

**Review on the synonymy concerning genus *Amphidromus* Albers, 1850
(Gastropoda: Camaenidae), with descriptions of new species**

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ABSTRACT This study rectifies several probable errors in recent research regarding synonymy of *Amphidromus* Albers, 1850, the infraspecific variation of which is extreme and can lead to improper nomenclature assignments. Two new species of *Amphidromus* recorded from Vietnam and Thailand are also described.

KEYWORDS Systematics, synonymy, *Amphidromus*, Vietnam, Thailand, Camaenidae, Helicoidea, Gastropoda, Mollusca, land snail, *A. fengae*, *A. bozhii*, new taxa

INTRODUCTION

Amphidromus Albers, 1850 is a highly diversified genus of terrestrial gastropods in Camaenidae, Helicoidea whose distribution range is extensive throughout southeast Asia. Due to the great variability of this genus, some authors (He & Zhou, 2017; Inkhavilay *et al.*, 2019), have synonymized several *Amphidromus* species which are likely valid. The synonymy likely arose as a result of the abundance as well as the inaccessibility of relevant literature (Thach & Huber, 2016; Inkhavilay *et al.*, 2017). These issues are analyzed in this study, with the conclusion that *Amphidromus richgoldbergi* Thach & Huber, 2017, *A. thakhekensis* Thach & Huber, 2017 and *A. pervariabilis* Bavay & Dautzenberg, 1909 ["1908"] are valid. *Amphidromus xiengkhuangensis* Inkhavilay & Panha, 2017 is synonymized with the older species *A. thanhhoaensis* Thach & Huber, 2016. In addition, two new species of *Amphidromus* from Indochina, viz. Vietnam and Thailand, are described based on materials that were obtained by the author and partially donated to the Da Lian Shell Museum.

Abbreviations.

AC	Author's collection
CUMZ	Chulalongkorn University Museum of Zoology, Bangkok
FMNH	Field Museum of Natural History, Chicago
DLSM	Da Lian Shell Museum, Da Lian
MNHN	Muséum National d'Histoire Naturelle, Paris
NHMUK	The Natural History Museum, London
SMF	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main
UMMZ	University of Michigan Museum of Zoology

SYSTEMATICS

Class: Gastropoda Cuvier, 1797
Family: Camaenidae Pilsbry, 1895

Genus: *Amphidromus* Albers, 1850

Type species *Helix perversus* Linnaeus, 1758 by subsequent designation of E. von Martens in Albers (1860)

Amphidromus richgoldbergi

Thach & Huber, 2017 (Plate 1, Figure A, B)

Amphidromus richgoldbergi Thach & Huber in Thach, 2017: 45, figs 505–508. Type locality: Vang Vieng, Ventiane Province, Central Laos [Vangvieng District, Vientiane Province, Laos]. *Amphidromus “richgoldbergi”*: Sutcharit & Panha, 2006: 26–28, figs. 4n–q, 18, 19. Inkhavilay *et al.*, 2017: 14–15, figs. 2c, 3c, 4i. Inkhavilay *et al.*, 2019: 90, figs. 43d–e. (Synonymized as *Amphidromus givenchyi* Geret, 1912).

Differential Diagnosis. This species can be distinguished from *Amphidromus givenchy* Geret, 1912 readily because the latter species has a more elongate spire and striped periostracum, whereas *A. richgoldbergi* have a periostracum continuously covering the exterior of its shell.

Materials Examined. Holotype of *Amphidromus richgoldbergi*, FMNH 381986; Syntype of *A. givenchy* Geret, 1912, MNHN-IM-2000-2035; Three specimens of *A. richgoldbergi*, collected in Bokeo Province (Laos), in AC.

Amphidromus thakhekensis

Thach & Huber, 2017 (Plate 1, Figures C–E)

Amphidromus thakhekensis Thach & Huber in Thach, 2017: 48, figs. 553–556. Type locality: Thakhek, Khammouane Province, South-Central Laos. *Amphidromus “thakhekensis”*: Inkhavilay *et al.*, 2017: 32, figs. 9e–f, 12g–i, 13i–m, 14c–d.

