

Checklist of the Carnivorous Snail Superfamily Streptaxoidea Gray, 1860 (Gastropoda: Eupulmonata) from Laos with Description of a New Species

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ABSTRACT.– The superfamily Streptaxoidea is widespread in the tropical region and represents a major portion of the land snail fauna of most Southeast Asian countries. Laos is located on one of the biodiversity hotspots in this region, with high mountain ranges and limestone karsts. Herein, an up-to-date checklist is provided of all known Streptaxoidea species recorded in Laos until the year 2022. This annotated checklist comprises 23 species (9 Diapheridae and 14 Streptaxidae) with brief taxonomic notes/remarks when necessary. Of these, *Haploptychius somsaki* Vanhdibay & Inkhavilay, **sp. nov.**, is described based on shell morphological characters of specimens collected from the limestone karsts in central Laos. The species has an aperture oblique-ovate; peristome discontinuous, expanded, reflected, and thickened with enlarged columella fold adjacent to columellar axis. A systematic revision and more field research are required to fully reveal the species diversity of the superfamily Streptaxoidea in Laos.

KEYWORDS: biodiversity, carnivorous snail, checklist, endemic, limestones

INTRODUCTION

Lao People's Democratic Republic or 'Laos' is located in the centre of mainland Southeast Asia, and the unique topography of the country supports high biodiversity of both plants and animals. Land snails received particular attention by European naturalists such as H. Mouhot and A. Pavie during the colonial period. Their collected specimens have been studied and published in several research articles (see Inkhavilay et al. (2019) for further references). A recent classification based on literature and collected specimens included more than 230 land snail taxa recorded throughout Laos (Inkhavilay et al., 2019). Since then, several new genera and species of terrestrial snails from these areas have been reported (e.g., Do, 2021; Jochum et al., 2020; Páll-Gergely et al., 2019, 2020b, c, 2022, 2023; Páll-Gergely and Grego, 2020; Tongkerd et al., 2023). These continued discoveries suggest that a considerable portion of the land snail diversity from Laos is still hidden, probably due to the cryptic diversity among the land snail species. In addition, most parts of Laos have been unexplored because they are remote and difficult to access, especially in the tropical forest and karstic areas, which have diverse habitats.

A recent survey (2019–2020) by the native Laotian malacologists of the massive limestone karsts in the Khammouan Limestone National Biodiversity Conservation Area (Phou Hin Poun) in central Laos, yielded

several peculiar morphotypes of various land snail groups that will continue to be systematically reported in the next several years. Among these, the genus *Haploptychius* Kobelt, 1906, which is characterized by having an oblique heliciform shell, with the last whorl being axially distorted from the columellar axis, and the presence of only one parietal lamella (Kobelt, 1906; Richardson, 1988; Schileyko, 2000, 2011). This genus is comprised of about 20 to 25 nominal species restricted to Indochina and peninsular Malaysia (Richardson, 1988). The specimens from the Phou Hin Poun karsts show a character distinct from all other known congeners recorded from Laos and nearby countries (Inkhavilay et al., 2016a, 2019; Man et al., 2022; Siriboon et al., 2020; Thach, 2018).

This paper aims to update the list of all the Streptaxoidea Gray, 1860, including the Diapheridae Panha & Naggs, 2010 and Streptaxidae recorded and/or described from Laos based mainly on the published literature. A new species of the genus *Haploptychius* is described here based on conchological characters. This research also represents a baseline species inventory on the limestone-restricted species for future biodiversity studies in Laos.

MATERIALS AND METHODS

The species list below incorporates all of the nominal streptaxid species and subspecies that had been recorded in Laos until the year 2022. The synonymy tabulation and the usage of each taxon name were

recently provided in Inkhavilay et al. (2016a, b, 2019). The original combination of the taxon name and the reference to Kobelt (1905, 1906), Richardson (1988), and the later work by Inkhavilay et al. (2016a, b) are mentioned. Under the type material, the unique name-bearing type with the accession number is given. The species are listed alphabetically according to genus, then the nominal species in each genus and additional comments are provided in the remarks when necessary.

For the new species description, field collections were performed from 2019 to 2020 in the massive limestone karsts in central Laos, mainly in Bolikhamxay and Khammouan provinces. Various habitat types of the limestone karst, including caves and crevices, were searched for snail samples. Leaf litter and topsoil were also collected and searched. Specimens were identified based on Inkhavilay et al. (2016a, b, 2019) and by comparison with type specimens from several natural history museums. The holotype is deposited at the National University of Laos, Museum of Zoology: Mollusca Collection (NUOL-Moll), Vientiane, Laos.

Institutional abbreviation.— Abbreviations of the museum collections mentioned in the type and species descriptions are listed as follows:

CUMZ: Chulalongkorn University Museum of Zoology, Bangkok.

NHMUK: The Natural History Museum, London.

NUOL-Moll: National University of Laos, Museum of Zoology: Mollusca Collection, Vientiane.

SMF: Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main.

VNMN: Vietnam National Museum of Nature, Hanoi, Vietnam.

MNHN: Muséum National d'Histoire Naturelle, Paris.

RMNH: National Museum of Natural History, Leiden.

Taxon name

Descriptions of the new species are here solely attributed to the first and the last authors. Thus, complete citation of the author is Vanhdibay and Inkhavilay in Vanhdibay et al.

