# Aquatic Polyphaga (Insecta: Coleoptera) from Kampong Speu Province, Cambodia

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## មូលន័យសង្ខេប

នេះជាការបង្ហាញលទ្ធផលនៃសារពើភណ្ឌសត្វ លើពពួកសត្វល្អិតទឹកស្លាបរឹង (aquatic Polyphaga beetles) ដែលជាផ្នែកមួយនៃសិក្ខាសាលារៀបចំដោយគម្រោង BIO-PHIL ក្នុងប្រទេសកម្ពុជា។ សំណាកត្រូវបានប្រមូលពីស្ទឹងតូចៗចំនួន៣ និងត្រពាំងចំនួន១ ដែលស្ថិតនៅក្នុងខេត្តកំពង់ស្ពឺ ក្នុងអំឡុងខែកក្កដា ឆ្នាំ២០១៨។ សត្វចំនួន២១ក្រុមត្រូវបានប្រមូល និងកំណត់អត្តសញ្ញាណដល់កម្រិតប្រភេទ ឬដល់កម្រិតប្រភេទដោយផ្អែកលើលក្ខណៈរូបរាងខាងក្រៅ។ លក្ខណៈសម្គាល់របស់ពួកវាត្រូវបានពណ៌នា រួមជាមួយយោបល់ស្តីពីទីជម្រក របាយ និងកំណត់សម្គាល់បន្ថែមផ្សេងៗទៀត។ បញ្ជីឈ្មោះពួក និងប្រភេទនៃសត្វល្អិតទឹកក្នុងអំបូរ៖ Dryopidae Elmidae Hydraenidae Hydrophilidae Psephenidae និង Spercheidae នៃប្រទេសកម្ពុជាត្រូវបានបង្ហាញ ដោយមានទាំងប្រភេទដែលជាកំណត់ត្រាថ្មីសម្រាប់ប្រទេសកម្ពុជាផងដែរ។

## Abstract

We present the results of a faunistic inventory undertaken on aquatic Polyphaga beetles as part of a workshop organised by the BIO-PHIL project in Cambodia. Three small rivers and a pond in Kampong Speu Province were sampled in July 2018. Twenty-one taxa were collected during the sampling and identified to species or morphospecies level. These are described with comments on habitat, distribution and further remarks, where applicable. A checklist of the genera and species of aquatic Dryopidae, Elmidae, Hydraenidae, Hydrophilidae, Psephenidae and Spercheidae of Cambodia is presented which includes new records for the country.

## Keywords

Biodiversity survey, checklist, Dryopidae, Elmidae, Hydraenidae, Hydrophilidae, Psephenidae, Spercheidae, taxonomy, water beetles.

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## Introduction

Cambodia forms part of the Indo-Chinese sub-region of the Indo-Burma biodiversity hotspot (Wikramanayake *et al.,* 2002). Most of its territory belongs to the 'Greater Mekong' region, so called because the river crosses the country in a north-south direction. Until recently, Cambodia was rarely the focus of entomological research. This changed after the country became an ASEAN member state, as endeavours such as the Cambodian Entomology Initiatives (CEI) at the Royal University of Phnom Penh (RUPP) began surveying the presumably rich insect diversity in 2015. Short-term projects such as the Scientific Consortium for Interdisciplinary Biodiversity Research have also supported the creation of scientific networks with Cambodian scientists, with results in aquatic entomology and taxonomy (Kodada *et al.,* 2017; Zettel *et al.,* 2017). Recently, the CEI team joined the Biodiversity Teaching in a Philippine-Cambodian-German Network (BIO-PHIL) funded by the German Academic Exchange Service.

A BIO-PHIL workshop on field sampling and morpho-taxonomy was delivered at the RUPP in July 2018 (Fig. 1A). Twenty students and instructors from affiliated institutions participated. The practical sessions, including a rapid field survey, focused specifically on aquatic beetles because occurrence and distribution data of Cambodian aquatic beetles are very scarce compared to the neighbouring countries of Laos, Thailand and Vietnam. For example, among the major families of aquatic Polyphaga, only 22 species of Hydrophilidae and no species of Dryopidae, Elmidae, Psephenidae or Hydraenidae were reported from Cambodia (Hansen, 1998, 1999; Short & Hebauer, 2006; Short & Fikacek, 2011; Jäch *et al.,* 2016). This contrasts with more than 87 species of Hydrophilidae, Hydraenidae and Elmidae recorded from Thailand, approximately 130 from Vietnam and 107 from the Philippines (Hansen, 1998, 1999; Short & Hebauer, 2006; Short & Fikacek, 2011; Freitag *et al.,* 2016; Jäch *et al.,* 2016; Vidal *et al.,* 2017). This is very unsatisfactory given the fact that many aquatic beetles have high potential as bioindicators (Freitag *et al.,* 2016) and for use in environmental impact assessments (Balke *et al.,* 1997).

This paper presents new faunistic data for Cambodia on aquatic Polyphaga collected during field sampling undertaken as part of the above workshop.

