

Anceyoconcha, a replacement name for the preoccupied tree snail genus *Giardia* Ancey, 1907 (Pulmonata: Helicoidea: Camaenidae)

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Abstract. *Giardia* Ancey, 1907, was proposed as a generic name for Indochinese tree snails with sinistral, transparent and elongated ovate to conic shells, which comprised *Bulimus siamensis* Redfield, 1853, and *Bulimus rhombostomus* Pfeiffer, 1861. Unfortunately, this generic name was preoccupied by protozoan parasite *Giardia* Künstler, 1882. There are no junior synonyms available for *Giardia* Ancey, 1907, so we propose a replacement generic name *Anceyoconcha*, and therefore new combinations, *Anceyoconcha siamensis* (Redfield, 1853) and *Anceyoconcha rhombostoma* (Pfeiffer, 1861), for the two species currently assigned to the genus. External morphology of shell, living body, radula, and genital system of both species are described and compared to other related genera, and the distinctiveness of *Anceyoconcha* is confirmed.

Key words. *Giardia* Ancey, 1907, *Giardia* Künstler, 1882, homonym, *Anceyoconcha*, radula, genital system

INTRODUCTION

Historically, the genera *Bulimus* Bruguière, 1789, *Buliminus* Beck, 1837, *Amphidromus* Albers, 1850, *Pseudobuliminus* Gredler, 1886, and *Giardia* Ancey, 1907, have been used for East and Southeast Asian tree snails with a relatively high conic or turreted shell (Solem, 1966; Schileyko, 2003; Tumpeesuwan, 2007; Sutcharit & Panha, 2008; Srihata et al., 2010; Tumpeesuwan & Tumpeesuwan, 2010; Jumlong et al., 2013; Tumpeesuwan et al., 2014; Sutcharit et al., 2017).

Giardia was originally proposed by Ancey (1907) to include *Bulimus siamensis* Redfield, 1853, and *Bulimus rhombostomus* Pfeiffer, 1861.

Only *Giardia siamensis* (Redfield, 1853), was reported by Schileyko (2003) from Thailand. Its shell morphology is very similar to *Pseudobuliminus* Gredler, 1886, and therefore often reported as *Pseudobuliminus* (*Giardia*) *siamensis* by other authors (Solem, 1966; Hemmen & Hemmen, 2001; Tumpeesuwan, 2007; Tumpeesuwan & Tumpeesuwan, 2010; Tumpeesuwan et al., 2014) or *Pseudobuliminus siamensis* (e.g., Boonngam et al., 2008; Nabhitabhata et al., 2009; Jumlong et al., 2013). *Giardia rhombostoma* (Pfeiffer, 1861) is distributed in Southern Vietnam and Cambodia

(Schileyko, 2011; Raheem et al., 2017), and has been reported from Thailand as *Ganesella rhombostomus* by Sutcharit et al. (2017) and *Ganesella rhombostoma* by Sutcharit et al. (2019) (Fig. 1). This species has a medium turreted shell, which has a height slightly longer than its width and a spire relatively shorter than that of *Giardia siamensis*.

However, *Giardia* Ancey, 1907, is a junior homonym of *Giardia* Künstler, 1882, a genus of well-known anaerobic flagellated protozoan parasites that can cause diarrhoeal disease (Adam, 2001). Therefore, the junior homonym must be rejected and must be replaced by the next oldest available synonym or by a new replacement name as mandated by the International Code of Zoological Nomenclature (ICZN, 1999, see Articles 60 and 23.3.5). In this case, there is no available junior synonym for *Giardia* Ancey, 1907. The proposal of a replacement name *Anceyoconcha*, new name, and descriptions of the two species currently assigned to the genus form the basis of this study. Its distinction and relationships with the genus *Ganesella* Blanford, 1863, and other related genera are described and discussed in detail.

MATERIAL AND METHODS

Specimens were collected on 15 October 2017 from limestone hills in Sa Kao Province, Eastern Thailand (Fig. 1). Live specimens were drowned in water and preserved in 70% ethanol to study their genital system and radula. Adult shells were counted for number of whorls, and shell height (SH), shell width (SW), aperture height (AH), and aperture width (AW) were measured using digital vernier calipers. Adult snails were dissected to examine their genital system under a stereo microscope. Radula were extracted from the buccal mass and examined under a scanning electron

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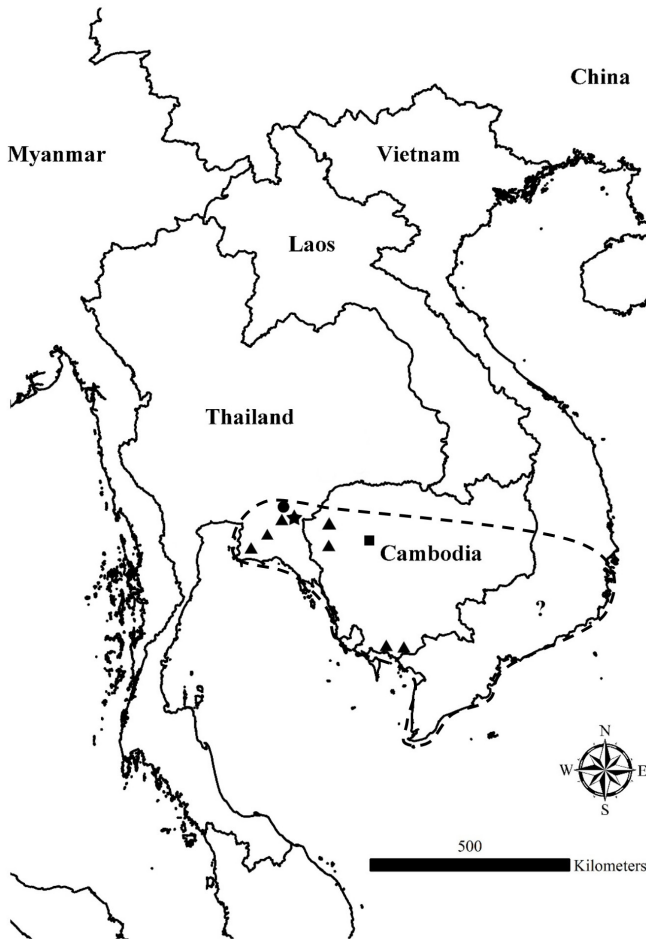