RESULTS

List of the carnivorous land snail superfamily Streptaxoidea Gray, 1860 from Laos

Superfamily Streptaxoidea Gray, 1860 Family Diaperidae Panha & Naggs, 2010

Remarks.— Originally the family Diaperidae Panha & Naggs in Sutcharit et al., 2010 was nominated to include *Diaphera* Albers, 1850 and *Sinoennea* Kobelt, 1904, based mainly on molecular evidence. Later, Páll-Gergely et al. (2020c) reviewed and analysed the synapomorphic characters, especially the apertural barriers, and suggested including another eight genera: *Bruggennea* Dance, 1972; *Laoennea* Páll-Gergely et al. in Páll-Gergely et al., 2020b; *Parasinoennea* Chen & Páll-Gergely in Páll-Gergely et al., 2020c; *Platycochlium* Laidlaw, 1950; *Platylennea* Páll-Gergely in Páll-Gergely et al., 2020c; *Pupennea* Páll-Gergely in Páll-Gergely et al., 2020c; *Rowsonia* Páll-Gergely in Páll-Gergely et al., 2020c; and *Tonkinia* Mabille, 1887. The ten genera in this family generally have a high spire, which is pupiform (or heliciform in two genera). However, this subsequent inclusion is still based solely on shell morphology; the systematic relationships among these genera is still provisional and requires information from further studies. In Laos, there are nine nominal species recorded from two genera, which are listed below:

Laoennea carychioides Páll-Gergely et al., 2020

Laoennea carychioides Páll-Gergely, Reischütz and Maassen in Páll-Gergely et al., 2020b: 2, figs 1a, b, 6a. Type locality: W of Vang Vieng, Tham Pou Kham Cave, Vientiane Province, Laos.

Type material.— Holotype NHMW 113107, figured in Páll-Gergely et al. (2020c: fig. 1a).

Distribution.— Known only from the type locality in Vientiane Province, Laos (Páll-Gergely et al., 2020b).

Laoennea renouardi Jochum & Wackenheim, 2020

Laoennea renouardi Jochum and Wackenheim in Jochum et al., 2020: 3–6, fig. 1a–j. Type locality: 2.7 km W of Vang Vieng, Tham Houey Yè, Vientiane Province, Laos.

Type material.— Holotype NMBE 565863 figured in Jochum et al. (2020: fig. 1a–j).

Distribution.— Known only from the type locality in Vientiane Province, Laos (Jochum et al., 2020).

Sinoennea angustistoma Páll-Gergely et al., 2020

Sinoennea angustistoma Páll-Gergely, Reischütz and Maassen in Páll-Gergely et al., 2020b: 4, 5, figs 2b, 6l. Type locality: E of road 1E about 300 m SE of

Gnommalat, NE of Thakhek, Khammouane Province, Laos.

Type material.— Holotype NHMW 113108, figured in Páll-Gergely et al. (2020b: fig. 2b).

Distribution.— Known only from the type locality in Khammouan Province, Laos (Páll-Gergely et al., 2020b).

Sinoennea euryomphala Inkhavilay & Panha, 2016

Sinoennea euryomphala Inkhavilay and Panha in Inkhavilay et al., 2016b: 226–229, fig. 6d–f. Type locality. Phathok Cave, Ngoi District, Luang Phrabang Province, Laos. Páll-Gergely et al., 2020b: 5, fig. 6.

Type material.— Holotype CUMZ 7067, figured in Inkhavilay et al. (2016b: fig. 6d–f).

Distribution.— Known only from the type locality in Luang Phrabang Province, Laos (Inkhavilay et al., 2016b).

Sinoennea infantilis Páll-Gergely & Grego, 2020

Sinoennea infantilis Páll-Gergely and Grego, in Páll-Gergely et al., 2020b: 5, fig. 1c, 6b. Type locality: earthquake dome, Tham Don Cave, Khammouan Province, south-central Laos.

Type material.— Holotype HNHM 103485, figured in Páll-Gergely et al. (2020b: fig. 1c).

Distribution.— Known only from the type locality in Khammouan Province, Laos (Páll-Gergely et al., 2020b).

Sinoennea lizae Maassen, 2008

Sinoennea lizae Maassen, 2008: 235, figs 1–4. Type locality: 500m SE of Phou Lek Village, Oung Pra Ngiene, Vieng Phouka, Luang Namtha, Laos. Inkhavilay et al., 2016b: 226, fig. 6a–c. Inkhavilay et al., 2019: 52, 109, fig. 22e. Páll-Gergely et al., 2020b: 5, 6, fig. 6j.

Type material.— RMNH 109522, figured in Maassen (2008: figs 1–4).

Distribution.— Known only from the type locality in Luang Namtha Province, Laos (Maassen, 2008; Inkhavilay et al., 2016b).

Sinoennea ljudmilena Páll-Gergely, 2020

Sinoennea ljudmilena Páll-Gergely in Páll-Gergely et al., 2020b: 6, 7, figs 3, 6i. Type locality: Province du Tran Ninh, Pah Hia, Laos [Xieng Khouang Province, Laos].

Type material.— Holotype MNHN-IM-2012-27277, figured in Páll-Gergely et al. (2020b: fig. 3).

Distribution.— Known only from the type locality in Xieng Khouang Province, Laos (Páll-Gergely et al. 2020b).

Sinoennea otostoma Páll-Gergely et al., 2020

Sinoennea otostoma Páll-Gergely, Reischütz and Maassen in Páll-Gergely et al., 2020b: 7, figs 2a, 6k. Type locality: Tham Pou Kham, west of Vang Vieng, Vientiane Province, Laos.

Type material.— Holotype NHMW 113109, figured in Páll-Gergely et al. (2020b: fig. 2a).

Distribution.— Known only from the type locality in Vientiane Province, Laos (Páll-Gergely et al., 2020b).

Sinoennea variabilis Páll-Gergely & Grego, 2020

Sinoennea variabilis Páll-Gergely and Grego, in Páll-Gergely et al., 2020b: 9–12, figs 5, 6c, e. Type locality: ca. 37 km east-northeast of Thakhek (Muang Khammouan), ca. 4.5 km west-northwest of Mahaxai, Khammouan Province, South-Central Laos. Páll-Gergely et al., 2020b.

Type material.— Holotype MNHN-IM-2012-27279, figured in Páll-Gergely et al. (2020b: fig. 5a).

Distribution.— Known only from the type locality in Khammouan Province, Laos (Páll-Gergely et al., 2020b).

