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The first record of an operculate micro land snail from the Alycaeinae (Caenogastropoda, Cyclophoridae) in Cambodia, with description of a new species of *Chamalycaeus* von Möllendorff, 1897

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ABSTRACT. This study reports the first record of the operculate micro land snail from the Alycaeinae, *Chamalycaeus* ***aduncus*** Jirapatrasilp sp. nov., also the first new species of the genus in Cambodia, based on a recent survey in Battambang. This new species is similar to *Chamalycaeus excisus* (Möllendorff, 1887) and *C. excisus sublimus* Páll-Gergely et Auffenberg, 2019 from the Philippines, in shell size and shape, and the strongly downwards coiling of R3, but differs in having a shorter R2 without any blunt keel, a round aperture without any incision, and a beak- or hook-like basal edge of the outer peristome.

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Первая находка микроскопической наземной улитки подсемейства Alycaeinae (Caenogastropoda, Cyclophoridae) в Камбодже, с описанием нового вида рода *Chamalycaeus* von Möllendorff, 1897

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РЕЗЮМЕ. В данном исследовании сообщается о первой находке микроскопической наземной улитки с крышечкой из подсемейства Alycaeinae, *Chamalycaeus* ***aduncus*** Jirapatrasilp sp. nov., а также о первом новом виде этого рода в Камбодже, основанном на недавнем исследовании в Баттамбанге. Новый вид похож на *Chamalycaeus excisus* (Möllendorff, 1887) и *C. excisus sublimus* Páll-Gergely et Auffenberg, 2019 с Филиппин по размеру и форме раковины, а также по сильно загнутой вниз R3, но отличается более короткой R2 без притупленного киля, округлым устьем без выемки и основанием наружного перистома в форме клюва или крючка.

Introduction

Micro land snails with an adult size not exceeding 5–7 mm, are fascinating land snail groups with an elaborate shell sculpture, apertural barriers and configuration of tuba [Panha, Burch, 2005; Dumrongrojwattana, Wongkamhaeng, 2024]. Micro land snails can be separated into two main groups: (i) one with an operculum in the families Hydrocenidae, Diplommatinidae, and Cyclophoridae, and (ii) another one without an operculum or the pulmonated land snails in several families, but most speciose in the Hypselostomatidae [Panha, Burch, 2005; Páll-Gergely *et al.*, 2023]. In the past few years, a number of new species of both hypselostomatid [Vermeulen *et al.*, 2019b; Sutcharit *et al.*, 2023] and operculated micro land snails have been reported from Cambodia [Vermeulen *et al.*, 2007, 2019a, b; Sutcharit *et al.*, 2020], all of which were from limestone hills in southern Cambodia (Table 1). However, no new species of operculated micro land snails from the subfamily Alycaeinae has yet been reported from Cambodia.

The subfamily Alycaeinae Blanford, 1864 of the Cyclophoridae Gray, 1847 is distinct in having a sutural tube that connects to numerous perpendicular microtunnels and these microtunnels open near the umbilicus [Páll-Gergely *et al.*, 2016, 2024]. Several taxa from this subfamily have been newly discovered and revised from mainland Southeast Asia, e.g., Laos and Vietnam [Páll-Gergely *et al.*, 2017; Do, Nguyen, 2022; Páll-Gergely, 2023], Myanmar and Thailand [Páll-Gergely, Hunyadi, 2018, 2022; Jirapatrasilp *et al.*, 2021; Páll-Gergely *et al.*, 2021], and Peninsular Malaysia [Foon, Liew, 2017]. Currently, this subfamily contains a total of 368 species from eight genera, and its distribution ranges from western India to East Asia, and down to Indonesia in the south [Gittenberger *et al.*, 2024; Páll-Gergely *et al.*, 2024]. In this study, based on a recent survey in Battambang, Cambodia, we report the first record of an operculate micro land snail from the Alycaeinae, *Chamalycaeus* ***aduncus*** Jirapatrasilp sp. nov., which is also the first new species of the genus *Chamalycaeus* von Möllendorff, 1897 from Cambodia.

