). All species of the genus have been rarely collected and the knowledge of their ecology is scanty (Wewalka 1999). Most of the known species have been collected at light and only a few from stream pools and small creeks (Wewalka & Wang 2007; Suprayitno *et al*. 2022).

Currently, eight *Agnoshydrus* species are known, all distributed in Southeast Asia: *A. barong* (Hendrich, Balke & Wewalka, 1995), *A. ciampori* Wewalka & Wang, 2007, *A. confusus* Wewalka & Biström, 1997, *A. densus* Biström, Nilsson & Wewalka, 1997, *A. laccophiloides* (Régimbart, 1888), *A. paulbrowni* Wewalka & Wang, 2007, *A. schillhammeri* Wewalka, 1999, and *A. taiwanus* Wewalka & Wang, 2007. As part of a recent field survey aiming of studying the diversity of Thailand diving beetles, several *Agnoshydrus* specimens were collected. In this paper all *Agnoshydrus* species from Thailand are reviewed, two new species are described and a key to species as well as a distribution map are given.

Material and methods

The specimens were mainly studied using Olympus SZX10 stereomicroscope, measurements were taken with an ocular graticule. For the habitus figures stacks of micrographs were taken with a Canon EOS 7D Mark II digital camera with attached Canon MP-E65mm f/2.8 macro lens. These stacks were subsequently treated with the image stacking software Helicon Focus (Helicon Soft Ltd., Kharkov), and subsequently edited by Adobe Photoshop elements (2008) (Adobe Systems Inc., USA). Specimens were glued on rectangular or triangular cards. Male genitalia were dissected and then glued onto the card. Male genitalia were studied in wet condition and using an Olympus BHT transmitted light microscope with RICOH GX6 attachment.

The following abbreviations are used: TL: total length of body (length from front of head to apex of elytra); TL-h: body length without head (length of body from anterior margin of pronotum to apex of elytra); EL: elytral length (length of elytra from anterior margin to apex); MW: maximum.

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Measurements of holotypes are given in parentheses. Label data of type specimens are cited in quotation marks. A backslash indicates separate lines and a double backslash notifies separate labels. Comments are given in square brackets. The terminology to denote the orientation of the genitalia follows Miller & Nilsson (2003).

The specimens are deposited in the following institutions and private collections:

CGW	coll. G. Wewalka, Vienna, Austria
NHMW	Naturhistorisches Museum Wien, Vienna, Austria (H. Shaverdo)
THNHM	Thailand Natural History Museum, Pathum Thani, Thailand (T. Jeenthong)
ZSM	Zoologische Staatssammlung München, Munich, Germany (L. Hendrich)

Taxonomy

Agnoshydrus thailandicus sp. nov.

(Figs 1–2, 5, 7)

Type locality. Thailand, Ubon Ratchatani Province, Nam Yuen Dist., Dom Pradit St. 221 (alt. 190 m), 14.402°N, 104.215°E.

Type material. Holotype, ♂, "THAI: Ubon Ratchatani / Nam Yuen Dist., / Dom Pradit St. 224 (alt. 190 m) / 27.II.2021 / R. Okada leg." [white printed label] // "HOLOTYPE / *Agnoshydrus thailandicus* sp. nov. / Okada 2024" [red label printed] (THNHM). Paratypes (32 exs): 6 ♂, 10 ♂, same label data as holotype (CGW, NHMW, THNHM, ZSM); 1 ♂, "THAI: Ubon Ratchatani / Nam Yuen Dist., / Dom Pradit St. 225 (alt. 190 m) / 6.III.2021 / R. Okada leg." [white printed label] (THNHM); 1 ♂, 1 ♂, "THAI: Ubon Ratchatani / Nam Yuen Dist., / Dom Pradit St. 239 (alt. 190 m) / 22.V.2021 / R. Okada leg." [white printed label] (THNHM); 1 ♂, "THAI: Ubon Ratchatani / Nam Yuen Dist., / Dom Pradit St. 284 (alt. 190 m) / 20.III.2022 / R. Okada leg." [white printed label] (CGW); 1 ♂, "THAI: Ubon Ratchatani / Si Mueang Mai Dist., / Na Kham St. 272 (alt. 140 m) / 8.I.2022 / R. Okada leg." [white printed label] (THNHM); 1 ♂, "THAI: Chiang Mai / Phrao Dist., / Ban Pong St. 226 (alt. 430 m) / 20.III.2021 / R. Okada leg." [white printed label] (THNHM); 3 ♂, 5 ♂, "THAI: Chiang Mai / Phrao Dist., / Ban Pong St. 263 (alt. 430 m) / 13.XI.2021 / R. Okada leg." [white printed label] (CGW, NHMW, THNHM, ZSM); 1 ♂, 1 ♂, "THAI: Nong Khai / Sangkhom Dist., / Pha Tang St. 319 (alt. 230 m) / 21.I.2023 / R. Okada leg." [white printed label] (THNHM, CGW). Each paratype is provided with the respective red label.