Inkhavilay *et al.*, 2019: 89–90, figs. 42f, 43a–b. (Synonymized as *Amphidromus fuscolabris* Möllendorff, 1898)

Differential Diagnosis. There are a multitude of *Amphidromus* species with similar pattern on their shell, namely: *A. eudeli* Ancey, 1897; *A. fuscolabris* Möllendorff, 1898; *A. thakhekensis*; *A. pengzhuoani* Thach, 2018; and *A. goldbergi* Thach & Huber, 2018. All but one of these species occur in Laos. The later two species are not discussed herein due to the lack of study material. Some recently collected specimens, which can be roughly categorized as two color forms, but are apparently belonging to one species (Inkhavilay *et al.*, 2017), are recognized as *A. fuscolabris* by some authors (Inkhavilay *et al.*, 2017; Inkhavilay *et al.*, 2019). Preliminary observation on the morphology of currently available materials reveals that the penultimate whorl of specimens recently collected in Laos is significantly larger in comparison to the total shell height and these specimens have larger apertures. Furthermore, a new specimen collected in Vietnam exhibits more resemblance to the holotype of *A. fuscolabris*, however, similar individuals have not been reported from Laos since the publication of *A. fuscolabris*. This implies that the original geographic record of *A. fuscolabris* is not congruent with its actual distribution range. In conclusion, *Amphidromus thakhekensis* is a valid name referring to CUMZ 7041–7042 and other recently collected Laotian specimens alike.

Materials Examined. Holotype of *Amphidromus fuscolabris* (SMF 7641); Holotype of *Amphidromus thakhekensis* (MNHN-IM-2000-33216); Specimen illustrated by Inkhavilay *et al.*, 2017 (CUMZ 7041–7042); Two specimens of *A. thakhekensis* from Laos, and one specimen of *A. fuscolabris* from Vietnam (probably Dak Lak Province), in AC.

Amphidromus pervariabilis
Bavay & Dautzenberg, 1909 ["1908"]
(Plate 1, Figures F, G)

Amphidromus pervariabilis Bavay & Dautzenberg 1909 ["1908"], 1909a: 279-281, pl. 9, figs 1–10, pl. 10, figs. 1–8. Type locality: Ban-Lao, MuongKong, Pha-Long, Pac Kha.
Amphidromus pervariabilis Bavay & Dautzenberg, 1909b: 246-247; Laidlaw & Solem, 1961: 527, 528; Richardson, 1985: 15; Inkhavilay *et al.*, 2017: 10, 13-14, figs. 5a-l.
Amphidromus "*pervariabilis*" He & Zhou, 2017: 5, figs. 8-9. (Synonymized as *Amphidromus dautzenbergi* Fulton, 1899)

Differential Diagnosis. The resemblance between this pair of species has been stated twice in previous studies (Laidlaw & Solem, 1961; and Inkhavilay *et al.*, 2017). He & Zhou, 2017 synonymized this species to *A. dautzenbergi* by taxonomic fiat and no written elucidation was explicitly given. Further, only two specimens of *A. pervariabilis* were illustrated; hence we are left to presume that this synonymy is solely on the basis of morphology. Although photographs of the syntypes of *A. pervariabilis* var. *lilacina* Bavay & Dautzenberg, 1909 ["1908"] and the holotype of *A. dautzenbergi* show an identity, because *A. pervariabilis* var. *lilacina* is not the nominotypical subspecies, its type specimens cannot be used to determine the synonymy of *A. pervariabilis* and *A. dautzenbergi* (ICZN 4th addition: Articles 45.6, 47, 61.2, 61.3). Both syntypes of the nominotypical subspecies of *A. pervariabilis* (MNHM-IM-2000-2049) are different from the holotype of *A. dautzenbergi*. Unless additional supporting materials are collected, evidence to verify the synonymy is insufficient at this time.