Material and methods

This study is based on material recently collected from Battambang, Cambodia, under the auspices of the Biodiversity Conservation to Mitigate the risks of emerging infectious diseases (BCOMING) project of the Terrestrial Conservation Programme, Fauna & Flora of Cambodia. Empty shells were hand-collected from the forest floor around limestone outcrops. Latitude, longitude, and elevation were obtained with a Garmin GPSMAP 60 CSx. Shells were photographed and measured under light microscopy using a Leica M205C microscope with a fusion optics stereo microscope and the Leica Application Suite Image System, and by scanning electron microscopy (SEM; JEOL, JSM-6610 LV) at Chulalongkorn University, Thailand. The counting of the shell whorls to the nearest quarter follows Kerney, Cameron [1979]. The nomenclature of external alycaeid shell features and the three-part division of the teleoconch namely R1 (the beginning of the teleoconch to the beginning of the differently ribbed region along the suture), R2 (the differently ribbed area to the constriction), and R3 (the constriction to the peristome) follow Páll-Gergely *et al.* [2017] and Jirapatrasilp *et al.* [2021].

Institutional abbreviations. CUMZ, Chulalongkorn University Museum of Zoology, Bangkok; NHM, The Natural History Museum, London; NHMUK, when citing specimen lots deposited in the NHM; SMF, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main.

Other abbreviations. SH, shell height; SW, shell width.

Description of this new species has been attributed to the first author. The complete citation of this new species is *Chamalycaeus* ***aduncus*** Jirapatrasilp in Jirapatrasilp *et al.*

Taxonomy

Family Cyclophoridae Gray, 1847
Subfamily Alycaeidae Blanford, 1864
Chamalycaeus von Möllendorff, 1897

Alycaeus (*Chamalycaeus*) von Möllendorff, 1897: 93. Kobelt, von Möllendorff, 1897: 148. Kobelt, 1902: 352. Gude, 1921: 223.

Chamalycaeus (*Chamalycaeus*) – Thiele, 1929: 107–108. Wenz, 1938: 477–478. Egorov, 2013: 35.

Chamalycaeus – Páll-Gergely *et al.*, 2020: 34–36. Páll-Gergely *et al.*, 2021: 5.

Type species. *Alycaeus* (*Chamalycaeus*) *fruhstorferi* von Möllendorff, 1897 [Páll-Gergely *et al.*, 2020: fig. 6b] by monotypy.

Remarks: This genus is diagnosed by having a spirally-striated teleoconch, a protoconch without spiral striae, and a wide umbilicus. At present, there is a total of 31 species and two subspecies of *Chamalycaeus* known from the southeastern Himalaya Region, Myanmar, Thailand, down to the Malay Peninsula, Sumatra, Java, Borneo, Sulawesi, including the Philippine Palawan Island [Páll-Gergely *et al.*, 2020, 2021; Vermeulen, Liew, 2022]. See Páll-Gergely *et al.* [2020] for extended diagnosis and taxonomic remarks.

Chamalycaeus ***aduncus***
Jirapatrasilp sp. nov.
(Figs 1–3)

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Table 1. List of all operculated micro land snail species recorded from Cambodia. References: 1 = Sutcharit *et al.* [2020], 2 = Vermeulen, Aiken [2020], 3 = Foon *et al.* [2017], 4 = Vermeulen *et al.* [2019b], 5 =Vermeulen *et al.* [2007], 6 = Vermeulen *et al.* [2019a], 7 = van Benthem Jutting [1962], and 8 = Dautzenberg, Fischer [1906].

