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A new species of *Medora* H. Adams & A. Adams, 1855 (Gastropoda: Eupulmonata: Clausiliidae) from Bosnia and Herzegovina distinguished by its unique shell ribbing

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Abstract. We describe a new species of *Medora* H. Adams & A. Adams, 1855, *M. calligraphica* sp. nov., from the vicinity of the city of Mostar in southern Bosnia and Herzegovina. The species is distinguished based on shell characters, but the description includes details of reproductive anatomy (both external and internal genitalia) as well. This species exhibits distinctive shell ribbing, which is sufficient to differentiate it from all other congeners.

Key words. Anatomy, land snail, morphology, shell surface sculpture, taxonomy

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Introduction

Medora H. Adams & A. Adams, 1855 is a genus of terrestrial pulmonate gastropods in the family Clausiliidae, subfamily Alopiinae. The genus is distributed across the western Balkans and Italy, comprising 17 species and 44 subspecies (MolluscaBase Eds 2026). The vast majority of these taxa occur in the Balkans, and many of them live geographically very close to each other, as is common in other clausiliid genera (Fehér *et al.* 2018). *Medora* species are restricted to areas of limestone and typically inhabit steep or vertical limestone surfaces and only occasionally are found on low rocks (Nordsieck 1970).

Nordsieck (1970) provided the first comprehensive revision of *Medora*, which defined the genus based on the following characters: a bulbous to spindle-shaped shell, a smooth or ribbed shell surface with a usually distinctly ribbed cervix, whitish to greyish shell colouration, absence of sutural papillae, cervix with absent to weak keel, apertural margin detached or attached, lunella dorsal, lateral or dorsolateral, a narrow and pointed clausilium, and varying strength of apertural barriers. Nordsieck (1970) concluded that *Medora* is most conchologically similar to *Agathylla* H. Adams & A. Adams, 1855, which is, however, smaller and more slender. After this work, several species and subspecies were subsequently described from the Balkans (Nordsieck, 1974, 2009; Fehér 2000) and Italy (Reitano *et al.* 2007; Nordsieck 2012). Giusti *et al.* (1986) presented a study examining relevant taxonomic characters concerning shell morphology and genital anatomy (including internal structure of the reproductive system). Colomba *et al.* (2012) presented important molecular data on the genus from Italy and summarised its taxonomic history. Despite these important contributions, the genus (and its species/subspecies concept) has not been comprehensively revised in modern times. This also stands for characters of genitalia, which still remain very poorly studied but might be of higher taxonomic importance as shown in other alopiine genera (De Mattia *et al.* 2020; De Mattia & Reitano 2026).

In this work, we present a new species of the genus *Medora* from Bosnia and Herzegovina with distinctive shell ribbing, clearly different from all other *Medora* taxa but much more similar to some *Agathylla* species, such as *A. exarata* (Rossmässler, 1835), *A. lamellosa* (J. A. Wagner, 1829), and *A. regularis* (L. Pfeiffer, 1861).

Material and methods

Snails were collected exclusively by hand from vertical rock surfaces (living specimens) or from the soil (empty

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shells). Empty shells were dry preserved, while living specimens were stored in 70% or 96% ethanol. Regarding genitalia terminology, proximal portions are considered those closer to the gonad, whereas distal portions are those closer to the genital atrium. For the purpose of dissection, shells were carefully crushed with forceps, starting from the palatal wall of the aperture and proceeding towards the apex. Using fine forceps, the genitalia were dissected from the rest of the body by cautiously cutting the tissue along the left side of the head, thereby exposing the distalmost portions of the genitalia and proceeding towards the proximal parts. After dissection, the genitalia were spread and fixed to black candle wax in a Petri dish using fine cactus needles. For the detailed analysis of apertural barriers, the palatal wall of the aperture was carefully broken just below the suture and separated from the rest of the shell. Shells and genitalia were photographed using a Nikon SMZ800N stereomicroscope equipped with a Nikon DS-Fi2 camera. Scale bars were set with a Nikon DS-L3 control unit. Living specimens were photographed with a Nikon D5300 digital camera fitted with a Tamron SP Di AF 90 mm F/2.8 macro lens and a Sigma EM-140 DG ring flash with a homemade light diffuser. Nomenclature of apertural barriers is presented on Figure 1.

Additional examined material included similarly ribbed *Medora* taxa, namely: one specimen of *M. armata* (Küster, 1844) from the vicinity of Omiš, Croatia (SMF 332769, 43.4654° N, 016.6169° E, *leg.* H. Nordsieck, 19 Oct. 2008), one specimen of *M. dalmatina leucopleura* (Brusina, 1866) from the island of Lastovo, Croatia (VG collection, *leg.* R. Crnković), and the holotype of *M. hiltrudae* H. Nordsieck, 1970 from Sumartin on the island of Brač, Croatia (SMF 195015, *leg.* H. Nordsieck, 03 Apr. 1969).

Abbreviations.

AH	apertural height
AW	apertural width
MSZ	private collection of Miklós Szekeres (Budapest, Hungary)
MV	private collection of Mihailo Vujić (Belgrade, Serbia)
NHMBEO	The Museum of Natural History (Belgrade, Serbia)
NV	private collection of Nikola Vesović (Belgrade, Serbia)
SH	shell height
SMF	Senckenberg Forschungsinstitut und Naturmuseum (Frankfurt am Main, Germany)
SW	shell width
VG	private collection of Vukašin Gojšina (Belgrade, Serbia)

Results

Family Clausiliidae J. E. Gray, 1855

Subfamily Alopiinae A. J. Wagner, 1913

Tribe Medorini H. Nordsieck, 1997

Genus *Medora* H. Adams & A. Adams, 1855

Type species. *Clausilia macarana* Rossmässler, 1833, by subsequent designation.

***Medora calligraphica* sp. nov.**

Figures 1, 2A–J, 3–5, 6A–C

ZooBank registration. urn:lsid:zoobank.org:act:59633E13-56F8-4735-B9BB-E73831BB0E2C

Type locality. Bosnia and Herzegovina, city of Mostar, Via Ferrata Podružje, limestone cliffs in a canyon, 43.3712° N, 017.8061° E, 118 m a.s.l.