Description of holotype. Habitus (Figs 1, 7) oblong-oval, globular.

Head. Pale ferrugineous, paler on anterior part; clypeus not bordered; densely, superficially and regularly punctured; completely but finely microreticulate. Antennae testaceous, long and slender.

Pronotum. Pale ferrugineous, darker along anterior and posterior margin; lateral margins finely bordered, lateral sides slightly rounded; punctation regular, dense and fine, with microreticulation except central part.

Elytra. Ferrugineous with testaceous markings: one small basal spot near shoulder not reaching base, one big, oblong and diagonal subapical spot; indistinctly paler near apex; laterally without distinct longitudinal notch; punctation regular, dense and coarse; longitudinal rows of punctures fine; without microreticulation, shiny. Epipleuron rufo-testaceous, densely and finely punctured.

Ventral side. Head and prothorax testaceous, metaventrite, metacoxae, and abdomen rufo-testaceous, sutures between metacoxae, ventrite 1 and ventrite 2 darker (Fig. 2); punctures on anterior part of metaventrite and on metacoxae dense and fine, posterior part of metaventrite with few coarse punctures and distally with large smooth area without punctures and reticulation (Fig. 5E); prosternal process broad, apex rounded, reaching metaventrite, lateral beads of process broad; distance between mesocoxal cavities broad; metaventral wings narrow; metacoxae smooth without wrinkles; lobes of metacoxal processes not covering base of trochanters. Notes: Wewalka & Wang (2007) showed in their figs. 9–11 for *A. paulbrowni*, *A. ciampori* and *A. taiwanus* only the coarse punctures on the metaventrite and omitted the small punctures (G. Wewalka, pers. comm.).

Legs. Rufo-testaceous; metatibial spurs not modified, almost straight and slender.

Male. Median lobe of aedeagus in ventral view laterally expanded at apex (Fig. 5A); distal part in lateral view slightly and evenly curved (Fig. 5B). Parameres as in Figs 5C–D, inner surface with distinct long setae; first segments of pro- and mesotarsi minimally enlarged; antennae not modified.

Female. Dorsal and ventral side as in male, sclerotized spermatheca not found.

Measurements (n = 33). TL: 1.8–2.0 mm (1.9 mm); TL-h: 1.6–1.75 mm (1.7 mm); EL: 1.2–1.3 mm (1.25 mm); MW: 1.15–1.3 mm (1.2 mm); TL/MW: 1.3–1.4 (1.4).

Variability. Specimens from Chiang Mai Province, northern Thailand have a larger body size (average TL: 1.89 mm in male, 1.93 mm in female) and paler body coloration while specimens from Ubon Ratchathani (type locality) are smaller (average TL: 1.87 mm in male, 1.91 mm in female) and have darker coloration, but no other differences have been observed.

Differential diagnosis. *Agnoshydrus thailandicus* **sp. nov.** very closely resembles *A. barong* in size and coloration but differs from this species by regularly attenuated elytra and laterally expanded median lobe at apex in ventral view (Hendrich & Balke 1995; Suprayitno *et al*. 2022).

Etymology. This species is named after Thailand.

Ecology. The type locality is a small stream, ca. 1–2 m wide, with dense layers of rotten leaves, flowing under primary forest (Fig. 9). At other localities, specimens were collected in pools of small or moderate sized streams (Figs 10–11).

Distribution. So far, this species is known as endemic to Thailand. The species has a wide geographic range in Thailand, known from the type locality in northeastern Thailand as well as from northern Thailand (Fig. 13).

