

First record and description of a new species of the land snail genus *Pearsonia* Kobelt, 1902 (Cyclophoridae: Pterocyclinae) from Thailand, with a note on radula morphology

Sakboworn Tumpeesuwan^{1, 2*} & Chanidaporn Tumpeesuwan¹

Abstract. A new cyclophorid species of the genus *Pearsonia* possessing a sub-discoidal shell with a sutural tube was discovered from a dolomitic limestone hill in Lamphun Province, northern Thailand. This discovery also represents the first record of the genus in Thailand. *Pearsonia lamphunensis*, new species, differs from the related congeners by the zig-zag brown stripes that are present on both dorsal and ventral sides of the shell. The radula morphology of the genus *Pearsonia* is examined for the first time. The central cusps of both central and lateral teeth are shovel-shaped, and the central cusp's width is more than half that of the tooth's width. Comparisons of the radula morphology of *Pearsonia lamphunensis*, new species, and the recently described *Pterocyclos diluvium* Sutcharit & Panha in Sutcharit et al., 2014, suggests that *Pearsonia* is more closely related to *Pterocyclos* than *Rhiostoma*, which has fewer cusps in the outer lateral teeth, and thus differs from both aforementioned genera.

Key words. Cyclophoridae, *Pearsonia*, sutural tube, radula morphology, dolomitic limestone hill

INTRODUCTION

The largest group of operculated landsnails in tropical and subtropical regions of Asia, Africa and Australia is the family Cyclophoridae Gray, 1847 (Kobelt, 1902). Based on Vaught (1989), the family comprises four subfamilies, including Cyclophorinae Gray, 1847, Spirostomatinae Tielecke, 1940, Alycaeinae Blanford, 1864, and Pterocyclinae Kobelt & Möllendorff, 1897. In Thailand, all subfamilies except Spirostomatinae have been discovered and reported upon. The subfamily Pterocyclinae comprises four genera with sub-discoidal shells, including *Pterocyclos* Benson, 1832, *Rhiostoma* Benson, 1860, *Platyrhaphis* Möllendorff, 1890, and *Pearsonia* Kobelt, 1902 (Vaught, 1989).

In June 2014, some limestone and sandstone hills in Lamphun Province (Fig. 1) were surveyed and land snails were collected. Three living snails and four shells of a species with a discoidal shell were discovered. These shells possess a sutural tube that originated from the suture, at the last part of the body whorl, and has its distal end pointed backward (Fig. 2B–D; 3A, C, D). The conchological characteristics indicated these shells belong to the genus *Pearsonia* Kobelt, 1902.

Based on the checklists of molluscan fauna of Thailand by Hemmen & Hemmen (2001) and Nabhitabhata (2009), that listed a total of 234 terrestrial snails (53 cyclophorid taxa), there is so far no record of the genus *Pearsonia*. This discovery thus represents first record of this genus in Thailand. Radula morphology of a member of the genus *Pearsonia* is also described for the first time in this paper, and briefly discussed.

MATERIAL AND METHODS

The specimens were discovered and collected from a dolomitic limestone hill near Tham [=cave] Erawan, Pa Sang District, Lamphun Province (18°19'39.1"N, 98°52'18.6"E) in June 2014 (Fig. 1). The type locality is situated between 543–546 m above mean sea level, with mixed deciduous and dry dipterocarp forests. Empty shells and aestivating snails were discovered under leaf litter deposited under outcrops, in rock crevices, holes and rock shelter (Fig. 2A, B).

Description of the new species in this paper is based on the shell morphology and colour pattern, external body colouration, operculum and radula morphology of three living snails and four empty shells. In the description of the sutural tube we used the term "proximal" to refer to the part connected to the shell and "distal" to refer to the part furthest from the shell. The three living specimens were drowned in water and preserved in 70% ethanol prior to dissection for examinations of the radula. Five complete adult specimens (one living snail + four empty shells) were used to determine whorl number, shell height (sh), shell width (sw). These parameters were measured by using vernier calipers. The radula was extracted from one adult specimen and examined under a scanning electron microscope (JSM-6460 LV) at

¹Department of Biology, Faculty of Science, Mahasarakham University, Kantharawichai District, Maha Sarakham, 44150 Thailand

²Palaeontological Research and Education Centre, Mahasarakham University, Kantharawichai District, Maha Sarakham, 44150 Thailand; Email: stumpeesuwan@yahoo.com (*corresponding author)