Type material. Holotype (NHMBEO 314) (Fig. 2A–J). 19 paratypes: 4 drowned, ethanol-preserved specimens, VG collection; 1 dry preserved specimen, NHMBEO 315 (Fig. 3A–D, H–J, L); 8 dry preserved specimens, VG collection; 2 specimens directly preserved in 96% ethanol, VG collection; 1 dry preserved specimen, NV collection; 2 dry preserved specimens, MV collection; 1 dry preserved specimen, MSZ collection). All specimens *leg.* M. Vujić & V. Gojšina, 28 March 2026.

Additional material examined. 9 specimens (broken/juveniles = not paratypes; Fig. 3E–G, K, M) and two dissected genitalia, preserved in 70% ethanol (not paratypes) (Figs 4, 5); same data as for type material; VG collection.

Diagnosis. A *Medora* species distinguishable by the combination of strong, raised, white colabral ribs, short parietal lamella not reaching the profile of the spiral lamella, which is undivided at its inner portion, and anterior upper palatal plica separated from the upper palatal plica.

Description. Shell high-conical, slightly ovoid, consisting of *c.* 9–10 whorls; separated by a relatively shallow, white suture (Figs 2A–D, 3A–D). Protoconch (first 2–2.5 whorls) light brown, smooth. Fine colabral growth lines appear a little before the third whorl, gradually strengthening into strong colabral ribs (Fig. 2E). Teleoconch sculptured with strong, raised, white colabral ribs (Figs 2F, 3L). Spacing between ribs increases with the whorls (i.e. initial teleoconch whorls show denser ribbing than last two whorls). Spaces between ribs usually variable, 1–4 rib widths wide (Figs 2A–D, 3A–D), and almost smooth, only occasionally showing very fine colabral growth lines (Figs 2F, 3L). All whorls weakly convex due to shallow suture. Shell ground

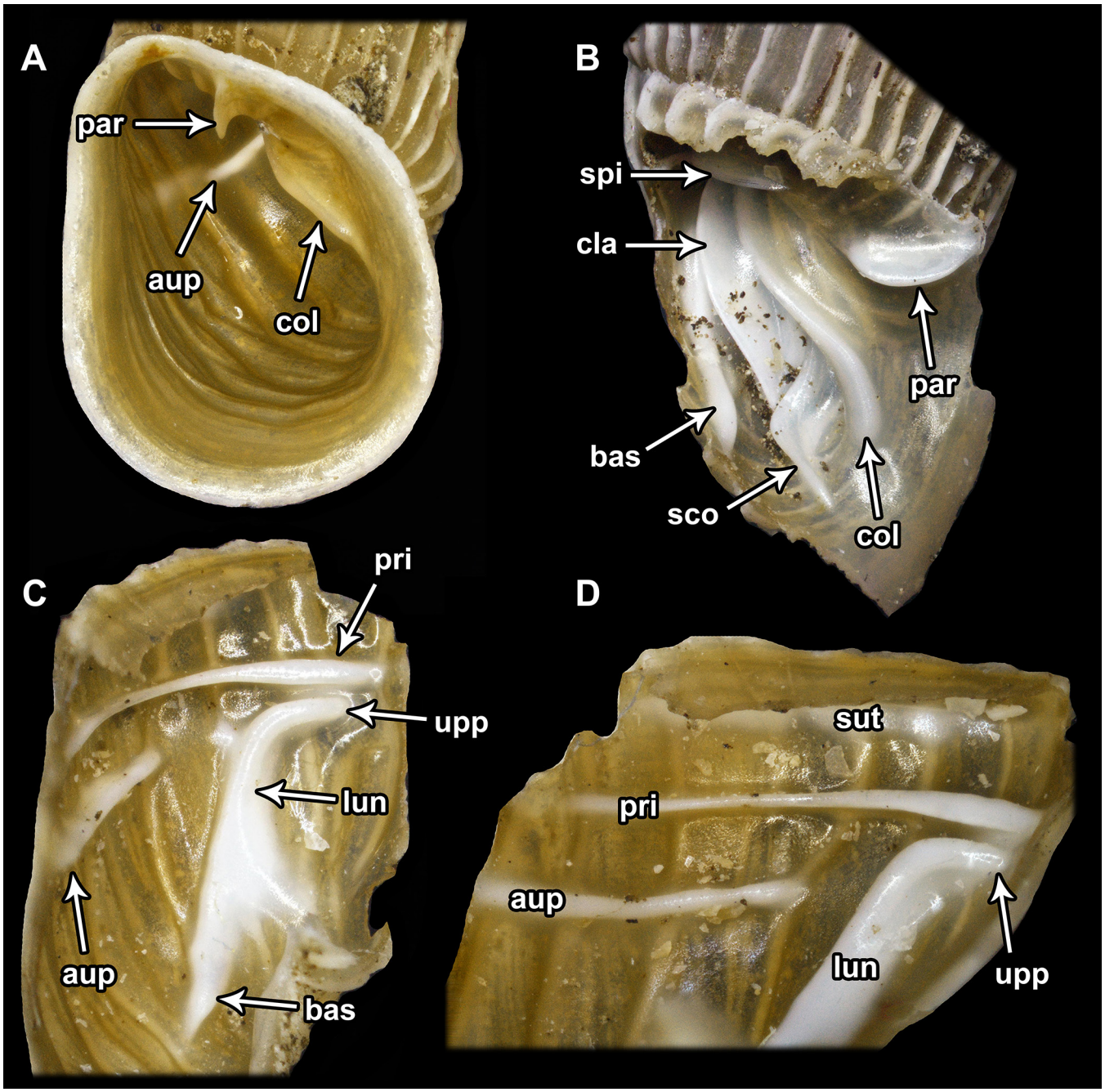


Figure 1. Nomenclature of apertural barriers in *Medora calligraphica* sp. nov. Abbreviations: aup = anterior upper palatal plica, bas = basal plica, cla = clausilium, col = columellar lamella, lun = lunella, par = parietal lamella, pri = principal plica, sco = subcolumellar lamella, spi = spiral lamella, sut = sutural plica, upp = upper palatal plica.