***Agnoshydrus wewalkai* sp. nov.**
(Figs 3–4, 6, 8)

Type locality. Thailand, Nan Province, Bo Kluea Dist., Bo Kluea Tai St. 313 (alt. 580 m), 14.402°N, 104.215°E.

Type material. Holotype, ♂, "THAI: Nan / Bo Kluea Dist., / Bo Kluea Tai St. 313 (alt. 580 m) / 18.XII.2022 / R. Okada leg." [white printed label] // "HOLOTYPE / *Agnoshydrus wewalkai* sp. nov. / Okada 2024" [red label printed] (THNHM). Paratypes (4 exs): 1 ♂, 3 ♂, same label data as holotype (CGW, NHMW, THNHM, ZSM). Each paratype is provided with the respective red label.

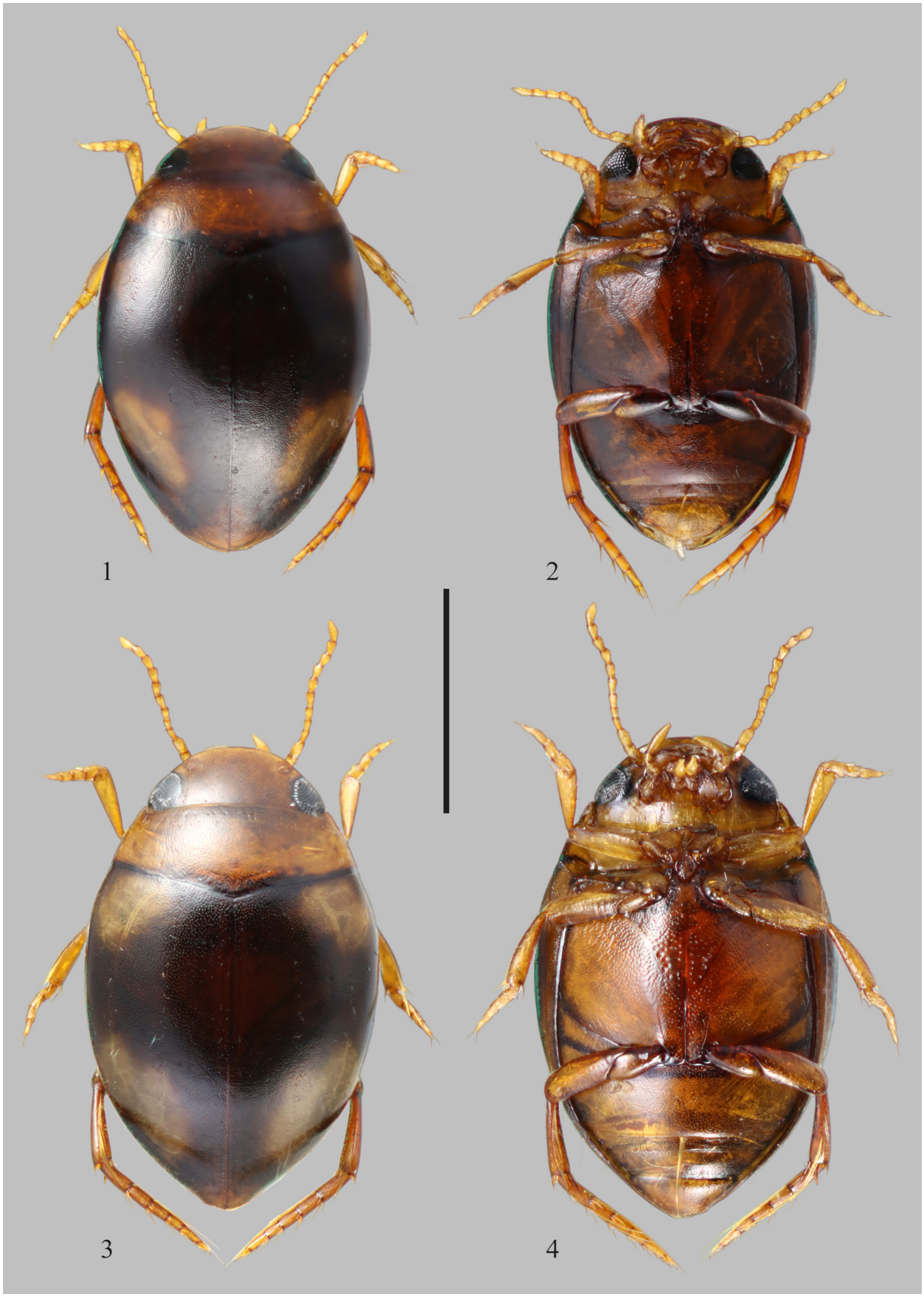
Description of holotype. Habitus (Figs 3, 8) regularly oblong-oval, globular.

