

# REDISCOVERY AND A REDESCRIPTION OF *VERMETUM FESTINANS* FROM LA PALMA, CANARY ISLANDS (GASTROPODA PULMONATA: GASTRODONTIDAE)

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*Abstract* *Vermetum festinans* was hitherto known only from a few shells collected on La Palma. It is the type species of *Vermetum*, which has sometimes been classified in the *Pristilomatidae*. The recent allocation of a second species newly discovered on Gran Canaria, *V. tamadabaensis*, to the same genus was based only on close similarity of its shells to those of *V. festinans*. The genus was transferred to the *Gastrodontidae* from the *Pristilomatidae* on the basis of characters of the genital anatomy shown by *V. tamadabaensis*. Efforts to refind living *V. festinans* were successful in 2015, allowing the redescription here of its shells and habitat and the first studies of its genital anatomy. It closely resembles *V. tamadabaensis* anatomically, sharing the presence of a *sarcobelum* and three "bridges" joining parts of the distal genitalia, differing only in details. The new data therefore confirm that the genus *Vermetum* should be transferred to the *Gastrodontidae* and that two species should be recognised.

*Key words* Canary Islands, land-snails, endemic, generic taxonomy, genital anatomy

## INTRODUCTION

*Vermetum festinans* (Shuttleworth 1852) is a poorly known species described from shells from the hills of La Palma, one of the western islands of the Canary Islands archipelago. During 2013 a similar snail was discovered by J. Santana and J. García on the island of Gran Canaria, in the east-central part of the archipelago, and this was subsequently described as *V. tamadabaensis* D.T. Holyoak, *et al.* (2014). The shell characters of the new species showed obvious similarities to those of *V. festinans*. The genital anatomy showed characters of *Gastrodontidae* rather than the *Pristilomatidae*, the family that had been suggested for *V. festinans* (Bank, Groh & Ripken, 2002: 93, 111). Initial efforts to refind living *V. festinans*, the type species of *Vermetum*, were unsuccessful, so some uncertainty therefore remained about the transfer of the genus to the *Gastrodontidae*.

In January 2015 J. Santana rediscovered living *V. festinans* on La Palma. This paper describes the location and habitat, redescribes the shells and provides new information on the external characters of the body and on the genital anatomy. The new data demonstrate a strong resemblance between *V. festinans* and *V. tamadabaensis* in genital anatomy and other characters. It is thus

confirmed that the genus *Vermetum* should be transferred to the *Gastrodontidae* and that two species should be recognised.

## MATERIAL AND METHODS

Living specimens were drowned in water and preserved in 70% ethanol. Shell growth is indeterminate in these snails, so comparative measurements given are from a few of the largest shells available, mainly those where dissection revealed mature genitalia. Shells and bodies were studied using Meiji RZ Series stereo-microscopes, with magnifications of up to  $\times 56$ . Measurements were made with an eyepiece micrometer accurate to  $<0.01\text{mm}$ . Methodology used in describing the specimens follows Kerney & Cameron (1979), Ibáñez *et al.* (2006) and Alonso *et al.* (2013). The descriptions below follow the sequence and terminology used in Holyoak *et al.* (2014) closely, in order to facilitate comparisons with *V. tamadabaensis*. In descriptions of the genital system the terms "proximal" and "distal" refer to the position in relation to the ovotestis.

Abbreviations: CGAH: G.A. and D.T. Holyoak private collection, Cabeçudo, Portugal; JCLP: J.M. Castro private collection, La Palma, Spain; JSGC: J. Santana private collection, Las Palmas de Gran Canaria, Spain; NMBE: Naturhistorisches

Museum, Bern, Switzerland; sh: shell; spm: specimen in alcohol; TFMC: Museo de Ciencias Naturales de Tenerife, Canary Islands, Spain; UTM: Universal Transverse Mercator, cartographic projection system.