Species	Type locality	Distribution	References
Family Hydrocenidae			
Georissa carinata Sutcharit et Jirapatrasilp, 2020	Phnom Kampong Trach Cave Temple, Kampong Trach District, Kampot Province, Cambodia (10°34'43.06"N, 104°28'17.67"E)	Southern Cambodia and southern Vietnam	1, 2
Georissa monterosatiana Godwin-Austen et Neville, 1879	Perak, Malaysia	Southern Cambodia, southern Thailand and Malaysia	1, 3
Family Cyclophoridae			
Subfamily Cyclophorinae			
Speleocyclotus laangensis Vermeulen *et al.*, 2019	Cave with shrine at its entrance, first chamber with collapsed roof, Phnom La'Ang, Kampot area, Kampot Province, Cambodia (10°42'25.84"N, 104°21'09.55"E)	Southern Cambodia	4
Speleocyclotus microcoryphe Vermeulen *et al.*, 2019	Phnom Koun Sat, Banteay Meas area, Kampot Province, Cambodia (10°39'53.01"N, 104°32'16.24"E)	Southern Cambodia and southern Vietnam	4
Subfamily Alycaeinae			
Chamalycaeus ***aduncus*** Jirapatrasilp, sp. nov.	Temple in Kantueu Pir (Kantueu Hill), Banan, Battambang, Cambodia (12°54'15.7"N 103°07'13.1"E)	Eastern Cambodia	This study
Family Diplommatinidae			
Diplommatina decapitata Vermeulen *et al.*, 2019	Phnom Chhngauk, Kampot area, Kampot Province, Cambodia (10°38'33.82"N, 104°16'17.42"E)	Southern Cambodia	4
Notharinia attenuata Vermeulen *et al.*, 2007	Nui Chua Hang (= Pagoda Hill), north flank of hill and west end, slopes bordering temple complex, Kien Luong, Kien Giang Province, Vietnam (10°08'22.83"N, 104°38'35.80"E)	Southern Cambodia and southern Vietnam	5, 6
Notharinia brevior Vermeulen *et al.*, 2007	Thach Dong Hill, Ha Tien, Kien Giang Province, Vietnam (10°24'38.33"N, 104°28'29.98"E)	Southern Cambodia and southern Vietnam	5, 6
Notharinia constricta Vermeulen *et al.*, 2019	Phnom Chhngauk, Kampot area, Kampot Province, Cambodia (10°38'33.82"N, 104°16'17.42"E)	Southern Cambodia	6
Notharinia crassilabris Vermeulen *et al.*, 2007	Thach Dong Hill, Ha Tien, Kien Giang Province, Vietnam (10°24'38.33"N, 104°28'29.98"E)	Southern Cambodia and southern Vietnam	5, 6
Notharinia lyostoma Vermeulen *et al.*, 2019	Phnom Kampong Trach, Kampong Trach area, Kampot Province, Cambodia (10°34'43.06"N, 104°28'17.67"E)	Southern Cambodia	6
Notharinia soluta Vermeulen *et al.*, 2019	Phnom Koun Sat, Banteay Meas area, Kampot Province, Cambodia (10°39'53.01"N, 104°32'16.24"E)	Southern Cambodia	6
Notharinia stenobasis Vermeulen *et al.*, 2019	Southeast-end, Phnom La'Ang, Kampot area, Kampot Province, Cambodia (10°42'25.84"N, 104°21'09.55"E)	Southern Cambodia	6
Opisthostoma supinum Benthem Jutting, 1962	Phnom Totong, à 4 km au N.-O. de Tuk Méas, Cambodia	Southern Cambodia and southern Vietnam	4, 7
Plectostoma lavillei (Dautzenberg et Fischer, 1906) (syn. *Plectostoma haplohelix* Vermeulen *et al.*, 2019)	Pnom-Roang, Cambodia	Southern Cambodia	4, 6, 8
Plectostoma tonkinianum (Dautzenberg et Fischer, 1906)	Tonkin	Southern Cambodia and southern Vietnam	4, 8

Type material: Holotype CUMZ 14461 (Fig. 1), paratypes CUMZ 14462 (25 shells; Fig. 2), NHMUK 20250001 (3 shells) and SMF 380296 (3 shells) from Locality C110, Temple in Kantueu Pir (Kantueu Hill), Banan, Battambang, Cambodia, 12°54'15.7"N, 103°07'13.1"E (Fig. 3), 2 Aug 2024, coll. W. Siriwut, C. Sutcharit.