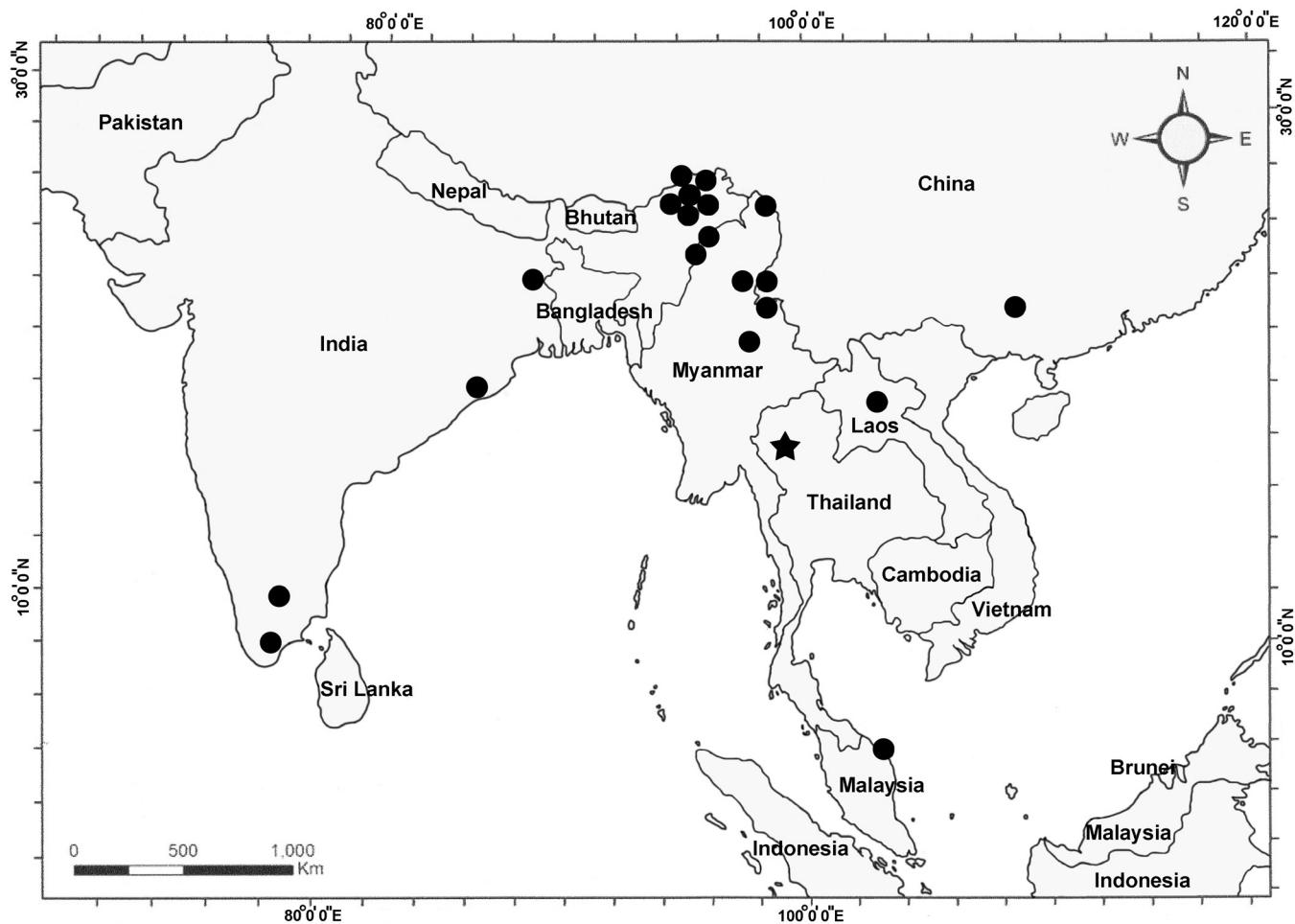


Fig. 1. Approximate location of type localities of *Pearsonia* spp. (circle); and type locality of *Pearsonia lamphunensis*, new species, from dolomitic limestone hill near Tham Erawan, Lamphun Province (star) (modified after Marzuki & Clements, 2013).

the Central laboratory, Faculty of Science, Mahasarakham University.

These specimens were deposited in the following institutions: Natural History Museum, Mahasarakham University, Maha Sarakham, Thailand (NHMSU) and the Zoological Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore (ZRC).