Materials Examined. Syntypes of *Amphidromus pervariabilis* (MNHM-IM-2000-

2049); one specimen of *A. pervariabilis* (AC); syntypes of *A. pervariabilis* var. *lilacina* (MNHM-IM-2000-2052); holotype of *A. dautzenbergi* (NHMUK 1899.12.18.38).

Amphidromus thanhhoaensis
Thach & Huber, 2016

Amphidromus thanhhoaensis Thach & Huber in Thach, 2016: 69-70, figs 35, 325-328. Type locality: Muong Lat District at the west of Thanh Hoa Province (North Vietnam).

Amphidromus (Syndromus) xiengkhaungensis Inkhavilay & Panha in Inkhavilay *et al.*, 2017: 35-37, figs. 13s-t. Type locality: Laos, limestone outcrop at Ban Nong Tang, Phou Kood District, Xieng Khaung, 19°30'59.2" N, 102°53'37.6" E, 1140 m asl.

Differential Diagnosis. The types of *A. xiengkhuangensis* are morphologically identical to *A. thanhhoaensis*, and no comparison is given in the description of *A. xiengkhuangensis*. The mountainous terrain with forest vegetation between the type localities of *A. xiengkhuangensis* and *A. thanhhoaensis* are approximately 200 km apart, which is unlikely to constitute an effective geographic barrier to dispersal for medium sized terrestrial snails (Goldberg & Severns, 1997). Since there is no persuasive evidence that suggests *A. xiengkhuangensis* is different from *A. thanhhoaensis*, I declare it to be in synonymy.

Materials Examined. Holotype of *A. thanhhoaensis* Thach & Huber, 2016 (NHMUK 20160299); Holotype and partial paratypes of *A. xiengkhaungensis* Inkhavilay & Panha, 2017 (CUMZ 7045-7046).

Amphidromus fengae Wang, new species
(Plate 2, Figures A-C)

Type Material. Holotype. Height 30.25 mm, width 12.45 mm, deposited in DLSM. Paratypes. Paratypes 1-4 in AC, dimensions: No. 1. Height 33.75 mm, width 12.50 mm; No. 2. Height 32.45 mm, width 14.15 mm; No. 3. Height 31.85 mm, width 12.40 mm; No. 4. Height 30.15 mm, width 12.65 mm.

Description. Shell sinistral; recorded height range 30.15-33.75 mm, average height 31.69 mm; width range 12.40-14.15 mm, average width 12.83 mm. Spire protracted, straight-sided; body whorls moderately inflated, upper extremity black; exterior surface yellowish-green to grayish-blue, the latter color is possibly the result of a color change after the death of the animal; adorned with oblique, parallel, beige streaks; subsutural area colored bright red as well as the umbilicus; aperture elongated ovate; peristome white or gray in color with black margin or completely black; columella vertical and outer lip flares outwards. Periostracum of the holotype is probably eroded, transparent corneous periostracum is whereas observed on paratype 3.

Habitat & Type Locality. All type specimens are collected as empty shells in monsoon rainforest during dry season in Kornsan District, Chaiyaphum Province, Thailand.

Differential Diagnosis. As compared to *Amphidromus anhdaoorum* Thach, 2017, this new species has the following distinguishing features: (1) Shell is bigger, average height 36.02 mm (Thach, 2017); (2) the protoconch is not tinted; (3) the subsutural area is pale yellowish in contrast to that of *A. fengae* n. sp. which is bright red; and, (4) *A. anhdaoorum* is, to date, only known from Dak Lak Province, Vietnam.

Comparison is also made to *A. dambriensis* Thach et Huber, 2016, *A. baolocensis* Thach et Huber, 2016, *A. ngocanhi* Thach, 2017, *A. yenlinhae* Thach et Huber, 2017, and *A. renkeri* Thach, 2018. All five of these species occur in Vietnam only, and all have different coloration on the subsutural area and peristome.