Family Streptaxidae Gray, 1860

Remarks.— The family Streptaxidae is characterised by an eccentric to cylindrical shell with complex apertural dentition, genitalia with developing hook-like structures, and the living animals usually having bright yellow to red or greenish bodies (Rowson et al., 2009, 2010; Siriboon et al., 2013, 2014a, b; Verdcourt, 2000). This family is widely distributed in Southeast Asia; ten genera and about 140 nominal species of streptaxid snails have been recognised in the Indochina region (Blanford and Godwin-Austen, 1908; Bruggen, 1967;

Do and Do, 2015; Inkhavilay et al., 2016a; Richardson, 1988; Schileyko, 2000; Siriboon et al., 2013, 2014a, b).

The previous records of the streptaxids in Laos include twelve nominal species (Inkhavilay et al., 2016a, 2019); also, the nominal species *Discartemon discus* (Pfeiffer, 1853), *Haploptychius fischeri* (Morlet, 1887), and *Perrottetia daedaleus* (Bavay & Dautzenberg, 1909) were mentioned by Schileyko (2011) as occurring in Laos, but without reference to the specimens or the precise collection localities. Later, these were recognised as ‘uncertain records’ in an annotated species list of land snails in Laos (Inkhavilay et al., 2019). Our additional two-year survey throughout the country yielded no specimens that could be identified to these three nominal species. Therefore, in this paper, we have excluded them from the species list in Laos. However, more intensive field exploration in the future may produce streptaxid specimens that match these three nominal species. The current list contains 14 nominal species of five genera, including a new species described herein.

Haploptychius blaisei (Dautzenberg & Fischer, 1905)

Streptaxis blaisei Dautzenberg and Fischer, 1905: 86, 87, pl. 3, figs 1–4. Type locality: Ile Krieu, Tonkin [Krieu Island, Ha Long, Quang Ninh Province, Vietnam].

Haploptychius blaisei—Kobelt, 1906: 173, pl. 66, figs 4–7. Richardson, 1988: 212. Schileyko, 2011: 24. Do and Do, 2015: 40, 41, fig. 3c. Inkhavilay et al., 2016a: 36, fig. 4d–f. Inkhavilay et al., 2019: 52, 53, fig. 22f, g.

Type material.— Holotype MNHN-IM 200030866, figured in Inkhavilay et al. (2016a: fig. 4d; 2019: fig. 22f).

Distribution.— Known from several localities in north Vietnam (Do and Do et al., 2015) and in Luang Phrabang Province, Laos (Inkhavilay et al., 2016a).

Haploptychius pellucens (Pfeiffer, 1863)

Streptaxis pellucens Pfeiffer, 1863 [1862]: 273, pl. 36, fig. 6. Type locality: Lao Mountain, Camboja [Cambodia].

Haploptychius pellucens—Kobelt, 1906: 132, 133, pl. 61, figs 17–20. Richardson, 1988: 217, 218. Inkhavilay, et al., 2016a: 27–33, figs 1, 2a, 3a–c, 7a, b, 8a–d, 9a–f, 10g. Inkhavilay et al., 2019: 53, fig. 23a, b.

Type material.— Lectotype NHMUK 20160249.1, figured in Inkhavilay et al. (2016a: fig. 3a; 2019: fig. 23a).

Distribution.— Known from several localities in Xayabouly, Luang Phrabang, Oudomxay, Luang Namtha and Bolikhamxay provinces in Laos (Inkhavilay et al., 2016a).

Remarks.— The locality recorded in the historical collection from ‘Camboja [Cambodia]’; however, this needed to be confirmed with newly collected specimens with precise collection locality.

Haploptychius porrectus (Pfeiffer, 1863)

Streptaxis porrecta Pfeiffer, 1863 [1862]: 273. Type locality: Lao Mountains, Camboja [Cambodia].

Haploptychius porrectus [sic.]—Kobelt, 1906: 133, pl. 61, figs 24–26. Richardson, 1988: 219. Inkhavilay et al., 2016a: 34, 35, figs 1, 2b, 3d–f, 7c, d, 9g–m, 10h. Inkhavilay et al., 2019: 53, fig. 23c, d.

Type material.— Lectotype NHMUK 20140750.1, figured in Inkhavilay et al. (2016a: fig. 3d).

Distribution.— Known from two localities in Xieng Khouang Province, Laos (Inkhavilay et al., 2016a; 2019: fig. 23c).

Remarks.— The locality recorded in the historical collection from ‘Camboja [Cambodia]’ is needed to confirm with new specimens with precise collection locality.

Haploptychius somsaki Vanhdibay & Inkhavilay, sp. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:FD5108D3-4090-4DFD-8054-4CE5BFA7A71D>

(Fig. 1)

Type material.— Holotype NUoL-Moll 000010 (Fig. 1A). Measurement: shell height 11.3 mm, shell width 12.6 mm, and with 7 whorls. Paratypes NUoL-Moll 000011 (2 shells+ 1 broken shell; Fig. 1B) from the same lot with the holotype. Measurement of first paratype: shell height 13.5 mm, shell width 14.5 mm, and with 7 whorls. Measurement of second paratype: shell height 12.8 mm, shell width 13.6 mm, and with 7 whorls. Ranges and mean \pm S.D. of the paratypes: shell height 13.5–12.8 mm, 12.4 \pm 0.5, shell width 14.5–13.6 mm, 14.05 \pm 0.36.