Abbreviation. Abbreviations used in this paper comprise sh: shell height; sw: shell width; op: operculum; st: sutural tube; pp: peristome projection; and vg: vaginal groove (Figs. 2C, D; 3A–D). Abbreviations and terminology for radula morphology used here follow Lee et al. (2008): ct: central tooth; ilt: inner latateral teeth; olt: outer lateral teeth; and mt: marginal teeth (Fig. 5B). The sequence of cusps in each tooth starts from the first cusp at the innermost cusp.

SYSTEMATICS

Family Cyclophoridae Gray, 1847

Subfamily Pterocyclinae Kobelt & Möllendorff, 1897

Genus *Pearsonia* Kobelt, 1902

Type species. *Spiraculum hispidum* Pearson, 1833

Pearsonia lamphunensis, new species

Figs. 2–5; Table 1

Type material. Holotype: NHMSU-0006 (Fig. 3) (shell height 9.0 mm, shell width 16.9 mm), Tham Erawan, Lamphun Province, northern Thailand, coll. Malacological Laboratory Team of Mahasarakham University, June 2014. Paratypes: NHMSU-0007 (two shells and three specimens in ethanol; shell height 9.1–10.0 mm, shell width 15.7–17.0 mm); ZRC.MOL.5792 (one shell; shell height 9.2 mm, shell width 16.3 mm).

Etymology. The specific epithet, *lamphunensis*, is named after its type locality Lamphun Province of Thailand.

Diagnosis. Shell possesses backward pointing sutural tube (st) and horizontal, somewhat linguiform, peristome projection (pp). Zig-zag brown stripes present on both dorsal and ventral sides of shell.

Description. Shell: Dextral, sub-discoidal depressed, widely umbilicate, height 9.0–10.0 mm, shell width 15.7–17.0 mm, slightly thin, whorls $5\frac{1}{4}$ – $5\frac{1}{2}$, rounded, spire a little raised. Background color pale brown, translucent, shiny, dorsal side with broad dark brown v-shaped or zig-zag stripes crossing the whorls; peripheral band broad, dark brownish; ventral