Etymology. This species is named in honor of Ms. Feng Xin Yue for her endearing spirit.

Amphidromus bozhii Wang, new species
(Plate 3, Figures A-B)

Type Material. Holotype. Height 74.10 mm, width 35.05 mm, deposited in DLSM. Paratypes. Paratypes 1-2 in AC. The dimensions of these paratypes are as follows: No. 1. Height 72.5 mm, width 33.8 mm; No. 2. Height 80.7 mm, width 34.5 mm.

Other Material Examined. One specimen measured 76.90 mm in height and 33.7 mm in width was inspected by the author but was lost during transportation.

Description. Shell colossal, average height 76.72 mm, average width 34.58 mm. Very solid, conical-tapering, dimorphic in coiling direction, sutures smooth, columellar straight, rima concealed, aperture somewhat flabellate; peristome white, expanded and reflected. Mostly purple; protoconch lacks coloration; middle and lower parts of body whorls dilated, upper part of whorls inclining and lighter-tinted; one broad but relatively shallow spiral channel occurs on the middle of the whorls - although this channel is weak on the holotype compared to the paratypes it is readily recognized on the last half whorl. The channel and the sloping upper part of the whorls emphasize the space between them, forming a ridge; filmy corneous periostracum covers the exterior surface below the ridge.

Habitat & Type Locality. Phu Yen Province, Vietnam. This species dwells in monsoon rainforests.

Differential Diagnosis. This species is similar to *Amphidromus placostylus* Möllendorff, 1900 (Plate 3, Figure C). Nonetheless, *A. placostylus* does not exhibit purplish coloration which is always seen on *A. bozhii* n. sp., and a spiral channel is absent on *A. placostylus* (the outline of *A. placostylus* is very smooth). Additionally, the known locality of *A. placostylus* is Phuc Son (Bac Giang Province, Vietnam), approximately 600 km north-west of Phu Yen Province, therefore it is barely possible for these two species to surmount the geographic barrier because of the limited capability of dispersing of terrestrial gastropods.

A. naggsi Thach & Huber, 2014 and *A. ingens* Möllendorff, 1900 (Plate 3, Figures D, E) have smaller average shell height, more conspicuous surface structures and more variable coloration. The average shell height of *A. naggsi* is 55-65mm, and that of *A. ingens* is 69mm (Thach *et* Huber, 2014). Both species possess obvious horizontal channels on the shell's exterior and a variety of color forms, for example white and yellow.

Etymology. This species is named in honor of Mr. Lv Bo Zhi, a passionate enthusiast of shell collecting who vigorously volunteers his work as a disseminator of knowledge of malacology.

