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## Monograph

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# *Cochlostoma* Jan, 1830 revised: an overview of the subgenus *Turritus* Westerlund, 1883 and its species (Caenogastropoda, Cochlostomatidae)

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**Abstract.** The taxa of the subgenus *Turritus* of *Cochlostoma* (Cochlostomatidae) are analysed based on molecular and morphological data. The phylogenetic trees, based on ribosomal (16S) and nuclear (H3) DNA, indicate that the currently accepted taxonomy should be revised. Based on our data, there are 37 species in *Turritus* of which 5 are new to science: *Cochlostoma (Turritus) pallgergelyi* sp. nov., *C. (T.) muranyii* sp. nov., *C. (T.) hallgassi* sp. nov., *C. (T.) kotschani* sp. nov. and *C. (T.) lacazei* sp. nov. Of these, we describe the shells and the female genitalia and summarize the distributional data. Some samples (or set of samples) will remain undetermined for lack of data and these are reported in the appendix.

**Keywords.** New species, morphology, molecular phylogeny, Palaearctic, Mediterranean.

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## Introduction

The genus *Cochlostoma* Jan, 1830 includes rock-dwelling, gonochoric snails with conical shells inhabiting the calcareous mountains surrounding the Mediterranean Sea. In previous papers, we revised the subgeneric taxonomy (Zallot *et al.* 2015) and the species within the subgenera *Lovcenia* Zallot *et al.*, 2018 and *Clessiniella* Zallot *et al.*, 2021 (Zallot *et al.* 2018, 2021) based on shell morphology, anatomy and molecular data.

In this paper, we treat the subgenus *Turritus* Westerlund, 1883. Contrary to other subgenera of *Cochlostoma*, it is almost impossible to characterize *Turritus* by known conchological and genital features. Nonetheless, *Turritus* forms a well-supported clade within *Cochlostoma* based on the DNA analysis of 16S and H3 genes (Zallot *et al.* 2015). Although fragmentary, the findings give a perspective that differs from the current views (Welter-Schultes 2012; MolluscaBase 2023).

### The subgenus *Turritus* Westerlund, 1883, a historical review

*Turritus* was introduced by Westerlund (1883) as “Sectio” of the genus *Pomatias* Studer, 1789. *Pomatias* was used for the genus *Cochlostoma* until the beginning of the 20<sup>th</sup> century. At that time, taxonomists considered shell morphology only, hence Westerlund mentioned as key characters the visible, open umbilicus and a flat, expanded columellar lobe reaching the body whorls (Fig. 1).

The taxa ‘*P. henricae* Strob.’ [*Cochlostoma* (*Eupomatias*) *henricae* (Strobel, 1851)], ‘*P. plumbeus* West.’ [*Cochlostoma* (*Eupomatias*) *henricae* (Strobel, 1851)] and ‘*P. stossichi* Cless.’ [*Cochlostoma* (*Turritus*) *stossichi* (Hirc, 1881)], were originally included in the Sectio, despite the fact that *stossichi* lacks the open umbilicus.

Wagner (1897) downgraded Sectio *Turritus* to “Formenkreis” *Turrita*, with ‘*Pomatias henricae*’ and ‘*P. braueri*’ [*Cochlostoma* (*Turritus*) *braueri* (Wagner, 1897)], in the Sectio *Eupomatias*. The key characters of the “Formenkreis” were the flat, enlarged columellar lobe, reaching the body whorl, and an open umbilicus. ‘*Pomatias stossichi*’ was considered a variety of ‘*P. nanus*’ [*Cochlostoma* (*Turritus*) *nanum* (Westerlund, 1879)] and classified into the Sectio *Auritus* because of the almost hidden umbilicus and the slightly curved columellar lobe.

Kobelt (1902) in his review of Cyclophoridae Gray, 1847 did not accept *Turritus* as a separate taxon whereby *Cochlostoma henricae* was assigned to the nominate subgenus *Cochlostoma*. *Cochlostoma stossichi* was placed into the subgenus *Auritus*. Thus, the two species were classified in different subgenera, following Wagner (1897), who considered it taxonomically relevant whether or not the umbilicus was visible.

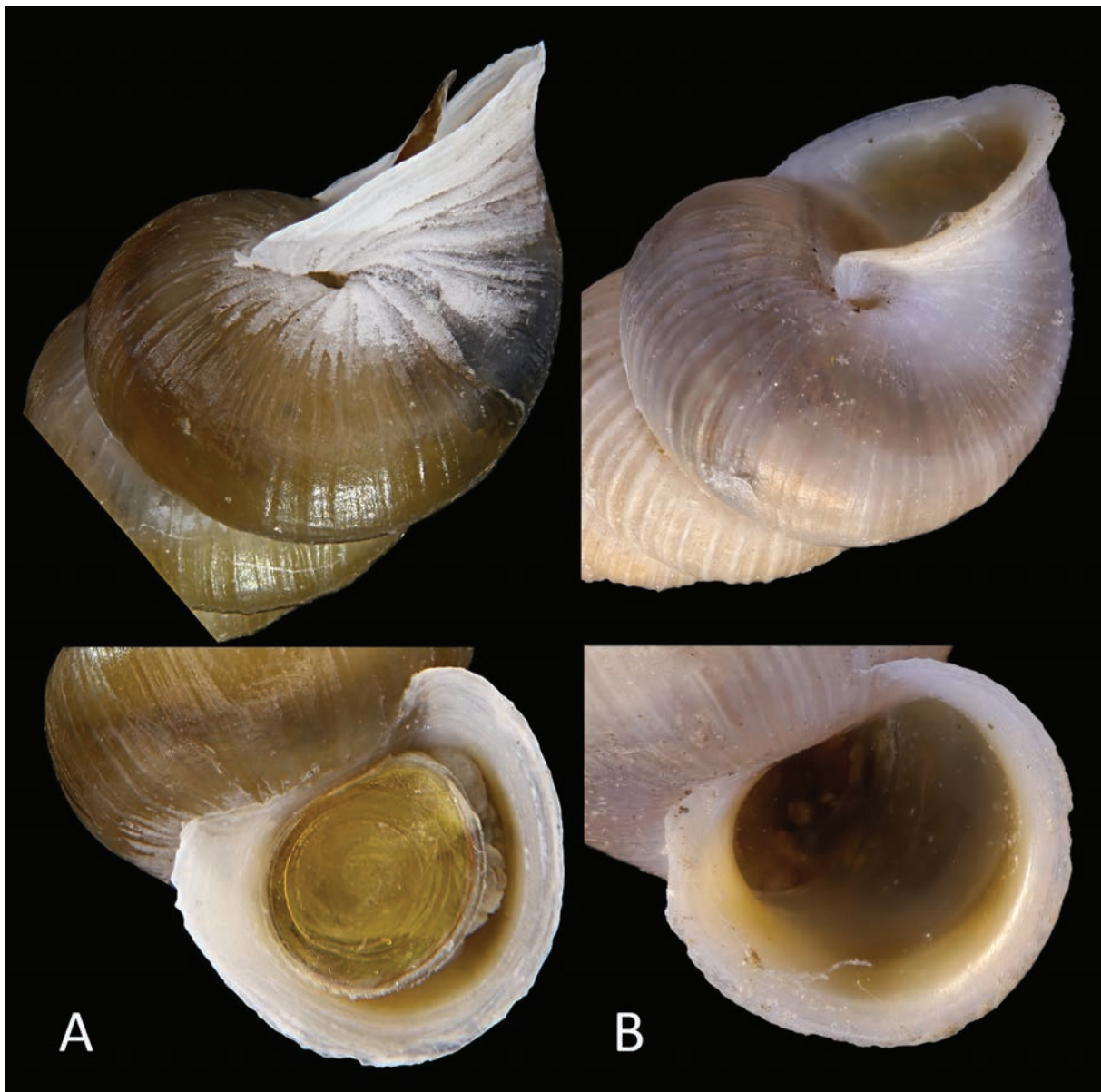
Wagner (1906) raised *Auritus* to genus level, including all the species with a hidden umbilicus. Within *Auritus*, he defined three subgenera based on the features of the operculum. The species with a simple operculum were assigned to the nominate subgenus. Most of the present-day species of *Turritus* have a hidden umbilicus and a simple operculum and were therefore assigned to the nominate subgenus.

Wenz (1923), while analyzing the fossil record of *Cochlostoma*, rediscovered *Turritus* and designated *Cochlostoma* (*Turritus*) *stossichi* as its type species.

Zilch (1958), in his list of the types and “typoids” of the Senckenberg Museum, followed the taxonomical criteria used by Kobelt (1902) and Wagner (1906), viz. a visible or hidden umbilicus, a simple operculum, or an operculum with a calcareous concretion or a supplementary plate. Therefore, the two species assigned to *Turritus* by Westerlund (1883) were placed in different subgenera, with *Cochlostoma henricae* stayed in the nominate subgenus because of the visible umbilicus and *Cochlostoma nanum stossichi* in *Turritus* because of the closed umbilicus.

Zalgot *et al.* (2015) proved that the visible versus hidden umbilicus is not a valid taxonomic character state at the subgenus level, but is only useful in species-level taxonomy. The simple operculum turned out to be a symplesiomorphy shared by different, only distantly related, subgenera. Hence, based both on genital features as well as molecular data, several species Zilch (1958) classified in *Turritus* ended up in other subgenera.

Obviously, *Turritus* has a complicated history, with different species assigned to it by different authors. It has been used in different ways for species with a simple operculum and a hidden umbilicus. Its revised interpretation is based now on anatomical data and DNA analyses.



**Fig. 1.** The “Sectio” *Turritus* in Westerlund, 1883. **A.** *Cochlostoma* (*Eupomatias*) *henricae* (Strobel, 1851), Sella Chianzutan, I (EZ0274). **B.** *Cochlostoma* (*Turritus*) *stossichi* (Hirc, 1881), Ponikve, HR (ZMB170.256).

## Material and methods

In this study, we combine the results of analyses of molecular markers as well as shell and genital morphology of female specimens. The male genitalia and shell were not analysed due to time constraints.

The sampling localities, mapped in Fig. 2, are listed for each sample in the taxonomic section (for the accepted taxa) and in the Appendix (for the samples with uncertain taxonomical status) with a short name and geographical coordinates, and with further details in [Supp. file 1](#). In the maps in the taxonomic section, the number close to the dots refers to the sampling locality as reported in the type and material lists. The type locality of the species is marked with “1”. The sampling localities yielding specimens for which we were able to amplify the 16S gene are marked with a pointer with a black center. An approximate position is used for (mostly older) samples for which the coordinates were not recorded in the field with GPS. The availability of specimens from the different sampling localities was unbalanced and for several samples it was impossible to amplify DNA. We analysed 298 samples of *Turritus*, viz from France (8), Italy (123), Austria (6) Slovenia (31), Croatia (62), Bosnia and Herzegovina (7), Montenegro (16), Albania (39), Kosovo (1) and Greece (4). 247 samples were ethanol-preserved and of 198 samples we analysed the female genital morphology in 499 specimens; 49 samples were either badly preserved or too rigid (mainly the ones in alcohol 98%) to perform the anatomical analysis and 14 were dry shell samples, and therefore only imaging and measurements of the shell characters were possible. Because most of the species have been described more than a hundred years ago, the type-specimens are dry shells. Thanks to the collaboration of museums where these shells are preserved, we obtained 38 pictures of type specimens that could be analysed.

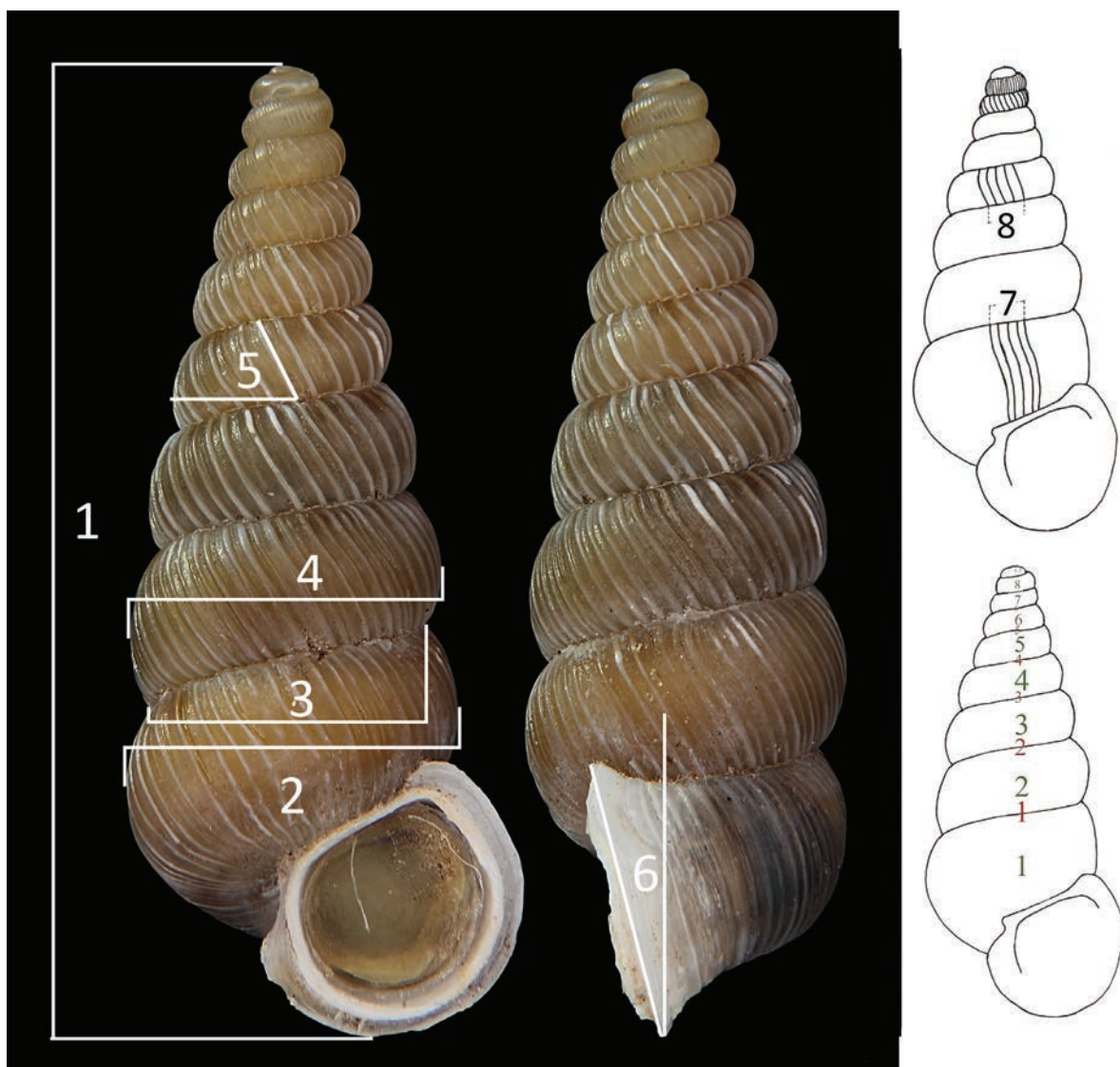
The methods for depicting the shells, obtaining measurements and dissecting genitalia were discussed previously (Zallot 2002: 94–97; Zallot *et al.* 2015: 64–67, 2018: 2–8, 2021: 50–56). We summarize the shell features used in the taxonomical part as in Fig. 3:

Aper. incl. = inclination of the aperture in lateral view in respect to the axis between the apex and the basis of the aperture



**Fig. 2.** Sampling localities.

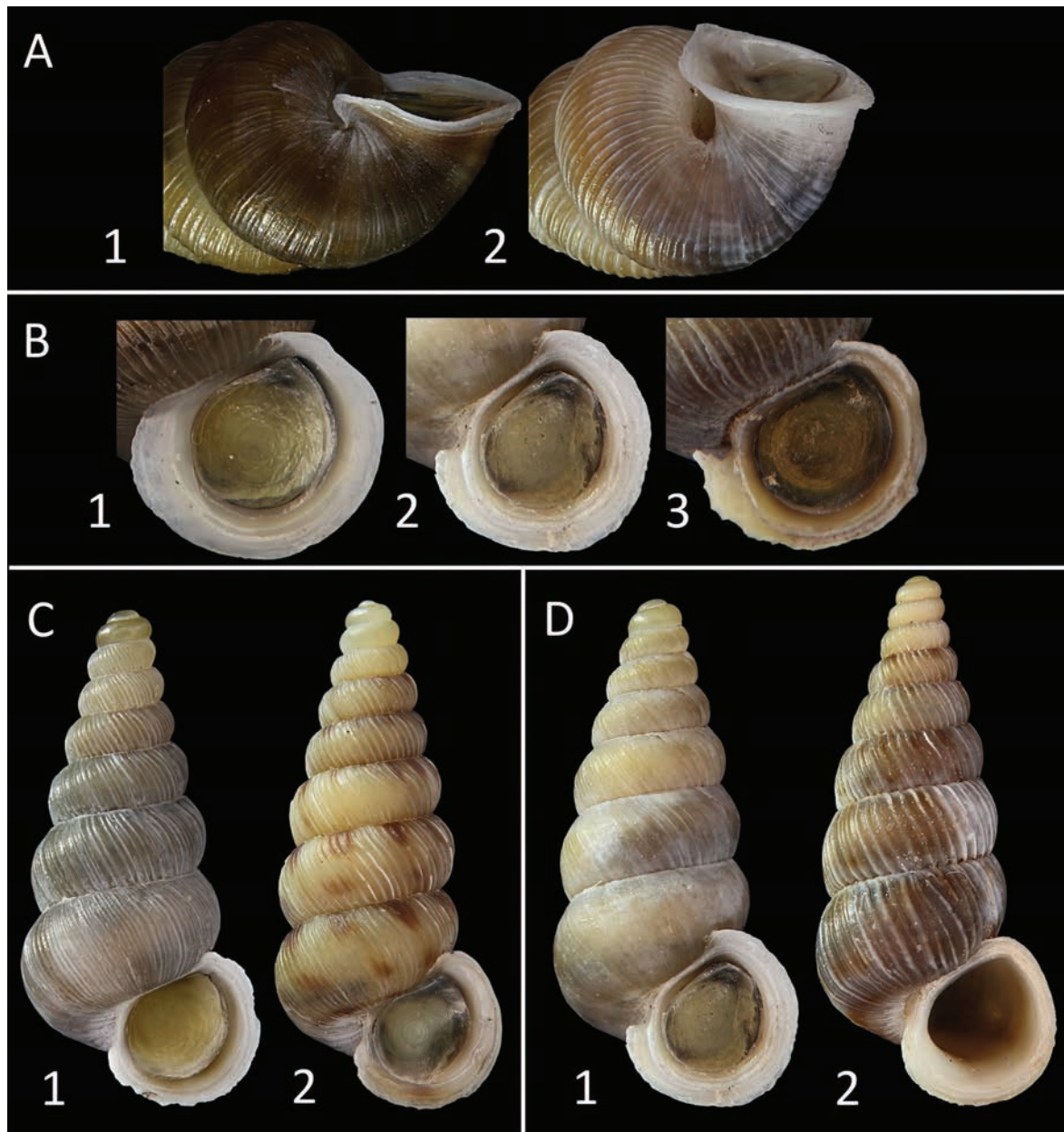
H	= height of the shell along the main axis
H/W	= height/max width (width of the 1 <sup>st</sup> whorl)
Ribs incl.	= inclination of the ribs in relation to the orthogonal line to the main axis.
Ribs/mm 1 <sup>st</sup> W.	= ribs per millimeter measured along the 1 <sup>st</sup> suture, calculated starting from measuring the distance between 5 <sup>th</sup> central ribs
Ribs/mm 4 <sup>th</sup> W.	= ribs per millimeter measured along the basal suture of the 4 <sup>th</sup> whorl, calculated starting from measuring the distance between 5 <sup>th</sup> central ribs
Roundness	= width of the 1 <sup>st</sup> suture / width of the 2 <sup>nd</sup> whorl-1
Whorls	= number of whorls



**Fig. 3.** Measurements taken on the shell. **1.** Height (H). **2.** Width of the 1<sup>st</sup> whorl (W). **3.** Width of the 1<sup>st</sup> suture. **4.** Width of the 2<sup>nd</sup> whorl. **5.** Inclination of the ribs in relation to the orthogonal line to the main axis. **6.** Inclination of the aperture lip in relation to the main axis in lateral view. **7.** Ribs per millimeter measured along the 1<sup>st</sup> suture. **8.** Ribs per millimeter measured along the basal suture of the 4<sup>th</sup> whorl. The figure in the lower right corner shows how the whorls (green) and sutures (red) are counted.

Some of the shell features are visually explained in Fig. 4. These are:

- the umbilicus is either ‘hidden’ when covered by a curved columellar lobe or ‘visible’ if the columellar lobe is flat. In some species it is somewhat halfway, with a narrow slit.
- the presence of spots on the whorls or a spotless shell.



**Fig. 4.** Diagnostic characters of the shell in *Turritus* Westerlund, 1883. **A1.** Hidden umbilicus, NFS064, Rio Fuggio, I. **A2.** Visible umbilicus, *C. (T.) elegans* (Clessin, 1879), Razbojste near Oltari, HR (WdM-6896). **B1.** Flat columellar lobe, *C. (T.) elegans*, Senj-Sveti Juraj, HR (WdM-6887). **B2.** Indented columellar lobe, *C. (T.) nanum* (Westerlund, 1879), Mt Snežnik 1764, HR (WdM-7005). **B3.** Deeply indented columellar lobe, *C. (T.) pallgergelyi* sp. nov., Kameno 1, MONT (HNHM-105450). **C1.** Spotless shell, *C. (T.) patulum* (Draparnaud, 1801), Cirque D’Archiane, FR (RMNH-117454). **C2.** Visible spots, *C. (T.) cassiniacum* (Saint-Simon in Paulucci, 1878), Val Canneto 1050, I (EZ-1131). **D1.** Weak ribbing, *C. (T.) nanum*, Mt Snežnik 1764, HR (WdM-7005). **D2.** Strong ribbing, *C. (T.) sardoum* (Westerlund, 1890), Cala Fuili, I (EZ-0577).

- the shape of the columellar lobe, flat or more or less abruptly inwardly curved.
- the strength of the ribs (the spacing is measured).

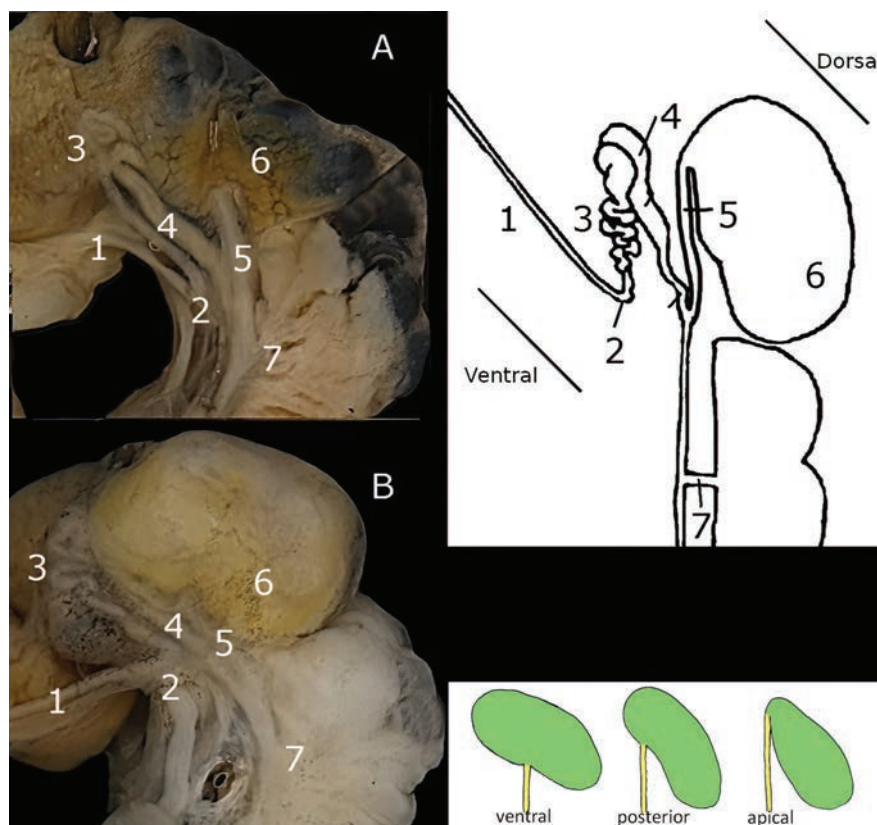
All the measurements and features are based on female specimens unless otherwise stated in the text.

In Figs 5–6, female genital features in *Turritus* have been summarized. All the female specimens of a species share:

- the position of the connection of the pedunculus to the bursa copulatrix: posterior or ventral;
- the shape, length and position of the seminal receptacle;
- the position of the junction of the uterus gland with respect to the connection between the pedunculus of the bursa copulatrix and the distal oviduct.

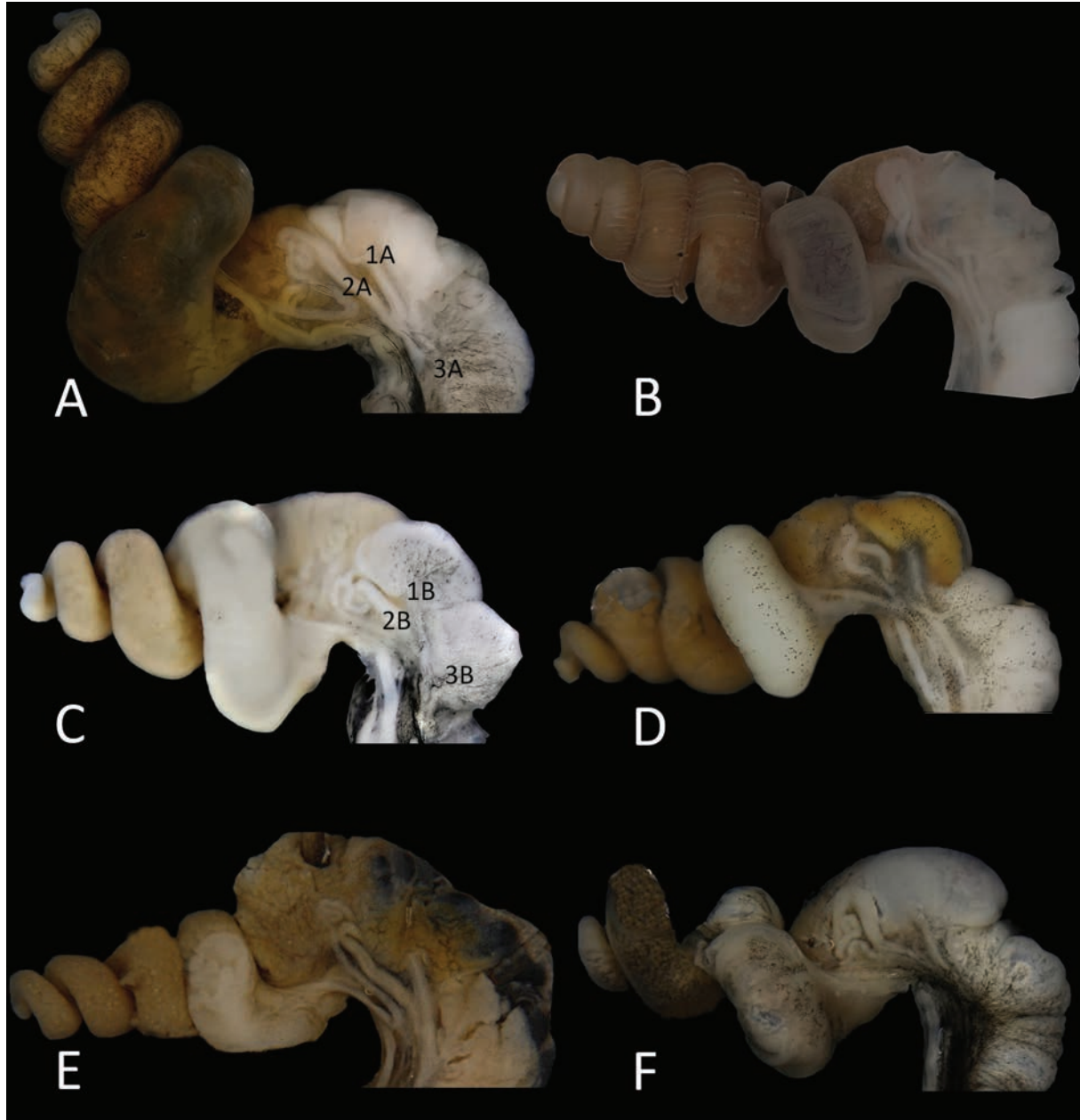
Part of the molecular data were obtained as described in Zallot *et al.* (2018). New DNA extractions and PCR amplifications were obtained as follows: approximately 1–3 mm<sup>3</sup> of foot tissue was used to extract genomic DNA with the E.Z.N.A.<sup>®</sup> Mollusc DNA Kit (Omega-Biotek) following the manufacturer's protocol. DNA extracts were stored at -20°C.

PCR was executed using a C1000<sup>TM</sup> Thermal Cycler (BIO-RAD, Hercules, CA, USA) to amplify a fragment of the mitochondrial 16S rRNA and a nuclear histone H3 with the following primers: H3–H3F and H3R (Colgan *et al.* 2007), 16S–16SF and 16SR (Palumbi *et al.* 1991). PCR reactions were carried



**Fig. 5.** Female genitals in *Turritus* Westerlund, 1883. 1. Visceral oviduct (VO). 2. Proximal loop (PL). 3. Loops of the visceral oviduct (LP). 4. Seminal receptacle (SR). 5. Pedunculus of the bursa copulatrix (CBC). 6. Bursa copulatrix (BC). 7. Channel of the uterine gland (JUG). A. *Cochlostoma* (*T.*) *adamii* (Paulucci, 1879), Monte Stella, I (EZ-1075). B. *C. (T.) crosseanum* (Paulucci, 1879), Posta, Via Salaria, I (EZ-0002). Bottom right: variation of the position of the pedunculus of the bursa copulatrix.

out in 25  $\mu\text{L}$  reaction volumes: 2.5  $\mu\text{L}$  10  $\times$  Buffer II, 2  $\mu\text{L}$  25 mM  $\text{MgCl}_2$ , 2  $\mu\text{L}$  2 mM dNTP, 1  $\mu\text{L}$  of each primer, 0.125  $\mu\text{L}$  (1 unit) AmpliTaq Gold® DNA Polymerase (ThermoFisher), 15.4  $\mu\text{L}$  Milli-Q® water and 1  $\mu\text{L}$  DNA template. The following temperature profile was used: initial denaturation 5 min



**Fig. 6.** Some examples of female genitals in *Turrilus* Westerlund, 1883 with explanation of relevant features. **A.** *Cochlostoma (T.) agriotes* (Westerlund, 1879), Monte Cucco, I (EZ-0001). **B.** NFS128, Crno Jezero, MONT (TxEx-du0001). **C.** *C. (T.) reitteri* (Boettger, 1880), Kapella Pass, HR (WdM-6882). **D.** *C. (T.) simrothi* (Caziot, 1908), Saorge, FR (EZ-0782). **E.** *C. (T.) adamii*, Monte Stella, I (EZ-1065). **F.** *C. (T.) nanum*, Mount Risnjak, HR (WdM-5666). **1.** Position of the connection of the pedunculus to the bursa. **1A.** Posterior view. **1B.** Ventral view. **2.** Shape, length and position of the seminal receptacle. **2A.** Seminal receptacle long, club shaped, reaching the dorsal side of the body. **2B.** Seminal receptacle short, oval shaped, confined to the ventral side of the body. **3.** Position of the junction of the uterus gland in respect to the connection of the distal oviduct with the pedunculus of the bursa. **3A.** Far from. **3B.** Close to.



at 95°C, followed by 38 cycles of 30 s denaturation at 95°C, 30 s primer annealing, primer extension 50 s at 72°C, and final extension of 7 min at 72°C. Annealing Temperatures were 54°C for H3 and 48°C for 16S. Subsequently, PCR products were sent for bidirectional sequencing at BaseClear (Leiden, The Netherlands).

### Sequence alignment and phylogenetic analysis

Geneious Prime® 2021.1.1 assembler was used for assembling the sequencing products. Primer sequences were trimmed, and poor-quality regions removed based on the following criteria: high-quality reads (<1.5% ambiguous bases and <25% missing data); medium-quality reads (1.5–3% ambiguous bases and 25–40% missing data) and low-quality reads (>3% ambiguous bases and >40% missing data). The sequences were aligned using the default parameters of Clustal Omega. All alignments had gaps and these were treated as missing data in subsequent analyses. The ModelFinder function incorporated in IQ-Tree (Kalyaanamoorthy *et al.* 2017) was used to find the best-fit models of nucleotide sequence evolution according to BIC (Bayesian Information Criterion).

The phylogenetic relationships were inferred by Bayesian analysis (further in the text referred to as BA) with MrBayes ver. 3.2.7a (Ronquist *et al.* 2012) and the Maximum Likelihood method (ML) implemented using IQ-Tree ver. 1.6.1 (Nguyen *et al.* 2015) within the W-IQ-TREE webserver (Trifinopoulos *et al.* 2016). In the ML method, branch support analysis was done by employing 10 000 ultrafast bootstrap repeats (Hoang *et al.* 2017) and SH-aLRT test with 5000 replicates (Anisimova *et al.* 2011). In the Bayesian analysis, the following parameters were chosen: a four-chain MCMC (Metropolis-coupled Markov chain Monte Carlo) analysis run for  $0.5 \times 10^7$  generations with sampling the trees every 1000<sup>th</sup> generation. The first 25% were discarded as burn-in, and Tracer (ver. 1.7.1) was used to inspect the convergence of the Bayesian runs (Rambaut *et al.* 2018).

The shell and female genital morphology and the molecular markers can, in some cases, not be sufficient to assess if a sample (or a set of samples) is part of a described taxon or instead a new undescribed entity. In such a case, we use the acronym “NFS” (“needs further study”) followed by a progressive number. They are reported separately in the Appendix and should, for the time being, not yet be interpreted as ‘species’.

In the following text and figure labels ‘*Cochlostoma (Turritus)*’ will be abbreviated as ‘*C. (T.)*’.

### Abbreviations

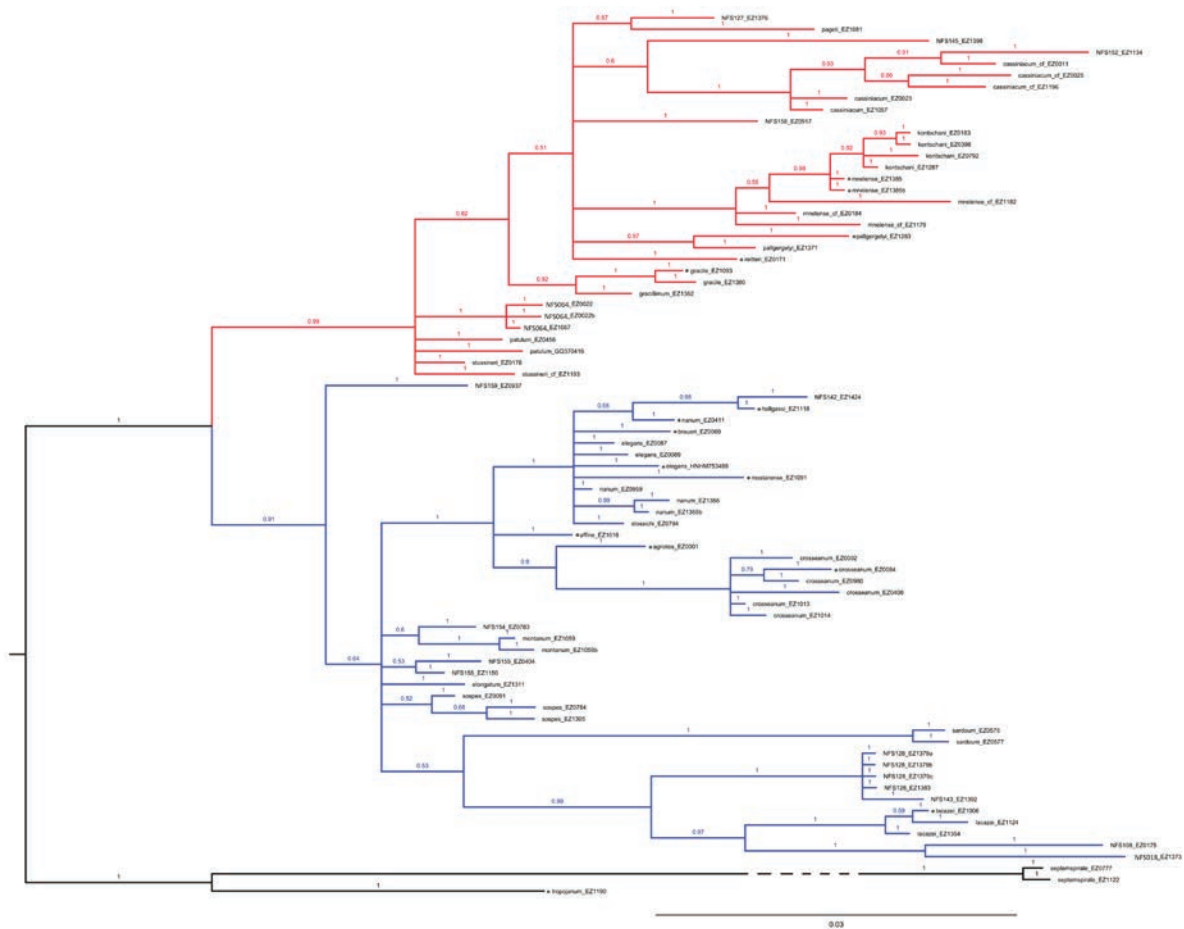
EZ	=	private collection of Enrico Zallot
HNHM	=	Hungarian Natural History Museum Budapest, Hungary
MIZPAS	=	Museum and Zoological Institute of the Polish Academy of Sciences, Warsaw, Poland
MZUF	=	Museo di Storia Naturale dell’Universita’ di Firenze, Italy
NHMW	=	Naturhistorisches Museum, Vienna, Austria
RMNH	=	Naturalis Biodiversity Center, Leiden, the Netherlands
SMF	=	Naturmuseum Senckenberg, Frankfurt am Main, Germany
WDM	=	private collection of Willy De Mattia

## Results

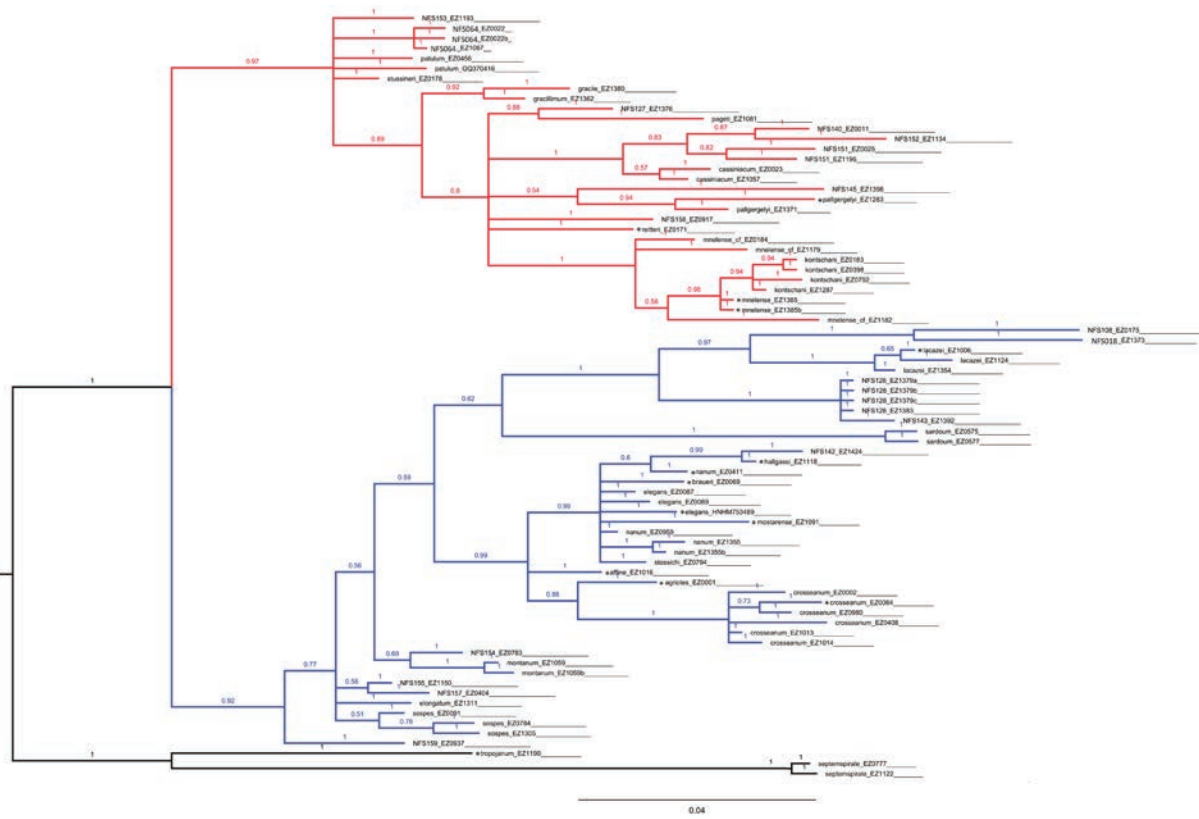
### *Molecular analysis*

Despite difficulties in PCR amplification because of the age of some specimens or the method of preservation, we obtained 55 H3 sequences and 25 16S sequences. The length of the amplified region was 356 bp for H3 and 559 bp for 16S. There were 21 parsimony informative sites for H3 while 16S showed more variability with 114 parsimony informative sites. Then we combined our data with previously

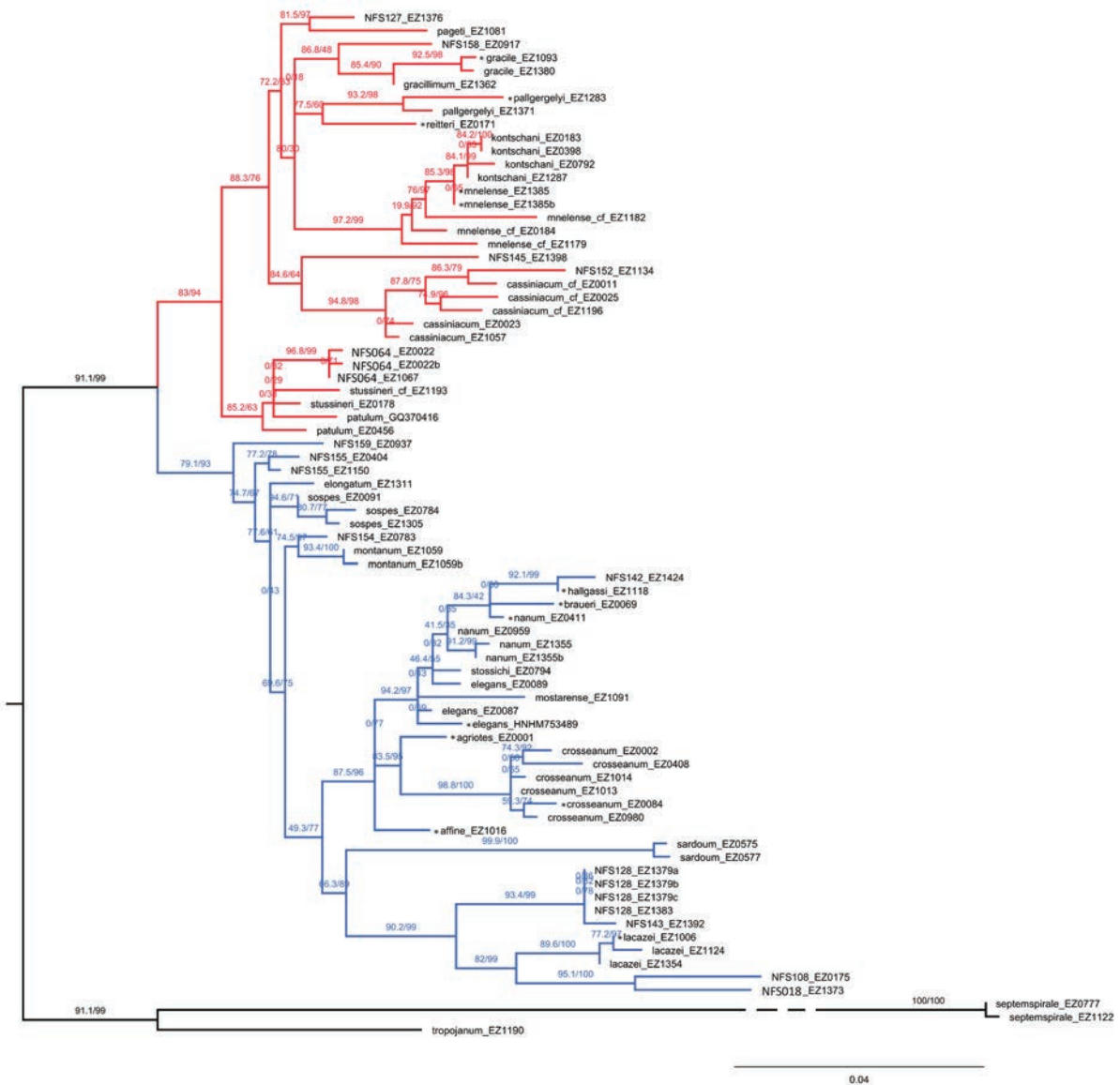
available H3 and 16S sequences of species of *Cochlostoma* (*Turritus*). The molecular phylogenetic tree based on these two markers used as of outgroup *C. (Cochlostoma) septemspirale* (Razoumowsky, 1789) and *C. (Lovcenia) tropojanum* Zallot *et al.*, 2018. The ML and BA trees based on 16S alone and on the concatenated 16S and H3, present the same topology (Figs 7–10). Two major clades can be identified: Clade A (PP=98%, BS=83/94 with 16S alone, PP=97 and BS=89/97 with the concatenated 16S and H3) and Clade B (PP=90%, BS=79/93 with 16S alone, PP=92 and BS=70/93 with concatenated 16S and H3). In the taxonomic part these clades are dealt with as unnamed species groups. The phylogenetic tree based on H3 (Fig. 11) was helpful to support the subgenus assignment of samples for which it was impossible to amplify the 16S, but the locus proved too conserved to infer phylogenetic relations within *Turritus*. The obtained phylogenetic trees are generally consistent with the morpho-anatomical data as well as with the paleogeographical and geographical considerations. For these reasons, we will tentatively assume them as species-trees, being aware that further studies and additional molecular data can change the resulting set-up. We calculate the 16S-based p-distances among samples (Supp. file 2). The average p-distance from the outgroup *C. (Cochlostoma) septemspirale* is 12.5% and 6.8% from *C. (Lovcenia) tropojanum*. The p-distances among conspecific samples vary from 0–0.2% if samples coming from the same locality to 2.2% for samples considered conspecific but from distant places. There is no strict correlation between the found p-distances and the degree of observed morpho-anatomical differences.



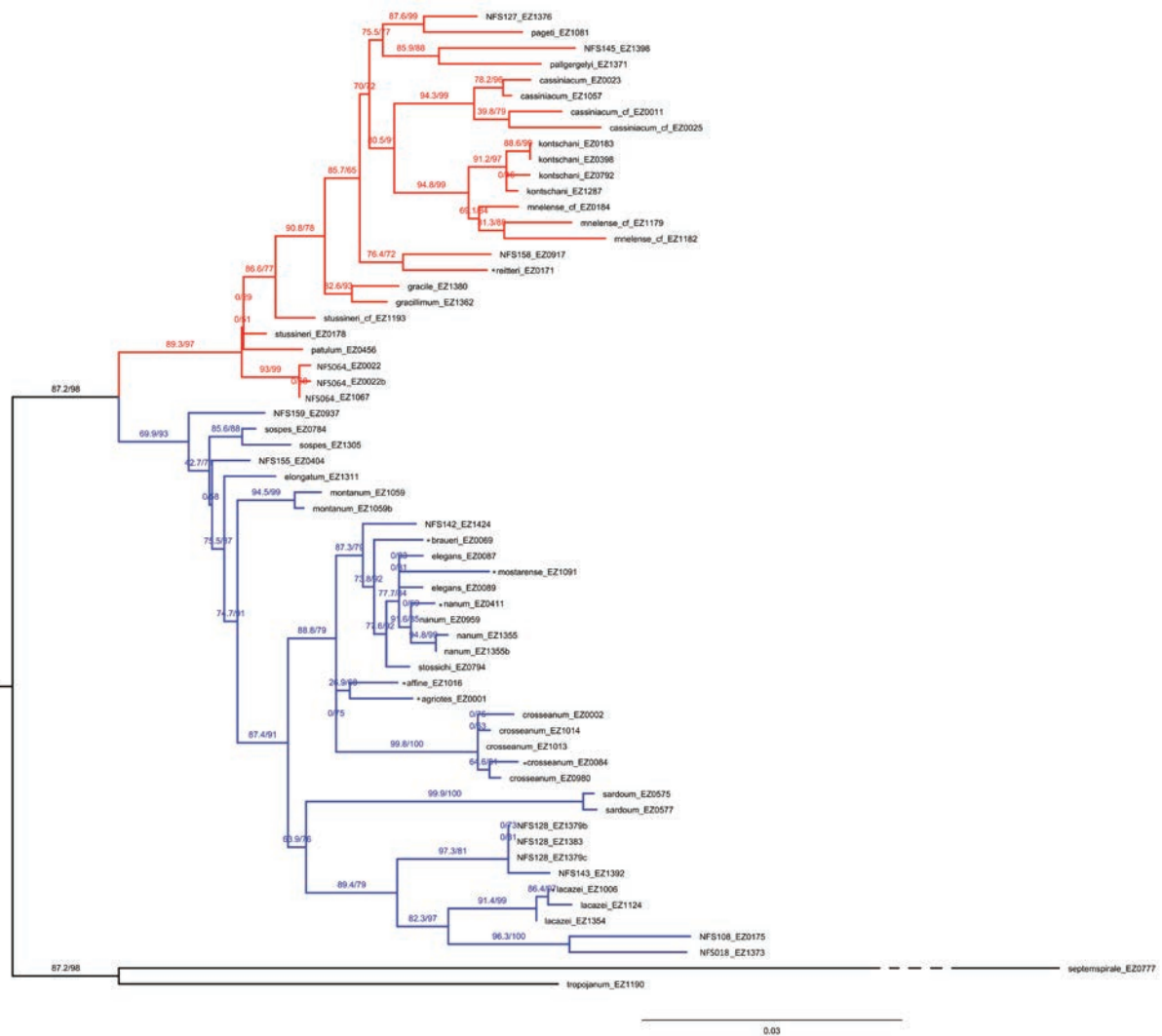
**Fig. 7.** Bayesian consensus tree based on 16S rRNA partial sequences, after the first 25% were discarded as burn-in. Posterior probability of the nodes is indicated. Asterisk before the taxon name for topotypical sample.



**Fig. 8.** Bayesian consensus tree based on H3 and 16S rRNA partial sequences, after the first 25% were discarded as burn-in. Posterior probability of the nodes is indicated. Asterisk before the taxon name for topotypical sample.



**Fig. 9.** Maximum Likelihood consensus tree based on 16S rRNA partial sequences in *Turritus* Westerlund, 1883 and the outgroup taxa. Bootstrap support of the nodes is indicated.



**Fig. 10.** Maximum Likelihood consensus tree based on H3 and 16S rRNA partial sequences in *Turritus* Westerlund, 1883 and the outgroup taxa. Bootstrap support of the nodes is indicated.

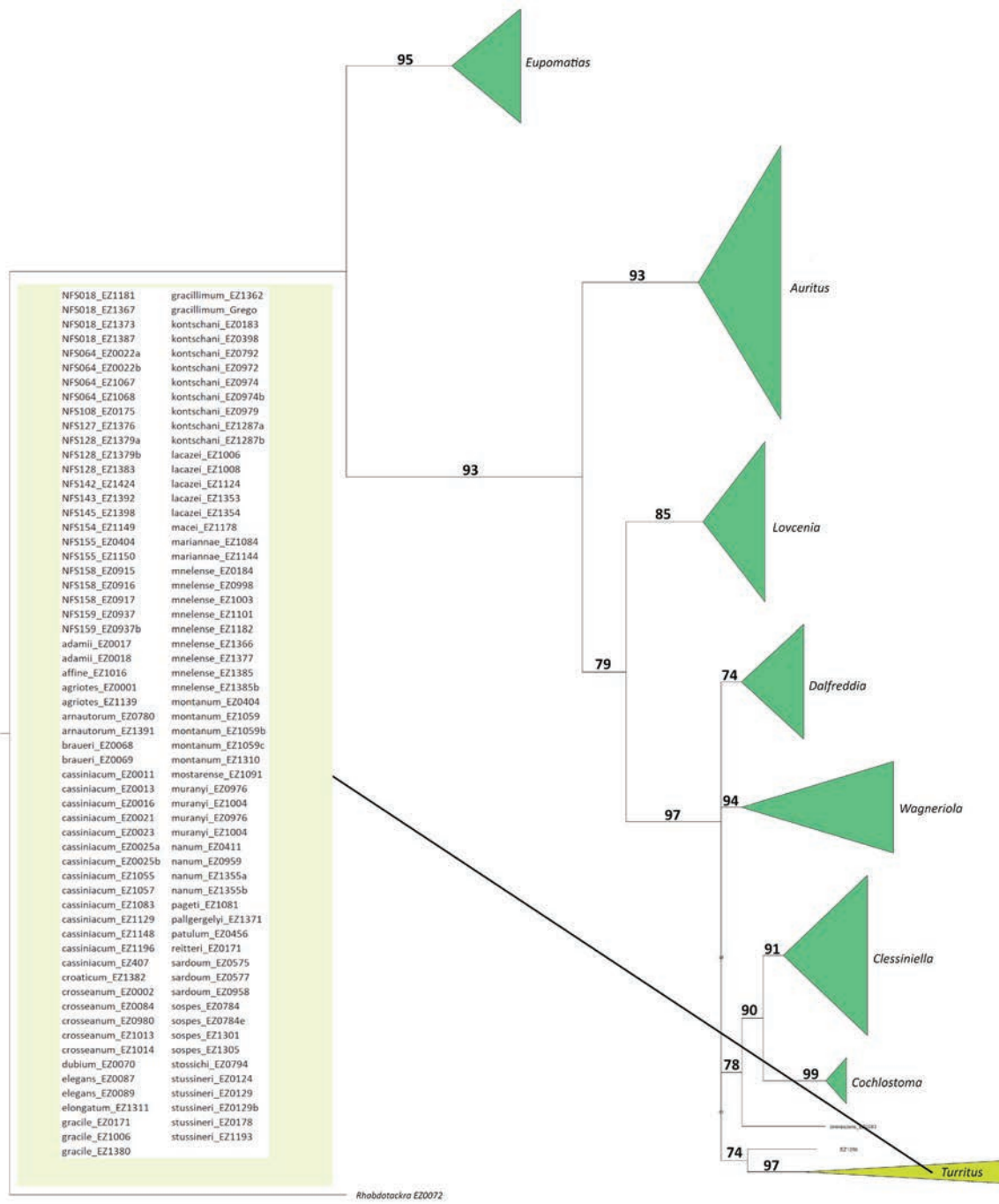


Fig. 11. Maximum Likelihood consensus tree based on H3. Bootstrap support of the nodes is indicated.