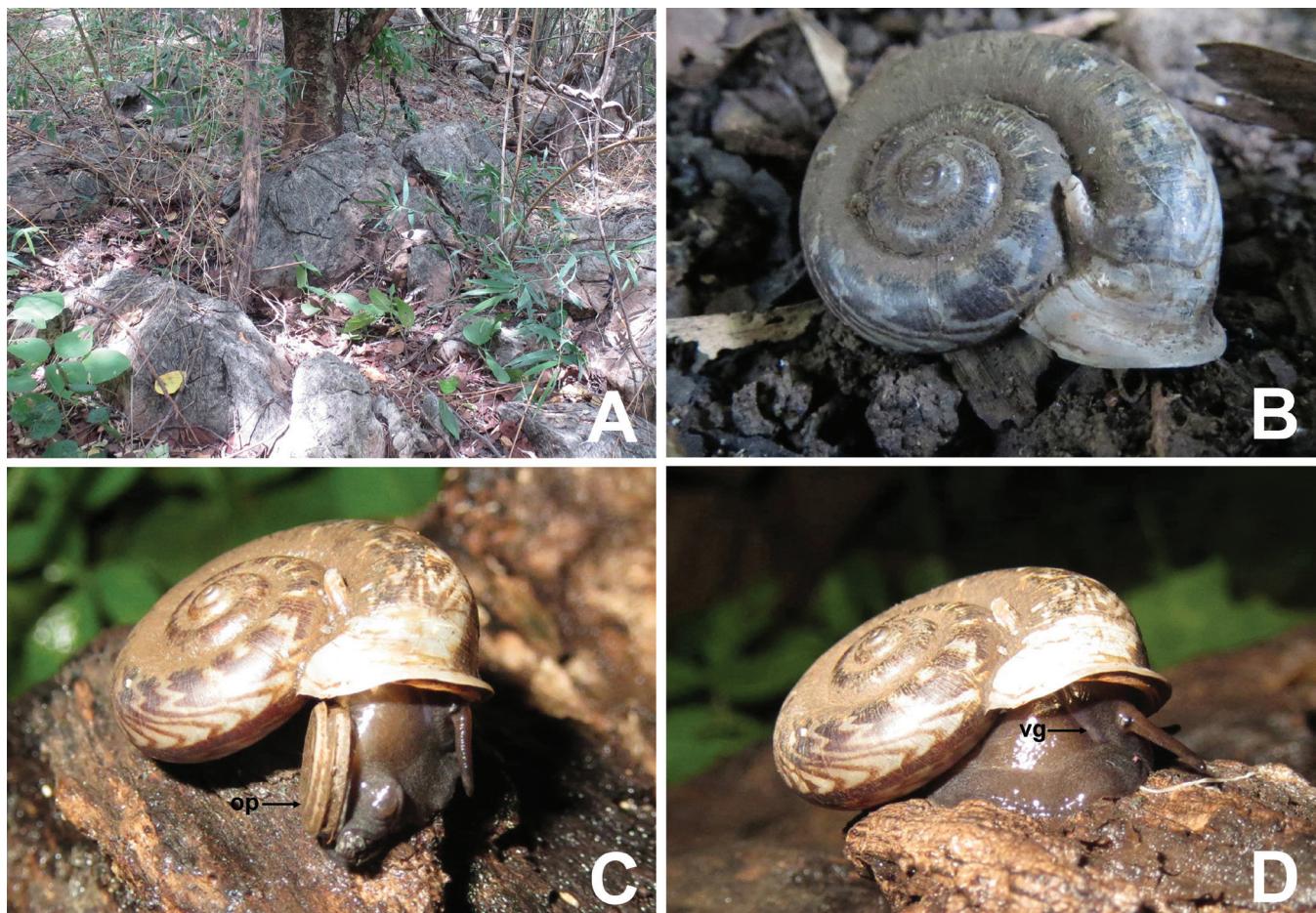


Fig. 2. *Pearsonia lamphunensis*, new species. A, Type locality habitat in dolomitic limestone hill, Lamphun Province; B, Aestivating living snail in natural habitat. Paratype (NHMSU-0007); C, Female partially retracted with the operculum (op) showing; D, vaginal groove (vg) near right tentacle visible.

Table 1. Comparison of shell morphology between *Pearsonia lamphunensis*, new species, and the recently described and two geographically close *Pearsonia* species.

Species	sh (mm)	sw (mm)	Sutural tube	pp	Zig-zag pattern	Reference
<i>P. bhamoensis</i>	5.5	11.0	backward	horizontal	absent	Gude (1921)
<i>P. avana</i>	8.0	17.0	backward	vertical	dorsal side	Gude (1921)
<i>P. tembatensis</i>	8.6–11.8	23.8–27.0	backward	horizontal	absent	Masaki & Clement (2013)
<i>P. lamphunensis</i>	9.0–10.0	15.7–17.0	backward	horizontal	Both sides	this study

side with many fine zig-zag brown stripes. Peristome double, the inner lip with sinus, at the parieto-columella angle, the outer lip expanded and forms a horizontal linguiform wing (peristome projection) near the suture. Sutural tube situated a little distance (ca. 3.6–5.3 mm.) from the peristome, in which the distal end is pointed backward (Figs 2B–D, 3A, C, D).

Body: Pale brown to dark brown body, foot dark brown. Black eye spot present at the base of short brown tentacles. All three living specimens available for study are female, with a vaginal groove (vg) on the right side of the head (Fig. 2D), which runs from the genital opening downwards to the area near the right tentacle.

Operculum: Solid, round, bi-layered; thick calcified layer form outer part of operculum, and thin corneous layer forms inner surface. The outer surface rather convex, multispiral with more than seven counter-clockwise whorls, covered with fine growth lines, nucleus normally abraded. Internal corneous layer concave and wider than calcified layer and outer surface, therefore, bending outwards at edges; opercular disc attachment site large, circular, and can be divided into 3 parts, the middle part forms horseshoe shape area, the outer part and the large circular nucleus depressed. Periphery bearing imbricated semi-circular growth line, which is concave on the left-side (Fig. 4).