Diagnosis: SH up to 2.0 mm, SW up to 2.7 mm, depressed-conical. Spire ca. 1/4 of shell height. Spiral striation with 11–13 spiral striae at apical view. R1 ca. 1¼ whorls with regular ribs; R2 ca. 1/5 whorl and nearly as long as R3; R2 with ca. 22 ribs. R3 strongly coils downwards, being highly oblique to the shell's horizontal axis, expanding near the end of the aperture. Aperture round. Inner peristome sharp, protruding. Outer peristome thickened, multilayered expanded; palatal to basal edge expanded, columellar to parietal edge not expanded, basal edge triangular and bending inwards, appearing beak- or hook-like. Umbilicus round.

Description: SH up to 2.0 mm, SW up to 2.7 mm, depressed-conical, solid, translucent, yellowish to pale crimson. Shell outline oval in apical view, spire ca. 1/4 of shell height. Whorls ca. 3¾–4. Protoconch low, ca. two whorls, glossy, smooth, without spiral striation. Spiral striation starts from R1, continuing to the end of aperture, with 11–13 spiral striae at apical view, spiral striation weaker than radial ribs in R1 and R2. R1 ca. 1¼ whorls, with fine, regular ribs; with ca. 13 ribs in ¼ whorl adjoining R2. Boundary between R1 and R2 distinct as R2 contains more close-set and thicker ribs than R1; R2 with ca. 22 ribs that are curved towards aperture, ribs less thickened at the beginning and the end of R2; R2 ca. 1/5 whorl and nearly as long as R3. Boundary between R2 and R3 distinct due to very shallow constriction; R3 with indistinct growth lines, strongly coils downwards being highly oblique to the shell's horizontal axis, expanding near the end of the aperture. Last whorl with bluntly shouldered and ended around the beginning of R3. Aperture round; opening obliquely downwards. Peristome double with prominent outer peristome. Inner peristome sharp, protruding. Outer peristome thickened, multilayered (visible in lateral view); palatal to basal edge expanded, columellar to parietal edge not expanded, basal edge triangular and bending inwards, appearing beak- or hook-like. Umbilicus round, open, approximately one third of shell width, and with weakly blunt-periumbilical ridge that ended around the beginning of R3. Operculum unknown.

Etymology: The specific epithet is derived from the Latin word 'uncus' meaning 'hook, barb or bent'. The epithet *aduncus* refers to the basal edge of the outer lip bending inwards and appearing beak- or hook-like.

Distribution and habitat: Known only from the type locality in Kantueu Hill, Battambang, Cambodia. The Kantueu Hill is an isolated limestone outcrop located south of Battambang town. The hill is about 400 m wide and surrounded by agricultural areas and temple buildings. The vegetation of this hill is a deciduous forest with moderate disturbance by clearing or mowing of low vegetation and with evidence of fire. The specimens examined herein are empty shells, which were collected from the topsoil under the leaf litter near rock base or crevices.

Remarks: Among all *Chamalycaeus* species, there are only three taxa where the R3 strongly coils downwards, being highly oblique to the shell's horizontal axis. They are *Chamalycaeus* ***aduncus*** sp. nov., *C. excisus excisus* (von Möllendorff, 1887) and *C. excisus sublimus* Páll-Gergely et Auffenberg, 2019; the latter two being from the Philippines [Páll-Gergely, Auffenberg, 2019]. These three species are also similar in shell size and depressed-conical shell shape. However, this new species differs from both *C. excisus excisus* and *C. excisus sublimus* in having a shorter R2 without any blunt keel, a round aperture without any incision, and a beak- or hook-like basal edge of the outer peristome (Fig. 1B).

The aperture of *Chamalycaeus* ***aduncus*** sp. nov. is also similar to *C. serratus* Páll-Gergely et Auffenberg, 2021 and *C. krabiensis* Páll-Gergely et A. Reischütz, 2021 from Thailand [Páll-Gergely *et al.*, 2021]. However, the basal edge of the outer peristome in this new species is triangular and highly bending inwards, appearing beak- or hook-like. Moreover, the new species has a shorter R2 with less ribs, and a more bluntly shouldered last whorl.

Five shells out of the 32 examined specimens had a scraping hole. It is possible that these specimens were predated by the carnivorous micro land snail *Diaphera saurini* Benthem Jutting, 1962, as they were found abundant at this locality.