Type locality.— Limestone karst with the low forest at Tam Kong Lor, Ban Kong Lor (village), Khounkham

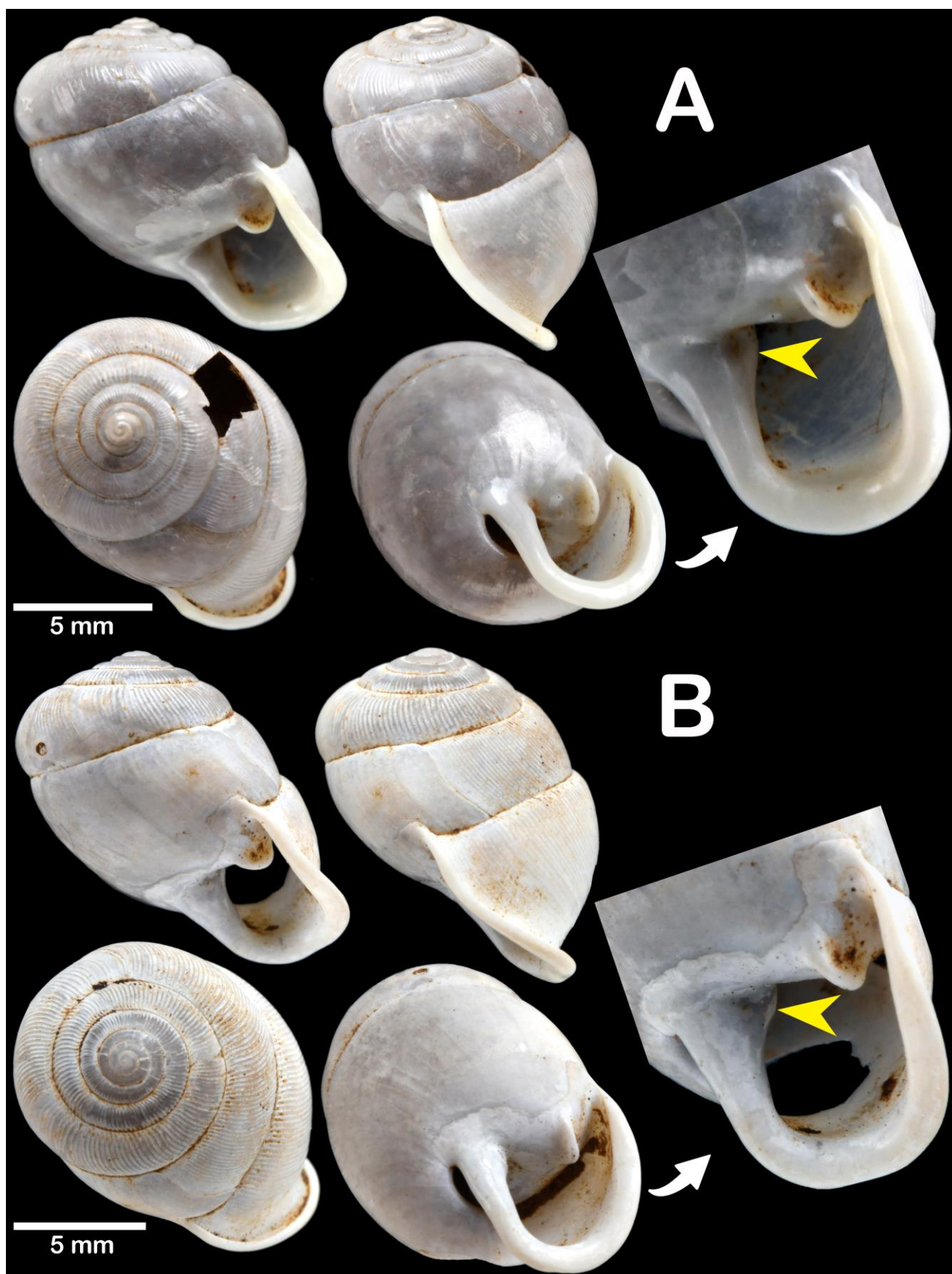


FIGURE 1. *Haploptychius somsaki* sp. nov. from Tam Kong Lor, Khammouan Province. **A.** Holotype NUOL-Moll 000010 with apertural dentition. **B.** Paratypes NUOL-Moll 000011 with apertural dentition. Arrows indicate the columella fold.

District, Khammouan Province, Laos (17°27'19.5"N, 104°54'28.3"E), 143 m asl.

Etymology.— The species name ‘*somsaki*’ refers to the first name of Professor Somsak Panha, Chulalongkorn University, who has extensively studied the taxonomy and systematics of land snails in Thailand and Laos.

Diagnosis.— *Haploptychius somsaki* sp. nov. can be distinguished from *H. fischeri* by having larger and thinner shell, higher spire, oblique-ovate aperture, thinner peristome with enlarged columella fold adjacent to columellar axis, deeper umbilicus, and thinner parietal lamella. In contrast, *H. fischeri* has a smaller and thicker shell, lower spire, subquadrangular aperture, thicker peristome, open umbilicus, and thicker parietal lamella. Compared with *H. pellucens*, this new species differs in having a larger and oblique-ovate shell, lower spire, more axially deflected last whorl, oblique-ovate aperture, thicker, more expanded peristome with enlarged columella fold adjacent to columellar axis, and narrower umbilicus. In contrast, *H. pellucens* has smaller, oblique-heliciform shell, higher spire, less axially deflected last whorl, subcircular aperture, thinner and less expanded peristome without enlarged columellar fold adjacent to columellar axis, and open umbilicus. *Haploptychius somsaki* sp. nov. is similar to *H. porrectus*, however it differs in its oblique-ovate aperture, larger shell, oblique-ovate aperture with enlarged columella fold adjacent to columellar axis, and narrower umbilicus. *Indoartemon diodonta*, which is found in the same type locality and areas nearby, is distinguished from *H. somsaki* sp. nov. by having smaller shell, less extended penultimate whorl, and subcircular aperture; one parietal and one small palatal lamellae are present.

Description.— Shell sub-oblique heliciform, white, and translucent; whorls 6³/₄–7; spire conical with distinct suture. Shell surface glossy with fine transverse ridges, nearly smooth with few transverse ridges near peristome; varices absent. Embryonic shell about 2½ whorls with smooth surface; following whorls regularly coiled. Shell periphery rounded; last whorl axially deflected. Aperture oblique-ovate; peristome discontinuous, expanded, reflected, and thickened with enlarged columella fold adjacent to columellar axis. Apertural dentition with one strong parietal lamella. Umbilicus narrow and deep (Fig. 1).