Fig. 1. Distribution map of *Anceyoconcha* (dashed line) and recorded localities in present study. ★: recorded locality of *Anceyoconcha rhombostoma* in Tham Phet Pho Thong, Khlong Hat District, Sa Kaeo Province. ●: recorded locality of *Anceyoconcha siamensis* in Khao Chakan, Khao Chakan District, Sa Kaeo Province. ■: recorded localities of *Amphidromus rhombostomus* in Battambang, Cambodia. ?: several recorded localities from Hong-Chon in Cochinchina (Southern Vietnam) could not be traced. ▲: recorded localities of *Pseudobuliminus harryleei* in Battambang; Banteay Meanchey, Cambodia; and of *Ganesella rhombostoma* in Klonghad District; Wang Somboon District; Muang District, Srakao Province; Pong Namron District, Chanthaburi Province; and Tha Takiep District, Chachoengsao Province (triangle data from Sutcharit et al., 2019).

microscope at the Centre for Scientific and Technological Equipment, Suranaree University of Technology. The examined specimens are deposited in the land snail collection of the Natural History Museum, Mahasarakham University (NHMSU), and Zoological Research Collection of Burapha University, Chonburi, Thailand (ZRCBUU). The proposed new genus name *Anceyoconcha* is attributed to second and third authors, thus the complete authorship citation of this taxon name should be *Anceyoconcha* S. Tumpeesuwan & C. Tumpeesuwan in Nahok, S. Tumpeesuwan & C. Tumpeesuwan.

SYSTEMATICS

Superfamily Helicoidea Rafinesque, 1815

Family Camaenidae Pilsbry, 1895

Subfamily Camaeninae Pilsbry, 1895

Anceyoconcha S. Tumpeesuwan & C. Tumpeesuwan, new name

Giardia Ancey, 1907: 195 (Animalia: Mollusca: Pulmonata: Camaenidae) (preoccupied by K nstler, 1882: 349 [Protista: Metamonada: Diplomonadida: Hexamitidae]).

Type species. *Bulimus siamensis* Redfield, 1853, by original designation of the replaced homonym *Giardia* Ancey, 1907 (Article 67.8; ICZN, 1999).

Remarks. Ancey (1907) proposed *Giardia* and designated *Bulimus siamensis* Redfield, 1853, as the type species. Ancey (1907) also included *Bulimus rhombostomus* Pfeiffer, 1861, in this new genus. This genus is currently in use for common tree snails in family Camaenidae (e.g., Schileyko, 2003, 2011; Raheem et al., 2017; Sutcharit et al., 2017; 2019). Earlier authors have likely overlooked the homonymy of the molluscan *Giardia* Ancey, 1907, with the protozoan genus *Giardia* K nstler, 1882, both of which are under the jurisdiction of the ICZN. The new replacement name *Anceyoconcha* for *Giardia* Ancey, 1907, is mandatory according to Article 60 (ICZN, 1999).

Diagnosis. Shell sinistral, elongated-ovate to conic, thin and rather transparent, with 6–9 slightly convex whorls. Last whorl rounded or slightly angulated. In living snails obviously branching vessel of mantle cavity present, approximately in the two last whorls, whereas the dark brown on pale black marble pattern is mostly present in the early whorls. Protoconch smooth. Post apical sculpture very weak and delicate radial wrinkles. Aperture irregularly ovate, slightly oblique, with shortly reflexed, thin margins. Columellar margin straight, well expanded. Umbilicus narrowly open. Dart sac and mucous glands absent. There is no distinct external boundary between epiphallus and penis. Flagellum moderately long and tapering. Vas deferens long, thin, entering epiphallus laterally. Free oviduct short. Vagina long, stout. Spermathecal stalk long, thin; proximal part wider than distal part; sac spear- or droplet- shaped, attending albumen gland.

Etymology. “Ancey” is in honour of the French conchologist C sar Marie F lix Ancey, and “concha” from the Latin word for shell or snail.

***Anceyoconcha siamensis* (Redfield, 1853), new combination**

(Figs. 2A, 3A, B, 4A, 5, 7A; Table 1)

Bulimus siamensis Redfield, 1853: 15; von Martens, 1860: 9; Pfeiffer, 1860: 170, pl. 46 figs. 3, 4; Crosse & Fischer, 1863: 360.
Bulimus (Napaeus) siamensis – von Martens, 1867: 81, pl. 19 fig. 7.
Petraeus siamensis – Morlet, 1889: 128.
Petraeus siamensis var. *minor* Morlet, 1889: 128.
Satsuma siamensis – von Möllendorff, 1901: 47.
Buliminus siamensis – Fischer & Dautzenberg, 1904: 18.
Buliminus(?) siamensis – Dautzenberg & Fischer, 1908: 185.
Giardia siamensis – Schileyko, 2003: 1519–1520, fig. 1960; 2011: 46.

Material examined. 1 empty shell, 1 live specimen (NHMSU-00021), 1 empty shell (ZRCBUU 0325), limestone hills, Khao Chakan District (13°39'41.73"N, 102°5'32.33"E), Thailand, at an elevation of about 130 m above mean sea level.

Diagnosis. Body pale orange to brown (Fig. 2A). Shell pale and shiny (Fig. 4A). Radula with unicuspid lanceolate-shaped central teeth (Fig. 5). Penis cylindrical in shape, constricted at the distal part connected to atrium. Flagellum is shorter than *A. rhombostoma* (Table 1; Fig. 7).