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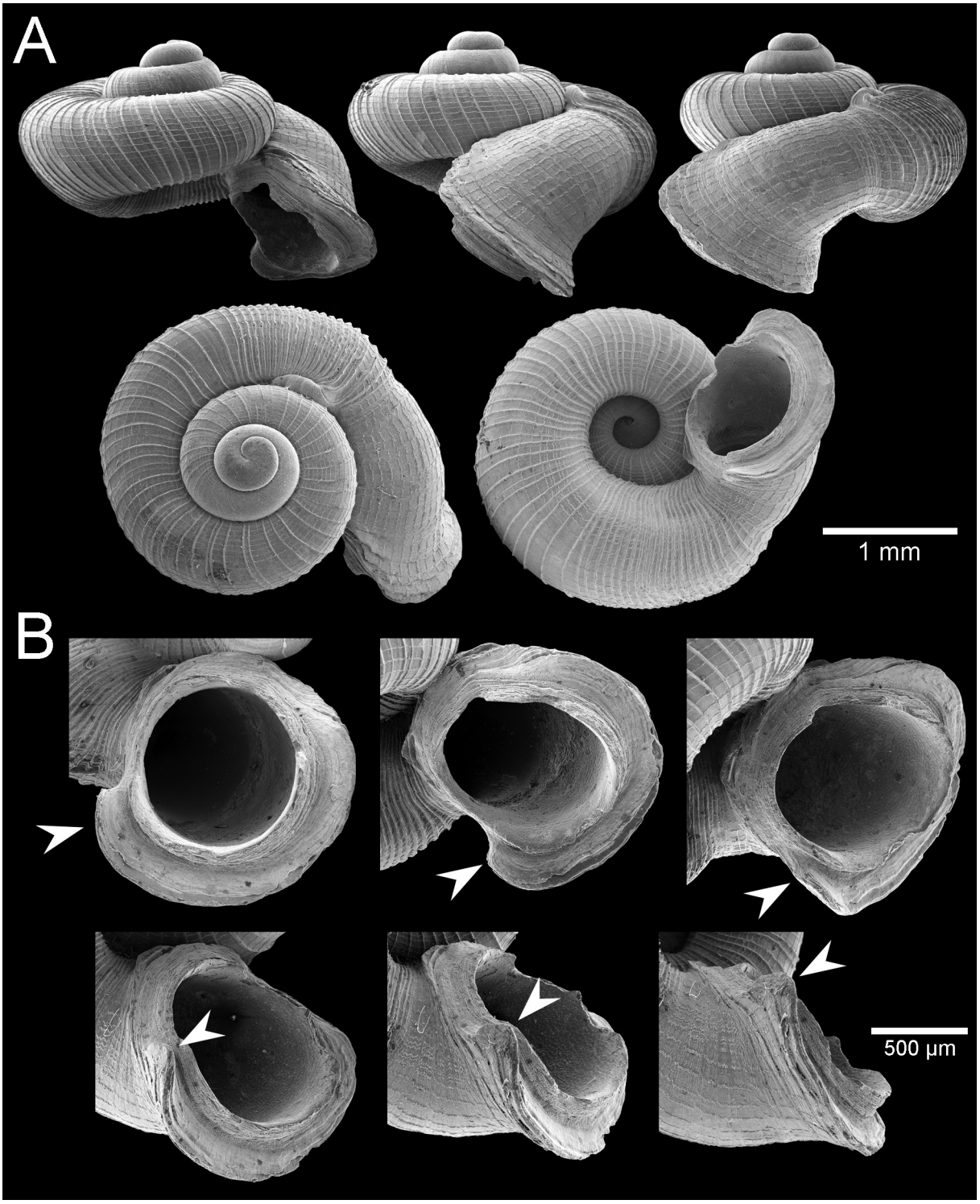

FIG. 1. Representative SEM images of *Chamalycaeus* ***aduncus*** sp. nov., holotype CUMZ 14461 **A** whole shell in different positions, and **B** Close-up images of the aperture; white arrows pointing to the beak- or hook-like basal edge of the outer peristome.