### Taxonomy

Subclass Caenogastropoda Cox, 1960  
Order Architaenioglossa Haller, 1892  
Superfamily Cyclophoroidea J.E. Gray, 1847  
Family Cochlostomatidae Kobelt, 1902  
Genus *Cochlostoma* Jan, 1830

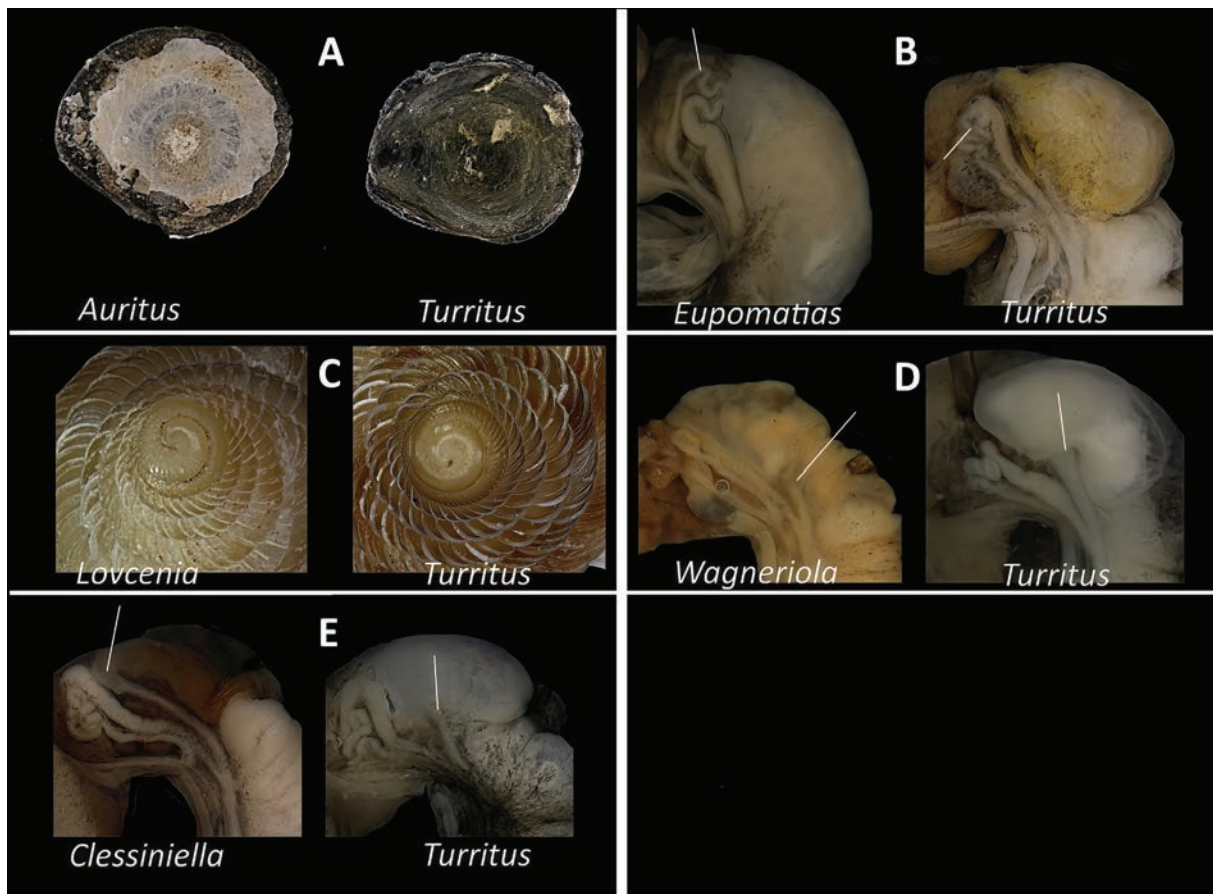
Subgenus *Turritus* Westerlund, 1883

### Type species

*Pomatias stossichi* Hirc, 1881 (subsequent designation Wenz, 1923: 1781).

### Diagnosis of the subgenus

The conical shell varies from 5.4 to 10.4 mm in height and has from 6.3 to 10 whorls, it is always ribbed, either spotless or with marked spots. The umbilicus is either hidden by an inwardly curved columellar lobe or visible. The protoconch is initially smooth and after 1.2–1.5 whorls finely ribbed. The columella is either solid or hollow. The operculum is thin, almost transparent and flexible. In the female genitals, the pedunculus of the bursa copulatrix and the seminal receptacle are superficial. The angle between the pedunculus of the bursa copulatrix and the distal oviduct is less than 45 degrees. In the male genitals, the penis is situated close to the right eye and has an internal spermiduct.



**Fig. 12.** Morpho-anatomical features which allow to distinguish *Turritus* Westerlund, 1883 from other subgenera of *Cochlostoma* Jan, 1830.

### Differential diagnosis

Morpho-anatomical features which allow to distinguish *Turritus* from the other *Cochlostoma* subgenera (see also Zallot *et al.* 2015: 78):

- from *Auritus*: the operculum is thin and transparent in *Turritus*, with more or less developed concretions in *Auritus* (Fig. 12A). The protoconch is dull and strong in *Turritus*; it is translucent and fragile in *Auritus*;
- from *Eupomatias* Wagner, 1897: in the female genitals of *Eupomatias*, the proximal oviduct always runs over the apex of the elongated seminal receptacle, never as such in *Turritus* (Fig. 12B);
- from *Lovcenia*: the protoconch is smooth in the first 1.5–2 whorls in *Turritus*, only the first 0.5 whorl in *Lovcenia* (Fig. 12C);
- from *Wagneriola* Zallot *et al.*, 2015: the seminal receptacle is moved dorsally and there is a ventral-anterior connection of the pedunculus to the bursa copulatrix in *Wagneriola*, never as such in *Turritus* (Fig. 12D);
- from *Cochlostoma* s.s. and *Clessiniella* Zallot *et al.*, 2015: in the female genitals, the pedunculus is connected apically to the bursa copulatrix in *Clessiniella* and *Cochlostoma* s.s., never apical in *Turritus* (Fig. 12E).

No known morpho-anatomical features allow to distinguish with certainty the subgenus *Dalfreddia* Zallot *et al.*, 2015 from *Turritus*; however, they resolved in well-separated clades in the molecular analysis (see Fig. 11).

### Distribution (Fig. 13)

The subgenus inhabits only rocky limestone soils. It is widespread along the Italian and Balkan peninsulas. It inhabits the most eastern and western parts of the Alps. West of the Alps, it is found in the southern coastal mountains of France and Spain. It inhabits the two main islands of the western Mediterranean, Sardinia and Sicily. One African species on the coast of Algeria probably also belongs to this subgenus. Clade A seems to be restricted to the Balkan and Italian Peninsulas and it is also present on the two main islands (Sicily and Sardinia) of the western Mediterranean Sea. It may be, however, that a species of this clade inhabits the south coast of France (see remarks in *C. (T.) macei* (Bourguignat, 1870)). Clade B is present both on the Balkan and Italian peninsulas. It is also found on the most western and eastern sides of the Alps and in the south coastal mountains of France and Spain. It is missing from the most parts of the Alps, which are inhabited on the calcareous south side by species of *Eupomatias*, *Clessiniella* and *Dalfreddia*; it is not living in the Puglia region in South of Italy either, which is inhabited by species of *Auritus* (except on the Gargano peninsula which does not host, despite the favourable environment, populations of *Cochlostoma*).

### Remarks

No morphological synapomorphies of *Turritus* are known, but its monophyly is supported in the molecular phylogenetic analyses (Zallot *et al.* 2015). Recognizing a species purely morphologically is often impossible without geographical information and molecular data. For this reason, classical dichotomous keys based on morpho-anatomical character states will not be presented.

### Clade A

#### Note to clade A

In an unresolved polytomy at the root of clade A there are morphologically and anatomically almost indistinguishable taxa, namely the Slovenian *C. (T.) stussineri* (Wagner, 1897), in the currently accepted taxonomy as a subspecies of *C. (T.) gracile* (Pfeiffer, 1849), *C. (T.) patulum* (Draparnaud, 1801) for the South of France and, in a small area of the Central Appennine, populations referred to in the Appendix as NFS064.





**Fig. 13.** Distribution of the samples by clade: yellow=clade A; red=clade B; white=unknown clade.

*Cochlostoma (Turritus) stussineri* (Wagner, 1897)

Figs 14 (cyan dots), 15C, 16–17

*Pomatias gracile* var. *stussineri* Wagner, 1897: 46, pl. 8 fig. 76a–b.

**Lectotype** (here designated)

SLOVENIA • ♀; 1- Nanos ober Präwald; NHMWE1262.

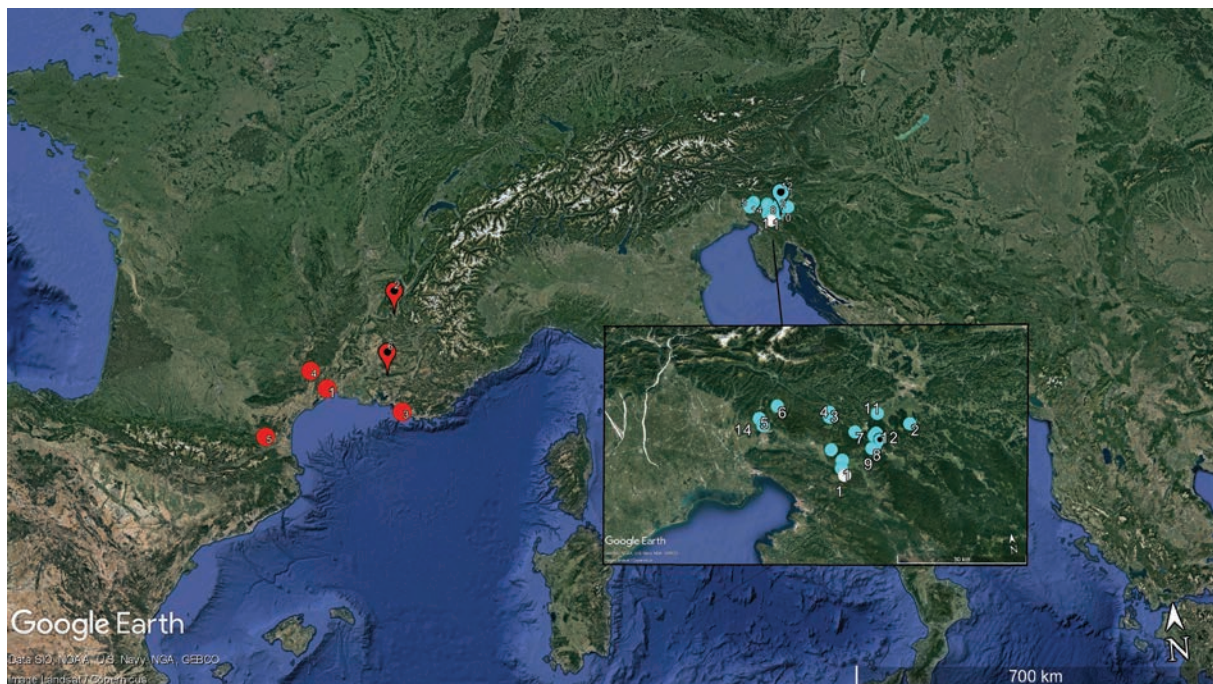
**Other specimens**

ITALY • 14- Mt Sabotino; 45.9849° N, 13.6282° E; 2009; De Mattia leg.; WdM6954.

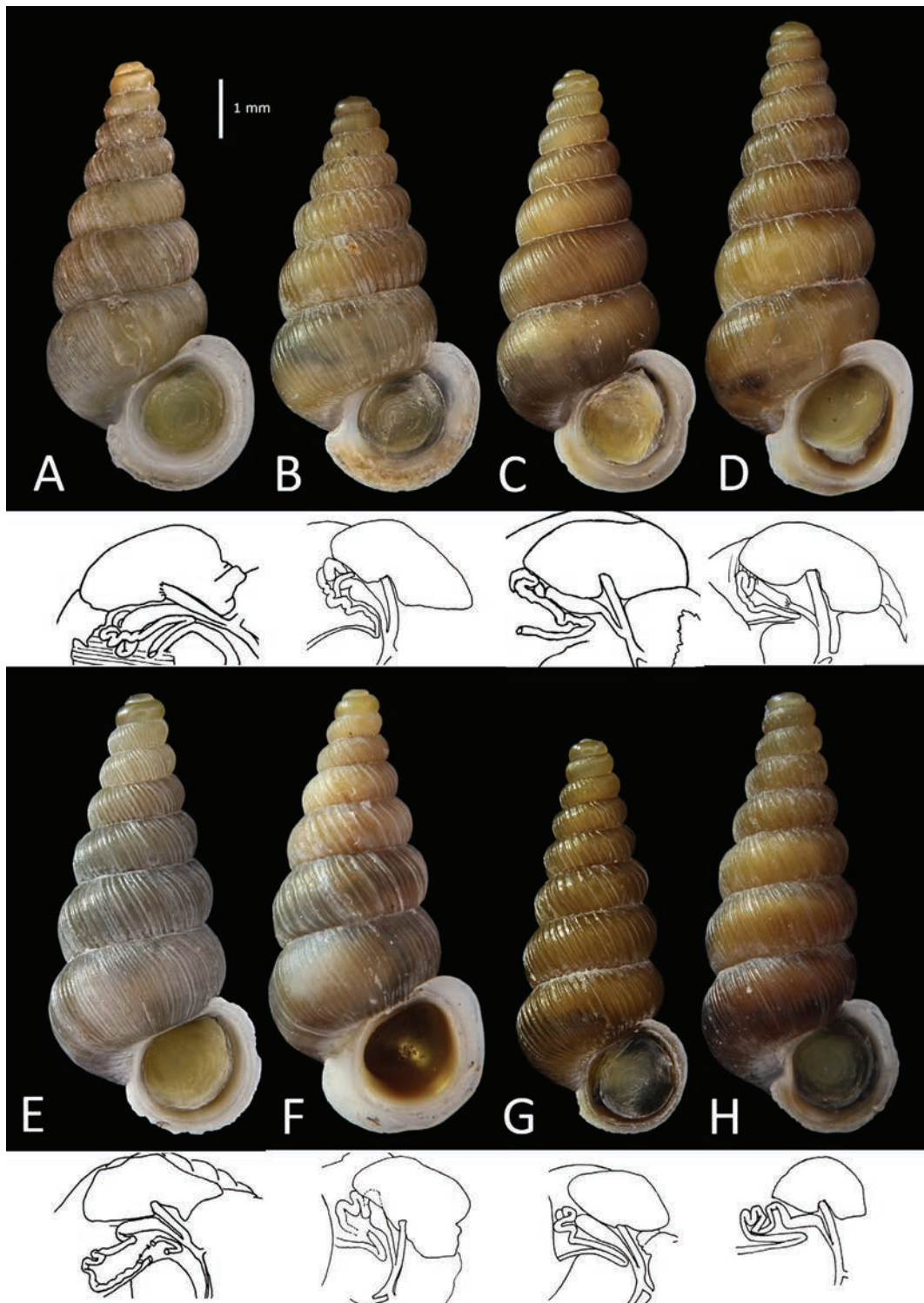
SLOVENIA • 1- Mt Nanos, top, loc. Plesa (topotypical); 45.7981° N, 14.067° E; 2005; De Mattia leg.; WdM6727 • 1- Mt Nanos, 3.7 km NNW of Abram (topotypical); 45.8476° N, 14.0103° E; 2009; De Mattia leg.; WdM-6730 • 4- Divje Jezero; 45.9827° N, 14.0277° E; 2009; De Mattia leg.; WdM6840 • 5- Solkan to Plava; 46.0157° N, 13.6112° E; 2009; De Mattia leg.; WdM6695 • 6- Podlešče-Bainsizza; 46.0574° N, 13.7271° E; 2009; De Mattia leg.; WdM6813 • 7- 2.4 NW of Kalce; 45.9074° N, 14.1647° E; 2009; De Mattia leg.; WdM6725 • 8- Planina; 45.8297° N, 14.2506° E; 2000; Zallot leg.; EZ0125 • 9- 3 km S of Planina; 45.8300° N, 14.2606° E; 2000; Zallot leg.; EZ0126 • 10- near Logatec; 45.8808° N, 14.2745° E; 2009; Zallot leg.; EZ0127 • 11- Vrhnika; 45.9706° N, 14.3119° E; 2000; Zallot leg.; EZ0128 • 12- Rakow Skocjan; 45.7947° N, 14.2895° E; 2009; Zallot leg.; WdM6918 • 13- Laška kukava; 45.8907° N, 14.2889° E; 2008; De Mattia leg.; WdM6924.

**Type locality**

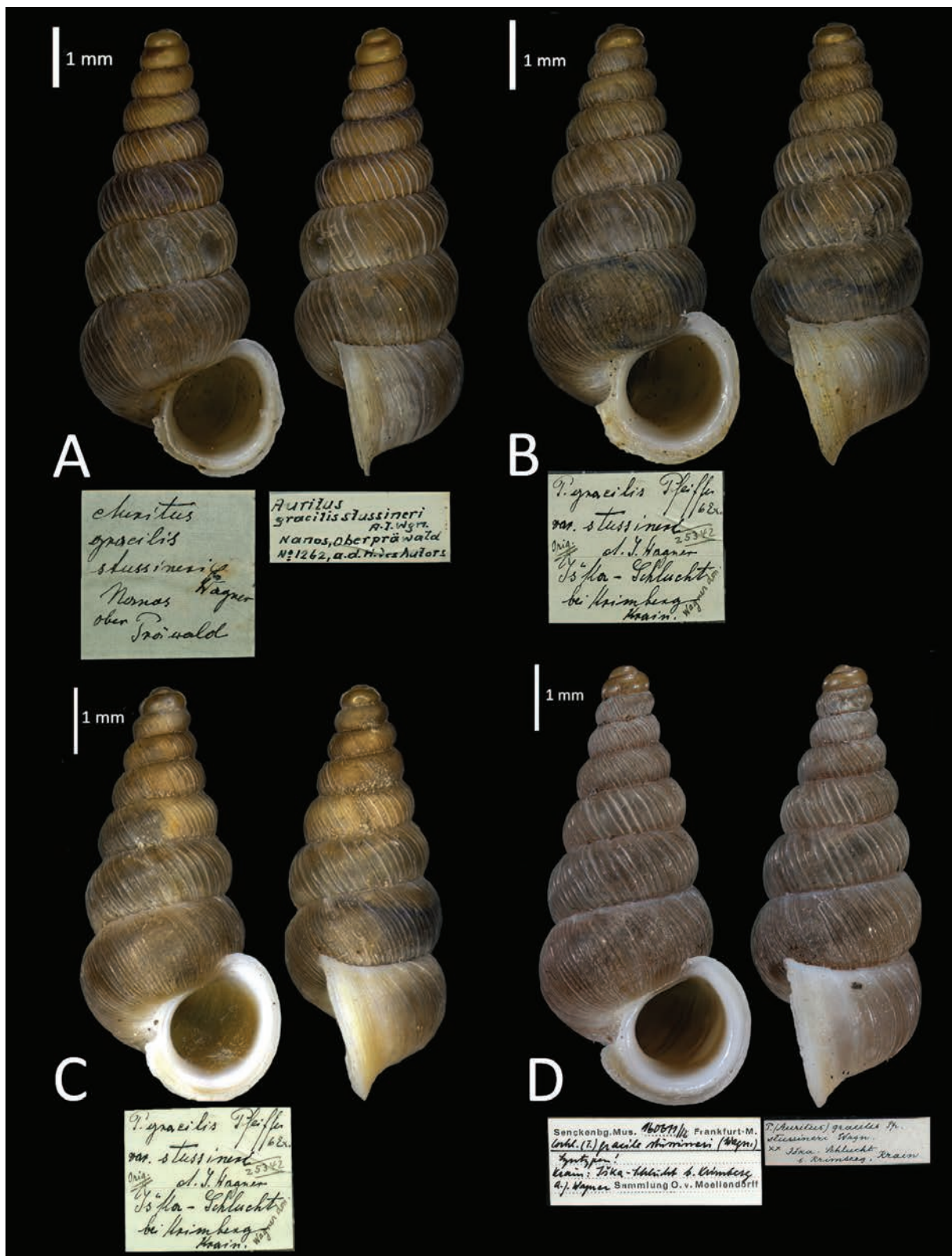
SLOVENIA • Mount Nanos, Inner Carniola.



**Fig. 14.** Distribution of samples part of clade A: cyan dots = *Cochlostoma (T.) stussineri* (Wagner, 1897); red dots = *C. (T.) patulum* (Draparnaud, 1801); white dot = *C. (T.) zawinkanum* (Wagner, 1906). Black center for the samples with amplified 16S.



**Fig. 15.** Shell and female genitals of clade A samples with amplified 16S which share the same female genital set-up. **A.** NFS158, Tisovec, SLO (WdM-6748). **B.** *Cochlostoma* (*T.*) *reitteri* (Boettger, 1880), Kapela Pass, HR (WdM-6882). **C.** *C. (T.) stussineri* (Wagner, 1897), Rakow Skocjan, SLO (WdM-6918). **D.** NFS064, Terminillo V. Dell’Inferno, I (EZ-1067). **E.** *C. (T.) patulum* (Draparnaud, 1801), Cirque D’Archiane, FR (RMNH-117454). **F.** NFS153, 3 km SE of Oltari, HR (HNHM-100381). **G.** *C. (T.) gracile gracile* (Pfeiffer, 1849), Omiš 1, HR (WdM-6667). **H.** *C. (T.) gracile gracillimum* (Wagner, 1901), Vrbac Valley, BeH (Gr001).



**Fig. 16.** Types of *Cochlostoma* (*T.*) *stussineri* (Wagner, 1897). **A.** Lectotype (here designated), 1- Nanos-Razdrto, SLO (NHMW-E1262). **B–D.** Paralectotypes. **B.** 4- Iska Gorge, SLO (NHMW-25342/1). **C.** 4- Iska Gorge, SLO (NHMW-25342/2). **D.** 4- Iska Gorge, SLO (SMF-1606).

## Description

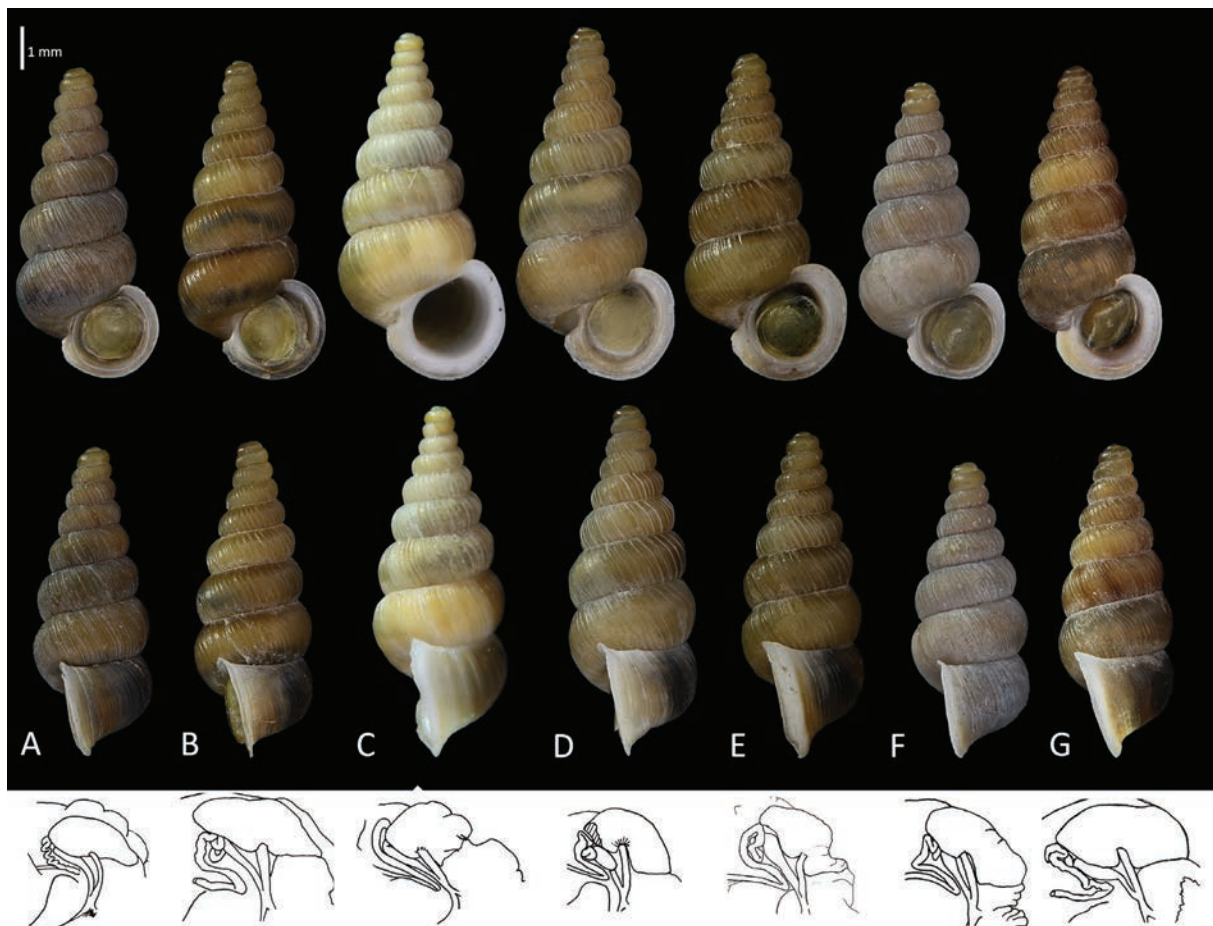
SHELL. Spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with ribs not very prominent. Moderately strong lip, with columellar lobe inwardly curved to cover the umbilicus.

MEASUREMENTS. 24 ♀♀: whorls = 7.1–8.3, H = 6.4–9 mm, H/W = 2.43–2.79, roundness = 0.11–0.16, ribs incl. = 57–67°, apert. incl. = 9–24°, ribs/mm 1<sup>st</sup> wh. = 6–20, ribs/mm 4<sup>th</sup> wh. = 6–16.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus of bursa copulatrix, short, oval-shaped seminal receptacle confined to ventral side of body, two to three loops close to apex of seminal receptacle and close connection of junction of uterus gland to connection between pedunculus of bursa copulatrix and distal oviduct.

## Remarks

Wagner (1897: 46 [610]) firstly mentioned as locality “Nanos”. He also referred to specimens from “Krain. Idrizathal” as unconditionally belonging to this species. By the designation of NHMW E1262 as lectotype, Mount Nanos becomes the type locality. The specimens MIZPASW6869 (5 ♀♀), 4- Krain, Iška Schlucht b. Krimberg, SMF160611 (1 ♀), 4- Krain, Iška Schlucht b. Krimberg and SMF160613 (1 ♂) were also mentioned, but considered transitional to “*croatica*”, and cannot be considered syntypes.



**Fig. 17.** Samples assigned to *Cochlostoma* (*T.*) *stussineri* (Wagner, 1897)? **A.** 2- Nanos, Plesa, SLO (WdM-6727). **B.** 16- Mt Sabotino, I (WdM-6954). **C.** 8- Podlešče-Bainsizza, SLO (WdM-6813). **D.** 3- 3.7 km NNW of Abram, SLO (WdM-6730). **E.** 9- 4 km NW of Kalce 2, SLO (WdM-6725). **F.** 6- Divje Jezero, SLO (WdM-6840). **G.** 14- Rakow Skocjan, SLO (WdM-6918).

De Mattia *et al.* (2011) reported *C. (T.) gracile* from Mount Sabotino, Italy. In the light of the results of our analysis, this has to be corrected to *C. (T.) stussineri*.

The great variability of the number of ribs per mm and the variable strength and shape of the lip may indicate that not all populations assigned to this species are conspecific.

***Cochlostoma (T.) zawinkanum* (Wagner, 1906)**

Figs 14 (white dot), 18

*Auritus sturanyii zawinkanus* Wagner, 1906: 92–101, 121–140, pls 3–4.

**Syntypes**

SLOVENIA • 1 ♀, 1 ♂; “Höhle Zawinka bei Laze, Krain (vom Author), *Cochlostoma sturanyi zawinkanum* AJW”; coll. W. Klemm; NHMWK51883 • 1 ♀, 1 ♂; “Eingang zur Höhle Zawinka bei Laze, Inner Krain, *Auritus sturanyii zawinkanus* Wagner”; MIZPASW7019.

**Type locality**

SLOVENIA • 1- Zawinka cave, Laze; 45.7351° N, 14.0682° E.

**Description**

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with rounded and moderately strong ribs, slightly weaker approaching aperture. Relatively strong and developed lip. Columellar lobe inwardly curved quite abruptly to cover umbilicus.

MEASUREMENTS. 2 ♀♀: whorls=7.2–7.5, H=6.5–6.8 mm, H/W=2.49–2.58, roundness=0.13–0.14, ribs incl.=63–63°, apert. incl.=17–17°, ribs/mm 1<sup>st</sup> wh.=12–15, ribs/mm 4<sup>th</sup> wh.=12–25.

FEMALE GENITAL ORGANS. Not known.

**Remarks**

The shell morphology of the syntypes is very similar to that of *C. (T.) stussineri* and the type localities of the two taxa are only 5 km apart. A strong resemblance is also seen with the samples from Trnovski Gozd (in Appendix as NFS153), as apparently also noticed by Wagner, who had in his collection a sample from this area (“Tarnowaner Wald”) classified as “*sturanyi zawinkanum*”.

For these reasons, the status of this taxon remains uncertain. We tentatively consider it as belonging to this clade, despite the lack of molecular and female genital data because of the strong similarity of the shell with that of *C. (T.) stussineri*.

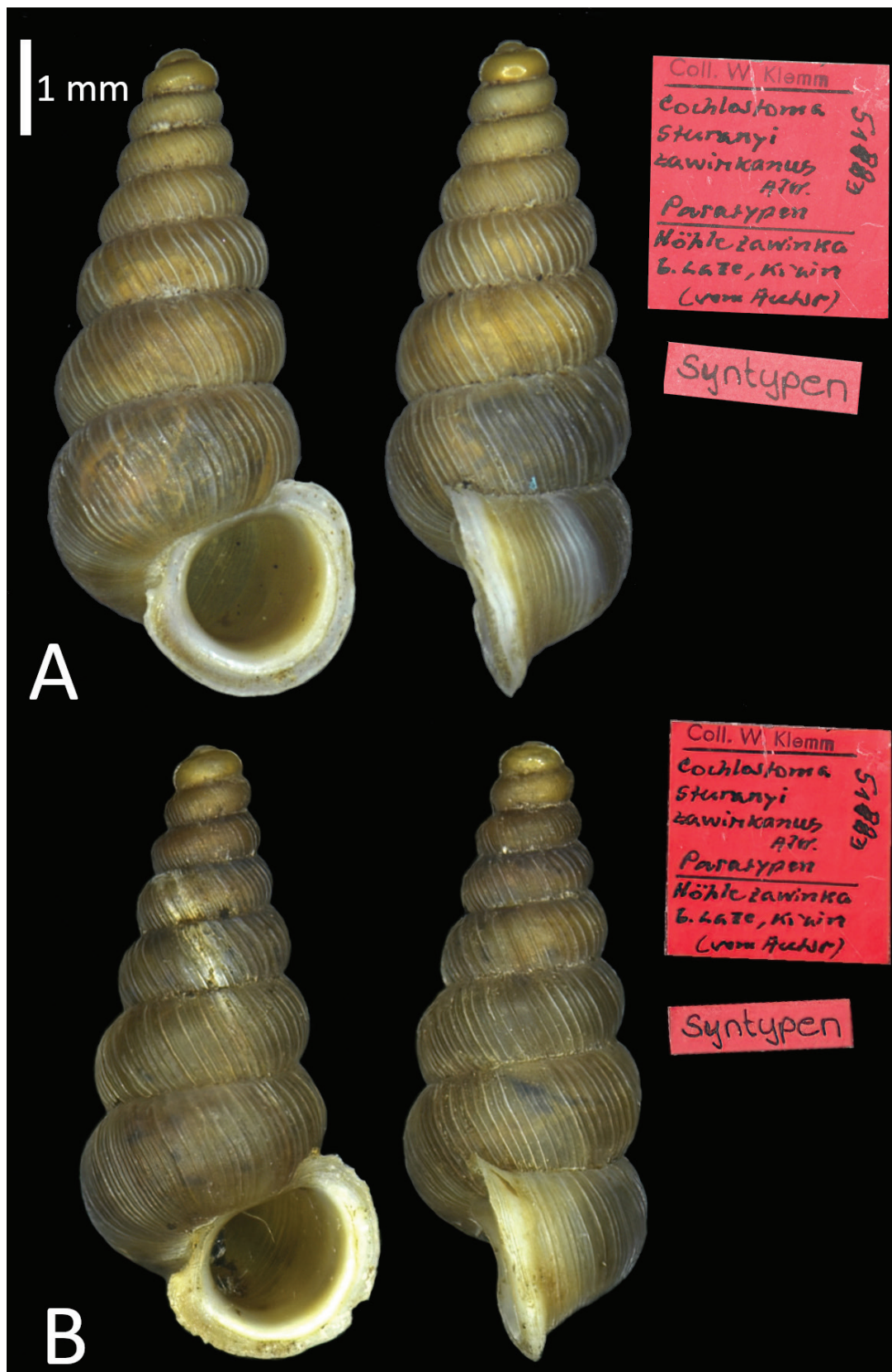
***Cochlostoma (Turritus) patulum* (Draparnaud, 1801)**

Figs 14 (red dots), 15E, 19–20

*Cyclostoma patulum* Draparnaud, 1801: 39.

**Lectotype** (here designated)

FRANCE • probably ♀; Hérault, Montpellier; “*Cyclostoma patulum* Coll. Draparnaud 1820 XXVI /13” and “*Cochlostoma patulum* (Drap.) Typus von Draparnaud!”; NHMW14710/1.



**Fig. 18.** Syntypes of *Cochlostoma* (*T.*) *zawinkanum* (Wagner, 1906). **A.** ♀ (NHMW-K51883/1). **B.** ♂ (NHMW-K51883/2).

### Other specimens

FRANCE • 2- Cirque d'Archiane; 44.7590° N, 5.4186° E; 1975; RMNH leg.; RMNH117454 • 3- Cassis; 43.2157° N, 5.5389° E; 2009; Pocaterra leg.; EZ0457 • 4- Cirque de Navacelles; 43.8945° N, 3.5115° E; 1978; de Winter leg.; A. de Winter-0882 • 5- Gorges de Galamus; 42.8402° N, 2.4794° E; 1987; de Winter leg.; A. de Winter5601.

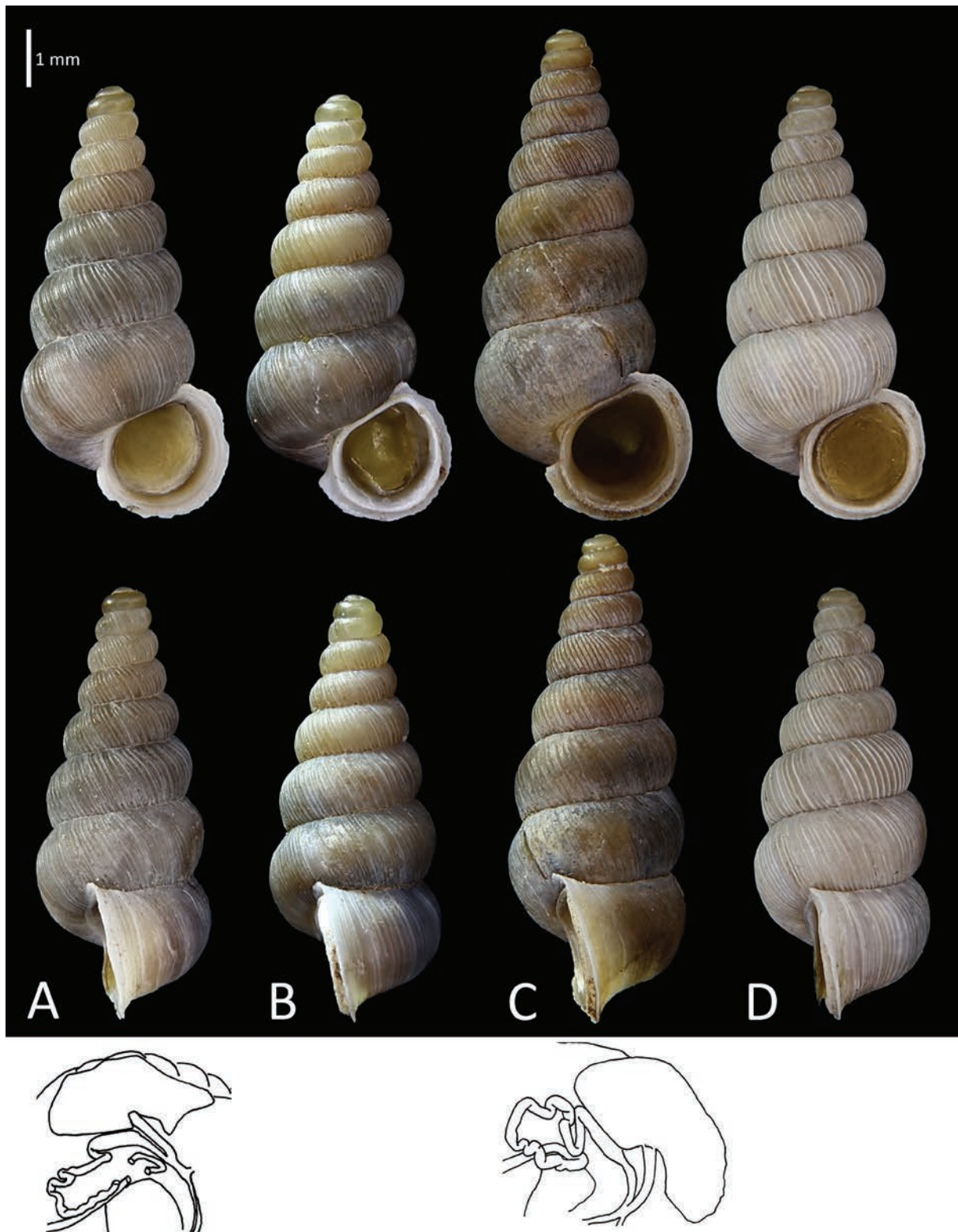
### Type locality

FRANCE • Hérault, Montpellier (“H.a.F.M.” in the original description=France meridionale. Wagner (1897) wrote: “Ich beurtheile diese Art nach Original-exemplaren Draparnaud's von Montpellier in Südfrankreich, welche sich im k. k. naturhistorischen Hofmuseum in Wien befinden”).



**Fig. 19.** Lectotype (here designated) of *Cochlostoma (T.) patulum* (Draparnaud, 1801), 1- Montpellier, FR ((NHMW-14710).





**Fig. 20.** *Cochlostoma (T.) patulum* (Draparnaud, 1801). **A–B.** 2- Cirque d'Archiane, FR (RMNH-117454). **C.** 3- Cassis, FR (EZ-0457). **D.** 6- Cirque de Navacelles, FR (AJW-0882).

## Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with strong ribs, slightly weaker and irregularly spaced approaching aperture. Strong and developed lip with columellar lobe abruptly inwardly curved to cover umbilicus.

MEASUREMENTS. 4 ♀♀: whorls=7.2–8.1, H=7.4–8.5 mm, H/W=2.41–2.7, roundness=0.12–0.13, ribs incl.=61–64°, apert. incl.=12–15°, ribs/mm 1<sup>st</sup> wh.=10–15, ribs/mm 4<sup>th</sup> wh.=11–13.

FEMALE GENITAL ORGANS. As in *C. (T.) stussineri*.

## Remarks

*Cochlostoma (T.) patulum* from Cirque D’Archiane and from Luberon (GENBANK, GQ370416) do not cluster in the 16S analysis as do conspecific samples belonging to other species. The p-distance between them is 1.5%, higher than the one (1.2–1.3%) found between *patulum* and *stussineri*. For this reason, it seems appropriate to better define the type locality, here restricted to Montpellier (France). Maybe ‘ancient’ DNA could be amplified from the lectotype, or a specimen of the same sample, to stabilize the taxonomy of the French *Turritus*.

***Cochlostoma (T.) gracile* (Pfeiffer, 1849)**  
Figs 15G, 21 (red dots), 22

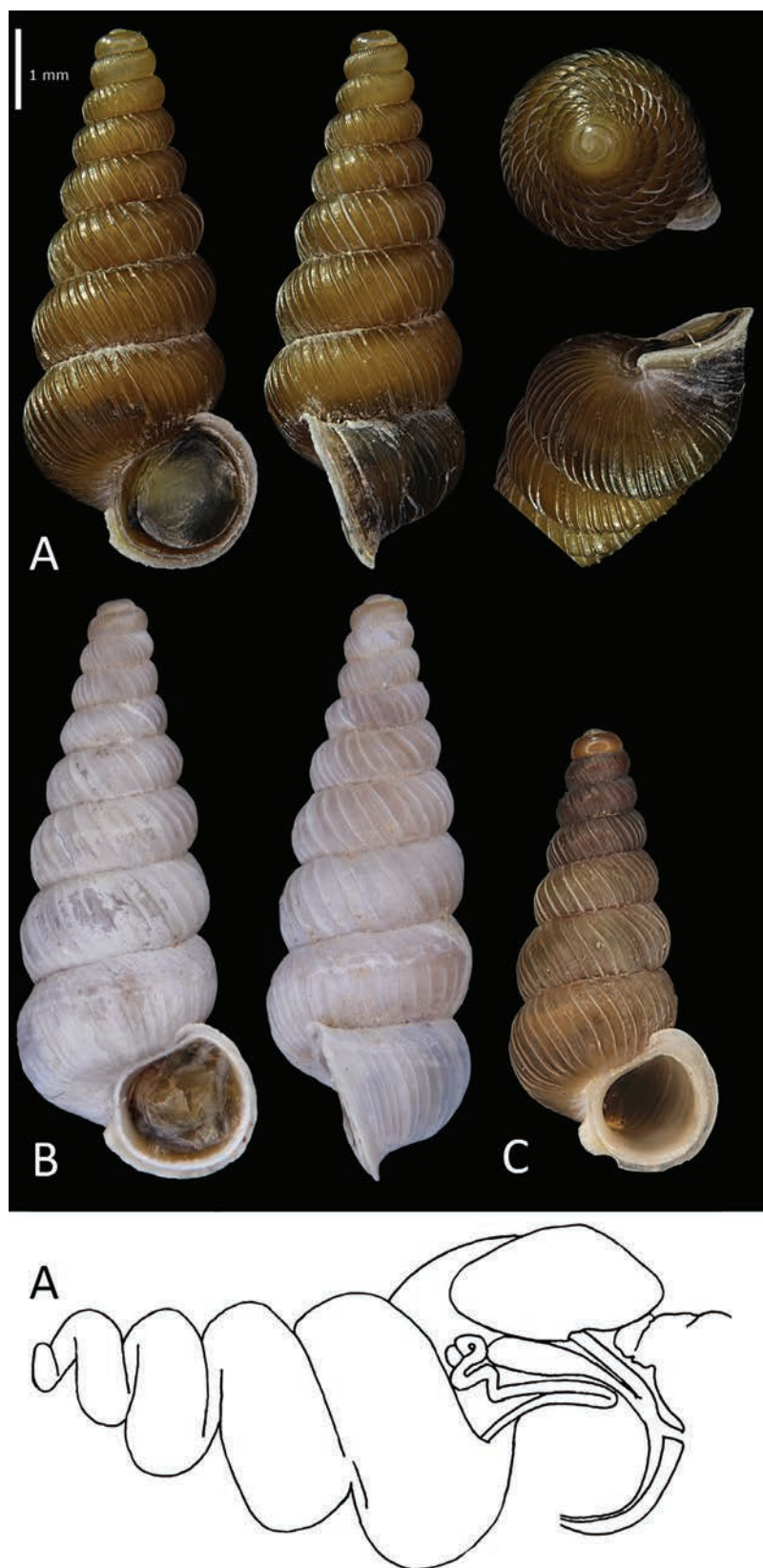
*Cyclostoma gracile* Pfeiffer, 1846–1850 (1846?): 191, pl. 26 figs 28–30.

## Types

Not seen.



**Fig. 21.** Distribution of the samples of *Cochlostoma (T.) gracile* (Pfeiffer, 1849): red dots = *C. (T.) gracile gracile*; green dots = *C. (T.) gracile gracillimum* (Wagner, 1901); cyan dots = *C. (T.) gracile croaticum* (Pfeiffer, 1870). A black center indicates samples with amplified 16S.



**Fig. 22.** Topotypical *Cochlostoma* (*T.*) *gracile gracile* (Pfeiffer, 1849), 1- Omiš nearby, HR (WdM-6667). A–B. ♀. C. ♂.

### Other specimens

CROATIA • 1- Omiš 2 (topotypical); 43.4425° N, 16.7317° E; 2011; De Mattia leg.; EZ1093 • 1- Omiš 1 (topotypical); 43.4428° N, 16.7319° E; 1998; De Mattia leg.; WdM6667 • 1- Omiš 3 (topotypical); 43.4428° N, 16.7319° E; 1985; Pintér leg.; HNHM43203.

### Type locality

CROATIA • Split-Dalmatia, Omiš; 43.4425° N, 16.7317° E.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with strong and well-spaced ribs. Lip is rather weak. Columellar lobe bent inwardly to cover umbilicus.

MEASUREMENTS. 2 ♀♀: whorls=8.1–8.6, H=6.7–7.2 mm, H/W=2.66–2.89, roundness=0.16–0.17, ribs incl.=57–57°, apert. incl.=21–23°, ribs/mm 1<sup>st</sup> wh.=5–8, ribs/mm 4<sup>th</sup> wh.=5–7.

FEMALE GENITAL ORGANS. As in *C. (T.) stussineri*.

### Remarks

This species is considered widespread with several subspecies all along the Balkan Peninsula, reaching south Greece with *C. (T.) gracile subaiorum* Schütt, 1977. Our findings, however, seem to indicate that it has in fact a limited range. Its p-distances from taxa currently considered as subspecies like *stussineri* and *reitteri* are 2.9 and 3.6%, respectively.

### *Cochlostoma (T.) gracile gracillimum* (Wagner, 1901)

Figs 15H, 21 (green dots), 23

*Pomatias gracilis* var. *gracillima* Wagner, 1901: 64.

### Syntypes

BOSNIA AND HERZEGOVINA • 1 ♀, 1 ♂; “Bočac zwisch. Jajce und Banjaluka”; 1 Aug. 1899; “*Auritus gracile gracillimus*, Wagner det.”; Sturany leg.; NHMW3230 • 4 ♀♀; “Bočac zw. Jajce und Banjaluka”; as *Pomatias gracilis* var. *gracillima*; MIZPASW6866.

### Other specimens

BOSNIA AND HERZEGOVINA • 2- Vrbac valley; 44.6833° N, 17.1783° E; 2013; J. Grego leg.; coll. Grego (Horna Micina Slovakia).

### Type locality

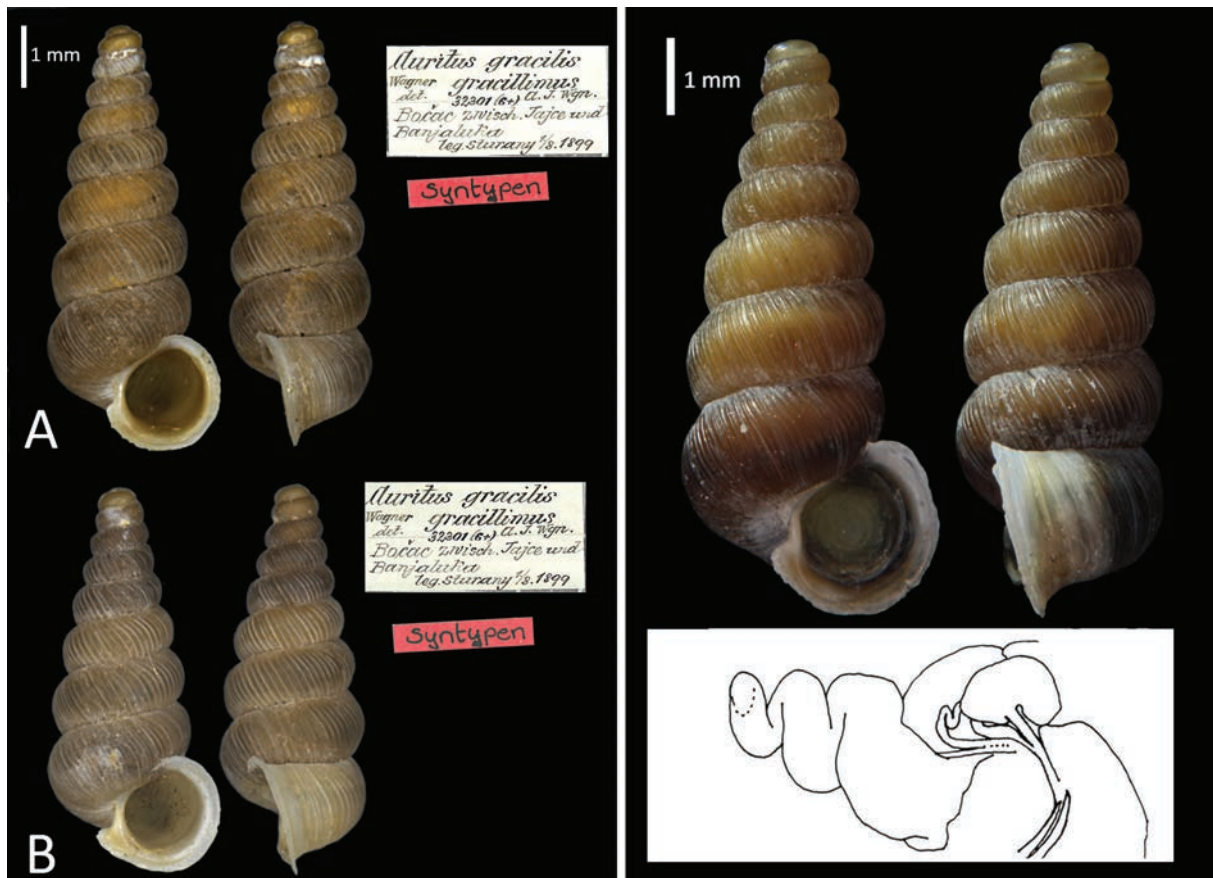
BOSNIA AND HERZEGOVINA • 1- Republika Srpska, Bočac.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with strong to moderately strong and rounded ribs. Rather weak lip with columellar lobe quite abruptly bent inwardly to cover umbilicus.

MEASUREMENTS. 2 ♀♀: whorls=7.8–8.6, H=6.8–7.5 mm, H/W=2.81–2.94, roundness=0.2–0.21, ribs incl.=58–61°, apert. incl.=17–20°, ribs/mm 1<sup>st</sup> wh.=10–10, ribs/mm 4<sup>th</sup> wh.=10–10.

FEMALE GENITAL ORGANS. As in *C. (T.) stussineri*.



**Fig. 23.** Types of *Cochlostoma* (*T.*) *gracile gracillimum* (Wagner, 1901) **A.** ♀ (NHMW32301/1). **B.** ♂ (NHMW32301/2). On the right a specimen from 2-Vrbac Valley, BeH.

### Remarks

We provisionally keep it as a subspecies of “*gracile*” because of insufficient data to revise its status in more detail. The name “*gracillimum*” is a declination in Latin of the superlative of “*gracilis*” and can be translated as ‘really slender’ but the analysed specimens do have a H/W ratio similar to that of the nominotype. In Wagner’s collection, there are specimens from the type locality and from Livno, another locality in Bosnia, situated more than 100 km south (MIZPAS-W6867), which might belong to the same taxon. The p-distance of this taxon with the nominotypical sample of the species is 1.4%.

### *Cochlostoma* (*T.*) *gracile croaticum* (Pfeiffer, 1870)

Figs 21 (cyan dots), 24–25

*Pomatias croaticus* Pfeiffer, 1870: 38-15–16.

### Types

Not seen.

### Other specimens

CROATIA • 1- Plitvice (topotypical); 44.8640° N, 15.5820° E; 2002; Murányi leg.; HNHM100120 • 2- Korenica Lake; 44.8931° N, 15.6083° E; 2000; De Mattia leg.; WdM2175 • 3- Gornja Ploča, Mount

Zir; 44.4305° N, 15.6166° E; 2017; Fehér leg.; HNHM100626 • 4- Velebit Mts, Prezid Pass; 44.2477° N, 15.8097° E; 2005; Murányi leg.; HNHM99895.

### Type locality

Pfeiffer (1870: 15–16) listed several localities: “Habitat in Croatia: Trovera (Zelebor), Slunj, Brinj, Plitvice, Perusic, Klek (Brusina)”. Here, we select as locus typicus restrictus Plitvice.

### Description

**SHELL.** Widely spaced riblets on last part of protoconch. Teleoconch spotless, with moderately strong and rounded ribs becoming weaker approaching aperture. Moderately strong lip with columellar lobe abruptly inwardly curved to cover umbilicus.

**MEASUREMENTS.** 6 ♀♀: whorls=7.3–8.1, H=7.0–7.8 mm, H/W=2.59–2.76, roundness=0.14–0.19, ribs incl.=59°–61°, apert. incl.=14°–18°, ribs/mm 1<sup>st</sup> wh.=7–13, ribs/mm 4<sup>th</sup> wh.=8–16.

**FEMALE GENITAL ORGANS.** As in *C. (T.) stussineri*.

### Remarks

We did not amplify DNA of this taxon and therefore we provisionally report it as a subspecies of *C. (T.) gracile*. Of note is the different shell morphology of the male compared with the females, with much closer ribs (in this respect it is different from the male of *C. (T.) gracile gracile* from the type locality, which has ribs in the male as widely spaced as in the female), the darker color of the upper whorls and the sturdier shape, a sexual differentiation common in *Cochlostoma*.

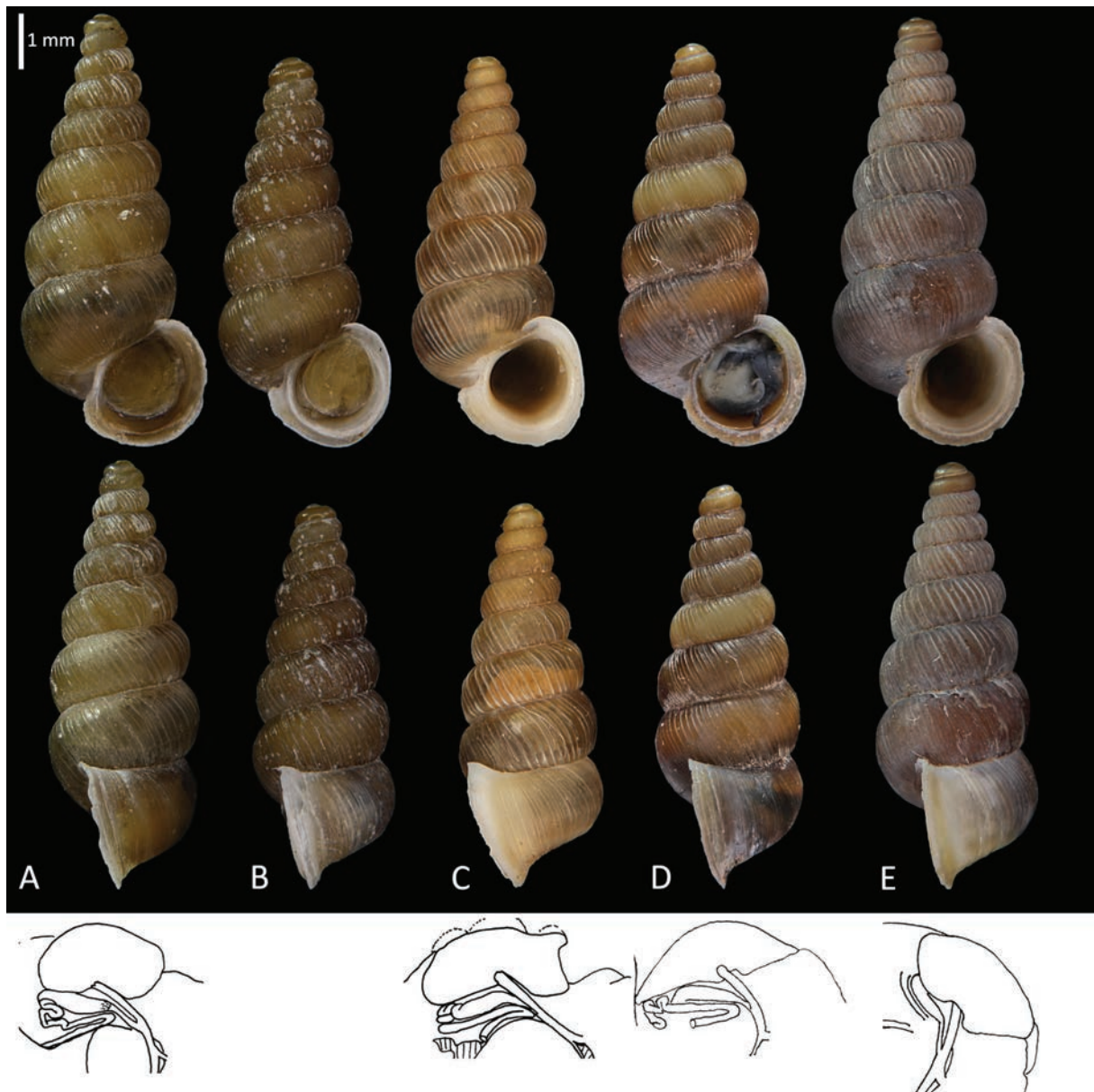
### Additional note to clade A

Within clade A there are then two supported branches, one with samples from the Central-Southern Appennine, which could be referred to *C. (T.) cassiniacum* (Saint-Simon in Paulucci, 1878) and *C. (T.)*



**Fig. 24.** Topotypical *Cochlostoma (T.) gracile croaticum* (Pfeiffer, 1870), 1- Plitvice, HR (HNHM-100120). **A.** ♀. **B.** ♂

*adamii* (Paulucci, 1879), and another with samples from Albania with *C. (T.) mnelense* (Wagner, 1914) and a new species in the following described as *C. (T.) kotschani* sp. nov. Beside these, there are polytomies in the BA or unsupported branches in the ML approach which include taxa from the Balkans: two are described entities from Croatia (*C. (T.) reitteri* (Boettger, 1880), currently reported as a subspecies of *C. (T.) gracile*) and Greece (*C. (T.) pageti* Klemm, 1962); furthermore, there is a new species here described (*C. (T.) pallgergelyi* sp. nov.) and two samples, one related to *C. (T.) pageti* and the other to the new species for which further studies are needed to understand their taxonomical status and here in the Appendix as NFS127 and NFS145. Finally, another sample from the Tarnova Forest in Slovenia, here in the Appendix as NFS158, raises issues which do not allow to properly classify it.



