

Myxostoma petiverianum tenggolensis (Gastropoda: Caenogastropoda: Cyclophoridae), a new subspecies of land snail from Peninsular Malaysia

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Abstract. *Myxostoma petiverianum tenggolensis*, new subspecies, is described from Pulau Tenggol, State of Terengganu, Peninsular Malaysia, based on shell characteristics. *Myxostoma petiverianum tenggolensis* is distinguished from its closest congener and nominal subspecies *Myxostoma petiverianum petiverianum* (Wood, 1828), by a rather uniformly brown shell with scarce zigzag patterns on the dorsal side and lack of peripheral banding. The discovery is the first record of *Myxostoma* in Peninsular Malaysia and represents a 500 km southwards range extension of the genus.

Key words. land snail, *Myxostoma*, new subspecies, Malaysia, Vietnam

INTRODUCTION

The family Cyclophoridae Gray, 1847, has a pan-tropical distribution, and comprises around 34 genera and 300 species described to date (Kobelt, 1902; Wenz, 1938–1944; Vaught, 1989; Bouchet & Rocroi, 2005; Lee et al., 2008). Cyclophorids occupy a wide variety of microhabitats including leaf litter, litho-refugia and trees, but are always confined to mesic bioregions (Egorov, 2009; Stanistic et al., 2010).

There are some 13 cyclophorid genera in Southeast Asia (Kobelt, 1902). One of the Southeast Asian genera is the monotypic *Myxostoma*, which was introduced by Troschel (1847) to accommodate *Cyclostoma petiverianum* Wood, 1828, on account of its distinct operculum, peristomal extension along the periphery of the last whorl and widely-umbilicated shell. Diagnostic shell, opercular and anatomical characters of the type species were provided in a recent redescription of *Myxostoma petiverianum* by Egorov (2016). A number of shells belonging to the genus *Myxostoma* from Pulau [=Island] Tenggol, off Terengganu, Peninsular Malaysia, were examined in an attempt to classify them. Although superficially similar to the Vietnamese *Myxostoma petiverianum*, the Tenggol population is clearly allopatric in distribution, and a comparative study of their morphological characteristics revealed consistent differences. The Tenggol *Myxostoma* is herein described as a new subspecies of *Myxostoma petiverianum* (Wood, 1828).

MATERIAL AND METHODS

Shells and opercula of the holotype and 11 paratypes of *Myxostoma petiverianum tenggolensis*, new subspecies, were examined. Description of the subspecies was based solely on conchological characteristics. No live specimens were available for this study. Shell terminology follows Troschel (1847), Kobelt (1902, 1911), Rees (1964) and Egorov (2016). Operculum terminology follows Golding et al. (2014). All measurements were read to the nearest 0.1mm using Vernier callipers. Shell height was measured from the apex to the lowest part of the peristome parallel to the coiling axis. Shell diameter was measured at the widest section perpendicular to the coiling axis (after Lee, 2009). The spire angle measurement follows Cain (1977). Whorl count follows Vermeulen & Whitten (1998).

Types were deposited in Universiti Malaysia Sabah Borneensis Mollusc Collection, Malaysia (BOR/MOL); Muzium Zoologi Institut Penyelidikan Kenyir, Malaysia (MZK); Muzium Zoologi Universiti Malaya, Malaysia (MZUM); and the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, Singapore (ZRC). Comparative specimens of *M. petiverianum* examined were from: Royal Belgian Institute of Natural Sciences, Belgium (IRSNB); Natural History Museum, United Kingdom (NHMUK); National Museum of Natural History, United States of America (USNM).