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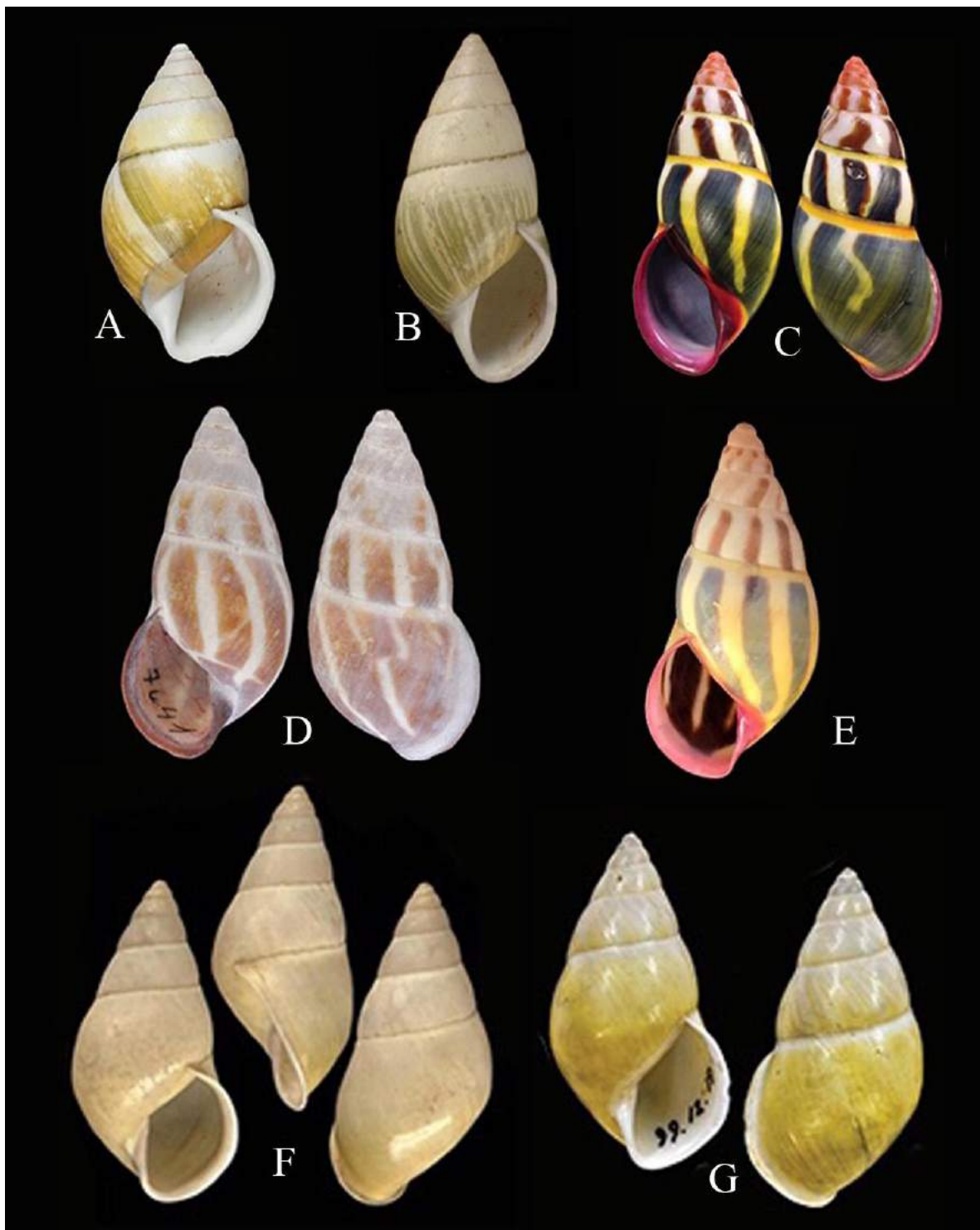


Plate 1. Figure A = Holotype of *Amphidromus richgoldbergi* (FMNH 381986), aperture view. B = Syntype of *A. givenchy* (MNHN-IM-2000-2035), aperture view. C = Atypical color form of *A. thakhekensis* (CUMZ 7041), collected in Ban Phon, Sekong Province, Laos. D = Holotype of *A. fuscolabris* (SMF 7641). E = Surmised specimen of *A. fuscolabris* (AC), possibly collected in Dak Lak Province, Vietnam. F = Syntype of *A. pervariabilis linacina* (MNHM-IM-2000-2052). G = Holotype of *A. dautzenbergi* (NHMUK 1899.12.18.38). Figures 1, 3-4 are excerpted respectively from Inkhavilay *et al.* (2019) and Inkhavilay *et al.* (2017).