Description. Shell (Fig. 4A). Sinistral, elongate-conic, SH 15.0 mm (SH 13–23 mm according to Schileyko, 2003), SW 7.0 mm (13–23 mm according to Schileyko, 2003), AH 2.5 mm and AW 5.0 mm. Whorls 7. Pale grey to light brown colour, rather transparent and lustrous. Apex obtuse. Aperture large, rounded. Peristome with reflexed and expanded outer lip. Umbilicus narrow, deep, half-closed by peristome.

Body (Fig. 2A). Living snails with pale orange to brown body. Foot rather narrow and short with pale margin.

Radula (Fig. 5). Comprises 88–90 transverse rows of teeth, and 45–53 teeth in each row (Fig. 5A, B). Dentition formula: (16–18) + (6–8) + C + (6–8) + (16–18). Central teeth symmetric unicuspid lanceolate-shaped (Fig. 5B, C). Lateral teeth similar to central tooth, but differ in being more oblique and with wider and longer cusps (Fig. 5C). Teeth on both sides begin transition into indistinct bicuspid marginal teeth with tiny ectocone at numbers 9–11 (Fig. 5D, E). Marginal teeth gradually change to broad tricuspid at numbers 12–14 (Fig. 5D, E), and begin transition into tetracuspid with two small finger-shaped ectocones from numbers 19–21 to end of teeth (Fig. 5B, E).

Genital system (Fig. 7A). Atrium (at) short. Penis (p) cylindrical and constricted at the part connected to atrium. Penial retractor muscle (prm) long. Epiphallus (ep) short and approximately half of penis length. Flagellum (fl) length approximately equal to epiphallus length; cylindrical; with relatively tiny distal hook. Vas deferens (vd) long. Vagina (v) longer than penis. Gametolytic duct (gd) extending from vagina, long slender to small tube distally. Gametolytic sac (gs), spear shape connected to distal end of gametolytic duct. Free oviduct (fo) short. Uterus (ut) and prostate gland (pro) long.



Fig. 2. Living adult snails of *Anceyoconcha*, new name, from Thailand. A, *Anceyoconcha siamensis*, new combination, from Khao Chakan, limestone hills, Khao Chakan District, Sa Kaeo Province; B, *Anceyoconcha rhombostoma*, new combination, from Tham Phet Pho Thong, limestone hills, Khlong Hat District, Sa Kaeo Province.

Habitat. This is an arboreal species that lives about 1–2 m above ground surface (Fig. 3A, B). Thus far seen only in natural forests and can be found from the foothills to higher elevations.

***Anceyoconcha rhombostoma* (Pfeiffer, 1861), new combination**

(Figs. 2B, 3C, D, 4B, 6, 7B; Table 1)

Bulimus rhombostomus Pfeiffer, 1861: 194.
Amphidromus rhombostomus – Morlet, 1889: 127; 1890: 121, pl. 3 fig. 6, 6a, 6b.
Buliminus rhombostomus – Dautzenberg & Fischer, 1905: 366.
Giardia rhombostoma – Schileyko, 2011: 46.
Pseudobuliminus harryleei Thach, 2017: 54, 55, figs. 756–760.
Pseudobuliminus tuongvyae Thach, 2017: 56, figs. 751–755.
Pseudobuliminus huberi Thach, 2017: 55, figs. 759, 760.
Ganesella rhombostoma – Raheem et al., 2017: 11; Sutcharit et al., 2019: 61–63, figs. 1C, 3C–I, 5E–G, 7D–F.
Ganesella rhombostomus – Sutcharit et al., 2017: 253, 257, fig. M.

Material examined. 34 empty shells, 15 live specimens (NHMSU-00022), limestone hills near Tham [= Cave] Phet Pho Thong, Khlong Hat District (13°24'52.89"N, 102°19'31.03"E), Thailand, at an elevation of about 236 m above mean sea level.

Diagnosis. Body yellowish to brown (Fig. 2B). Shell is brownish to light brown, conic last whorl with brownish spiral