Head. Testaceous; clypeus slightly bordered; finely and regularly punctured, coarser posteriorly, with some stronger punctures alongside inner margin of eyes, with superficial transverse microreticulation in anterior third. Antennae testaceous, slender.

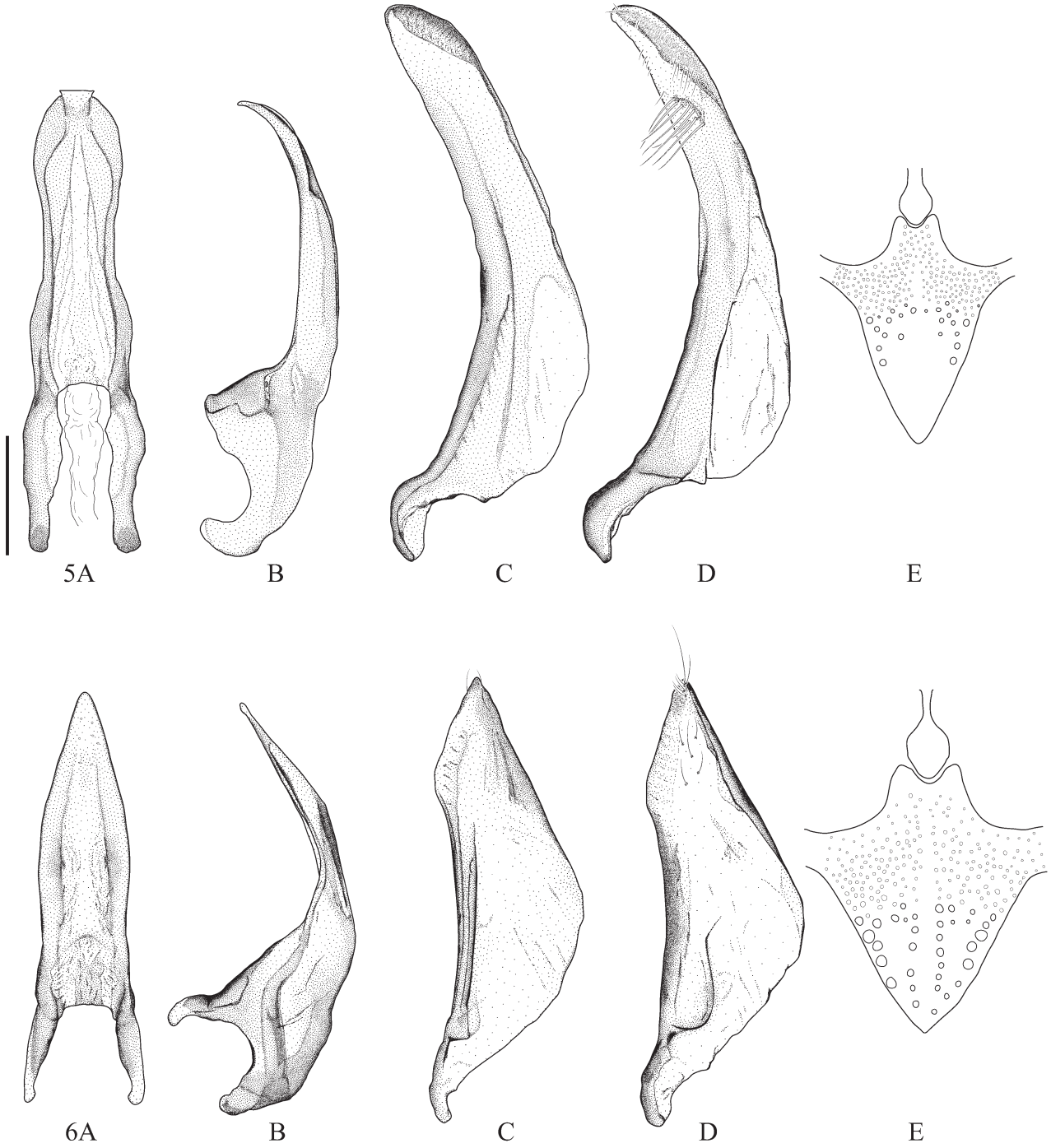
Pronotum. Testaceous, narrowly ferrugineous along posterior margin; lateral margins finely bordered, lateral sides almost straight; punctures coarse and dense, less dense on central part; without microreticulation; with superficial wrinkles on posterior part.