## RESULTS AND SYSTEMATICS

### Family Gastrodontidae Tryon 1866

#### Genus *Vermetum* Wollaston 1878

Wollaston (1878: 323) introduced the generic name as a new section of *Hyalina* Gray, apparently with the single species *Hyalina festinans* based on *Zonites festinans* Shuttleworth 1852. However, Wollaston added a list (*op. cit.*: 569) including *Hyalina scintilla* Lowe in the section *Vermetum*, a species currently placed as *Lucilla scintilla* (R.T. Lowe 1852) in the Helicodiscidae (Bank, Groh & Ripken, 2002: 110; Seddon, 2008: 50). Thus, the type species of *Vermetum* was subsequently designated as *Zonites festinans* Shuttleworth 1852 by Bank *et al.* (2002: 142). As discussed above, transfer of *Vermetum* from Pristilomatidae (where it was placed by Bank *et al.*, 2002: 111) to Gastrodontidae follows Holyoak *et al.* (2014), based on studies of *V. tamadabaensis*.

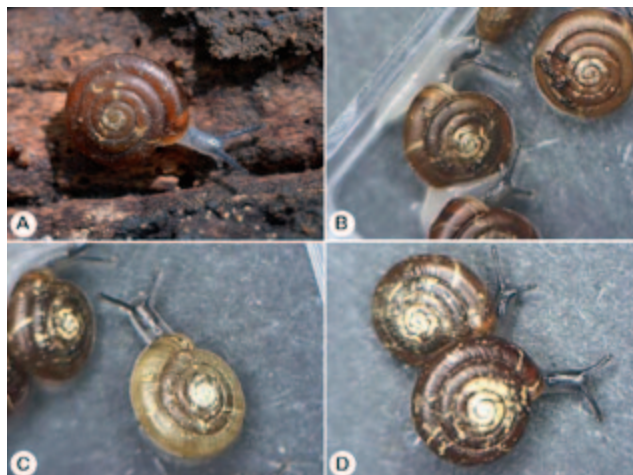
#### *Vermetum festinans* (Shuttleworth 1852)

##### Figs 1, 3–4

*History* Shuttleworth (1852: 138) named *Zonites festinans* on the basis of a single shell (“Diam. maj. 5, min. 4½, Alt. 2 mill.”) from “Sub foliis emortuis, Palma”. The holotype (and only original specimen: Bank *et al.*, 2002: 163) is now housed at Natural History Museum, Bern (NMBE no. 18766) and was illustrated by Holyoak *et al.* (2014: fig. 1D). The coloured illustrations which were intended to accompany Shuttleworth’s description of this and other new species were not published until over a century later (Shuttleworth, 1975: pl. 1 fig. 4, in a volume edited by W. Backhuys; the original plates were made in 1853). Tryon (1887: 160, pl. 51 figs 91, 92) described and illustrated the species as *Zonites festinans* in subgenus *Hyalinia*, section *Polita*.

*Material examined* CGAH 16 spm, JSGC 53 sh, JCLP 28 sh.

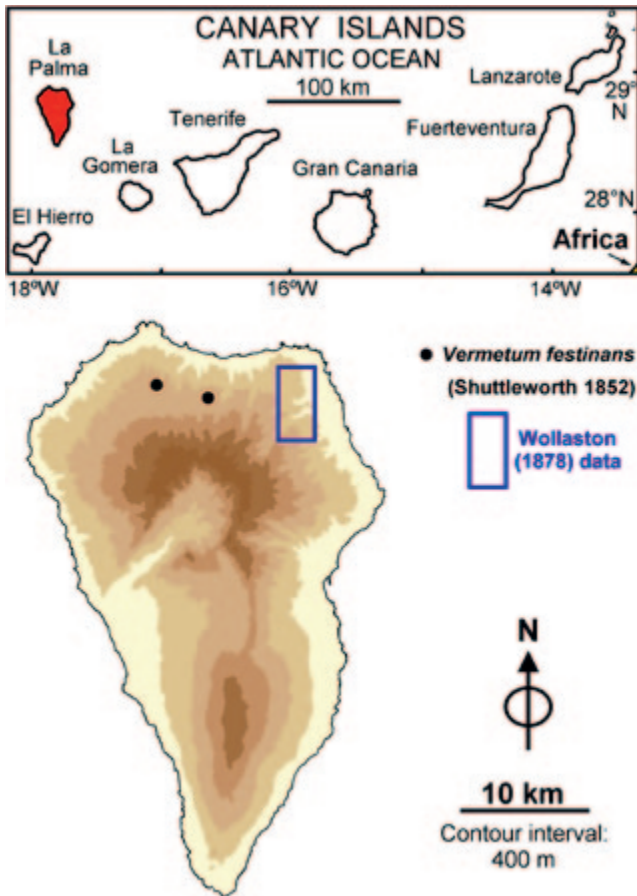
*Description of body and shell* A low ridge on front of dorsum of body passes backwards