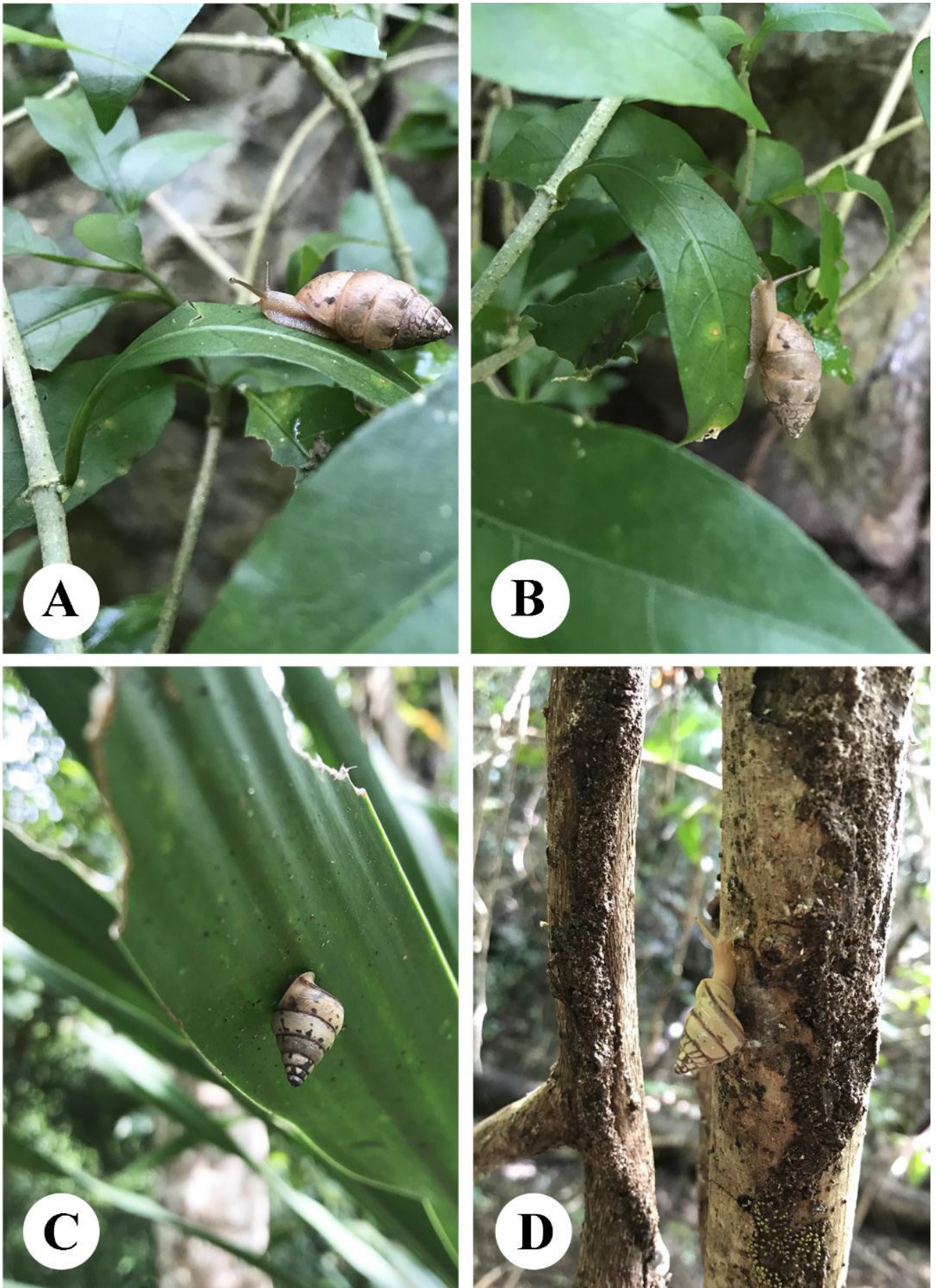


Fig. 3. Arboreal land snail of *Anceyoconcha*, new name, in situ, Thailand. A, B, *Anceyoconcha siamensis*, new combination; C, D, *Anceyoconcha rhombostoma*, new combination, in natural habitat (elevation approximately 1–2 m).

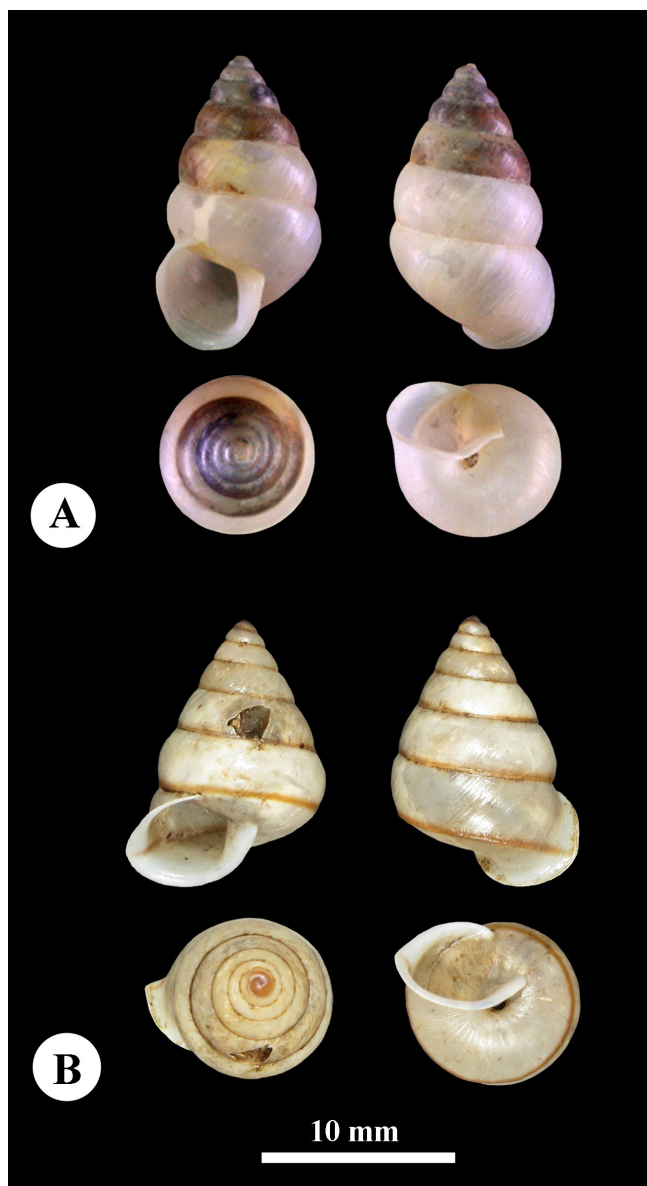


Fig. 4. External shell morphology of *Anceyoconcha*, new name, from Thailand. A, *Anceyoconcha siamensis*, new combination (ZRCBUU-0325); B, *Anceyoconcha rhombostoma*, new combination (NHMSU-00022). Fig. 4A photograph courtesy of Pongrat Dumrongrojwattana.

band on peripheral keel (Fig. 4B). Radula have unicuspid tongue-shaped central teeth (Fig. 6). Penis has long cylindrical shape and epiphallus is shorter than penis length. Flagellum is longer than that of *A. siamensis* (Table 1; Fig. 7).

Description. Shell (Fig. 4B). Sinistral, trochoid, SH 7.6–14.6 mm (11.7 ± 1.7 mm), SW 3.3–8.6 mm (7.3 ± 0.9 mm), AH 1.4–5.5 mm (3.8 ± 1.0 mm) and AW 1.9–6.0 mm (3.9 ± 0.9 mm). Whorls six. Brownish to light brown colour, transparent and lustrous, with thin brown band on suture and on peripheral keel of last whorl. Apex obtuse. Aperture large, rounded. Peristome reflexed and expanded. Umbilicus narrow, deep, half closed by peristome.

Body (Fig. 2B). Living snails with brown to yellowish body. Foot rather narrow and short with pale margin.