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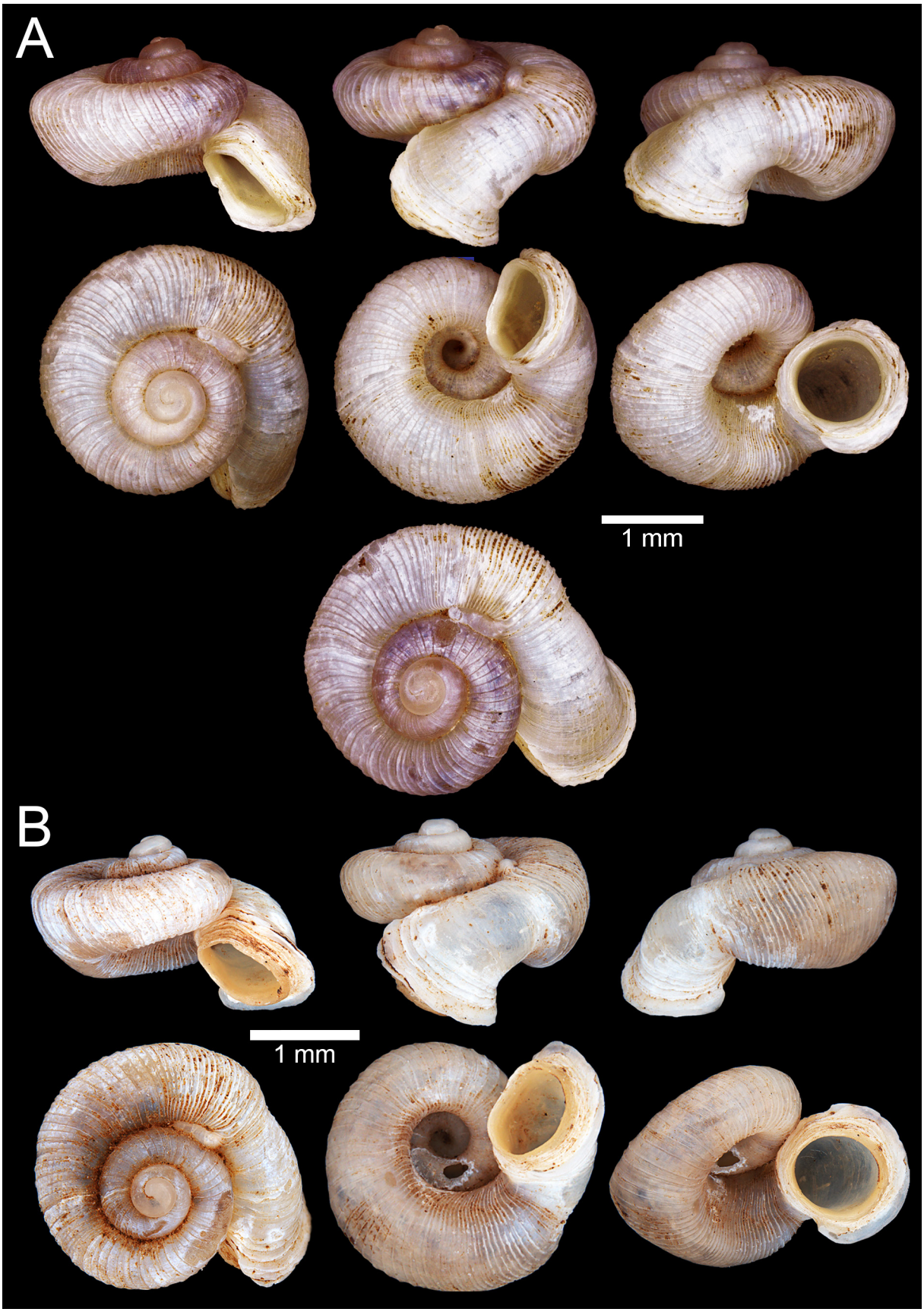

FIG. 2. *Chamalycaeus* ***aduncus*** sp. nov. **A** paratype CUMZ 14462/1, and **B** paratype CUMZ 14462/2, showing a scraping hole at the umbilical side.