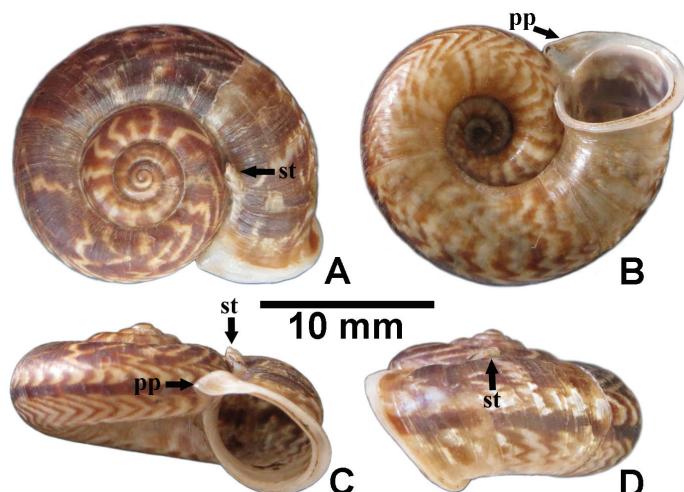


Fig. 3. *Pearsonia lamphunensis*, new species, dolomitic limestone hill near Tham Erawan, Lamphun Province. Holotype (NHMSU-0006). A, dorsal view; B, ventral view; C, apertural view; D, side view. Arrow indicates position of sutural tube.

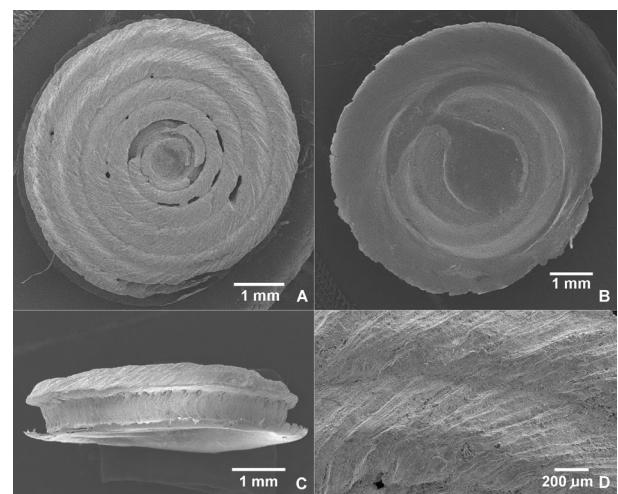


Fig. 4. Operculum of *Pearsonia lamphunensis*, new species. Paratype (NHMSU-0007). A, outer surface; B, inner surface; C, side view; D, close up view of outer surface.