colour pale brownish to yellowish (Figs 2A–D, 3A–D). Peristome edge slightly detached from penultimate whorl (Figs 2D, 3D), strongly expanded (but weaker on parietal side), and white (Figs 2G–I, 3H, I). Cervix with much coarser, more irregular colabral ribbing than rest of shell (Figs 2J, 3J). Umbilicus very narrow, slit-like. Parietal lamella thin, highest at its middle portion, not reaching profile of spiral lamella (Figs 1B, 3F, M). Spiral lamella thinner than parietal lamella and clearly longer, undivided at its inner portion but slightly thickened(Fig. 3M). Columellar lamella much thicker than parietal lamella, ending obliquely near peristome (Figs 1B, 2I, 3I). Subcolumellar lamella strong, visible in oblique view but invisible in apertural view (Figs 1B, 2I). Principal plica long, slender, and thicker closer to

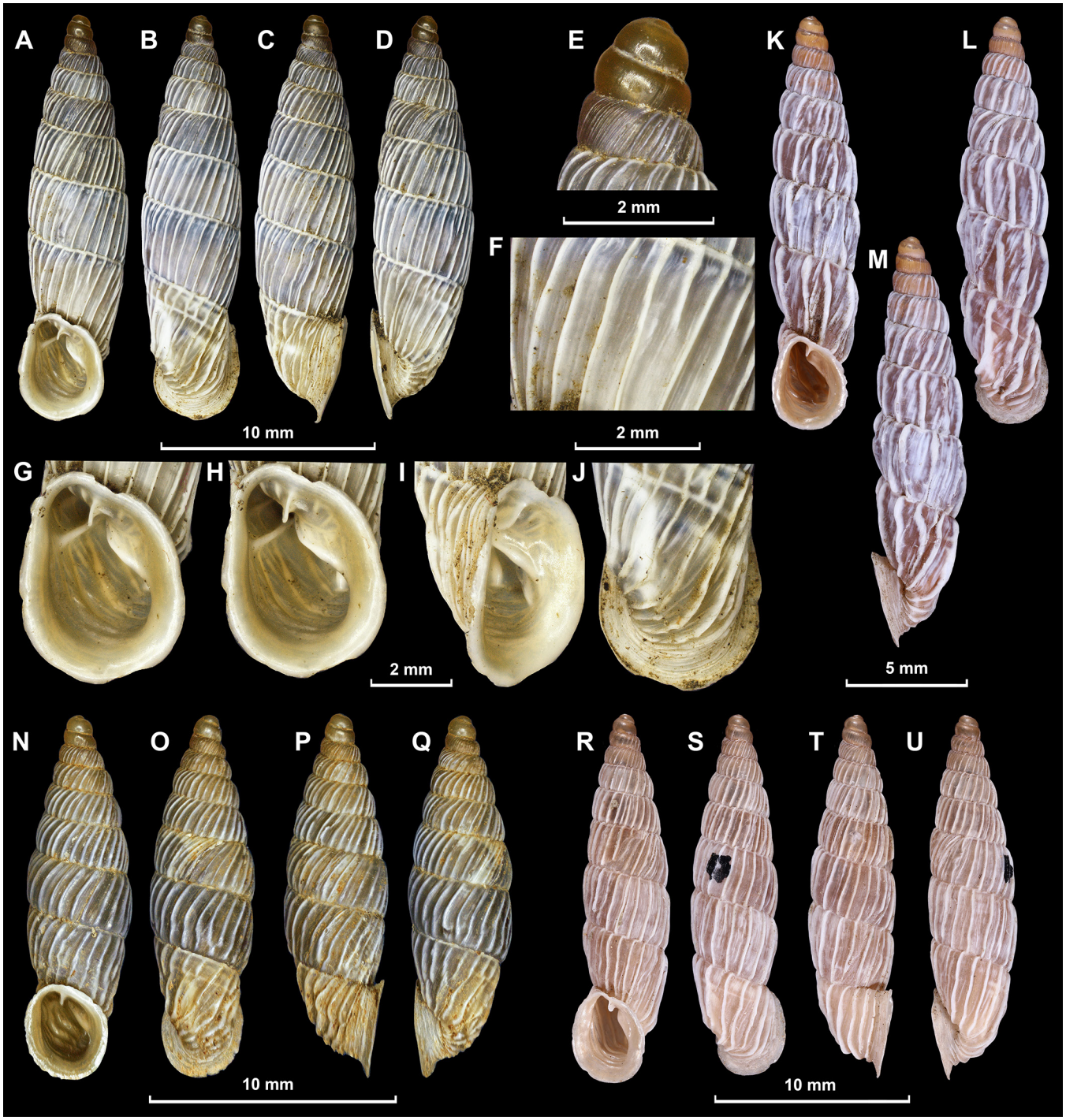


Figure 2. Synoptic view of *Medora* taxa exhibiting very distinctive, strong colabral ribbing. **A**–**J**, holotype of *Medora calligraphica* sp. nov. (NHMBEO 314). **A**–**D**, whole shell. **E**, enlarged view of protoconch and first teleoconch whorls. **F**, surface sculpture of teleoconch. **G**–**I**, enlarged apertural views. **J**, enlarged view of cervix. **K**–**M**, *M. armata* from the vicinity of Omiš (SMF 332769). **N**–**Q**, *M. dalmatina leucopleura* from the island of Lastovo (VG collection). **R**–**U**, holotype of *M. hiltrudae* (SMF 195015).

upper palatal plica and lunella (Figs 1C, D, 3E, G). Principal plica originating slightly before upper palatal plica (Figs 1C, D, 3E). Lunella well visible through semitranslucent shell, thick, situated dorsolaterally (Figs 2J, 3J). Upper palatal plica short but well separated from well-developed anterior upper palatal plica (Figs 1C, D, 3E, G). Basal plica short and thick (Figs 1C, 3E). Sutural plica shorter and lower than principal plica (Figs 1D, 3G). Clausilium tongue-shaped,