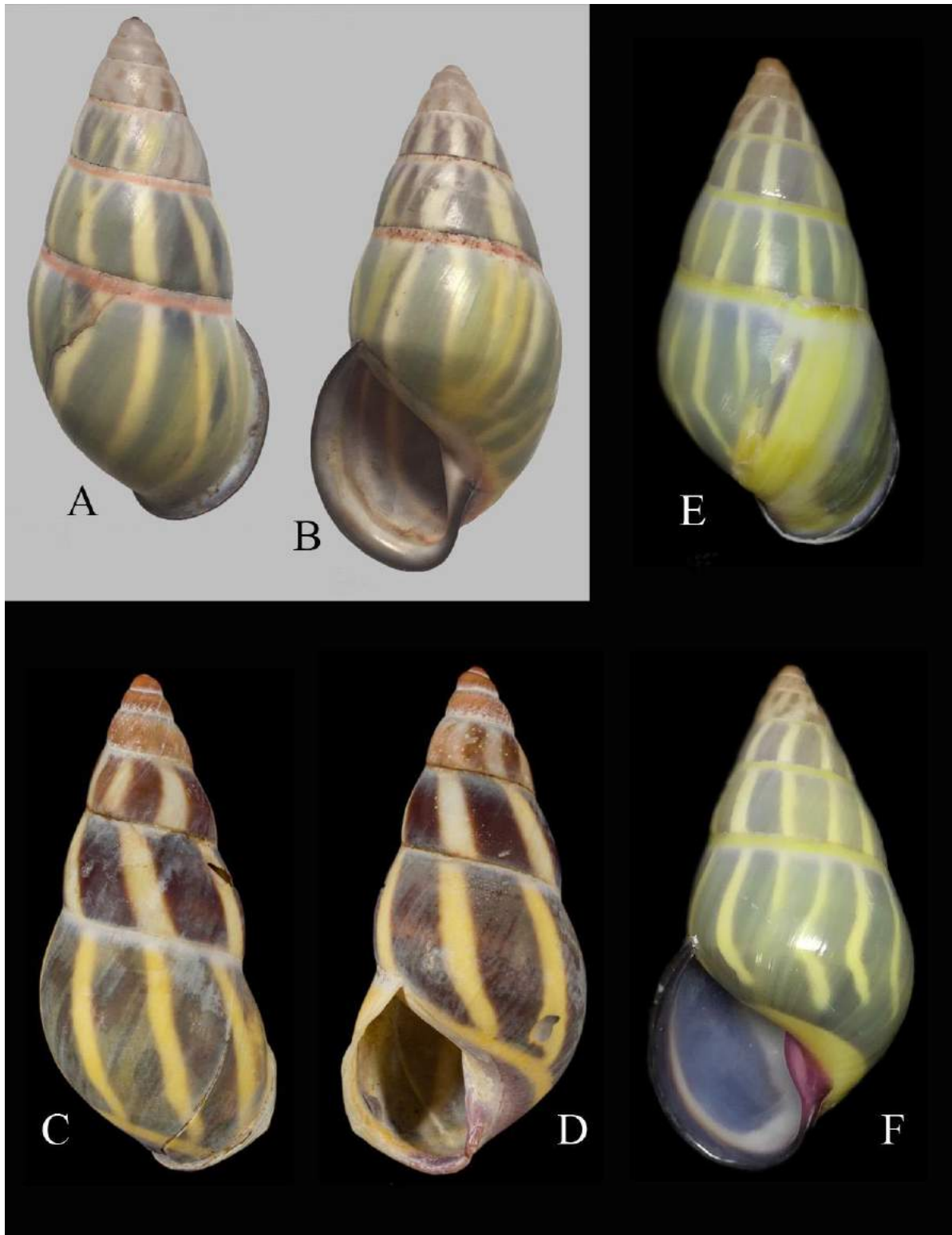


Plate 2. Figures A-B = Holotype of *Amphidromus fengae* n. sp. C-D = Holotype of *A. yenlinhae*, photo of MNHN. E-F = *A. anhdaoorum*.