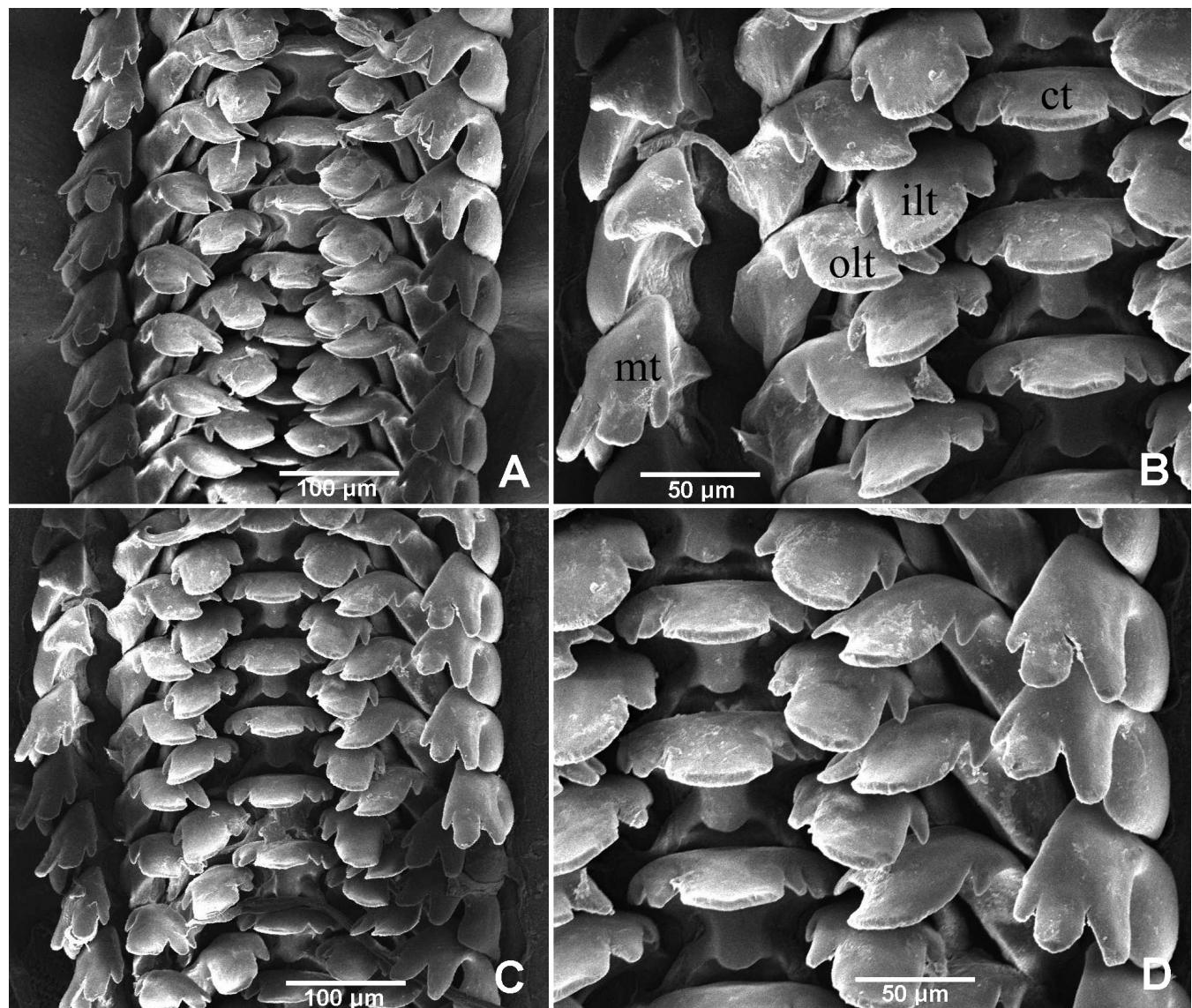


Fig. 5. *Pearsonia lamphunensis*, new species, radula of paratype (NHMSU-0007). A, curled position, most central teeth were covered by lateral teeth; B, close up view of left side of radula; C, uncurled position, all cuspidal features are visible; D, close up view of right side of radula (st).

Radula: Taenioglossate, the sole specimen examined has at least 84 transverse rows and each row comprises seven teeth (1-2-1-2-1), including one left marginal tooth, two left lateral teeth, one central tooth, two right lateral teeth and one right marginal tooth. Central tooth is low, stout mushroom shape, pentacuspid, central cusp very large trapezoid shape, lateral and marginal cusps, small triangle knobs. Inner and outer lateral teeth tetracuspid, the first and second cusps are small robust finger shaped, the third cusp is very large shovel-shaped and the fourth cusp is small finger shaped. Marginal tooth, tricuspid, possesses the first finger shaped cusp, the second cusp, tongue shaped and the third cusp large triangular shape (Fig. 5A–D, Table 2).

Remarks. The new species differs from *Pearsonia tembatensis* Marzaki & Clements, 2013, by its higher spire, presence of a broader dark brown peripheral band and zig-zag stripes on both dorsal and ventral sides of shell. It is easily distinguished from *Pterocyclos diluvium* Sutcharit & Panha in Sutcharit et al., 2014, by the backward pointing sutural tube and horizontal somewhat linguiform peristome projection. *Opisthoporus pterocycloides* (Pfeiffer, 1854) is very similarly patterned, but differs from the new species by its flat spire, expanded outer peristome, forward pointing sutural tube, and absence of a peripheral band.

Shell morphology of *Pearsonia lamphunensis* appear superficially similar to Gude's (1921) illustrations and descriptions of *Pearsonia bhamoensis* (Theobald, 1876) from Bhamo, and *Pearsonia avana* (Blanford, 1863) from Shan Hill to the east of Ava, northeast Myanmar. The shell size of *Pearsonia lamphunensis* is however significantly larger and the spire is higher than *Pearsonia avana* and *Pearsonia bhamoensis* (see Table 1). The peristome projection (pp) of *Pearsonia lamphunensis* is horizontal as in *Pearsonia bhamoensis*, but unlike *Pearsonia avana*, which is vertical. The sutural tube of both *Pearsonia lamphunensis* and *Pearsonia bhamoensis* is curved upward and backward in the suture, whereas in *Pearsonia avana* it is curved upward. The colour pattern of *Pearsonia lamphunensis* differs from these two geographically close species by the presence of dark brown zig-zag stripes on both dorsal and ventral sides of the shell, whereas stripes are only present on the dorsal side in *Pearsonia avana* and absent in *Pearsonia bhamoensis*.