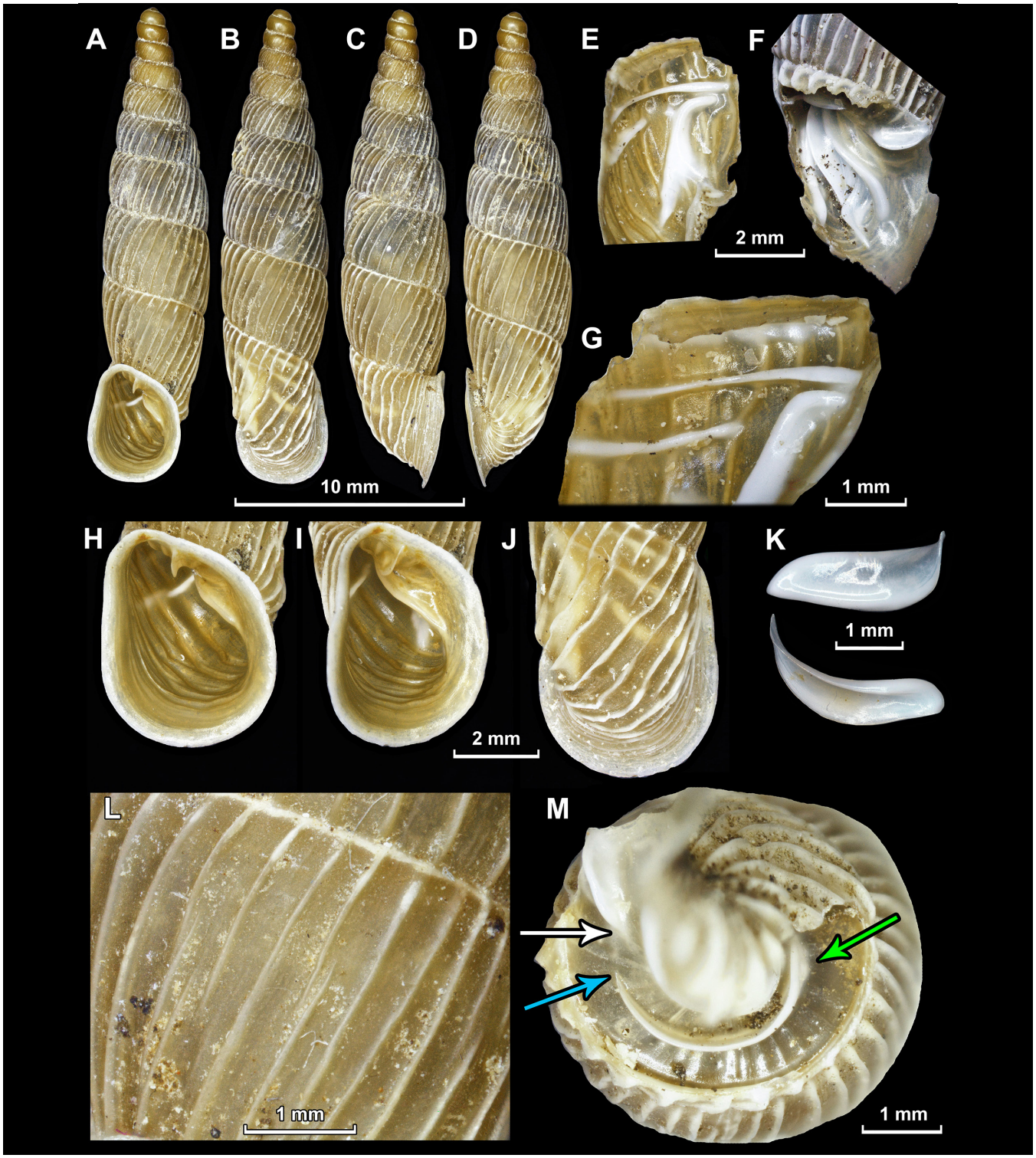


Figure 3. *Medora calligraphica* sp. nov. **A**–**D**, whole shell of paratype (NHMBEO 315). **E**, broken palatal wall to show internal plicae (non-type specimen, VG collection). **F**, broken last whorl to show internal lamellae and plicae (non-type specimen, VG collection). **G**, part of palatal wall to show internal plicae (non-type specimen, VG collection). **H**–**I**, enlarged apertural views of paratype (NHMBEO 315). **J**, enlarged view of cervix of the paratype (NHMBEO 315). **K**, clausilium (non-type specimen, VG collection). **L**, enlarged sculpture of teleoconch of the paratype (NHMBEO 315). **M**, a view showing appearance and position of parietal and spiral lamellae (white arrow points to inner portion of parietal lamella, blue arrow points to outer portion of spiral lamella, and green arrow points to inner portion of spiral lamella) (non-type specimen, VG collection).

unbifurcated, roughly rectangular, tapering at its tip (Figs 1B, 3K).

Measurements (range, in mm; n = 12): SH = 17.03–21.03; SW = 4.51–5.64; AH = 4.53–5.87; AW = 3.73–4.32. Holotype: SH = 18.99 mm; SW = 4.8 mm; AH = 5.29 mm; AW = 3.97 mm.

Genitalia. Duct of the bursa copulatrix of similar diameter as free oviduct. Diverticulum of bursa copulatrix relatively stout, with a slightly tapering tip. Bursa broadly rounded, very slightly elongated (Fig. 4). Vagina internally with numerous, irregular, longitudinal pleats, with one particularly well developed (Fig. 5D). Genital atrium relatively short (Fig. 4). Penis thick, *c.* 2× wider than vagina. Internal surface of penis markedly different in its distal and proximal portions: distal portion bearing a strong crest with a horseshoe-like bend; low, weak longitudinal folds emerge next to crest and become thicker and higher towards proximal portion of penis (Fig. 5B). Penial caecum at proximal portion of penis, roughly at its boundary with epiphallus. Penial caecum normally elongated, finger-like, wider at its base and regularly tapering towards its tip, but thumb-like in appearance when inverted. Penial caecum internally with several very strong longitudinal folds converging towards caecum tip, and some weaker folds between them (Fig. 5A). Epiphallus paler than penis and of almost equal width, bent into a U shape. Epiphallus wider near penis and narrower near junction with vas deferens (Fig. 4). Inside epiphallus, four longitudinal folds present, with two medial folds slightly thinner than outer ones (Fig. 5C). Penial retractor muscle bifurcated, with both branches attached to epiphallus (Fig. 4). Vas deferens long and narrow, broadening near free oviduct and bursa duct (Fig. 4).