## Methods

### Field sampling

Aquatic beetles were collected at four main sites in Kampong Speu Province (Figs 1B–D & 2) between 11–13 July 2018, as follows:

- Cam3P—Vegetated pond, 0.1 km north of Chambok Community, secondary vegetation (90 m above sea level (a.s.l.), 11°23′00′′ N, 104°06′50′′ E);
- Cam3R—Chambok River, 1.83 km from Chambok Community, secondary forest (240 m a.s.l., 11°21′58′′ N, 104°06′17′′ E);
- Cam4—Kokie Waterfall, secondary forest remnants (110 m a.s.l., 11°12′11′′ N, 104°03′49′′ E);
- Cam5—Waterfall at Kirirom National Park, rural area partly with secondary forest (640 m a.s.l., 11°20′26′′ N, 104°02′14′′ E).

The beetles were obtained by checking various microhabitats with hand-nets and manual examination of submerged substrates (Fig. 1D) as outlined in Freitag (2015). Specimens collected in this way are indicated by 'M' at the end of the label and the microhabitats sampled were as follows: a—sand/gravel deposits in littoral run areas (with distinct current) of a stream; b—sand/gravel deposits in calm littoral pool areas of a stream; c—bottom gravel in a run/riffle; e—leaf litter/ coarse particulate organic matter (CPOM) in side pools adjacent to a stream; f—submerged wood; g—submerged rock surface in a run/riffle; h—littoral root packs/grass bunches in a run/riffle; p—rock surface in calm pool areas of a stream.

Black light traps were also used to sample between 1800 and 2100 hrs at the Cam3P and Cam3R sites. Specimens collected with these traps are indicated by 'L' at the end of the label. An emergence trap, as described in Freitag (2004), was also installed at the Cam3R sampling site (Fig. 1B) for one week, but did not yield any specimens as the device was flooded and partly damaged by heavy monsoon rains.

### Specimen preservation and identification

Specimens were preserved in 96% ethanol or glued on entomological card-mounts when dissected for identification. The material we list is deposited at the CEI collection in the RUPP. Original descriptions or re-descriptions of taxa, regional faunal guides (Komarek, 2003; Shepard & Sites, 2016) and comparisons to type material at the Natural History Museum of Vienna, Austria (NMW) were used to identify specimens to species when possible. Specimens were examined with Olympus SZ60 stereomicroscopes. Specimens of selected taxa were photographed under a Zeiss Axio Zoom V16 microscope using diffuse LED lighting and a Canon 5D Mark II SLR. Photographs were taken at various focus layers and subsequently stacked using Zerene Stacker software (Zerene Systems, Washington, USA).

 

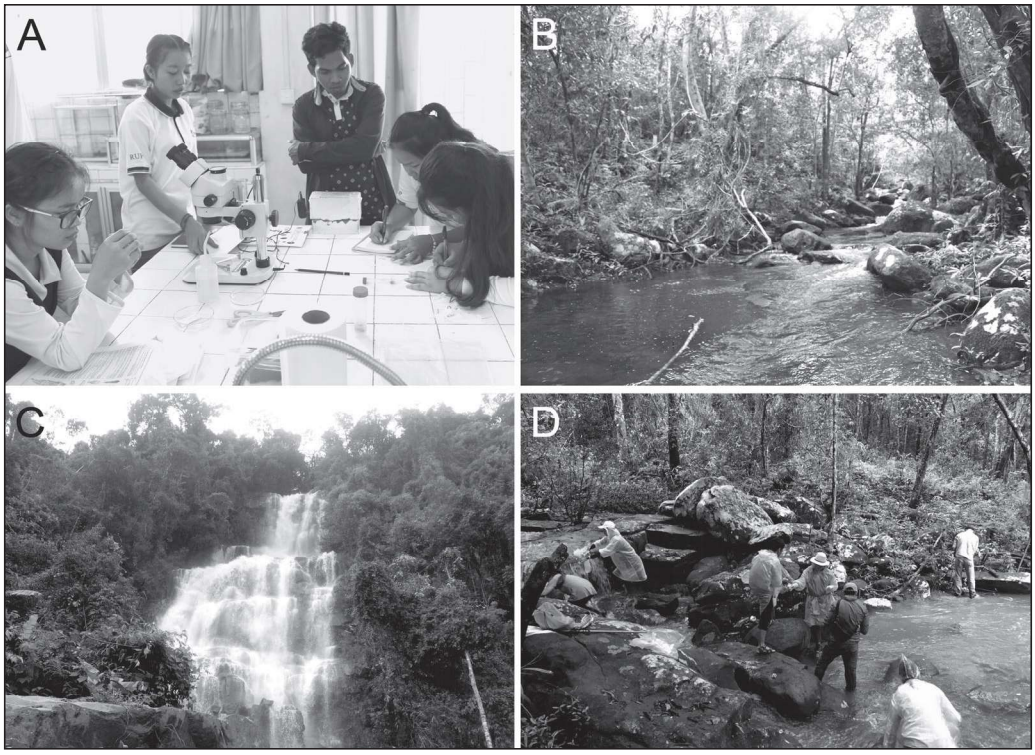


**Fig. 1** Laboratory work and collecting sites: A) BIO-PHIL workshop participants working on sample identification at Royal University of Phnom Penh, B) Cam3R sampling site, C) Cam4 sampling site, D) Participants sampling at Cam5 site.