DISCUSSION

Twenty-two species of the genus *Pearsonia* are presently known from the Indo-Malayan region (Gude, 1921; Morlet, 1892; Yen, 1939; Marzuki & Clements, 2013). Two species from southern India, two species from eastern India, 10 species from northeastern India, five species from northern Myanmar, one species from northern Laos, one species from southeastern China, and one species from the Peninsular Malaysia. The recent discovery of *Pearsonia tembatensis* Marzuki & Clements, 2013, in non-limestone areas from the Peninsular Malaysia represents the southernmost distribution of this genus in Sundaland (Fig. 1). Based on the geographic distribution, the discovery of *Pearsonia lamphunensis* from northern Thailand represents a link between *Pearsonia*

tembatensis Marzuki & Clements, 2013, from Malaysia and *Pearsonia avana* and *Pearsonia bhamoensis* from Myanmar (Gude, 1921). However, northwestern and western Thailand remain poorly surveyed for landsnail fauna, and it is therefore possible that more undescribed *Pearsonia* species from the isolated limestone hills in these parts remain undiscovered.

The diagnostic characters of *Pearsonia* Kobelt, 1902 are the sub-discoidal and depressed shell shape with a backward pointing sutural tube that is a short distance behind the aperture (Kobelt, 1902; Gude, 1921; Marzuki & Clements, 2013). Other characters are the inner lip with sinus and the outer lip that is expanded and forms a wing, or peristome projection, at the parieto-columellar angle of the peristome (Mitra et al., 2004). Recently, Sutcharit et al. (2014) transferred *Pterocyclos regelspergeri* de Morgan, 1885, to the genus *Pearsonia* Kobelt, 1902. This species lacks a sutural tube, and in our opinion, does not belong to *Pearsonia*. It should instead be transferred to the genus *Crossopoma* Martens, 1891, because of its sub-discoidal and depressed shell, deep sutural groove, and relatively small peristome projection.

Thus far radula morphology has not been studied in any of the *Pearsonia* species. In this study, the cuspidal features of the *Pearsonia* radula were carefully investigated and compared to previous studies of the subdiscoidal shaped cyclophorids (Tumpeesuwan, 2001; Lee et al., 2008; Tumpeesuwan & Tumpeesuwan, 2010; Sutcharit et al., 2014). *Pterocyclos diluvium* Sutcharit & Panha in Sutcharit et al., 2014, was described from specimens collected from Tham Sumano, Patthalung Province, which the radula morphology of this taxon from the same localities was studied and reported as “*Pterocyclos asiphon*” by Tumpeesuwan (2001). The number of cusps on outer lateral teeth of *Pterocyclos diluvium* and *Pearsonia lamphunensis* are 4 cusps, and other teeth are also of the same number. However, it differs from each other due to the size of the central cusp of the central tooth. The central cusp covers half the central tooth's width in *Pearsonia lamphunensis*, but in *Pterocyclos diluvium* it covers only one-third of the central tooth's width (see fig. 4.1C, D, and fig. 5.3 in Tumpeesuwan, 2001). Based on the similarity between the radula morphology of *Pearsonia lamphunensis*, new species, and *Pterocyclos diluvium*, it might be hypothesized that *Pearsonia* is more closely related to *Pterocyclos* than *Rhiostoma*, which differs from both former genera due to a smaller amount of cusps on the outer lateral teeth. The number of cusps on each tooth in the radula plays an important role in classification at the generic level (Lee et al., 2008; Tumpeesuwan & Tumpeesuwan, 2010), and will be the subject of a future study.

ACKNOWLEDGEMENTS

We would like to thank Passakorn Bunchari, Wattana Vongsap, Wittawat Lakkhamphan and Jirayut Weangin for their help with field surveys and sampling. We thank Kitti Tanmuangpak and Nuan-Anong Nak Khong for their kind help in preparing the radula figures with the SEM. Special thanks to Jolyon Dodgson for kindly checking the

manuscript. We thank two anonymous reviewers and Tan Siong Kiat for their valuable comments and suggestions. This research project obtained financial support from the annual government statement Year 2011 of Mahasarakham University (5505016/2555).

LITERATURE CITED

Benson WH (1832) Account of new genus of land snails, allies to the genus *Cyclostoma* of Lamarck with a description of species found on the outlying rock of the Rajmahal range of hills. *Journal of the Asiatic Society of Bengal*, 1: 11–14.

Benson WH (1860) On *Clostophis* and *Rhiostoma*, new Burmese genera of land shells. *The Annals and Magazine of Natural History*, ser 3, 5: 95–97.