Differential diagnosis. At first glance, *Medora calligraphica* sp. nov. can be distinguished from most of its congeners by the shell surface sculpture in form of strong, thick and raised white ribs. The only three taxa which have a very distinctly ribbed shell are *M. armata*, *M. dalmatina leucopleura* and *M. hiltrudae*. *Medora armata* is slenderer and has

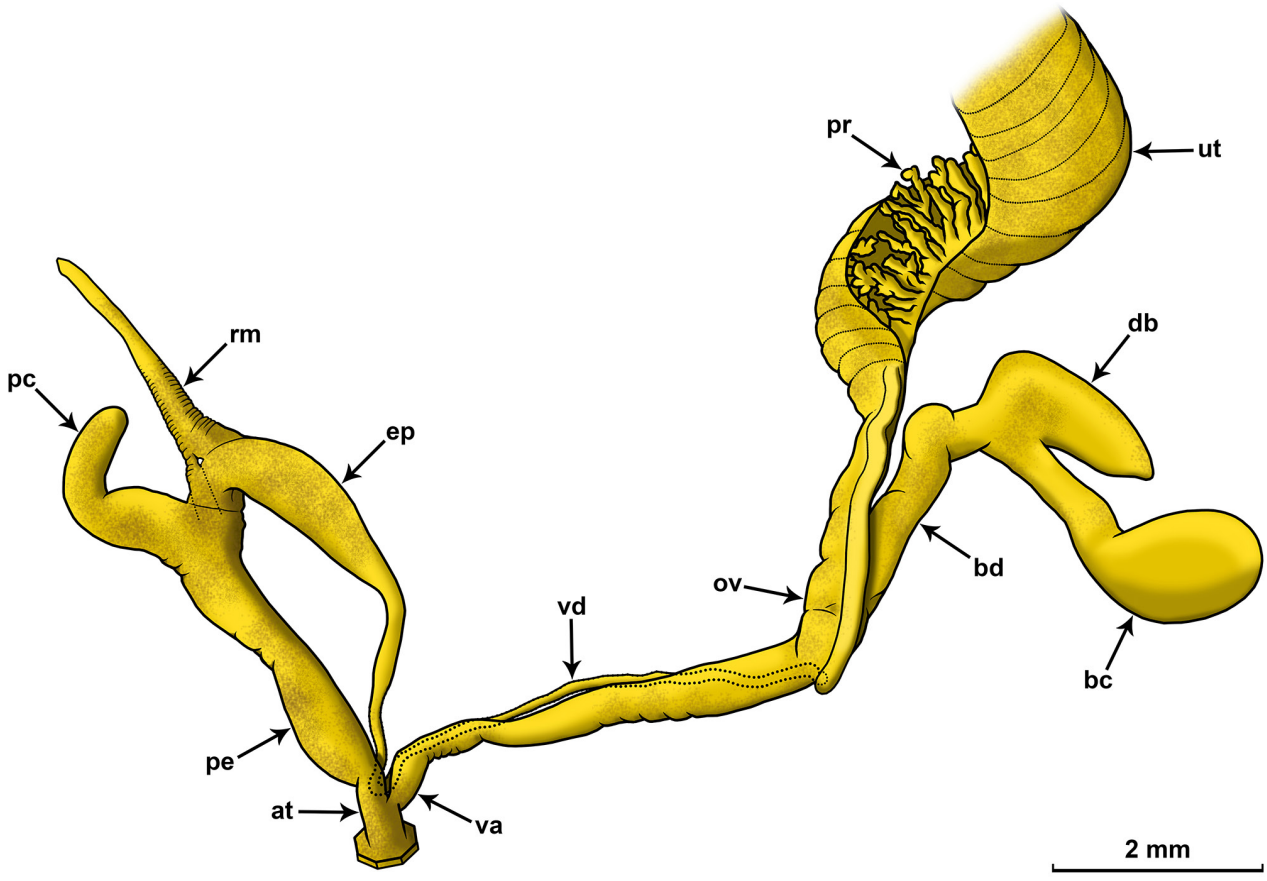


Figure 4. Illustration of the whole genitalia of *Medora calligraphica* sp. nov., non-type specimen (VG collection). Abbreviations: at = genital atrium, bc = bursa copulatrix, bd = duct of the bursa copulatrix, db = diverticulum of the bursa copulatrix, ep = epiphallus, ov = oviduct, pc = penial caecum, pe = penis, pr = prostatic portion of the spermoviduct, rm = penial retractor muscle, ut = uterine portion of the spermoviduct, va = vagina.