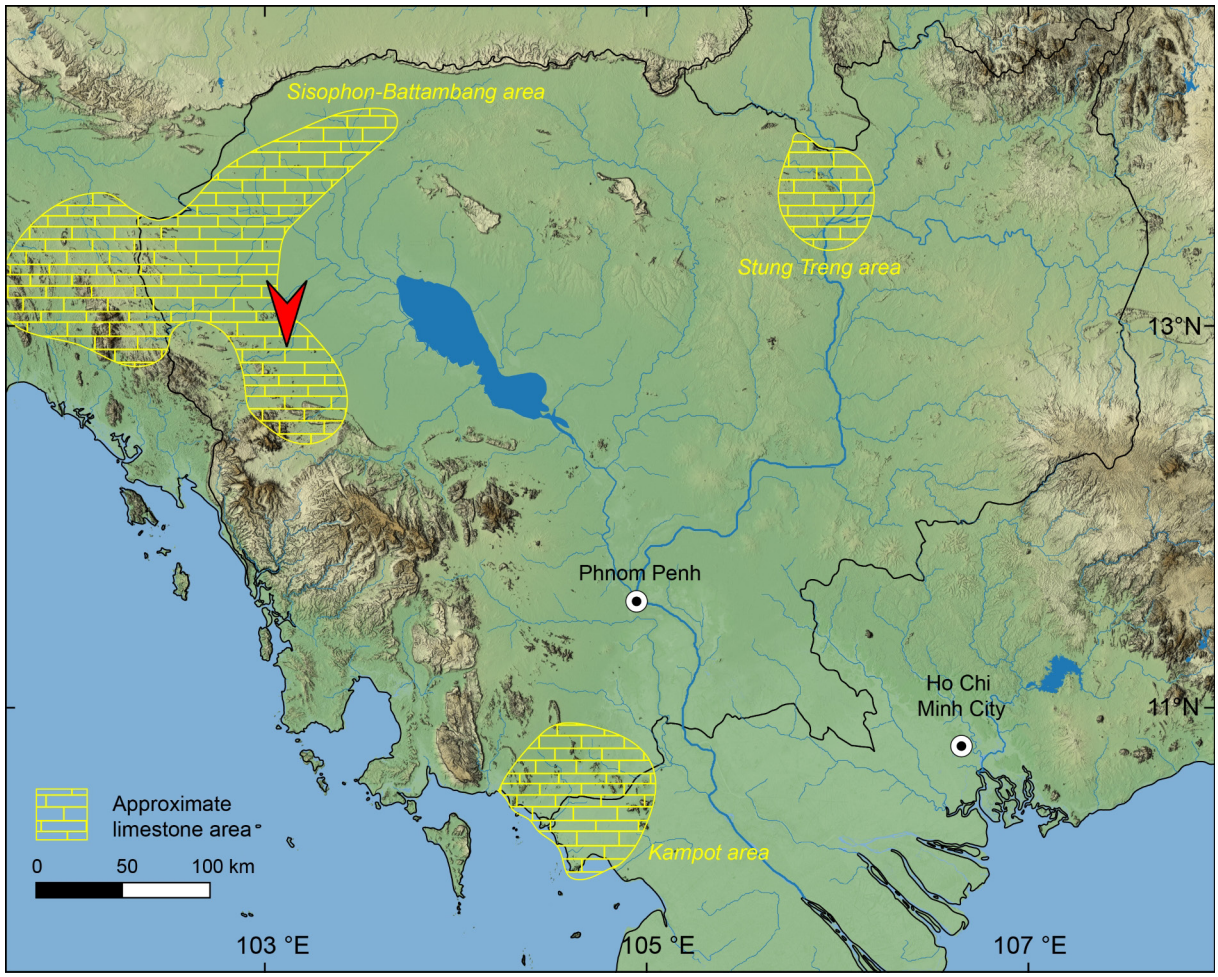

FIG. 3. Geographical position of the type locality of *Chamalycaeus* ***aduncus*** sp. nov. (red arrow) in Battambang, Cambodia. The approximate location of limestone areas (yellow rectangular pattern) in Cambodia (Sisophon-Battambang, Stung Treng, and Kampot areas) is modified from Mouret [2004].

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