Distribution.— This new species is currently known from the type localities in limestone karsts in Khammouan Province of Central Laos. The empty shells

were found under leaf litter at the base of the limestone karsts.

Remarks.— To date, no living specimens have been collected.

Indoartemon tridens (Möllendorff, 1898)

Streptaxis tridens Möllendorff, 1898: 67. Type locality: Boloven, Laos [=Boloven Plateau, Paksong, Champasak, Laos].

Odontartemon tridens—Kobelt, 1905: 94, 95, pl. 58, figs 19, 20.

Indoartemon tridens—Richardson, 1988: 225. Schileyko, 2011: 23. Inkhavilay et al., 2016a: 44–46, fig. 6c. Inkhavilay et al., 2019: 54, fig. 23f.

Type material.— Holotype SMF 108507, figure in Inkhavilay et al. (2016a: fig. 6c).

Distribution.— Known only from the type locality in Champasak Province, Laos (Inkhavilay et al., 2016a).

Remarks.— Schileyko (2011: 23) suggested that this species occurs in central Vietnam; however, this needs to be confirmed with specimens with precise locality records.

Indoartemon diodonta Inkhavilay & Panha, 2016

Indoartemon diodonta Inkhavilay and Panha in Inkhavilay et al., 2016a: 46–49, fig. 6d–f. Type locality: Tam Xang, Tha Khek, Khammouan, Laos. Inkhavilay et al., 2019: 53, 54, fig. 23e.

Type material.— Holotype CUMZ 6289, figure in Inkhavilay et al. (2016a: fig. 6d).

Distribution.— Known only from the type locality in Khammouan Province, Laos (Inkhavilay et al., 2016a).

Indoartemon franzhuberi Thach, 2021

(Fig. 2)

Indoartemon huberi Thach, 2018: 39, figs 516–520. Type locality: Thakhek, Khammouane Province, Central Laos [not *Indoartemon huberi* (Thach, 2016)].

Indoartemon franzhuberi Thach, 2021: 40. New replacement name.

Type material.— Holotype MNHN-IM-2000-34072 (Fig. 2).

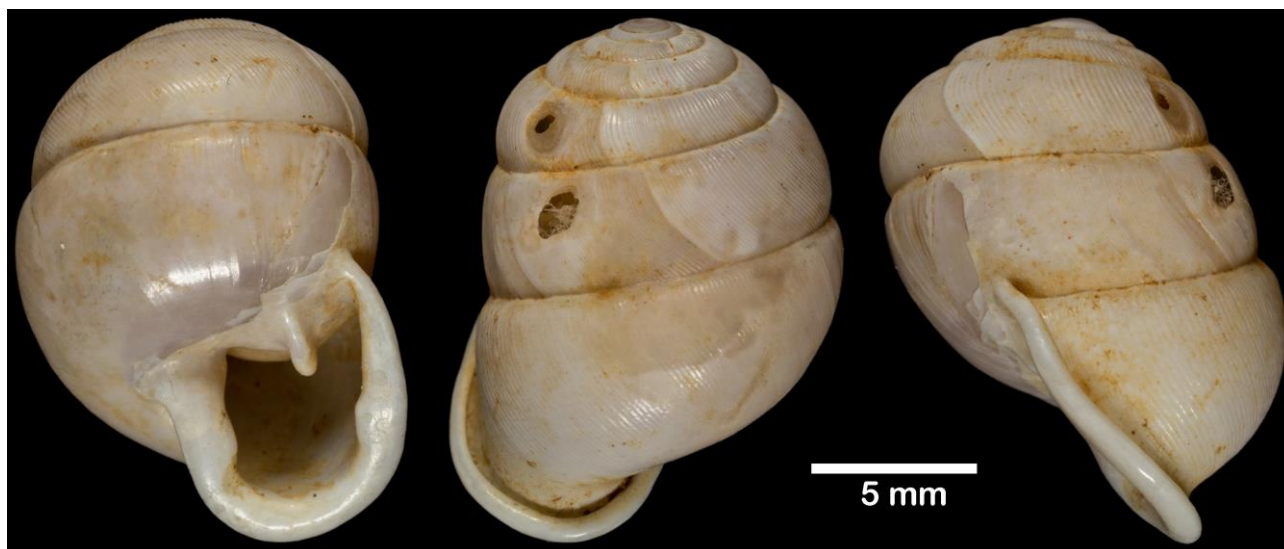


FIGURE 2. *Indoartemon franzhuberi*, holotype MNHN-IM-2000-34072.

Distribution.— Known only from the type locality in Khammouan Province, Laos (Thach, 2021).

Remarks.— The neotropical genus *Streptartemon* Kobelt, 1905 (Schileyko, 2000) was wrongly applied to the Southeast Asian streptaxid specimens in Thach (2016). Páll-Gergely et al. (2020a) noticed this and transferred *Streptartemon huberi* Thach, 2016 to genus *Indoartemon* (with similar shell morphology) that occupies the Indochina region. Later, *Indoartemon huberi* Thach, 2018 was nominated and became the secondary homonym. The original author replaced the younger name with *Indoartemon franzhuberi* Thach, 2021. In addition, the holotype of *I. huberi* (Thach, 2016) from Vietnam and *I. franzhuberi* Thach, 2021 from Laos clearly differ by shell shape and apertural dentition.

***Perrottetia aquilonaria* Siriboon & Panha, 2013**

Perrottetia aquilonaria Siriboon and Panha in Siriboon et al., 2013: 50–52, figs 3d–h, 4d–f: Type locality: Wat Tam Pha Plong, Chiangdao, Chiangmai, Thailand. Inkhavilay et al., 2016a: 40, fig. 5e. Inkhavilay et al., 2019: 54, fig. 24a.