**Fig. 25.** *Cochlostoma (T.) gracile croaticum* (Pfeiffer, 1870). **A–C.** 2- Korenica Lake, HR (WdM-2175). **D.** 3- Gornja Ploča, HR (HNHM-100626). **E.** 4- Prezid Pass. HR (HNHM-99895).

*Cochlostoma (Turritus) reitteri* (Boettger, 1880)

Figs 26 (cyan dots), 27B, 28–29

*Pomatias reitteri* Boettger, 1880: 7, 224–235.

**Syntype**

CROATIA • specimen in Wagner’s collection; “*Pomatias gracilis* var. *reitteri* Boettger, Wagner (1897: 45 [609]) wrote: “Die Original exemplare dieser Form, welche mir Dr. Boettger mit der Fundortsangabe »Grosse Kapella« übergab...”; MIZPASW6843.

**Other specimens**

CROATIA • 1- Kapela Pass (topotypical); 45.0946° N, 15.2120° E; 2009; De Mattia leg.; WdM68822 • 2- Rudnica; 45.2173° N, 15.3893° E; 2009; De Mattia leg.; WdM5981 • 3- Brinje fortress; 44.9983° N, 15.1315° E; 1987; Pintér leg.; HNHM93362.

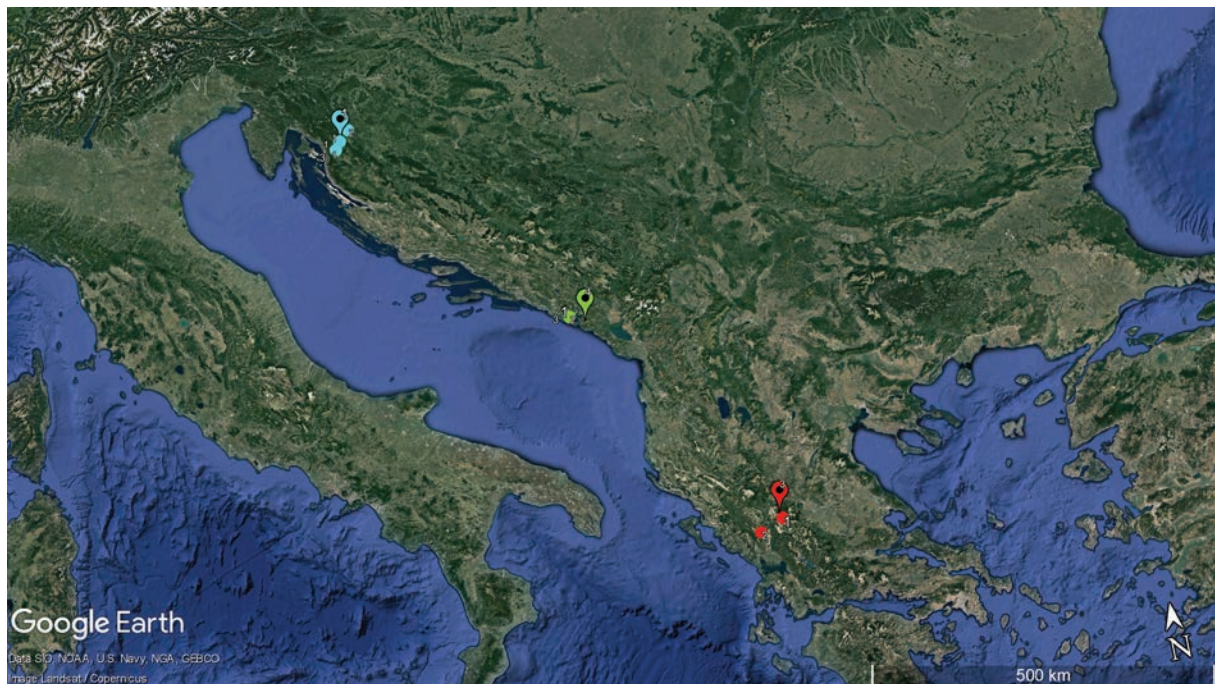
**Type locality**

CROATIA • Gorski Kotar, Velika Kapela.

**Description**

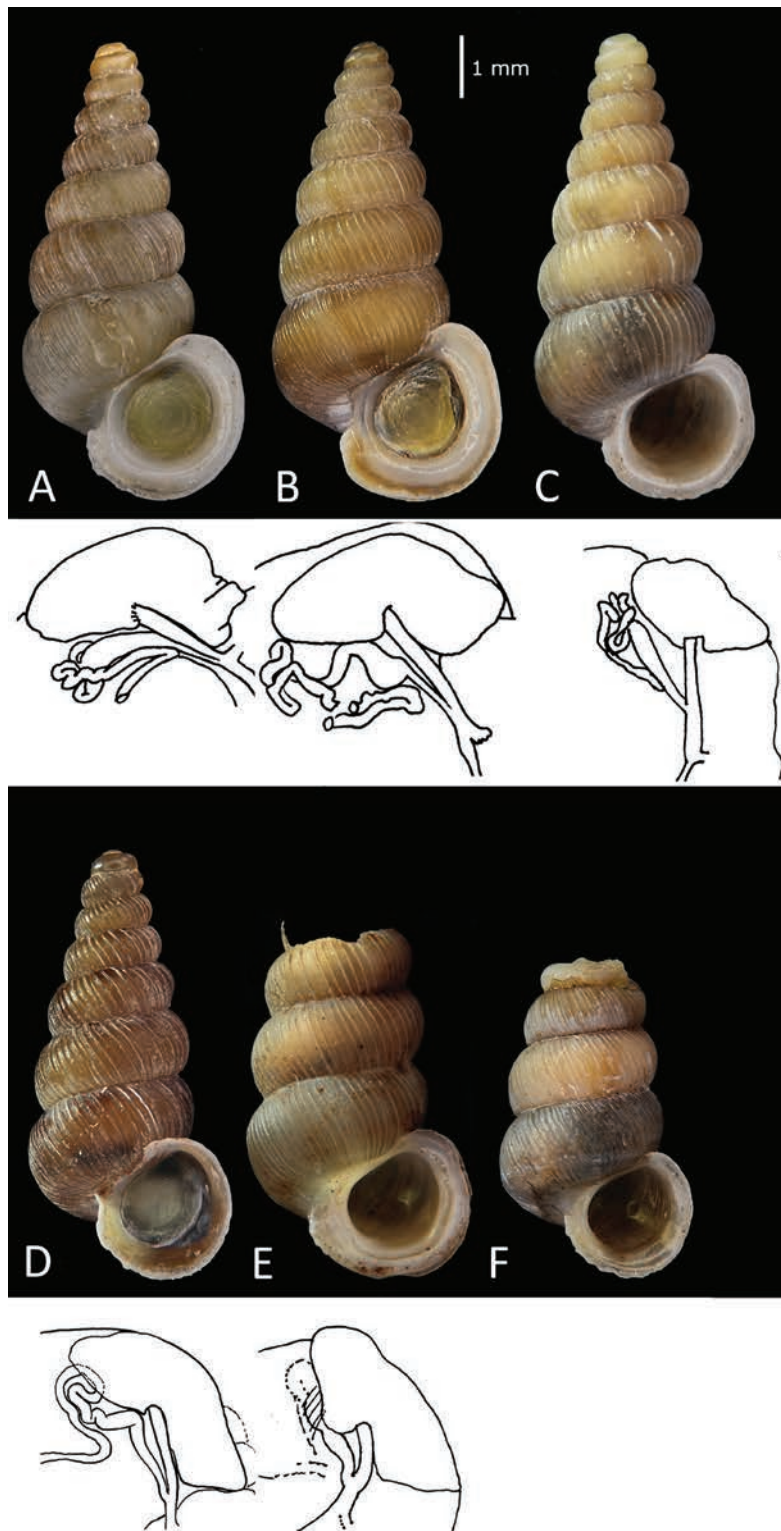
SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with strong, rounded and well-spaced ribs. Very strong and developed lip with columellar lobe quite abruptly inwardly curved to cover umbilicus.

MEASUREMENTS. 8 ♀♀: whorls=6.7–8, H=6.7–7.7 mm, H/W=2.36–2.64, roundness=0.11–0.14, ribs incl.=65–68°, apert. incl.=15–22°, ribs/mm 1<sup>st</sup> wh.=7–9, ribs/mm 4<sup>th</sup> wh.=7–11.



**Fig. 26.** Distribution of taxa part of clade A: cyan dots=*Cochlostoma (T.) reitteri* (Boettger, 1880); green dots = *C. (T.) pallgergelyi* sp. nov.; red dots = *C. (T.) pageti* Klemm, 1962. Black center indicates samples with amplified 16S.





**Fig. 27.** Samples part of clade A with amplified 16S. **A.** NFS158, Tisovec, SLO (WdM-6748). **B.** *Cochlostoma* (*T.*) *reitteri* (Boettger, 1880), Kapella Pass, HR (WdM-6882). **C.** NFS127, Mt Shelegur, AL (HNHM-99880). **D.** *C. (T.) pageti* Klemm, 1962, Katafiko, GR (HNHM-99329). **E.** *C. (T.) pallgergelyi* sp. nov., near Lovcén peak, MONT (HNHM-99889). **F.** NFS145, 2 km S of Vilusi, MONT (HNHM-99893).

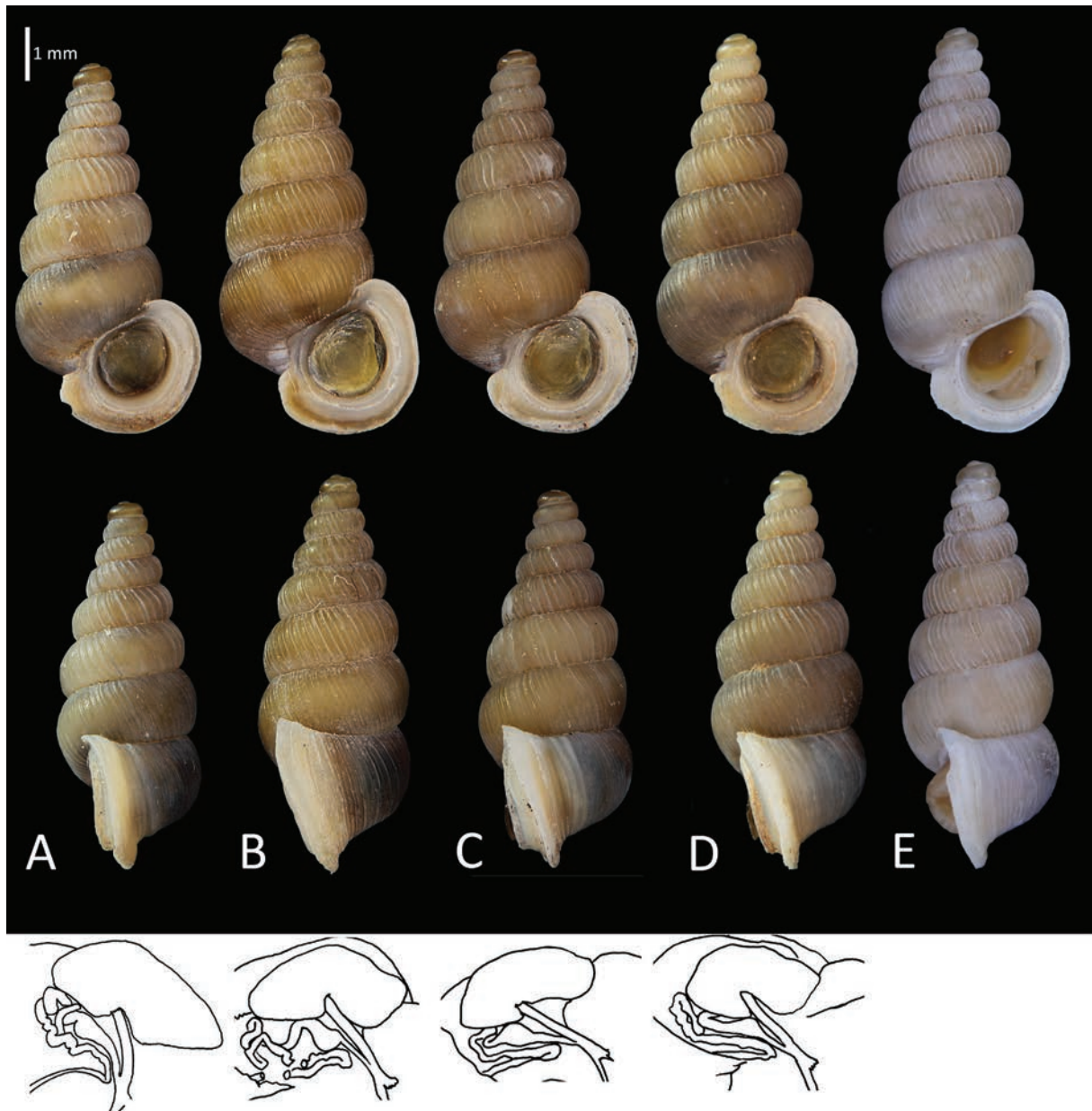


Fig. 28. *Cochlostoma (T.) reitteri* (Boettger, 1880), syntype, 1- Kapela Pass, HR (MIZPAS-W6843).

FEMALE GENITAL ORGANS. As in *C. (T.) stussineri*.

### Remarks

Its shell is characterized by a sturdy shape and a very large and thick lip. It is not clear why it was considered a subspecies of *C. (T.) gracile*: the shell is stumpier and the lip sturdier. The p-distance between the topotypical samples of *gracile* and *reitteri* is 2.9%.



**Fig. 29.** *Cochlostoma (T.) reitteri* (Boettger, 1880). A–D. Topotypical specimens from 1- Kapela Pass, HR (WdM-6882). E. 3- Brinje, HR (HNHM-93392).

*Cochlostoma (T.) pallgergelyi* sp. nov.

urn:lsid:zoobank.org:act:AD1709F8-EBA2-4C81-81E7-9A6923E95BB4

Figs 26 (green dots), 27E, 30–31

**Differential diagnosis**

The shell is characterized by the shape of the columellar lobe, with a deep indentation, and the regular prominent and whitish ribs.

**Etymology**

This species is dedicated to Barna Páll-Gergely, malacologist, and a prominent member of the latest generation of Hungarian taxonomists.

**Holotype**

MONTENEGRO • ♀; 1- Kameno; 42.4877° N, 18.5603° E; Eröss and Fehér leg.; Apr. 2000; HNHM105450.

**Other specimens**

MONTENEGRO • 1- Kameno 2 (topotypical); 42.4877° N, 18.5603° E; 2015; Deli, Eröss, Fehér leg.; HNHM100380 • 3- near Lovcén peak; 42.4004° N, 18.794° E; 2008; Dányi, Fehér, Kontschán and Murányi leg.; HNHM99889.

**Type locality**

MONTENEGRO • 1- Kameno; 42.4877° N, 18.5603° E.



**Fig. 30.** *Cochlostoma (T.) pallgergelyi* sp. nov., female holotype, 1- Kameno, MONT (HNHM105450).



**Fig. 31.** *Cochlostoma* (*T.*) *pallgergelyi* sp. nov., 1- Kameno, MONT (HNHM-100380).

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with prominent, thin and well-spaced ribs becoming weaker toward aperture. Moderately strong lip with indented columellar lobe covering umbilicus.

MEASUREMENTS. 4 ♀♀: whorls=8.2–9.1, H=6.8–9.2 mm, H/W=2.57–2.77, roundness=0.14–0.17, ribs incl.=60–68°, apert. incl.=17–26°, ribs/mm 1<sup>st</sup> wh.=5–6, ribs/mm 4<sup>th</sup> wh.=4–9.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Short, oval seminal receptacle confined to ventral part of body. 2–3 short loops situated close to seminal receptacle apex. Junction of uterus gland moderately far from connection between distal oviduct and pedunculus of bursa copulatrix.

### Remarks

The female genital morphology differs from that of the previous taxa because of the junction of the uterus gland which is not as close to the connection between the distal oviduct and the pedunculus of the bursa copulatrix. The shell morphology is distinctive, with thin, regular ribs and a deeply indented columellar lobe. The p-distance between the two samples assigned to this taxon is 1.7%.

*Cochlostoma (T.) pageti* Klemm, 1962  
Figs 26 (red dots), 27D, 32–33

*Cochlostoma pageti* Klemm, 1962: 213, pl. 1 fig. 1.

*Cochlostoma gracile subaiorum* Schütt, 1977: 21, pl. 1 fig. 7.

### Holotype

GREECE • probably ♀; “Paraskevi, 1500 m, im Epirus”; May 1933; Beier leg.; NHMW74159.

### Other specimens

GREECE • 2- Terovo; 39.4488° N, 20.8833° E; 1975; Subai leg.; NHMWK69266 • 3- Katafito; 39.6333° N, 21.2242° E; 2011; Kontschán, Murányi, Szederjesi and Ujvári leg.; HNHM99329.

### Type locality

GREECE • 1- Epirus, Paraskevi; 39.5682° N, 21.2607° E.

### Description

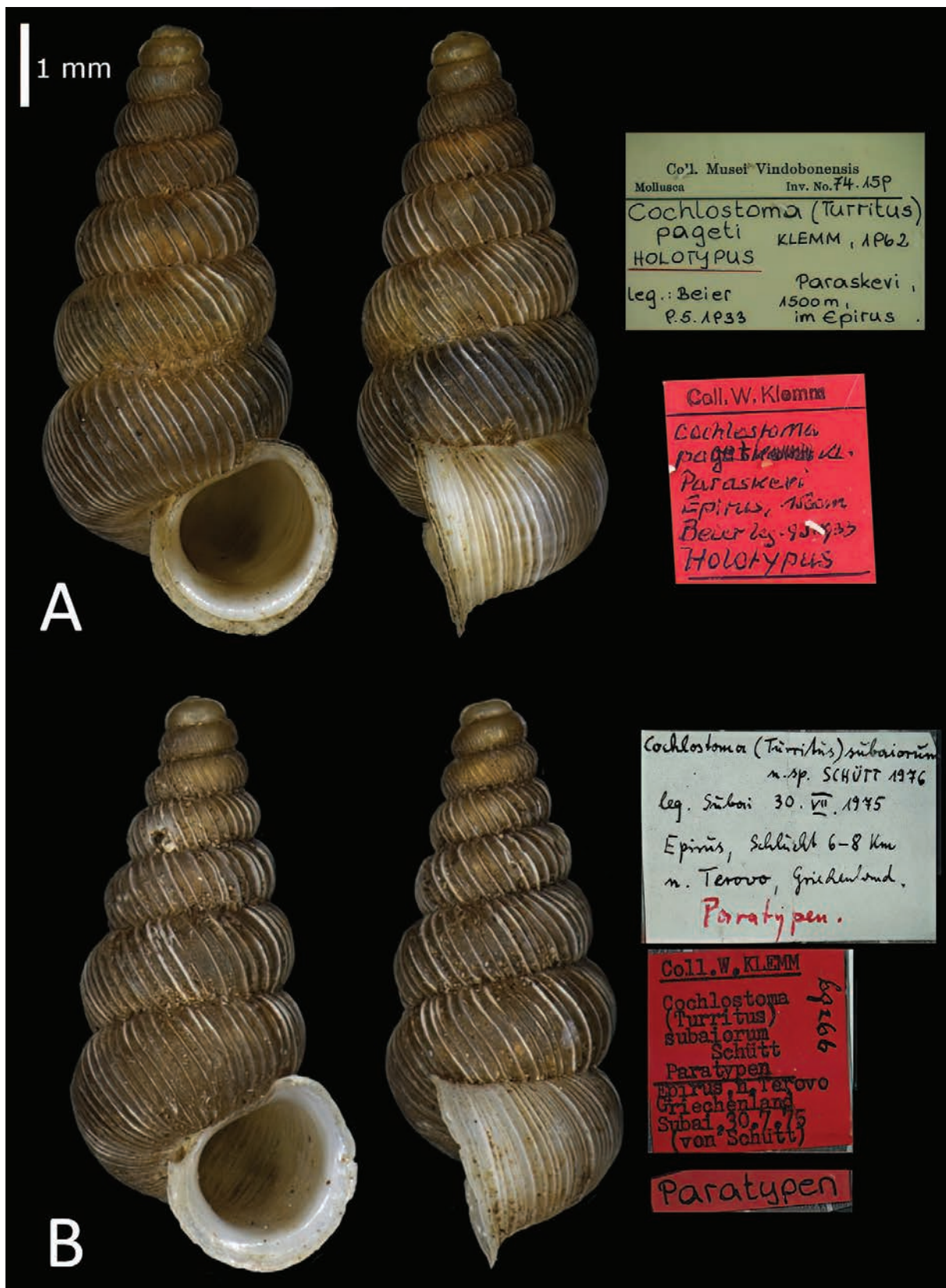
SHELL. Spaced riblets on last part of protoconch. Teleoconch spotless, with prominent and rather thin ribs becoming weaker toward aperture. Moderately strong lip with indented columellar lobe covering umbilicus.

MEASUREMENTS. 5 ♀♀: whorls=7.1–8, H=5.4–7.4 mm, H/W=2.43–2.62, roundness=0.13–0.16, ribs incl.=56–66°, apert. incl.=14–26°, ribs/mm 1<sup>st</sup> wh.=6–10, ribs/mm 4<sup>th</sup> wh.=7–10.

FEMALE GENITAL ORGANS. Ventral-posterior connection of pedunculus to bursa copulatrix. Short, oval seminal receptacle confined to ventral side of body with 2–3 loops close to apex. Junction of uterus gland moderately far from connection between pedunculus and distal oviduct.

### Remarks

The analysis of the type series indicates that *C. (T.) pageti* and *C. gracile subaiorum* Schütt, 1977 are conspecific. The short distance between the type localities supports this conclusion. In Wagner’s



**Fig. 32.** A. Holotype of *Cochlostoma (T.) pageti* Klemm, 1962 (NHMW-74159). B. Paratype of *C. (T.) gracile subaiorum* Schütt, 1977 (NHMW-K69266). The latter is here synonymized with *C. (T.) pageti*.

collection (MIZPAS -W7085) there is a specimen (Fig. 34), named “*pindicus*” from the Acarnania region, roughly 100 km south of the range of *C. (T.) pageti*. Despite the low resolution of the picture, the deep indentation of the columellar lobe is clearly visible, like in *C. (T.) pageti*. It remains unclear whether this population is conspecific with or only related to *C. (T.) pageti*.



Fig. 33. *Cochlostoma (T.) pageti* Klemm, 1962, 3- Katafiko, GR (HNHM-99329).





**Fig. 34.** Specimen in Wagner's collection (MIZPAS-W7085) from the Acarnania region of Greece, named as *Pomatias pindicus* (nomen nudum).

### Additional note to clade A

A terminal branch of clade A includes samples from the central and southern Apennines that can be referred to *C. (T.) cassiniacum* and *C. (T.) adamii*. They share the female genital morphology and some shell features, like the umbilicus hidden by the curved columellar lobe and the pronounced ribbing, with rounded, whitish ribs.

*Cochlostoma (T.) cassiniacum* (Saint-Simon in Paulucci, 1878)  
Figs 35 (green dots), 36A–E, 37–40

*Pomatias cassiniacus* Saint-Simon in Paulucci, 1878: 15.

### Types

Not seen.

### Other specimens

ITALY – **Appennino Umbro-Marchigiano, Abruzzese and Subappennino Laziale** • 1- Monte Cassino (topotypical); 41.4849° N, 13.811° E; 2010; Hallgass and Zallot leg.; EZ0407 • 2- Mt Semprevista 2; 41.5636° N, 13.124° E; 2011; Hallgass and Zallot leg.; EZ1058 • 3- Mt Semprevista 1; 41.5629° N, 13.1231° E; 2011; Hallgass and Zallot leg.; EZ1057 • 4- Mt Scalambra; 41.8414° N, 13.116° E; 2010; Hallgass leg.; EZ0023 • 5- Mt Gennaro; 42.0437° N, 12.8313° E; 2010; Hallgass leg.; EZ0021 • 6- Alfedena; 41.7346° N, 14.032° E; 2007; Niero leg.; EZ0409 • 7- Alfedena to Barrea; 41.7405° N, 14.0492° E; 2011; Hallgass leg.; EZ1055 • 8- Carpineto Romano; 41.5973° N, 13.0839° E; 2011; Hallgass and Zallot leg.; EZ1056 • 9- Montagna dei fiori; 42.7815° N, 13.5847° E; 1987; Hallgass leg.; EZ1070 • 10- Monte Meta; 41.6675° N, 13.9146° E; 1986; Hallgass leg.; EZ1072 • 11- Val Canneto; 41.6892° N, 13.9081° E; 1986; Hallgass leg.; EZ1073 • 12- Vallepietra; 41.9528° N, 13.2518° E; 2011; Hallgass leg.; EZ1074 • 13- Filettino; 41.9186° N, 13.3606° E; 2011; Hallgass leg.; EZ1076 • 14- Valle dell'Aniene; 41.8805° N, 13.3082° E; 2011; Hallgass leg.; EZ1077 • 15- Mt Gennaro 1082; 42.0495° N, 12.8247° E; 2011; Piredda leg.; EZ1083 • 16- Gioia Vecchia-Pescasseroli; 41.8523° N, 13.7761° E; 2013; Hallgass leg.; EZ1127 • 17- Forca d'Acero; 41.7712° N, 13.8401° E; 2013; Hallgass leg.; EZ1129 • 18- Piazzale della Camosciara; 41.7606° N, 13.9077° E; 2013; Hallgass leg.; EZ1130 • 19- Val Canneto 1050; 41.6746° N, 13.9828° E; 2013; Hallgass leg.; EZ1131 • 20- Val Canneto 1750; 41.7422° N, 13.8663° E; 2013; Hallgass leg.; EZ1132 • 21- Val Canneto 1017; 41.6682° N, 13.8692° E; 2013; Hallgass leg.; EZ1133 • 22- Collelongo; 41.8916° N, 13.6086° E; 2014; De Mattia leg.; EZ1196 • 23- Valle Cupa; 41.4396° N, 14.0141° E; 1995; S. Cianfanelli and E. Talenti leg.; MZUFGC65002/25561 • 24- Monte Sant'Angelo; 41.3333° N, 14.1333° E; 2021; S. Cianfanelli and E. Talenti leg.; MZUF65765 • 25- Terelle 1 km SE; 41.55° N, 13.7833° E; 2021; S. Cianfanelli and E. Talenti leg.; MZUF65310 • 26- Carsoli; 42.1013° N, 13.0878° E; 1881; Paulucci? leg.; MZUF-13647\_10200. – **Matese Mountains** • 27- Passo Santa Crocella; 41.3792° N, 14.5804° E; 2001; Zallot leg.; EZ0025 • 28- Sella Perrone; 41.4032° N, 14.4832° E; 2001; Zallot leg.; EZ0024 • 29- Miralago; 41.4023° N, 14.4212° E; 2008; Hallgass leg.; EZ0405 • 30- San Gregorio Matese; 41.3844° N, 14.3688° E; 2013; Hallgass leg.; EZ1147 • 31- Piedimonte Matese; 41.3643° N, 14.3808° E; 2015; Scarlassara leg.; EZ1257 • 32- Gallo Matese; 41.4666° N, 14.2166° E; 1995; Cianfanelli S., Talenti E. leg.; MZUF10886. – **Lattari, Picentini mountains and Cilento** • 33- Valico di Chiunzi; 40.7186° N, 14.62° E; 2000; Zallot leg.; EZ0011 • 34- Acerno-Pian del Gaudio; 40.755° N, 15.0519° E; 2000; Zallot leg.; EZ0012 • 35- Trentinara; 40.3976° N, 15.1277° E; 2000; Zallot leg.; EZ0013 • 36- Mt Soprano-Passo Vesole; 40.4161° N, 15.1378° E; 2000; Zallot leg.; EZ0014 • 37- Mt Soprano; 40.4037° N, 15.1567° E; 2000; Zallot leg.; EZ0015 • 38- Gole del Calore; 40.3539° N, 15.2464° E; 2001; Zallot leg.; EZ0016 • 39- Mt Terminio; 40.8096° N, 14.9457° E; 2009; Hallgass leg.; EZ0026 • 40- Pian del Gaudio; 40.7789° N, 15.0375° E; 2000; Zallot leg.; EZ0027 • 41- Mt Vergine; 40.9376° N, 14.7174° E; 2013; Hallgass leg.; EZ1148 • 42- Monte Faito; 40.6461° N,

14.5136° E; 2021; S. Cianfanelli and E. Talenti leg.; MZUF65288 • 43- Olevano sul Tusciano; 40.65° N, 15.0166° E; 1994; S. Cianfanelli and E. Talenti leg.; MZUF10775 • 44- Fiume Platano 1; 40.65° N, 15.5166° E; 2021; S. Cianfanelli and E. Talenti leg.; MZUF65732 • 45- Fiume Platano 2; 40.65° N, 15.5166° E; 2021; S. Cianfanelli and E. Talenti leg.; MZUF65651.

### Type locality

ITALY • Lazio, Monte Cassino.

### Description

#### Topotypical

SHELL. Quite widely spaced riblets on last part of protoconch. Teleoconch with barely visible reddish spots on upper part of whorls. Very strong and whitish ribs becoming weak approaching aperture. Moderately developed and strong lip with gently inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 84 ♀♀: whorls=7.0–9.2, H=6.8–9.3 mm, H/W=2.4–3.05, roundness=0.08–0.19, ribs incl.=58–66°, apert. incl.=12–25°, ribs/mm 1<sup>st</sup> wh.=5–16, ribs/mm 4<sup>th</sup> wh.=4–14.

#### Matese Mountains

SHELL. Moderately close riblets on last part of protoconch. Teleoconch with barely visible reddish spots on upper part of whorls. Strong and often whitish ribs, in average more closely spaced than in topotypical specimens, becoming very weak toward aperture. Quite strong lip with gently inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 11 ♀♀; Whorls=7–9.1; H=6.8–9.2 mm.; H/W=2.4–3.01; roundness=0.14–0.15; ribs incl.=59–66°; apert. incl.=13–17°; ribs/mm 1<sup>st</sup> wh.=8–16; ribs/mm 4<sup>th</sup> wh.=7–12.



**Fig. 35.** Distribution of samples of clade A inhabiting the Apennine: green dots=*Cochlostoma* (*T.*) *cassiniacum* (Saint-Simon in Paulucci, 1878); red dots=*C.* (*T.*) *adamii* (Paulucci, 1879). Black center for the samples with amplified 16S.

### Lattari, Picentini Mountains and Cilento

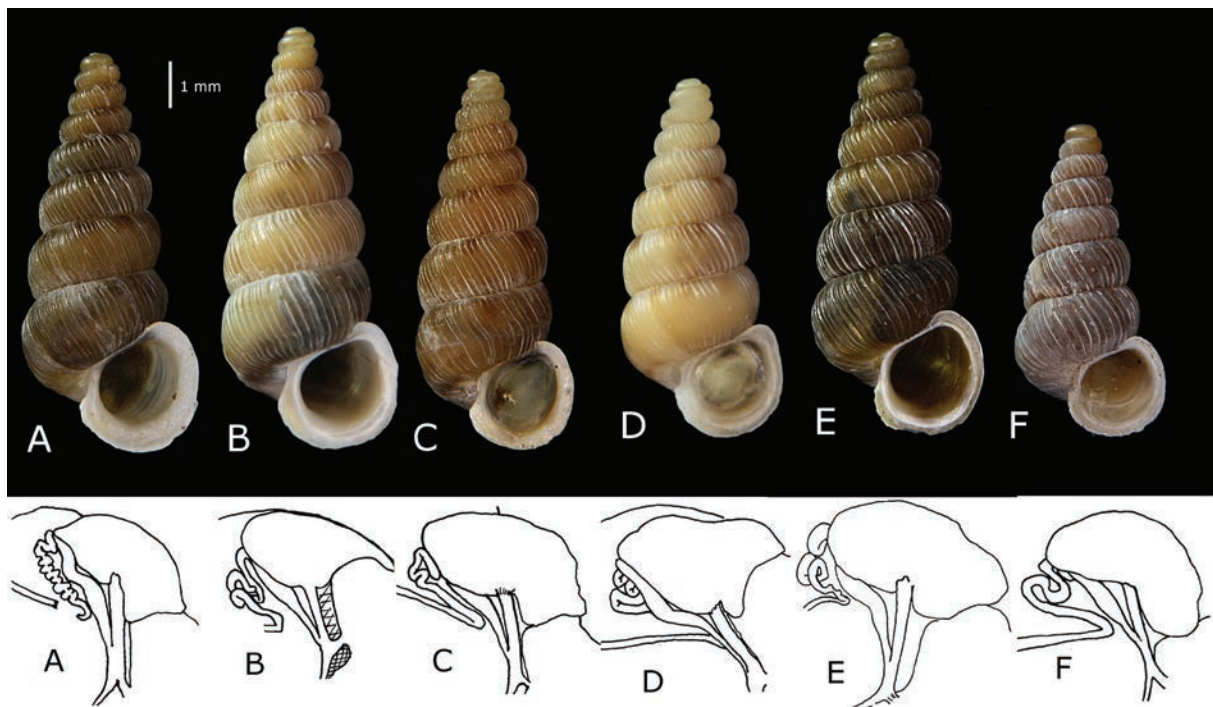
**SHELL.** Closely spaced riblets on last part of protoconch. Teleoconch with barely visible reddish spots on upper part of whorls. Very strong (in some populations much stronger than in topotypical and Matese specimens) and irregular in size whitish ribs weaker approaching aperture. Quite developed and strong lip with gently inwardly curved columellar lobe covering umbilicus.

**MEASUREMENTS.** 22 ♀♀: whorls=7.1–8.1, H=6.7–8.6 mm, H/W=2.45–2.78, roundness=0.12–0.17, ribs incl.=58–66°, apert. incl.=14–24°, ribs/mm 1<sup>st</sup> wh.=5–13, ribs/mm 4<sup>th</sup> wh.=7–10.

**FEMALE GENITAL ORGANS.** Ventral connection of the pedunculus to the bursa copulatrix. Elongated, reaching distal edge of bursa copulatrix, roughly oval-shaped, more or less tortuous, seminal receptacle with indistinct base and apex, close junction of uterus gland from connection between distal oviduct and pedunculus of bursa copulatrix.

### Remarks

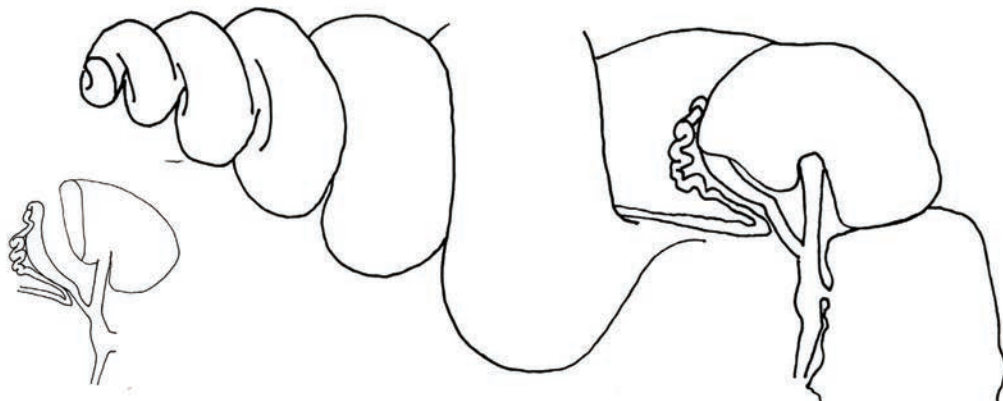
Molecular data of topotypical samples are not available. There is a large conchological variability among the samples tentatively assigned to this taxon. The p-distances observed among the samples are high and increase with the geographical distances of the sampling localities. It seems possible to distinguish different sets of populations, living in different mountains ranges (Matese Mountains, Lattari and Picentini mountains) and particularly the samples from the Pollino area here presented as NFS152 in the Appendix.



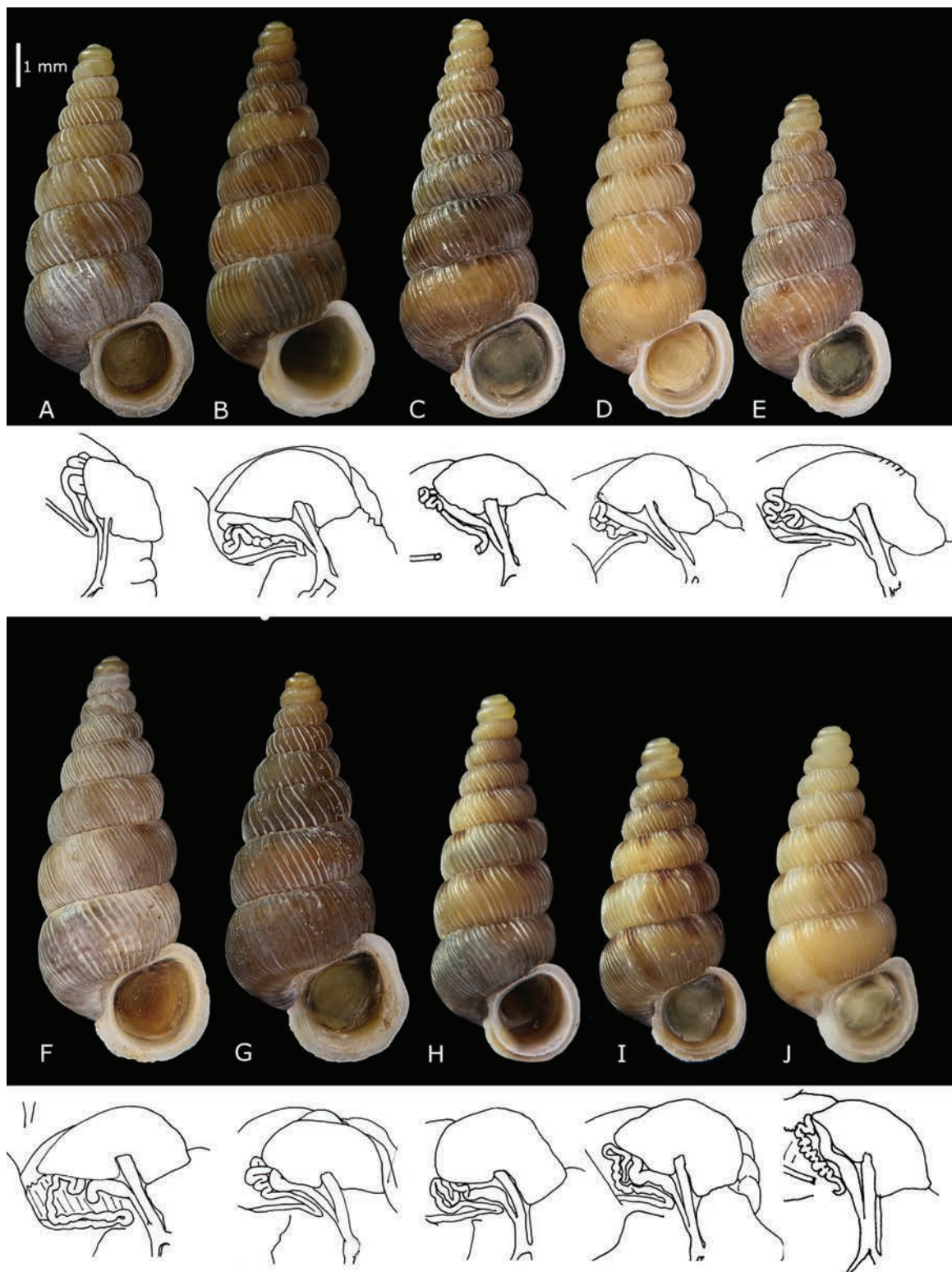
**Fig. 36.** Shell and female genitals of samples from the central-southern Apennine with amplified 16S. **A.** Passo Sta Crocella, I (EZ-0025). **B.** Mt Scalambra, I (EZ-0023). **C.** Mt Semprevisa, I (EZ-1057). **D.** Collelongo, I (EZ-1196). **E.** Valico di Chiunzi, I (EZ-0011). **F.** NFS152, Trecchina, I (EZ-1134).

The sample from “Montagna dei fiori” in the northeastern Apennines is of particular interest because of the disjunct range of this population, quite far (roughly 90 km) from the closest other one with similar features and surrounded by populations of *Turritus* belonging to clade B.

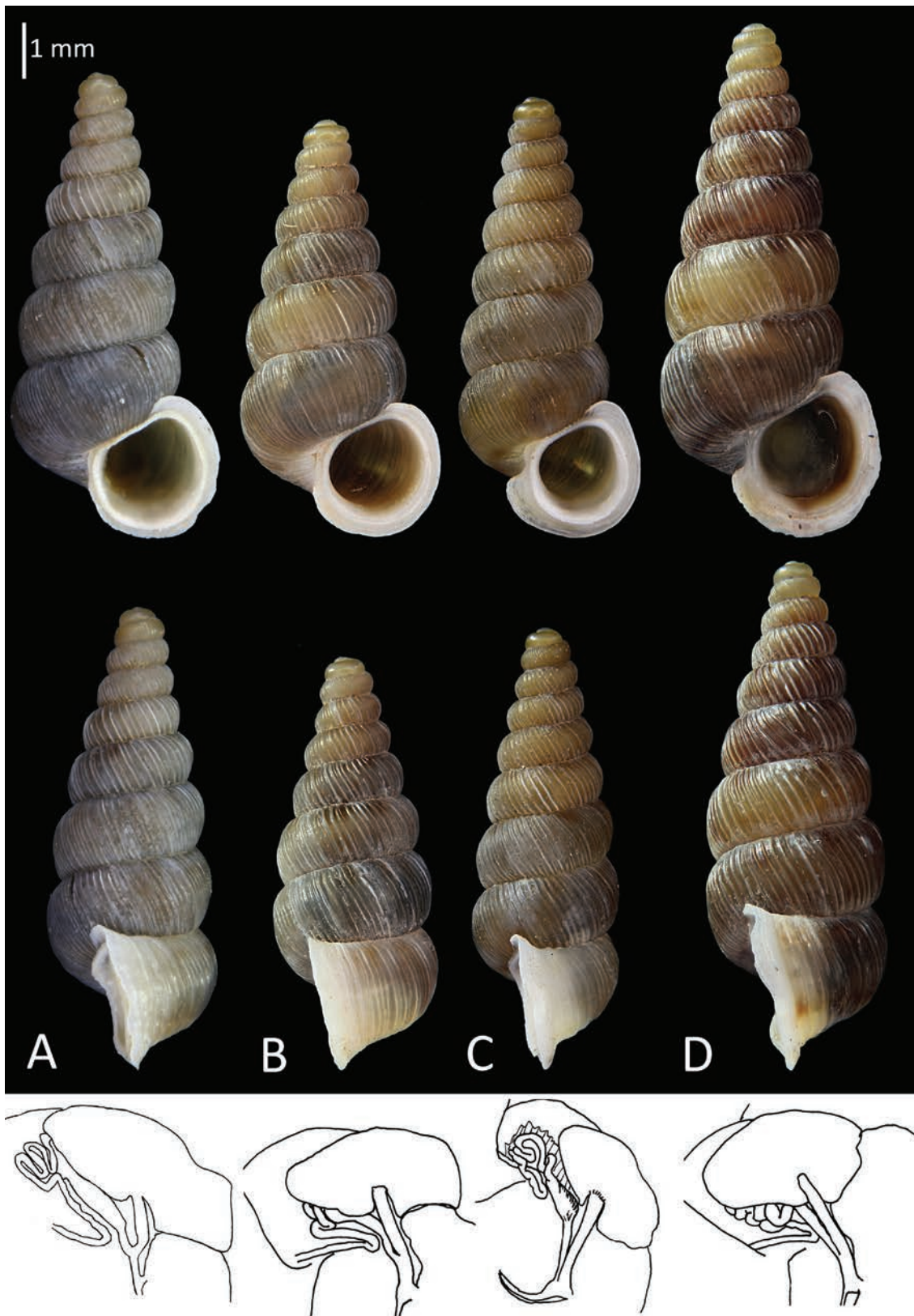
*Cochlostoma (T.) cassiniacum* is reported in MolluscaBase (2023) as a subspecies of *C. (T.) montanum* (Issel, 1866). The latter is an endemic species of the Apuane Alps, having a very different female genital morphology, and belonging to clade B.



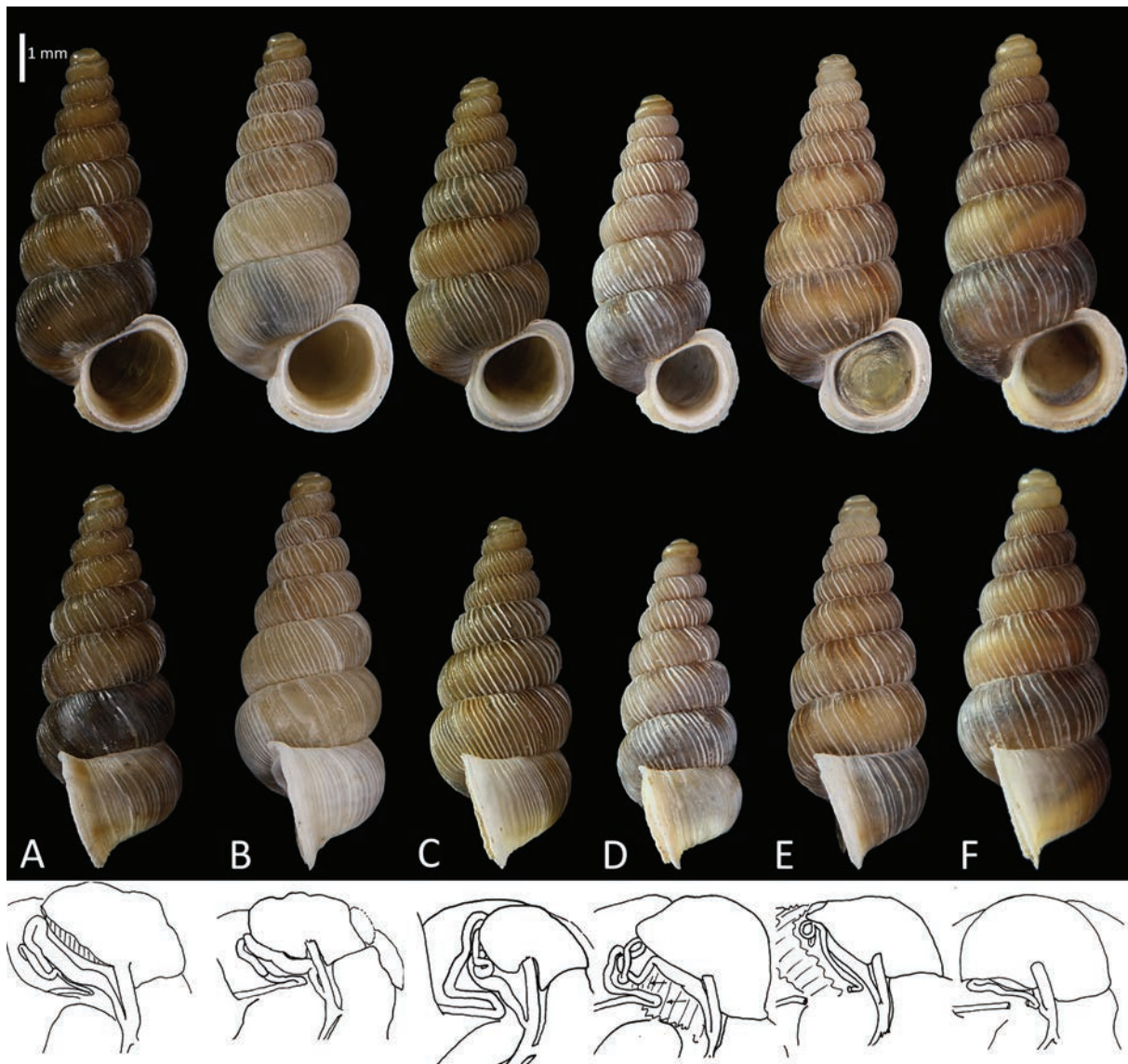
**Fig. 37.** Topotypical *Cochlostoma (T.) cassiniacum* (Saint-Simon in Paulucci, 1878), 1- Monte Cassino, I (EZ-0407).



**Fig. 38.** Samples tentatively assigned to *C. (T.) cassiniacum* (Saint-Simon in Paulucci, 1878). **A.** 5- Mt Gennaro, I (EZ-0021). **B.** 4- Mt Scalambra, I (EZ-0023). **C.** 1- Mt Cassino, I (EZ-0407). **D.** 6- Alfedena, I (EZ-0409). **E.** 2- Mt Semprevista, I (EZ-1057). **F.** 9- Montagna dei fiori, I (EZ-1070). **G.** 15- Mt Gennaro 1082, I (EZ-1083). **H.** 16- Gioia Vecchia, I (EZ-1127). **I.** 19- Val Canneto, I (EZ-1131). **J.** 22- Collelongo, I (EZ-1196).



**Fig. 39.** Samples tentatively assigned to *Cochlostoma (T.) cassiniacum* (Saint-Simon in Paulucci, 1878) from the Matese Mountains. **A.** 1- Passo Santa Crocella, I (EZ-0025). **B.** 2- Sella Perrone, I (EZ-0024). **C.** 3- Miralago, I (EZ-0405). **D.** 4- San Gregorio Matese, I (EZ-1147).



**Fig. 40.** Samples tentatively assigned to *Cochlostoma (T.) cassiniacum* (Saint-Simon in Paulucci, 1878) from the Lattari and Picentini Mountains and Cilento. **A.** 1- Valico di Chiunzi, I (EZ-0011). **B.** 2- Acerno-Pian del Gaudio, I (EZ-0012). **C.** 3- Trentinara, I (EZ-013). **D.** 6- Gole del Calore, I (EZ-0016). **E.** 7- Monte Terminio, I (EZ-0026). **F.** 9- Monte Vergine, I (EZ-1148).

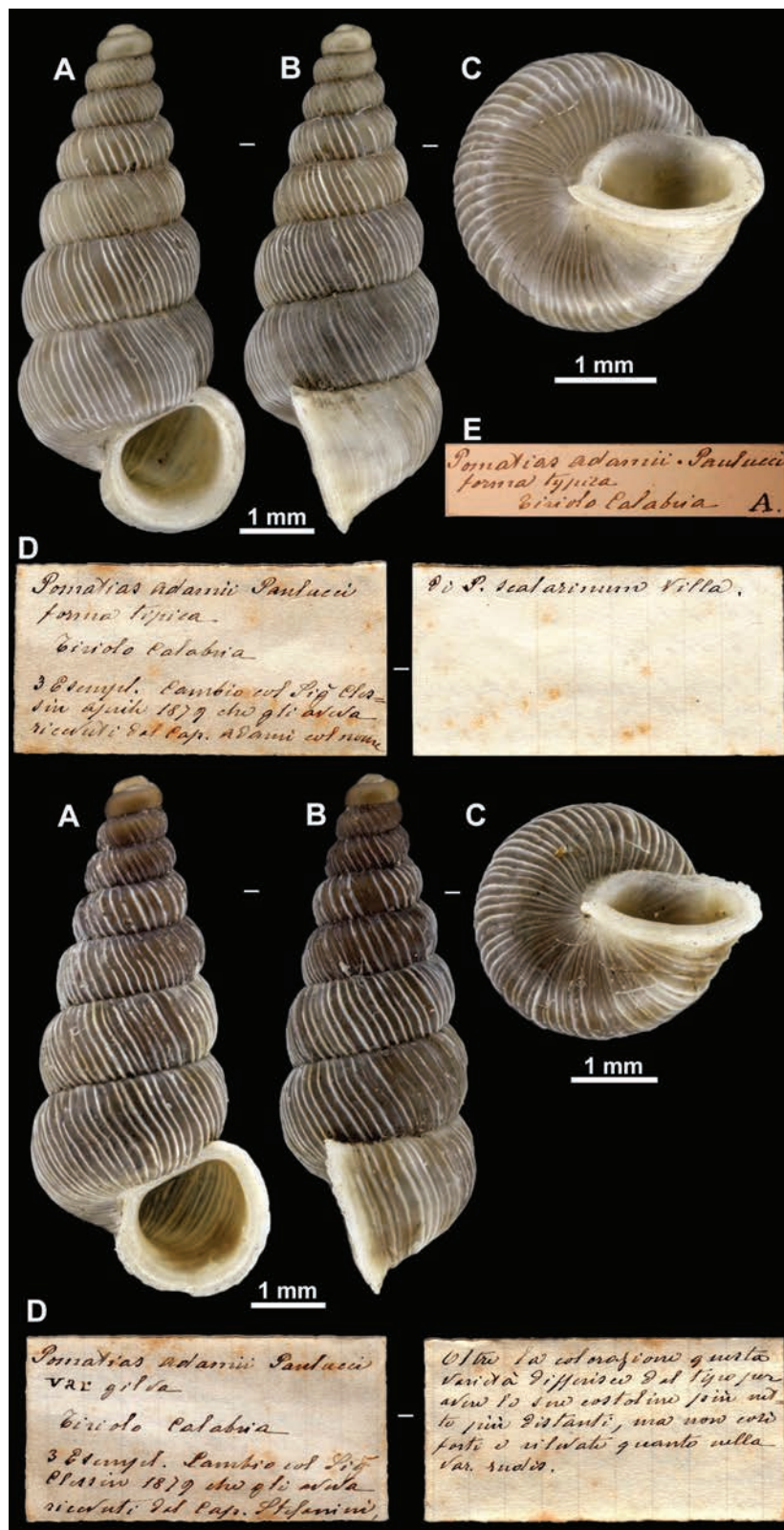
*Cochlostoma (T.) adamii* (Paulucci, 1879)  
Figs 35 (red dots), 41–43

*Pomatias adamii* Paulucci, 1879a: 188.

**Syntypes**

ITALY • 1 ♀; “*Pomatias adamii* Paulucci, forma tipica, Tiriolo Calabria. 3 esempl. cambio col Sig. Clessin aprile 1879 che gli ha ricevuti dal Cap. Adami col nome di *P. Scalarinum* Villa”; MZUF13650 • 1 ♂; “*Pomatias adamii* Paulucci var *gilva*, Tiriolo, Calabria. 3 esempl. cambio col Sig. Clessin 1879 che gli ha ricevuti dal Cap. Stefanini”; MZUF10964.





**Fig. 41.** Syntype, ♀ (MZUF-13650) and ♂ (MZUF-10964) of *Cochlostoma* (*T.*) *adamii* (Paulucci, 1879), Monte Tiriolo. I.