SYSTEMATICS

Family Cyclophoridae Gray, 1847

Subfamily Cyclophorinae Gray, 1847

Genus *Myxostoma* Troschel, 1847

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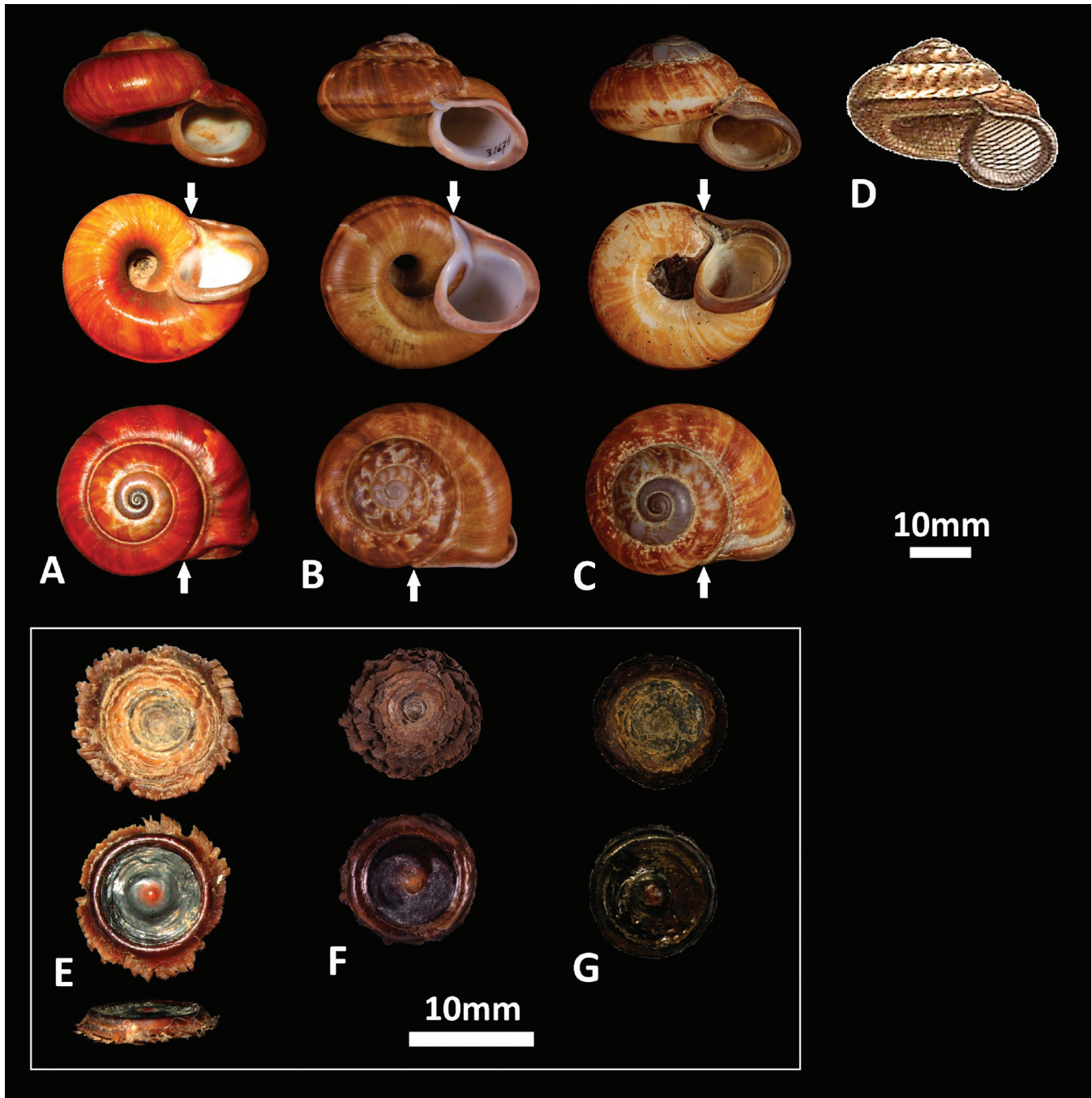


