

NEOTYPE DESIGNATION AND RE-DESCRIPTION OF THE VANISHING
TREE SNAIL, *AMPHIDROMUS (AMPHIDROMUS) MUNDUS* (PFEIFFER, 1853)
(PULMONATA: CAMAENIDAE)

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ABSTRACT. – A population of *Amphidromus (Amphidromus) mundus* (Pfeiffer, 1853) was recently discovered on a Malaysian island in the South China Sea. Here we investigate and describe its internal anatomy for the first time, and its shell is also re-described. The small, white, chirally dimorphic shells with a reflected lip that is not attached to the outer wall, as well as its pale brown body colour allow clear discrimination from the related species *A. (A.) perversus*, *A. (A.) inversus albulus*, and *A. (A.) atricallosus*. The distinctively long epiphallic caecum provides a clear discriminating character in genital anatomy. Type material could not be traced and a neotype is designated herein for nomenclatural stability.

KEY WORDS. – *Amphidromus*, Malaysia, taxonomy, biodiversity.

INTRODUCTION

Amphidromus Albers, 1850, is a genus of tree-dwelling snails that range from Indochina to the Philippines, through the Sunda Islands, and to the north of Australia (Pilsbry, 1900; Laidlaw & Solem, 1961; Solem, 1983). About 90 species are recognized (Laidlaw & Solem, 1961; Lehman & Maassen, 2004; Dharma, 2007; Severns, 2006; Chan & Tan, 2010). Most nominal species were based on few individuals, often with poor locality information. The paucity of data frequently leads to considerable confusion in the literature.

Seven nominal species of *Amphidromus* have been recorded from Peninsular Malaysia (Fulton, 1896, 1901; Pilsbry, 1900; Laidlaw & Solem, 1961; Maassen, 2001). One of these, *Bulimus mundus* Pfeiffer, 1853, has been regarded as being of uncertain taxonomic status, primarily because of the dubious locality records given in the original description (Laidlaw & Solem, 1961; Richardson, 1985) and a few recorded occurrences from disparate localities left the taxonomic status and distribution of this species uncertain (Laidlaw & Solem, 1961).

In February 2008, approximately 30 living land snails were collected from Pulau Besar, a small island off Peninsular Malaysia in the South China Sea. Among these specimens, some were provisionally identified as *Amphidromus* s.s.

species. After comparison with material in reference collections and examination of Pfeiffer's example of *Bulimus mundus* var. β , cited in Pfeiffer's original description, we conclude that *A. (A.) mundus* has been rediscovered. However, in the absence of type material, the identity of this species remains in doubt and in our opinion, stability will best be served by the designation of a neotype and re-description under the terms provided by ICZN (1999, Article 75).

MATERIAL AND METHODS

Shell height (H) and shell diameter (D) were measured in mm, and the whorl count and H/D ratios were recorded. The radula was examined under a scanning electron microscope. In descriptions of the genitalia, 'proximal' refers to the region closest to the genital orifice and 'distal' to the region furthest away from the genital orifice. D = dextral; S = sinistral.

Institutional abbreviations. – BMNH, The Natural History Museum, London; CUMZ, Chulalongkorn University, Museum of Zoology, Bangkok; RBINS, Royal Belgian Institute of Natural Sciences, Brussels; ZRC, Raffles Museum of Biodiversity Research, Singapore; RMNH, National Museum of Natural History, Leiden; ZMB, Natural History Museum, Humboldt University, Berlin; ZMUC, Zoological Museum, University of Copenhagen, Denmark.

SYSTEMATIC ACCOUNT

Genus *Amphidromus* Albers, 1850
Subgenus *Amphidromus* Albers, 1850

Amphidromus (Amphidromus) mundus (Pfeiffer, 1853)

Bulimus mundus Pfeiffer, 1853a: 57 (Type locality: Sincapore [=Singapore]). Pfeiffer, 1853b: 651. Pfeiffer, 1856: 261, 262, pl. 70, figs. 21 & 22.