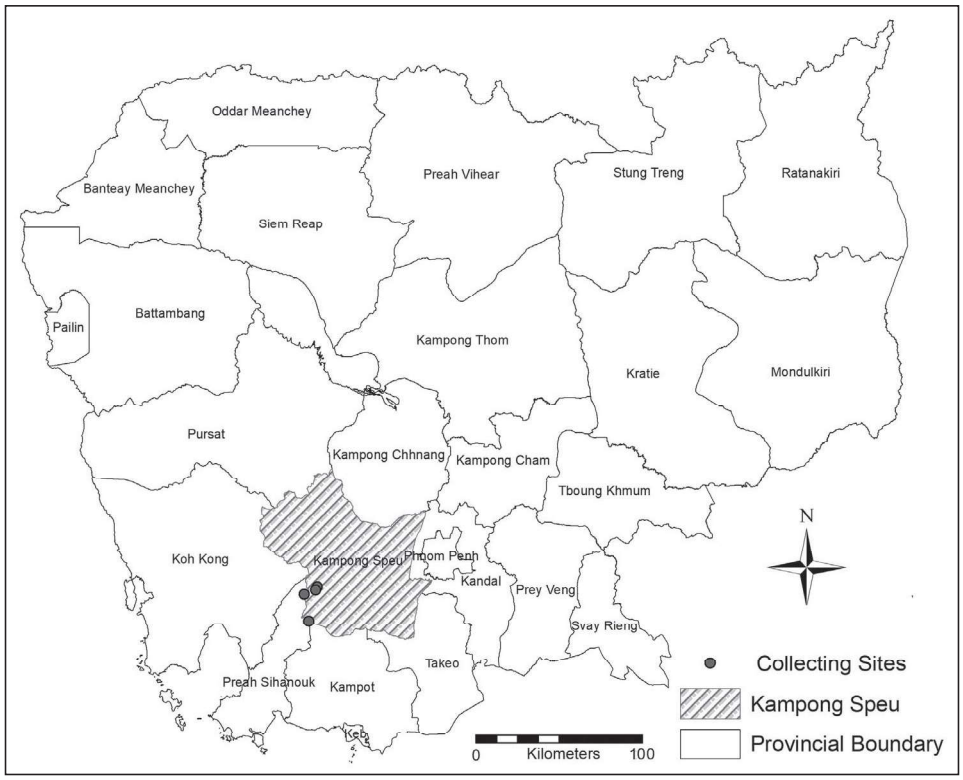


**Fig. 2** Collecting localities in Kampong Speu Province, Cambodia.

## Results

Twenty-one taxa were collected during the sampling and identified to species or morphospecies level. These are described with comments on habitat, distribution and additional remarks, where applicable.

### HYDRAENIDAE (Minute Moss Beetles)

***Hydraena (Hydraenopsis)* spp.** (Fig. 3A)

*Material*: Sp. 1, one male (Cam3R, b, 11.7.2018, M), one female (Cam4, p, 12.7.2018, M); Sp. 2: one male (Cam3R, b, 11.7.2018, M).

*Habitat*: Our specimens were collected from littoral sandy deposits and rock surfaces in calm pool sections of streams, respectively. *Hydraena* Kugelann, 1794 species are most commonly collected from such shallow littoral microhabitats in slow-flowing or stagnant waters, but also among leaf litter and other CPOM deposits. However, some species are also adapted to special habitats like helocrenes, hygropetric rocks and even trapped leaf litter in fast-flowing streams (Freitag, 2015).

*Remarks*: These two species of the subgenus *Hydraenopsis* Janssens, 1972 are unnamed and our report is the first for Cambodia. The genus is mega-diverse in the Oriental Realm (Jäch & Balke, 2008), but commonly overlooked due to species' small size, patchy distribution and hidden habitats (Freitag, 2014). It would not be surprising if *Hydraena* turns out to be the most speciose genus of aquatic beetles in Cambodia, as in the Philippines (Freitag *et al.*, 2016). However, only six species of *Hydraena* are known from the Indo-Chinese sub-region, all of them from Vietnam (Hansen, 1998). We refrain from formally describing our material until more is available.

### HYDROPHILIDAE (Water Scavenger Beetles), Hydrophilinae

***Berosus (Euoplurus) chinensis* Knisch, 1922** (Fig. 3B)

*Berosus (Enoplurus) indicus* ssp. *chinensis* Knisch, 1922, 111 (orig. descr.); *Berosus (Enoplurus) chinensis* Knisch: Schödl, 1991, 124; Hansen, 1999, 75 (cat.).

*Material*: One male, one female (Cam3P, 12.7.2018, L).