Type material.— Holotype CUMZ 5003, figured in Siriboon et al. (2013: fig. 3d).

Distribution.— Known from several localities in northern Thailand (Siriboon et al., 2013), and Phong-saly and Xayabouly provinces in Laos (Inkhavilay et al. 2016a).

***Perrottetia unidentata* Inkhavilay & Panha, 2016**

Perrottetia unidentata Inkhavilay and Panha in Inkhavilay et al., 2016a: 40–42, figs 5f–i, 7e, f, 10a–f, i. Type locality. Ban Nawit, Viengxay, Houaphanh, Laos. Inkhavilay et al., 2019: 55, fig. 24d.

Type material.— Holotype CUMZ 6281, figure in Inkhavilay et al. (2016a: fig. 5f).

Distribution.— Known only from the type locality in Houaphanh Province, Laos (Inkhavilay et al., 2016a).

***Perrottetia megadentata* Inkhavilay & Panha, 2016**

Perrottetia megadentata Inkhavilay and Panha in Inkhavilay et al., 2016a: 42–44, fig. 6a, b. Type locality. Limestone outcrop at Ban Phone Can, Yommalat, Khammouan, Laos. Inkhavilay et al., 2019: 55, fig. 24c.

Type material.— Holotype CUMZ 6286, figure in Inkhavilay et al. (2016a: fig. 6a).

Distribution.— Known only from the type locality in Khammouan Province, Laos (Inkhavilay et al., 2016a).

***Perrottetia dugasti laosianus* Thach & Huber, 2020**

Perrottetia dugasti laosianus Thach and Huber in Thach, 2020: 34, 35, figs 426–429. Type locality: Luang Prabang, North Laos.

Type material.— Holotype MNHN-IM-2000-35529.

Distribution.— Known only from the type locality in Luang Phrabang Province, Laos (Thach, 2020).

Perrottetia thachorum Huber, 2021

Perrottetia thachorum Huber in Thach, 2021: 40, 41, figs 293, 294. Type locality: Vieng Xai, Houaphanh Province, North Laos.

Type material.— Holotype MNHN-IM-2000-37303.

Distribution.— Known only from the type locality in Houaphanh Province, Laos (Thach, 2021).

Perrottetia huberorum Thach, 2021

Perrottetia huberorum Thach, 2021: 41, figs 296, 297. Type locality: Vieng Xai, Houaphanh Province, North Laos.

Type material.— Holotype MNHN-IM-2000-37304.

Distribution.— Known only from the type locality in Houaphanh Province, Laos (Thach, 2021).

Remarks.— There are two nominal species, namely *Perrottetia thachorum* and *Perrottetia huberorum* each described based solely on the holotype and with the same collection locality in Vieng Xai, Houaphanh Province, Laos. These two nominal species fall within the range of morphological variation of *Perrottetia unidentata*, which was also described from Vieng Xai, Houaphanh Province.

Stemmatopsis dolium Do, 2021

Stemmatopsis dolium Do, 2021: 24, 25, fig 2d, e. Type locality: Pa Kha Village, Nam Phan Commune, Khun District, Xieng Khouang Province, Laos.

Type material.— Holotype VNMN-IZ 000.000.182, figured in Do (2021: fig. 2d).

Distribution.— Known only from the type locality in Xieng Khouang Province, Laos (Do, 2021).

Remarks.— The two specimens illustrated in the original description show very weakly tractable parietal lamella. The ovate shell shape clearly differs from the type species, which has a flattened shell with a unique aperture shape. This nominal species might be a member of the *Haploptychius* Möllendorff in Kobelt, 1906; however, further specimens are needed to clarify the generic position of this species.

DISCUSSION

In this annotated checklist, the members of Streptaxoidea from Laos were increased to comprise 23 species consisting of nine species of Diapheridae and 14 species of Streptaxidae including *Haploptychius somsaki* sp. nov. Laos' topography (and biodiversity hotspot) is dominated by the Annamese Mountains in the northeast and east, and the Luang Phrabang Range in the northwest.

The streptaxoidea fauna apparently is restricted in northern to central of Laos between latitudes of 17°–21°. Two species of the genus *Laoennea*, namely *L. carychioides* and *L. renouardi*, were discovered in a cave environment in the limestone area of Vientiane Province. Furthermore, all members of the genus *Sinoennea* have been reported from northern (Luang Phrabang, Luang Natmtha, Xieng Khouang, and Vientiane provinces) or central Laos, particularly in Khammouan Province.

Genus *Haploptychius* can be found from northern to central Laos, between the latitudes of 18°–21°. *Haploptychius somsaki* sp. nov. has been described herein based on shell morphology, and it becomes the fourth species of the genus and the first record from Khammouan Province in central Laos. The new species is distinguished from the congeners *H. pellucens*, *H. porrectus*, and *H. blaisei* by having an oblique-ovate aperture with enlarged columella fold adjacent to columellar axis, and narrower umbilicus. *Indoartemon diodontia*, *I. franzhuberi*, and *P. megadentata* were discovered in Khammouan Province's limestone karsts at altitudes of 200 meters above sea level. The new species is distinguished from the other three genera by having more extended penultimate whorl, and oblique-ovate aperture with only one parietal lamella.

Khammouan Province in central Laos has been identified as a key biodiversity hotspot, where seven streptaxoidids species have been recorded (three diapherid and four streptaxid species). Streptaxoidea has not yet been recorded in southern Laos. The extensively changed environments of southern Laos may support a lesser diversity of species.