Radula (Fig. 6). Comprises 104–106 transverse rows of teeth and 57–65 teeth in each row (Fig. 6A, B). Dentition formula: (19–21) + (9–11) + C + (9–11) + (19–21). Central tooth symmetric unicuspid tongue-shaped (Fig. 6C, D). Lateral teeth similar to central tooth, but difference is oblique and cusps are wider and longer (Fig. 6D). Teeth on both sides begin to transform into indistinct bicuspid marginal teeth with tiny ectocone at numbers 10–12 (Fig. 6C, E). Marginal teeth gradually change to broad tricuspid starting at numbers 11–13 (Fig. 6C, E), and begin to transform into tetracuspid with two small finger-shaped ectocones from numbers 28–30 to end of teeth (Fig. 6C, F).

Genital system (Fig. 7B). Atrium (at) very short. Penis (p) relatively long and cylindrical. Penial retractor muscle (prm) short. Epiphallus (ep) short and approximately one third of penis length. Flagellum (fl) longer than epiphallus, cylindrical, with relatively small distal hook. Vas deferens (vd) long. Vagina (v) long cylindrical, almost same length as penis. Gametolytic duct (gd) extending from vagina, proximal part rather stout and gradually slender to small tube distally. Gametolytic sac (gs), swollen gland as balloon shape connected to distal end of gametolytic duct. Free oviduct (fo) short. Uterus (ut) and prostate gland (pro) long and large. Hermaphroditic duct (hd) slender. Albumin gland (ag) yellowish and dark brown distally.

Habitat. This is an arboreal species seen in both natural forests and gardens in limestone areas. The animals can be found around 1–2 m above ground surface (Fig. 3C, D).

Remarks. Distinct characters differentiating *Anceyoconcha rhombostoma* from *Anceyoconcha siamensis* are their body and shell colouration as well as shell, radula, and genital organ morphologies.

DISCUSSION

Anceyoconcha is apparently endemic to Vietnam, Thailand, and Cambodia (Schileyko, 2003, 2011; Sutcharit & Panha, 2008; Srihata et al., 2010; Sutcharit et al., 2017). It is presently classified in the family Camaenidae (Schileyko, 2003; Bouchet et al., 2017). Originally described as *Bulimus rhombostomus* Pfeiffer, 1861, *Anceyoconcha rhombostoma* has been placed in the Camaenidae for a long time. Morlet (1889, 1890) classified this taxon as *Amphidromus rhombostomus*, while Schileyko (2011) reported it as *Giardia rhombostoma* in a checklist of pulmonate land snails from Vietnam. More recently, it was identified as *Ganesella rhombostoma* by Raheem et al. (2017) and Sutcharit et al. (2019) based on its globularly conic shell shape. Many synonyms and combinations were reported for *Anceyoconcha rhombostoma* and there is still confusion between *Ganesella* and *Giardia*. Here we compare radula morphology and genital system between *Anceyoconcha* and *Ganesella*. The genital system of the type species of *Ganesella*, *Helix capitium* Benson, 1848, has been reported in detail by Budha et al. (2012) as *Darwininitium shiwalikianum* Budha & Mordan in Budha et al., 2012, which was shown to be a junior synonym