*Distribution*: *Berosus chinensis* is widely distributed from Afghanistan in the West to China (Hong Kong) in the East including Thailand and Vietnam (Hansen, 1999). Our record is the first from Cambodia.

*Habitat*: Our two specimens were caught by a black light trap near a pond which is a typical microhabitat for *Berosus* spp., which generally inhabit sun-exposed, stagnant water bodies (Freitag, 2015).

***Berosus* (s.str.) *pulchellus* MacLeay, 1825** (Fig. 3C)

*Berosus pulchellus* MacLeay, 1825, 35 (orig. descr.); *Berosus* (s.str.) *pulchellus* MacLeay: Schödl, 1993, 214–218; Hansen, 1999, 92 (cat.); Freitag & Pangantihon, 2010, 142.

*Material*: One male, two females (Cam3P, 12.7.2018, L).

*Distribution*: *Berosus pulchellus* is widely distributed in the Oriental Realm and neighbouring areas of the Australasian, Afrotropical and Palaearctic Realms (Hansen, 1999). This is the first record from Cambodia.

*Habitat*: See respective remarks for *Berosus chinensis*.

***Paracymus mimicus* Wooldridge, 1977**

*Paracymus mimicus* Wooldridge, 1977, 123 (orig. descr.).

*Material*: One male (Cam3P, 12.7.2018, L).

*Distribution*: *Paracymus mimicus* is known from Laos and Thailand (Wooldridge, 1977). This is the first record from Cambodia.

*Habitat*: The single specimen was caught by a black light trap near a vegetated pond and its preferred microhabitat is therefore unknown. *Paracymus* spp. are usually found in shallow littoral sand and gravel deposits or under stones in stagnant water bodies and pool sections of streams (Freitag, 2015).

***Pelthydrus* cf. *vitalisi* Orchymont, 1926** (Figs 3D–E)

*Pelthydrus vitalisi* Orchymont, 1926, 239–40 (orig. descr.); Orchymont, 1932, 696–698 & Schönmann, 1995, 113–115, Abb. 6 (redescr.); Hansen, 1999, 129 (cat.).

Material: One male (Cam4, f, 12.7.2018, M).

*Distribution*: The presumed complex of species currently recognized as *Pelthydrus vitalisi* s.l. is known from China (Hong Kong & Taiwan), Vietnam, Thailand, Malaysia and Indonesia (Sumatra, Java, Bali & Lombok). The type locality is in northern Vietnam. This is the first record of *P. vitalisi* s.l. from Cambodia.

*Diagnosis of the sole male from Cambodia*: Body ovoid elongate and dorsally moderately convex, calculated length of pronotum and elytra (CL) 2.2 mm, body length approximately 2.4 mm, maximum elytral width (EW) 1.1 mm, 2.0 times as long as wide (CL/EW).

Dorsal colouration (Fig. 3D) predominantly chestnut brown. Head rectangular, distinctly narrower than pronotum, head width including eyes 0.65 mm; interocular distance 0.50 mm; lateral portion indistinctly microreticulate. Pronotum sub-rectangular (Fig. 3D), pronotum length along midline (PL) 0.5 mm, maximum pronotum width (PW) 1.0 mm, 2.0 times as long as wide (PL/PW); lateral margin finely dentate, evenly convex, broadest at

 

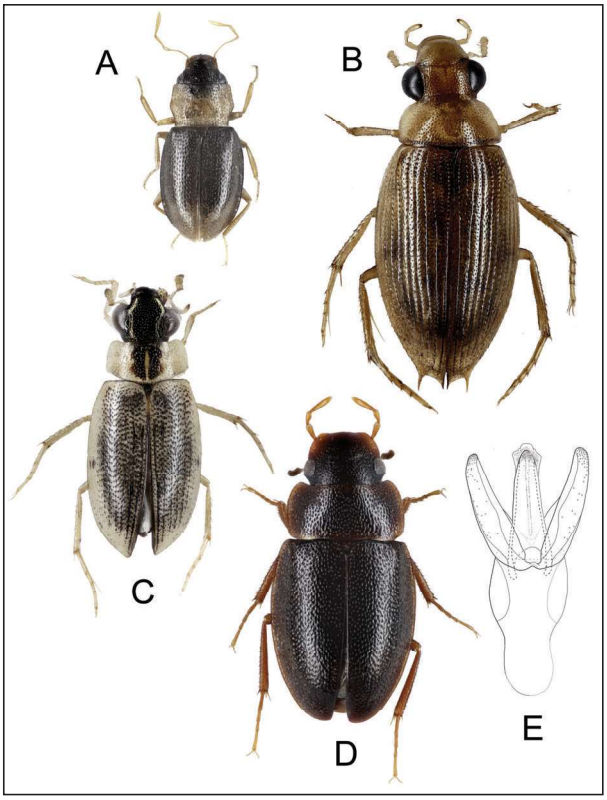


**Fig. 3** Aquatic Polyphaga collected during the field survey: Hydraenidae A) *Hydraena (Hydraenopsis)* sp.1, Hydrophilidae B) *Berosus (Euoplurus) chinensis*, C) *Berosus* (s.str.) *pulchellus*, D) *Pelthydrus* cf. *vitalisi*, E) *Pelthydrus* cf. *vitalisi* (aedeagus drawing).