**Figure 1** Live animals of *Vermetum festinans* from Barranco de Magdalena, La Palma, Canary Islands: A: photographed in field on rotting wood, March 2015; B–D: photographed indoors using stereo-microscope, January 2015.

from between bases of ommatophores. Exposed parts of body (Fig. 1) mostly whitish with skin appearing somewhat translucent, except for dark grey areas of variable extent dorsally, mainly in two lines corresponding to retractor muscles of ommatophores and often extending from dorsum onto upper forepart of flanks and front of head; eyes ~ spherical, black. Mantle inside body-whorl with front of dorsal edge with rather ill-defined and variable grey collar. Much of spire of body whitish externally, with grey on some of upper whorls; the uppermost whorls (digestive gland) pale brown.

Shell (figured by Holyoak *et al.*, 2014: fig. 1D, E) almost discoid, with low rounded spire; breadth 4.88–5.09mm, height 2.01–2.21mm, breadth/height 2.30–2.50; of 4.8–5.0 whorls that increase regularly in width. Whorls rounded overall, distinctly flattened above with sutures of moderate depth, somewhat less flattened below. Umbilicus moderately broad, 1.13–1.16mm (forming 22.5–23.2% of shell breadth), almost symmetrical, revealing interior of all whorls of spire. Mouth broadly oval overall, except where interrupted by penultimate whorl, but with flatter top and bottom of body whorl, combined with steeply descending columellar margin giving a somewhat rectangular profile; maximum width 1.86–1.92mm, maximum height 1.48–1.63mm, width/height 1.18–1.26mm. Peristome simple, thin, extending further along body whorl on top of mouth than on bottom, slightly reflected at



**Figure 2** Map to show distribution of *Vermetum festinans*.

umbilicus, not reflected upwards or outwards. Body whorl widens gradually and progressively to mouth, not descending near mouth. Interior of body whorl lacking any internal teeth or ridges. Shell colour polymorphic, the dark shells deep medium-brown (Fig. 1A, D), some of them with a greenish hue, the light shells whitish with a cream tinge (Fig. 1C), intermediate shells variable from light brown (Fig. 1B top right-hand shell) to cream. Shell rather thin but strong, translucent. Surface somewhat glossy, especially below, the micro-sculpture tending to result in impression of waxy lustre. Upper whorls of spire somewhat corroded in living adults, resulting in whitish apical whorls and variable whitish spots on spire (e.g. Fig. 1D). Periostracum with moderately strong to rather weak transverse-oblique low ribs and growth lines that are somewhat irregular in height and spacing, generally much weaker below. A few stronger growth lines often present on later whorls, where emphasised by surface corrosion. Much finer micro-sculpture

of even, closely spaced, spiral lines present on whole upperside of teleoconch where superimposed on the ribs to give a minutely decussate pattern; spiral sculpture not much weaker beneath. Protoconch smooth; transverse ribs begin at whorl 1.0–1.2, spiral micro-sculpture just visible by whorl 0.5–0.6 but juvenile shells not studied and adult shells generally rather corroded apically.