### Other specimens

ITALY • 1- Mt Stella 2 (topotypical); 38.4659° N, 16.4392° E; 2009; Renda leg.; EZ0017 • 2- Mt Stella (topotypical); 38.4682° N, 16.4483° E; 2007; Niero leg.; EZ0018 • 3-Tiriolo (topotypical); 38.9495° N, 16.5103° E; 2007; Niero leg.; EZ0019 • 5- Mt Stella (topotypical); 38.4682° N, 16.4483° E; 2007; Niero leg.; EZ1065 • 6- Canolo; 38.3128° N, 16.1993° E; 1986; Hallgass leg.; EZ1071 • 7- Gimigliano; 38.9602° N, 16.5109° E; 1980; Pintér leg.; HNHM41106.

### Type localities

ITALY • “Monte Stella e Tiriolo, Calabria”.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch with two lines of reddish spots on whorls. Rather thin ribs barely weakening approaching aperture. Moderately strong lip with gently inwardly curved columellar lobe in many specimens only partially covering umbilicus.

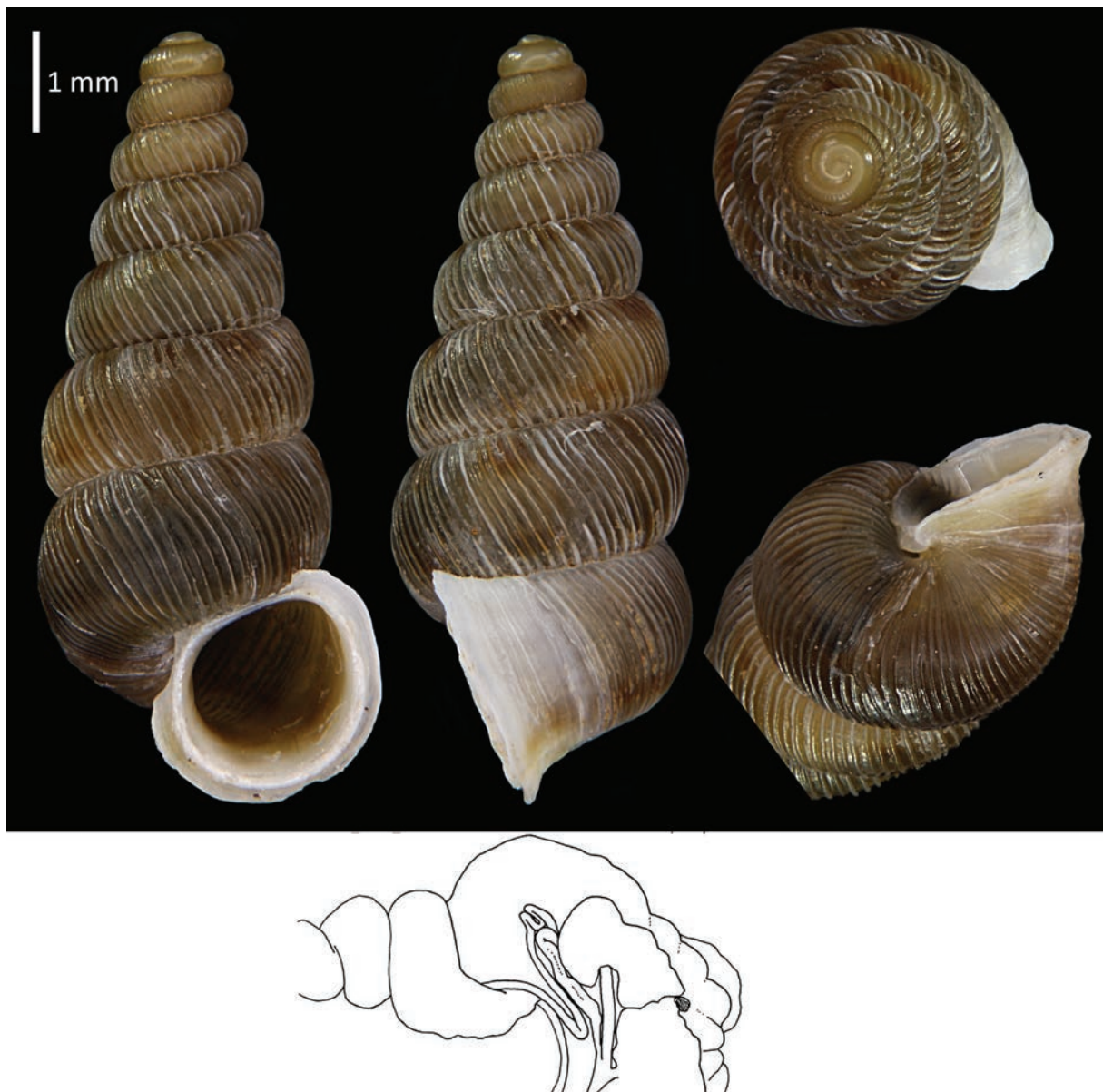
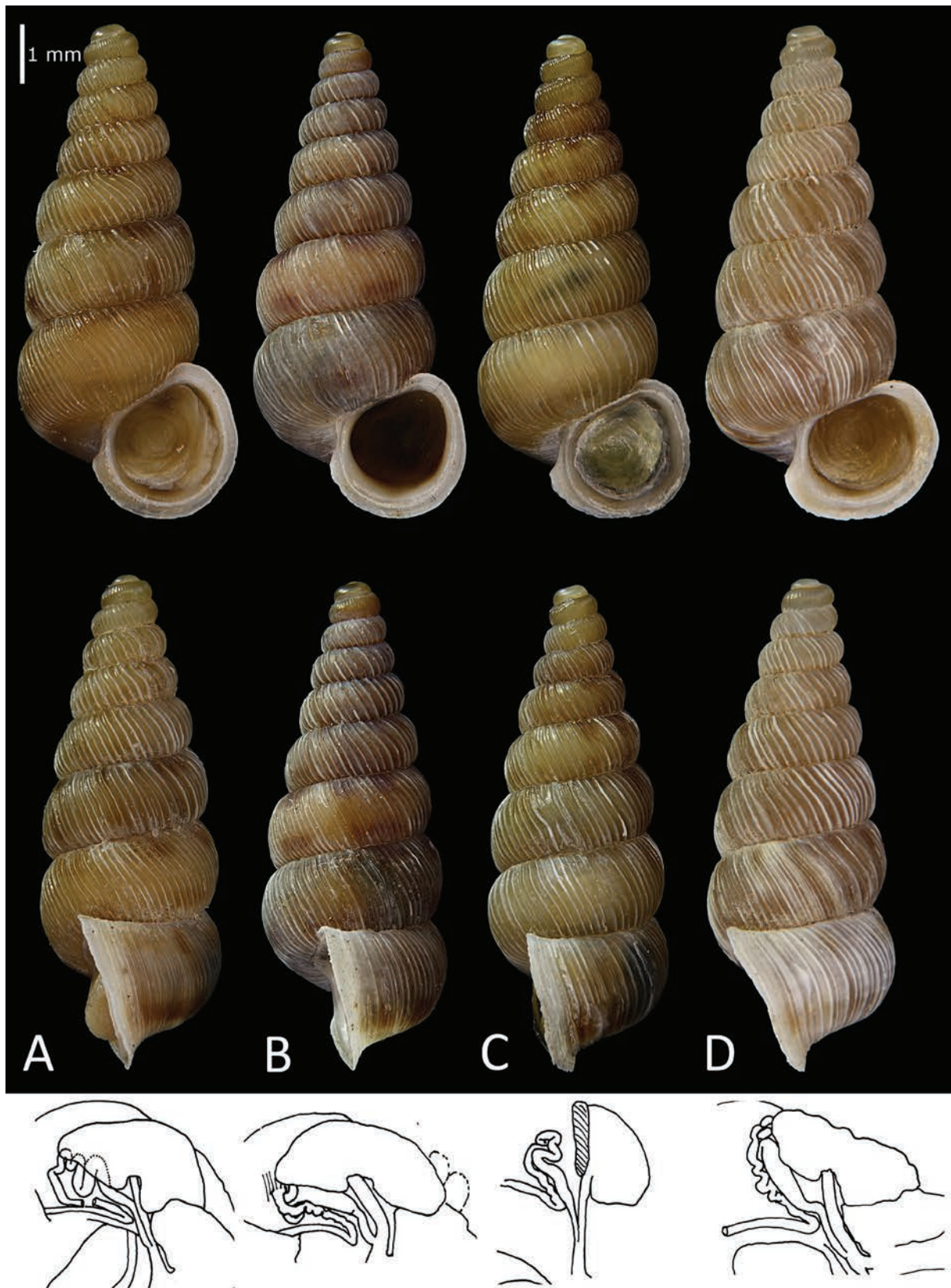


Fig. 42. Topotypical *Cochlostoma* (*T.*) *adamii* (Paulucci, 1879), 2- Monte Stella, I (EZ-1065).



**Fig. 43.** *Cochlostoma (T.) adamii* (Paulucci, 1879). **A.** 1- Monte Stella 2, I I (EZ-0018). **B.** 2- Monte Stella, II (EZ-1065). **C.** 3- Tiriolo, II (EZ-0019). **D.** 6- Canolo, II (EZ-1071).

MEASUREMENTS. 11 ♀♀: whorls=7.3–8.2, H=6.8–8.9 mm, H/W=2.58–2.76, roundness=0.11–0.14, ribs incl.=58–65°, apert. incl.=15–26°, ribs/mm 1<sup>st</sup> wh.=5–13, ribs/mm 4<sup>th</sup> wh.=6–11.

FEMALE GENITAL ORGANS. As in *C. (T.) cassiniacum*.

### Remarks

It has to be established if the populations living on the Sila and Aspromonte mountains in Calabria are a species on its own as *C. (T.) adamii* or just part of *C. (T.) cassiniacum*. The shell and female genital morphology are not sufficient to distinguish them and our molecular data are poor for this taxon (only H3 was amplified for samples from Monte Stella). We tentatively report it as a distinct species. It is labelled as “taxon inquirendum” in MolluscaBase (2023) and not considered in Welter-Schultes (2012). The type locality of the variety “*gilva*” is the same as for *C. (T.) adamii*. The variety *gilva* (MZUF-10964.9193) is the male of the nominotype, with a different color (the males are always darker, mainly on the upper whorls), being in average smaller than the females.

### Additional note to clade A

Our data result in a rather confusing picture of the taxonomy of the entities which live on the mountain ranges which run North-South in Albania and are part of a well supported (PP=100%, BS=99%) subclade. There are two different female genital morphologies, one presented in the toptotypical specimens of *C. (T.) mnelense* and the other in the samples here assigned to the new species *C. (T.) kotschani*. The morphological features found in the toptotypical *mnelense* have been observed in samples of populations living a few (EZ1182-Mali I Shentit) and more than 150 km (EZ1179-Strelcë to Selcë) to the south. Despite this similarity, in the phylogenetic trees the toptotypical *C. (T.) mnelense* and these samples were more distantly related than *mnelense* with the new species *kotschani*. Therefore, we will present these samples as *C. (T.) mnelense* cf., waiting for more detailed studies of these populations. The sample “Orenjë” from a locality halfway between Mali I Shentit and Strelcë to Selcë has a female genital morphology similar to *C. (T.) kotschani*. This is in contradiction with the results of the molecular data where it is more related to the EZ1182-Mali I Shentit.

### *Cochlostoma (T.) mnelense* (Wagner, 1914)

Figs 44 (red dots; *mnelense* cf. = orange dots), 45A–D, 46–50

*Auritus sturanyi mnelensis* Sturany & Wagner, 1914: 66–67, pl. 18 fig. 109.

### Syntypes

ALBANIA • 3 ♀♀; “*Auritus sturanyi mnelensis*, Orig. Expl. A. J.Wgn, Berg Mnela b. Oroshi, Mirdita, Albanien”, Buljubašić leg.; 1905; NHMW41173 • 1 ♀, 3 ♂♂; “*A. sturanyi mnelensis*, Berg Mnela bei Oroshi Mirdita Albanien”, MIZPASW7087.

### Other specimens

ALBANIA • 1- Mali i Munellës (topotypical); 41.9697° N, 20.1131° E; 2016; Eröss, Fehér, Szekeres and Grego leg.; HNHM99864 • 2- 2.5 km N of Ndërshenë; 41.8423° N, 20.0945° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99321 • 3- Mërkuth; 41.8135° N, 20.1397° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99322 • 4- Shent Mts; 41.8546° N, 20.1217° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99325 • 4- Mali i Shentit 1383; 41.8524° N, 20.1234° E; 2014; Angyal, Eröss, Fehér and Grego leg.; HNHM99167 • 5- Mali i Shentit 1310; 41.8595° N, 20.1493° E; 2014; Angyal, Eröss, Fehér and Grego leg.; HNHM99170 • 6- Krej-Lurë; 41.8382° N, 20.1665° E; 2007; Dányi, Eröss, Fehér, Hunyadi and Murányi leg.; HNHM99883 • 7- Strelcë to Selcë e Poshtëme; 40.7462° N, 20.5123° E; 2014; Angyal, Eröss, Grego and Fehér leg.; HNHM99400 • 8- Strelcë; 40.7301° N, 20.5039° E; 2014;

Angyal, Eröss, Fehér and Grego leg.; HNHM99388 • 9- Maja e Ramiës; 40.5602° N, 20.2645° E; 2004; Barina, Fehér, Németh and Pifkó leg.; HNHM97140 • 10- Kukur; 40.8665° N, 20.3774° E; 2011; Barina, Mező and Pifkó leg.; HNHM99328 • 11- Bishnicë; 40.9211° N, 20.4492° E; 2014; Fehér, Németh and Mizsei leg.; HNHM98949 • 12- Maja e Faqekuqit; 40.5325° N, 20.4256° E; 2006; Fehér, Hunyadi, Huszár and Murányi leg.; HNHM99885 • 13- Orenjë; 41.2831° N, 20.2006° E; 2006; Eröss, Fehér, Hunyadi and Murányi leg.; HNHM97138 • 14- Shtyllë pass Gropë Mts; 41.3705° N, 20.0855° E; 2012; Fehér, Kovács and Murányi leg.; HNHM99872 • 15- Qafa e Tujanit; 41.3738° N, 19.9195° E; 2016; Eröss, Fehér, Szekeres and Grego leg.; HNHM99869.

### Type locality

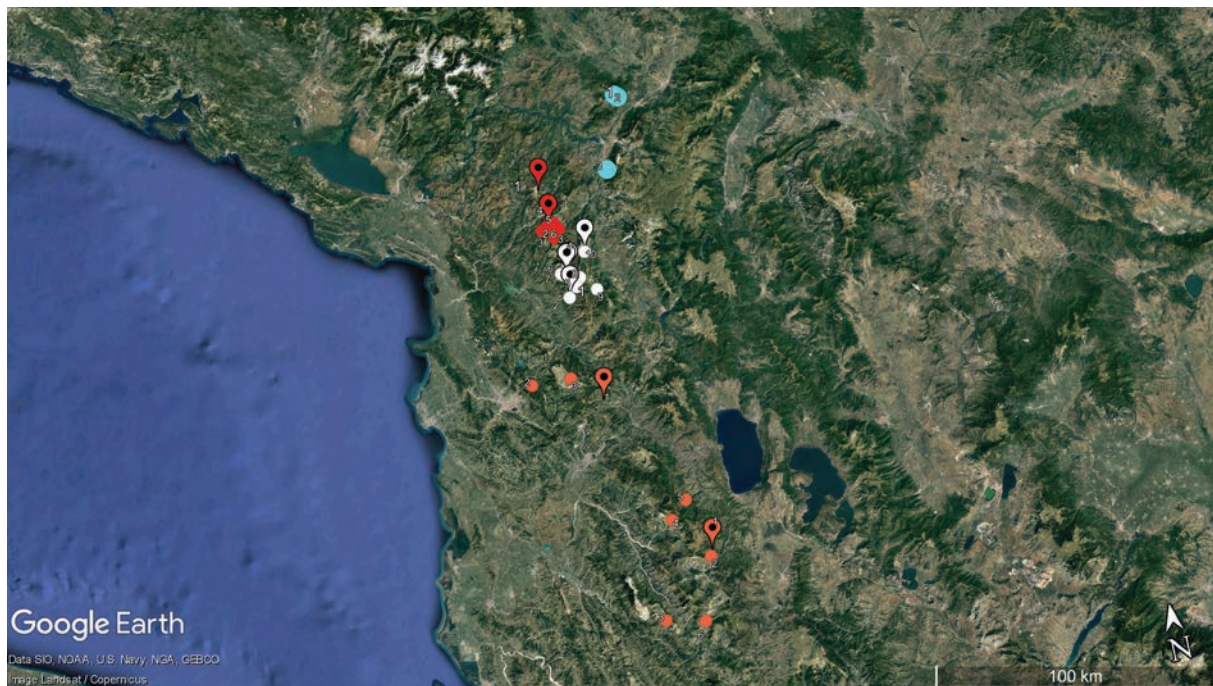
ALBANIA • “Berg Mnela b. Oroshi” (= Mali i Munellës, Mirditës, Albania).

### Description

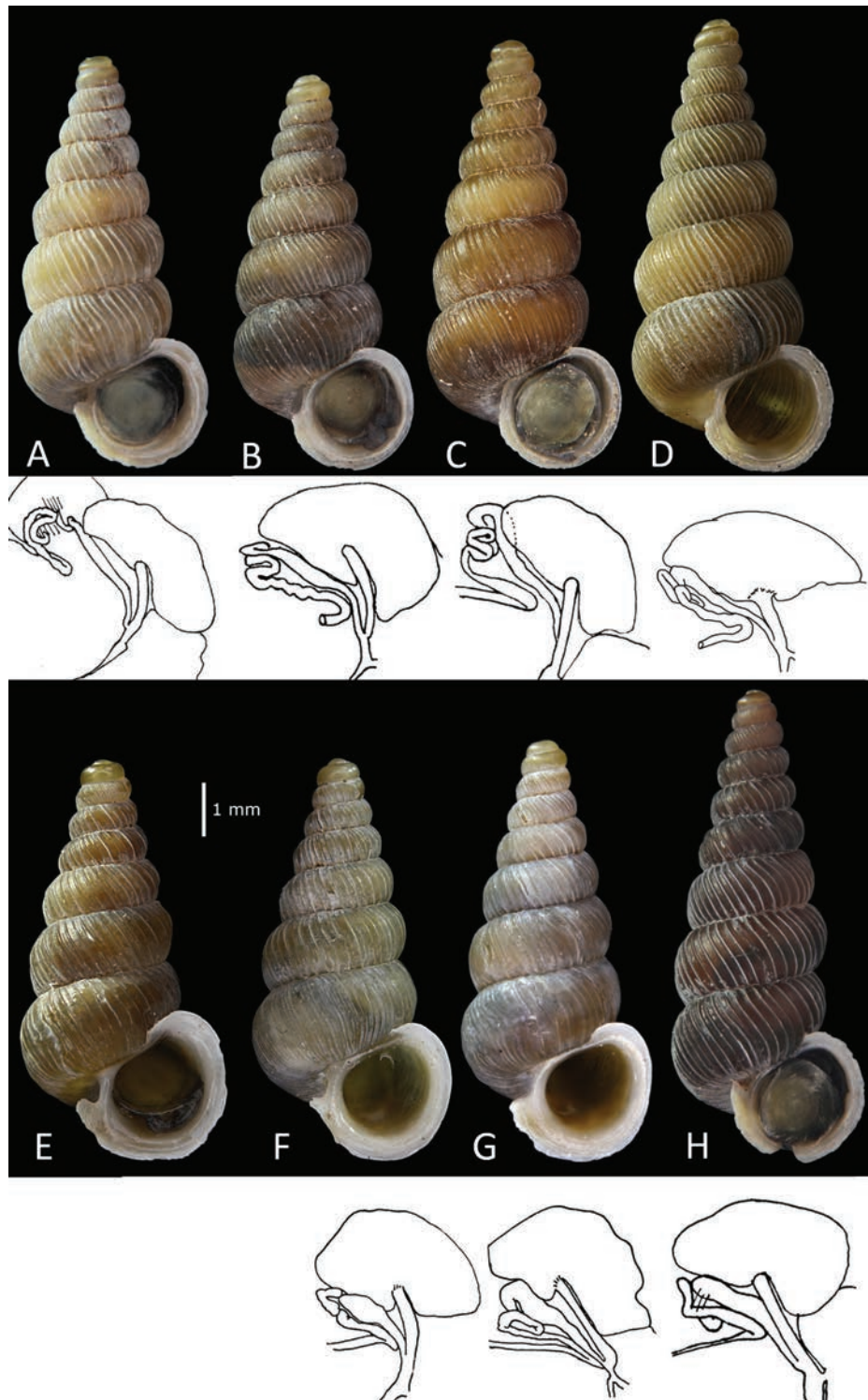
SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with strong or moderately strong spaced ribs. Moderately developed lip with either gently or abruptly inwardly curved columellar lobe often only partially covering umbilicus.

MEASUREMENTS. 25 ♀♀: whorls=7–8.3; H=6.5–8.5 mm; H/W=2.44–2.94; roundness=0.12–0.22; ribs incl.=55–66; apert. incl.=16–25°; ribs/mm 1<sup>st</sup> wh.=6–16; ribs/mm 4<sup>th</sup> wh.=6–14.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Elongated, slim and tortuous seminal receptacle with indistinct basis and apex. Apex on dorsal side of body, close to proximal edge of bursa copulatrix. 2–4 loops close to apex of seminal receptacle. Junction of uterus gland moderately far from connection between distal oviduct and pedunculus of bursa copulatrix.



**Fig. 44.** Distribution of samples of clade A from Albania: red dots = *Cochlostoma (T.) mnelense* (Wagner, 1914); white dots = *C. (T.) kotschani* sp. nov.; cyan dots = *C. (T.) muranyii* sp. nov.; orange dots = samples tentatively assigned to *C. (T.) mnelense*.



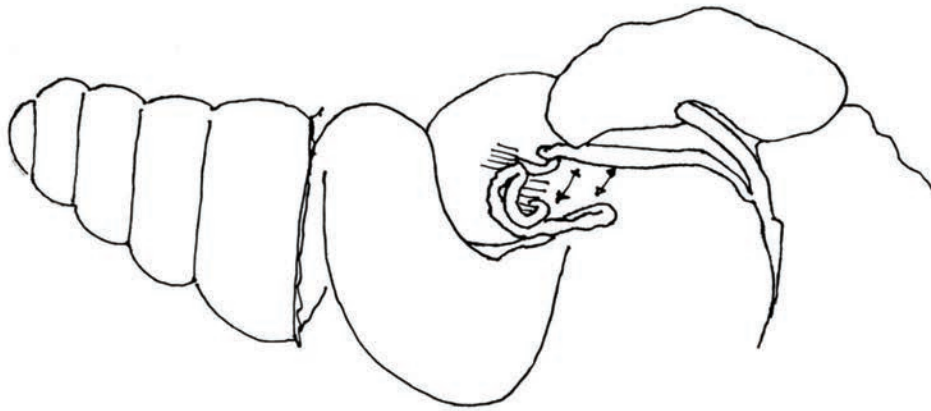
**Fig. 45.** Shell and female genitalia of samples from Albania of clade A with amplified 16S. **A.** *Cochlostoma (T.) mnelense* (Wagner, 1914), Mali i Munellës, AL (HNHM-99864). **B.** *C. (T.) mnelense*, Mali I Shentit 1383, AL (HNHM-99167). **C.** *C. (T.) mnelense* cf., Strelcë to Selcë e Poshtëme, AL (HNHM-99400). **D.** *C. (T.) mnelense* cf., Orenjë, AL (HNHM-97138). **E.** *C. (T.) kotschani* sp. nov., 6- 3 km W of Qafa e Murrës, AL (HNHM-97125). **F.** *C. (T.) kotschani*, Macukull 1939, AL (HNHM-97131). **G.** *C. (T.) kotschani*, Macukull 1702, AL (HNHM-97130). **H.** *C. (T.) kotschani*, Pr i Setës, AL (NHMW110430/MN/0328, HNHM 99787).

### Remarks

*Cochlostoma* (*T.*) *mnelense* is reported in MolluscaBase (2023) as a subspecies of *C. (T.) sturanyi* and not considered in Welter-Schultes (2012).

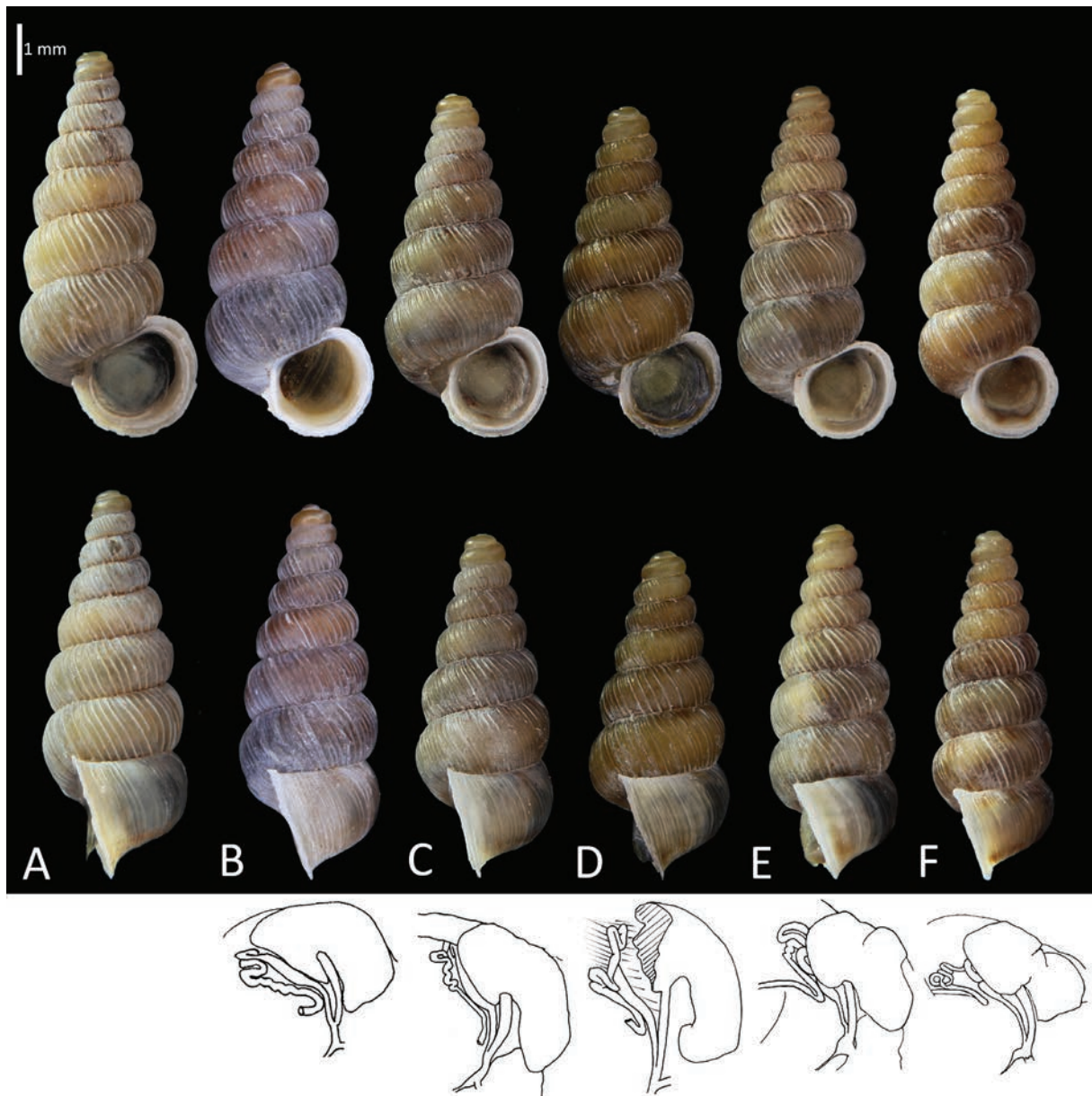


**Fig. 46.** Syntype of *Cochlostoma* (*T.*) *mnelense* (Wagner, 1914) (NHMW-41173), “Berg Mnela b. Oroshi”, AL.

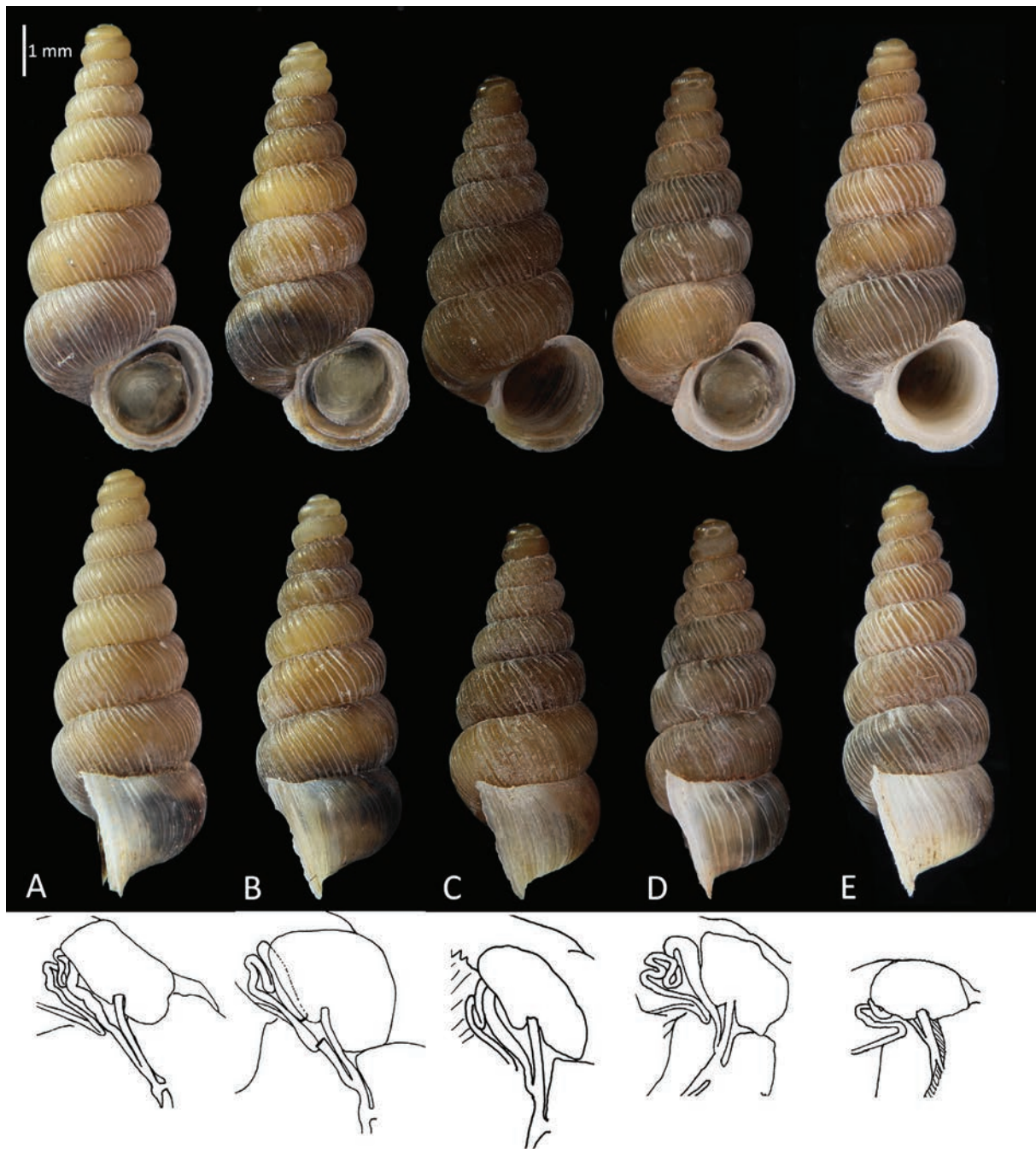


**Fig. 47.** Topotypical *Cochlostoma (T.) mnelense* (Wagner, 1914), 1- Mali i Munellës, AL (HNHM-99864).

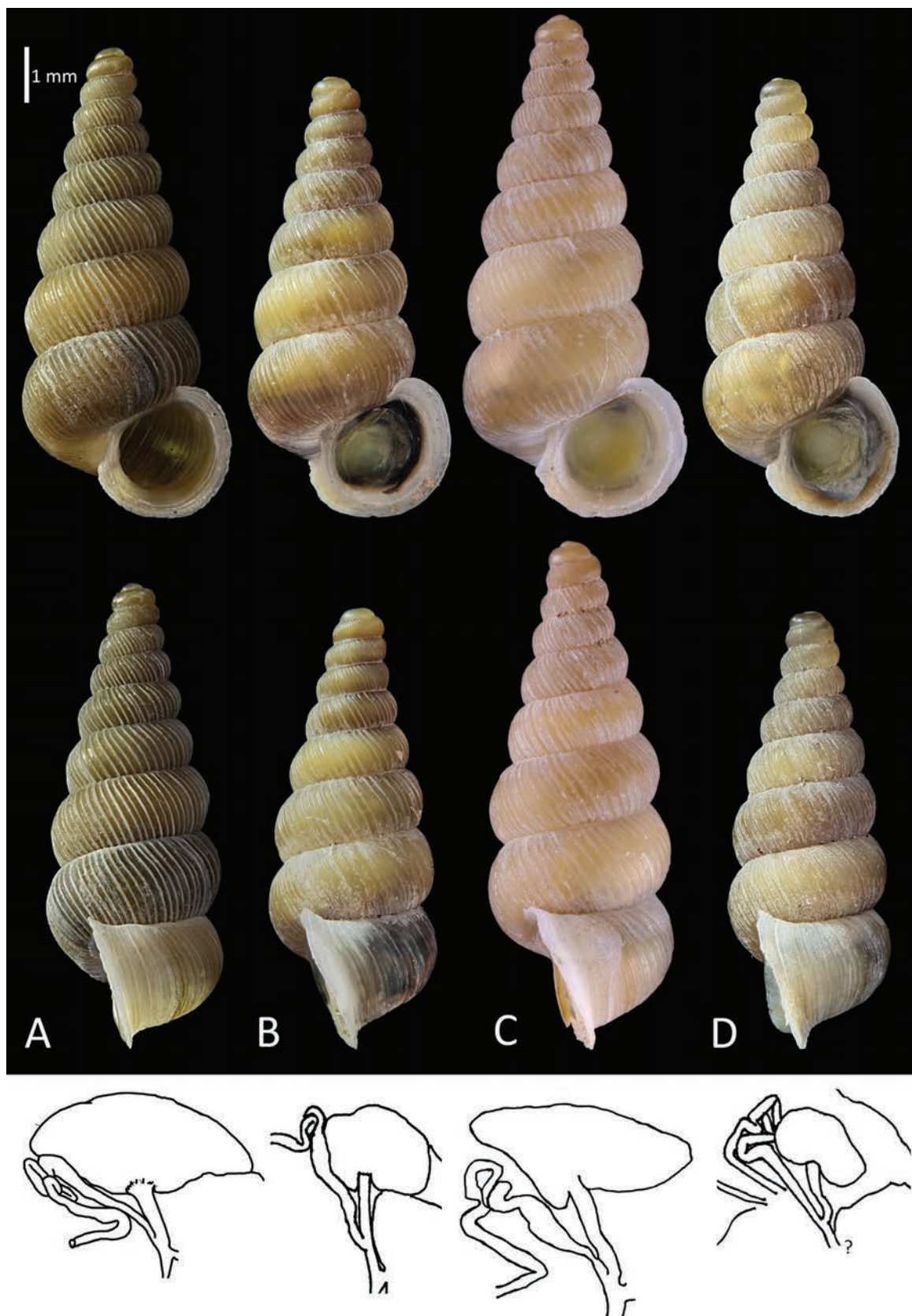




**Fig. 48.** *Cochlostoma* (*T.*) *mnelense* (Wagner, 1914). **A.** 1- Mali i Munellës, AL (HNHM-99864). **B.** 7- Mali i Shentit 1310, AL (HNHM-99170). **C-D.** 2- 2.5 km N of Ndërshenë, AL (HNHM-99321). **E-F.** 3- Mërkuth, AL (HNHM-99322).



**Fig. 49.** Samples here as *Cochlostoma (T.) mnelense* cf. (Wagner, 1914). **A.** 1- Strelcë to Selcë e Poshtëme, AL (HNHM-99400). **B.** 2- Strelcë, AL (HNHM-99388). **C.** 4- Kukur, AL (HNHM-99328). **D.** 5- Bishnicë, AL (HNHM-98949). **E.** 6- Maja e Faqekuqit, AL (HNHM-99885).



**Fig. 50.** Samples here as *Cochlostoma (T.) mnelense* cf. (Wagner, 1914). **A.** 1- Orenjë, AL (HNHM-97138). **B–C.** 3- Qafa e Tujanit, AL (HNHM-99869). **D.** 2- Shtyllë pass Gropë Mts, AL (HNHM-99872).

*Cochlostoma (T.) kotschani* sp. nov.

urn:lsid:zoobank.org:act:C9B93114-A1F2-493A-8A80-255DC6ABE04E

Figs 44 (white dots), 45E–H, 51–52

**Differential diagnosis**

*Cochlostoma (T.) mnelense* has a female genital morphology with a long, almost tubular and slim seminal receptacle, whereas it is short, with a simplified loop path, in the new taxon. *Cochlostoma (T.) muranyii* sp. nov. has much thinner and regular ribs. Although often not clearly visible, in *C. (T.) kotschani* sp. nov. the columellar lobe is deeply indented.

**Etymology**

The species is dedicated to Jenő Kotschán, a leading figure in Hungarian agro-zoological research, once an enthusiastic mite taxonomist, who used to have time to participate in some of the field trips where this species was collected.

**Types**

**Holotype**

ALBANIA • ♀; 1- Mat district, Shkëmb i Skanderbeut, gorge of Lumi i Varoshit; 41.6465° N, 20.1901° E; 970 m a.s.l.; Barina, Fehér, Murányi, Pifkó and Ujvári leg.; May 2010; HNHM99656a/1.

**Paratypes**

ALBANIA • 2 ♀♀; same collection data as for holotype; HNHM99656b/2 • 1 ♂; same collection data as for holotype; HNHM99656b/3.

**Other specimens**

ALBANIA • 2- Lumi i Varoshit 975; 41.6186° N, 20.151° E; 2005; Deli, Eröss, Fehér and Murányi leg.; HNHM97139 • 3- Macukull 1939; 41.6902° N, 20.1659° E; 2009; Barina and Pifkó leg.; HNHM97131 • 4- Macukull 1702; 41.6886° N, 20.1557° E; 2009; Barina and Pifkó leg.; HNHM97130 • 5- Macukull 1472; 41.6908° N, 20.1468° E; 2009; Barina and Pifkó leg.; HNHM97129 • 6- 3 km W of Qafa e Murrës; 41.6186° N, 20.151° E; 2003; Eröss, Fehér, Kotschán and Murányi leg.; HNHM97125 • 7- Macukull 1280; 41.6971° N, 20.1362° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99324 • 8- Lumi I Varoshit 1540; 41.6747° N, 20.2112° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99657 • 9- Selishtë; 41.627° N, 20.2713° E; 2003; Eröss, Fehér, Kotschán and Murányi leg.; HNHM99876 • 1- Pr i Setës; 41.7529° N, 20.2522° E; 2015; Eröss, Fehér and Grego leg.; NHMW110430/MN/0328, HNHM 99787 • 2- Pr i Setës gorge 710; 41.7508° N, 20.2528° E; 2006; Eröss, Fehér, Hunyadi and Murányi leg.; HNHM97141.

**Type locality**

ALBANIA • 1- Mat district, Shkëmb i Skanderbeut, gorge of Lumi i Varoshit; 970 m a.s.l.; 41.6465° N, 20.1901° E.

**Description**

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with rather strong ribs. Quite developed and strong lip with wide, abruptly inwardly curved or indented columellar lobe covering umbilicus.

MEASUREMENTS. 16 ♀♀: whorls=7.1–8, H=7.1–8.8 mm, H/W=2.42–3.05, roundness=0.13–0.2, ribs incl.=54–68°, apert. incl.=13–24°, ribs/mm 1<sup>st</sup> wh.=4–12, ribs/mm 4<sup>th</sup> wh.=6–15.

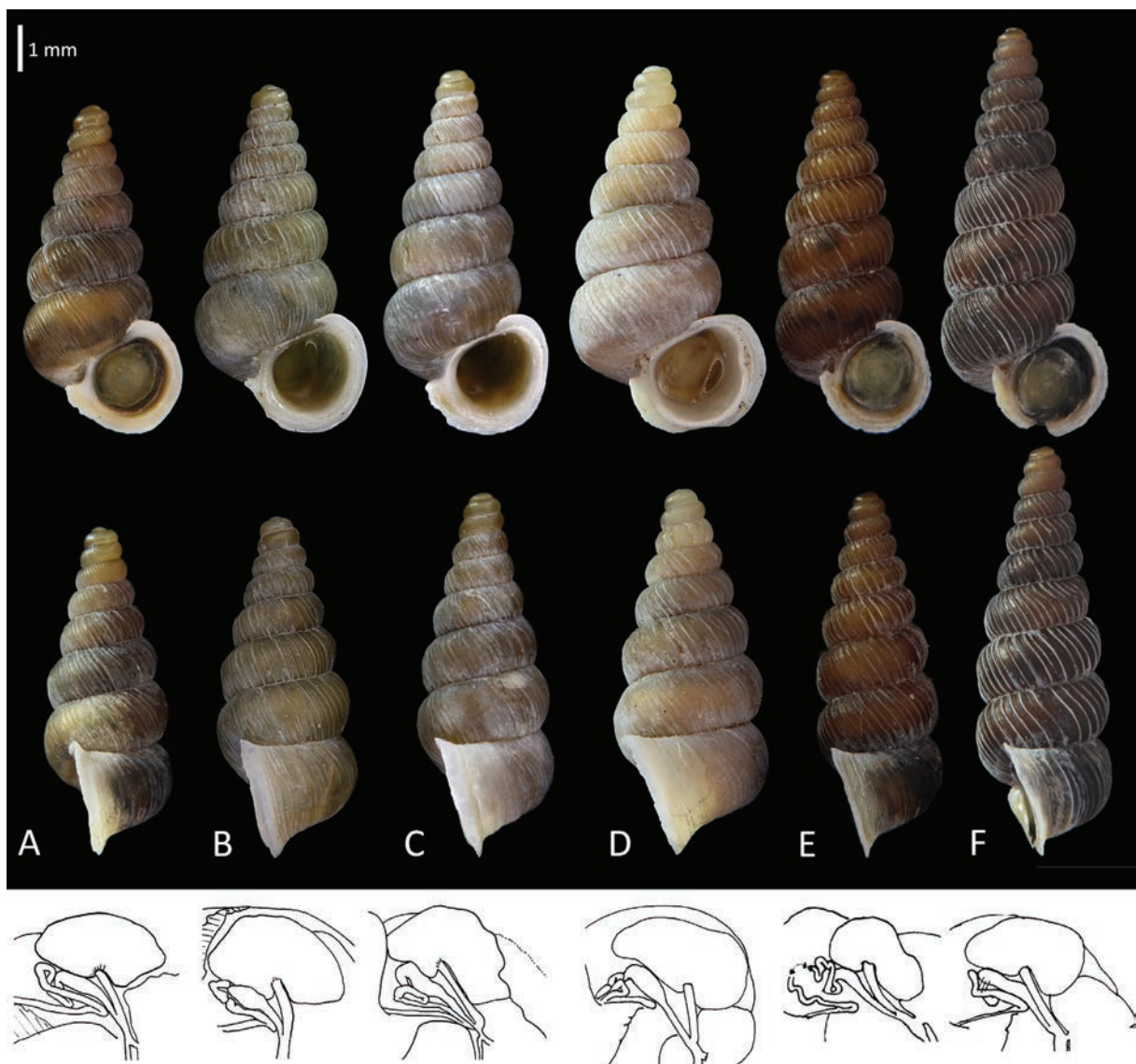


**Fig. 51.** *Cochlostoma (T.) kotschani* sp. nov., female holotype (Hf) (HNHM99656a/1), female (Pf) (HNHM99656b/2) and male paratype (Pm) (HNHM99656b/3).

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Short seminal receptacle confined to ventral side of body with 2–3 loops close to apex. Junction of uterus gland close to connection between distal oviduct and pedunculus.

### Remarks

These samples come from an area located in the Burrel and Dibrë districts. They are closely related with each other ( $p$ -distances=0.0–0.5%). The samples from “Pr. i Setës” have a very distinctive shell morphology (Fig. 52F).



**Fig. 52.** *Cochlostoma (T.) kotschani* sp. nov. A. 1- Lumi i Varoshit, 970 m a.s.l., AL (HNHM-99656). B. 3- Macukull 1939, AL (HNHM-97131). C. 4- Macukull 1702, AL (HNHM-97130). D. 8- Lumi I Varoshit 1540, AL (HNHM-99657). E–F. 2- Pr. i Setës gorge 710, AL (HNHM-97141).

*Cochlostoma (T.) muranyii* sp. nov.

urn:lsid:zoobank.org:act:7DABC097-C443-4D4A-863F-F8B54756F316

Figs 44 (Cyan dots), 53–54

**Differential diagnosis**

It can be distinguished from the other species inhabiting Albania because the thin, closely spaced and very regular in strength and spacing ribs. Compared with *C. (T.) mnelense*, it shows, in the female genitals, a shorter and straight seminal receptacle.

**Etymology**

This species is dedicated to Dávid Murányi, entomologist and field zoologist, who has made a significant contribution to our knowledge of the aquatic insect fauna of the Balkans and Albania in particular.

**Types**

**Holotype**

ALBANIA • ♀; 1- Has district, Mali i Pashtrikut 1730; 42.207° N, 20.5285° E; Fehér, Murányi and Ujvári leg.; May 2010; HNHM99320a/1.

**Paratypes**

ALBANIA • several specimens; same collection data as for holotype; HNHM99320b (1 ♀ and 1 ♂ out of the lot are depicted in Fig. 53).

**Other specimens**

ALBANIA • 2- Salghinë; 42.2155° N, 20.5171° E; 2010; Fehér, Murányi and Ujvári leg.; HNHM99658 • 3- Shkallë Bicaj; 41.9897° N, 20.4202° E; 2007; Dányi, Eröss, Fehér, Hunyadi and Murányi leg.; HNHM99887.

**Type locality**

ALBANIA • 1- Has district, Mali i Pashtrikut 1730; 42.207° N, 20.5285° E.

**Description**

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with thin and very closely spaced ribs. Moderately strong lip with more or less abruptly inwardly curved columellar lobe, often only partially covering umbilicus.

MEASUREMENTS. 6 ♀♀: whorls=7.2–8.1, H=7.2–8.5 mm, H/W=2.46–2.7, roundness=0.12–0.16, ribs incl.=59–61°, apert. incl.=16–23°, ribs/mm 1<sup>st</sup> wh.=11–16, ribs/mm 4<sup>th</sup> wh.=10–18.

FEMALE GENITAL ORGANS. Connection of pedunculus to bursa copulatrix slightly moved posteriorly. Relatively short and straight (compared with *C. (T.) mnelense*) seminal receptacle. Few short loops close to apex. Junction of uterus gland close to connection between pedunculus of bursa copulatrix and distal oviduct.

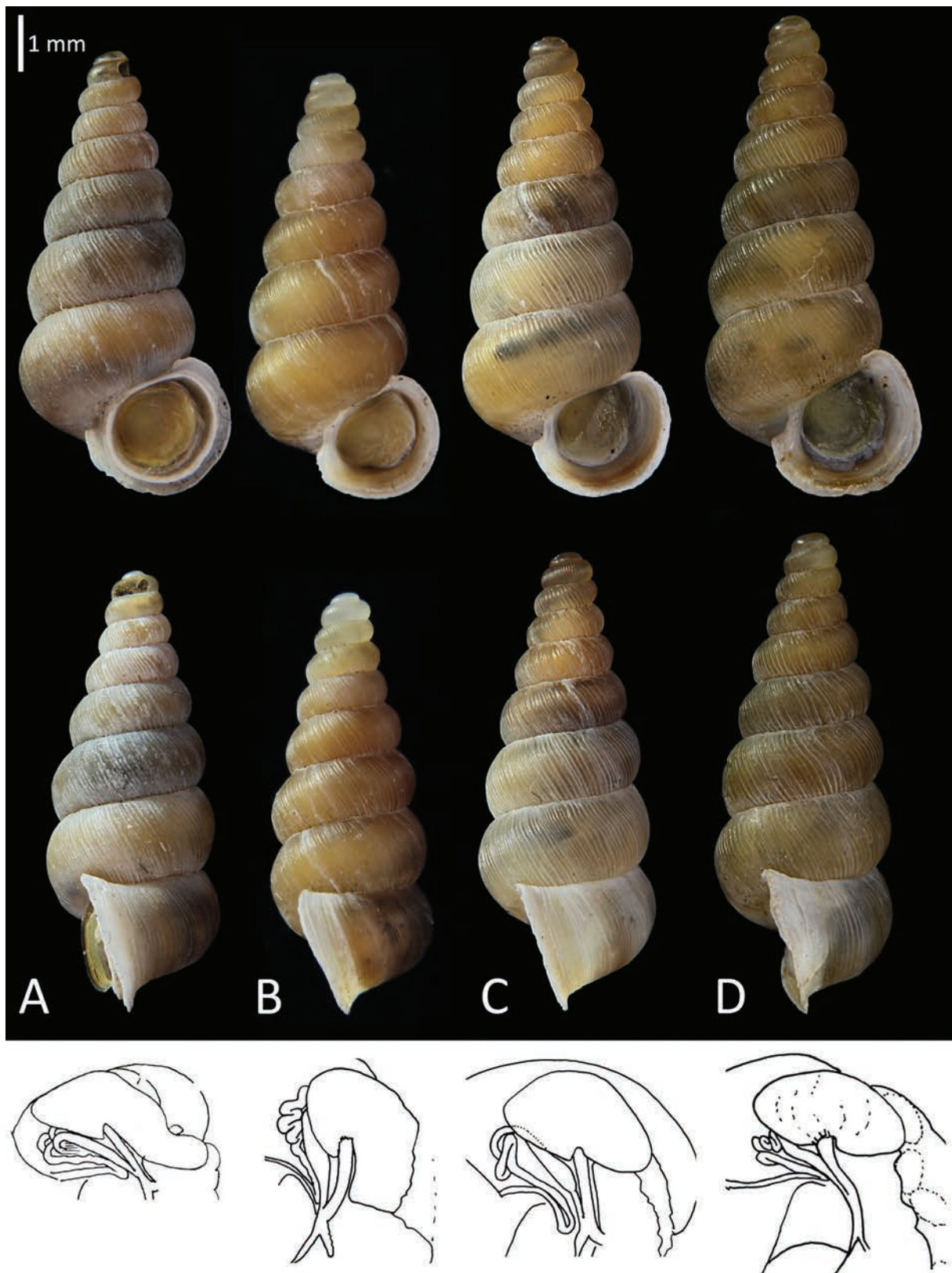
**Remarks**

In an area northeast of the range of *C. (T.) mnelense*, we collected samples characterized by a very distinct shell ribbing and female genital morphology. Despite the absence of molecular data, we describe them as *C. (T.) muranyii* sp. nov., next to *C. (T.) mnelense* because of the geographical proximity. The assignment to clade A is tentative, waiting for clarifying molecular data.



**Fig. 53.** *Cochlostoma (T.) muranyii* sp. nov., female holotype (Hf) (HNHM-99320a/1), female (Pf) (HNHM-99320b) and male paratype (Pm) (HNHM-99320b), Mali i Pashtrikut 1730, AL.





**Fig. 54.** *Cochlostoma* (*T.*) *muranyii* sp. nov. A–C. 1- Mali i Pashtrikut 1730, AL (HNHM-99320). D. 2- Salghinë, AL (HNHM-99658).

## Clade B

### Note on clade B

In an unresolved polytomy at the roots of the clade there are the samples collected in the Apuane Alps, which are a small calcareous mountain range in the northern Apennine region surrounded by arenaceous terrains. We obtained both the 16S and H3 markers in 10 samples of the 31 we analysed. All the populations of *Cochlostoma* of the Apuane share the same female genital morphology but differ in shell morphology, with 2 main types, one having a horn-brown shell with more or less visible reddish spots and a variable ribbing, and a second one with a spotless, cream-coloured shell with thin and regular ribs. Some samples of the first form have rather thin and closely spaced ribs, whereas others have a coarser ribbing. The shape of the shell varies from slim (the slimmest shell observed in *Cochlostoma*) to sturdy.

These differences in the shell morphology are reflected in the phylogenetic trees, with the analysed samples not clustering in a branch of the BA and ML trees. Apparently, more than one endemic species of *Cochlostoma* inhabits this small mountain range, contrary to the currently accepted view, where only the nominotypical subspecies of *C. (T.) montanum* (Issel, 1866) is reported from this area. We recognize three nominal taxa for the Apuane Alps, namely *C. (T.) montanum*, *C. (T.) sospes* (Westerlund in Paulucci, 1879) and *C. (T.) elongatum* (Paulucci, 1879). Further sets of problematic samples are reported in Appendix.

### *Cochlostoma (T.) elongatum* (Paulucci, 1879)

Figs 55 (red dots), 56E, 57–59

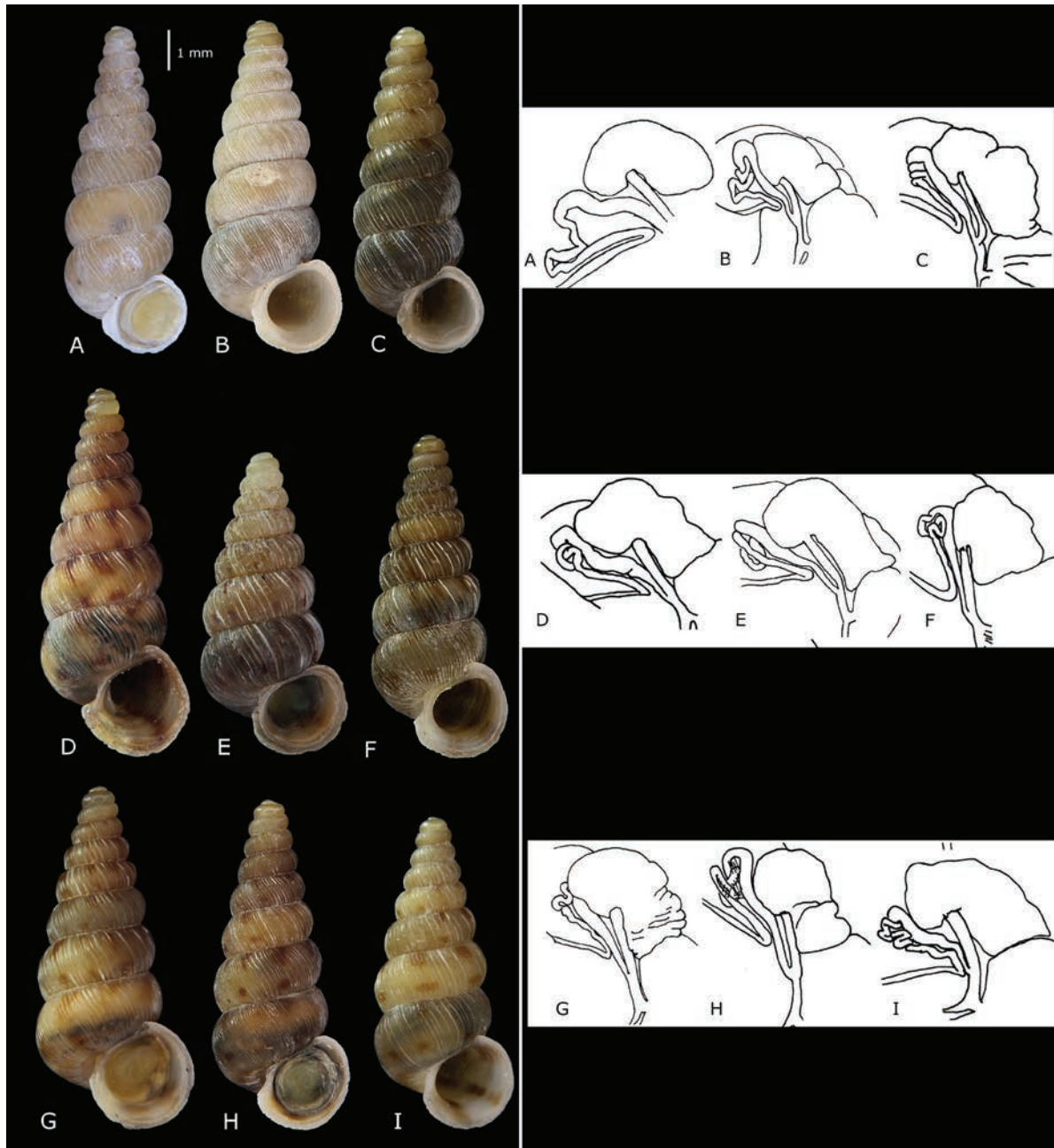
*Pomatias elongatus* Paulucci, 1879a: 13–14.