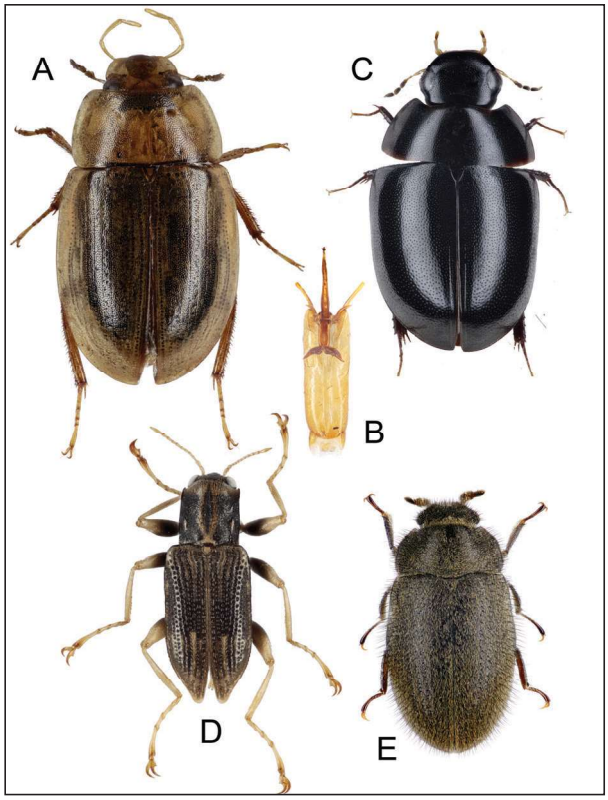


**Fig. 4** Aquatic Polyphaga collected during the field survey: Hydrophilidae A) *Helochares (Hydrobaticus)* sp., B) *Helochares (Hydrobaticus)* sp. (aedeagus), C) *Coelostoma* sp., Elmidae D) *Graphelmis boukali*, Dryopidae E) *Ceradryops* sp.

middle. Elytra (Fig. 3D) elongate, lateral margin finely dentate, elytral length (EL) 1.7 mm, ca. 3.0 times as long as wide (EL/EW), widest at anterior 0.3; apices separately rounded. Venter predominantly with plastron pubescence. Aedeagus as in Fig. 3E.

*Remarks*: Our specimen is very similar to other material from the sub-region determined as *P. vitalisi* by Schönmann (material in NMW). However, it varies slightly from the redescription and from the holotype by some characters: aedeagus (Fig. 3E) ca. 400 μm long (vs. 500 μm); median lobe, although conical, relatively broader in upper half, more distinctly tapered apically and with a more roundly pointed tip (vs. almost subparallel in apical fourth); corona very distally localized (vs. in apical forth (Schönmann, 1995)). Median lobe apically extended by a membranous sac. Certainly, the specimen belongs to the *P. vitalisi* complex of species. We are planning to investigate the species delimitation with mtDNA analysis before attempting a formal description of the presumed new species, since Schönmann (1995) suggested more detailed studies to clarify if *P. vitalisi* s.l. comprises one or several species.

*Habitat*: The specimen was collected from submerged wood in fast flowing water. For many species of the genus, it is somewhat typical to dwell in runs and riffles of streams. This is quite exceptional among hydrophilids, which are usually adapted to slow-moving or stagnant waters.

### Chaetarthriinae

#### *Chaetarthria* sp.

*Material*: One female (Cam5, e, 13.7.2018, M).

*Habitat*: The specimen was collected in the same site and microhabitat as *Notionotus notaticollis* (see respective remarks for that species).

*Remarks*: *Chaetarthria almorana* Knisch, 1924, *C. indica* Orchymont, 1920, *C. malickyi* Hebauer, 1995 and *C. saundersi* Orchymont, 1923 are known from the Indo-Chinese sub-region (Hansen, 1999) and *C. kuiyanae* Jia, Wang & Aston, 2018 from neighbouring areas of China (Jia *et al.*, 2018), but none of these have been recorded from Cambodia and the genus is therefore recognized in the country for the first time. We did not attempt to identify our sole female specimen, which was brown in colour.

### Acidocerinae

***Agraphydrus* (s.str.) *coomani* (Orchymont, 1927)**

*Helochares (Agraphydrus) coomani* Orchymont, 1927, 248 (orig. descr.); *Agraphydrus coomani* Orchymont: Hansen, 1999, 156 (cat.).

*Material*: One male (Cam3P, 12.7.2018, L).

*Distribution*: *Agraphydrus coomani* is widely distributed from Vietnam, peninsular Malaysia across Papua New Guinea up to Australia (Hansen, 1999). This is the first record from Cambodia.

*Habitat*: The single specimen was attracted to a light trap placed near a vegetated pond. *Agraphydrus* species are usually found in littoral deposits of stagnant water bodies or calm stream sections (Freitag, 2015).