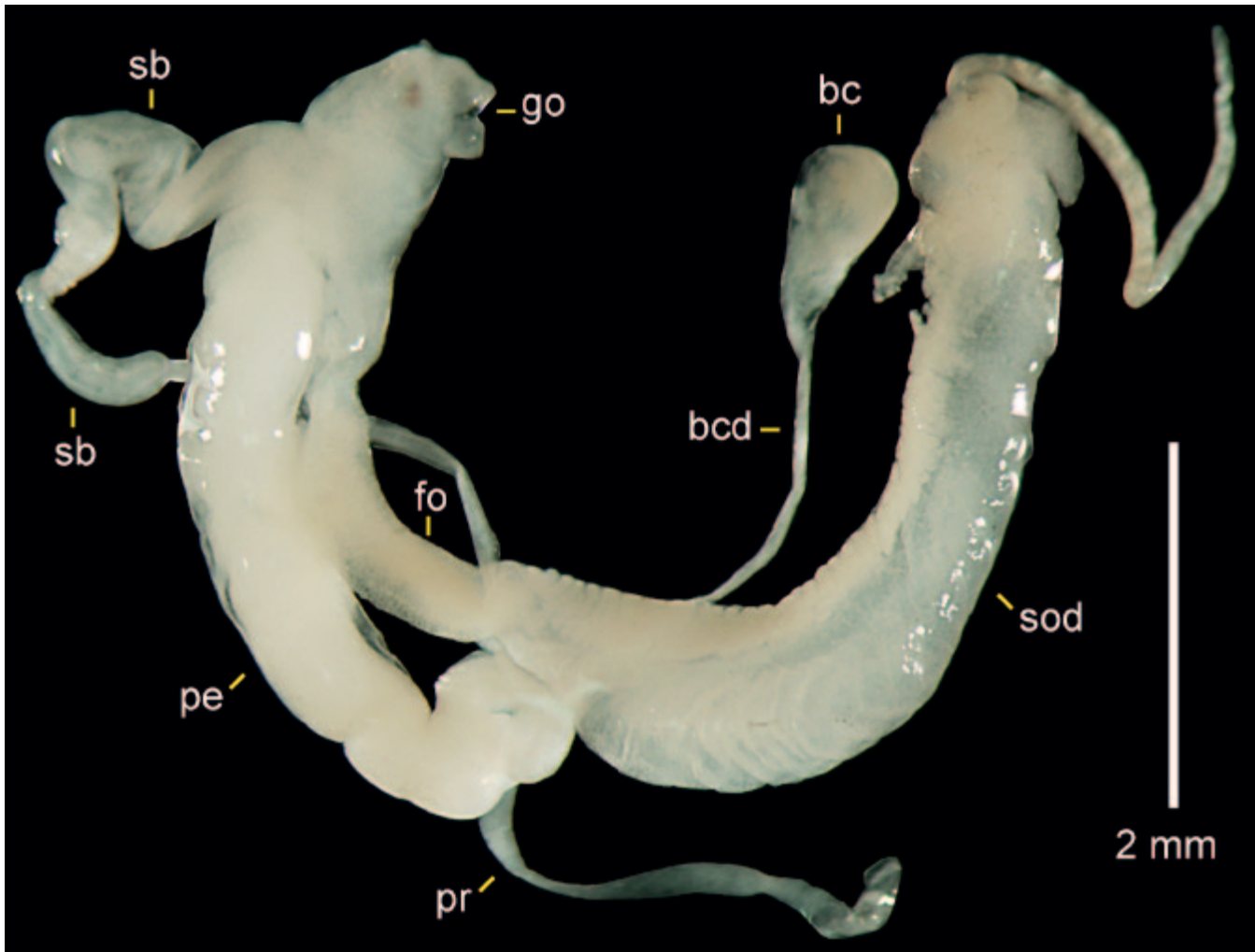
**Genital system** (Figs 3, 4) Genital orifice a pore on right-hand side of body, behind base of right ommatophore, at mid-height between top of body and foot and at about half distance from front of head to base of tail.

Genital atrium a short cylinder, widening proximally. The bursa duct, sarcobelum, penis and free oviduct all arise independently from the proximal end of the genital atrium, so there is no vagina. The proximal end of genital atrium thus gives rise to sarcobelum and free oviduct on opposite sides, the penis in between them, with the bursa copulatrix duct arising at base of free oviduct adjacent to distal end of penis. Right ommatophore retractor muscle free from penioviductal angle.

Free oviduct rather less than half length of penis, somewhat more than half length of distal plus middle parts of sarcobelum, cylindrical, narrowing proximally. Bursa copulatrix duct very long, wide for short distance near distal end, continuing proximally as a rather narrow tube alongside free oviduct and spermoviduct. Bursa copulatrix ovate, located close alongside proximal part of spermoviduct when *in situ*.

Sarcobelum shorter and more slender than penis, comprises three distinct parts: distal part a slender cylinder with thin (translucent) walls; middle part narrower, recurved sharply near its centre and narrowing abruptly at proximal end; proximal part about half diameter of middle part, but with thick muscular wall, curved, ending proximally at origin of Bridge 2. The sarcobelum lacks any laterally inserted coronal glands, but its narrow proximal part might have a similar function. The sarcobelum was not opened in search of a dart.