Elytra. Ferrugineous, with two large testaceous spots, one basal spot near shoulder not reaching base and one oblong and diagonal subapical spot; indistinctly paler near apex; laterally with distinct longitudinal notch; punctation regular, dense and coarse; longitudinal rows of punctures fine; without microreticulation, shiny. Epipleuron pale ferrugineous, densely and finely punctured.

Ventral side. Head, prothorax and abdomen testaceous, metaventrite and metacoxae rufo-testaceous (Fig. 4); punctures in anterior half of metaventrite, on metacoxae and on abdomen dense and fine, posterior half of metaventrite with two triangular smooth areas without punctures and reticulation, framed by several coarse punctures (Fig. 6E); prosternal process broad, apex rounded, reaching metaventrite, lateral beads of process fine; distance between mesocoxal cavities broad; metaventral wings narrow; metacoxae smooth without wrinkles; lateral lobes of metacoxal processes not covering base of trochanters.



FIGURES 1–4. Habitus of *Agnoshydrus* species from Thailand: (1–2) *A. thailandicus* **sp. nov.**, (1) male, holotype, dorsal aspect; (2) female, paratype, ventral aspect. (3–4) *A. wewalkai* **sp. nov.**, (3) male, holotype, dorsal aspect; (4) ditto, ventral aspect. Scale bar: 1.0 mm.



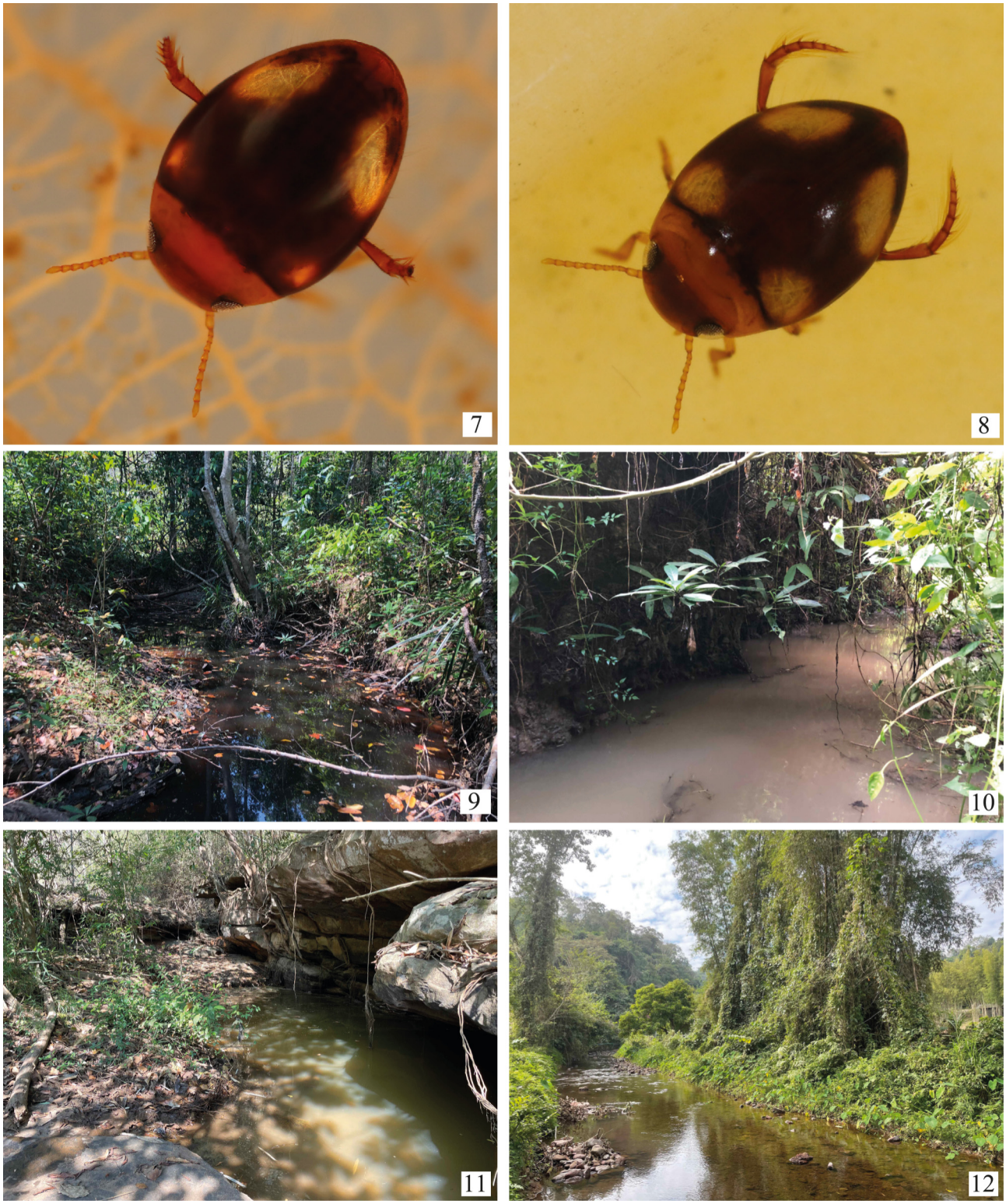
FIGURES 5–6. (5) *Agnoshydrus thailandicus* **sp. nov.**, (6) *A. wewalkai* **sp. nov.**: A, median lobe in ventral aspect; B, median lobe in lateral aspect; C, left paramere, outer aspect; D, right paramere, inner aspect; E, metaventrite. Scale bar: 0.25 mm.