**Fig. 55.** Distribution of samples of the Apuane Alps part of clade B: red dots=*Cochlostoma (T.) elongatum* (Paulucci, 1879); green dots=*C. (T.) montanum* (Issel, 1866); orange dots=*C. (T.) sospes* (Westerlund in Paulucci, 1879). The samples with amplified 16S are marked with a black center.

**Lectotype** (here designated)

ITALY • “*Pomatias elongatus* Paulucci in *Bullet. Soc. Malacol. Ital.* Febbraio 1879 pag. 13 n° 1, Foce Del Lucese alpi apuane 5 esempl. ricevuti dal Dr. Del Prete 1877 e da lui raccolti”; MZUF13605\_10158.



**Fig. 56.** Shell and female genitals of samples from the Apuane Alps with amplified 16S. **A.** *Cochlostoma* (*T.*) *sospes* (Westerlund in Paulucci, 1879), Turrite Secca 4, I (WP-78). **B.** *C.* (*T.*) *sospes*, Val Serenaia, I (EZ-0784). **C.** *C.* (*T.*) *sospes*, Vagli, I (EZ-1064). **D.** NFS155, Piastra, I (EZ-1064). **E.** *C.* (*T.*) *elongatum* (Paulucci, 1879), Monte Prana, I (WP-99). **F.** NFS159, Val Serenaia, I (EZ-0937). **G.** NFS155, Gragnana, I (WdM-4143). **H.** *C.* (*T.*) *montanum* (Issel, 1866), Pania della Croce, I (EZ-1059). **I.** NFS154, Equi Terme, I (EZ-0783).

### Other specimens

ITALY • 2- Mt Prana; 43.9566° N, 10.3533° E; 2015; Scarlassara leg.; Scarlassara99 • 3- Ponte Stazzemese; 43.997° N, 10.2949° E; 2011; Hallgass leg.; EZ1089 • 4- Turrite di Gallicano 1; 44.045° N, 10.3877° E; 2015; Scarlassara leg.; Scarlassara86 • 5- Turrite di Gallicano 2; 44.0284° N, 10.3546° E; 2015; Scarlassara leg.; Scarlassara87 • 6- Ponte Tomarlo; 43.9937° N, 10.2988° E; 2015; Scarlassara leg.; Scarlassara79.

### Type locality

The Marquese Marianna Paulucci, in the original description of the species, mentioned several localities: “Abita le Alpi Apuane, il Monte Forato, la foce del Lucese, Prana e Gabberi, Ponte Stazzemese in

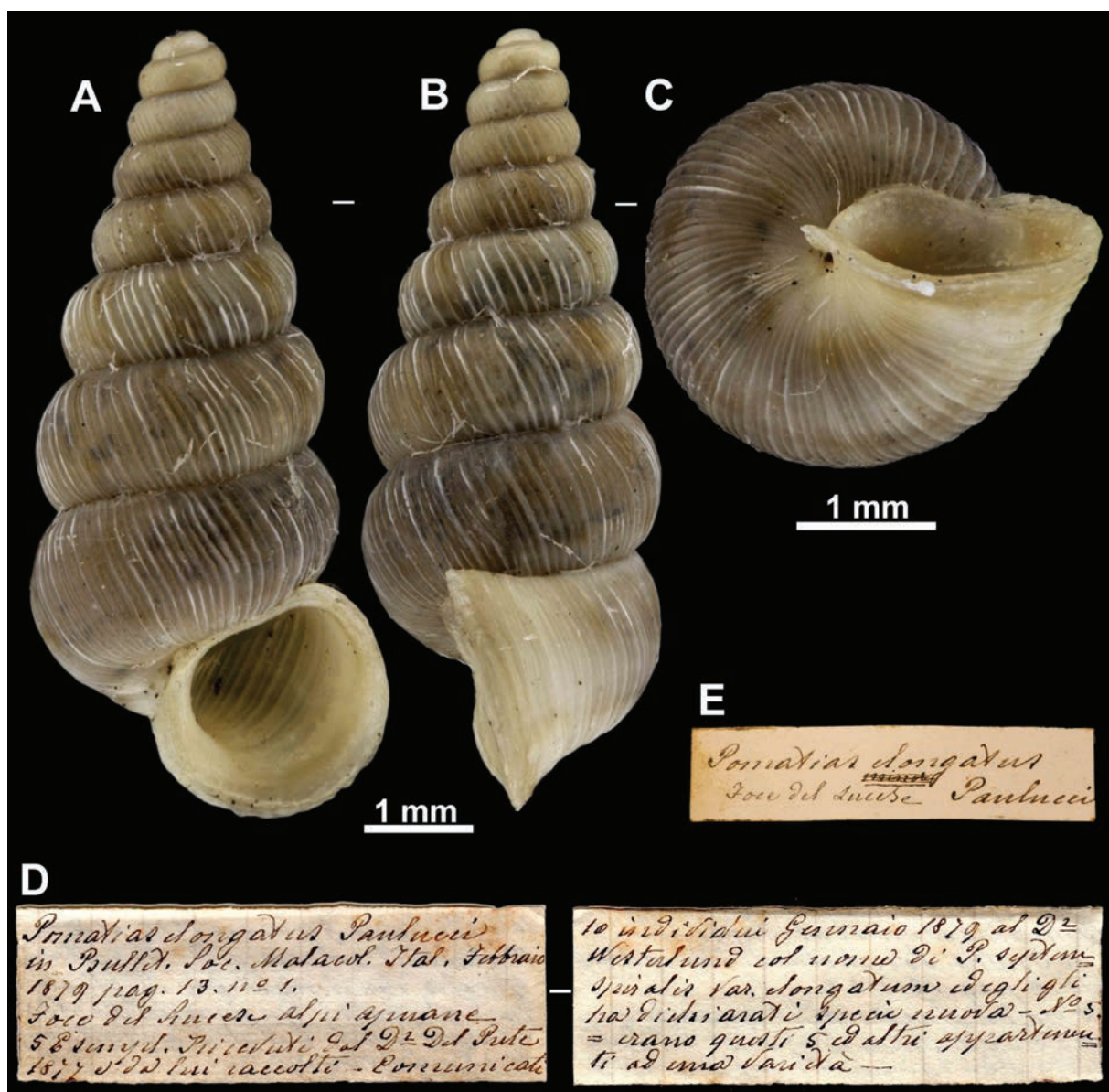


Fig. 57. Lectotype (here designated) of *Cochlostoma* (*T.*) *elongatum* (Paulucci, 1879), 1- Foce del Lucese, I (MZUF-13605\_100158).

provincia di Lucca...". By the designation of MZUF13605\_10158 as lectotype, ITALY • 1- Foce del Lucese; 43.9354° N, 10.3821° E, becomes the type locality.

### Description

SHELL. Barely visible riblets on last part of protonch. Teleoconch with two lines of reddish spots on whorls. Ribs strong, more or less whitish and quite irregular in strength, becoming weaker toward aperture. Rather weak lip with gently inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 11 ♀♀: whorls=7.5–8.6, H=7.2–8.9 mm, H/W=2.4–2.8, roundness=0.14–0.21, ribs incl.=57.9–71.5°, apert. incl.=16.1–28.8°, ribs/mm 1<sup>st</sup> wh.=6–23, ribs/mm 4<sup>th</sup> wh.=8–21.

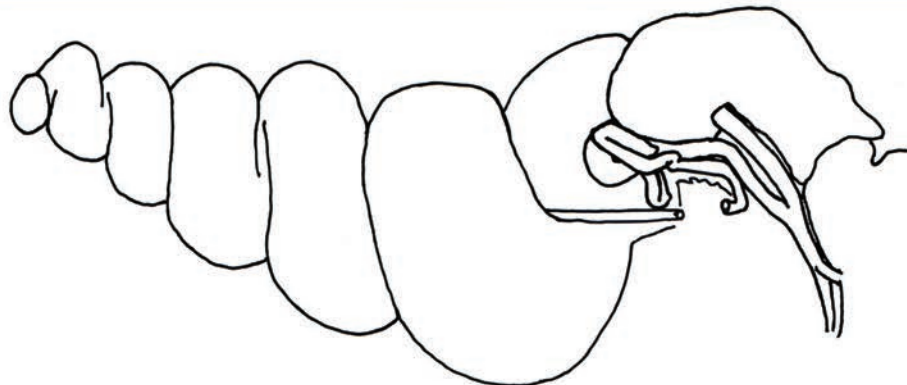
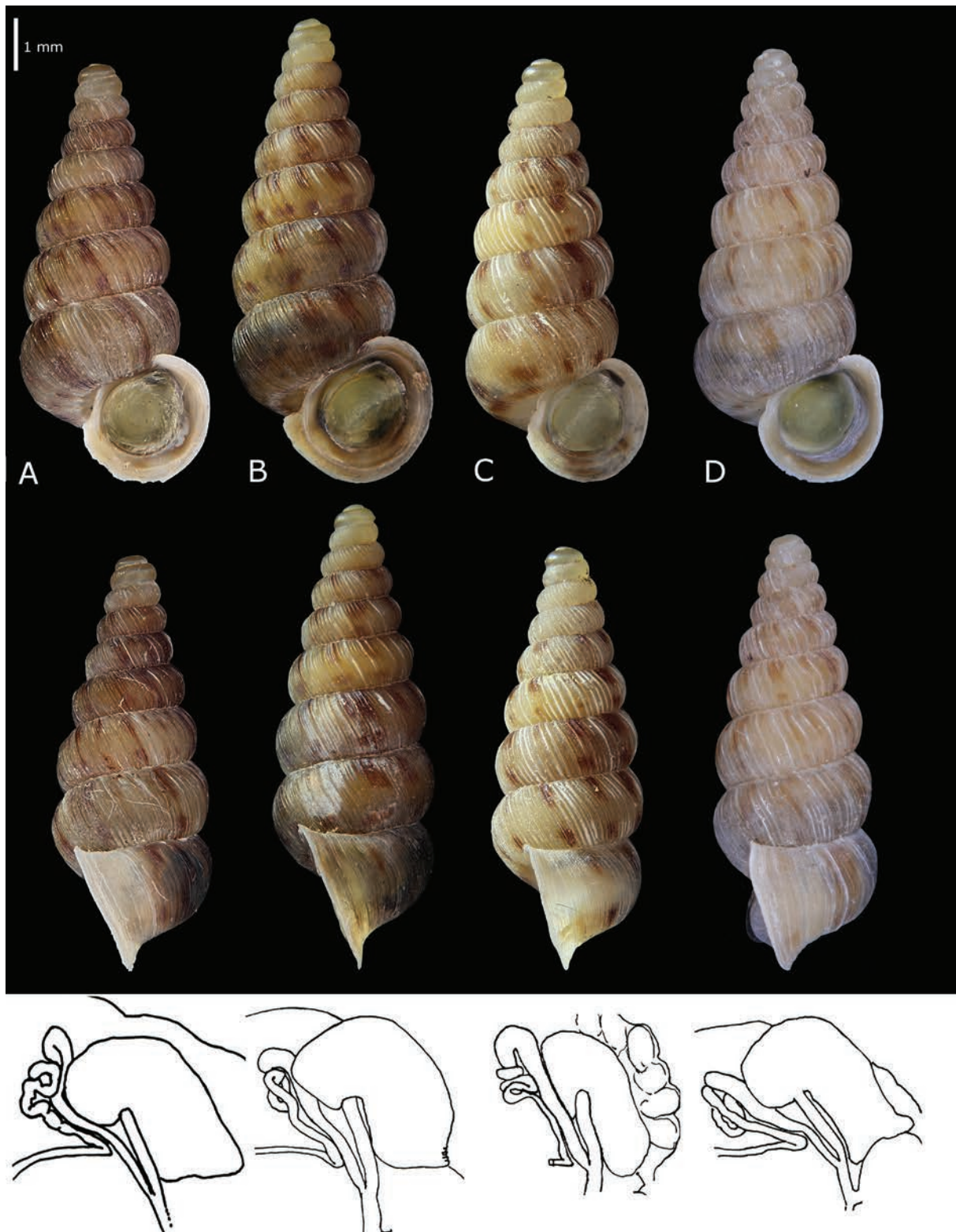


Fig. 58. *Cochlostoma (T.) elongatum* (Paulucci, 1879), 3- Pontestazzemese, I (EZ-1089).



**Fig. 59.** Samples assigned to *Cochlostoma* (*T.*) *elongatum* (Paulucci, 1879). **A.** 3- Pontestazzemese, I (EZ-1089). **B.** 6- Ponte Tomarlo, I (WP-79). **C.** 5- Turrite del Gallicano 2, I (WP-87). **D.** 2- Mt Prana, I (WP-99).

FEMALE GENITAL ORGANS. Posterior connection of pedunculus to bursa copulatrix. Elongated, club-shaped and more or less tortuous seminal receptacle with bent apex. 2–4 loops clustered close to apex of seminal receptacle. Junction of uterus gland far from connection of distal oviduct with pedunculus of bursa copulatrix.

### Remarks

Due to the high conchological variability observed among the populations inhabiting the relatively small area of the Apuane, it seems useful to designate a lectotype and a unique type locality.

### *Cochlostoma (T.) montanum* (Issel, 1866)

Figs 55 (green dots), 56H, 60–61

*Pomatias patulum* var. *montanus* Issel, 1866: 29.

### Types

Not seen.

### Other specimens

ITALY • 1- Mt Pania della Croce top (topotypical); 44.0365° N, 10.323° E; 2015; Scarlassara leg.; Scarlassara97 • 2- Pania della Croce; 44.0249° N, 10.2969° E; 2011; Zallot leg.; EZ1059 • 3- Passo Del Vestito; 44.0656° N, 10.2248° E; 2009; Margelli leg.; EZ0785 • 4- tunnel del Cipollaio; 44.0509° N, 10.2649° E; 2011; Hallgass leg.; EZ1086 • 5- Fosciomboli-Foce di Moscetta; 44.0419° N, 10.2855° E; 2011; Hallgass leg.; EZ1087 • 6- Via Arni; 44.0585° N, 10.2630° E; 2011; Hallgass leg.; EZ1088 • 7- Turrite Secca 1; 44.0621° N, 10.2891° E; 2015; Scarlassara leg.; Scarlassara-84 • 8- Turrite Secca 3; 44.0932° N, 10.3856° E; 2015; Scarlassara leg.; Scarlassara-76.

### Type locality

ITALY • “sulla sommita’ della Pania della Croce” (Top of Mount Pania della Croce, Lucca, Toscana).

### Description

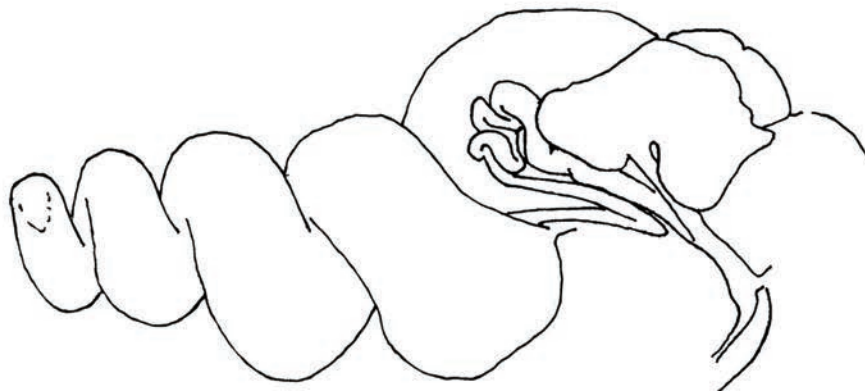
SHELL. Closely spaced riblets on last part of protoconch. Teleoconch with two lines of reddish spots on whorls. Moderately strong, some whitish and quite narrowly spaced ribs becoming weaker approaching aperture. Moderately weak lip with gently inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 17 ♀♀: whorls=7.7–10, H=7.4–9.1 mm, H/W=2.6–3.4, roundness=0.15–0.2, ribs incl.=56–66.2°, apert. incl.=15.4–27.6°, ribs/mm 1<sup>st</sup> wh.=8–19, ribs/mm 4<sup>th</sup> wh.=7–17.

FEMALE GENITAL ORGANS. As in *C. (T.) elongatum*.

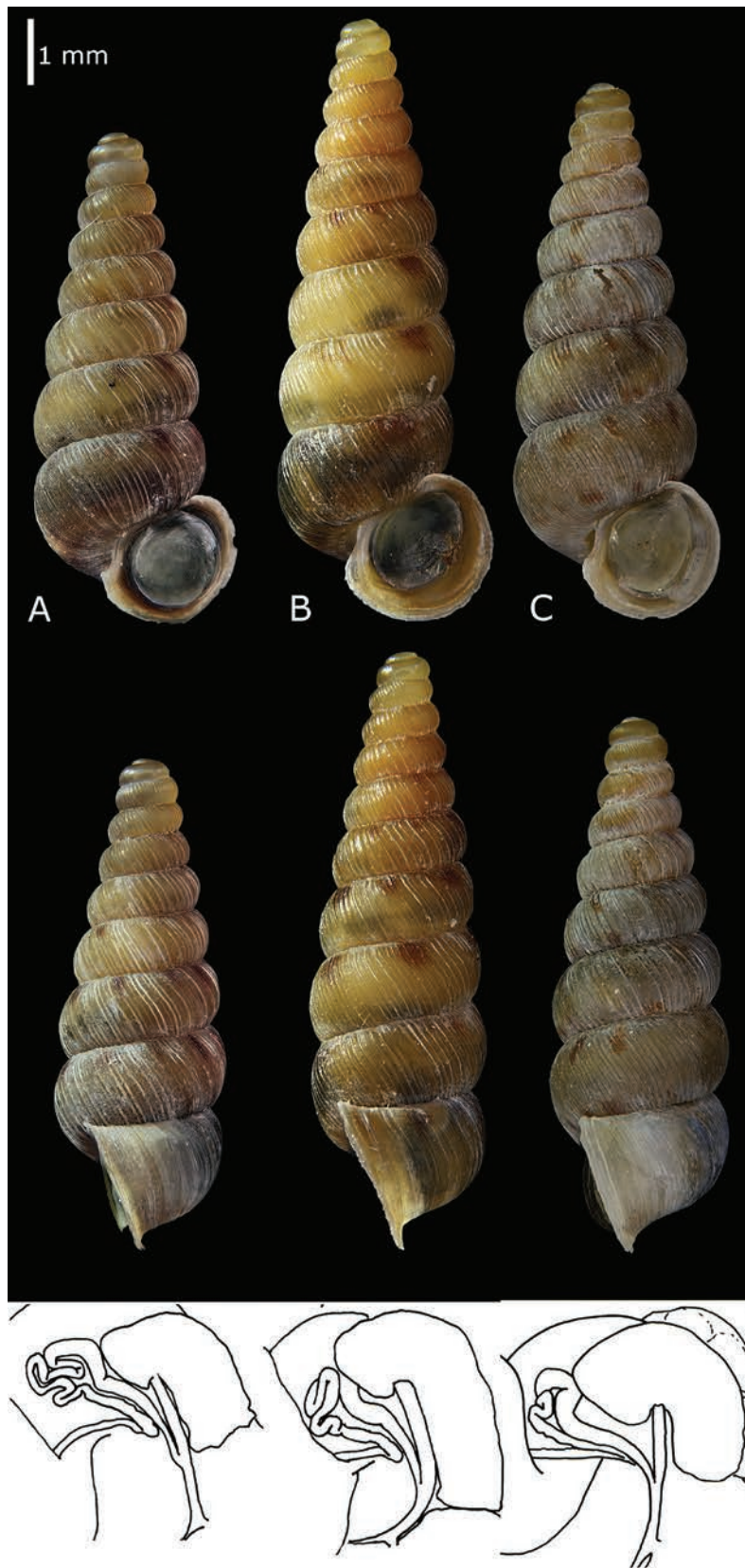
### Remarks

A horn-brown form with homogeneous ribbing has been found on the summit of Pania della Croce, the type locality of *C. montanum* (Issel, 1866). Therefore, we can identify it with this species. Some populations are doubtfully assigned to *C. (T.) montanum* because of differences in the ribbing of the shell. However, more morphological, molecular and distributional data of the different types are needed.



**Fig. 60.** Topotypical *Cochlostoma (T.) montanum* (Issel, 1866), 1- top of Pania della Croce, I (WP-99-).





**Fig. 61.** Samples assigned to *Cochlostoma (T.) montanum* (Issel, 1866). **A.** 2- Pania della Croce, I (EZ-1059). **B.** 4- Tunnel del Cipollaio, I (EZ-1086). **C.** 5- Fosciomboli-Foce di mosceta, I (EZ-1087).

*Cochlostoma (T.) sospes* (Paulucci, 1879)

Figs 55 (orange dots), 56A–C, 62–64

*Pomatias sospes* Westerlund in Paulucci, 1879a: 21.

**Syntypes**

ITALY • probably 2 ♀♀ and 2 ♂♂; “*Pomatias sospes*, Westerl., Livignano a Mosceta”; MZUF GC/9836.

**Other specimens**

ITALY • 1- Verso Foce Mosceta (topotypical); 44.0255° N, 10.303° E; 2015; Scarlassara leg.; Scarlassara-82 • 2- Vagli; 44.1102° N, 10.2894° E; 2009; Margelli leg.; EZ0091 • 3- Val Serenaia; 44.1339° N, 10.1973° E; 2009; Pocaterra leg.; EZ0784 • 4- Val Serenaia; 44.1289° N, 10.2029° E; 2015; Scarlassara leg.; Scarlassara-59 • 5- Foce Cardeto; 44.1219° N, 10.2161° E; 2015; Scarlassara leg.; Scarlassara-61 • 6- Turrite Secca 2; 44.063° N, 10.2218° E; 2015; Scarlassara leg.; Scarlassara-72 • 7- Turrite Secca 4; 44.0481° N, 10.2624° E; 2015; Scarlassara leg.; Scarlassara-78 • 8- 1.3 km S–SW of Gorfigliano; 44.1459° N, 10.2483° E; 2021; Cianfanelli, Bodon, Calcagno and Vezzali leg.; MZUF-65312.

**Type locality**

ITALY • Levigliani, Lucca, Toscana, Italy (“Livignano a Mosceta” on the label of MZUF GC/9836).

**Description**

SHELL. Moderately spaced riblets on last part of protoconch. Teleoconch spotless with peculiar reddish-yellowish hue (not evident in preserved syntypes). Very regular ribbing with quite closely spaced ribs slightly weaker approaching aperture. Weak lip with gently inwardly curved columellar lobe covering more or less completely umbilicus.



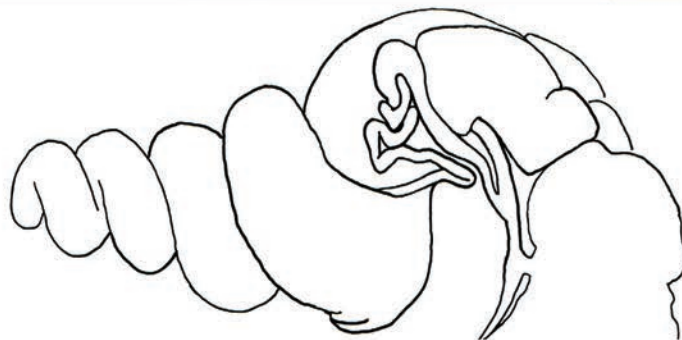
**Fig. 62.** Syntypes *Cochlostoma (T.) sospes* (Westerlund in Paulucci, 1879) (“Livigliani a Mosceta”) (MZUF GC9836). Foto Simone Taglienti.

MEASUREMENTS. 17 ♀♀: whorls=7.1–9.1, H=6.9–9.2 mm, H/W=2.5–3, roundness=0.14–0.19, ribs incl.=55.8–67.5°, apert. incl.=13.4–28.4°, ribs/mm 1<sup>st</sup> wh.=8–16, ribs/mm 4<sup>th</sup> wh.=7–16.

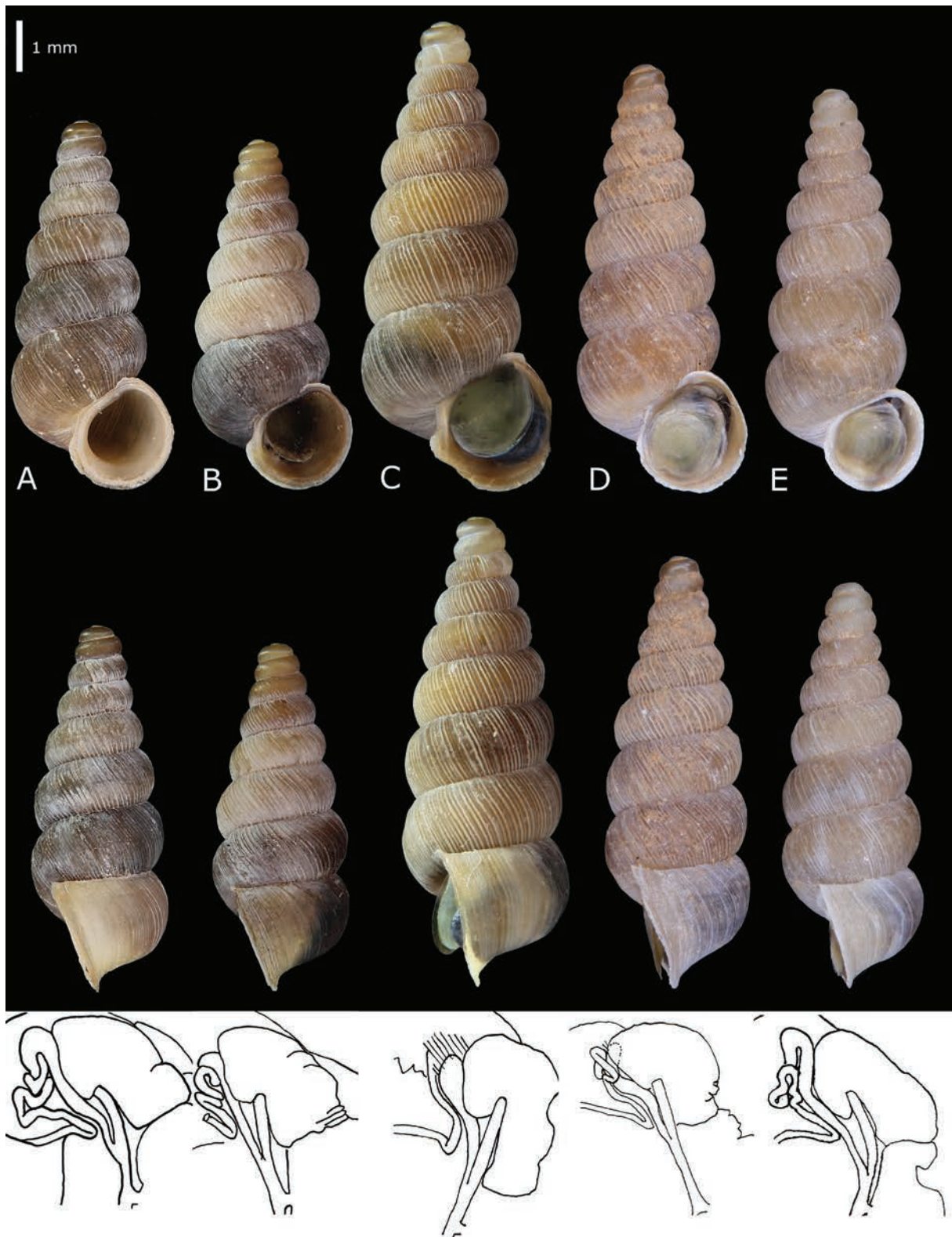
FEMALE GENITAL ORGANS. As in species *C. (T.) elongatum*.

### Remarks

Cianfanelli *et al.* (2023) noted that a paper by Paulucci (1879a), containing the description of this taxon, was published “before April 23 1879” and the one of Westerlund (1879) in which he redescribed the species on July 1 1879. Thus, it has to be reported as *C. (T.) sospes* (Westerlund in Paulucci, 1879).



**Fig. 63.** *Cochlostoma (T.) sospes* (Westerlund in Paulucci, 1879), 1- verso Foce di Mosceta, I (WP-82), assumed as topotypical.



**Fig. 64.** *Cochlostoma (T.) sospes* (Westerlund in Paulucci, 1879). **A.** 3- Val Serenaia, I (EZ-0784). **B.** 2- Vagli, I (EZ-1064). **C.** 5- Foce Cardeto, I (WP-61). **D.** 6- Turrite Secca 2, I (WP-72). **E.** 1- verso Foce Mosceta, I (WP-82).

It was described as a shell “lutescenti-ferruginea, subopaca, dense oblique striata [dull reddish-brown, with inclined, narrowly spaced ribs]”.

#### Additional note to clade B

One (although not supported: PP=62; BS=64/76) subclade includes two branches with *C. (T.) sardoum* (Westerlund, 1890) on one side and a new species on the other, inhabiting the Karawanken Alps in Austria and Slovenia. Four other samples, part of this branch, come from the southern part of the Balkans (Montenegro, Kosovo and Albania). Because of insufficient data, they are reported in the Appendix as NFS018, NFS108, NFS128, NFS143.

#### *Cochlostoma (Turritus) sardoum* (Westerlund, 1890)

Figs 65 (cyan dots), 66A–B, 67–68

*Pomatias (Auritus) sardous* Westerlund, 1890: 96–97 (Sardinia, Dorgali, Maltz. Ex.).

#### Types

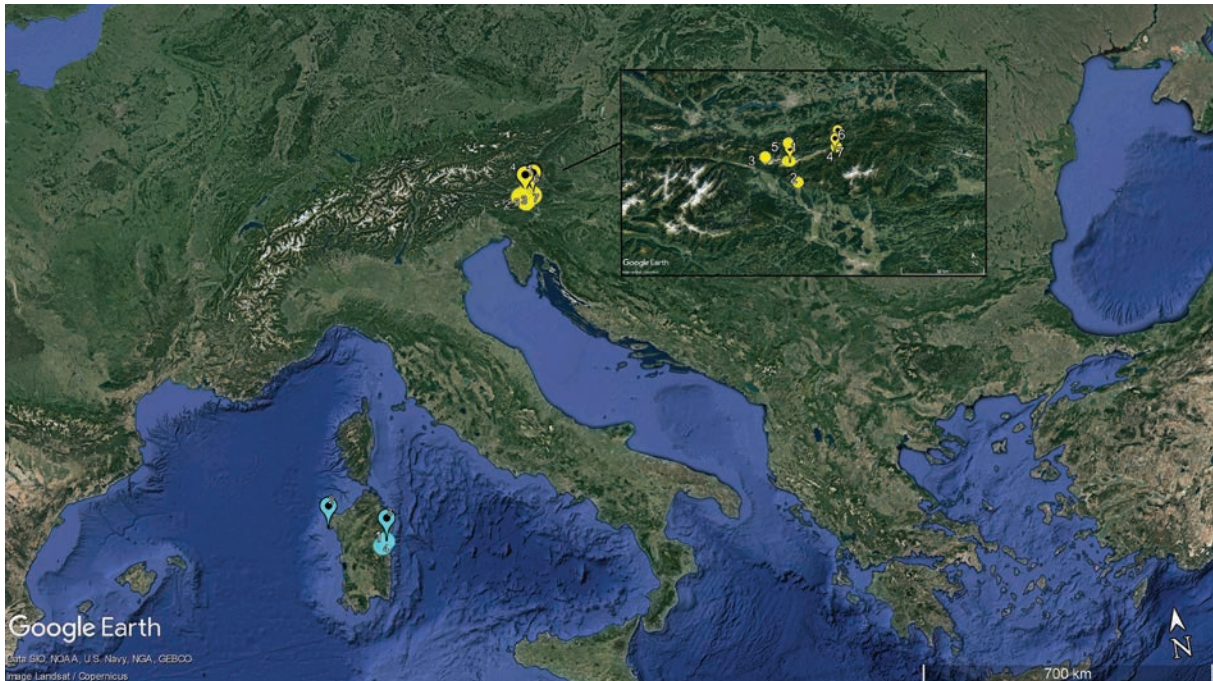
Not seen.

#### Other specimens

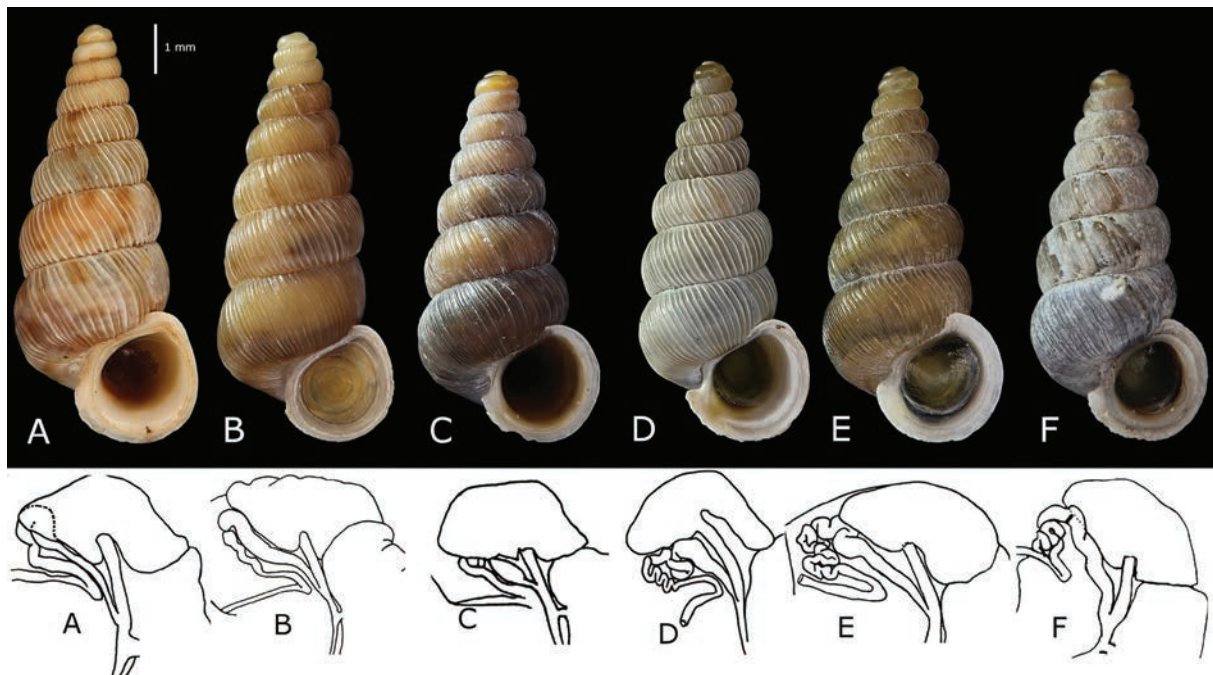
ITALY • Dorgali (Topotypical); 40.2575° N, 9.6209° E; 1984; RMNH leg.; RMNH-117455 • Capo Caccia; 40.5666° N, 8.1640° E; 2007; De Mattia leg.; WdM-6155 • Cala Fuili; 40.2630° N, 9.6269° E; 2009; Margelli leg.; EZ0577 • Ispingoli; 40.1769° N, 9.5273° E; 2007; De Mattia leg.; WdM-6141.

#### Type locality

ITALY • Sardegna, Nuoro, Dorgali.



**Fig. 65.** Distribution of samples of clade B part of the same branch: cyan = *Cochlostoma (T.) sardoum* (Westerlund, 1890); yellow = *C. (T.) lacazei* sp. nov. Black center for the samples with amplified 16S.



**Fig. 66.** Shell and female genitals of samples of Clade B with amplified 16S. **A.** *Cochlostoma* (*T.*) *sardoum* (Westerlund, 1890), Cala Fuili, I (EZ-0577). **B.** *C. (T.) sardoum*, Capo Caccia, I (WdM-6155). **C.** NFS018, Marbicit Mt, AL (HNHM-99878). **D.** NFS108, Lučane, HR (HNHM-92278). **E.** *C. (T.) lacazei* sp. nov., Podljubelj 1, SLO (EZ-1006). **F.** *C. (T.) lacazei*, Trögenger Klamm 1, A (NHMW-109000/AL/00713).



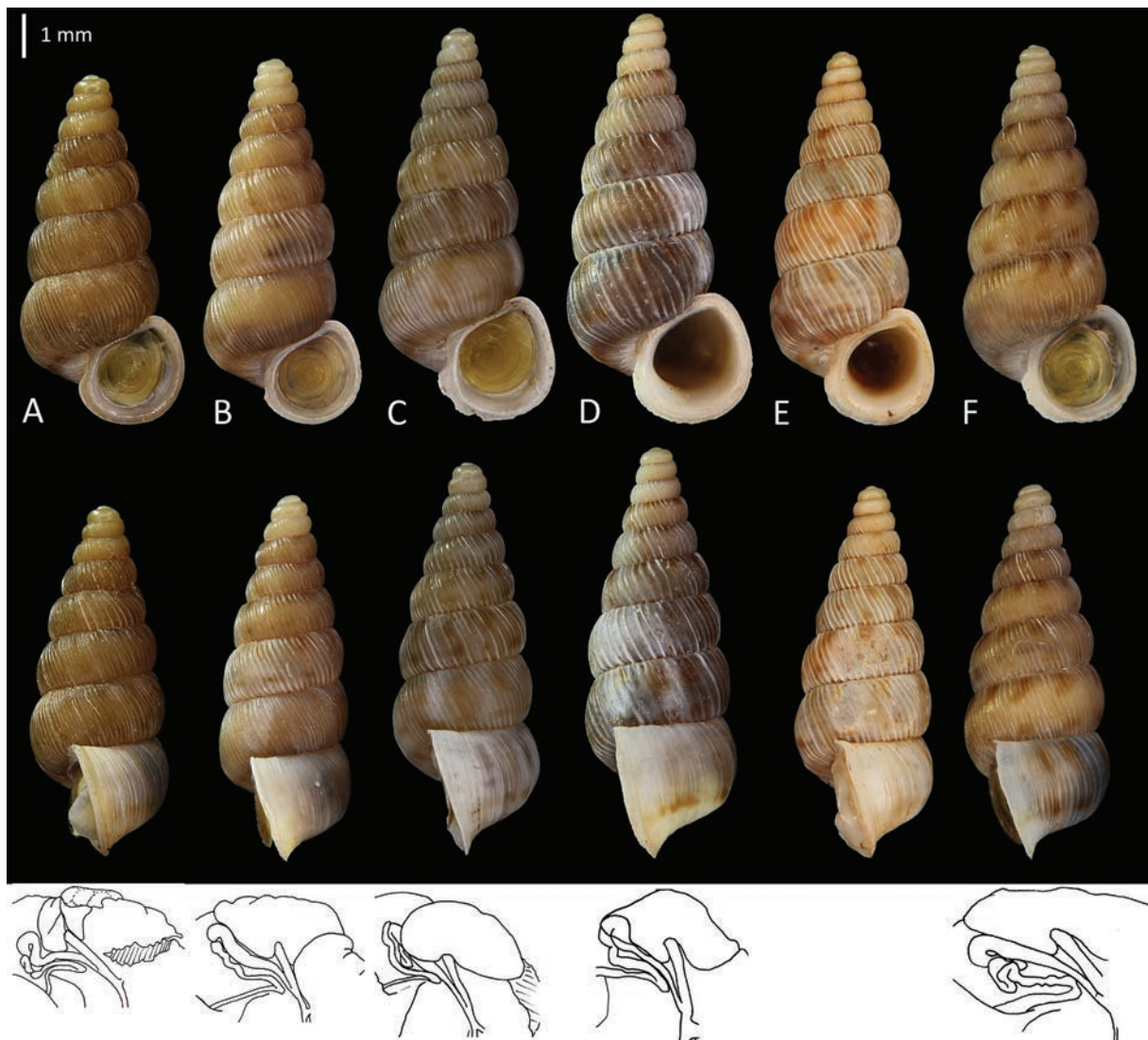
**Fig. 67.** Topotypical specimen of *Cochlostoma* (*T.*) *sardoum* (Westerlund, 1890), 1- Dorgali, I, (RMNH117455).

### Description

**SHELL.** Closely spaced riblets on last part of protoconch. Teleoconch with two lines of more or less visible reddish spots on whorls. Regular, strong and often whitish ribs becoming very weak approaching aperture. Relatively strong lip with gently inwardly curved columellar lobe covering umbilicus. Whorls on average less rounded than in other species of *Turritus*.

**MEASUREMENTS.** 7 ♀♀: whorls=7.2–8.3, H=7.9–9.7 mm, H/W=2.51–2.78, roundness=0.09–0.13, ribs incl.=61–68°, apert. incl.=15–18°, ribs/mm 1<sup>st</sup> wh.=5–15, ribs/mm 4<sup>th</sup> wh.=6–11.

**FEMALE GENITAL ORGANS.** Ventral connection of pedunculus of bursa copulatrix. Elongated seminal receptacle reaching dorsal side of body. Junction of uterus gland moderately far from connection between pedunculus and distal oviduct.



**Fig. 68.** *Cochlostoma* (*T.*) *sardoum* (Westerlund, 1890). **A–B.** 2- Capo Caccia, I (WdM-6155). **C.** 1- Dorgali, I (RMNH-117455). **D–E.** 3- Cala Fuili, I (EZ-0577). **F.** 4- Ispingoli, I (WdM-6141).

## Remarks

Our specimens come either from the west or the east coast of Sardinia, but the species has been also found in the center of the island (see [https://www.naturamediterraneo.com/forum/topic.asp?TOPIC\\_ID=26893;TOPIC\\_ID=81053](https://www.naturamediterraneo.com/forum/topic.asp?TOPIC_ID=26893;TOPIC_ID=81053)). The areas of the island with a limestone substrate are limited to the central east and northwest coasts and some limited areas south of the Gennargentu Mountains. The p-distance between the sample from the east (Cala Fuili) and northeast coast (Capo Caccia) is 0.5%.

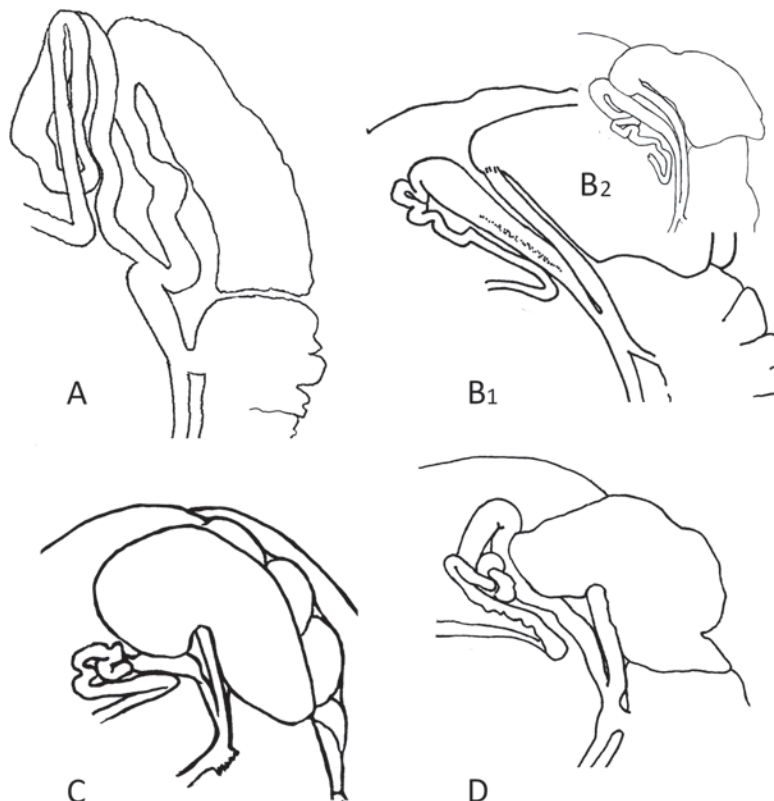
*Cochlostoma (Turritus) lacazei* sp. nov.

urn:lsid:zoobank.org:act:61C853D1-BC2F-4B75-B336-D51638320A8E

Figs 65 (yellow dots), 66E–F, 69D, 70–71

## Differential diagnosis

The other species of *Cochlostoma* living in the Karawanken Alps are distinguished as follows: *C. (Cochlostoma) septemspirale* (Razoumowsky, 1789) (Fig. 69A), *C. (Clessiniella) anomphale* Boeckel, 1939 (Fig. 69B1) and *C. (Clessiniella) tergestinum* (Westerlund, 1878) (Fig. 69B2) have a pedunculus of the bursa copulatrix connected apically, whereas it is ventrally connected in *C. (T.) lacazei* sp. nov. It can be distinguished from *C. (T.) gracile* (Fig. 69C) and the other taxa of clade B because of the long seminal receptacle, reaching the dorsal side of the body (short and confined to the ventral side of the body in clade B).



**Fig. 69.** Female genitalia morphology of the species of *Cochlostoma* Jan, 1830, living on the Karawanken Alps and *C. (Turritus) gracile* (Pfeiffer, 1849). **A.** *C. (Cochlostoma) septemspirale* (Razoumowsky, 1789). **B1.** *C. (Clessiniella) anomphale* Boeckel, 1939. **B2.** *C. (Clessiniella) tergestinum* (Westerlund, 1878). **C.** *C. (Turritus) gracile*. **D.** *C. (Turritus) lacazei* sp. nov.



### Etymology

This species is dedicated to the French journalist André Lacaze (1915–1986).

### Types

#### Holotype

SLOVENIA • ♀; 1- Loibl Pass 1; 46.4236° N, 14.269° E; De Mattia and Zallot leg.; 2010; RMNH.MOL.507276.

#### Paratypes

SLOVENIA • 1 ♀; same collection data as for holotype; RMNH.MOL.507277 • 1 ♂; same collection data as for holotype; RMNH.MOL.507278.

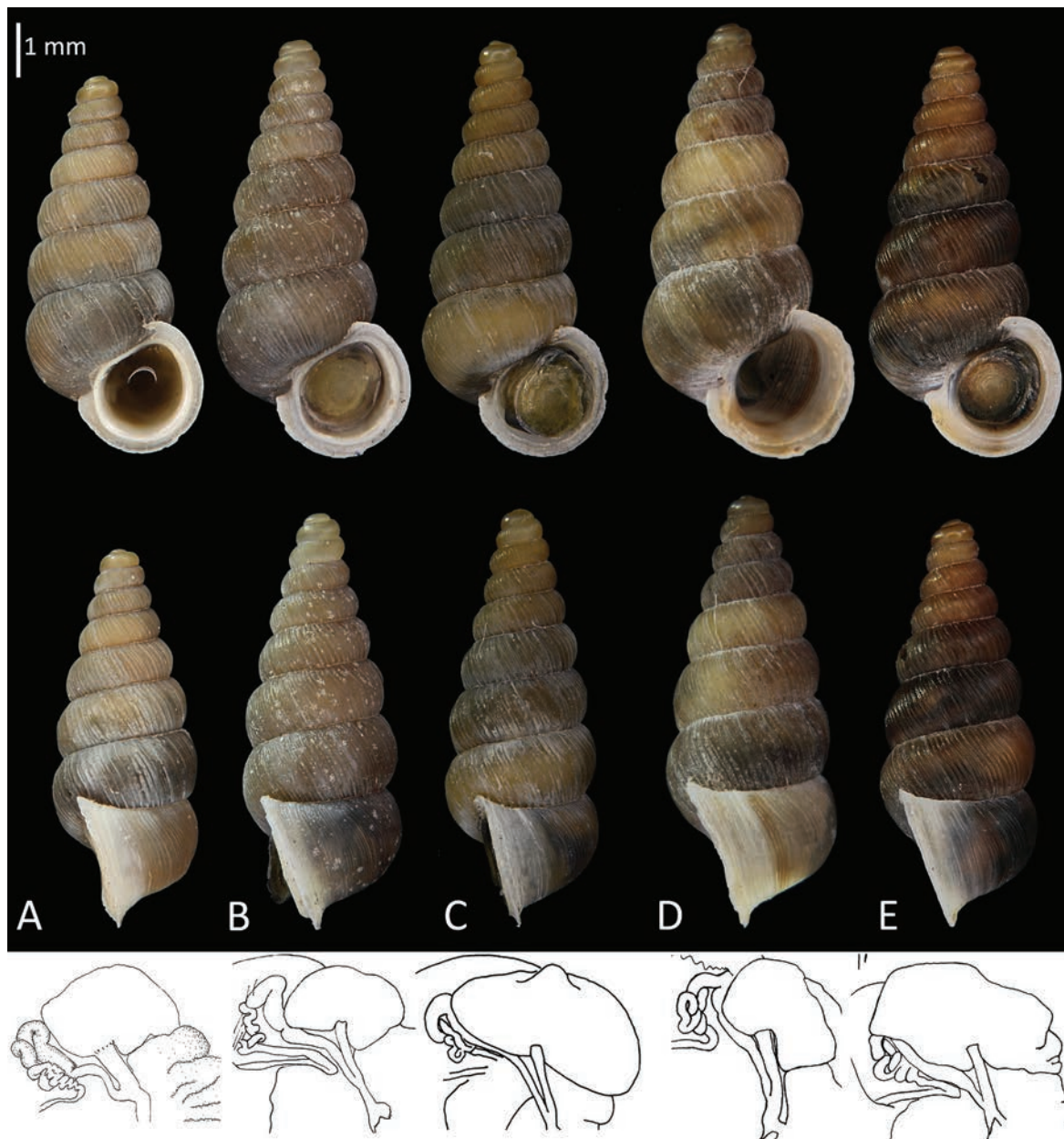


**Fig. 70.** *Cochlostoma (T.) lacazei* sp. nov., female holotype (Hf) (RMNH.MOL.507276), female (Pf) (RMNH.MOL.507277) and male paratype (Pm) (RMNH.MOL.507278).

**Other specimens**

AUSTRIA • 5- Johannsenruhe; 46.4533° N, 14.1599° E; Mildner leg.; EZ0186 • 6- Trögern; 46.4363° N, 14.4858° E; 2012; Groenenberg leg.; Dick Groenenberg4532 • 7- entrance to the Tscheppaschlucht; 46.4876° N, 14.2769° E; 2015; Sattmann *et al.* leg.; NHMW109000/AL/00718 • 8- Trögerner Klamm 1; 46.4608° N, 14.5038° E; 2015; Sattmann *et al.* leg.; NHMW109000/AL/00713.

SLOVENIA • 2- Loibl Pass 2; 46.4299° N, 14.2607° E; 2010; De Mattia and Zallot leg.; EZ1008 • 3- Loibl Pass 3; 46.4283° N, 14.2738° E; 2010; De Mattia and Zallot leg.; EZ1009 • 4- Tržič; 46.3572° N, 14.2958° E; 2000; Zallot leg.; EZ0179.



**Fig. 71.** *Cochlostoma (T.) lacazei* sp. nov. **A.** 4- Trzic, SLO (EZ-017). **B.** 1- Podljubelj 1, SLO (EZ-1006). **C.** 2- Podljubelj 2, SLO (EZ-1008). **D.** 7- Eingang Tscheppaschlucht, A (NHMW-109000/AL/00718). **E.** 6- Trogern, A (DG-4532).

### Type locality

SLOVENIA • 1- Loibl Pass 1; 46.4236° N, 14.269° E.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with rounded and moderately strong ribs. Moderately strong lip with columellar lobe quite abruptly inwardly curved to cover umbilicus.

MEASUREMENTS. 12 ♀♀: whorls=7.1–8.2, H=6.9–8 mm, H/W=2.49–2.7, roundness=0.1–0.13, ribs incl.=59–66°, apert. incl.=17–24°, ribs/mm 1<sup>st</sup> wh.=6–12, ribs/mm 4<sup>th</sup> wh.=7–15.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Seminal receptacle tortuous, elongated and thick. No proper distal oviduct, seminal receptacle gradually narrowing toward junction with pedunculus of bursa copulatrix. Loop path consisting of series of loops clustering close to seminal receptacle apex. Uterus gland connection close to distal oviduct-pedunculus junction.

### Remarks

This species living in the Karawanken Alps has probably been reported in Austrian checklists (Klemm 1973; Edlinger & Mildner 1979) as *Cochlostoma (Turritus) gracile*. The shell is easily misidentified, but the analysis of the female genitals shows a different morphology of the seminal receptacle and loop paths. At the type locality, the species lives syntopically with *C. (Cochlostoma) septemspirale* on a S-exposed talus slope.

### Additional note to clade B

The other B supported (PP=99, BS=99) subclade includes two branches, with the first distributed along the northern part of the Balkan Peninsula and two species of the central Appenine in Italy, and the second inhabiting the northern and central part of the Appenine in the Italian peninsula. The samples within the subclade share the same female genital morphology but are highly differentiated in the shell morphology. The p-distances among samples, despite this evident shell diversity, are relatively low (0.7–1.9% between heterospecific samples).

### *Cochlostoma (T.) nanum* (Westerlund, 1879)

Figs 72 (red dots), 73A–C, 74–76

*Pomatias nanus* Westerlund, 1879: 167-16.

*Pomatias clessini* Hirc, 1881: 521–522.

### Types

Not seen.

### Other specimens

AUSTRIA: 5- Tepke; 46.3888° N, 14.5738° E; 2015; AL leg.; NHMW109000/AL/00703.

SLOVENIA • 1- Mt Risnjak, 1400 m (topotypical); 45.4251° N, 14.6162° E; 2006; De Mattia leg.; WdM5666 • 2- Mt Snežnik 1764; 45.5884° N, 14.4478° E; 2010; De Mattia leg.; WdM7005 • 3- Mt Snežnik 1451; 45.5825° N, 14.4312° E; 2010; De Mattia leg.; EZ0960 • 4- Logarska Dolina; 46.4274° N, 14.6572° E; 2009; Slapnik leg.; HNHM97239.

### Type locality

A generic “Croatia” in the original description. We define as type locality restricted: CROATIA • Mount Risnjak (see remarks).

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, with weak or very weak ribs almost disappearing on last whorl and approaching aperture. Strong lip with columellar lobe either barely or abruptly inwardly bent, only partially covering umbilicus.

MEASUREMENTS. 13 ♀♀: whorls=7–8, H=7–8.4 mm, H/W=2.4–2.64, roundness=0.1–0.15, ribs incl.=53–61°, apert. incl.=16–24°, ribs/mm 1<sup>st</sup> wh.=8–11, ribs/mm 4<sup>th</sup> wh.=8–17.