Penis a long cylinder with thin translucent sheath around at least distal half, the proximal half tightly rolled *in situ*. Penial retractor muscle arising near proximal end of penis, forming a strong well-defined muscle at least two-thirds



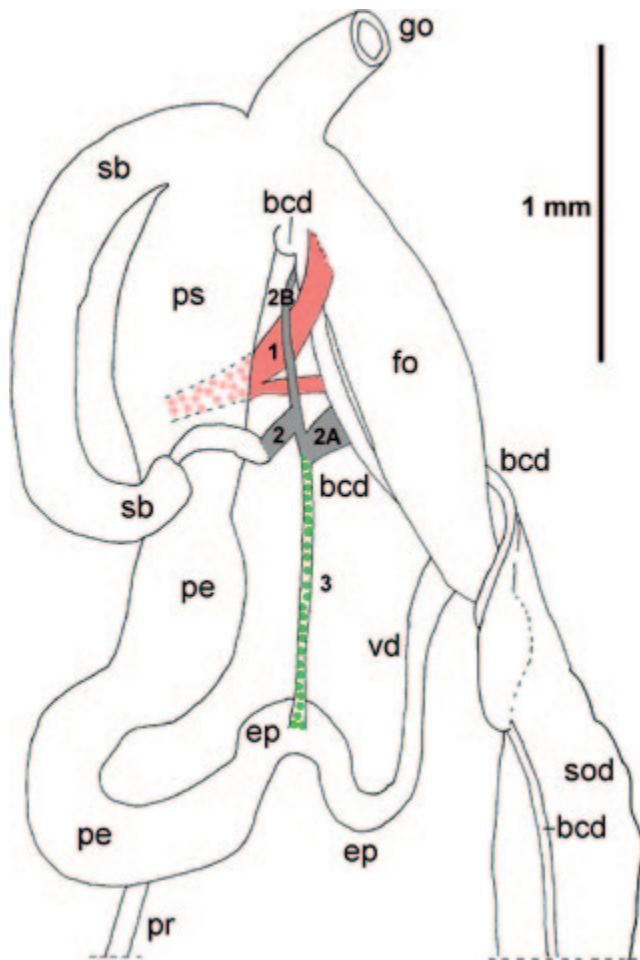
**Figure 3** Photograph of distal genitalia of *Vermetum festinans*. Abbreviations: **bc** bursa copulatrix; **bcd** duct of bursa copulatrix; **fo** free oviduct; **go** genital orifice; **pe** penis; **pr** penis retractor muscle; **sb** sarcobelum; **sod** spermoviduct.

length of penis, ending where attached proximally with a wide and rather profuse insertion onto membrane-like connective tissue around spermoviduct (not attached to body-wall). Epiphallus ~ one-quarter length of penis, narrow, convoluted, narrowing proximally to junction with vas deferens, giving rise to Bridge 3 towards distal end. Vas deferens short, narrower, but somewhat longer than epiphallus, passing proximally to distal end of spermoviduct. There is no flagellum.

“Bridges” of strong connective tissue (numbered 1 to 3 on Fig. 4) link different organs of the distal genitalia. The bridges are arranged in a similar manner to those described for *V. tamadabaensis* by Holyoak *et al.* (2014: 697 fig. 5) and appear to be homologous, so a similar numbering system is adopted here.

Bridge 1 arises near inside of distal end of free oviduct close to insertion of distal end of bursa copulatrix duct and consists of a substantial strap of connective tissue; it passes over bursa copulatrix duct (without joining it), then under bridge 2B (without joining it), ending where it joins sheath of middle of distal part of penis. A branch from Bridge 1 is narrow; it passes from origin on Bridge 1 near its middle to partly join bridge 2B, then continues to finish by joining bursa copulatrix duct.

Bridge 2 is a substantial strap, originating on proximal end of proximal part of sarcobelum, passing to connect it to Bridge 3 (at point defining the junction of Bridges 3 and 2B). Bridge 2A is a broad thin band, uniting Bridge 3 with the bursa copulatrix duct. Bridge 2B starts as a distal continuation of Bridge 3 (from its union with



**Figure 4** Drawings of distal genitalia of *Vermetum festinans*, with proximal part of penis unrolled. “Bridges” are coloured and numbered 1, 2, 2A, 2B and 3 (as in Holyoak *et al.*, 2014: fig. 5). Abbreviations as in Fig. 3, plus: **ep** epiphallus; **ps** penis sheath; **vd** vas deferens.

Bridge 2), to end on bursa copulatrix duct near distal end of latter; it passes over the main wide part of Bridge 1 without joining it.