Legs. Rufo-testaceous; metatibial spurs not modified, almost straight and slender.

Male. Median lobe of aedeagus in ventral view evenly tapering to apex in distal half (Fig. 6A); in lateral view distal half almost straight on ventral side, apex narrowly rounded (Fig. 6B). Parameres as in Fig. 6C–D; first segments of pro- and mesotarsi minimally enlarged; antennae not modified.

Female. Dorsal and ventral side as in male, sclerotized spermatheca not found.

Measurements (n = 5). TL: 2.1–2.2 mm (2.1 mm); TL-h: 1.8–2.0 mm (1.8 mm); EL: 1.35–1.55 mm (1.35 mm); MW: 1.3–1.5 mm (1.3 mm); TL/MW: 1.3–1.4 (1.4).



FIGURES 7–12. Habitus and collecting localities of *Agnoshydrus* species from Thailand: (7–8) Dorsal habitus, (7) *A. thailandicus* **sp. nov.** from Ubon Ratchathani; (8) *A. wewalkai* **sp. nov.** from Nan; (9–12) Collecting localities, (9) Dom Pradit, Ubon Ratchathani Province, type locality of *A. thailandicus* **sp. nov.**; (10) Ban Pong, Chiang Mai Province, one of the localities of *A. thailandicus* **sp. nov.**; (11) Pha Tang, Nong Khai Province, one of the localities of *A. thailandicus* **sp. nov.**; (12) Bo Kluea Tai, Nan Province, type locality of *A. wewalkai* **sp. nov.**

Differential diagnosis. *Agnoshydrus wewalkai* **sp. nov.** resembles *A. ciampori* in body shape and presence of distinct longitudinal notch along the lateral side of each elytron, but it can be distinguished from the latter by its smaller size and the presence of distinct elytral markings.

Etymology. This species is dedicated to Günther Wewalka, Vienna, Austria. The specific name is a noun in the genitive singular.

Ecology. The specimens were collected from a slowly flowing stream on gravelly bed, ca. 5 m wide, moving through open secondary forest (Fig. 12).

Distribution. So far known only from the type locality, Nan Province, northern Thailand (Fig. 13).