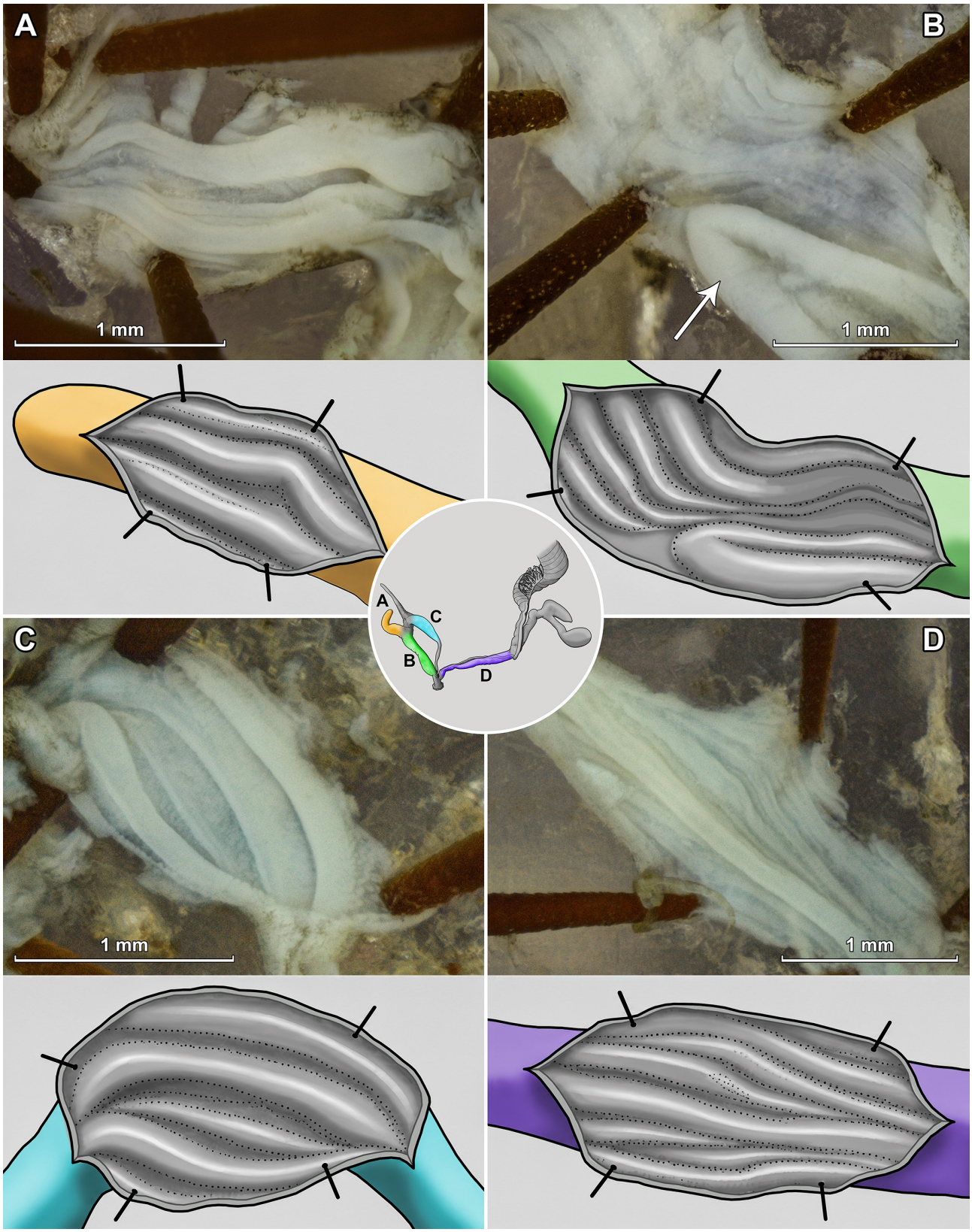


Figure 5. Internal structure of the genitalia of *Medora calligraphica* sp. nov. (original photographs and interpretative drawings). **A**, internal structure of the penial caecum. **B**, internal structure of the penis. **C**, internal structure of the epiphallus. **D**, internal structure of the vagina. The arrow points to the horseshoe-shaped crest within the distal portion of the penis.

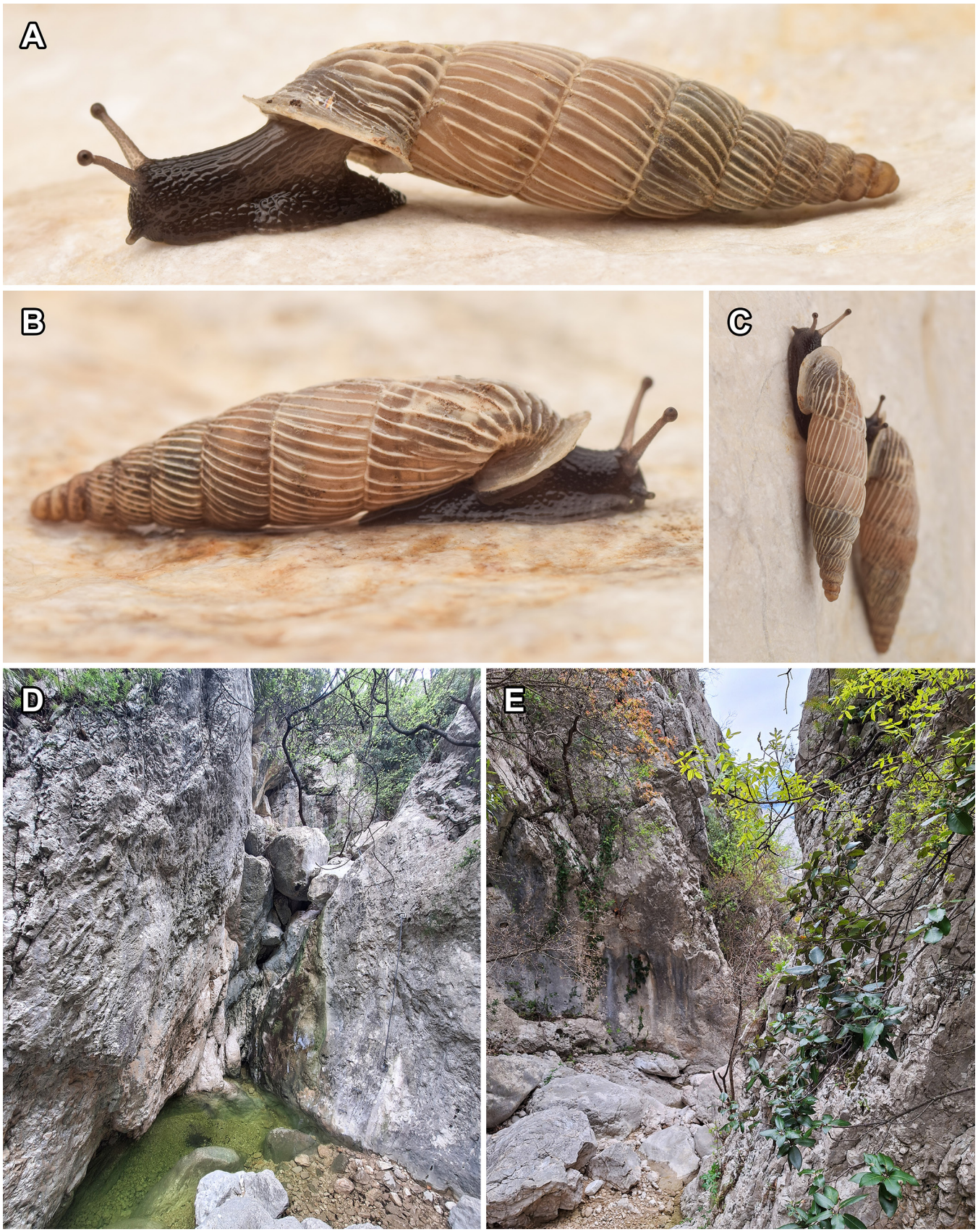


Figure 6. A–C, living specimens of *Medora calligraphica* sp. nov., paratypes (coll. MV). **D**, **E**, type locality of *Medora calligraphica* sp. nov.