Fig. 1. Comparison of shells and opercula of *Myxostoma petiverianum tenggolensis*, new subspecies (A, E), and *Myxostoma petiverianum petiverianum* (Wood, 1828) (B–D, F–G). Arrows indicate the peristomal extension along the periphery of the last whorl. A, *Myxostoma petiverianum tenggolensis*, new subspecies, holotype (SH 22.9 × SD 32.7 mm) (MZUM MOG 000001), Pulau Tenggol, Malaysia; B, *Myxostoma petiverianum petiverianum* (Wood, 1828) (SH 24.2 × SD 36.1 mm) (USNM 316711), Con Son Island, Con Đảo Archipelago, Vietnam; C, *Myxostoma petiverianum petiverianum* (Wood, 1828) (SH 22.1 × SD 29.0 mm) (IRSNB p334781), southern Vietnam; D, original figure of *Cyclostoma petiverianum* illustrated in Wood (1828); E, operculum of *Myxostoma petiverianum tenggolensis* holotype (MZUM MOG 000001); F, operculum of *Myxostoma petiverianum petiverianum* (Wood, 1828) (USNM 316711); G, eroded operculum of *Myxostoma petiverianum petiverianum* (Wood, 1828) (IRSNB p334781). Photographs A and E by the author; photographs B and F, courtesy of Robert Hershler (USNM); photographs C and G by Yves Barette, courtesy of Yves Samyn (IRSNB); illustration D from Wood (1828) (no longer in copyright and digitised by the Biodiversity Heritage Library: <http://dx.doi.org/10.5962/bhl.title.30661>).

Type species. *Turbo petiverianus* Wood, 1828; original designation by Troschel (1847: 44).

Remarks. *Myxostoma* is distinguished from other sub-discoidal confamilials by its medium to large shell size, peristomal extension along the periphery of the last whorl and its corneous (horny) operculum (Troschel, 1847; Egorov, 2016).

***Myxostoma petiverianum petiverianum* (Wood, 1828)**
(Fig. 1B–D, F, G)

Turbo petiverianus Wood, 1828: 18 (Type locality: not stated); Coan & Petit, 2011: 31.

Cyclostoma petiverianum Wood, 1828: 36, pl. 6, fig. 2a (Type locality: not stated); Reeve, 1842: 98, pl. 184, fig. 13; Sowerby, 1843: 116, pl. 25, figs. 100, 101; Petit de la Saussaye, 1850: 43.

Cyclostoma (Lituus) brevis Pfeiffer, 1846: 166, pl. 24, figs. 1, 2 (Type locality: Pulo Condore [=Con Son Island, Con Đảo Archipelago, Vietnam]).

Myxostoma petiverianum — Troschel, 1847: 44; Kobelt, 1902: 86, 659, fig. 21; Thiele, 1929: 97; Wenz, 1938–1944: 457, fig. 1148; Abbott, 1989: 38, text fig.; Egorov, 2016: 97–102, pl. 1.

Myxostoma petiverianus [sic] — Gray, 1847: 182.

Myxostoma brevis — Pfeiffer, 1847: 111; Baird, 1850: 15; Frauenfeld, 1869: 878; Fischer, 1885: 745; Fischer, 1891: 104; Kobelt & Möllendorff, 1897: 88; Fischer & Dautzenberg, 1904: 429; Dautzenberg & Fischer, 1905: 435–437; Dang, 2008: 9.

Pterocyclos brevis — Pfeiffer, 1851: 9 (unjustified emendation); Pfeiffer, 1852a: 26; Crosse & Fischer, 1863: 364–366; Reeve, 1864: 58, pl. 1, figs. 4a, 4b; Mabilie & Le Mesle, 1866: 131.

Pterocyclos (Lituus) brevis — Pfeiffer, 1852b: 42.

Cyclophorus (Lituus) brevis — Benson, 1855: 16.

Cyclophorus brevis — Pfeiffer, 1858: 40; Pfeiffer, 1865: 60; Pfeiffer, 1876: 99; Nevill, 1878: 268.

Cyclostoma lynchus Morelet, 1862: 478 (Type locality: Insula Pulo-Condor [=Con Son Island, Con Đảo Archipelago, Vietnam]).

Myxostoma petiveriana [sic] — Egorov, 2009: 22, fig. 30.

Remarks. *Cyclostoma petiverianum* Wood, 1828, was described without a type locality. The holotype, supposedly in the NHMUK, is believed to be lost (Coan & Petit, 2011; pers. comm. Eugene Coan, 2014). It is thus far known only from Con Son Island off southern Vietnam and Kep in southern Cambodia (Egorov, 2016; Fig. 2). The species was recently redescribed in detail by Egorov (2016).