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LITERATURE CITED

- Albers, J.C. 1850. Die Heliceen, nach natürlicher Verwandtschaft systematisch geordnet. Enslin, Berlin, 262 pp.
- Bavay, A. and Dautzenberg, P. 1909 Molluscorum terrestrium tonkinorum diagnoses. Journal de Conchyliologie, 56[1908]: 229–251.
- Blanford, W.T. and Godwin-Austen, H.H. 1908. The Fauna of British India, including Ceylon and Burma. Mollusca. Testacellidae and Zonitidae. Taylor and Francis, London, 311 pp.
- Bruggen, A.C. van. 1967. An introduction to the pulmonate family Streptaxidae. Journal of Conchology, 26: 181–188.
- Dance, S.P. 1972. *Bruggeneia*, n. gen., proposed for recent streptaxids from Borneo (Gastropoda: Streptaxidae). Archiv für Molluskenkunde, 102: 131–132.
- Dautzenberg, P.H. and Fischer, H. 1905. Liste des mollusques récoltés par M. le Frégate Blaise au Tonkin, et description d'espèces nouvelles. Journal de Conchyliologie, 53: 85–234.
- Do, D.S. 2021. Two new species of the genus *Stemmatopsis* J. Mabille, 1887 (Gastropoda: Stylommatophora: Streptaxidae) from Vietnam and Laos. Ruthenica, 31: 21–25.
- Do, D.S. and Do, V.N. 2015. The terrestrial snail family Streptaxidae J. Gray, 1860 (Gastropoda: Pulmonata) from Son La, Vietnam, with description of two new species. Ruthenica, 25: 37–43.
- Gray, J.E. 1860. On the arrangement of the land pulmoniferous Mollusca into families. Annals and Magazine of Natural History (Series 3), 6: 267–269.
- Inkhavilay, K., Siriboon, T., Sutcharit, C., Rowson, B. and Panha, S. 2016a. The first revision of the carnivorous land snail family Streptaxidae in Laos, with description of three new species (Pulmonata, Stylommatophora, Streptaxidae). ZooKeys, 589: 23–53. doi.org/10.3897/zookeys.589.7933.
- Inkhavilay, K., Sutcharit, C., Tongkerd, P. and Panha, S. 2016b. New species of micro snails from Laos (Pulmonata: Vertiginidae and Diapheridae). Journal of Conchology, 42: 213–232.
- Inkhavilay, K., Sutcharit, C., Bantaowong, U., Chanabun, R., Siriwut, W., Srisonchai, R., Pholyotha, A., Jirapatrasilp, P. and Panha, S. 2019. Annotated checklist of the terrestrial molluscs from Laos (Mollusca, Gastropoda). ZooKeys, 834: 1–166. doi.org/10.3897/zookeys.589.7933
- Jochum, A., Bochud, E., Favre, A., Ferrand, M. and Wackenheim, Q. 2020. A new species of *Laoennea* microsnail (Stylommatophora, Diapheridae) from a cave in Laos. Subterranean Biology, 36: 1–9. doi.org/10.3897/subtbiol.36.58977
- Kobelt, W. 1904. Die systematische Stellung der chinesischen Ennea. Nachrichtenblatt der Deutschen Malakozoologischen Gesellschaft, 36: 26–30.
- Kobelt, W. 1905, 1906 [1905–1906]. Die Raublungenschnecken (Agnatha). Zweite Abtheilung: Streptaxidae und Daudebaridiidae. Systematisches Conchylien-Cabinet von Martini und Chemnitz 1(12b) (2): 1–96, pls 42–59 [1905]; 97–211, pls 60–71 [1906].
- Laidlaw, F.F. 1950. Description of a new genus of land-mollusc, belonging to the family Streptaxidae, from the Bau district of Sarawak. Sarawak Museum Journal, 5: 370–372.
- Maassen, W.J.M. 2008. Remarks on a small collection of terrestrial molluscs from north-west Laos, with descriptions of three new species (Mollusca: Pulmonata: Streptaxidae, Vertiginidae). Basteria, 72: 233–240.
- Mabille, J. 1887. Molluscorum tonkinorum diagnoses. Meulan, Seine-Oise, 18 pp.
- Man, Sian. N., Siriboon, T., Lin, A., Sutcharit, C. and Panha, S. 2022. Revision of the carnivorous land snail family Streptaxidae (Stylommatophora, Achatinina) in Myanmar, with description of four new species. ZooKeys, 1110: 39–102. doi.org/10.3897/zookeys.1110.85399
- Möllendorff, O.F. von. 1898. Die Binnenmollusken Annams. Nachrichtenblatt der Deutschen Malakozoologischen Gesellschaft, 30: 65–85.
- Morlet, L. 1887. Liste des coquilles recueillies, au Tonkin par M. Jourdy, chef d'escadron d'artillerie, et description d'espèces nouvelles. Journal de Conchyliologie, 34[1886]: 257–295.
- Páll-Gergely, B. and Grego, J. 2020. *Kontschania tetragyra* n. gen. & sp. from Laos (Gastropoda: Cyclophoroidea: Diplommatinidae). Journal of Conchology, 43: 461–465.
- Páll-Gergely, B., Grego, J., Vermeulen, J.J., Reischütz, A., Hunyadi, A. and Jochum, A. 2019. New *Tonkinospira* Jochum, Slapnik & Páll-Gergely, 2014 species from Laos and Vietnam (Gastropoda: Pulmonata: Hypselostomatidae). Raffles Bulletin of Zoology, 67: 517–535
- Páll-Gergely, B., Hunyadi, A. and Auffenberg, K. 2020a Taxonomic vandalism in malacology: Comments on molluscan taxa recently described by N. N. Thach and colleagues (2014–2019). Folia Malacologica, 28: 35–76.
- Páll-Gergely, B., Reischütz, A., Maassen, W.J.M., Grego, J. and Hunyadi, A. 2020b. New taxa of Diapheridae Panha & Naggs in Sutcharit et al. 2010 from Laos and Thailand (Gastropoda: Eupulmonata: Stylommatophora). Raffles Bulletin of Zoology, 68: 1–13.
- Páll-Gergely, B., Hunyadi, A., Grego, J., Sajan, S.K. and Chen, Z.-Y. 2020c. A review of the Diapheridae (Gastropoda: Eupulmonata: Streptaxoidea), with special emphasis on India and Myanmar. Raffles Bulletin of Zoology, 68: 682–718.
- Páll-Gergely, B., Hunyadi, A., Vermeulen, J.J., Grego, J., Sutcharit, C., Reischütz, A., Dumrongrojwattana, P., Botta-Dukát, Z., Örstan, A., Fekete, J. and Jochum, A. 2023. Five times over: 42 new Angustopila species highlight Southeast Asia's rich biodiversity (Gastropoda, Stylommatophora, Hypselostomatidae). ZooKeys, 1147: 1–177. doi.org/10.3897/zookeys.1147.93824
- Páll-Gergely, B., Jochum, A., Vermeulen, J.J., Anker, K., Hunyadi, A., Örstan, A., Szabó, Á., Dányi, L. and Schilthuizen, M. 2022. The world's tiniest land snails from Laos and Vietnam (Gastropoda, Pulmonata, Hypselostomatidae). Contributions to Zoology, 91: 62–78. doi.org/10.1163/18759866-bja10025
- Pfeiffer, L. 1853. Description of fifty-four new species of helicea, from the collection of Hugh Cuming, Esq. Proceedings of the Zoological Society of London, 19[1851]: 252–263.
- Pfeiffer, L. 1863. Description of thirty-six new land shells, from the collection of H. Cuming, Esq. Proceedings of the Zoological Society of London, 30[1862]: 268–278.
- Richardson, L. 1988. Streptaxacea: Catalog of species, Part I, Streptaxidae. Tryonia, 16: 1–326.
- Rowson, B., Seddon, M.B. and Tattersfield, P. 2009. A new species of *Gulella* (Pulmonata: Streptaxidae) from montane forest in the Ndoto Mountains, Kenya. Zoologische Mededelingen Leiden, 83: 651–659.
- Rowson, B., Tattersfield, P. and Symondson, W.O.C. 2010. Phylogeny and biogeography of tropical carnivorous land-snails (Pulmonata: Streptaxoidea) with particular reference to East Africa and the Indian Ocean. Zoologica Scripta, 40: 85–98. doi.org/10.1111/j.1463-6409.2010.00456.x