very irregular, stronger ribs which are more coarsely spaced (Fig. 3K–M). *Medora dalmatina leucopleura* also has a more irregular ribbing and blunter, thicker ribs (Fig. 3N–Q). *Medora hiltrudae* has more elevated, sharper ribs which are more coarsely spaced (Fig. 3R–U). Apart from the surface sculpture, comparison with the available literature (Nordsieck 1970, 2009) revealed some other differences between *M. calligraphica* sp. nov. and its congeners, particularly in apertural barrier morphology: *Medora adensameri* H. Nordsieck, 2009 usually lacks the anterior upper palatal plica which is always present in *M. calligraphica* sp. nov. and has a much less coarse, finer cervical ribbing; same differences apply to *M. almissana* (Küster, 1847); *M. agnata* (L. Pfeiffer, 1842) is smaller, more slender and with fine colabral striation; *M. contracta* (Rossmässler, 1842) lacks the anterior upper palatal plica; *M. dalmatina* (Rossmässler, 1835) has its parietal lamella reaching or surpassing the profile of the spiral, the latter is usually forked (simple in *M. calligraphica* sp. nov.) and in several subspecies of *M. dalmatina*, anterior upper palatal plica is connected to the upper palatal; from two subspecies of *M. dalmatina* occurring in the immediate vicinity of Mostar (as *M. calligraphica* sp. nov.), namely *M. dalmatina latecostata* H. Nordsieck, 1970 and *M. dalmatina vultur* (Brancsik, 1906), the new species can be separated (apart from the distinct surface sculpture) by the parietal lamella not reaching the profile of the spiral lamella; the parietal lamella in *M. eris* (L. Pfeiffer, 1866) surpasses the profile of the spiral lamella and anterior upper palatal plica is connected to the upper palatal; in *M. hiltrudae* and *M. lesinensis* (Küster, 1847), parietal lamella reaches the spiral and anterior upper palatal plica is frequently absent; *M. proxima* (Walderdorff, 1864) usually lacks the anterior upper palatal plica; in *M. stenostoma* (Rossmässler, 1839), parietal lamella surpasses the profile of the spiral; *M. macascarensis* (G.B. Sowerby I, 1828) is paler, larger, normally less slender and lacks the distinctive colabral ribbing of *M. calligraphica* sp. nov.

Etymology. The specific epithet is derived from Greek words *kallos* (beautiful) and *graphein* (to write, to draw). It refers to the beautiful, calligraphy-like appearance of the shell.

Habitat. The species' habitat consists of a relatively deep, karstified limestone canyon approximately 2,000 m in length (*c.* 6,200 m including the shallow initial and central parts of the canyon) and with a steep gradient (total elevation drop of about 580 m). The canyon is dominated by an incision into a thick limestone layer, while large limestone monoliths occur along the canyon floor. An ephemeral, torrential stream flows through the canyon. There is a streambed outside the canyon, which has a weak, shallow flow of water over rocks and with occasional small pools in eroded depressions (Fig. 6D, E). The canyon vegetation is composed of Mediterranean to sub-Mediterranean species, predominantly *Quercus ilex* L., *Punica granatum* L., and *Pistacia terebinthus* L., while rock crevices, exposed rock surfaces, and soil accumulations are overgrown with *Hedera helix* L., *Asplenium trichomanes* L., *Polypodium cambricum* L., *Dioscorea communis* (L.) Caddick & Wilkin, *Ruscus aculeatus* L., *Euphorbia characias* subsp. *wulfenii* (Hoppe ex W.D.J.Koch) Radcl.-Sm., and *Rubus* L. sp. Outside the canyon and at its entrance, sub-Mediterranean pseudomaquis develops, dominated by *P. granatum*, *Ficus carica* L., *Phillyrea latifolia* L., *Paliurus spina-christi* Mill., *Juniperus deltoides* R.P.Adams, *Petteria ramentacea* (Sieber) C.Presl, *E. characias* subsp. *wulfenii*, and *Ephedra foeminea* Forssk. Living individuals (Fig. 6A–C) of *M. calligraphica* sp. nov. occur on vertical limestone cliff faces within the canyon, mostly sheltered in crevices or in geometrically protected parts of the rock faces. Aggregations of numerous adult and juvenile individuals have been observed at suitable microhabitats. No living individuals were found on exposed rocks at the canyon entrance. Empty shells were recorded in the leaf litter within the canyon, as well as in torrential deposits located around plant roots and crevices at the canyon entrance and outside the canyon section. The habitat is not subject to strong anthropogenic pressure, except for minimal modifications made during the installation of a via ferrata in the canyon.

Distribution. This species is known only from the type locality (Fig. 7).

Discussion

According to Nordsieck (1970), the morphological boundaries between *Agathylla* and *Medora* are somewhat arbitrary. Both genera include taxa with both smooth and ribbed shell surfaces, and no clear anatomical differences have yet been observed. However, *Agathylla* species typically have a smaller shell diameter, making the shell much slenderer than in *Medora*. Our specimens from the vicinity of the city of Mostar exceeded a shell diameter of 5 mm, which does not make the shell particularly slender. In comparison with similar taxa, we have observed that the lunella in *Agathylla* is much less visible than in almost all *Medora* species. Nevertheless, the shell of *M. calligraphica* sp. nov. exhibits distinct ribbing, which differs from all other congeners, but it is similar to several *Agathylla* species (e.g. *A. exarata*, *A. lamellosa*, and *A. regularis*). Due to the strong lunella and large size, we