Bulimus mundus var. β Pfeiffer, 1853a: 57 (Locality: Borneo ?). Pfeiffer, 1853b: 651.

Amphidromus mundus—Missing citation: Morgan, 1885: 387. Fulton, 1896: 71. Pilsbry, 1900: 174, pl. 61, figs 57-59. Laidlaw & Solem, 1961: 589, 590, 642, 643, fig. 38. Richardson, 1985: 31. Maassen, 2001: 119.

Type material. – Neotype, herein designated, CUMZ 4917 (1 shell, Fig. 1A, height 35.3 mm, width 21.3 mm, 5¼ whorls, h/d ratio 1.66). Topotypic material, CUMZ 4913 (Fig. 1B) (14D, 19S in ethanol, height 35.6 ± 1.69 mm, width 21.6 ± 0.93 mm, 5½ – 6 whorls, h/d ratio 1.65 ± 0.06), 4914 (7D, 6S shells, height 35.6 ± 1.25 mm, width 21.4 ± 0.90 mm, 5½ – 6 whorls, h/d ratio 1.66 ± 0.05); BMNH 20110305 (1D, 1S shells), ZRC-MOL 3068 (1D, 1S shells), SMF 336637 (1D, 1S shells).

Type locality. – Based on the neotype, the type locality is Pulau Besar, Mersing, Johor, Malaysia (2° 26' 7.02" N, 103° 58' 38.59" E).

Other material examined. – Pfeiffer's examined specimens of var. β from Borneo (?) or China (?): BMNH 19601542.1 (2S shells, Fig. 1C–E). Singapore: ZMB, Paetel coll. (1S shell); RMNH #19a (1D shell); BMNH 98.10.25.131 (2S shells). Singapore or Borneo: RBINS Dautzenberg ex. Crosse coll. (1D shell), Dautzenberg coll. 6990 (1D shell). Java: ZMB Seckendorf coll. (1D shell). Unknown locality: ZMB Bürger coll. (1S shell), Wallenberg coll. (1S shell); RBINS Dautzenberg coll. #6990 α (1S shell); ZMUC #295 (2S shells).

Taxonomic remarks. – The nominal species "*Bulimus mundus*" was described from "Gruner's collection". After his death, the collection was sold and the most part was purchased by H. Maltzan, whose collections are currently housed in Aquazoo-Löbbecke Museum in Düsseldorf. However, some of Gruner's specimens are also extant in other museums including SMF and ZMB (Tëmkin et al. 2009: 44). After a long investigation, the original type series of "*Bulimus mundus*" from "Gruner's collection" was not located, and is presumed to be lost (M. Glaubrecht, R. Janssen, B. Hausdorf, R. Seemann and S. Stoll, personal communication). The absence of type material of the nominate form has been the cause of doubt about the identity and status of this species (Laidlaw & Solem, 1961). We consider that the specimen of *Bulimus mundus* var. β cited by Pfeiffer (1853a) from the Cuming collection, is an example of this species but having