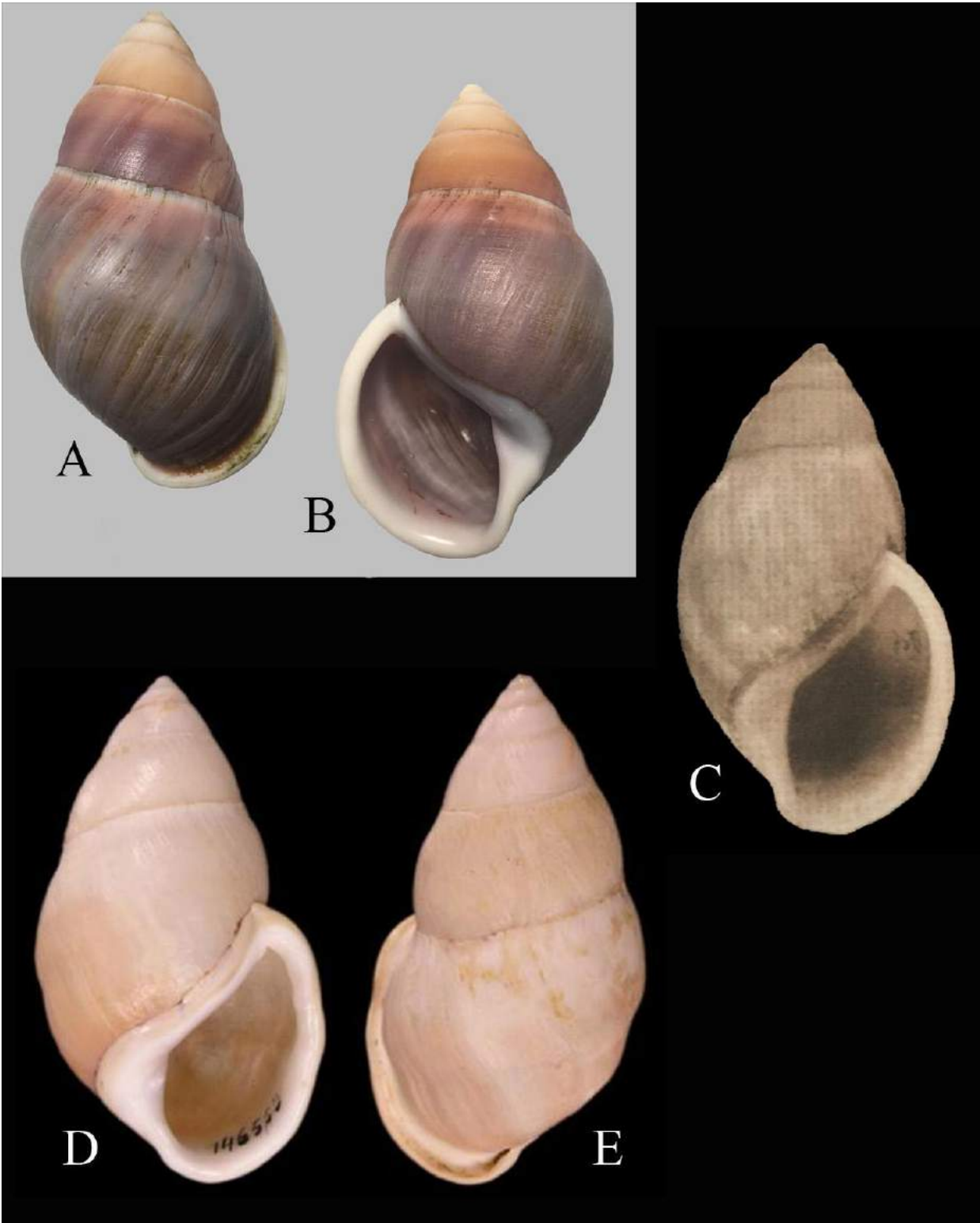


Plate 3. Figures A-B = Holotype of *Amphidromus bozhii*. C = Holotype of *A. placostylus*, extracted from Thach, 2017. D-E = Cotype of *A. ingens* (UMMZ 146553).