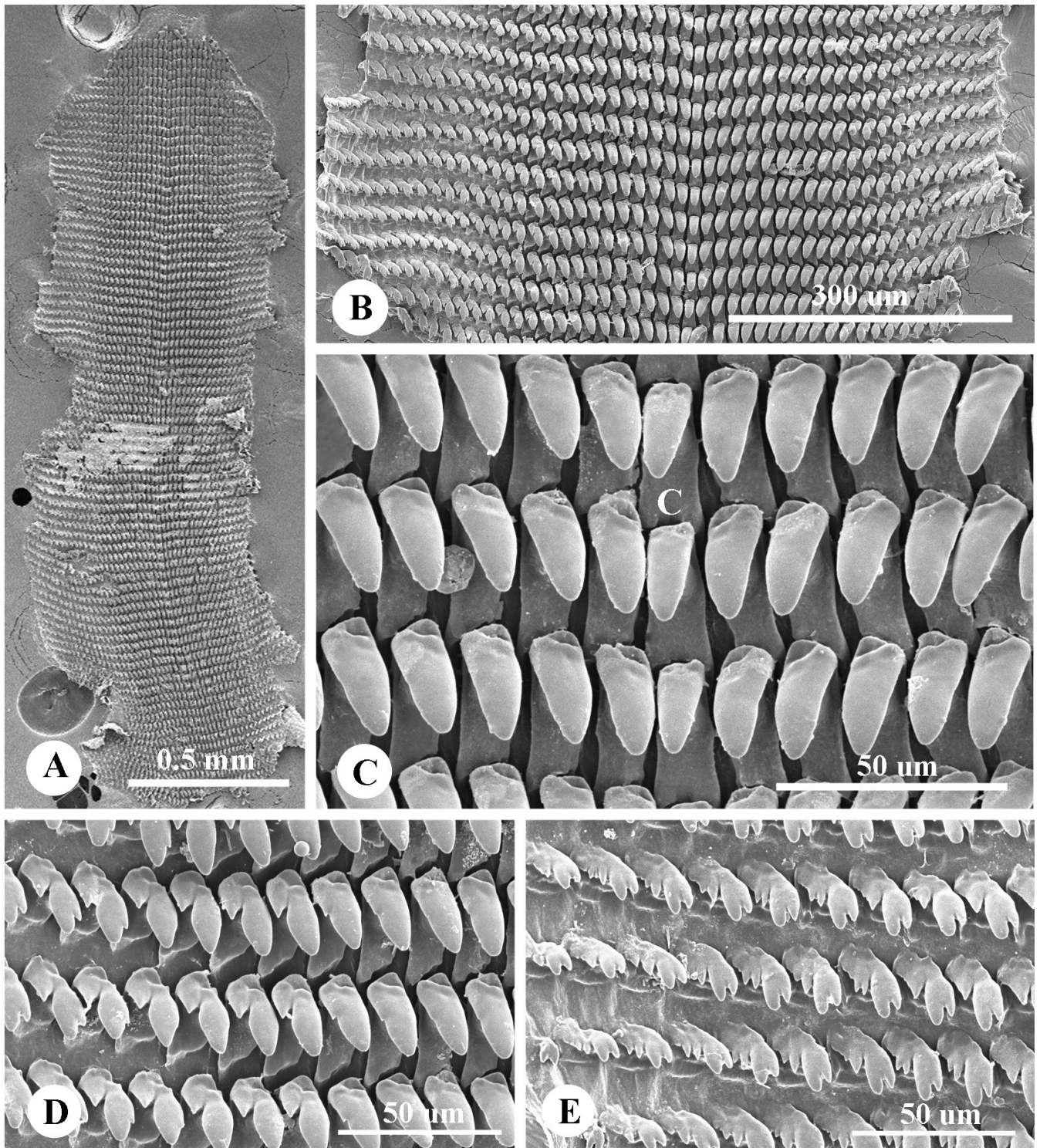


Fig. 5. Radula morphology of *Anceyoconcha siamensis*, new combination (NHMSU-00021). A, whole radula; B, close-up view of radula; C, close-up view of central tooth (position indicated by C) and lateral teeth; D, close-up view of left lateral and marginal teeth; E, close-up view of left marginal teeth.

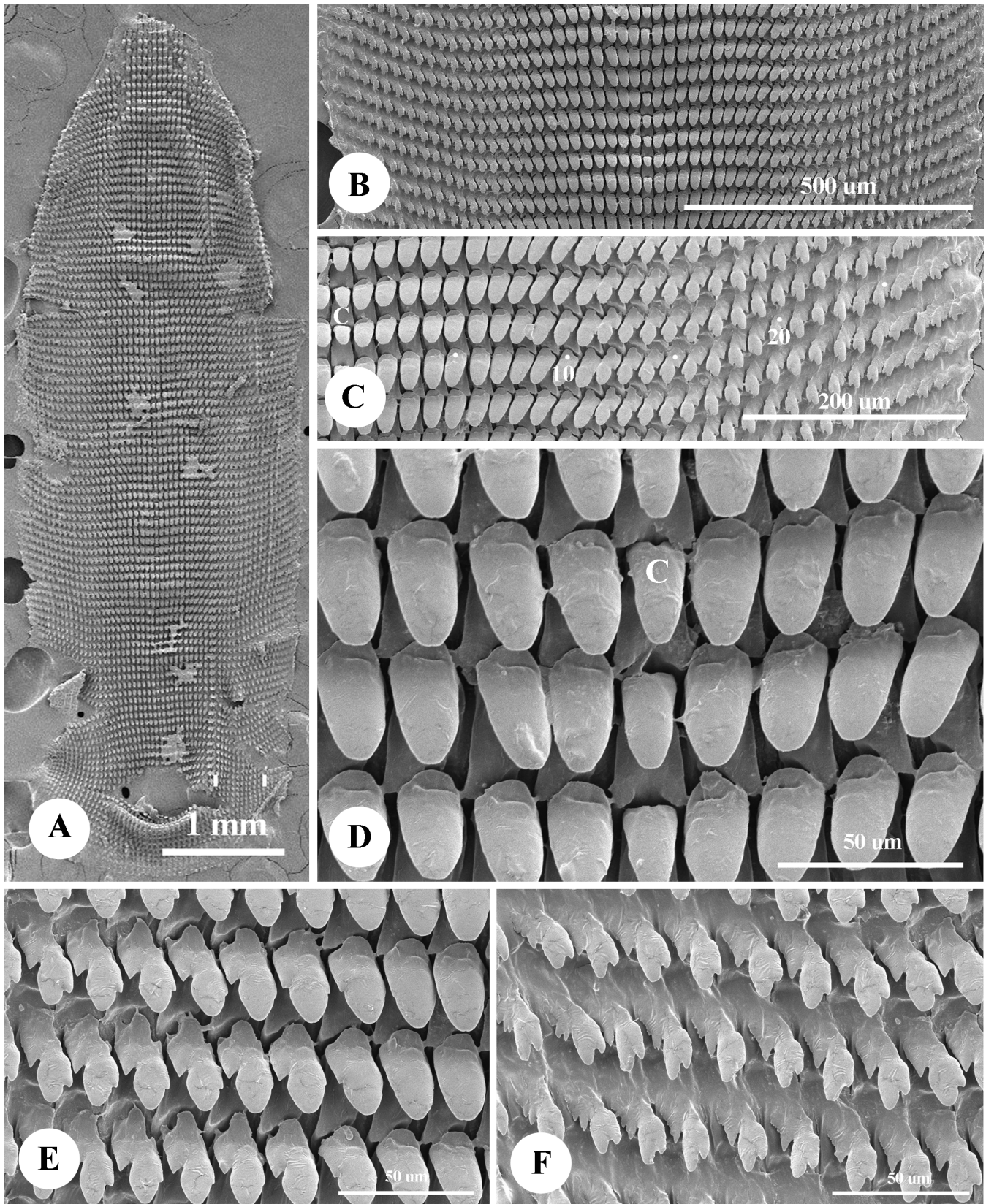


Fig. 6. Radula morphology of *Anceyoconcha rhombostoma*, new combination (NHMSU-00022). A, whole radula; B, close-up view of central part of radula; C, right side of central teeth (indicated by C), lateral and marginal teeth (indicated by numbers); D, close-up view of central tooth (position indicated by C) and lateral teeth; E, close-up view of left lateral and marginal teeth; F, close-up view of marginal teeth.