***Myxostoma petiverianum tenggolensis*, new subspecies**
(Figs. 1A, E, 3A–L)

Material examined. Holotype: Shell with operculum (SH 22.9 × SD 32.7 mm) (MZUM MOG 000001), Pulau Tenggol, State of Terengganu, Malaysia (4°48'27.27"N, 103°40'45.60"E), coll. Junn Kitt Foon, 11 April 2008.

Paratypes: 1 shell with operculum (SH 21.9 × SD 33.7 mm) (MZUM MOG 000002), 3 shells (SH 21.7 × SD 31.9 mm, SH 20.6 × SD 30.1 mm, SH 23.4 × SD 32.3 mm) (MZUM MOG 000003–000005), 3 shells (SH 23.9 × SD 32.7 mm, SH 21.0 × SD 30.9 mm, SH 23.4 × SD 32.6 mm) (BOR/MOL/6220), 2 shells (SH 23.5 × SD 32.3 mm, SH 23.0 × SD 32.7 mm) (MZK/G/0001–0002), 2 shells (SH 22.7 × SD 32.6 mm, SH 23.5 × SD 32.0 mm) (ZRC.MOL.6339), same data as holotype.

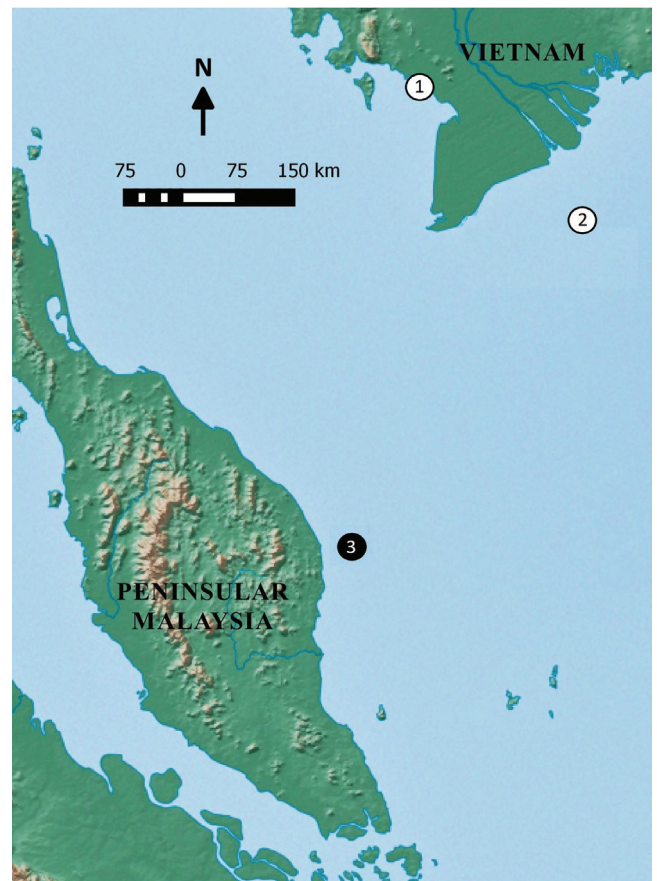


Fig. 2. Locality records of *Myxostoma petiverianum petiverianum* (Wood, 1828) (white circles) and *Myxostoma petiverianum tenggolensis* new subspecies (black circle): 1, Kep National Park, Cambodia (after Egorov, 2016); 2, Con Son Island, Vietnam (after Egorov, 2016); 3, Pulau Tenggol, Peninsular Malaysia (this study).

Comparative material. — *Myxostoma petiverianum petiverianum*: 1 shell and operculum (SH 24.2 × SD 36.1 mm) (USNM 316711), Paulo Condor Island [=Con Son Island, Con Đảo Archipelago, Vietnam], coll. Evezard & Henderson, no date; 1 shell and operculum (SH 22.1 × SD 29.0 mm) (IRSNB p334781), Cochinchine [=southern Vietnam], coll. Germaine de Gottal Anvers, no date.