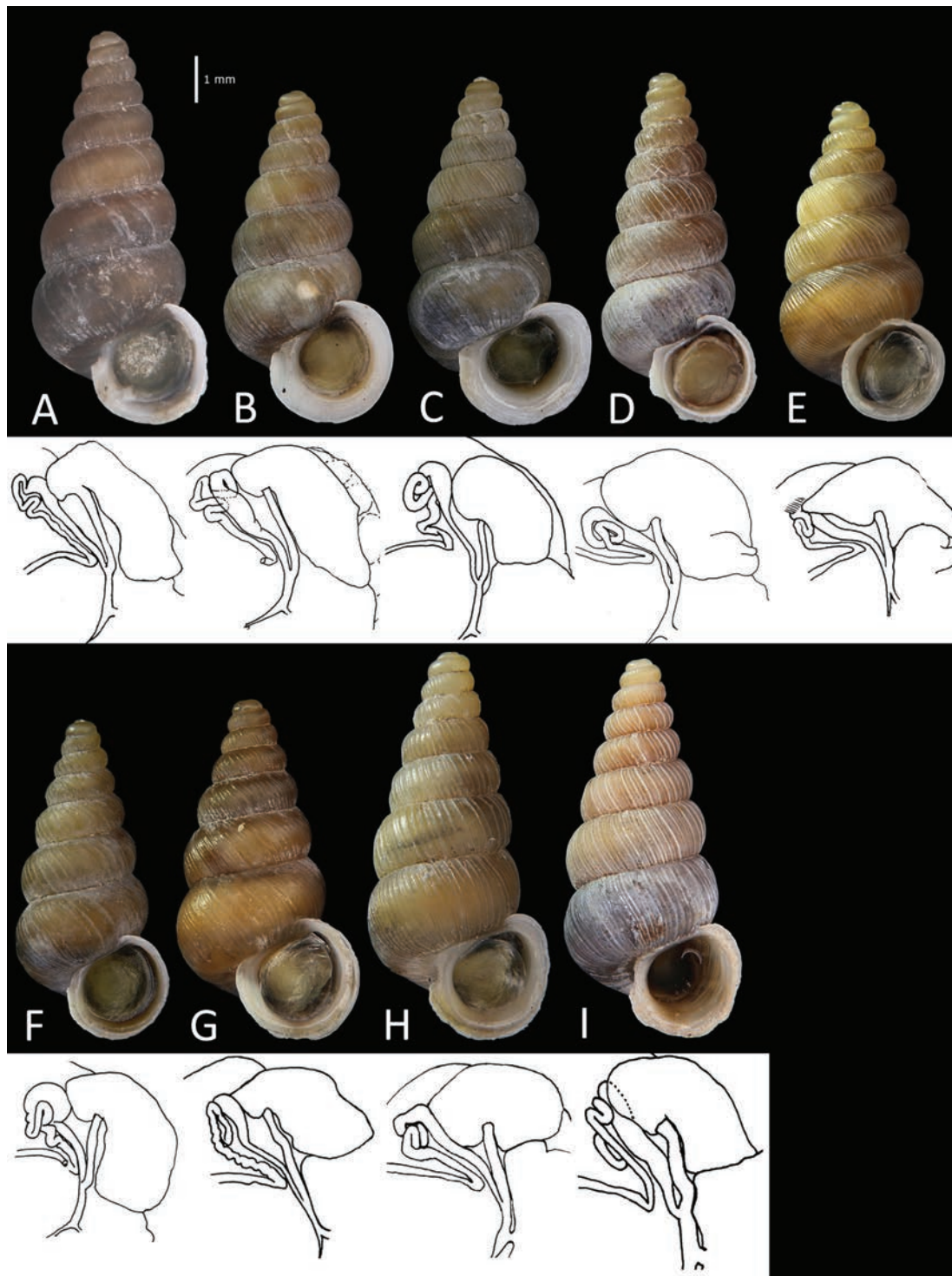
FEMALE GENITAL ORGANS. Posterior connection of pedunculus of bursa copulatrix and junction of uterus gland moved far from connection between distal oviduct and pedunculus of bursa copulatrix. Seminal receptacle normally club-shaped, situated on dorsal side of body and with long and undefined basis/distal oviduct.

### Remarks

The type locality in the original description is rather undefined. We consider Mount Risnjak in the northern part of Croatia as type locality restricted by A.J. Wagner (1897: 54 [618]): “Die mir vom Autor übergebenen Original Exemplare stammen ohne nähere Fundortsangabe aus Croatien (ein bestimmter Fundort wird auch sonst vom Autor nirgends angeführt); dieselben erwiesen sich aber als vollkommen identisch mit den mir ebenfalls vorliegenden Original Exemplaren des *P. clessini* Hirc vom Berge Risnjak in Croatien und dürften wohl auch daher stammen [The original specimens were given to me by the author labeled ‘Croatia’ without any further information on where they were found (a specific site is also not mentioned anywhere else by the author); but it turned out that they are completely identical to the



**Fig. 72.** Distribution of samples of clade B: red=*Cochlostoma (T.) nanum* (Westerlund, 1879); cyan=*C. (T.) elegans*. Black center for the samples with amplified 16S.



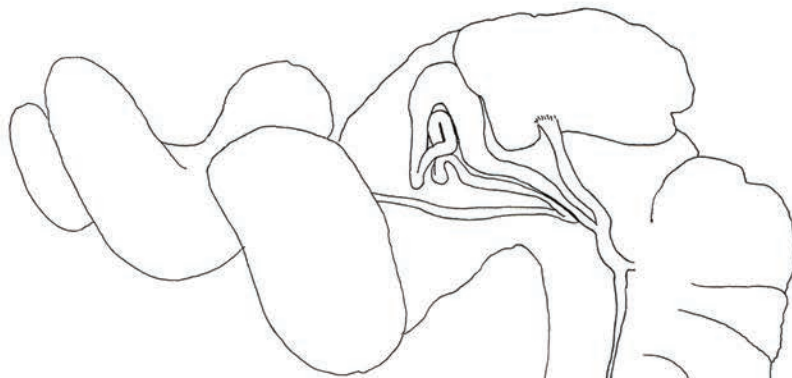
**Fig. 73.** Shell and female genitals of Clade B samples with amplified 16S. **A.** *Cochlostoma* (*T.*) *nanum* (Westerlund, 1879), Tepke, AT (NHMW-109000/AL/00703). **B.** *C. (T.) nanum*, Mt Snežnik 1764, SI (WdM-7005). **C.** *C. (T.) nanum*, Mt Risnjak, 1400 m a.s.l., HR (WdM-5666). **D.** *C. (T.) mostarensis* (Wagner, 1906), Mostar, BeH (EZ-1091). **E.** *C. (T.) elegans* (Clessin, 1879), Razbojište near Oltari, HR (WdM-6896). **F.** *C. (T.) stossichi* (Hirc, 1881), 2 km NNW of Meja, HR (WdM-1240). **G.** *C. (T.) braueri* (Wagner, 1897), Klek Mt, HR (EZ-0068). **H.** NFS142, Škrčko Jezero, MONT (TxEx-du0044). **I.** *C. (T.) hallgassi* sp. nov., Monte Petrella 1010, I (EZ-1118).



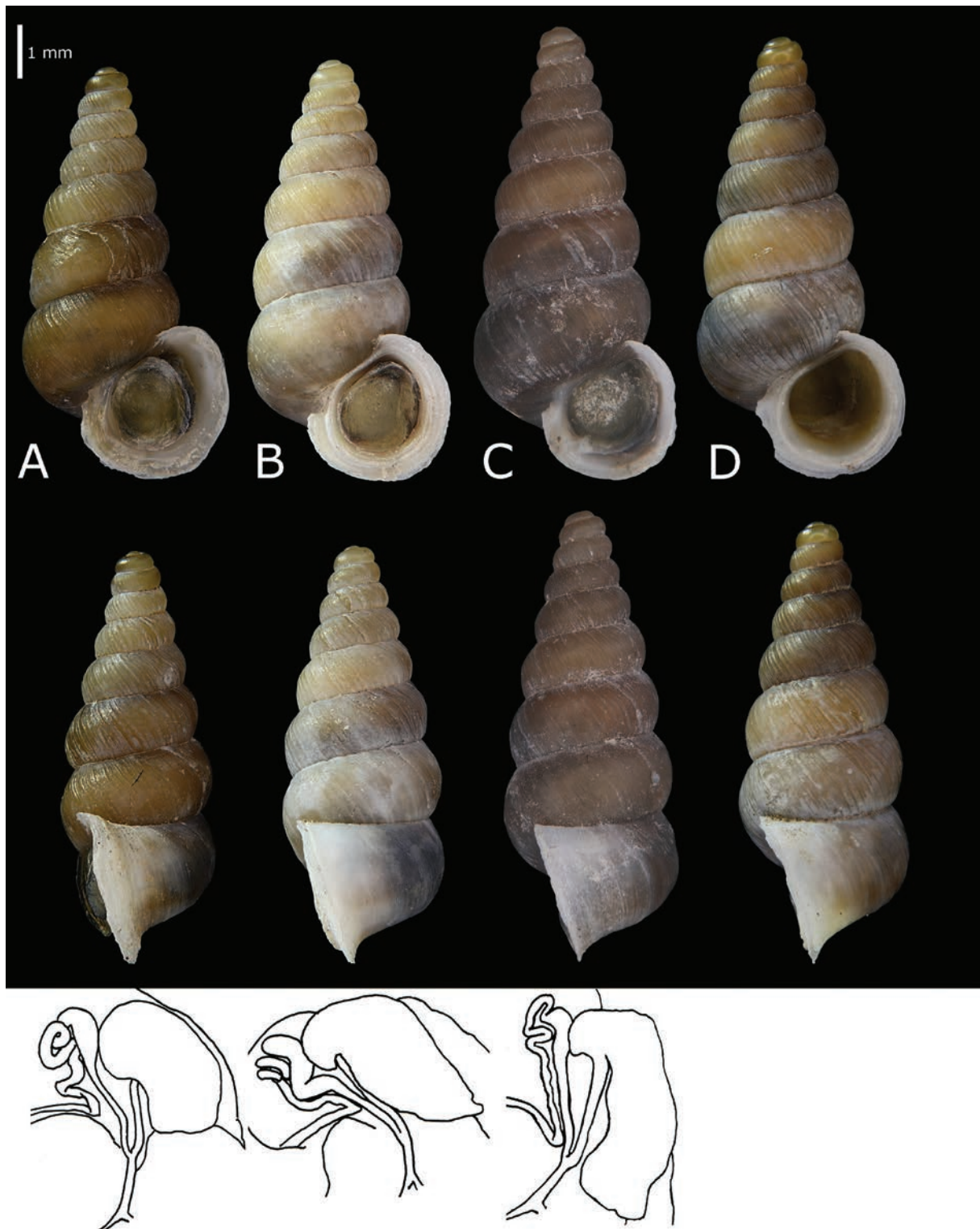
Fig. 74. Type of *Pomatias clessini* Hirc, 1881 = *Cochlostoma (T.) nanum* (Westerlund, 1879), ♂, in Wagner's collection (NHMW – without collection number) from Mount Risnjak, HR.

original specimens of *P. clessini* Hirc from the Risnjak mountain in Croatia that I also have and it may well be that they are from there]”.

For what is known, the species lives in a few scattered alpine localities not connected by suitable habitats. In the phylogenetic trees the *nanum* samples do not cluster together and the intraspecific p-distances are of the same magnitude of the ones with samples of the other species of the subclade.



**Fig. 75.** *Cochlostoma (T.) nanum* (Westerlund, 1879) from the type locality restricted, 1- Mount Risniak, HR (WdM-5666).



**Fig. 76.** *Cochlostoma (T.) nanum* (Westerlund, 1879). **A.** 1- Mt Risnjak, 1400 m a.s.l., SLO (WdM-5666). **B.** 2- Mt Snežnik 1764, SLO (WdM-7005). **C.** 5- Tepke, A (NHMW-109000/AL/00703). **D.** 4- Logarska dolina, SLO (HNHM-97239).



***Cochlostoma (T.) elegans* (Clessin, 1879)**

Figs 72 (cyan dots), 73E, 77–81

*Pomatias elegans* Clessin, 1879: 122–123.

*Pomatias (Eupomatias) elegans* var. *irregularis* Wagner, 1897: 11, pl. 1 fig. 11.

*Pomatias (Eupomatias) elegans* var. *spectabilis* Wagner, 1897: 11, pl. 1 fig. 12.

*Pomatias (Eupomatias) elegans* var. *tumida* Wagner, 1897: 12, pl. 1 fig. 13a–b.

*Pomatias (Eupomatias) elegans* var. *similis* Wagner, 1897: 12, pl. 1 fig. 14.

*Pomatias (Eupomatias) elegans* var. *oostoma* Westerlund, 1883: 12, pl. 1 fig. 10a–b.

*Pomatias (Eupomatias) elegans* var. *imoschiensis* Wagner, 1906: 98–99, pl. 3 fig. 1a–b.

*Pomatias (Eupomatias) braueri* var. *latestriatum* Wagner, 1897: 10, pl. 1 fig. 8.

**Syntype**

CROATIA • ♀; “*Cochlostoma (C.) elegans* (Clessin) Orig. 1897 T.1 F.9–Kroatien: Podgorje, Velebith, Clessin 1889”; SMF158949.

**Other specimens**

CROATIA • syntype of *C. (T.) elegans irregularis*; Velebit; 43.8634° N, 15.83° E; A.J. Wagner leg.; SMF158959/5 • syntype of *C. (T.) elegans tumida*; 10- Visočica near Gospić; 44.43° N, 15.3713° E; A.J. Wagner leg.; SMF158970/3 • syntype of *C. (T.) elegans imoschiensis*; 7- Imoschi, Süddalmatien; 43.4505° N, 17.2091° E; Sturany leg.; SMF158972/10 • syntype of *C. (T.) elegans irregularis*; 1?- Velebit; 44.5339° N, 15.0772° E; A.J. Wagner leg.; NHMW25349 • syntype of *C. (T.) elegans imoschiensis*; 7- Imotski; 43.4473° N, 17.214° E; 1901; Sturany leg.; NHMW34514 • syntype of *C. (T.) elegans tumida*; 8- Rača by Sveta Juraj; 44.9277° N, 14.9199° E; A.J. Wagner leg.; NHMWK46907 • syntype of *C. (T.) braueri latestriatum*; 9- VakanskiVrh; 44.3661° N, 15.509° E; A.J. Wagner leg.; NHMW66398 • syntype of *C. (T.) braueri spectabilis*; 11- Lukovo Zugarje; 44.26° N, 15.12° E; A.J. Wagner leg.; MIZPASW6590 • 2- Senj (topotypical); 44.9851° N, 14.9311° E; 1999; De Mattia leg.; WdM1862 • 3- Senj-Sveti Juraj (topotypical); 44.9187° N, 14.9241° E; 2009; De Mattia leg.; WdM6887 • 4- Razbojište near Oltari; 44.9084° N, 14.9453° E; 2009; De Mattia leg.; WdM6896 • 5- 1.7 km E of Vidovac; 44.5246° N, 15.0718° E; 1999; Fehér and Tamás leg.; HNHM91857 • 6- Velika Paklenica; 44.3326° N, 15.4833° E; 1999; Fehér and Tamás leg.; HNHM91859 • 7- Imotski; 43.4505° N, 17.2091° E; 2008; Dányi, Fehér, Kontschán and Murányi leg.; HNHM97265.

**Type locality**

Clessin (1879) wrote: “Diese Art wurde mir von Professor Stossich von Croatien mitgetheilt, ohne nähere Angabe des Fundortes. [This species was communicated to me by Professor Stossich of Croatia, without any further details of the place of discovery]”. The label SMF-158949 states: “Kroatien: Podgorje, Velebith, Clessin 1889”. This is a region at the foothill of the Velebit Mountains along the Croatian coast between Senj and Zrmanja, more than 130 km long.

**Description**

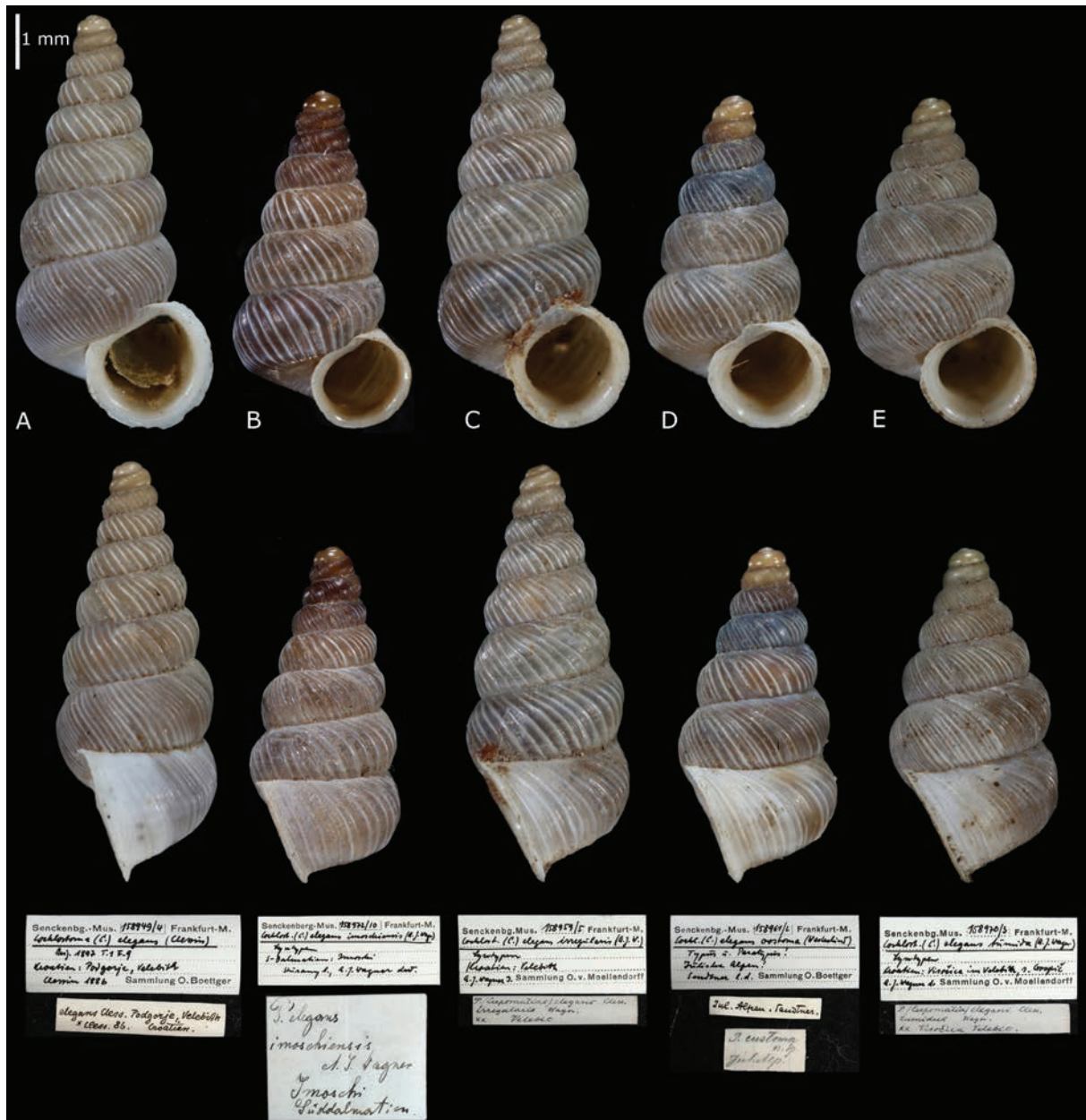
SHELL. Spaced riblets on last part of protoconch. Teleoconch spotless. Whitish not very prominent ribs often highly but irregularly inclined with respect to main axis. Mouth very inclined too, with moderately strong lip and flat columellar lobe leaving wide umbilicus well visible.

MEASUREMENTS. 18 ♀♀: whorls=6.3–8.5, H=5.5–8.0 mm, H/W=2.01–2.57, roundness=0.09–0.17, ribs incl.=45–58°, apert. incl.=18–33°, ribs/mm 1<sup>st</sup> wh.=3–17, ribs/mm 4<sup>th</sup> wh.=6–14.

FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

Remarks

We synonymize all the so-called subspecies because they do not have their own exclusive ranges with diagnostic character states. We synonymize *C. (T.) braueri latestriatum* (Wagner, 1897) with *C. (T.) elegans* despite the lack of anatomical and molecular data on the following ground: the syntype of *C. (T.) braueri latestriatum* from Vaganski Vrh (Fig. 80A) has a shell substantially differing from the other supposed syntype of “*latestriatum*” from Visočica peak (Fig. 80B. Vaganski Vrh and Visočica



**Fig. 77.** Types of subspecies of *Cochlostoma (T.) elegans* (Clessin, 1879) at the Naturmuseum Senckenberg Frankfurt. **A.** *C. (T.) elegans elegans*, ♀, Podgorie, Velebith, HR (SMF-158949/4). **B.** *C. (T.) elegans imoschiensis* Wagner, 1906, ♂, Imoschi, South Dalmatia, HR (SMF1-58972/10). **C.** *C. (T.) elegans irregularis* Wagner, 1897, ♀, Velebith, HR (SMF-158959/5). **D.** *C. (T.) elegans oostoma* Westerlund, 1883, ♂, Julian Alps (SMF-158961/2). **E.** *C. (T.) elegans tumida* Wagner, 1897, probably ♀, Visočica in Velebith, Gospić, HR (SMF-158970/3).

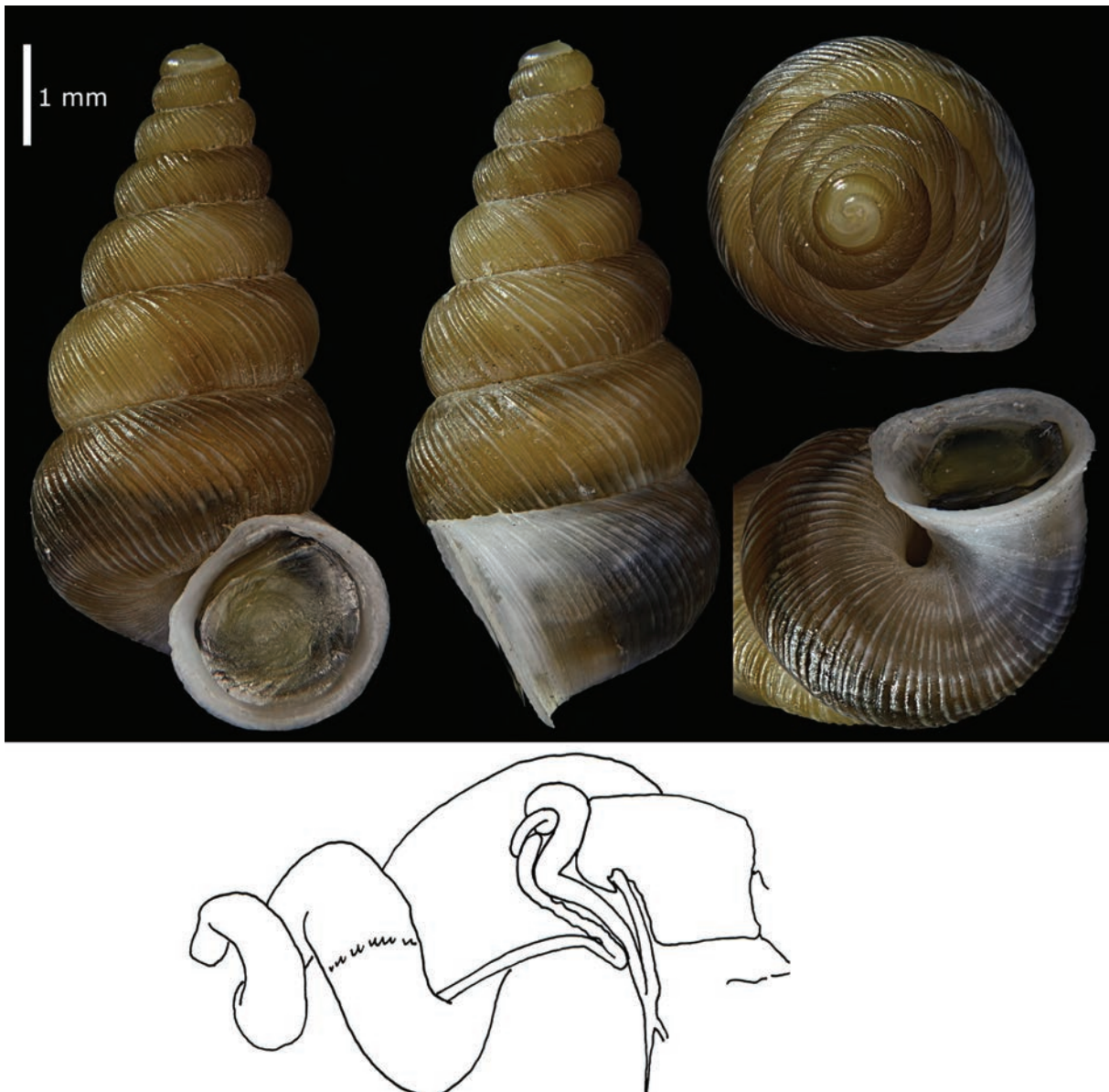
peak are mentioned as type localities in the original description). The latter presents the same shell morphology of the “*dubium*” specimens from Mount Metla (Fig. 89). The same shell morphology and geographical proximity (roughly 20 km along the same mountain range) between Visočica peak and Mount Metla induce to think that they are conspecific and both specimens of *C. (T.) dubium* (Wagner, 1897). Therefore, the syntype of this taxon is the specimen from Vaganski Vrh, but it is not clear why



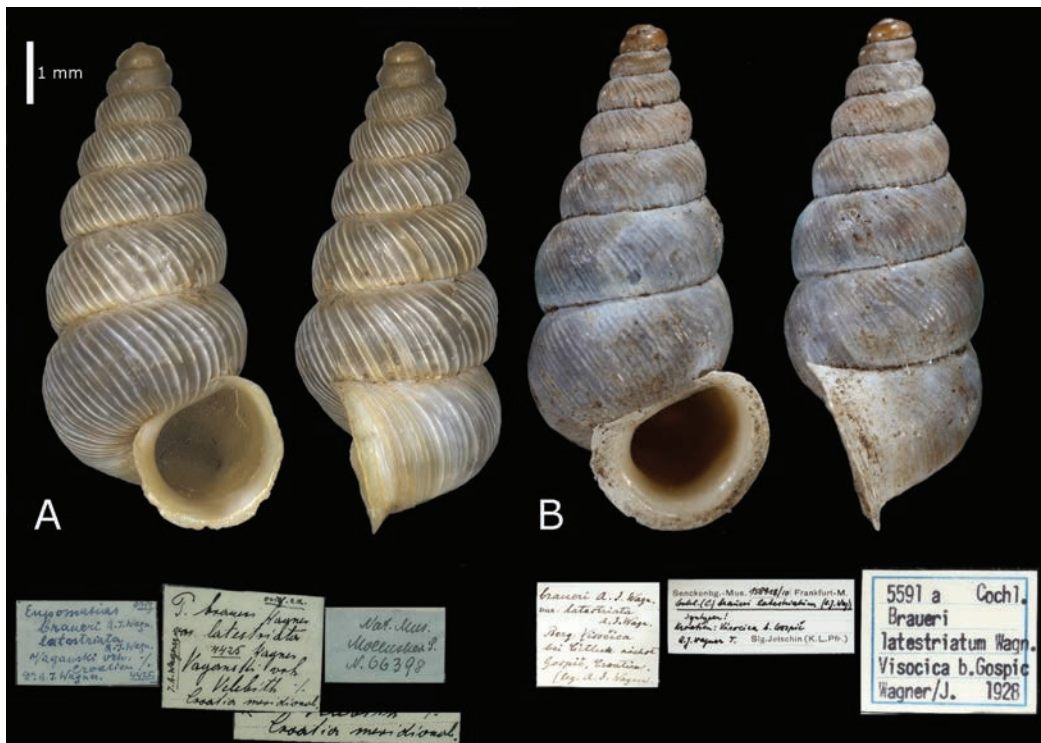
**Fig. 78.** Types of *Cochlostoma (T.) elegans* (Clessin, 1879). **A.** *C. (T.) elegans similis* Wagner, 1897, ♂, Velebith? (MIZPAS no number). **B.** *C. (T.) elegans spectabilis* Wagner, 1897, ♀, Lukovo, Zujanje, HR (MIZPAS-6590).

it has been defined as a subspecies of “*braueri*” instead of *C. (T.) elegans*: comparing specimens as in Fig. 81, this appears much more probable than assigning it to a species living much further north and, as far as is known, restricted to a single mountain (Mount Klek). Moreover, Vakanski Vrh is only a few kilometers distant from Velika Paklenica, from where the sample is embedded in the phylogenetic tree in the “*elegans*” branch.

There are probably populations of *C. (T.) elegans* that have a subspecific status, but this has to be studied in more detail.



**Fig. 79.** *Cochlostoma (T.) elegans* (Clessin, 1879), 4- Razbojište near Oltari, HR (WdM-6896).



**Fig. 80.** Wagner assigned these two specimens to *Cochlostoma* (*T.*) *braueri* *latestriatum* (Wagner, 1897). **A.** Vaganski Vrh, HR (NHMW-66398). **B.** Visočica bei Gospić, HR (SMF-158918/10). They are not conspecific.



**Fig. 81.** Wagner assigned these 2 specimens to two different species. **A.** *Cochlostoma* (*T.*) *braueri* *latestriatum* (Wagner, 1897), probably ♂, Vaganski Vrh, HR (NHMW-66398). **B.** *C.* (*T.*) *elegans* *imoschiensis*, ♀, Imoski, Dalmatia, HR (RNHM-W34514).

*Cochlostoma (T.) mostarensis* (Wagner, 1906)

Figs 73D, 82 (white dots), 83–84

*Pomatias (Eupomatias) mostarensis* Wagner, 1906: 99–100, pl. 3 fig. 2a–b.

**Syntypes**

BOSNIA AND HERZEGOVINA • ♀; “*Pomatias mostarensis* A. J. Wgn., Wagner det. Hercegovina: Podvelez bei Mostar, leg. Sturany 21.IV.1903”; NHMW38262 • 2 ♂♂; “*Pomatias mostarensis*, Wagner, Podvelez bei Mostar”; MIZPASW7059.

**Other specimens**

BOSNIA AND HERZEGOVINA • 1- Podvelež (topotypical); 43.2976° N, 17.9306° E; 2000; Eröss and Fehér leg.; HNHM79933 • 2- Mostar 1; 43.3435° N, 17.8887° E; 2011; De Mattia leg.; EZ1092 • 3- Mostar 2; 43.3372° N, 17.8832° E; 2011; De Mattia leg.; EZ1091.

**Type locality**

“Podvelez bei Mostar und Abhänge des Hum bei Mostar” (BOSNIA AND HERZEGOVINA • Podvelez near Mostar and slopes of mount Hum near Mostar).

**Description**

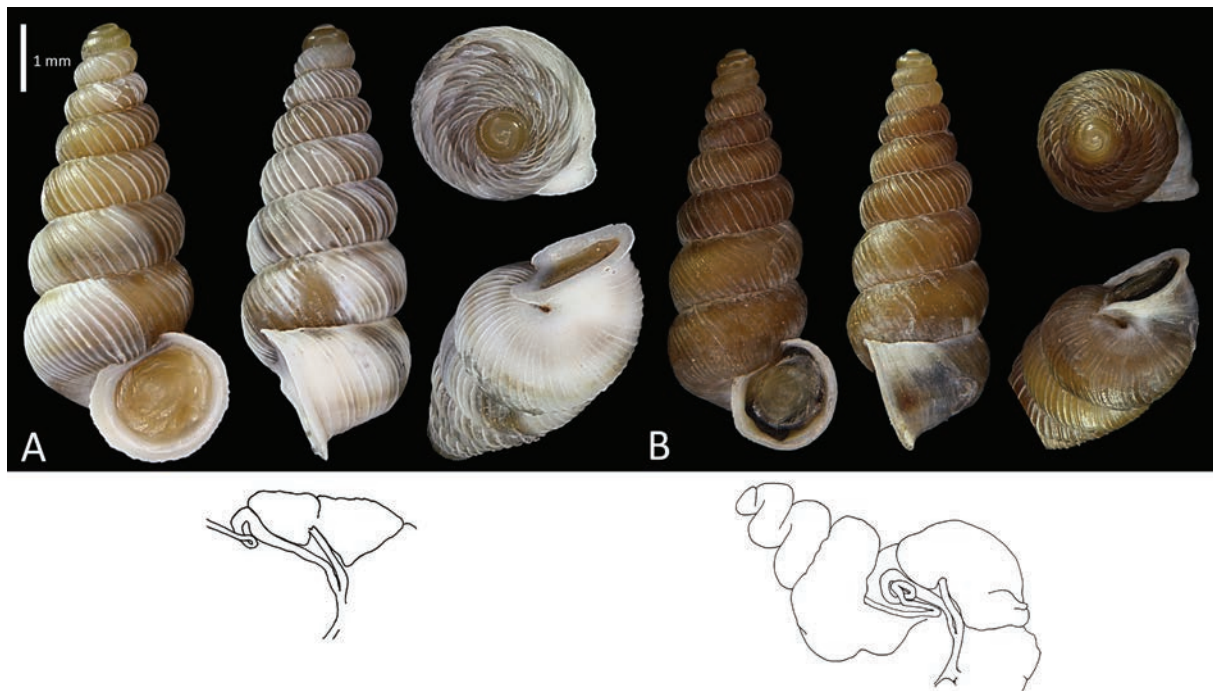
SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless. Quite widely spaced, thin and whitish ribs on upper whorls, weakening and being more closely spaced on body whorl and toward aperture. Relatively weak lip with flat columellar lobe and visible umbilicus.



**Fig. 82.** Distribution of samples in Clade B: red=*Cochlostoma (T.) braueri* (Wagner, 1897); purple=*C. (T.) stossichi* (Hirc, 1881); blue=*C. (T.) hallgassi* sp. nov.; yellow=*C. (T.) mariannae* Nordsieck, 2011; green=*C. (T.) dubium* (Wagner, 1897); white=*C. (T.) mostarensis* (Wagner, 1906). Black center for the samples with amplified 16S.



Fig. 83. Syntype of *Cochlostoma* (*T.*) *mostarensis* (Wagner, 1906), ♀ (NHMW-38262).



**Fig. 84.** *Cochlostoma (T.) mostarensis* (Wagner, 1906). **A.** 1- Podvelez, BeH (HNHM-79933). **B.** 2- Mostar, BeH (EZ-1091).

MEASUREMENTS. 5 ♀♀: whorls=7.4–8.5, H=6.2–8 mm, H/W=2.58–2.85, roundness=0.1–0.17, ribs incl.=51–58, apert. incl.=24–26°, ribs/mm 1<sup>st</sup> wh.=7–11, ribs/mm 4<sup>th</sup> wh.=6–14.

FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

### Remarks

The shells and the female genital morphology of *C. (T.) mostarensis* and *C. (T.) elegans* are very similar but the umbilicus is, although visible, narrower than in *C. (T.) elegans*.

### *Cochlostoma (T.) braueri* (Wagner, 1897) Figs 73G, 82 (red dot), 85–86

*Pomatias (Eupomatias) braueri* Wagner, 1897: 10, pl. 1 fig. 7a–b.

### Syntypes

CROATIA • 3 ♀♀, 1 ♂; “*Pom. Braueri* A. J.Wgn. Orig.Ex. Klek B/Ogulin Kroatien, Wagner don.”; NHMW25346.

### Other specimens

CROATIA • 1- Klek Mt, close to the top (topotypical); 45.259° N, 15.1404° E; 2009; De Mattia and Zallot leg.; EZ0069 • 2- Klek Mt Cliffs halfway (topotypical); 45.2544° N, 15.1456° E; 2009; De Mattia and Zallot leg.; EZ0068.

### Type locality

CROATIA • Karlovac County, Mount Klek.



### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with not prominent and closely spaced ribs almost disappearing toward aperture. Moderately developed lip with flat columellar lobe. Umbilicus visible but narrower than in *C. (T.) elegans*.

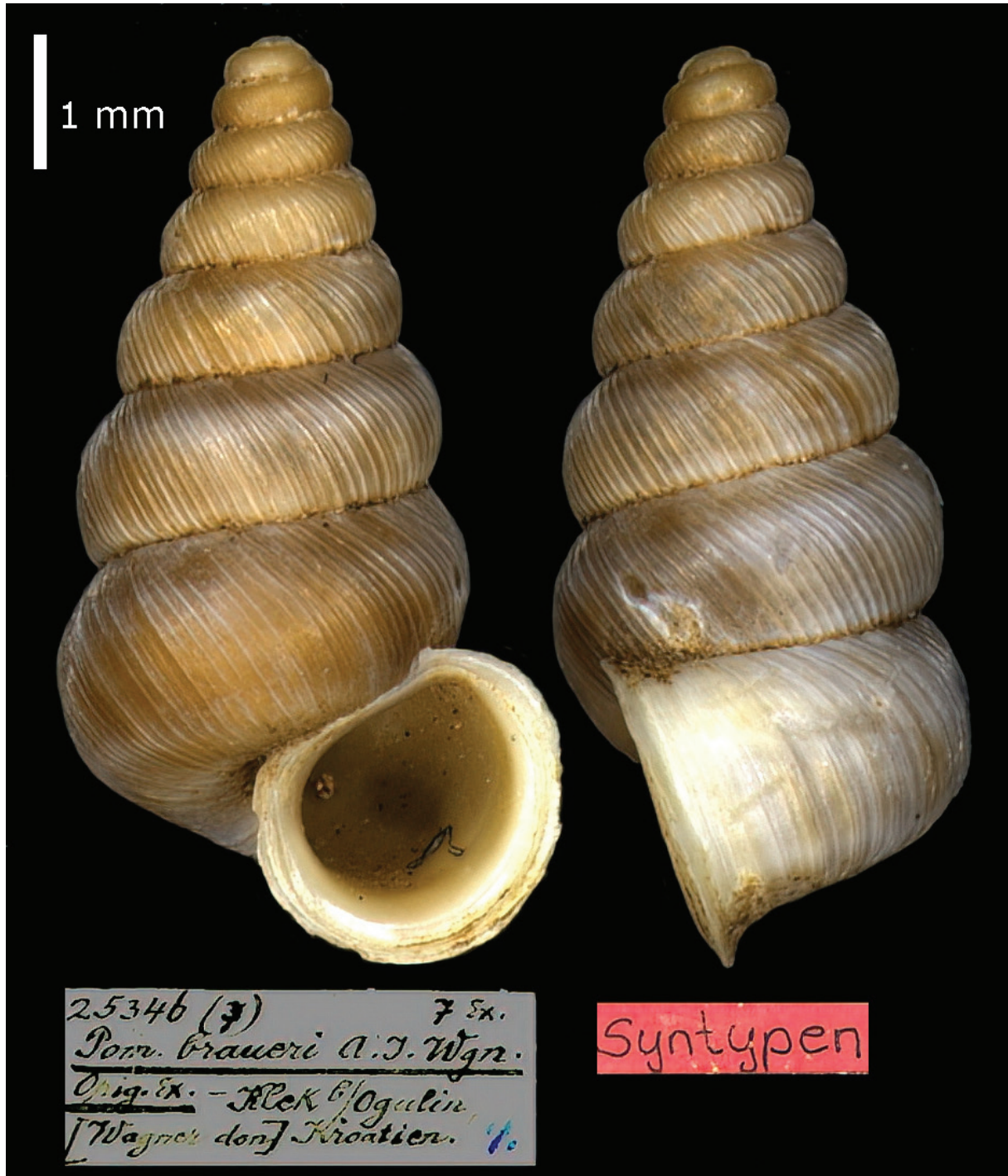


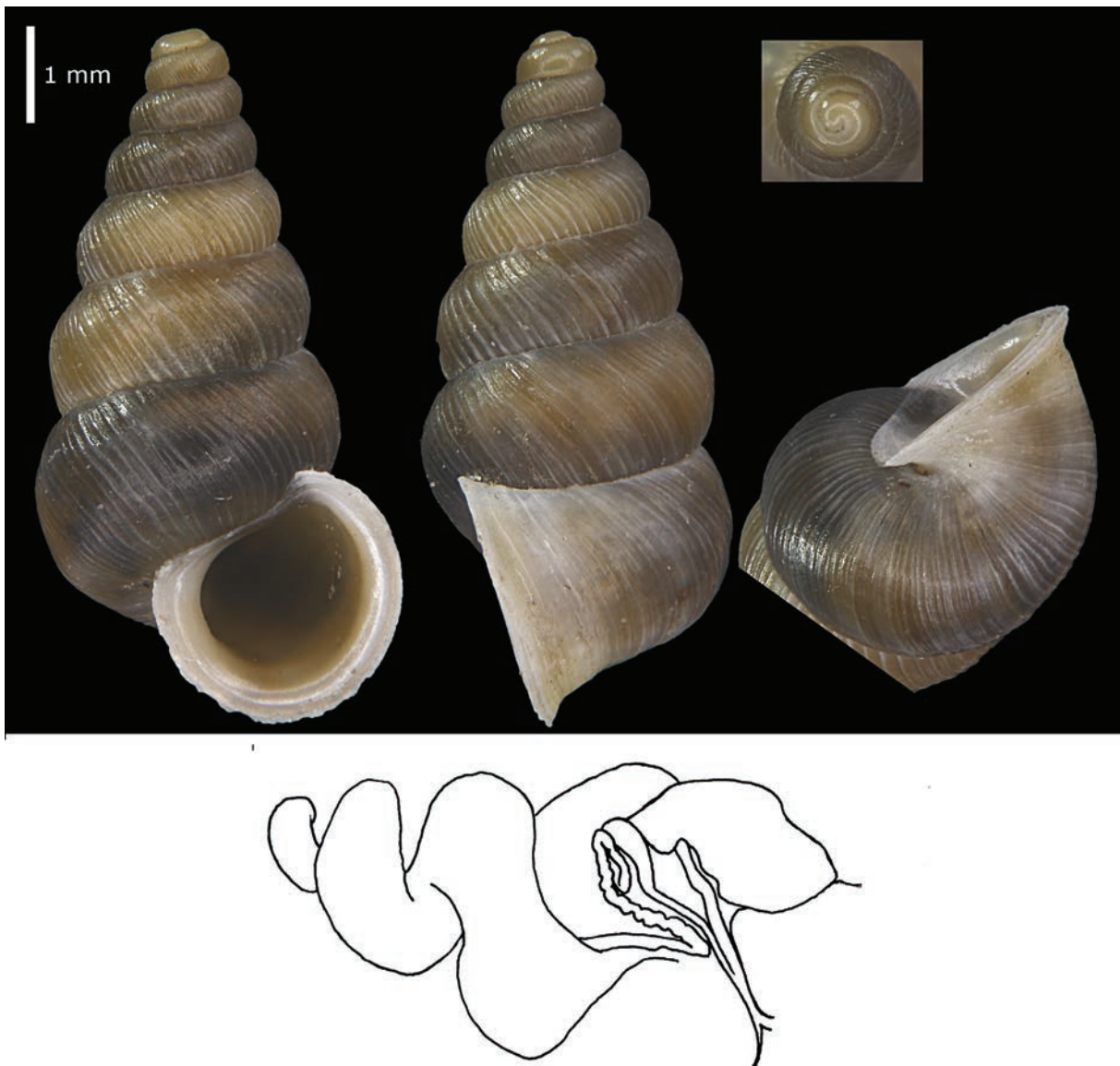
Fig. 85. Syntype of *Cochlostoma (T.) braueri braueri* (Wagner, 1897), ♀, 1- Mount Klek, HR (NHMW-25346).

MEASUREMENTS. 8 ♀♀: whorls=6.7–7.2, H=6.2–7.7 mm, H/W=2.25–2.44, roundness=0.09–0.13, ribs incl.=48–56°, apert. incl.=20–24°, ribs/mm 1<sup>st</sup> wh.=7–14, ribs/mm 4<sup>th</sup> wh.=9–13.

FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

### Remarks

The specimens reported in Welter-Schultes (2012: 92) do not belong to this species. *Cochlostoma (T.) braueri* has a flat columellar lobe with the umbilicus visible. The illustrated specimen has a curved columellar lobe obstructing the umbilicus. The ribbing of the types and of fresh specimens from the type locality is different too. As far as known, this species lives only on Mount Klek.



**Fig. 86.** Topotypical *Cochlostoma (T.) braueri* (Wagner, 1897), 1- Mount Klek, HR (EZ-0068).

*Cochlostoma* (*T.*) *stossichi* (Hirc, 1881)

Figs 73F, 82 (purple dots), 87–88

*Pomatias stossichi* Hirc, 1881: 522.

**Syntypes**

CROATIA • probably ♂; “*Pomatias Stossichii*, Clessin, 1880.XIII.33. Orig. der Hirc’schen arbeit, Ponikve bei Buccari”; NHMWno number • “*nanus* West. var. *stossichi* Hirc, Buccari bei Fiume Croatien”; Stossich leg.; Sep. 1882; ZMB170.256,

**Other specimens**

CROATIA • 2- 2 km NNW of Meja; 45.3070° N, 14.5871° E; 1999; De Mattia leg.; WdM1240.

**Type locality**

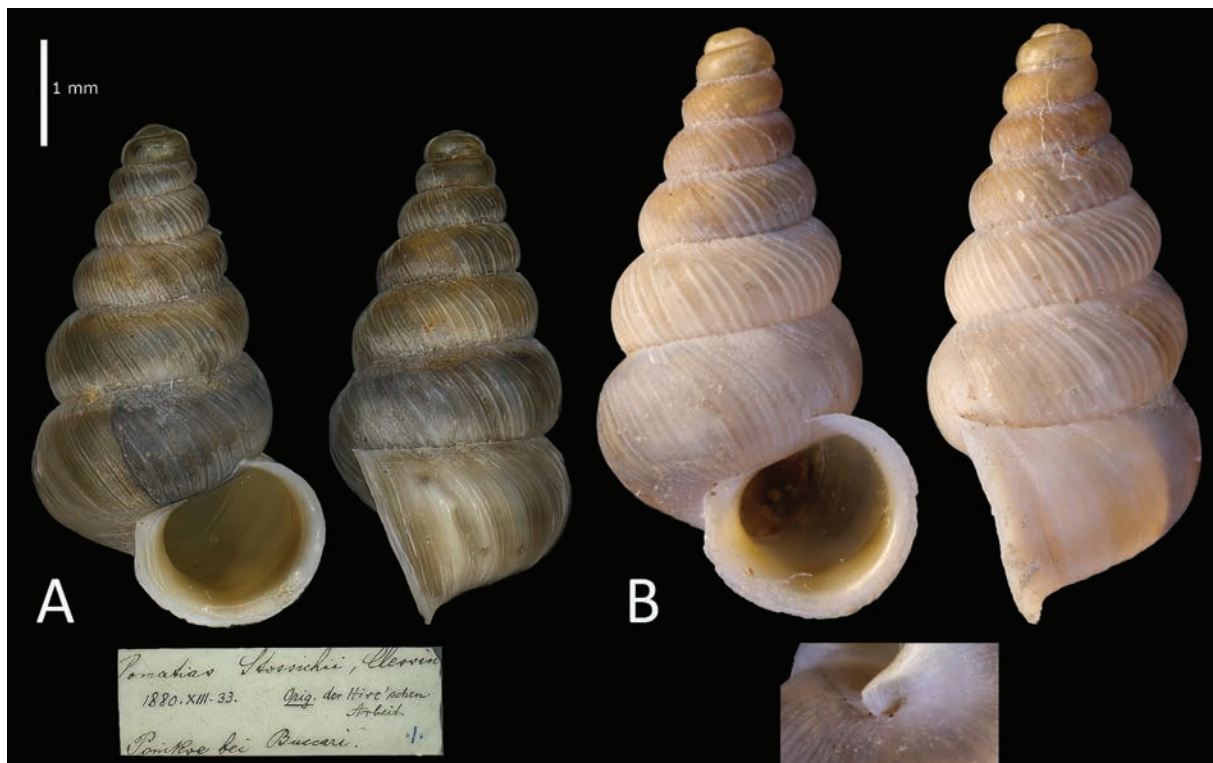
CROATIA • 1- Primorje-Gorski Kotar County, Ponikve, Bakar.

**Description**

SHELL. Closely spaced riblets on last part of protonconch. Teleoconch spotless, ribs rounded, irregular in size and shape and not prominent, disappearing toward aperture. Moderately developed lip with slightly bent columellar lobe hiding almost completely umbilicus.

MEASUREMENTS. 5 ♀♀: whorls=6.8–8.1, H=6–7.3 mm, H/W=2.14–2.64, roundness=0.09–0.15, ribs incl.=48–56°, apert. incl.=21–24°, ribs/mm 1<sup>st</sup> wh.=9–9, ribs/mm 4<sup>th</sup> wh.=8–14.

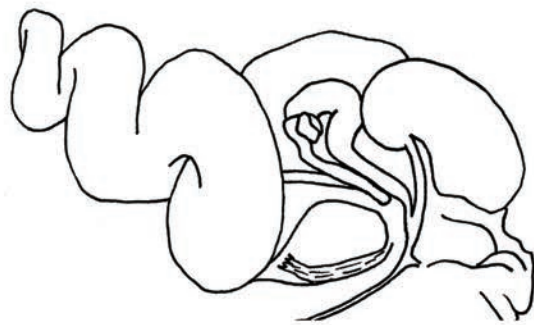
FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.



**Fig. 87.** Syntypes of *Cochlostoma* (*T.*) *stossichi* (Hirc, 1881). **A.** ♂? (NHMW no number). **B.** ♀ (ZMB170.256). Note the not visible umbilicus in the specimen B.

### Remarks

The species differs from *C. (T.) elegans* because it has either a hidden umbilicus or a narrow slit behind a barely curved columellar lobe (umbilicus wide and well visible in *elegans*). Moreover, the ribbing is weaker in this species.



**Fig. 88.** *Cochlostoma (T.) stossichi* (Hirc, 1881), 2- Meja, HR (WdM-1240) .

*Cochlostoma (T.) dubium* (Wagner, 1897)

Figs 82 (green dots), 89–91

*Pomatias (Auritus) nanus* var. *dubia* Wagner, 1897: 55, pl. 9 fig. 93a–b.

**Types**

**Lectotype** (here designated)

CROATIA • ♀; “*P. nanus* W var. *dubia* Wagner orig. Metla bei Trnovac Croatien”; SMF160822.

**Paralectotypes**

CROATIA • ♂; “*P. nanus* Westerl. var. *dubia* A. J. Wagner, Metla bei Trnovac Croatien, Wagner det. et don.”; NHMW25358/1 • 1 ♀ 4 ♂♂; “*P. nanus* Westerl. var. *dubia* A. J. Wagner, Metla bei Trnovac Croatien”; MIZPASW7076 • ♂; “*P. nanus* Westerl. var. *dubia* A. J. Wagner, Metla bei Trnovac Croatien, Wagner det. et don.”; NHMW25358/2.



**Fig. 89.** Lectotype (here designated) of *Cochlostoma (T.) dubium* (Wagner, 1897) (SMF-180822).

### Other specimens

CROATIA • 1- Metla (topotypical); 44.645° N, 15.2459° E; 1900; unknown leg.; HNHM70300 • 2- Visočica peak 934; 44.4248° N, 15.331° E; 2008; Náđai leg.; HNHM97143 • 3- Baške Oštarije; 44.5262° N, 15.1747° E; 1987; Kiss and L. Pintér leg.; HNHM 1987/D022 • 4- Jakšina, Biješe Stijene; 45.2162° N, 14.9688° E; 1994; J. Steffek leg.; HNHM94017 • 5- Rossijev Kuk sp 1; 44.7643° N, 14.9882° E; 2007; L. Dányi and Á. Vári leg.; HNHM DL243.

### Type locality

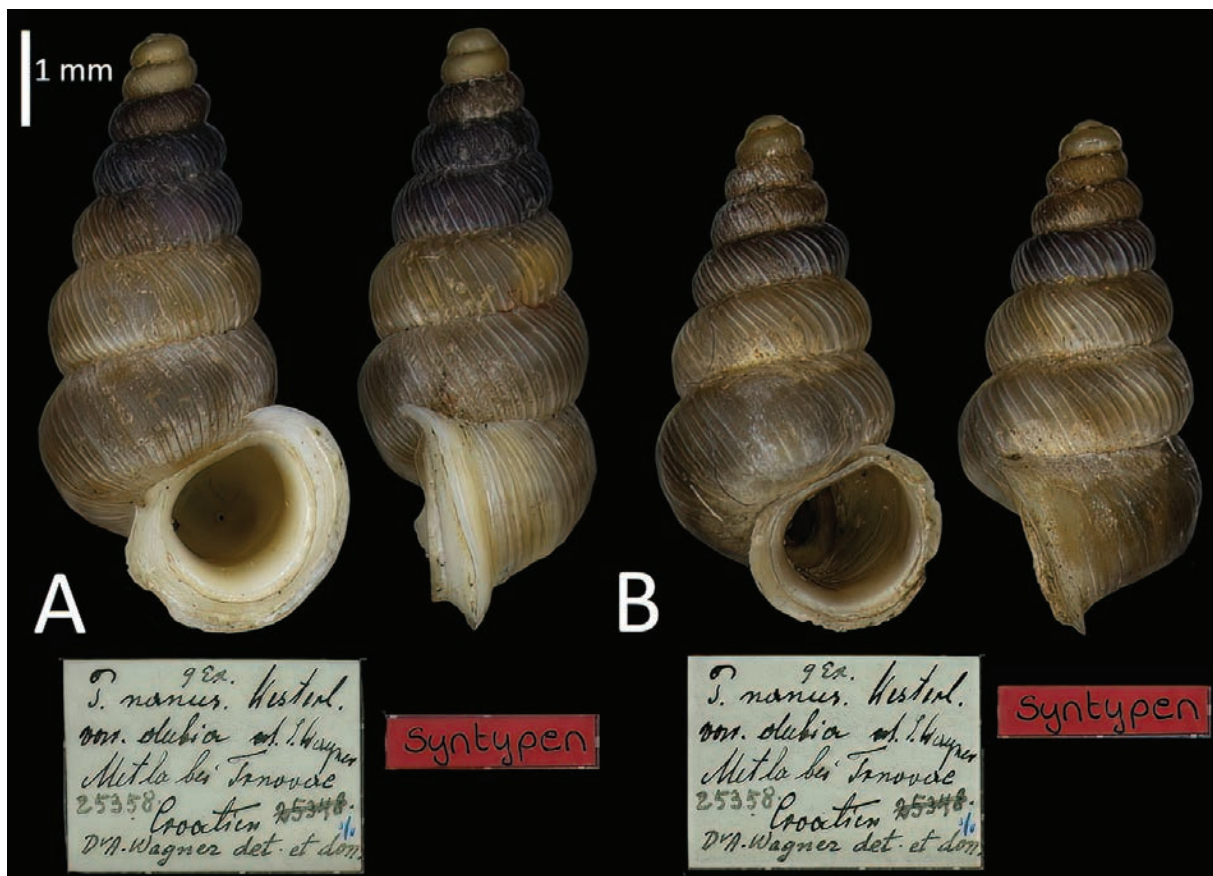
CROATIA • Lika-Senj County, Trnovac, Mt Metla.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with not prominent ribs regularly spaced. Very developed and strong lip with indented columellar lobe covering umbilicus.

MEASUREMENTS. 8 ♀♀: whorls = 7.1–8.1, H = 7.2–8.4 mm, H/W = 2.28–2.67, roundness = 0.11–0.14, ribs incl. = 53–56°, apert. incl. = 17–23°, ribs/mm 1<sup>st</sup> wh. = 5–11, ribs/mm 4<sup>th</sup> wh. = 7–12.

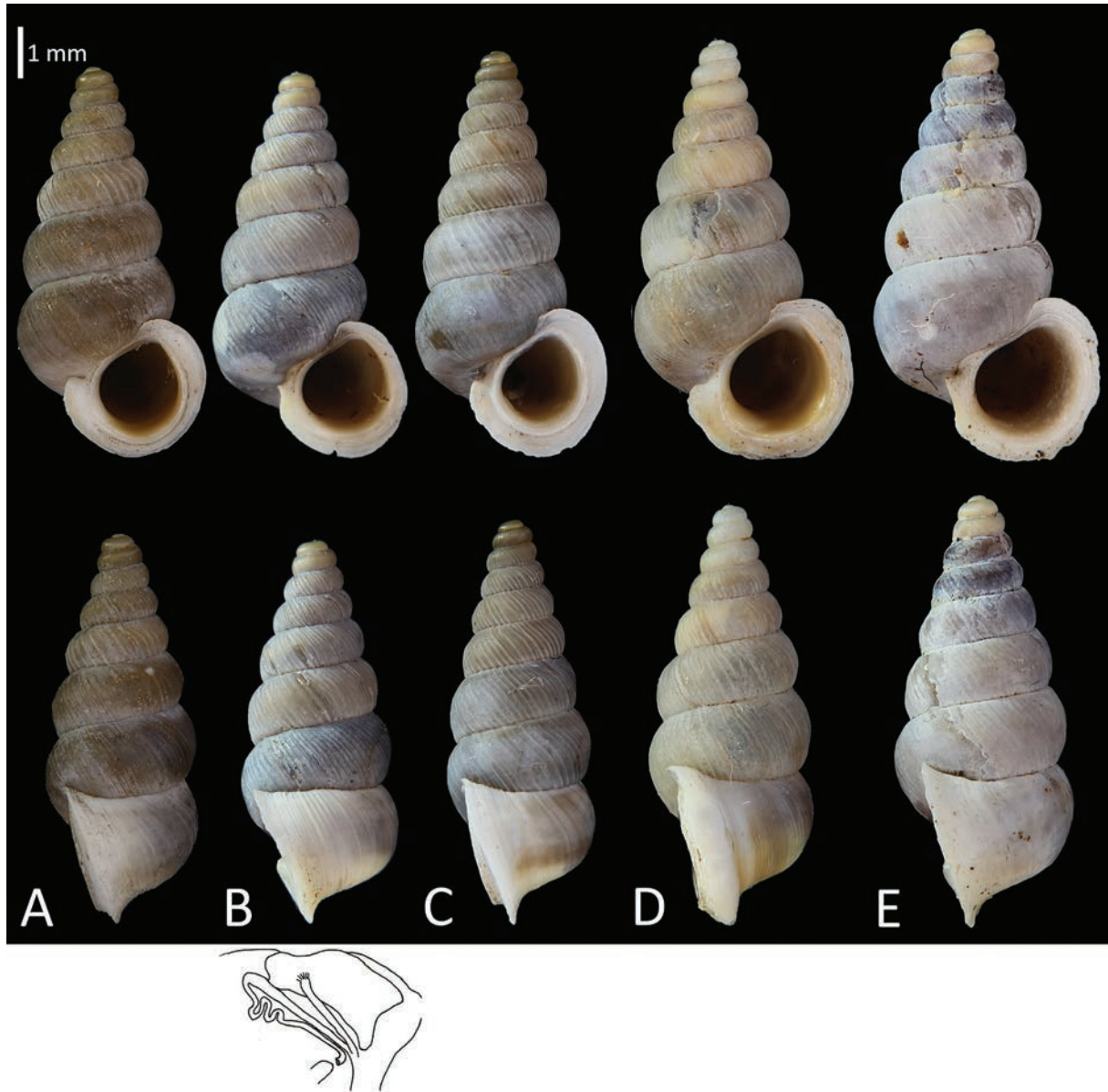
FEMALE GENITAL ORGANS. Only badly preserved specimen from Visočica peak 934 was available for analysis of female genital morphology and it resulted as in *C. (T.) nanum*.