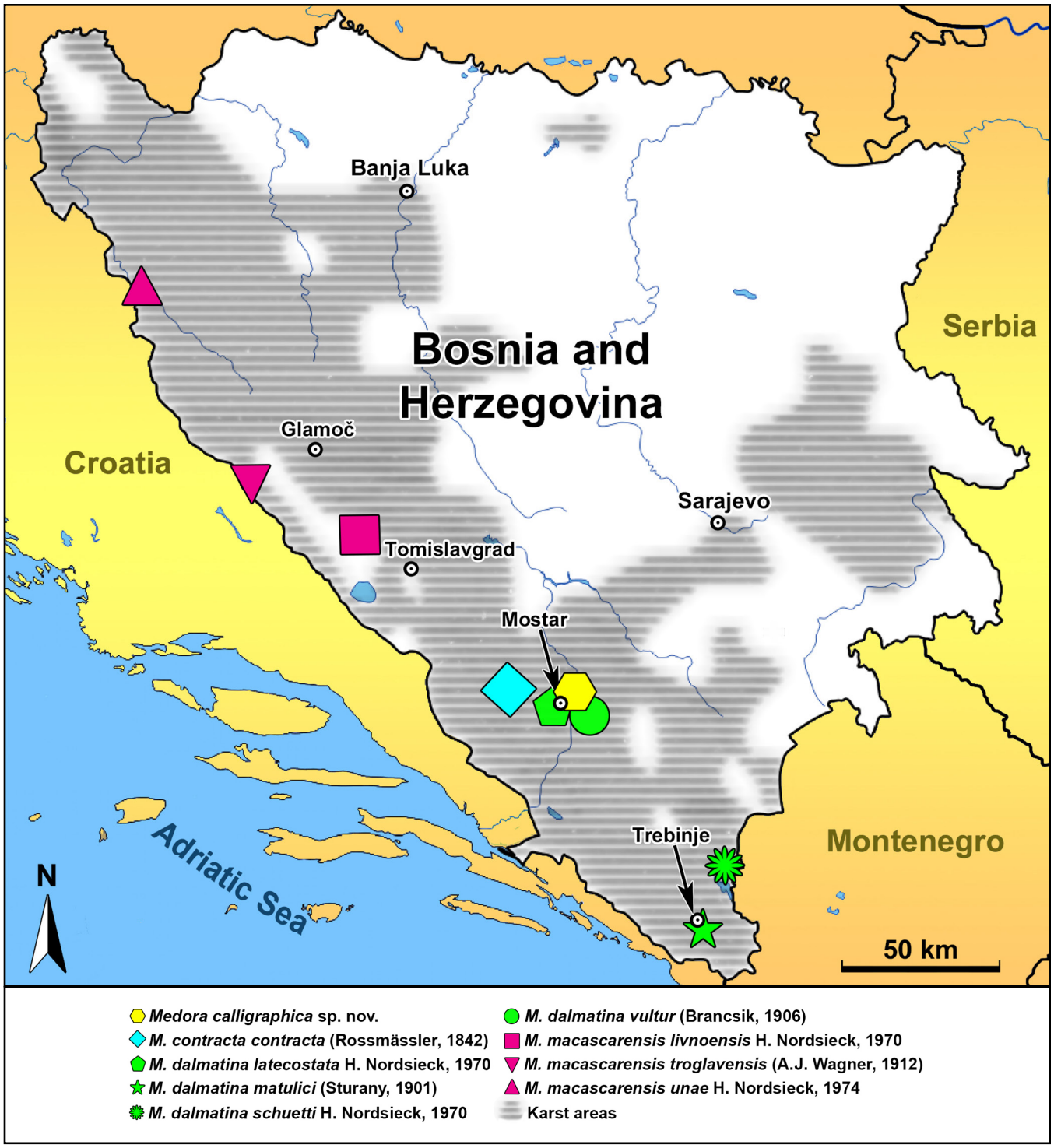


Figure 7. Distribution map showing type localities of all *Medora* taxa originally described from Bosnia and Herzegovina.

consider the newly described species to be a representative of *Medora*.

The current species and subspecies concept in *Medora* relies almost exclusively on shell characters (apertural barrier morphology and surface sculpture). *Medora calligraphica* sp. nov. is distinct from all its congeners by the peculiar surface sculpture of strong colabral ribs. In terms of apertural barrier morphology, the new species shows no unique traits to distinguish it from other *Medora* species, but the combination of strong colabral ribs, a non-bifurcated spiral lamella,

a short parietal lamella that does not reach the profile of the spiral lamella, and an anterior upper palatal plica separated from the upper palatal enables the distinction of this species. Of three previously known, strongly ribbed *Medora* taxa (*M. armata*, *M. dalmatina leucopleura*, and *M. hiltrudae*), only *M. dalmatina leucopleura* is recognised at the subspecific level. For many genera of Alopiinae, it is true that strongly ribbed subspecies appear within otherwise non-ribbed species. Some notable examples include *Herilla ziegleri costulifera* (Möllendorff, 1873), *Macedonica frauenfeldi transiens* (Möllendorff, 1873), and *Montenegrina puskasi gurelurensis* Fehér & Szekeres, 2016 (Nordsieck 1971; Fehér & Szekeres 2016; De Mattia *et al.* 2020; Nordsieck 2024). Fehér & Szekeres (2016) revised the taxonomy of the genus *Montenegrina*, but the concept of the genus has been significantly altered following the revision by De Mattia *et al.* (2020). In that work, De Mattia *et al.* elevated many subspecific taxa to full species or transferred some subspecies to a different species—for example, *Montenegrina skipetarica gurelurensis* of Fehér & Szekeres (2016) became *Montenegrina puskasi gurelurensis* following De Mattia *et al.* (2020). This example illustrates the dynamic nature of clausiliid taxonomy, with taxonomic ranks and species concepts being subject to change as new evidence becomes available. Examples within other genera exist as well (e.g. for *Muticaria* Lindholm, 1925, see De Mattia & Reitano 2026).

While it is possible that *M. calligraphica* sp. nov. may eventually be shown to fit within the morphological range of *Medora dalmatina* or some other species, it seems preferable to treat this morphologically distinct and immediately recognisable form as separate species rather than provisionally including it within a broadly defined *M. dalmatina* until a more expansive taxonomic revision is conducted. Otherwise, the inclusion of highly distinct forms, such as that described here, to *M. dalmatina*, or any other species, could contribute to the formation of "a waste-bucket taxon" and potentially resulting in non-monophyly of *M. dalmatina*. Recognition of *M. calligraphica* sp. nov. as a separate species should therefore be regarded as a testable taxonomic hypothesis that can be evaluated in future integrative revisions using additional morphological and molecular evidence. Recognition of such morphologically distinct forms may also facilitate subsequent assessments of their distribution, population status, and conservation needs.

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