Bridge 3 is a long and slender but strong band (looking like a retractor muscle), originating in middle of epiphallus, passing proximally to join with Bridges 2A then 2, these then continuing distally (renamed) as Bridge 2B.

**Comparisons** Shells generally similar to those of *V. tamadabaensis*, but smaller (breadth up to 5.1mm, cf. 6.7mm), with outline of mouth broadly oval rather than nearly round (width/height 1.18–1.26, cf. 0.97–1.05), umbilicus narrower in proportion to shell breadth (22.5–23.2%, cf. 28–30%) and with steeper sides internally so exposing less of each whorl of spire; underside

of body whorl perhaps slightly flatter on average; spiral micro-sculpture on underside slightly stronger, appearing more regular; the dark shells a deeper shade of brown.

The genital anatomy is generally similar to that of *V. tamadabaensis*. However, in a fully mature snail (Fig. 4) the proximal part of the penis is larger and longer relative to sizes of sarcobelum and free oviduct (so penis is nearly twice length of sarcobelum). In two snails the penial retractor muscle was found to be attached proximally to membrane-like connective tissue around the spermoviduct (the attachment to the body-wall reported for *V. tamadabaensis* was therefore probably incorrect). The “bridges” joining parts of the distal genitalia are essentially similar to those in *V. tamadabaensis* and clearly homologous to those in that species although they differ as follows: Bridge 1 differs in having the main part passing to the penis sheath, with a smaller branch extending to the bursa copulatrix duct. Bridge 2 ends at Bridge 3, so the link to the bursa copulatrix duct is only via Bridge 2A. Bridge 2B is more obviously a proximal continuation of Bridge 3.

**Distribution and habitat** (Fig. 2) Found on 17<sup>th</sup> January and 11<sup>th</sup> February 2015 on La Palma Island, Garafia, along the road from La Zarza to La Caldera del Agua, in the Barranco de Magdalena (UTM: 28R BS1691), a ravine at 960m altitude. This is a wet area on the windward slope of the northern part of La Palma, where the humid trade winds provide high levels of moisture. *Z. festinans* was found living on wet, rotting tree trunks lying amongst leaf litter of the shady laurel forest (laurisilva). The laurel forest is dominated by *Laurus novocanariensis* Rivas-Mart. *et al.*, *Erica arborea* L. and *Morella faya* (Aiton) Wilbur. Other snails found in the same habitat included *Leiostyla* sp., *Janulus traviesus* Castro *et al.* 2014 and *Plutonia* sp. The same area was recently described and illustrated by photographs in Castro *et al.* (2014: 744–746, fig. 2) as a locality for the newly described *Janulus traviesus*.

The original records given by Wollaston (1878: 323) were apparently from similar habitats “ in damp sylvan spots of intermediate and lofty altitudes...., in the Barranco de Galga, and by the sides of the Vueltas (on the ascent to the Cumbre) above Buenavista; and ... in the wood of El Bucco, at El Monte, above Barlovento”. In

addition, Holyoak *et al.* (2014: fig. 1E) reported a recent find of a single shell of this species in the Barranco de La Traviesa, in the north of the island (UTM: 28R BS2090, at 800m altitude) in “fayal-brezaal” vegetation (specimen now in TFMC).

### DISCUSSION

The likely affinities of *Vermetum tamadabaensis* were discussed at length by Holyoak *et al.* (2014), mainly on the basis of the structure of its distal genitalia. It was concluded that it shows several distinctive features which may justify maintaining it in a separate genus of Gastrodontiidae, resulting in the Macaronesian fauna possessing a third endemic genus of the family (additional to *Atlantica* Ancey 1887 and *Janulus* R.T. Lowe 1852). The present paper should meet the need expressed there “to investigate the genital anatomy of *Vermetum festinans*, the type species of *Vermetum*, to confirm that its conchological similarity to *V. tamadabaensis* reflects real affinity.” *V. festinans* is clearly very close in genital anatomy to *V. tamadabaensis*, as it is also in shell structure. Nevertheless, several differences in shell form and small differences in genital anatomy suggest the two are best regarded as separate species, each of them thus being a single-island endemic. The gap between their ranges on the islands of La Palma and Gran Canaria is occupied by the large islands of La Gomera and Tenerife, both of which also possess substantial areas of wet laurel forest, so searches for other as yet undiscovered populations of *Vermetum* on those islands might prove fruitful.

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