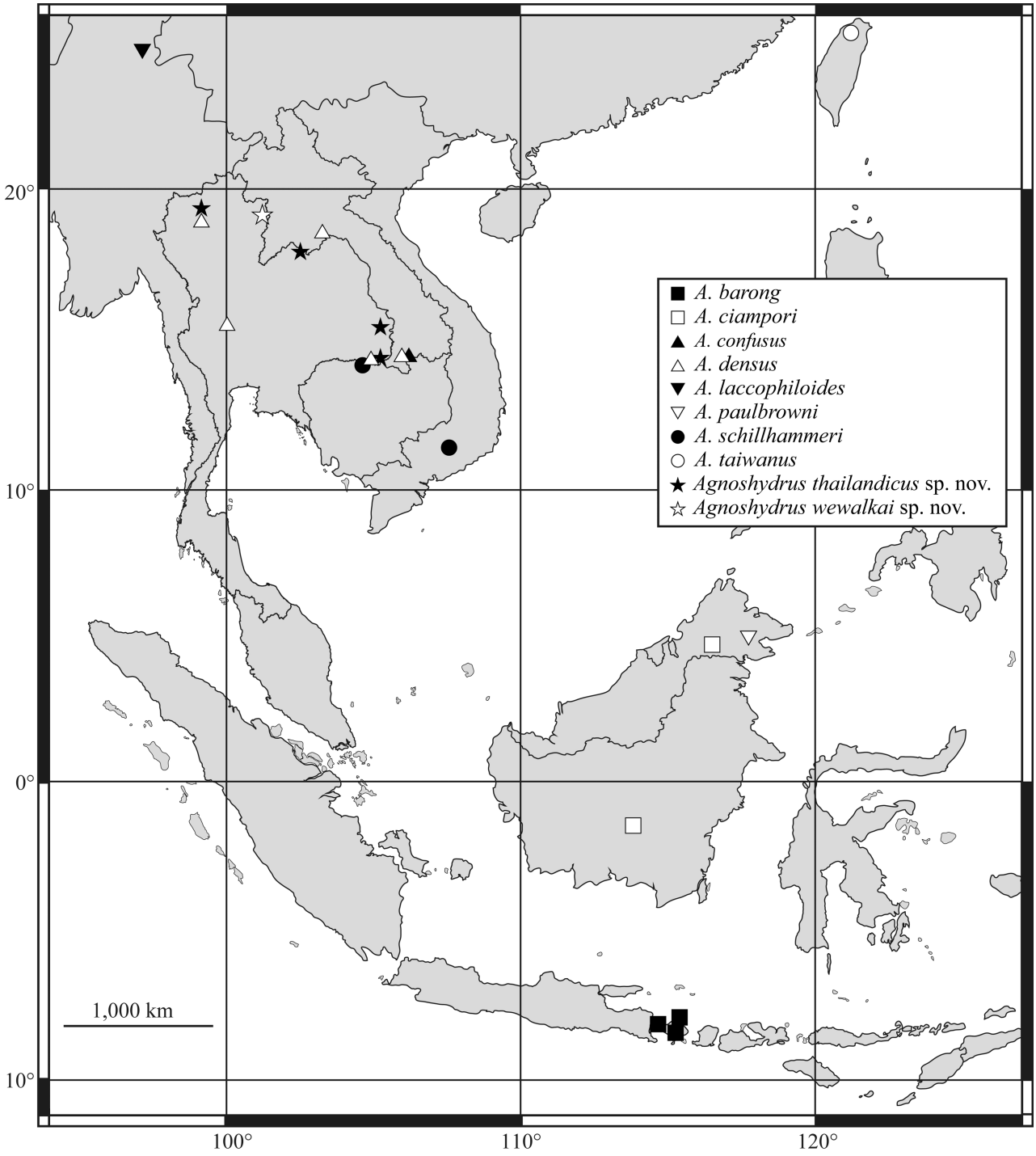


FIGURE 13. Distribution map of *Agnoshydrus* species.

New locality records

Agnoshydrus densus Biström, Nilsson & Wewalka

Agnoshydrus densus Biström, Nilsson & Wewalka, 1997: 74; Wewalka & Biström 1997: 851; Wewalka 1999: 25; Wewalka & Wang 2007: 1; Nilsson & Hájek 2024: 199.

Material examined. 1 ♂, Ubon Ratchatani Province, Nam Yuen Dist., Dom Pradit St. 239 (alt. 190 m), 26.II.2021, R. Okada leg. (THNHM).

Remarks. The only specimen from Ubon was collected at the same locality as *A. thailandicus* sp. nov. (cf. above).

Distribution. Laos, Thailand: Chiang Mai, Uthai Thani, Ubon Ratchathani (first provincial record) (Fig. 13).