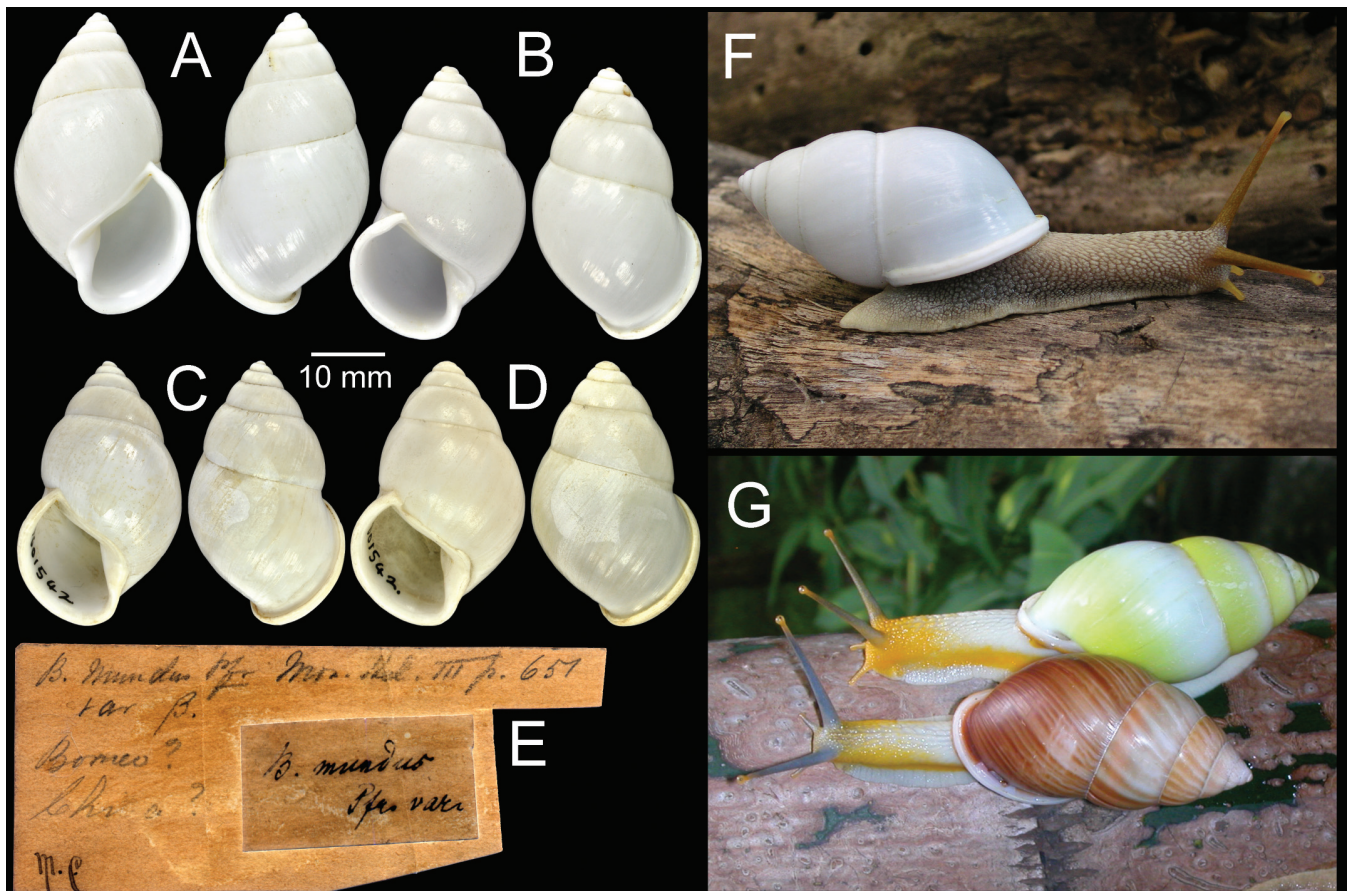


Fig. 1. A–B. *Amphidromus (Amphidromus) mundus*. A. Neotype CUMZ 4917; B. additional, topotypic material, CUMZ 4914 from Pulau Besar, Johor, Malaysia. C, D. Original specimens of *Bulimus mundus* var. β Pfeiffer, 1853, BMNH 19601542. E. Pfeiffer's original handwritten label of the lot BMNH 19601542, on the smaller label attached to the bottom left of the larger label is given "Borneo?/China?/M.C.". The acronym M.C. is identifying the material as originating from the Hugh Cuming collection, Acc. No. 1829. F. Living specimen of A. (A.) *mundus* (shell height about 35 mm), CUMZ 4914. G. Living snails of A. (A.) *atricallosus leucoxanthus* from Makham, Chanthaburi, Thailand; the lower snail is the 'laidlawi' form (both have shell heights of about 45 mm).

been identified by Pfeiffer as a variety, it was excluded from the original type series of *Bulimus mundus*. Because of the uncertain origin of this lot according to the label information ('Borneo?' and 'China?'), the form β is deemed unsuitable for designation as a neotype. The neotype selected here from our Pulau Besar collection allows a proper re-description of this taxon with the aim to stabilise the taxonomy.