Description. Shell medium to large sized (SH 20.6–23.9 mm, SD 30.1–33.7 mm [mean SH 22.63±1.07 mm, SD 32.21±0.93 mm]), sub-discoidal to sub-globose (spire angle 37°–45°), dome-shaped at aperture view, discoid at dorsal view. Umbilicus wide. Whorls smooth, suture simple and distinct. Fine radial sculpture on all post-apical whorls. Whorls 4.40 when matured. Periphery smooth, rounded. Peristome double, reflexed, thickened and circular; upper part of the peristome developed into a pointed extension along the periphery of the last whorl perpendicular to the coiling axis. Prominent sutural ridge from about 3.5 whorls onwards, with a deep channel running concurrently along the suture interior, terminating at the pointed peristomal extension (indicated with arrow, Fig. 1A). Shell interior porcellaneous, white. Dorsal side of apical whorls dark purple, occasionally with sparse white or yellow-brown zigzag pattern; dorsal side of post-apical whorls dark brown; umbilical side of apical whorls either purple or brown; umbilical side of post-apical whorls light brown. Peristome colour varies from dark to



Fig. 3. Shells (A–K) and operculum (L) of *Myxostoma petiverianum tenggolensis*, new subspecies, paratypes from Pulau Tenggol, Malaysia. A, SH 21.9 × SD 33.7 mm (MZUM MOG 000002); B, SH 21.7 × SD 31.9 mm (MZUM MOG 000003); C, SH 20.6 × SD 30.1 mm (MZUM MOG 000004); D, SH 23.4 × SD 32.3 mm (MZUM MOG 000005); E, SH 23.9 × SD 32.7 mm (BOR/MOL/6220); F, SH 21.0 × SD 30.9 mm (BOR/MOL/6220); G, SH 23.4 × SD 32.6 mm (BOR/MOL/6220); H, SH 23.5 × SD 32.3 mm (MZK/G/0001); I, SH 23.0 × SD 32.7 mm (MZK/G/0002); J, SH 22.7 × SD 32.6 mm (ZRC.MOL.6339); K, SH 23.5 × SD 32.0 mm (ZRC.MOL.6339); L, exterior (top) and interior (bottom) view of an eroded operculum (MZUM MOG 000002). All photographs taken by the author.

ochre brown. Periostracum thin, brown, glossy. Without the periostracum, shell base colour is yellow with numerous fine brown radial colour stripes.

Operculum (Figs. 1E, 3L): Thick, brown, circular, horny, with a hard nucleus. Interior has strong circular ridge with a depressed centre, a mammilla at the nucleus. Exterior has nine flattened lamellae running anti-clockwise. Periphery is decorated with brown hair-sheets (ciliate) when intact (Fig. 1E) but becomes indistinct when eroded (Fig. 3L).

Habitat and ecology. Lives on the forest floor of beach and coastal dipterocarp rainforests.

Distribution. Pulau Tenggol, State of Terengganu, Peninsular Malaysia (Fig. 2).

Etymology. This subspecies is named after the type locality Pulau Tenggol.

Remarks. Shell colouration and patterning are distinctively different between *Myxostoma petiverianum petiverianum* and *M. petiverianum tenggolensis*. Shells of *M. p. petiverianum* is characterised by strong white mottled pattern on the dorsal surface and the presence of a dark brown band on the shell periphery. In contrast, shells of *M. p. tenggolensis* consistently lack peripheral banding and rarely exhibit strong zigzag patterns on the dorsal side of its whorls. In addition, the peristome colour is dark brown to maroon for *M. p. petiverianum*, while *M. p. tenggolensis* is dark to ochre brown.

DISCUSSION

Myxostoma p. tenggolensis is conservatively proposed as a new subspecies even though it can be easily distinguished from *M. p. petiverianum* based solely on shell colouration and patterns. Although shell colouration is known to be variable in some cyclophorids and thus has limited use for species delimitation (Vermeulen, 1999; Sutcharit et al., 2014), the differences between *M. p. petiverianum* and *M. p. tenggolensis* are clearly consistent. In addition, the two are evidently allopatric in distribution, which supports the recognition of *M. petiverianum tenggolensis* as a distinct, but apparently closely related taxon. The discovery of *M. petiverianum tenggolensis* extends the range of *Myxostoma* 500 km south of Vietnam and is the first record of *Myxostoma* in the Malay Peninsula.

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