Agnoshydrus schillhammeri Wewalka

Agnoshydrus schillhammeri Wewalka, 1999: 25; Wewalka & Wang 2007: 1; Nilsson & Hájek 2024: 200.

Material examined. 2 ♂, 1 ♂, Cambodia, Preah Vihear, Choam Khsant, 1.–12.V.2012, local collector (CGW).

Distribution. *Agnoshydrus schillhammeri* was originally described from southern Vietnam (Wewalka, 1999); the first record of the species reported here expands its distribution to Cambodia (Fig. 13).

Key to the species of *Agnoshydrus* (modified from Wewalka & Wang 2007)

1	Metaventrite with coarse punctures (Figs 5E, 6E)	2
-	Metaventrite without coarse punctures	7
2	Each elytron laterally with distinct longitudinal notch	3
-	Elytra laterally without distinct longitudinal notch	4
3	Elytra without testaceous spots. TL 2.4 mm; species from Borneo	*A. ciampori*
-	Elytra with testaceous spots. TL 2.1–2.2 mm; species from Thailand	*A. wewalkai* **sp. nov.**
4	Metatarsomeres in male with extreme long hair-tufts; large species; TL: 2.3–2.7 mm; species from Borneo	*A. paulbrowni*
-	Metatarsomeres in male without extreme long hair-tufts; smaller species; TL: 1.8–2.1 mm	5
5	Elytra without testaceous spots; TL: 2.1 mm; species from Taiwan	*A. taiwanus*
-	Elytra with testaceous spots; TL: 1.8–2.0 mm	6
6	Elytra distinctly attenuated posterior of basal third; Median lobe of aedeagus strongly curved at apex in lateral view, narrower at apex in ventral view; species from Bali	*A. barong*
-	Elytra regularly attenuated posterior of basal half; Median lobe of aedeagus slightly and equally curved in lateral view, laterally expanded at apex in ventral view; species from Thailand	*A. thailandicus* **sp. nov.**
7	Metatibial spurs modified, short and broad; TL: 2.36 mm; species from Myanmar	*A. laccophiloides*
-	Metatibial spurs not modified	8
8	Head and pronotum almost black, body shape less globular; TL: 2.2–2.3 mm; species from southern Laos	*A. confusus*
-	Head and pronotum pale ferrugineous, body shape more globular	9
9	Median lobe in ventral view regularly attenuated to apex	*A. schillhammeri*
-	Median lobe in ventral view shovel-like at apex	*A. densus*

Discussion

The two new *Agnoshydrus* species described in this article bring the number of species contained in this genus to ten. Since all specimens studied were collected by thorough sweeping along submerged roots of trees in small streams, this study suggests that *A. thailandicus* **sp. nov**. and *A. wewalkai* **sp. nov**. are restricted to such microhabitat.

Wewalka & Wang (2007) divided the members of the genus *Agnoshydrus* into two groups. The first group contains *A. barong*, *A. ciampori*, *A. paulbrowni* and *A. taiwanus* which are only known from Bali, Borneo and Taiwan (Fig. 13). These species are characterized by a metaventrite which is covered with coarser punctures and smooth areas between them. The second group contains *A. confusus, A. densus, A. laccophiloides* and *A. schillhammeri* which are

restricted to Southeast Asia mainland and are characterized by the presence of dense and regular punctation on the metaventrite.

The two new Thailand species of *Agnoshydrus* belong to the first group. Assuming that the punctation of the metaventrite represents a putative synapomorphy supporting a monophyletic origin of each of these species-groups, this study is the first report of members of this species-group from Southeast Asia mainland. It is worth noting also that *A. thailandicus* **sp. nov.** and *A. barong* share the presence of distinct long setae on the inner surface of the parameres (Fig. 5D and Hendrich & Balke 1995: fig. 19), and that *A. wewalkai* **sp. nov.** and *A. ciampori* both are characterized by the presence of a distinct longitudinal notch along the lateral side of each elytron (Fig. 3 and Wewalka & Wang 2007: fig. 2). Such similarities are particularly surprising because the species are distributed far apart from each other: the two new species occur in Thailand, but *A. barong* in Bali and *A. ciampori* in Borneo (Fig. 13). Further studies are certainly needed to better assess the phylogenetic relationship of members of *Agnoshydrus*.

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