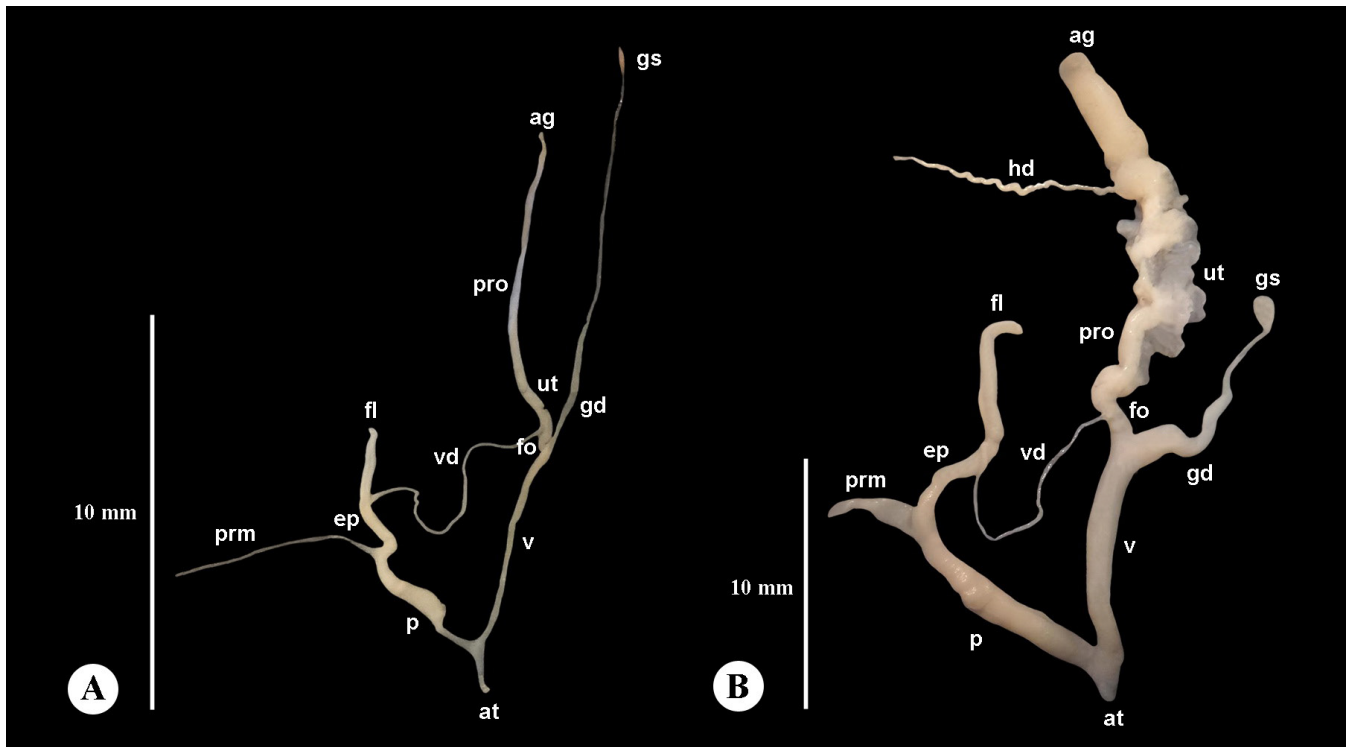


Fig. 7. Genital system of *Anceyoconcha*, new name. A, *Anceyoconcha siamensis*, new combination (NHMSU-00021); B, *Anceyoconcha rhombostoma*, new combination (NHMSU-00022). Abbreviations: at, atrium; p, penis; prm, penial retractor muscle; ep, epiphallus; fl, flagellum; vd, vas deferens; v, vagina; gd, gametolytic duct; gs, gametolytic sac; fo, free oviduct; ut, uterus; pro, prostate gland; hd, hermaphroditic duct; ag, albumen gland.

based on shell morphology, COI, and 28S rDNA sequences (see Budha et al., 2016). The synonymy of *Darwininitium shiwalikianum* Budha & Mordan in Budha et al., 2012, with *Ganesella capitum* (Benson, 1848) is also accepted by Sutcharit et al. (2019) and our team, and we use the anatomical characters of *D. shiwalikianum* published in Budha et al. (2012) as representing *G. capitum*.

The reproductive anatomy of two other species of *Ganesella* were reported in literature (Yen, 1939; Wu & Chang, 1975). *Ganesella (Coniglobus) nux* (von Möllendorff, 1888), studied by Wu & Chang (1975), was reassigned to the genus *Coniglobus* Pilsbry & Hirase, 1906, by Chang (1989). *Coniglobus* was subsequently treated as the subgenus of *Satsuma* A. Adams, 1868, of the subfamily Bradybaeninae Pilsbry, 1939, by Schileyko (2004). The other species is *Ganesella brevibarbis* (Pfeiffer, 1859), mentioned in Yen (1939) as *Helix brevibarbis* Pfeiffer, 1859, and treated as *Ganesella brevibarbis* by Pilsbry (1894). Zhou et al. (2011) clarified its reproductive anatomy and assigned it as *Plectotropis brevibarbis* (Pfeiffer, 1859). Since these species, now *Satsuma (Coniglobus) nux* and *Plectotropis brevibarbis*, were moved to other genera, their genital anatomies are inappropriate for comparison with *Anceyoconcha siamensis* and *Anceyoconcha rhombostoma*. Only the genital system of *Anceyoconcha siamensis* illustrated by Schileyko (2003; as *Giardia siamensis*) and *Ganesella capitum* by Budha et al. (2012; as *Darwininitium shiwalikianum*) were considered representative of the genera *Giardia* and *Ganesella* (see Table 1).

The traditional classification of Camaenidae relies predominantly on shell features. Previously, only one *Giardia* species (i.e., *Giardia siamensis*) was reported from Thailand (Schileyko, 2003, 2011; Sutcharit & Panha, 2008; Srihata et al., 2010; Sutcharit et al., 2017), but it is also known as *Pseudobuliminus (Giardia) siamensis* or *Pseudobuliminus siamensis* classified solely based on shell morphology (Solem, 1996; Hemmen & Hemmen, 2001; Boonngam et al., 2008; Nabhitabhata et al., 2009; Tumpeesuwan & Tumpeesuwan, 2010; Jumlong et al., 2013; Tumpeesuwan et al., 2014). According to Schileyko (2003), dart sac and mucous glands are absent in *Giardia siamensis*, whereas both organs are present in *Pseudobuliminus* (Habe, 1955; Wu, 2004), which is unique to the subfamily Bradybaeninae Pilsbry, 1939 (e.g., Páll-Gergely et al., 2013; Wang et al., 2014). As it has been shown that *Pseudobuliminus* is distributed only in East Asia, especially in Mainland China, Taiwan, and Japan (Chang & Hwang, 1999; Schileyko, 2004; Hirano et al., 2014), we consider *Pseudobuliminus* to be non-existent in Thailand. All so-called *Giardia* and *Pseudobuliminus* species of Thailand must be reassigned to *Anceyoconcha*.