Blanford WT (1863) Contribution to Indian malacology, No. IV. Description of new land shells from Ava, and other parts of Burma. *Journal of the Asiatic Society of Bengal*, 32(2): 319–327.

Blanford WT (1864) On the classification of the Cyclostomacea of eastern Asia. *Annals and Magazine of Natural History*, ser 3, 13: 441–465.

Gray JE (1847) A list of the genera of recent Mollusca, their synonyms and types. *Proceedings of the Zoological Society of London*, 15: 129–219.

Gude GK (1921) Land operculates (Cyclophoridae, Truncatellidae, Assimimideidae, Helicinidae). In: Shipley AS & Marshall GAK (eds.). *The Fauna of British India including Ceylon and Burma. Mollusca III* Taylor & Francis, Bombay, India. 386 pp.

Hemmen J & Hemmen C (2001) Aktualisierte Liste der terrestrischen Gastropoden Thailand. *Schriften zur Malakzoologie*, 18: 35–70.

Kobelt W (1902) *Das Tierreich. Cyclophoridae*. R. Friedländer und Sohn Berlin, Germany, 662 pp.

Kobelt W & von Möllendorff O (1897) Catalog der gegenwärtig lebend bekannten Pneumonopomon. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, 29(7–8): 105–120.

Lee Y-C, Lue K-Y & Wu W-L (2008) A molecular phylogenetic investigation of *Cyathopoma* (Prosobranchia: Cyclophoridae) in East Asia. *Zoological Studies*, 47(5): 591–604.

von Martens E (1891) *Landschnecken des Indischen Archipels. Zoologische Ergebnisse einer reise in Niederlandisch Ost-Indien*, 2: 209–264.

Marzuki ME & Clement GR (2013) A new species of cyclophorid snail (Mollusca: Prosobranchia) from Terengganu, Peninsular Malaysia. *The Raffles Bulletin of Zoology*, 61: 21–24.

Mitra SC, Dey A & Ramakrishna (2004) *Pictorial Handbook Indian Land Snails (Selected Species)*. Zoological Survey of India, Kolkata, India, 344 pp.

von Möllendorff O (1890) *Die Landschnecken-Fauna der Insel Cebu. Bericht der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main*, (1889–90): 189–292, pls. 7–9.

de Morgan J (1885) *Mollusques terrestres & fluviatiles du royaume de Perak et des pays voisins (Presquile Malaise)*. *Bulletin de la Société Zoologique de France*, 10: 353–249.

Morlet L (1892) *Diagnoses Molluscorum novorum*, in *Indo-Chinā collectorum*. *Journal de Conchyliologie*, 40: 82–86.

Nabhitabhatta J (2009) *Checklist of Mollusca Fauna in Thailand*. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand, 576 pp.

Pearson JT (1833) Note on the genus *Spiraculum*. *Journal of the Asiatic Society of Bengal*, 2: 590–592.

Pfeiffer L (1854) Descriptions of eighteen new species of Cyclostomacea, from Mr. Cuming's collection. *Proceedings of the Zoological Society of London*, 22: 299–303, pl. 35.

Sutcharit C, Tongkerd P & Panha S (2014) The land snails genus *Pterocyclos* Benson, 1832 (Caenogastropoda: Cyclophoridae) from Thailand and Peninsular Malaysia, with descriptions of two new species. *Raffles Bulletin of Zoology*, 62: 330–338.

Theobald W (1876) Descriptions of some new land- and freshwater shells from India and Burmah. *Journal of the Asiatic Society of Bengal*, 45(2) 3: 184–189, pl. 19.

Tielecke H (1940) *Anatomie, Phylogenie und Tiergeographie der Cyclophoriden*. *Archiv für Naturgeschichte*, new ser., 9(3): 317–371.

Tumpeesuwan S (2001) *Taxonomy of Snorkel snails genus Rhiostoma* Benson, 1860 in Thailand. Unpublished Master Thesis, Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok, 178 pp.

Tumpeesuwan C & Tumpeesuwan S (2010) Radula morphology of some genera of land operculated snails in Thailand. *Journal of Science and Technology Mahasarakham University*, Special Issue 2010: 332–337. [In Thai]

Vaught KC (1989) *A classification of the living Mollusca*. American Malacologist, Inc., Melbourne, Florida, USA, 189 pp.

Yen T (1939) *Die chinesischen Land- und SuBwasser-Gastropoden des Natur-Museum Senckenberg Vittorio Klostermann*, Frankfurt Am Main, 234 pp. 15 pls.