***Agraphydrus* sp.**

*Material*: Sp. 1, one female (Cam5, e, 13.7.2018, M).

*Habitat*: Our specimen was collected from a shallow, isolated side pool with CPOM and leaf litter near a small river in secondary forest.

*Remarks*: Except for the previous record, no species of *Agraphydrus* has been recorded from Cambodia (Hansen, 1999; Short & Hebauer, 2006; Short & Fikacek, 2011). We did not attempt to identify our single female specimen. The genus is currently undergoing a taxonomic revision by Albrecht Komarek (NMW).

***Helochares (Hydrobaticus)* sp.** (Fig. 4A–B)

*Material*: Three males, two females (Cam3P, 12.7.2018, L).

*Habitat*: See respective remarks for *Agraphydrus coomani*.

*Remarks*: Only the following species of *Helochares (Hydrobaticus)* MacLeay, 1871 were previously known from Cambodia: *H. anchoralis* Sharp, 1890; *H. lentus* Sharp, 1890; *H. neglectus* (Hope, 1845); and *H. salvazai* Orchymont, 1919. Our specimens do not agree with the descriptions of any of these or other comparative material from Southeast Asia and is probably new to science. It is easily recognizable by its aedeagus: the long and slender parameres and internal fibula that can be outstretched presumably during copulation (Fig. 4B). Two of our males have identical features, but their genitalia are retracted and conically aligned. Comparisons with species known from the sub-region suggests this is a new species but further study is needed to confirm this and allow for formal description.

***Helochares* (s.str.) *pallens* (MacLeay, 1825)**

*Enhydrus pallens* MacLeay, 1825, 140 (orig. descr.); *Helochares pallens* (MacLeay, 1825), Orchymont, 1932, 688; *Helochares* (s.str.) *pallens* MacLeay, 1825, Hansen 1999, 162 (cat.); Freitag, 2013, 18.

*Material*: One female (Cam3P, 12.7.2018, L).

*Distribution*: *Helochares pallens* is widely distributed from New Guinea to the Afrotropical region and the southern Palaearctic (Hansen, 1999). Several records are known from Thailand (Hansen, 1999), but this is the first record from Cambodia.

*Habitat*: See respective remarks for *Agraphydrus coomani*.

### Enochrinae

***Enochrus* sp.**

*Material*: One male (Cam3P, 12.7.2018, L).

*Habitat*: See respective remarks for *Agraphydrus coomani*.

*Remarks*: *Enochrus (Methydrus) haroldi* (Sharp, 1884) is the only species of the genus recorded from Cambodia (Satô & Chujô, 1961). The available literature and lack of immediately accessible types do not allow us to identify the species at present.

***Notionotus notaticollis* Hebauer, 2001**

*Notionotus notaticollis* Hebauer, 2001, 11 (orig. descr.); Short & Hebauer, 2006, 329 (cat.).

*Material*: Two males, two exemplars (Cam5, e, 13.7.2018, M); three males, two females (Cam3R, e, 11.7.2018, M).

*Habitat*: Most specimens were collected at the same site and microhabitat as *Agraphydrus* sp.

*Distribution*: *Notionotus notaticollis* is known from Laos, Vietnam and China (Hebauer, 2001). This is a new record for Cambodia.

### Sphaeridiinae

***Coelostoma* sp.** (Fig. 4C)

*Material*: One male (Cam4, f, 12.7.2018, M); one female (Cam3R, a, 11.7.2018, M).

*Habitat*: Our two specimens were found in wet semi-submerged wood in the sprayzone of a waterfall

 

and in a shallow littoral in slow-flowing water, respectively. Shallow flowing or stagnant waters are generally a common habitat for *Coelostoma* Brullé, 1835 and specimens are often observed on hygropetric rocks (H. Freitag, unpublished data).

*Remarks*: The following species of *Coelostoma* are recorded from Cambodia: *C. (Hammacoelostoma) salvazai* Orchymont, 1919; *C. (Lachnocoelostoma) phallicum* Orchymont, 1940; and *C. (Lachnocoelostoma) vagum* Orchymont, 1940. Seven more species are known from neighbouring countries (Hansen, 1999). However, the specimens from our collection do not agree well with any of those, especially in the male aedeagus, and they are probably new to science. Further study needed to confirm this assessment.

## ELMIDAE (Riffle Beetles), Elminae

***Graphelmis boukali* Čiampor, 2004** (Fig. 4D)

*Graphelmis boukali* Čiampor, 2004, 8–10, figs 4, 28–31 (orig. descr.); Short & Hebauer, 2006, 329 (cat.).

*Material*: One female (Cam3R, f, 11.7.2018, M).

*Habitat*: As with most representatives of the genus, this taxon was found on submerged wood in rapidly flowing water.

*Distribution*: Our sole female agrees well with the original description and type material at NMW. *Graphelmis boukali* was previously only known from Laos, Malaysia and Thailand (Čiampor, 2004). This is a new record for Cambodia.

***Grouvellinus* sp.**

*Material*: One larva (Cam3R, g, 11.7.2018, M).