Anceyoconcha rhombostoma was not reported in Thailand until very recently by Sutcharit et al. (2017; as *Ganesella rhombostomus*) and Sutcharit et al. (2019; as *Ganesella rhombostoma*). Assignment to the genus *Ganesella* was due to the superficial similarity of the high conic shell. The type species of *Ganesella*, *Ganesella capitum*, has an opaque conic shell with irregular flame-like patterns of white and pale brown (Zhou et al., 2011; Sutcharit et al., 2019). Formerly, all *Ganesella*-like species in China were

Table 1. Comparison of shells, radulae and genital systems of *Anceyoconcha siamensis*, new combination, *Anceyoconcha rhombostoma*, new combination, *Ganesella capitum*, and *Ganesella carinella*. ?: no data. Numbers in parentheses in *A. rhombostoma* column from Sutcharit et al., 2019.

Characters	<i>A. siamensis</i>	<i>A. rhombostoma</i>	<i>G. capitum</i>	<i>G. carinella</i>
Shell				
Chirality	Sinistral	Sinistral	Dextral	Dextral
Shell texture	Transparent	Transparent	Opaque	Opaque
Peripheral keel	Absent	Absent or present	Present	Present
Shell height (mm)	13–23	7.6–14.6	13.3–14.4	14.8–17.6
Shell width (mm)	6–7	3.3–8.6	13.5–13.8	18.2–18.5
Number of whorls	7–9	6	5–6	5–6
Radula				
Number of rows	88–90	104–106	?	74
Number of teeth in rows	45–53	57–65 (58)	?	82–86
Number of cusps				
Central teeth	1	1 (1)	?	1
Lateral teeth	1	1 (1)	?	1–2
Marginal teeth	3–5	2–4 (2–3)	?	3–5
Central teeth shape	Lanceolate	Tongue-shape (triangular)	?	Spatulate and truncate cusp
Central teeth length (cusp body)	$\frac{3}{4}$ to $\frac{3}{5}$ of cusp base length	$\frac{1}{2}$ to $\frac{3}{4}$ of cusp base length	?	$\frac{1}{3}$ of cusp base length
Genital system				
Flagellum shape	Moderately long, cylindrical with tiny hook shape at distal end	Long cylindrical with hook shape at distal end	Short and robust C-shape with small appendix at the distal end	Short and robust C-shape with small appendix at the distal end
Flagellum length	Equal to epiphallus length	Twice of epiphallus length	Triple of epiphallus length	Twice of epiphallus length
Penis	Long cylindrical shape	Long cylindrical shape	Short	Long cylindrical shape
Vagina	Longer than penis	Equal to penis	Longer than penis	Equal to penis
Gametolytic sac	Small spear shape	Balloon shape	Balloon shape	Balloon shape
Gametolytic duct	Long and thin tube	Long tube, cylindrical, gradually tapering toward sac	Long tube with half expanded basal part	Long tube with half expanded basal part
References	This study; Schileyko (2003)	This study; Sutcharit et al. (2019)	Budha et al. (2012); Sutcharit et al. (2019)	Sutcharit et al. (2019)

classified as *Ganesella*. However, most Chinese *Ganesella* are actually closer to *Satsuma* in conchological characters than to *Ganesella* (see Zhou et al., 2011), so all eastern Asian species were subsequently transferred to *Satsuma*, with *Coniglobus* as a synonym (Hwang, 2011; Zhou et al., 2011; Wang et al., 2014).

Based on a general view of the genital system of *Ganesella carinella* and *Anceyoconcha rhombostoma* in Sutcharit et al. (2019), only *G. carinella* possesses short and robust

C-shaped flagellum with small appendix at distal end, which is similar to the type species *G. capitum*, whereas the flagellum in *A. rhombostoma* is long cylindrical in shape similar to that of *A. siamensis* presented in Schileyko (2003). The radula morphology is also discernibly distinct. Cusp body of central teeth length ranges from $\frac{1}{2}$ to $\frac{3}{5}$ of cusp base in *Anceyoconcha siamensis* and *Anceyoconcha rhombostoma* versus only $\frac{1}{3}$ of cusp base in *Ganesella carinella* (see also Table 1). Comparisons of the shell, radula, and genital system morphology demonstrate that there are

distinguishing characteristics between *Anceyoconcha* and *Ganesella* (Table 1).

Anceyoconcha is characterised by its sinistral, high conic, and rather transparent shell; radular central tooth and lateral teeth unicuspid with tongue-shaped marginal teeth tricuspid-tetracuspid with finger shaped ectocone; and cusp body length of central teeth ranging from $\frac{1}{2}$ to $\frac{3}{4}$ of cusp base length (Table 1; Figs. 5, 6). Although the radula of *Anceyoconcha siamensis* is similar to *Anceyoconcha rhombostoma*, the marginal teeth and number of rows and teeth in each row show slight differences in the cusps of ectocone in marginal teeth (Figs. 5, 6). Their genital systems are similar with long cylindrical shape penis, long and tapering flagellum, long vagina, and short free oviduct, but the gametolytic sac of *A. siamensis* is small spear-shaped and the flagellum is shorter, while *A. rhombostoma*'s gametolytic sac is balloon-shaped and flagellum is long cylindrical with hook-shaped at distal end (Fig. 7). The long cylindrical shape of penis and flagellum, gametolytic duct a long cylindrical tube that gradually tapers toward gametolytic sac at the distal end are characters of *Anceyoconcha* distinct from *Ganesella* Blanford, 1863 (see Table 1; Fig. 7).

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