**Fig. 90.** *Cochlostoma (T.) dubium* (Wagner, 1897). A. Paralectotype (NHMW-25358/1). B. Supposed syntype, not conspecific with specimen A (NHMW-25358/2).

### Remarks

We did not amplify the 16S of *C. (T.) dubium*. However, the shell and female morphology indicate that it is part of this clade. The shell similarity with *C. (T.) nanum* could be a convergent adaptation to an alpine environment. The male paralectotype NHMW25358/2 (Fig. 90B) differs substantially from the lectotype, not having the strong lip with an indented columellar lobe. It seems to be a specimen of *C. (T.) elegans*. Thus, NHMW25358/2 is not accepted as *C. (T.) dubium*.



**Fig. 91.** *Cochlostoma (T.) dubium* (Wagner, 1897). **A.** 1- Metla (HNHM-70300). **B.** 3- Baške Oštarije (HNHM-1987/D022). **C.** 2- Visočica peak 934 (HNHM-97143). **D.** 4- Jaksina, Bijele Stijene (HNHM-94107). **E.** 5- Rossijev Kuk (HNHM-DL243).

*Cochlostoma (T.) hallgassi* sp. nov.

urn:lsid:zoobank.org:act:37863EA3-D020-49FF-B4D6-640C063A3B9E

Figs 73I, 82 (blue dot), 92B, 93–94

**Differential diagnosis**

*Cochlostoma (T.) cassiniacum* and NFS064 have a different female genital morphology (Fig. 92D–E). *Cochlostoma (T.) crosseanum* (Paulucci, 1879) can be distinguished because of the spotless shell with widely spaced ribs (Fig. 92C), whereas there are well-marked spots and stronger and closely spaced ribs in *C. (T.) hallgassi* sp. nov. It can be distinguished by the ribbing of the shell (ribs irregular in size in *hallgassi*, of the same size in *mariannae*) and the more curved columellar lobe from *C. (T.) mariannae* Nordsieck, 2011 (Fig. 92A).

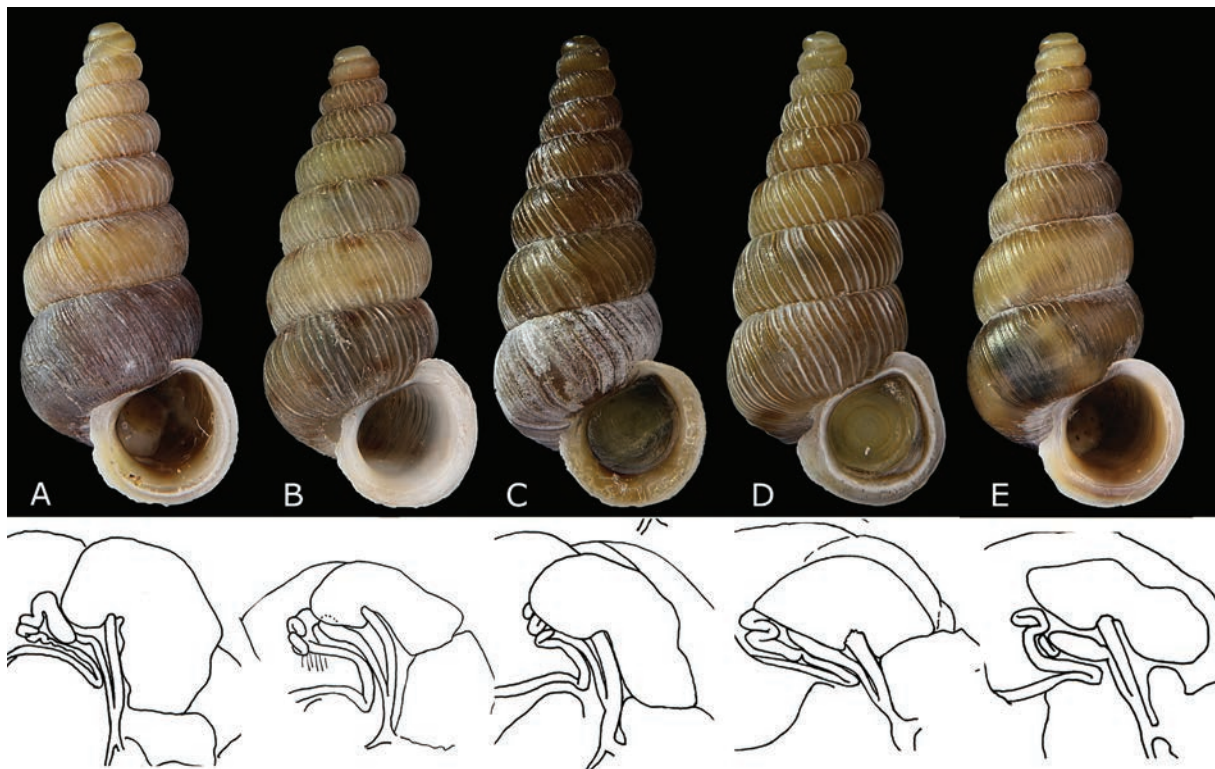
**Etymology**

The species is named after Alessandro Hallgass, a malacologist and friend, who collected most of the samples we have from central Italy.

**Types**

**Holotype**

ITALY • ♀; 1- Mount Petrella, 1280 m a.s.l.; 41.3166° N, 13.6542° E; Hallgass leg.; 11 Sep. 2011; RMNH.MOL.507272.



**Fig. 92.** *Turritus* Westerlund, 1883 inhabiting the central Apennines. **A.** *Cochlostoma (T.) mariannae* Nordsieck, 2011, 1- Vado di Sole, I (EZ-1084). **B.** *C. (T.) hallgassi* sp. nov., topotypical specimen, 1- Monte Petrella, I (EZ-1075). **C.** *C. (T.) crosseanum* (Paulucci, 1879), 3- Via Salaria, I (EZ-0002). **D.** *C. (T.) cassiniacum* (Saint-Simon in Paulucci, 1878), 15- Monte Gennaro, I (EZ-0021). **E.** NFS064, 1- Rio Fuggio, I (EZ-0022).





**Fig. 93.** *Cochlostoma (T.) hallgassi* sp. nov., female holotype (Hf) (RMNH.MOL.507272), female (Pf1, Pf2) (RMNH.MOL.507273, RMNH.MOL.507274) and male paratype (Pm) (RMNH.MOL.507275).

**Paratypes**

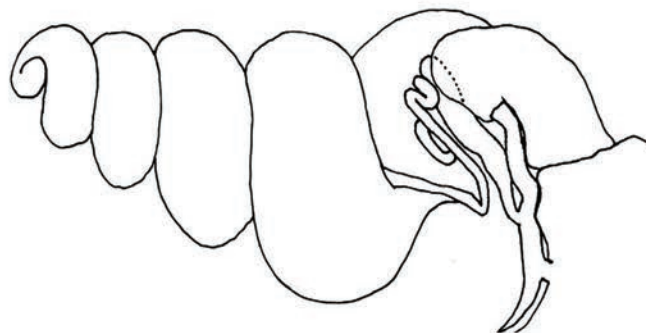
ITALY • 2 ♀♀; same collection data as for holotype; RMNH.MOL.507273, RMNH.MOL.507274 • 1 ♂; same collection data as for holotype; RMNH.MOL.507275.

**Other specimens**

ITALY • 2- Mt Petrella 1010; 41.3187° N, 13.6175° E; 2012; Hallgass leg.; EZ1118 • 3- Formia; 41.3069° N, 13.6355° E; 2021; S. Cianfanelli and E. Talenti leg., MZUF65650.

**Type locality**

ITALY • 1- Mount Petrella, 1280 m a.s.l.; 41.3166° N, 13.6542° E.



**Fig. 94.** *Cochlostoma (T.) hallgassii* sp. nov., 1- Monte Petrella, I (EZ-1075).

### Description

SHELL. Moderately spaced riblets on last part of protoconch. Teleoconch with two lines of reddish spots on whorls and with ribs not very prominent, rounded and irregular in size. Moderately strong lip with columellar lobe only barely curved toward umbilicus partially covered by it.

MEASUREMENTS. 6 ♀♀: whorls=7.5–8, H=7.3–8.1 mm, H/W=2.45–2.67, roundness=0.15–0.18, ribs incl.=64–67, apert. incl.=14–19°, ribs/mm 1<sup>st</sup> wh.=7–11, ribs/mm 4<sup>th</sup> wh.=9–13, umb.=narrow slit.

FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

### Remarks

In the 16S analysis (H3 not amplified), *C. (T.) hallgassi* is a very close relative (p-distance=0.2%) of a sample from Montenegro, in the Appendix as NFS142. However, the shells of the two samples are different, with marked spots and stronger, narrowly spaced, whitish ribs on the whorls in the Monte Petrella and spotless whorls with weaker ribs of the same color as the background in NFS142.

### *Cochlostoma (T.) mariannae* Nordsieck, 2011

Figs 82 (yellow dots), 95–96

*Cochlostoma mariannae* Nordsieck, 2011: 15–16.

### Types

Not seen.

### Other specimens

ITALY • 1- Vado di Sole 1(topotypical); 42.3968° N, 13.788° E; 2011; Hallgass leg.; EZ1084 • 2- Vado Di Sole 2 (topotypical); 42.3968° N, 13.788° E; 2013; Margelli leg.; EZ1145 • 3- Rigopiano; 42.43° N, 13.7807° E; 2013; Margelli leg.; EZ1140 • 4- Farindola loc. Angri; 42.4442° N, 13.8199° E; 2013; Margelli leg.; EZ1141 • 5- Rigopiano prov 37; 42.4482° N, 13.7501° E; 2013; Margelli leg.; EZ1143 • 6- Rigopiano camping; 42.4306° N, 13.7795° E; 2013; Margelli leg.; EZ1144.

### Type locality

ITALY • L'Aquila, Vado di Sole.

### Description

SHELL. Closely spaced riblets on last part of protonch. Teleoconch with two barely visible lines of reddish spots on whorls. Moderately strong, often whitish ribs becoming weaker approaching aperture. Well-developed and strong lip with slightly and gently curved columellar lobe almost completely covering umbilicus.

MEASUREMENTS. 11 ♀♀: whorls=7.2–8.4, H=7.3–9.8 mm, H/W=2.39–2.83, roundness=0.11–0.17, ribs incl.=55–62°, apert. incl.=16–25°, ribs/mm 1<sup>st</sup> wh.=6–16, ribs/mm 4<sup>th</sup> wh.=5–9.

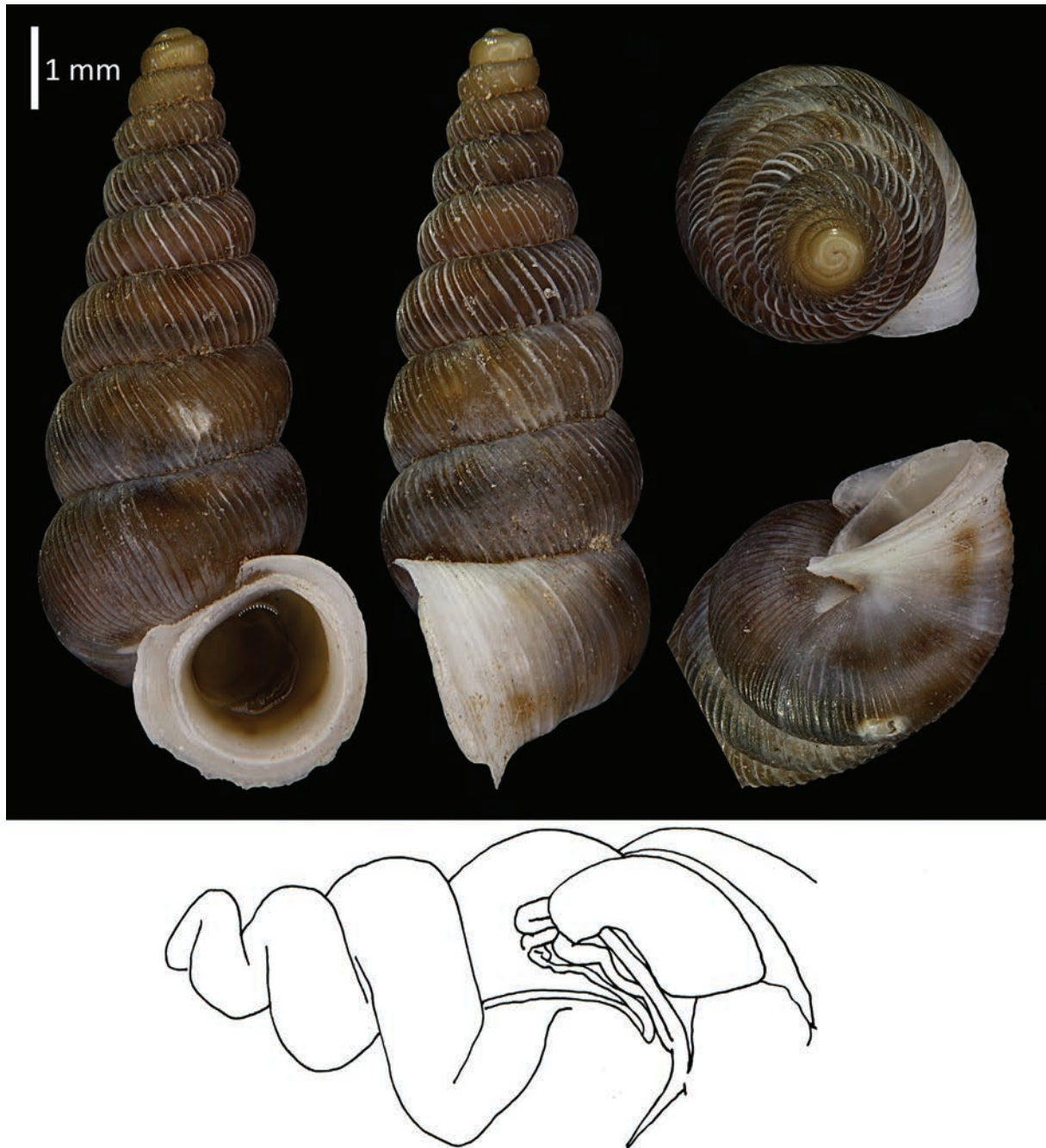
FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

### Remarks

Although this species was described recently (2011), only the shell morphology was taken into consideration in the original description.

**Additional note to clade B**

The following species *C. (T.) affine* (Benoit, 1879), *C. (T.) agriotes* (Westerlund, 1879) and *C. (T.) crosseanum* (Paulucci, 1879) have an almost identical shell and female genital morphology. Despite the morphological similarity, only *agriotes* and *crosseanum* cluster together whereas *affine* appears in an unresolved polytomy. They live in the central and northern parts of the Apennines and in Sicily.



**Fig. 95.** Topotypical *Cochlostoma (T.) mariannae* Nordsieck, 2011, 1- Vado di Sole, I (EZ-1084).



**Fig. 96.** *Cochlostoma* (*T.*) *mariannae* Nordsieck, 2011. **A.** 1- Vado di Sole, I (EZ-1084). **B.** 2- Farindola loc. Angri, I (EZ-1141). **C.** 3- Rigopiano, I. (EZ-1140)

*Cochlostoma (T.) affine* (Benoit, 1881)  
Figs 97 (red dot), 98E, 99

*Pomatias affinis* Benoit, 1881: 154.

**Types**

Not seen.

**Other specimens**

ITALY • 1- Isnello (topotypical); 37.9289° N, 14.0131° E; 2010; Liberto leg.; EZ1016.

**Type locality**

ITALY • “Madonie” (mountain range located on the north of Sicily).

**Description**

SHELL. Closely spaced riblets on last part of the protoconch. Teleoconch spotless. Very strong, widely spaced white ribs not fading toward aperture. Whorls more or less covered by whitish powder. Rather weak lip with slightly and gently inwardly bent columellar lobe partially covering umbilicus.

MEASUREMENTS. 2 ♀♀: whorls=8.1–8.1, H=8.2–8.5 mm, H/W=2.78–2.8, roundness=0.15–0.15, ribs incl.=57–59°, apert. incl.=17–19°, ribs/mm 1<sup>st</sup> wh.=3–4, ribs/mm 4<sup>th</sup> wh.=5–5.

FEMALE GENITAL ORGANS. As in *C. (T.) nanum*.

**Remarks**

Shells of this species are distinguishable from *C. (T.) agriotes/crosseanum* only by the stronger ribs. In the obtained phylogenetic trees, this taxon appears in a polytomy with the *elegans/nanum* cluster on one side and the *crosseanum/agriotes* on the other. The presence of this species in Sicily is highly important in a paleogeographic perspective (see discussion).

*Cochlostoma (T.) agriotes* (Westerlund in Paulucci, 1879)  
Figs 97 (yellow dots), 98G, 100–101

*Pomatias (patulus* Drap. Subsp.) *agriotes* Westerlund in Paulucci, 1879: 20.

**Types**

Not seen.

**Other specimens**

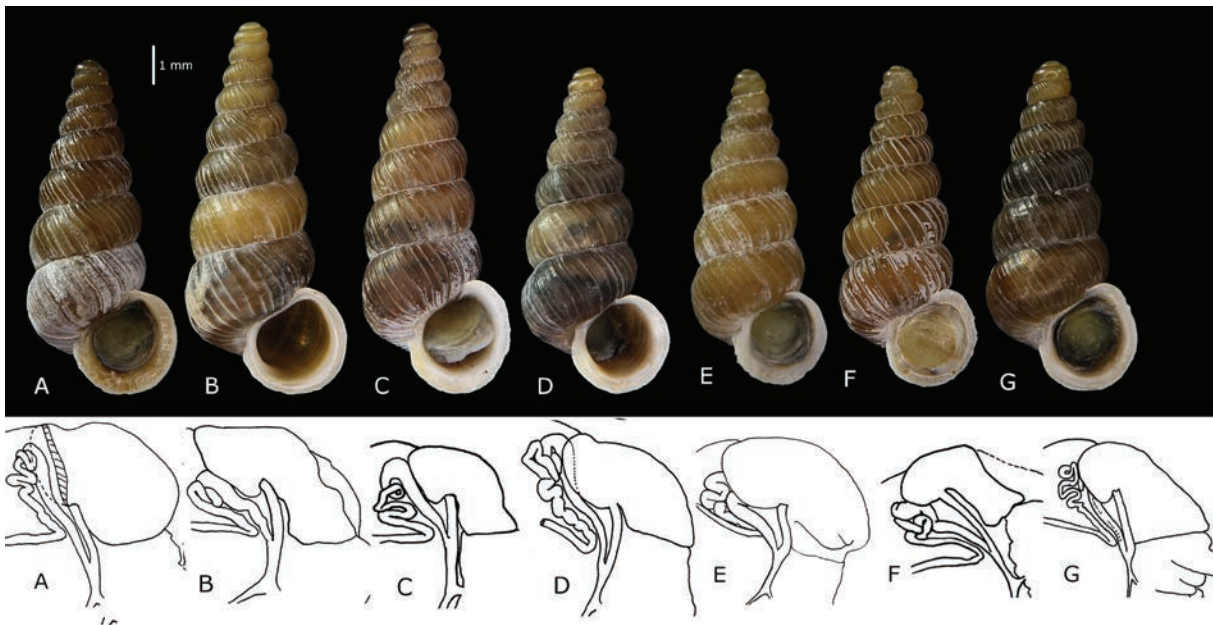
ITALY • 1- Mt Cucco (10 km south along the same mountain range, here assumed as topotypical); 43.3646° N, 12.731° E; 2010; Zallot leg.; EZ0001 • 2- Gualdo Tadino; 43.2302° N, 12.7957° E; 2013; Margelli leg.; EZ1139 • 9- Gole dell’Infernaccio; 42.9397° N, 13.3159° E; 2013; Margelli leg.; EZ1142.

**Type locality**

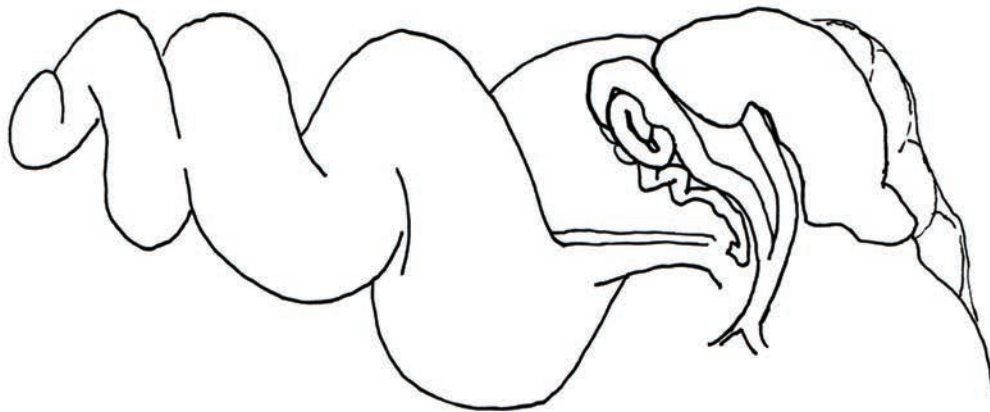
ITALY • Marche, Pesaro and Urbino, Fonte Avellana. Westerlund reported as localities “Italia at Suellana and Saorgio”. Paulucci already noticed that “Suellana” is the misspelled name of the hermitage Fonte Avellana. “Saorgio”, which is the second locality cited by Westerlund was once in Italy, but it is now



**Fig. 97.** Distribution of samples in Clade B: green=*Cochlostoma (T.) crosseanum* (Paulucci, 1879); yellow=*C. (T.) agriotes* (Westerlund, 1879); red=*C. (T.) affine* (Benoit, 1876). Black center for samples with amplified 16S.



**Fig. 98.** Shell and female genitals of samples of clade B with amplified 16S. **A.** *Cochlostoma (T.) crosseanum* (Paulucci, 1879), Posta, via Salaria, I (EZ-0002). **B.** Gole del Velino 2, I (EZ-1014). **C.** Gole del Velino 1, I (EZ-1013). **D.** Roccalbegna, I (EZ-0980). **E.** Lucchio, I (WdM-6953). **F.** *C. (T.) affine* (Benoit, 1876), Isnello, I (EZ-1016). **G.** *C. (T.) agriotes* (Westerlund, 1879), Monte Cucco, I (EZ-0001).



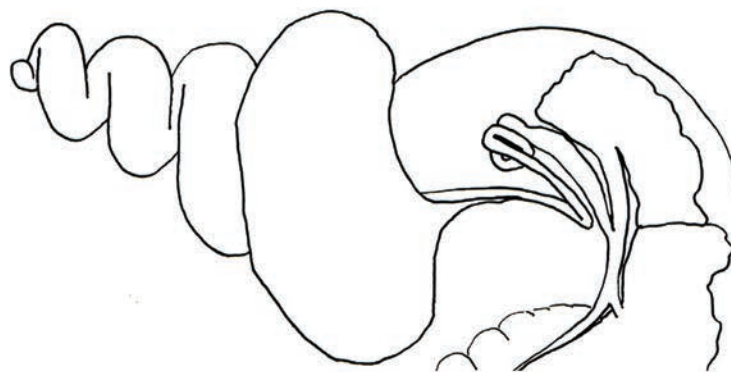
**Fig. 99.** *Cochlostoma (T.) affine* (Benoit, 1876), 1- Isnello, I (EZ-1016).



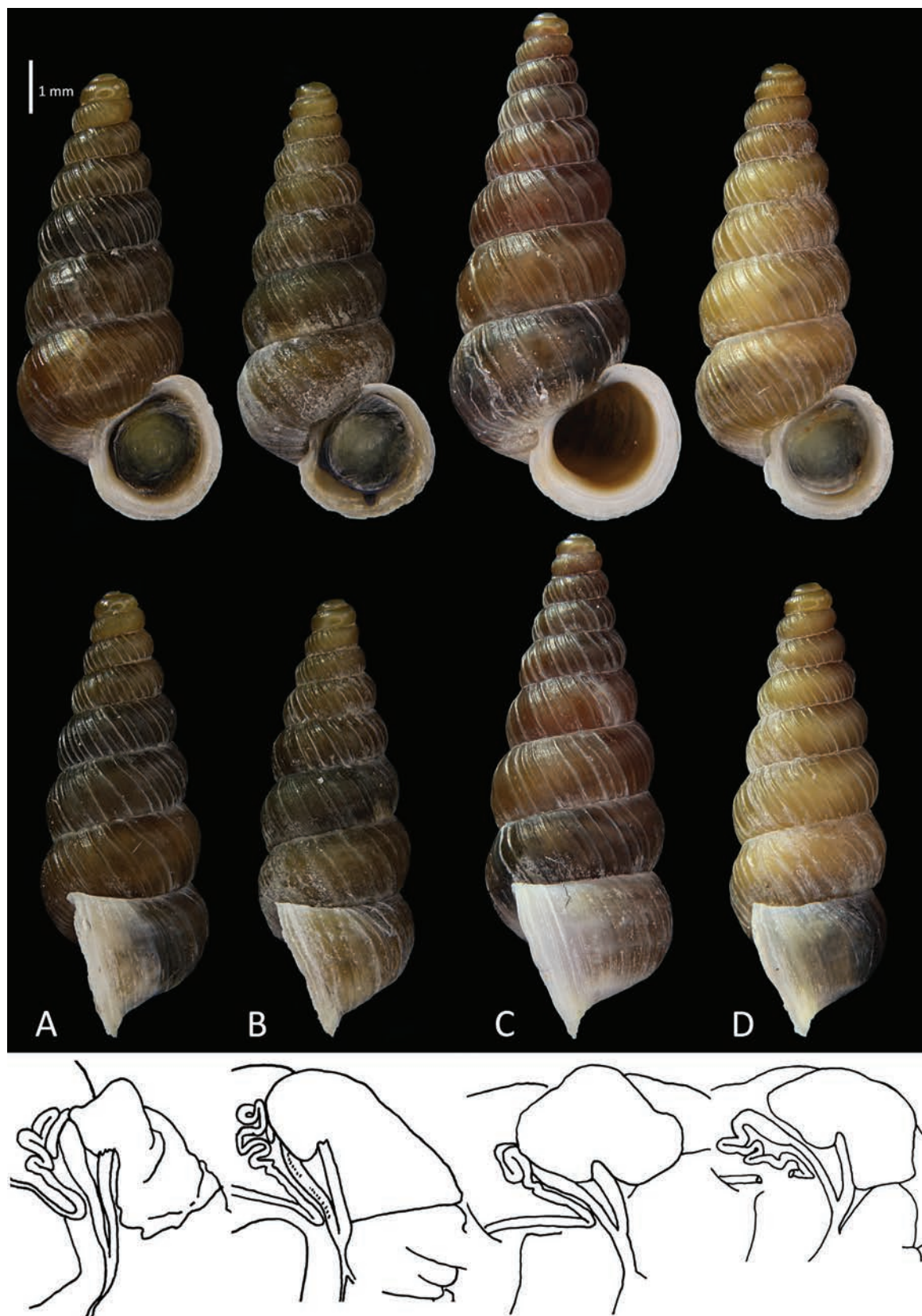
a French village in the Maritime Alps which is inhabited by another taxon (locus typicus of *C. (T.) simrothi*).

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless with more or less strong, often whitish, irregularly spaced ribs. Whitish powder on whorls. Rather weak lip with gently inwardly bent columellar lobe covering almost completely umbilicus.



**Fig. 100.** *Cochlostoma (T.) agriotes* (Westerlund, 1879), 1- Monte Cucco, I (EZ-0001).



**Fig. 101.** *Cochlostoma (T.) agriotes* (Westerlund, 1879). **A.** 1- Monte Cucco, I (EZ-0001). **B.** 1- Monte Cucco, I (EZ-0001). **C.** 2- Gualdo Tadino, I (EZ-1139). **D.** 3- Gole dell'Infernaccio (EZ-1142).

MEASUREMENTS. 29 ♀♀: whorls=7.1–9.2, H=7.5–10.2 mm, H/W=2.54–3.04, roundness=0.1–0.18, ribs incl.=52–64°, apert. incl.=15–24°, ribs/mm 1<sup>st</sup> wh.=2–10, ribs/mm 4<sup>th</sup> wh.=4–10.

FEMALE GENITAL ORGANS. As in *C. (T.) affine*.

### Remarks

*Cochlostoma (T.) agriotes* is considered a subspecies of *C. (T.) crosseanum* in MolluscaBase (2023) but actually they have the same shell and female genital morphology. However, the Sicilian *C. (T.) affine* is equally similar and therefore, on morphological characters, it should be synonymized too. The p-distances between the samples of *agriotes* and *crosseanum* are very high (2.4–3.1%), higher than the one between the Sicilian *affine* and *agriotes* (1.7%). The assignment of populations to this species rather than to the nearby living *C. (T.) crosseanum* is purely tentative and based on geographical consideration.

### *Cochlostoma (T.) crosseanum* (Paulucci, 1879)

Figs 97 (green dots), 98A–E, 102–104

*Pomatias Crosseanus* Paulucci, 1879: 15–16.

### Syntype

ITALY • ♂; “*Pomatias Crosseanus* Paulucci N.2. Lucchio a M<sup>tri</sup> 700 Provincia di Lucca. 33 esempl. Parte raccolti da Marietta 1879, parte da noi 1877”; MZUF11960\_9622.

### Other specimens

ITALY • 1- Lucchio loc. Scesta (topotypical); 44.0458° N, 10.6922° E; 2009; De Mattia leg.; WdM6953 • 2- Botri; 44.0828° N, 10.6038° E; 2010; Margelli leg.; EZ0984 • 3- Sassorosso; 44.1842° N, 10.3983° E; 2011; Hallgass leg.; EZ1085 • 2- Gole del Velino 2; 42.4746° N, 13.0868° E; 2010; Pocaterra leg.; EZ1013 • 3- Posta, via Salaria; 42.4693° N, 13.0838° E; 2010; Zallot leg.; EZ0002 • 4- Roccalbegna; 42.7858° N, 11.5079° E; 2010; Margelli leg.; EZ0980 • 5- Cervara; 41.9811° N, 13.0666° E; 2014; De Mattia leg.; EZ1194 • 6- Monte Calvi; 43.0943° N, 10.6245° E; 2022; S. Cianfanelli and M. Calcagno leg.; MZUF65915 • 7- Gerfalco; 43.1463° N, 10.9794° E; 2022; S. Cianfanelli and M. Calcagno leg.; MZUF65813 • 3- Celano-Gole del Celano; 42.0875° N, 13.5676° E; 2000; Zallot leg.; EZ0406 • 4- Scanno; 41.9129° N, 13.8786° E; 2008; Hallgass leg.; EZ0408 • 5- Gole del Sagittario; 41.9789° N, 13.8121° E; 2011; Hallgass and Zallot leg.; EZ1066 • 6- Mt Marsicano; 41.8028° N, 13.8694° E; 1989; Hallgass leg.; EZ1069 • 7- Gole di Celano; 42.0893° N, 13.569° E; 2011; Hallgass leg.; EZ1090 • 8- Gole di Fara San Martino; 42.089° N, 14.1915° E; 2013; Hallgass leg.; EZ1128.

### Type locality

ITALY • Lucchio, Lucca.

### Description

SHELL. As in *C. (T.) agriotes*.

MEASUREMENTS. 26 ♀♀: whorls=7.2–8.8, H=7.6–9.5 mm, H/W=2.65–3.08, roundness=0.1–0.17, ribs incl.=54–60°, apert. incl.=15–24°, ribs/mm 1<sup>st</sup> wh.=3–9, ribs/mm 4<sup>th</sup> wh.=4–11, umb.=hidden.

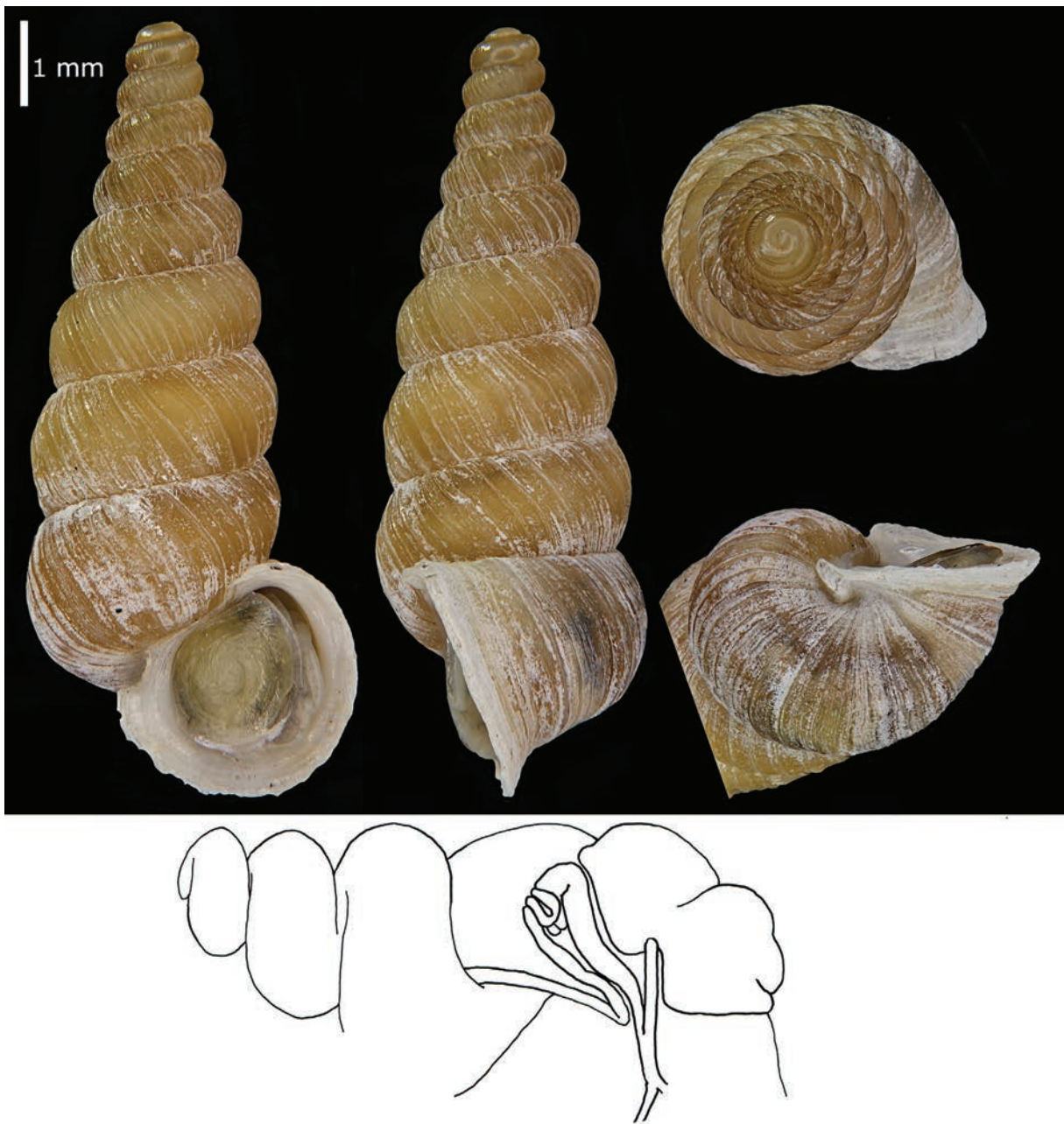
FEMALE GENITAL ORGANS. As in *C. (T.) affine*.

Remarks

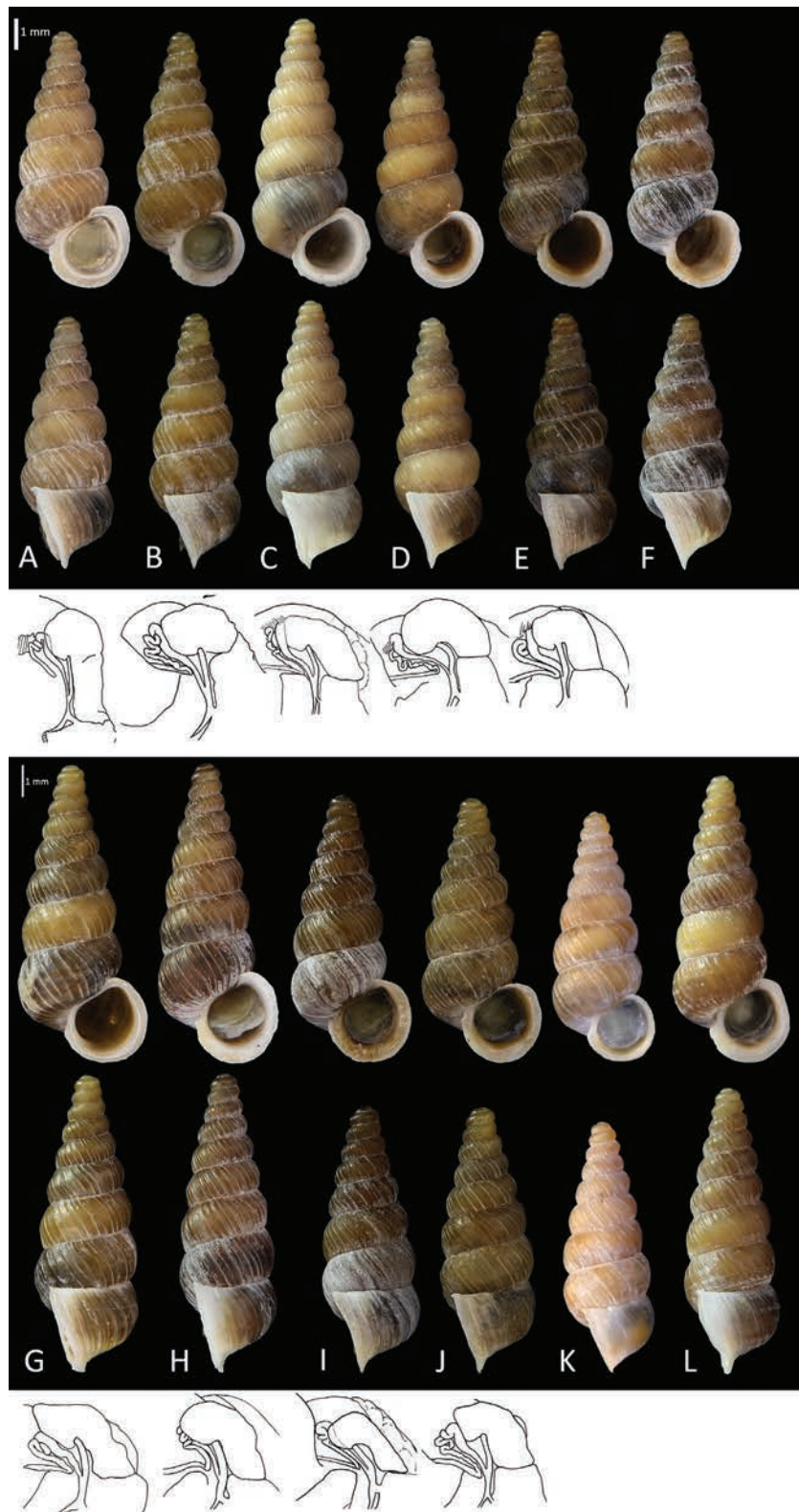
The relative position in the phylogenetic trees with respect to the very similar *agriotes* suggests to consider it a separate species. The samples classified with this species without molecular data are identified according to distributional data. The topotypical population of the species lives in the Garfagnana area, which borders to the west with the Apuane Alps and is isolated from the other conspecific populations. Other isolated populations live in “limestone islands” in the Tuscany region (Roccalbegna, Monte Calvi).



Fig. 102. Syntype (male) of *Cochlostoma (T.) crosseanum* (Paulucci, 1879), 1- Lucchio, I (MFS-11960\_9622).



**Fig. 103.** Topotypical *Cochlostoma* (*T.*) *crosseanum* (Paulucci, 1879), 1- Lucchio, I (WdM-6953).



**Fig. 104.** *Cochlostoma* (*T.*) *crosseanum* (Paulucci, 1879). **A–B.** 1- Lucchio, I (WdM-6953). **C–D.** 2- Orrido di Botri, I (EZ-0984). **E–F.** 3- Sassorosso, I (EZ-1085). **G.** 1- Gole del Velino 1, I (EZ-1013). **H.** 2- Gole del Velino 2, I (EZ-1014). **I.** 3- Posta Via Salaria, I (EZ-0002). **J.** 4- Roccalbegna, I (EZ-0980). **K.** 7- Gerfalco, I (MZUF-65813). **L.** 5-Cervara, I (EZ-1194).

### *Taxa with unclear phylogenetic position*

#### Remarks

There is not sufficient information to determine the position of the following species in the phylogenetic tree.

*Cochlostoma (T.) simrothi* (Caziot, 1908)  
Figs 105 (magenta dot), 106

*Pomatias simrothi* Caziot, 1908: 460.

#### Types

Not seen.

#### Other specimen

FRANCE • 1- Saorge (topotypical); 43.9881° N, 7.5513° E; 2009; Margelli leg.; EZ0782.

#### Type locality

FRANCE • Provence-Alpes-Côte d'Azur, Gorge de Saorge.

#### Description

SHELL. Last part of protoconch ribbed with very closely spaced riblets. Teleoconch spotless, with moderately strong and rounded ribs becoming weaker approaching aperture. Strong and developed lip. Columellar lobe bent inwardly to cover umbilicus.



**Fig. 105.** Distribution of samples with undetermined position in the phylogenetic trees: white = *Cochlostoma (T.) macei* (Bourguignat, 1870); purple = *C. (T.) sturarii* (Wagner, 1897); orange = *C. (T.) kleciaki* (Braun, 1887); yellow = *C. (T.) arnautorum* (Wagner, 1906); red = *C. (T.) atlanticum* (Bourguignat, 1868); green = *C. (T.) euboicum* (Westerlund, 1885); blue = *C. (T.) martensianum* (Möllendorff, 1873); magenta = *C. (T.) simrothi* (Caziot, 1908); cyan = *C. (T.) fontqueri* Haas, 1924.

MEASUREMENTS. 2 ♀♀: whorls=8.1–8.2, H=8.1–8.8 mm, H/W=2.62–2.76, roundness=0.1–0.11, ribs incl.=53–60°, apert. incl.=14–15°, ribs/mm 1<sup>st</sup> wh.=8–8, ribs/mm 4<sup>th</sup> wh.=8–10.

FEMALE GENITAL ORGANS (1 ♀). Ventral connection of pedunculus of bursa copulatrix. One or no loops between apex of seminal receptacle and proximal loop. Almost tubular seminal receptacle with undefined basis. Junction of uterus gland close to connection between pedunculus of bursa copulatrix and distal oviduct.

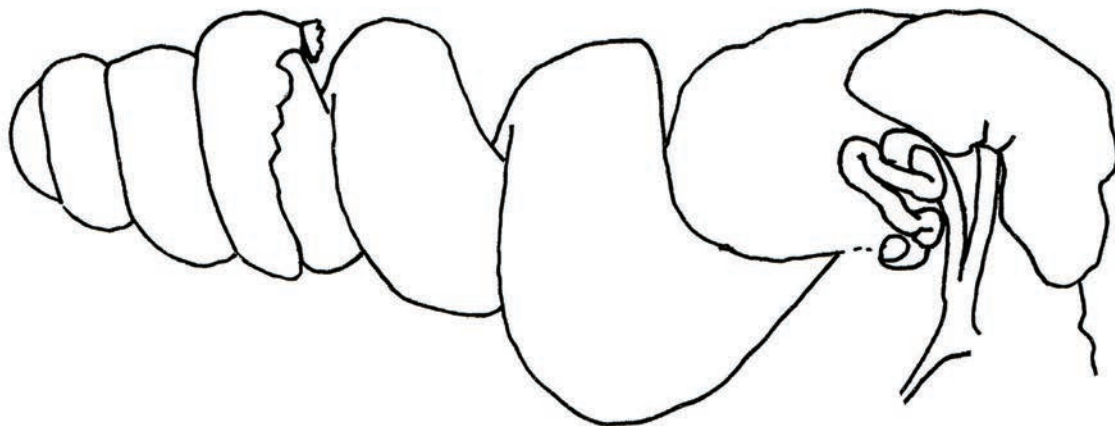


Fig. 106. Topotypical *Cochlostoma (T.) simrothi* (Caziot, 1908), 1- Saorge, FR (EZ-0782).



### Remarks

*Cochlostoma (T.) simrothi* lives in the Maritime Alps, an area where different taxa have been described (*Pomatias simrothi* Caziot, 1908, *Pomatias acutum* Caziot, 1908, *Pomatias galloprovincialis* Locard, 1894 and *Pomatias subalpinus* Pini, 1885). We lack a proper sampling of this area which needs a dedicated study.

Previous authors considered *C. (T.) simrothi* a subspecies of *C. (T.) patulum* (Zilch 1958; “possibly conspecific” in Welter-Schultes 2012: 101). The similarities of the shell suggest a relation with *patulum* but the female genital morphology of the specimen we analysed differs from the samples of *patulum*. Another entity has been described from the same area (roughly 5 km south) as *Cochlostoma acutum* (Caziot, 1908). This is considered a synonym of “*simrothi*” by Boato *et al.* (1984) but accepted as a species on its own by Gargominy & Ripken (2006) because found syntopically with *C. (T.) simrothi*. We did not analyse samples of this taxon (only seen in pictures). It cannot be excluded that it is not part of *Turritus* and instead belongs to the subgenus *Dalfreddia* Zallot *et al.*, 2015.

### *Cochlostoma (T.) fontqueri* Haas, 1924

Fig. 105 (cyan dots)

*Cochlostoma (Auritus) patulum fontqueri* Haas, 1924: 148–149, pl. 8 fig. 9a–b.

### Types

Not seen.

### Other specimens

Seen in pictures (4 males) in Alba *et al.* (2012) where the following localities are cited:

SPAIN • Mont Caro; 40.8035° N, 0.343° E • La Senia; 40.6319° N, 0.2838° E • El Toscar; 40.8735° N, 0.4003° E • Cova del Vidre; 40.7731° N, 0.3153° E • Cova Avellanes; 40.7891° N, 0.3067° E.

### Type locality

SPAIN • Catalonia, Monte Caro.

### Remarks

Molecular or anatomical data of this taxon are not available. It is considered a *C. (T.) patulum* subspecies in MolluscaBase (2023) as it was originally described by Haas (1924). It is instead reported as a separate species in Alba *et al.* (2012). We tentatively accept the concept of Alba *et al.* (2012) and report it as a species on its own.

### *Cochlostoma (T.) martensianum* (Möllendorff, 1873)

Figs 105 (blue dot), 107

*Pomatias martensianus* Möllendorff, 1873: 56–57.

### Lectotype

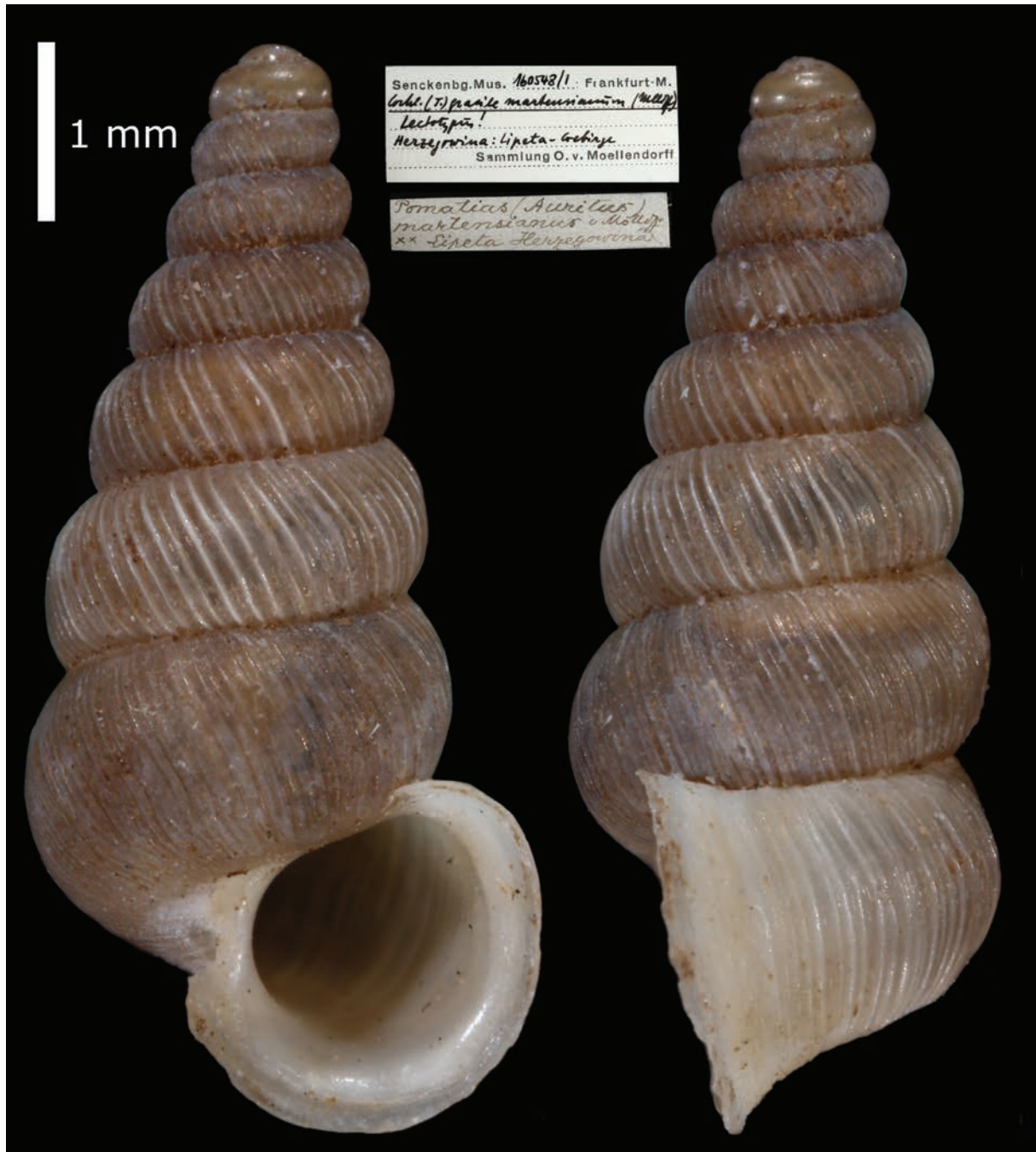
BOSNIA AND HERZEGOVINA • probably ♀; “*Pomatias (Auritus) martensianus* Mlldrf, Lipeta Herzegovina”; SMF160548/1.

### Type locality

BOSNIA AND HERZEGOVINA • 1- Lipeta and Porim Mountains.

### Description

SHELL. Teleoconch spotless, with rounded often whitish ribs more closely spaced on body whorl. Well-developed and strong lip with inwardly bent columellar lobe presumably (only seen in frontal and lateral view in picture) covering umbilicus.



**Fig. 107.** Lectotype (male) of *Cochlostoma (T.) martensianum* (Möllendorff, 1873), 1- Lipeta, BeH (SMF-160548/1).

MEASUREMENTS. 1 ♂, SMF160548/1: whorls=7.5, H=6.1, H/W=2.54, roundness=0.11, ribs incl.=60°, apert. incl.=18°, ribs/mm 1<sup>st</sup> wh.=20, ribs/mm 4<sup>th</sup> wh.=16.

FEMALE GENITAL ORGANS. Not seen.

### Remarks

Because the lectotype is a male specimen, its measurements and features cannot be compared. This species occurs in a poorly explored area from which we have no samples. Based on the morphology of the lectotype, it is not plausible that it is a subspecies of *C. (T.) gracile* as currently reported.

### *Cochlostoma (T.) sturanii* (Wagner, 1897)

Figs 105 (purple dots), 108–109

*Pomatias gracile* var. *sturanii* Wagner, 1897: 45–46, pl. VIII fig. 75a–b.

### Syntypes

CROATIA • 1 ♂; “*P. gracilis* Pf. var. *sturanii* Wgnr. Orig. Korenica Kroatien”; SMF160600 • 1 ♂; “*P. gracilis* Pfr. var. *sturanii* A.J. Wagner, Jezero bei Korenica Kroatien”; SMF1160601 • 2 ♀♀, 1 ♀; “*Cochlostoma sturanyi* AJW. Plješevica Gebirge Zm Priboj. Geta Kroatien”; NHMWK45395.