*Habitat*: A single larva was collected from a rock surface in a forest river.

*Remarks*: The general habitus of *Grouvellinus* larvae is known from Kodada *et al.* (2016a), Hayashi & Sota (2010) and works of the first author in Borneo and the Philippines (H. Freitag, unpublished data). In Indochina, the species *Grouvellinus pelacoti* Delève, 1970, *G. setosus* Delève, 1970 and *G. tonkinus* (Grouvelle, 1889) are known from Vietnam, and *G. punctatostriatus* Bollow 1940 and *G. sculptus* Bollow 1940 from Myanmar, respectively (Jäch *et al.*, 2016). Due to the lack of larval descriptions, our specimen cannot be identified. This is the first record of the genus from Cambodia.

***Stenelmis* sp.**

*Material*: One female (Cam5, c, 13.7.2018, M).

*Habitat*: Our specimen was collected from gravel deposits in a stream riffle section.

*Remarks*: Species of *Stenelmis* (s.l.) are usually very common in Southeast Asian streams (H. Freitag, unpublished data). However, many of them are undescribed and the genus needs revision, as it may comprise several unrelated genera.

## Larinae

***Potamophilinus* sp. *[? longipes]***

*Material:* Three males, three females (Cam3R, h, 11–12.7.2018, M).

*Habitat*: Our specimens were collected from littoral grass bunches.

*Remarks*: *Potamophilinus longipes* Grouvelle, 1892 is only known from Myanmar. Due to the brief original description (Grouvelle, 1892) and lack of immediate access to type material, our specimens cannot be identified with certainty. There is an obvious sexual dimorphism on the sub-basal section of the elytra: females display distinct rounded humps between the 2nd and 3rd elytral striae, similar to the spiny humps in females of *P. bispinosa* (Bollow, 1938, 172–174: Fig. 31) for which material has been checked at NMW for comparison. The genus is recorded from Cambodia for the first time.

## DRYOPIDAE (Longtoed Water Beetles)

***Ceradryops* sp.** (Fig. 4E)

*Material*: Two exemplars (Cam4, f, 12.7.2018, M).

*Habitat*: Our specimens were collected from semi-submerged wood in rapidly-flowing water below a waterfall. We presume they were not really submerged.

*Remarks*: This species is unknown to science. Several species of the genus are known from India and Sri Lanka. Within the region adjacent to Indochina, only one species, *Ceradryops matei* Kodada & Boukal 2003, is known from Hong Kong (China) which obviously differs in lacking a dense setaceous body cover underlying the erected setae (Kodada & Boukal, 2003: Fig. 12) and by possessing a slenderer pronotum and smaller overall size (ca. 1.8 mm). This interesting discovery will be described in a separate paper. Whether or not the genus represents a true dryopid is currently questionable (Kodada *et al.*, 2016b).

***Elmomorphus* sp.**

*Material*: Eight exemplars (Cam3R, f, 11.7.2018, M).

*Habitat*: Our specimens were collected from fully submerged wood and leaf litter in rather slow-flowing, shallow water.

*Remarks*: The *Elmomorphus* genus is common and wide-spread and is currently being revised by David Ziak & Jan Kodada of the Comenius University Bratislava. We therefore do not attempt a detailed diagnosis.

PSEPHENIDAE (Waterpenny Beetles), Eubrianacinae

***Jinbrianax* sp.**

*Material*: One larva (Cam4, g, 20.7.2018, M).

*Habitat*: Our specimen was collected from rock surface in torrential water below a waterfall.

Remarks: Due to the lack of larval descriptions at the species level, our specimen cannot be identified further. The species *Jinbrianax metallicus* (Pic, 1922) (West Malaysia, Thailand & Vietnam) and *J. schillhammeri* Lee, Satô & Yang, 1999 (Laos) are known from the sub-region (Lee *et al*., 1999). Our report is the first record of the genus from Cambodia.

## Discussion

Although our study was based on just three days of fieldwork, we were able to record 21 taxa of aquatic Polyphaga (seven confidently identified species, eight treated as morphospecies and six presumably new species) from four study sites. This figure might have been much higher with better weather conditions, because heavy monsoon rain and flooding occurred before and during our sampling. At least 16 (76%) of our taxa (excluding unidentified specimens of genera already recorded in the country) have never been recorded from Cambodia. This illustrates the lack of historical survey activity and reflects the current incompleteness of knowledge regarding Cambodian water beetles and aquatic macroinvertebrates in general.

Jäch & Balke (2008) predicted that 39% of Oriental water beetles have yet to be described. While our knowledge does not yet allow for precise estimates (Appendix 1), many new species likely still await discovery and scientific description, some of them within our collections. This is exemplified by our first records of the Dryopidae, Elmidae, Hydraenidae and Psephenidae families from Cambodia, although we only provide genus and morpho-species records here, except for *Graphelmis boukali*.