Description. – Shell (Fig. 1A): Medium sized to small, (height 32.7–40.3 mm, diameter 19.3–23.8 mm) white, solid, ovate conic; umbilicus perforate; chirally dimorphic. Apex acute; spire short; suture depressed. Whorls slightly convex; last whorl round to ovate. Dark varix absent; periostracum thin and transparent. Aperture broadly ovate. Lip thickened, expanded and reflexed but not attached externally to last whorl. Parietal callus thickened; columella twisted.

External anatomy (Fig. 1B): Living specimens with pale brown body, covered with darker recessed reticulations on skin. Foot broad and long with pale margin, extended across posterior tail. Upper tentacles drumstick-shaped, orange-brown, with dark eyespots on tentacular tips. Lower tentacles short, orange to pale orange; head and mouthparts brown. Mantle edge light orange; mantle cavity with dark pigmentation.

Genital anatomy (Fig. 2A): Atrium (at) relatively short ($n = 5$). Penis (p) cylindrical, about $\frac{3}{4}$ of vagina length, and enlarging slightly distally. Epiphallus (e) long and slightly smaller in diameter than penis. Flagellum (fl) almost the same length as epiphallus with coiled distal portion. Appendix (ap), located beyond coiled portion of flagellum, nearly same length as flagellum. Vas deferens (vd), a narrow tube, extending from free oviduct ending at epiphallus. Penial retractor muscle (pm) long, thin, originating distally from penis, attached to penis near distal end.

Internal wall of penis corrugated, exhibiting series of thickened, swollen, longitudinal penial pilasters (pp), which form a fringe around conical penial verge. Penial verge (pv) short, conic with smooth surface (Fig. 2B).

Vagina (v) long, slender and cylindrical. Gametolytic duct (gd) extends from vagina, proximally as enlarged cylindrical tube, abruptly tapering to small tube distally, terminally connected to gametolytic sac (gs). Free oviduct (fo) short, oviduct compact and enlarged to form lobule alveoli. Prostate gland ventrally fused with oviduct. Albumen gland (ag) slightly large and lingulate. Hermaphroditic gland (hg) contracts from numerous small lobules; narrow and convoluted hermaphroditic duct (hd) connects to middle of talon (Fig. 2A).

Internally the vagina possesses longitudinal vaginal pilasters (vp). Pilasters have continuous ridges with short smooth ridges near genital orifice; extends to slightly swollen portion with irregular shaped, deep crenellations (Fig. 2B).

Digestive anatomy (Fig. 2C, 2F): Jaw light brown and corneous with strong vertical ridges. Radular teeth arranged

in anteriorly pointed V-shaped rows, each row containing about 206 teeth (102-(17-15)-1-(15-17)-103). Central tooth tricuspid, spatulate, with small ectocones (Fig. 2D). Lateral teeth bicuspid, endocone large with truncated cusp, ectocone larger with curved cusp. From tooth 15 to 17 outwards lateral teeth gradually transformed to tricuspid marginals (Fig. 2E). Marginal teeth asymmetric, endocone medium; mesocone large with curved margins; ectocone small.

Distribution. – The confirmed distribution of this species is currently restricted to the type locality, Pulau Besar, Johor, Malaysia. Species determinations of samples from museum collections with records from a numerous localities, such as Singapore, the Philippines, Borneo and Java (Laidlaw & Solem, 1961: 589; S. Panha, personal observation in collections) require verification. Occurrence in China, as given on the label of '*B. mundus forma β* ' cited above, can be ruled out with certainty because China is outside of the geographic range of *Amphidromus* (Solem, 1959, 1983; Laidlaw & Solem, 1961; Sutcharit & Panha, 2006a).