- Schileyko, A.A. 2000. Treatise on recent terrestrial pulmonate molluscs: Rhytididae; Chlamydephoridae; Systrophiiidae; Haplotrematidae; Streptaxidae; Spiraxidae; Oleacinidae; Testacellidae. *Ruthenica Supplement 2, Part 6*: 731–880.
- Siriboon, A.A. 2011. Check-list of land pulmonate molluscs of Vietnam (Gastropoda: Stylommatophora). *Ruthenica*, 21: 1–68.
- Siriboon, T., Naggs F., Wade, C.M., Jeratthitikul, E., Tongkerd, P., Jirapatrasilp, P., Panha, S. and Sutcharit, C. 2020. Phylogenetic relationships of the carnivorous terrestrial snail family Streptaxidae (Stylommatophora: Achatinina) in Thailand and surrounding areas of Southeast Asia. *Systematics and Biodiversity*, 18: 720–738. doi.org/10.1080/14772000.2020.1783384
- Siriboon, T., Sutcharit, C., Naggs F. and Panha, S. 2013. Three new species of the carnivorous snail genus *Perrottetia* Kobelt, 1905 from Thailand (Pulmonata, Streptaxidae). *ZooKeys*, 287: 41–57. doi.org/10.3897/zookeys.287.4572
- Siriboon, T., Sutcharit, C., Naggs F., Rowson, B. and Panha, S. 2014a. Revision of the carnivorous snail genus *Discartemon* Pfeiffer, 1856, with description of twelve new species (Pulmonata, Streptaxidae). *ZooKeys*, 401: 45–107. doi.org/10.3897/zookeys.401.7075
- Siriboon, T., Sutcharit, C., Naggs, F., Rowson, B. and Panha, S. 2014b. Revision of the carnivorous snail genus *Indoartemon* Forcart, 1946 and a new genus *Carinartemis* from Thailand (Pulmonata: Streptaxidae). *Raffles Bulletin of Zoology*, 62: 161–174.
- Sutcharit, C., Naggs F., Wade, C.M., Fontanilla, I. and Panha, S. 2010. The new family Diapheridae, a new species of *Diaphera* Albers from Thailand, and the position of the Diapheridae within a molecular phylogeny of the Streptaxoidea (Pulmonata: Stylommatophora). *Zoological Journal of the Linnean Society*, 160: 1–16.
- Thach, N.N. 2016. Vietnamese New Mollusks with 59 New Species. 48HrBooks Company, Ohio, USA, 205 pp.
- Thach, N.N. 2018. New shells of South Asia Seashells-Freshwater & Land Snails, 3 new genera, 132 new species & subspecies. 48HrBooks Company, Ohio, USA, 173 pp.
- Thach, N.N. 2020. New shells of South Asia, Volume 2, Seashells, Freshwater, Land Snails with one new genu and 140 new species and subspecies, reply to comments made in error. 48Hr Books Company, Ohio, USA, 189 pp.
- Thach, N.N. 2021. New Shells of South Asia and Taiwan, China, Tanzania, Seashells, Freshwater, Land snails, with 116 new species & subspecies and rejected synonyms, accepted species. 48Hr Books, Akron, Ohio, USA, 201 pp.
- Tongkerd, P., Tumpeesuwan, S., Inkhavilay, K., Prasankok, P., Jeratthitikul, E., Panha, S. and Sutcharit, C. 2023. Systematic revision of the snorkel snail genus *Rhiostoma* Benson, 1860 (Gastropoda, Caenogastropoda, Cyclophoridae) with descriptions of new species. *ZooKeys*, 1142: 1–144. doi.org/10.3897/zookeys.1142.90097
- Verdcourt, B. 2000. The penial armature of three species of East African Streptaxidae (Gastropoda: Stylommatophora). *Folia Malacologica*, 8: 215–221. doi.org/10.12657/folmal.008.015
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