Notwithstanding this increase in faunistic data, knowledge on Cambodian water beetles remains far from complete. Further sampling and rigorous identifications are needed to provide a basis for ecological studies. Sampling is especially needed in areas of high-endemicity such as mountain ranges, as well as sampling in different seasons. A high variety of microhabitats and various environmental parameters should be included in the data collection (Freitag, 2015; Freitag *et al*., 2016: 207–208). Different trapping methods should also be employed, such as emergence traps and drift nets, which have proven useful in several studies (Freitag, 2015 and references therein).

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## Appendix 1 Checklist of aquatic Polyphaga (families Spercheidae, Hydrophilidae, Hydraenidae, Elmidae, Dryopidae, Psephenidae) known to occur in Cambodia

The list below compiles data from this study and relevant catalogues (Hansen 1998, 1999; Short & Hebauer 2006; Short & Fikacek, 2011; Jäch *et al.*, 2016). Representatives of genera which are recorded for the first time are included, even if not identified to species level. Unidentified species of genera previously recorded in Cambodia are excluded, as are taxa which are considered terrestrial (e.g., *Sphaeridium* Fabricius, 1775 and *Coelofletium* Orchymont, 1925 (Hydrophilidae)). N = new record from this study, P = previously published record.

| # | Taxon | Record |
|---|---|---|
| | SPERCHEIDAE | |
| 1 | *Spercheus stangli* Schwarz & Barber, 1918 | P |
| | HYDROPHILIDAE, Hydrophilinae | |
| 2 | *Allocotoccerus myronius* (Orchymont, 1939) | P |
| 3 | *Allocotoccerus nigellus* Chujô & Satô, 1964 | P |
| 4 | *Amphiops mater* Sharp, 1873 | P |
| 5 | *Berosus siamensis* Schodel, 1992 | P |
| 6 | *Berosus (Euoplurus) chinensis* Knisch, 1922 | N |
| 7 | *Berosus* (s.str.) *pulchellus* MacLeay, 1825 | N |
| 8 | *Hydrobiomorpha* (s.str.) *cambodiensis* (Régimbart, 1903) | P |
| 9 | *Hydrobiomorpha* (s.str.) *malaisica* Mouchamps, 1959 | P |
| 10 | *Hydrophilus* (s.str.) *bilineatus caschmirensis* Redtenbacher, 1844 | P |
| 11 | *Hydrophilus* (s.str.) *cavisternum* (Bedel, 1891) | P |
| 12 | *Regimbartia attenuata* (Fabricius, 1801) | P |
| 13 | *Paracymus mimicus* Wooldridge, 1977 | N |
| 14 | *Pelthydrus vitalisi* Orchymont, 1926 (s.l.) | N |
| 15 | *Sternolophus inconspicuus* (Nietner, 1856) | P |
| 16 | *Sternolophus rufipes* (Fabricius, 1792) | P |
| | HYDROPHILIDAE, Chaetarthrinae | |
| 17 | *Chaetharthria* sp. | N |
| | HYDROPHILIDAE, Acidocerinae | |
| 18 | *Agraphydrus coomani* (Orchymont, 1927) | N |
| 19 | *Chasmogenus abnormalis* (Sharp, 1890) | P |
| 20 | *Helochares (Hydrobaticus) anchoralis* Sharp, 1890 | P |
| 21 | *Helochares (Hydrobaticus) lentus* Sharp, 1890 | P |
| 22 | *Helochares (Hydrobaticus) neglectus* (Hope, 1845) | P |
| 23 | *Helochares (Hydrobaticus) salvazai* Orchymont, 1919 | P |
| 24 | *Helochares* (s.str.) *pallens* (MacLeay, 1825) | N |
| 25 | *Helochares* (s.str.) *taprobanicus* Sharp, 1890 | P |
| 26 | *Helochares* (s.str.) *vitalisi* Orchymont, 1919 | P |
| | HYDROPHILIDAE, Enochrinae | |
| 27 | *Enochrus (Methydrus) haroldi* (Sharp, 1884) | P |
| 28 | *Notionotus notaticollis* Hebauer, 2001 | N |
| | HYDROPHILIDAE, Sphaerindinae | |
| 29 | *Coelostoma (Hammacoelostoma) salvazai* Orchymont, 1919 | P |
| 30 | *Coelostoma (Lachnocoelostoma) phallicum* Orchymont, 1940 | P |
| 31 | *Coelostoma (Lachnocoelostoma) vagum* Orchymont, 1940 | P |
| | HYDRAENIDAE, Hydraeninae | |
| 32 | *Hydraena (Hydraenopsis)* spp. | N |
| | ELMIDAE, Elminae | |
| 33 | *Graphelmis boukali* Ciampor, 2004 | N |
| 34 | *Grouvellinus* sp. | N |
| 35 | *Stenelmis* sp. | N |
| | ELMIDAE, Larinae | |
| 36 | *Potamophilinus* sp. | N |
| | DRYOPIDAE | |
| 37 | *Ceradryops* sp. | N |
| 38 | *Elmomorphus* sp. | N |
| | PSEPHENIDAE, Eubrianacinae | |
| 39 | *Jinbrianax* sp. | N |

 