DISCUSSION

Because of the absence of type material and uncertainty about its distribution, the status of *Amphidromus (A.) mundus* has long been uncertain. Based on the shell morphology only, Laidlaw & Solem (1961) assumed that *Bulimus mundus* Pfeiffer, 1853 was probably identical with *A. (A.) perversus* (Linnaeus, 1758), a species exhibiting a wide range of shell variation. According to this study, *A. (A.) mundus* can be distinguished from the former species by possessing a smaller, white shell, a shorter spire, a globose last whorl and a reflected lip that is not attached to the outer wall. In addition, the genitalia of *A. (A.) mundus* (Fig. 2A, B) exhibit a slightly longer epiphallal caecum and a corrugated vaginal pilaster (Solem, 1983; Sutcharit & Panha, 2006a).

Two *Amphidromus* species from Peninsular Malaysia, *A. (A.) atricallosus perakensis* Fulton, 1901, *A. (A.) atricallosus temasek* Tan, Chan & Panha, 2011 and *A. (A.) inversus albulus* Sutcharit & Panha, 2006, are similar but distinct from *A. (A.) mundus*. The differences from *A. (A.) atricallosus perakensis* and *A. (A.) atricallosus temasek* are a smaller, stout and white shell, short spire, and a much shorter appendix (Collinge, 1902; Sutcharit & Panha, 2006a; Tan et al., 2011). *Amphidromus (A.) atricallosus* (Gould, 1843) exhibits a white shell morph (Sutcharit & Panha, 2006a, Figs. 3, 4), however, the pale brown body with pale orange on the tentacles in *A. (A.) mundus* (Fig. 1B) is clearly distinct from the white to yellowish body with a bright orange head and stripes along the foot and sole of *A. (A.) atricallosus* (Fig. 1C). *Amphidromus (A.) mundus* is clearly distinguished from *A. (A.) inversus albulus*; most notably, *A. (A.) mundus* possesses a long penial appendix, which is almost absent in *A. (A.) inversus albulus*. In addition, the dark pigment of the lung cavity and the pale orange tentacles and mantle collar of *A. (A.) mundus* are clearly distinct from those of *A. (A.) inversus albulus* (see also Sutcharit & Panha, 2006b for comparison).

We consider that *Amphidromus* (*A.*) *mundus* is a robustly defined species that differs from the three adjacent species *A.* (*A.*) *perversus*, *A.* (*A.*) *atricollosus perakensis*, *A.* (*A.*) *atricollosus temasek* and *A.* (*A.*) *inversus albulus*, in its shell, genital morphology and the soft body pigmentation.

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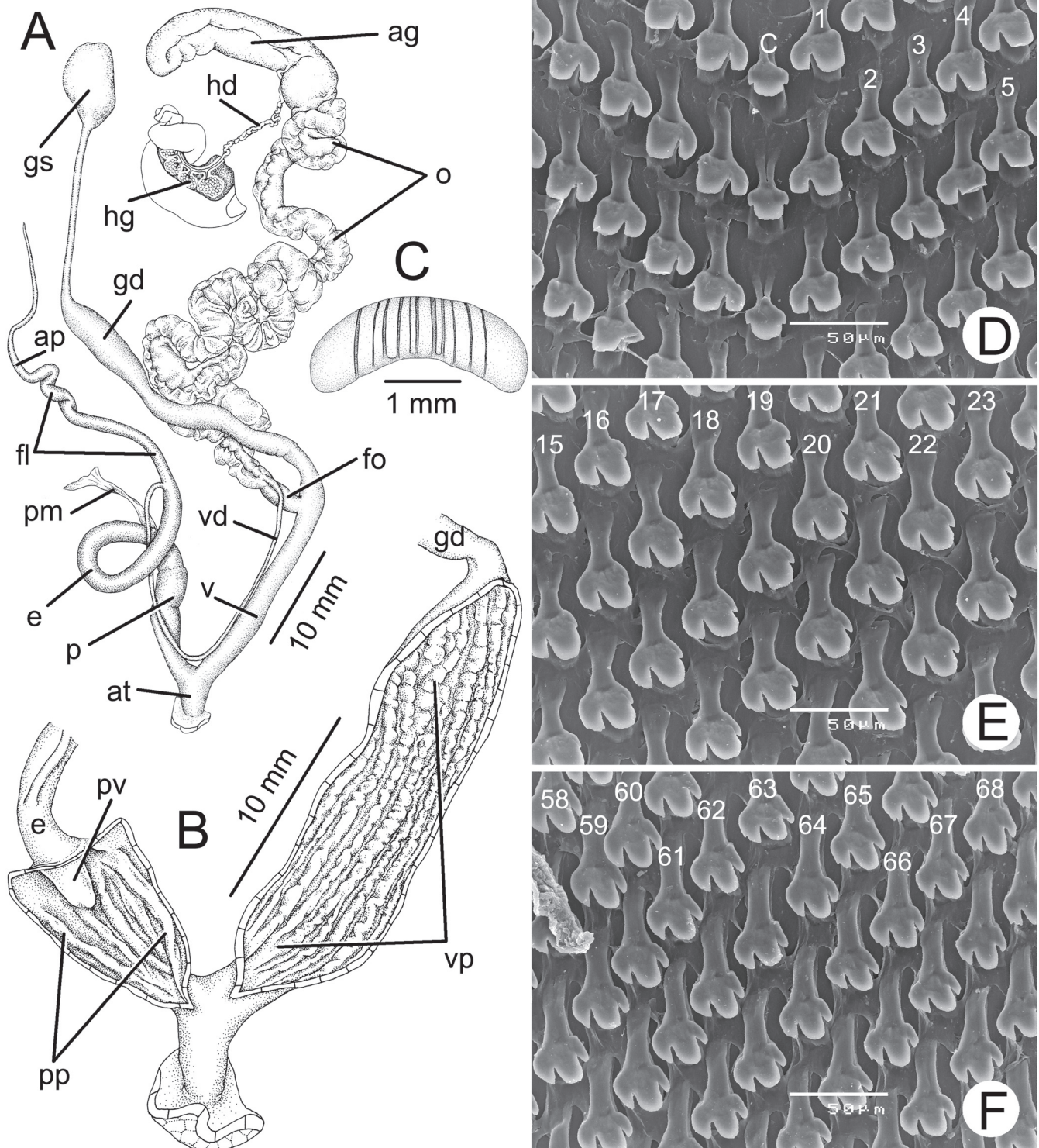


Fig. 2. Genitalia, jaw and SEM radula images of *A.* (*A.*) *mundus* (CUMZ 4913). **A.** Reproductive system. **B.** Interior structures of penis and vaginal chamber. **C.** Jaw. **D.** Central teeth with first to fifth lateral teeth. **E.** Lateral teeth with tricuspid marginal transition. **F.** Marginal and outermost marginal teeth. Anatomical abbreviation as described in Sutcharit & Panha (2006a): ag, albumin gland; ap, appendix; at, atrium; e, epiphallus; fl, flagellum; fo, free oviduct; gd, gametolytic duct; gs, gametolytic sac; hd, hermaphroditic duct; hg, hermaphroditic gland; o, oviduct; p, penis; pp, penial pilaster; pm, penial retractor muscle; pv, penial verge; v, vagina; vd, vas deferens; vp, vaginal pilaster. Central tooth is indicated by 'C' and the other numbers indicate the order of lateral and marginal teeth.

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