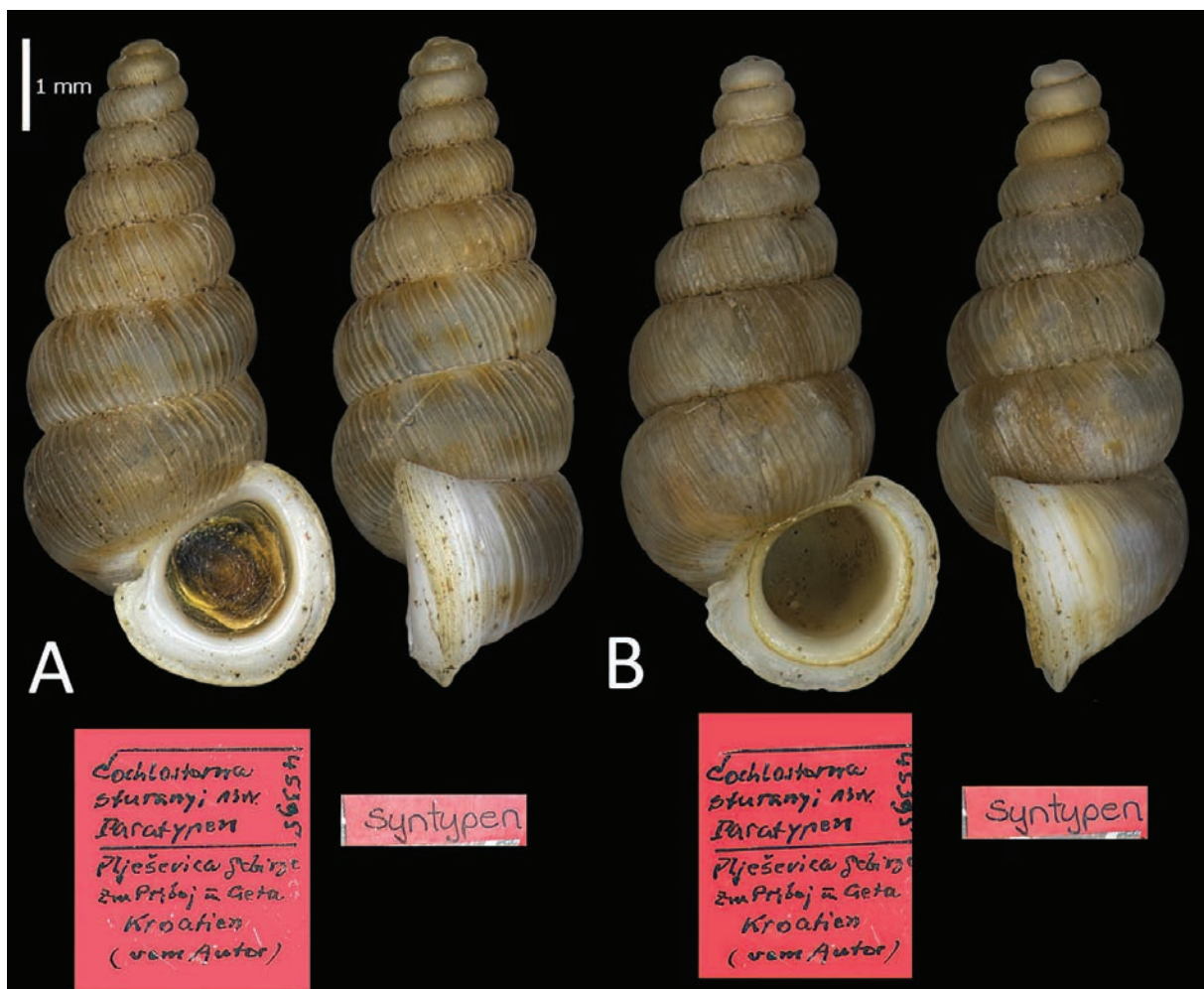
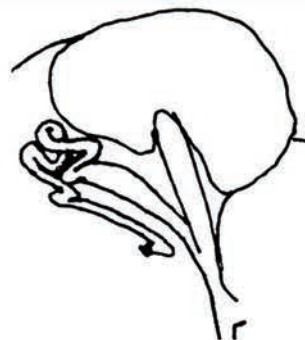
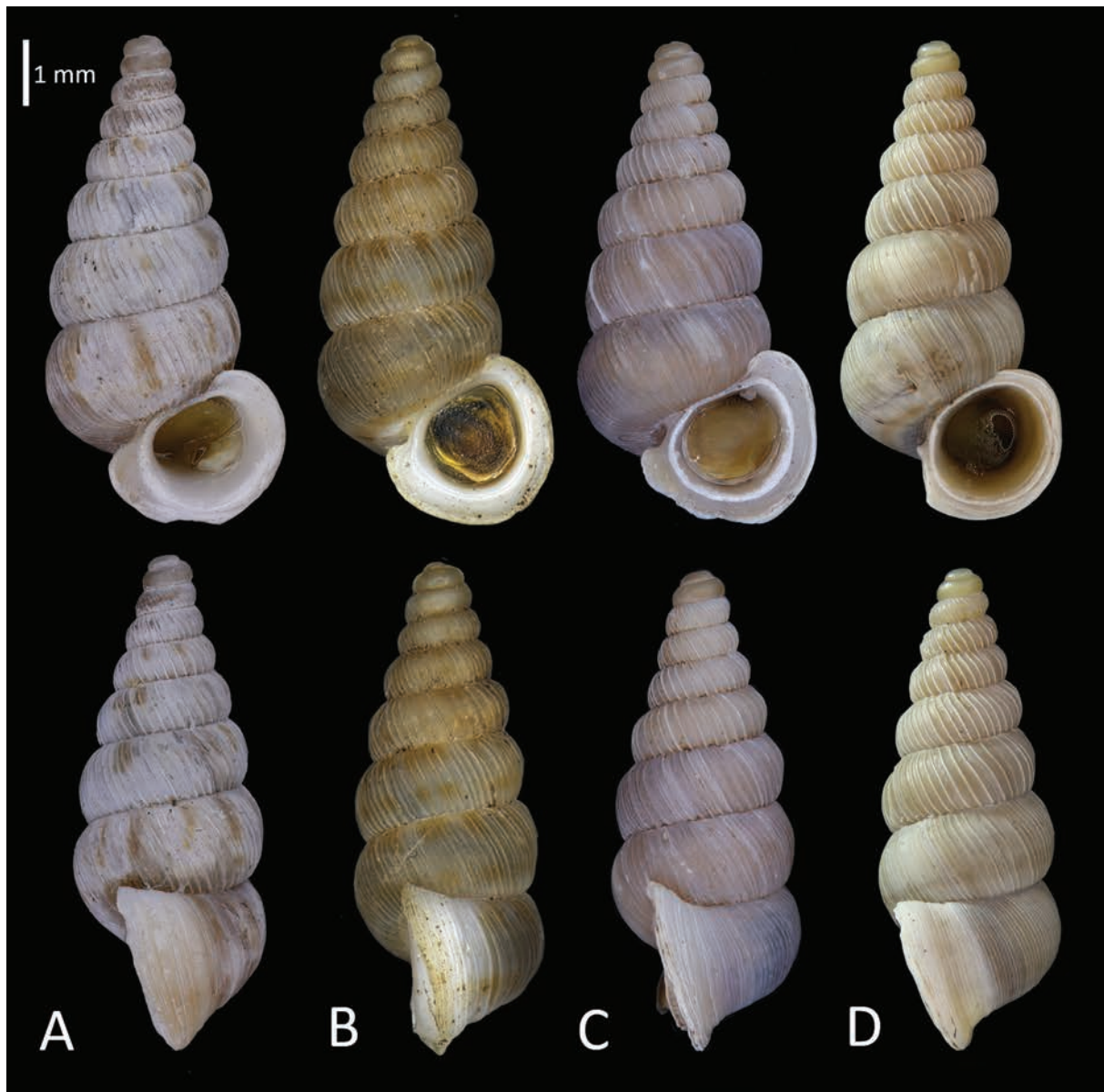


Fig. 108. Syntypes of *Cochlostoma (T.) sturanii* (Wagner, 1897), 1-“Plješevica- Priboj”, HR. A. NHMW-K45395/1. B. NHMW-K45395/3.



**Fig. 109.** *Cochlostoma (T.) sturanii* (Wagner, 1897). **A.** 2- Plitvice, HR (HNHM-100120). **B.** Syntype, 1- Plješevica, HR (NHMW-K45395/1). **C.** 3- Gračac, HR (HNHM-100406). **D.** 5- Crnopac Pass, HR (NHMW-93345).

### Other specimens

CROATIA • 2- Plitvice; 44.8641° N, 15.5820° E; 2002; Murányi leg.; HNHM100120 • 3- Gračac; 44.2431° N, 15.813° E; 1987; Pintér leg.; HNHM100406 • 4- Gračac, Čerovacka pečina; 44.2764° N, 15.8747° E; 2009; Jochum leg.; HNHM97238 • 5- Crnopac Pass; 44.2501° N, 15.8502° E; 1999; Eröss, Fehér and Kovács leg.; HNHM93345.

### Type locality

CROATIA • 1- “Plješevica-Gola bei Priboj”.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch with two lines of reddish spots on whorls. Quite closely spaced ribs on teleoconch. Very strong lip with abruptly inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 2 ♀♀ from Plješevica: whorls=7.1–7.5, H=6.9–7.0 mm, H/W=2.50–2.6, roundness=0.16–0.17, ribs incl.=66–67°, apert. incl.=13–17°, ribs/mm 1<sup>st</sup> wh.=9–10, ribs/mm 4<sup>th</sup> wh.=10–12.

### Remarks

Fresh material from the type locality was not available. Wagner (1897: 45–46) described this species as a “variety” of *gracile*, and mentioned, next to the type locality, Korenica as its habitat. We analysed specimens from the vicinity of this locality (Plitvice), having the same shell morphology as the syntypes, with evident spots on the whorls and a thick lip (Fig. 109A), but it was not possible to analyse the female genital morphology because of the poor preservation. In Wagner’s collection, there are specimens from Gračac, HR (MIZPASW7041) and “Berg Crnopac”, HR (MIZPASW7042) identified as this taxon. We tentatively report fresh material from these localities, ca 60 km south of Plješevica as such. The female genital organs of the sample from Gračac show a “*patulum*-like” morphology.

### *Cochlostoma (T.) atlanticum* (Bourguignat, 1863)

Figs 105 (red dot), 110

*Pomatias atlanticus* Bourguignat, 1863: 430–432.

### Types

Not seen.

### Other specimens

ALGERIA • 1- Isser (topotypical); 36.8803° N, 3.8563° E; 1929; Polinski leg.; NHMW49199.

### Type locality

ALGERIA • Kabilye, Oued Isser.

### Description

SHELL. Rather widely spaced riblets on last part of protoconch. Teleoconch with two lines of reddish spots on whorls. Ribs moderately strong, regularly spaced, not fading toward aperture. Rather weak lip with inwardly bent columellar lobe.

MEASUREMENTS. 1 ♀: whorls=7.8, H=7.8 mm, H/W=2.69, roundness=0.17, ribs incl.=66°, apert. incl.=14°, ribs/mm 1<sup>st</sup> wh.=11, ribs/mm 4<sup>th</sup> wh.=7.

### Remarks

Only empty shells were available. The assignment of this species to *Turritus* is based on the general morphology of the shell, which is similar to *C. (T.) macei* (Bourguignat, 1870) and substantially differs from the other known African species (*Obscurella marocana* (Pallary, 1928); *C. (Auritus) perseianum*

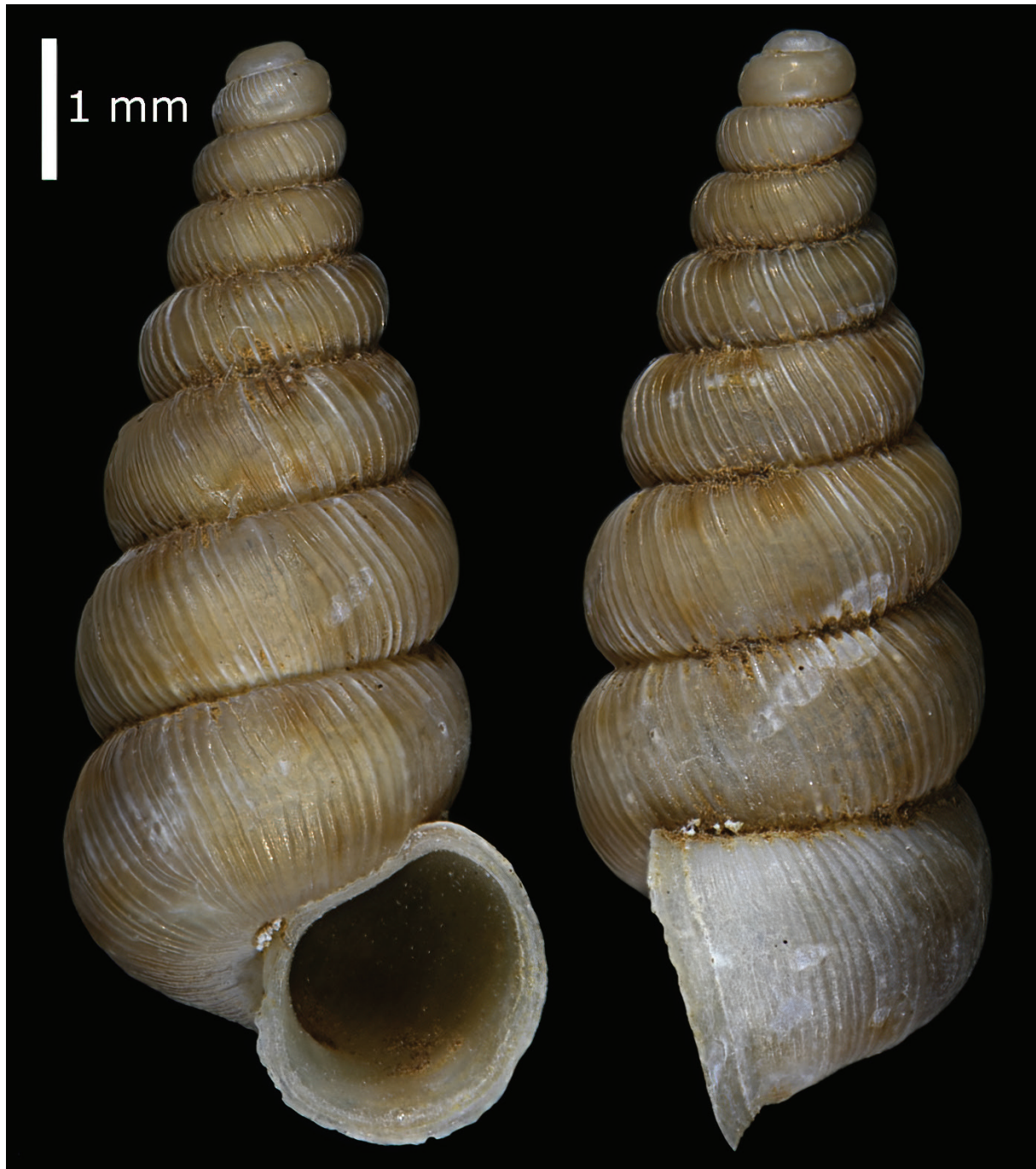


Fig. 110. *Cochlostoma (T.) atlanticum* (Bourguignat, 1868), 1- Isser, DZ.

(Kobelt, 1886); *C. (Auritus) euconus* (Ancey, 1888); *C. (Auritus) letourneuxi* (Bourguignat, 1866); *C. (Apolloniana) susaense* Brandt, 1958 and *C. (Apolloniana) barcaense* Brandt, 1958). The assignment could be supported by paleogeographical considerations, the Kabilye being a part of a European microplate which migrated south and crashed against the African plate (see Leprêtre *et al.* 2018).

*Cochlostoma (T.) macei* (Bourguignat, 1870)

Figs 105 (white dots), 111

*Pomatias macei* Bourguignat 1870: 56–57.

**Types**

Not seen.

**Other specimens**

FRANCE • 1- Gourdon; 43.7305° N, 6.959° E; 1976; RMNH leg.; EZ0399 • 2- Gorge du Trevans; 43.9471° N, 6.2267° E; 2014; Zallot leg.; EZ1178.

**Type locality**

FRANCE • Drôme, Grasse, Saint Vallier.

**Description**

SHELL. Closely spaced riblets on last part of protoconh. Teleoconch spotless with moderately strong ribs. Relatively strong lip with quite abruptly inwardly curved columellar lobe covering umbilicus.

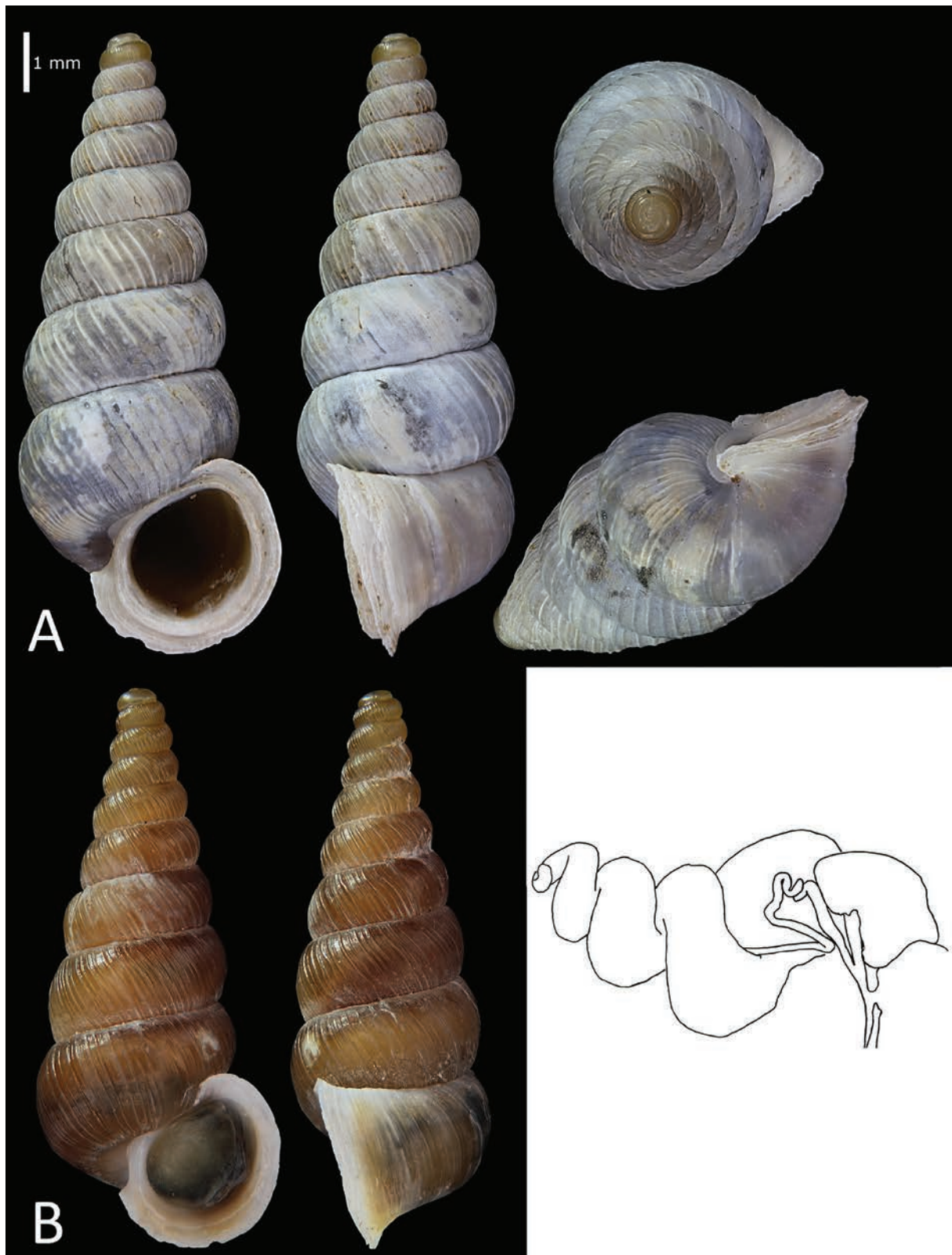
MEASUREMENTS. 3 ♀♀: whorls = 8.3–9.1, H = 9.4–10.4 mm, H/W = 2.79–3.1, roundness = 0.1–0.14, ribs incl. = 57–59°, apert. incl. = 17–19°, ribs/mm 1<sup>st</sup> wh. = 5–13, ribs/mm 4<sup>th</sup> wh. = 7–15.

FEMALE GENITAL ORGANS. 2 specimens analysed. Slightly posterior connection of pedunculus to bursa copulatrix. Short, roughly oval seminal receptacle with undefined basis. 2–4 loops clustered beside apex of seminal receptacle. Junction of uterus gland far from connection of pedunculus of bursa copulatrix with distal oviduct.

**Remarks**

Our sample closest to the type locality originates from Gourdon, ca 10 km east of Saint Vallier. The other sample, from the Gorge du Trevans, is located 50 km northeast of the type locality. Only of the latter we were able to analyse the genitals.

The shell morphology and the female genitalia suggest that this species belongs to *Turritus*. Only H3 was sequenced and the results support this conclusion. Based on some similarity of the female genital morphology with that of *C. (T.) sardoum*, it could belong to the same subclade within clade B. This would be interesting in a paleogeographic perspective because it would be the ‘remnant’ on the European plate of the closest relative to the *sardoum*, *agriotes/affine*, and *atlanticum* taxa (see Discussion), which originated on the southern border of the European plates before the geological eras which led to the current shape of the western Mediterranean Sea and the lands that surround it.



**Fig. 111.** *Cochlostoma (T.) macei* (Bourguignat, 1870). **A.** 1- Gourdon, FR (EZ-0399). **B.** 2- Gorge du Trevans, FR (EZ-1178).



*Cochlostoma (T.) arnautorum* (Wagner, 1906)

Figs 105 (yellow dots), 112–113

*Auritus (Auritus) kleciaki arnautorum* Wagner, 1906: 131–132, pl. 4 fig. 17a–b.

**Lectotype** (here designated)

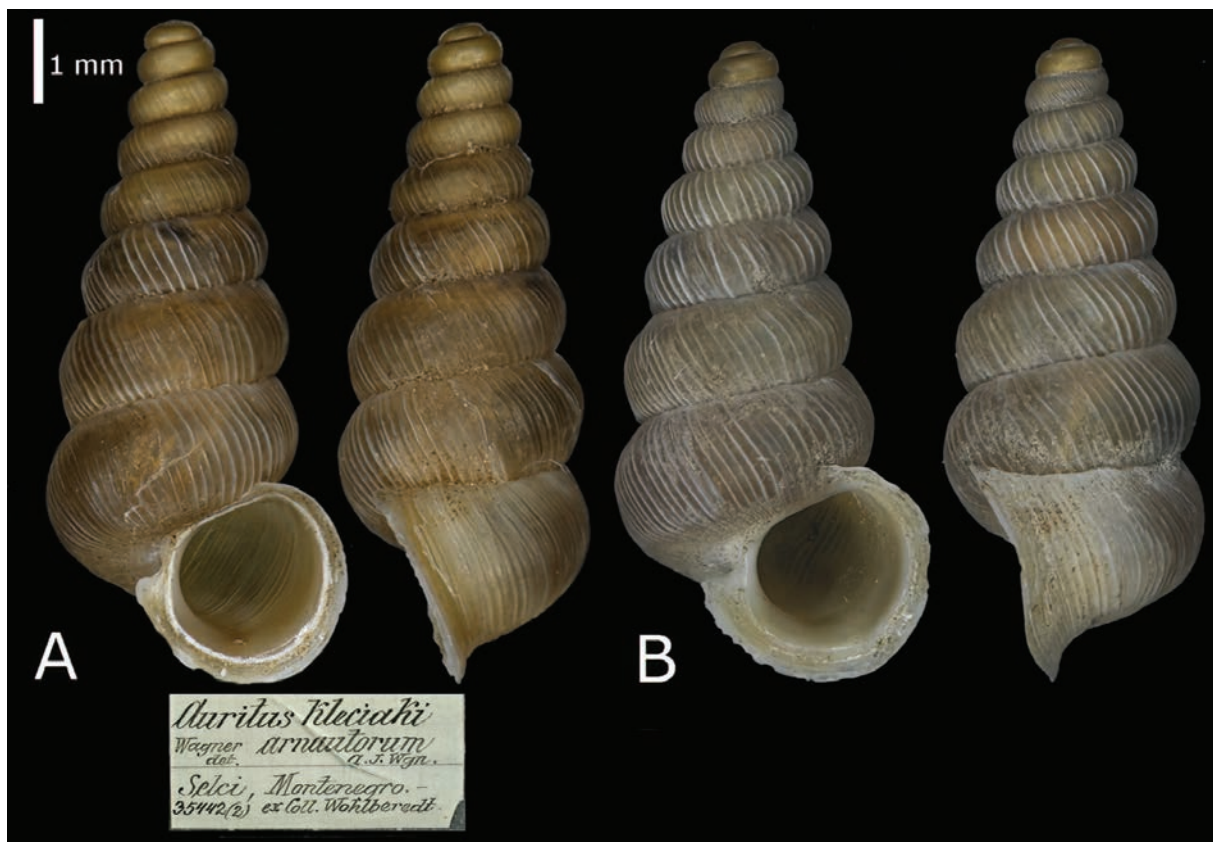
ALBANIA • ♀; “*Auritus Kleciaki arnautorum* A. J. Wgn., Wagner det., Selci, Montenegro, ex Coll. Wohlberedt”; NHMW35442.

**Other specimens**

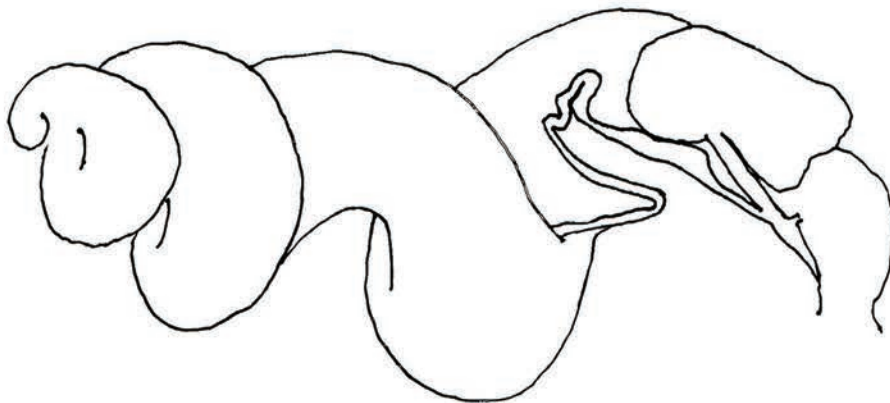
ALBANIA • 1- Selcë (topotypical); 42.5199° N, 19.6271° E; 2018; M. Schilthuizen and I. Njunjić leg.; TxExDU0137.

**Type locality**

The author (Wagner 1906: 131–132) listed a series of localities: “Rikovak, Selci (“Selci” at that time in Montenegro is now *Selcë*, Albania) und Korito in Montenegro; Dr. Sturany sammelte entsprechende Exemplare zwischen Fundina und Zatriebac an der montenegrinisch-albanesischen Grenze, ferner eine kleinere, dunkelrotbraun gefärbte Form mit etwas kräftigeren und weitläufigeren Rippchen auf den oberen Umgängen am Berge Sildinja östlich von Skutari in Albanien.”. Due to the present lectotype designation, the type locality is restricted to ALBANIA • Shkodër County, Selcë.



**Fig. 112.** Types of *Cochlostoma (T.) arnautorum* (Wagner, 1906). **A.** Lectotype (here designated), Selcë, AL (NHMW-35442). **B.** Paralectotype, Fundina, MONT (NHMW-K47011).



**Fig. 113.** Topotypical *Cochlostoma* (*T.*) *arnautorum* (Wagner, 1906), 1- Selcë, AL (TxEx-du0137).

### Description

SHELL. Widely spaced riblets on last part of protonch. Teleoconch spotless, ribbed with rather prominent ribs. Moderately strong lip with abruptly inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 6 ♀♀: whorls=7.4–8.5, H=6–8 mm, H/W=2.46–2.81, roundness=0.12–0.17, ribs incl.=57–68°, apert. incl.=16–29°, ribs/mm 1<sup>st</sup> wh.=7–12, ribs/mm 4<sup>th</sup> wh.=7–11.

FEMALE GENITAL ORGANS. Posterior connection of pedunculus to bursa copulatrix. Seminal receptacle with indistinct basis and apex, almost tubular, with 2–3 narrow loops close to apex. Junction of uterus gland close to distal oviduct-pedunculus connection.

### Remarks

Wagner (1906) described this taxon as a subspecies of *C. (T.) kleciaki*, and as such it is reported in MolluscaBase (2023). We consider it a separate species because of the differences in the female genital morphology: the junction of the uterus gland is close to the connection between the distal oviduct and the pedunculus of the bursa copulatrix in the sample from Selcë where the junction of the uterus gland is far from the connection between the distal oviduct and the pedunculus of the bursa copulatrix in the sample from Zupanje Selo.

### *Cochlostoma (T.) kleciaki* (Braun, 1887)

Figs 105 (orange dots), 114–116

*Pomatias kleciaki* Braun, 1887: 110–111.

### Lectotype

CROATIA • ♂; “*Pom. kleciaki* Bttg. Lesina Klečiak 80”; SMF160836.

### Other specimens

CROATIA • 2- Makarska; 43.3000° N, 17.0300° E; A.J. Wagner leg.; MIZPASW7082 • 3- Županje Selo; 42.9637° N, 17.3084° E; 1985; Kiss and L. Pintér leg.; HNHM105302.

### Type locality

CROATIA • “Lesina insula” (Hvar island, Split-Dalmatia).

### Description

SHELL. (based on the male lectotype). Teleoconch spotless. Rather strong ribs becoming less strong and closely spaced toward aperture. Very strong lip with indented columellar lobe presumably (lectotype only seen in frontal and lateral view) covering umbilicus.

MEASUREMENTS. ♀ MIZPASW7082: whorls=8.1, H=8.9 mm, H/W=2.6, roundness=0.13, ribs inclin.=63°, ribs per mm 1<sup>st</sup> whorl=6, ribs per mm 4<sup>th</sup> whorl=10. 3 ♀♀ Županje Selo: whorls 7.2–7.7, H=6.1–6.4 mm, H/W=2.44–2.63, roundness=0.15–0.17, ribs inclin.=57–62, ribs per mm 1<sup>st</sup> whorl=8–12, ribs per mm 4<sup>th</sup> whorl=10–17.

FEMALE GENITAL ORGANS. Poorly preserved specimens from Županje Selo were dissected. Slightly posterior pedunculus of bursa copulatrix, club-shaped, elongated, tortuous seminal receptacle and short loops clustered close to apex of seminal receptacle, junction of uterus gland far from connection between distal oviduct and pedunculus of bursa copulatrix.



Fig. 114. *Cochlostoma (T.) kleciaki* (Wagner, 1906), lectotype (male), SMF-160836/1, Hvar Island, HR (SMF-160836/1).

### Remarks

The lectotype is a male specimen. The female specimen in Wagner's collection (Fig. 115) is from Makarska, a Croatian city on the coast opposite Hvar Island. The female genital morphology of the specimens from Županje Selo, Pelješac peninsula, south of Hvar Island (Croatia), here assumed as representative of the species, show clade B features. The similarity with *C. (T.) nanum* and *C. (T.) stossichi* was also noticed by Braun who remarked it in the original description (1887: 110–111: “Die Form steht den beiden croatischen Arten *P. nanus* West, von Udbina bei Gospic und *P. stossichi* Cless. vom Mte. Risniak in Südcroatien sehr nahe, dürfte aber vorläufig schon wegen des weitentlegenen Fundortes nicht ohne weiteres mit einer derselben identifiziert werden.” To be noted that the localities cited by Braun are not correct).



**Fig. 115.** *Cochlostoma (T.) kleciaki* (Wagner, 1906), MIZPAS-W7082, 2-Makarska, HR (MIZPAS-W7082).



Fig. 116. *Cochlostoma (T.) kleciaki* (Wagner, 1906), 3- Županje Selo, HR (HNHM-105302).

*Cochlostoma (T.) euboicum* (Westerlund, 1885)

Figs 105 (green dot), 117

*Pomatias banaticus* var. *euboicus* Westerlund, 1885: 124–125.

**Types**

Not seen.

**Other specimens**

Photo of specimen MIZPASW7057 from the type locality in Wagner's collection.

**Type locality**

GREECE • 1- Euboea, Delphi.

**Description**

SHELL. Very strong, well-spaced and whitish ribs becoming weaker and less spaced on body whorl. Moderately developed lip with abruptly inwardly curved columellar lobe presumably covering umbilicus.

MEASUREMENTS. Based on MIZPASW7057: whorls=7.3, H=7.5 mm, H/W=2.69, roundness=0.14, ribs inclin.=59, ribs per mm 1<sup>st</sup> whorl=12, ribs per mm 4<sup>th</sup> whorl=9.

**Remarks**

We tentatively assign *C. (T.) euboicum* to the subgenus *Turritus* based on the shell morphology of the specimen in A.J. Wagner's collection. Wagner (1897: 46–47) classified this species as part of the "Formenkreis *Difficilis*", with *C. (T.) patulum* and *C. (T.) gracile* (on the label of the specimen, however, it is classified as a subspecies of *C. (T.) sturanii*).

**Discussion**

Our results give a new perspective on the taxonomy of the subgenus *Turritus* and readdress some of the issues currently presented in the most frequently used checklists, such as MolluscaBase (2023) and Welter-Schultes (2012) (Table 1). However, the results raise more questions than answers and therefore the resulting taxonomy should be intended as a step forward, a work in progress which will need additional studies with supporting molecular data.

In this respect, we underscore and suggest for further studies three main challenging characteristics of the subgenus:

The presence of more or less closely related allopatric sets of populations sharing the same female genital and shell morphology. In the case of *C. (T.) crosseanum/agriotes* of northern Italy and the Sicilian *C. (T.) affine*, their phylogenetic relation, the more distant one with the Sardinian *C. (T.) sardoum* and the presence of a "Turritus-like" *Cochlostoma* in the Kabilye region in Algeria (*C. (T.) atlanticum*) seems to reflect the paleogeographical history of the regions surrounding the western Mediterranean Sea. Based on accredited theories (see Hinsbergen *et al.* 2014), Sardinia, the part of Sicily currently inhabited by *C. (T.) affine* and the area that afterwards formed the Kabilya region of the coast of Africa were once attached to the European plate (where now is the Golfe du Lion in France). There is no full agreement on the timing of the separations of the different microplates. However, roughly 30–40 Ma they detached, started to migrate south and rotate counter-clockwise. Sardinia was separated by the Calabrian-Peloritani block around 10 Ma. The closer relation between *crosseanum/agriotes* and *affine* could implicate that a part of Sicily and the central Apennines remained connected after the separation



Fig. 117. *Cochlostoma* (*T.*) *euboicum* (Westerlund, 1885), MIZPAS-W7057, 1- Mount Delphi, GR (MIZPAS-W7057).



from the Sardinia-Corsica plate and from the terrains that would form Tuscany afterwards. As in many other studies regarding organisms living around the western Mediterranean Sea, these timings could be used to calibrate the nodes of the phylogenetic tree (Pfenninger *et al.* 2010; Ribera *et al.* 2010). More difficult is to propose a reasonable hypothesis for the almost indistinguishable French *C. (T.) patulum*, Slovenian *C. (T.) stussineri* and Appenninic populations as NFS064 in the Appendix. It has to be noted that the p-distances among these taxa are of the same magnitude as found between *crosseanum/agriotes* and *affine*.

Sets of populations well differentiated in shell morphology but not in the female genital morphology, which corresponds with phylogenetically more close relationships than in the above mentioned indistinguishable *C. (T.) agriotes* and *C. (T.) affine*. For instance, within clade B, *C. (T.) elegans* and *C. (T.) nanum* evidently differ in the shell morphology and live in a different environment (coastal vs alpine, respectively).

Populations morphologically similar (both in the shell and in the female genitalia) which live in contiguous area and are phylogenetically not very closely related. This happens, for instance, with the two samples of *C. (T.) patulum* from Cirque D'Archiane and Vaucluse, roughly 90 km apart on the west side of the French Alps or for the Southern Appennine populations of *C. (T.) cassiniacum*.

## Conclusion

Based on our data, there are 37 species in the subgenus *Turritus* of which 5 are new to science (Table 1). In addition, 13 samples or sets of samples are presented in the Appendix, because it is impossible to properly describe them. Only two subspecies are maintained here.

## Acknowledgments

We thank Sigrid Hof of the Senckenberg Forschungsinstitut for the photos of the types at the Seckenberg Museum. We thank “il Bollettino Malacologico Italiano” who allowed us to reprint the photos of the types of the species described by the Marquise Paulucci. We are grateful to Marco Bodon, Simone Cianfanelli and Enrico Taglienti for precious advice and interesting samples. We are equally grateful to all the participants of the online forum Naturamediterraneo and to all the other malacologists who provided a lot of useful material and information. Suzanne Saenko is gratefully acknowledged for her support during the molecular phylogenetics part of this study.

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**Table 1** (continued on next two pages). List of the taxa reported in MolluscaBase (2021), Welter-Schultes (2012) and in this paper. Gray background for the subspecies; yellow background for the species not assigned to *Turritus* Westerlund, 1883 in MolluscaBase (2021); green background for the new species. Names in red refer to taxa inquirenda in MolluscaBase.

MolluscaBase (2023)	Welter-Schultes (2012)	In this paper	Taxon inquirendum in MolluscaBase	Assign to the subgenus	Accepted	Raised to species	New	Synonymized
<i>Cochl. (Auritus) adamii</i> (Paulucci, 1879)		<i>C. (T.) adamii</i> (Paulucci, 1879)	*	*	*			
<i>Cochl. (T.) affine</i> (Benoit, 1876)	<i>Cochl. affine</i> (Benoit, 1876)	<i>C. (T.) affine</i> (Benoit, 1876)			*			
<i>Cochl. (T.) crosseanum agriotes</i> (Westerlund, 1879)		<i>C. (T.) agriotes</i> (Westerlund, 1879)				*		
<i>Cochl. (T.) kleciaki arnautorum</i> (Wagner, 1906)		<i>C. (T.) arnautorum</i> (Wagner, 1906)				*		
<i>Cochl. atlanticum</i> (Bourguignat, 1868)		<i>C. (T.) atlanticum</i> (Bourguignat, 1868)		*				
<i>Cochl. (T.) braueri braueri</i> (Wagner, 1897)	<i>Cochl. braueri</i> (Wagner, 1897)	<i>C. (T.) braueri</i> (Wagner, 1897)			*			
<i>Cochl. (T.) montanum cassiniacum</i> (Saint-Simon in Paulucci, 1878)		<i>C. (T.) cassiniacum</i> (Saint-Simon in Paulucci, 1878)				*		
<i>Cochl. (T.) gracile croaticum</i> (Pfeiffer, 1870)		<i>C. (T.) gracile croaticum</i> (Pfeiffer, 1870)			*			
<i>Cochl. (T.) crosseanum crosseanum</i> (Paulucci, 1879)	<i>Cochl. crosseanum</i> (Paulucci, 1879)	<i>C. (T.) crosseanum</i> (Paulucci, 1879)			*			
<i>Cochl. (T.) nanum dubium</i> (Wagner, 1897)		<i>C. (T.) dubium</i> (Wagner, 1897)			*			
<i>Cochl. (T.) braueri latestriatum</i> (Wagner, 1897)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans elegans</i> (Clessin, 1879)	<i>Cochl. elegans</i> (Clessin, 1879)	<i>C. (T.) elegans</i> (Clessin, 1879)			*			
<i>Cochl. (T.) elegans imoschiense</i> (Wagner, 1906)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans irregularis</i> (Wagner, 1897)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans oostoma</i> (Westerlund, 1883)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans simile</i> (Wagner, 1897)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans spectabile</i> (Wagner, 1897)		<i>C. (T.) elegans</i> (Clessin, 1879)						*
<i>Cochl. (T.) elegans tumidum</i> (Wagner, 1897)		<i>C. (T.) elegans</i> (Clessin, 1879)						*

**Table 1** (continued). List of the taxa reported in MolluscaBase (2021), Welter-Schultes (2012) and in this paper. Gray background for the subspecies; yellow background for the species not assigned to *Turritus* Westerlund, 1883 in MolluscaBase (2021); green background for the new species.

MolluscaBase (2023)	Welter-Schultes (2012)	In this paper	Taxon inquirendum in MolluscaBase	Assignend to the subgenus	Accepted	Raised to species	New	Synonymized
<i>Cochl. elongatum</i> (Paulucci, 1879)		<i>C. (T.) elongatum</i> (Paulucci, 1879)		*				
<i>Cochl. euboicum</i> (Westerlund, 1885)	<i>Cochl. euboicum</i> (Westerlund, 1885)	<i>C. (T.) euboicum</i> (Westerlund, 1885)		*				
<i>Cochl. (T.) patulum fontiqueri</i> Haas, 1924	<i>Cochl. fontiqueri</i> Haas, 1924	<i>C. (T.) fontiqueri</i> Haas, 1924				*		
<i>Cochl. (T.) gracile gracile</i> (Pfeiffer, 1849)	<i>Cochl. gracile</i> (Pfeiffer, 1849)	<i>C. (T.) gracile</i> (Pfeiffer, 1849)			*			
<i>Cochl. (T.) gracile gracillimum</i> (Wagner, 1901)		<i>C. (T.) gracile gracillimum</i> (Wagner, 1901)			*			
		<i>C. (T.) hallgassi</i> sp. nov.					*	
<i>Cochl. (T.) kleciaki kleciaki</i> (Braun, 1887)	<i>Cochl. kleciaki</i> (Braun, 1887)	<i>C. (T.) kleciaki</i> (Braun, 1887)			*			
		<i>C. (T.) kotschani</i> sp. nov.					*	
		<i>C. (T.) lacazei</i> sp. nov.					*	
<i>Cochl. (T.) macei</i> (Bourguignat, 1870)	<i>Cochl. macei</i> (Bourguignat, 1870)	<i>C. (T.) macei</i> (Bourguignat, 1870)			*			
<i>Cochl. (T.) mariannae</i> Nordsieck, 2011	<i>Cochl. mariannae</i> Nordsieck, 2011	<i>C. (T.) mariannae</i> H. Nordsieck, 2011			*			
<i>Cochl. (T.) gracile martensianum</i> (Möllendorff, 1873)		<i>C. (T.) martensianum</i> (Möllendorff, 1873)				*		
<i>Cochl. (T.) montanum montanum</i> (Issel, 1866)	<i>Cochl. montanum</i> (Issel, 1866)	<i>C. (T.) montanum</i> (Issel, 1866)			*			
<i>Cochl. (T.) mostarensis</i> (Wagner, 1906)	<i>Cochl. mostarensis</i> (Wagner, 1906)	<i>C. (T.) mostarensis</i> (Wagner, 1906)			*			
<i>Cochlostoma sturarii mnelense</i> (Wagner, 1914)		<i>C. (T.) mnelense</i> (Wagner, 1914)		*		*		
		<i>C. (T.) muranyii</i> sp. nov.					*	
<i>Cochl. (T.) nanum nanum</i> (Westerlund, 1879)	<i>Cochl. nanum</i> (Westerlund, 1879)	<i>C. (T.) nanum</i> (Westerlund, 1879)			*			
<i>Cochl. (T.) gracile subaioorium</i> Schütt, 1977		<i>C. (T.) pageti</i> Klemm, 1962						*

**Table 1** (continued). List of the taxa reported in MolluscaBase (2021), Welter-Schultes (2012) and in this paper. Gray background for the subspecies; yellow background for the species not assigned to *Turritus* Westerlund, 1883 in MolluscaBase (2021); green background for the new species.

MolluscaBase (2023)	Welter-Schultes (2012)	In this paper	Taxon inquirendum in MolluscaBase	Assigend to the subgenus	Accepted	Raised to species	New	Synonymized
<i>Cochl. (T.) pageti</i> Klemm, 1962	<i>Cochl. pageti</i> Klemm, 1962	<i>C. (T.) pageti</i> Klemm, 1962	*	*				
<i>Cochl. (T.) patulum patulum</i> (Draparnaud, 1801)	<i>Cochl. patulum</i> (Draparnaud, 1801)	<i>C. (T.) patulum</i> (Draparnaud, 1801)	*	*			*	
<i>Cochl. (T.) gracile reitteri</i> (Boettger, 1880)		<i>C. (T.) reitteri</i> (O. Boettger, 1880)			*	*		
<i>Cochl. (T.) sardoum</i> (Westerlund, 1890)	<i>Cochl. sardoum</i> (Westerlund, 1890)	<i>C. (T.) sardoum</i> (Westerlund, 1890)	*	*				
<i>Cochl. (T.) simrothi</i> (Caziot, 1908)	<i>Cochl. simrothi</i> (Caziot, 1908)	<i>C. (T.) simrothi</i> (Caziot, 1908)	*	*				
<i>Cochl. (Aurritus) sospes</i> (Westerlund, 1879)		<i>C. (T.) sospes</i> (Westerlund in Paulucci, 1879)	*	*				
<i>Cochl. (T.) stossichi</i> (Hirc, 1881)	<i>Cochl. stossichi</i> (Hirc, 1881)	<i>C. (T.) stossichi</i> (Hirc, 1881)	*	*				
<i>Cochl. sturanii</i> (Wagner, 1897)	<i>Cochl. sturanii</i> (Wagner, 1897)	<i>C. (T.) sturanii</i> (Wagner, 1897)	*	*				
<i>Cochl. (T.) gracile stussineri</i> (Wagner, 1897)		<i>C. (T.) stussineri</i> (Wagner, 1897)	*	*		*		
<i>Cochl. (T.) zawinkanum</i> (Wagner, 1906)	<i>Cochl. zawinkanum</i> (Wagner, 1906)	<i>C. (T.) zawinkanum</i> (Wagner, 1906)	*	*		*		

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**Supp. file 1.** List of the sampling localities. Abbreviations: E = ethanol preserved; D = dray shell sample; P = front and side photo; L = picture from literature; TL = type locality; TA = type area; \* = if approximated geographical coordinates – blank if taken in place.

<https://doi.org/10.5852/ejt.2024.927.2475.11009>

**Supp. file 2.** p-distances calculated on the 16S marker. Green background for the conspecific samples; gray background for the taxa belonging to other subgenera. Above the p-distances within clade A; below the p-distances within clade B. <https://doi.org/10.5852/ejt.2024.927.2475.11011>



## Appendix

### Remarks

The following samples need further studies because of a lack of material, or insufficient or contradictory data.

Clade A

**NFS064**

Figs 15D, 118 (green dots), 92E, 119

### Material

ITALY • 1- Rio Fuggio; 42.5331° N, 12.9538° E • 2- gole del Rio Fuggio; 42.5313° N, 12.9512° E; 2009; Hallgass leg.; EZ0022 • 3- Terminillo V. dell'Inferno; 42.4734° N, 12.9800° E; 2011; Hallgass and Zallot leg.; EZ1067 • 4- Terminillo Sella di Leonessa; 42.4744° N, 13.0024° E; 2011; Hallgass and Zallot leg.; EZ1068.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with moderately strong ribs becoming weaker approaching aperture. Strong lip with columellar lobe inwardly curved to cover umbilicus.

MEASUREMENTS. 12 ♀♀: whorls=7.3–8.1, H=7.4–8.3 mm, H/W=2.54–2.74, roundness=0.12–0.14, ribs incl.=60–67°, apert. incl.=17–24°, ribs/mm 1<sup>st</sup> wh.=7–17, ribs/mm 4<sup>th</sup> wh.=6–15, umb.=hidden.

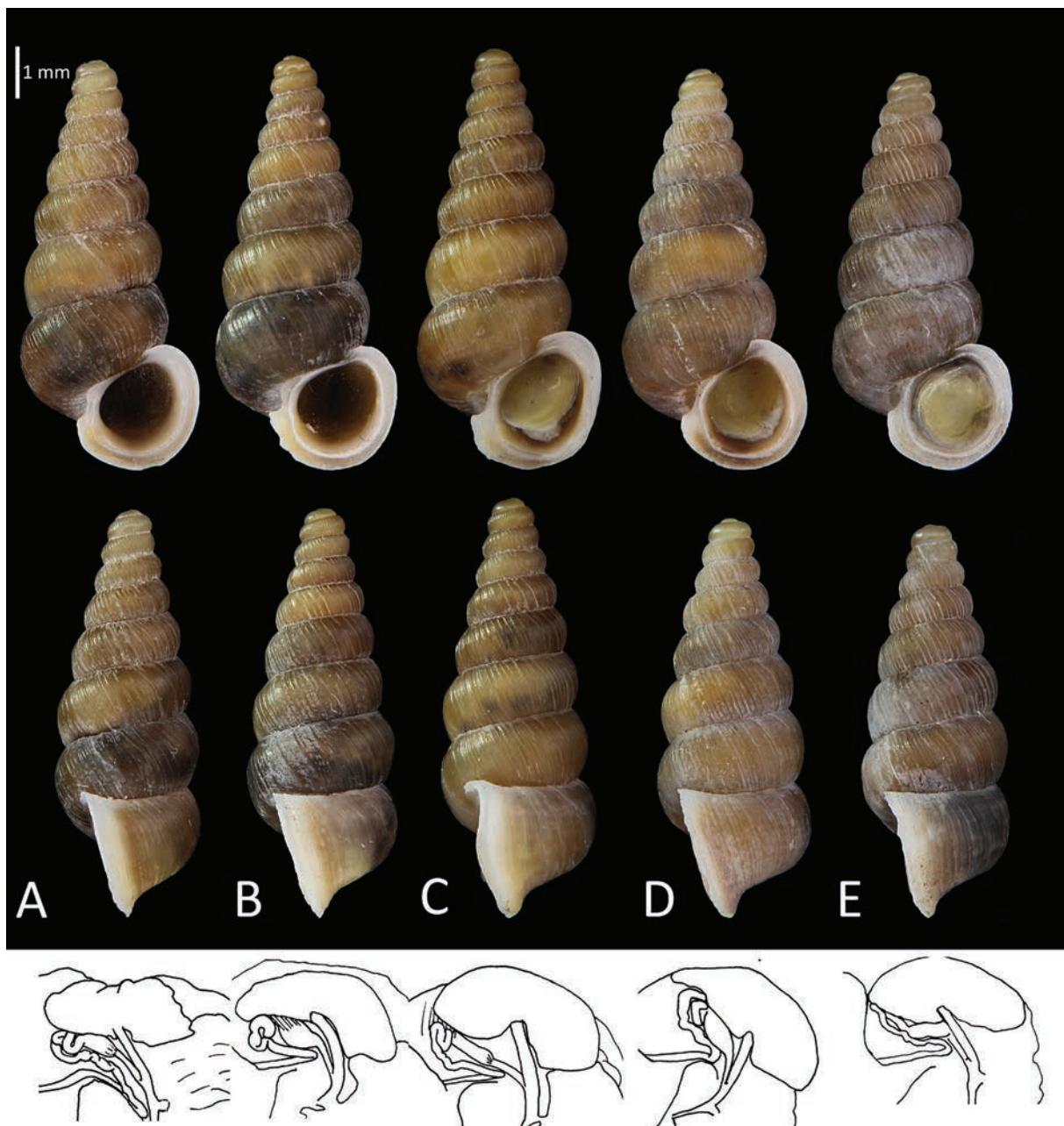
FEMALE GENITAL ORGANS. As in *C. (T.) stussineri*. In some specimens, seminal receptacle shorter than in *stussineri*, almost spherical-shaped.



**Fig. 118.** Distribution of samples of clade A which will need further studies: green=NFS064; white=NFS127; blue=NFS145; orange=NFS152; yellow=NFS158; red=NFS153.

### Remarks

These populations have been found on the Monte Terminillo and surroundings. *Cochlostoma* (*T.*) *patulum* and *C.* (*T.*) *stussineri* are impossible to distinguish on the basis of shell and anatomical features, if not for the shorter and rounded seminal receptacle observed in specimens (but not in all) of this taxon. Two samples come from the same gorge (Rio Fuggio) and have been collected in places a few hundred meters apart; the other samples comes from 6 km south, at a much higher altitude, on Mount Terminillo. The p-distance among the samples is 0.2–0.3%. It is instead 1.7–2.0% in *patulum* and 1.0–1.2% in the Slovenian *stussineri*. The absence of known morphological and anatomical diagnostic characters and the relatively low p-distances with *stussineri* and *patulum* would induce to consider these central Appennine populations as in need of further analysis.



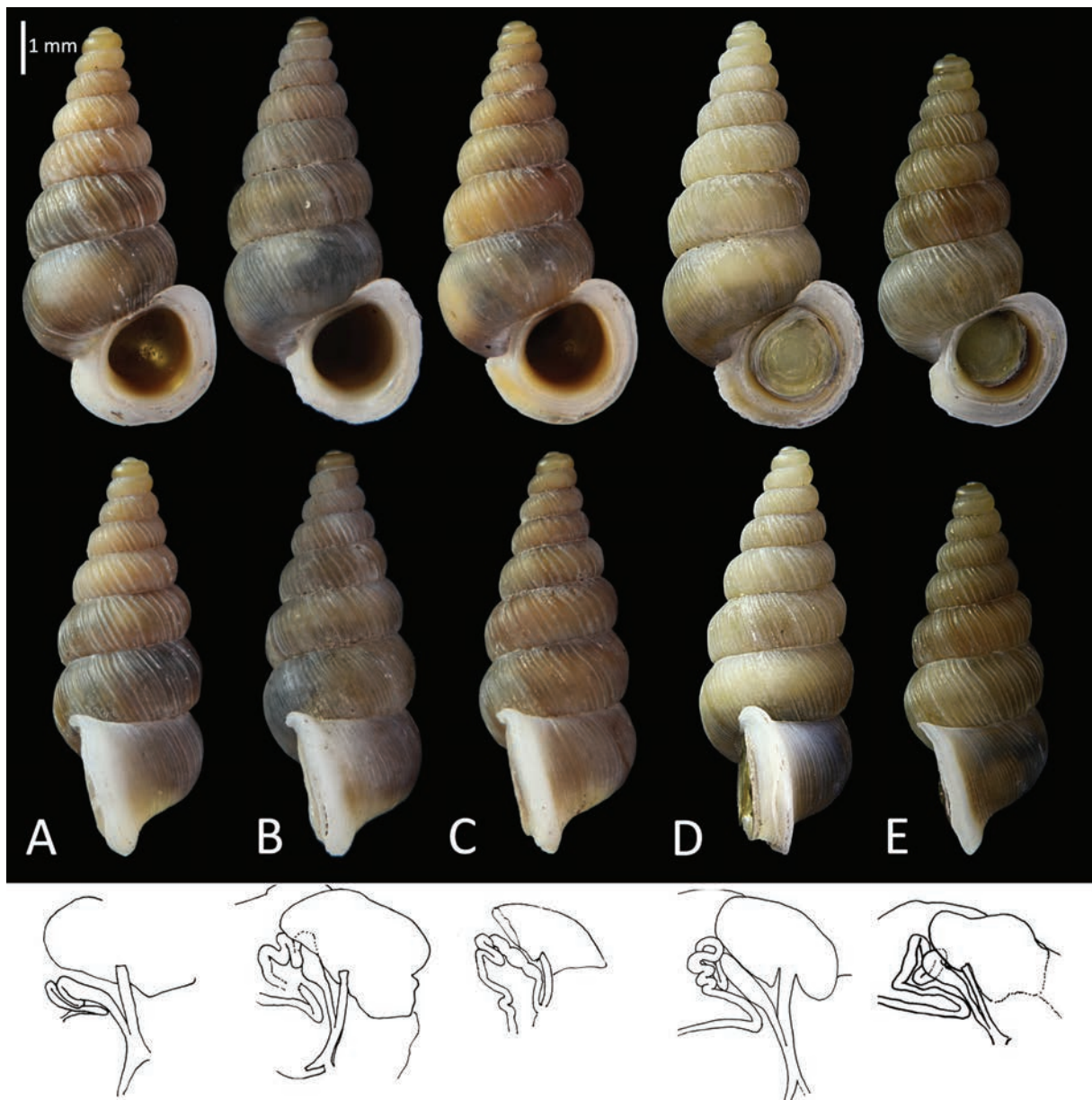
**Fig. 119.** NFS064. **A–B.** 2- Gole del rio Fuggio, I (EZ-1000). **C–D.** 3- Terminillo V. Dell’Inferno, I (EZ-1067). **E.** 4- Terminillo, Sella di Leonessa, I (EZ-1068).

**NFS158**

Figs 15A, 118 (yellow dots), 120–121

**Material**

SLOVENIA • 1- Tisovec; 45.9461° N, 13.9551° E; 2009; De Mattia leg.; WdM6748 • 2- Otlca; 45.9282° N, 13.9092° E; 2009; De Mattia leg.; WdM6751 • 3- Mejerija; 45.9066° N, 13.9479° E; 2009; De Mattia leg.; WdM6742 • 4- Kovk; 45.9461° N, 13.9506° E; 2009; De Mattia leg.; WdM6738 • 5- Farjev Vrh; 45.9243° N, 13.9544° E; 2009; De Mattia leg.; WdM6741 • 6- Gozd; 45.8982° N, 13.9667° E; 2001; De Mattia leg.; WdM6745 • 7- Tarnova; 45.8982° N, 13.9667° E; 2001; De Mattia leg.; WdM2761.



**Fig. 120.** NFS153. **A–C.** 1- 3 km SE of Oltari, HR (HNHM-100381). **D.** 2- Oltari, HR (WdM-6892). **E.** 3- Krasno Polje, HR (WdM-6900).

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with moderately strong ribs weakening toward aperture. Very strong and developed lip with abruptly inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 8 ♀♀: whorls=7.9–8.3, H=7.6–8.2 mm, H/W=2.65–2.83, roundness=0.12–0.18, ribs incl.=57–65°, apert. incl.=13–19°, ribs/mm 1<sup>st</sup> wh.=10–13, ribs/mm 4<sup>th</sup> wh.=7–14.

FEMALE GENITAL ORGANS. As in species *C. (T.) stussineri*

### Remarks

To distinguish this taxon from *C. (T.) stussineri* on morphological (both shell and genitals) characters is almost impossible. The high p-distance observed between the “*stussineri*” samples and “NFS158” (3.3%), however, suggests to present it as a ‘subject of inquiry’. Bole (1994) classified specimens from the area where we collected these samples as *C. zawinkanum* (Wagner, 1906).



Fig. 121. NFS158, 1- Tisovec, SLO (WdM-6748).

### NFS153

Figs 15F, 122 (red dots)

### Material

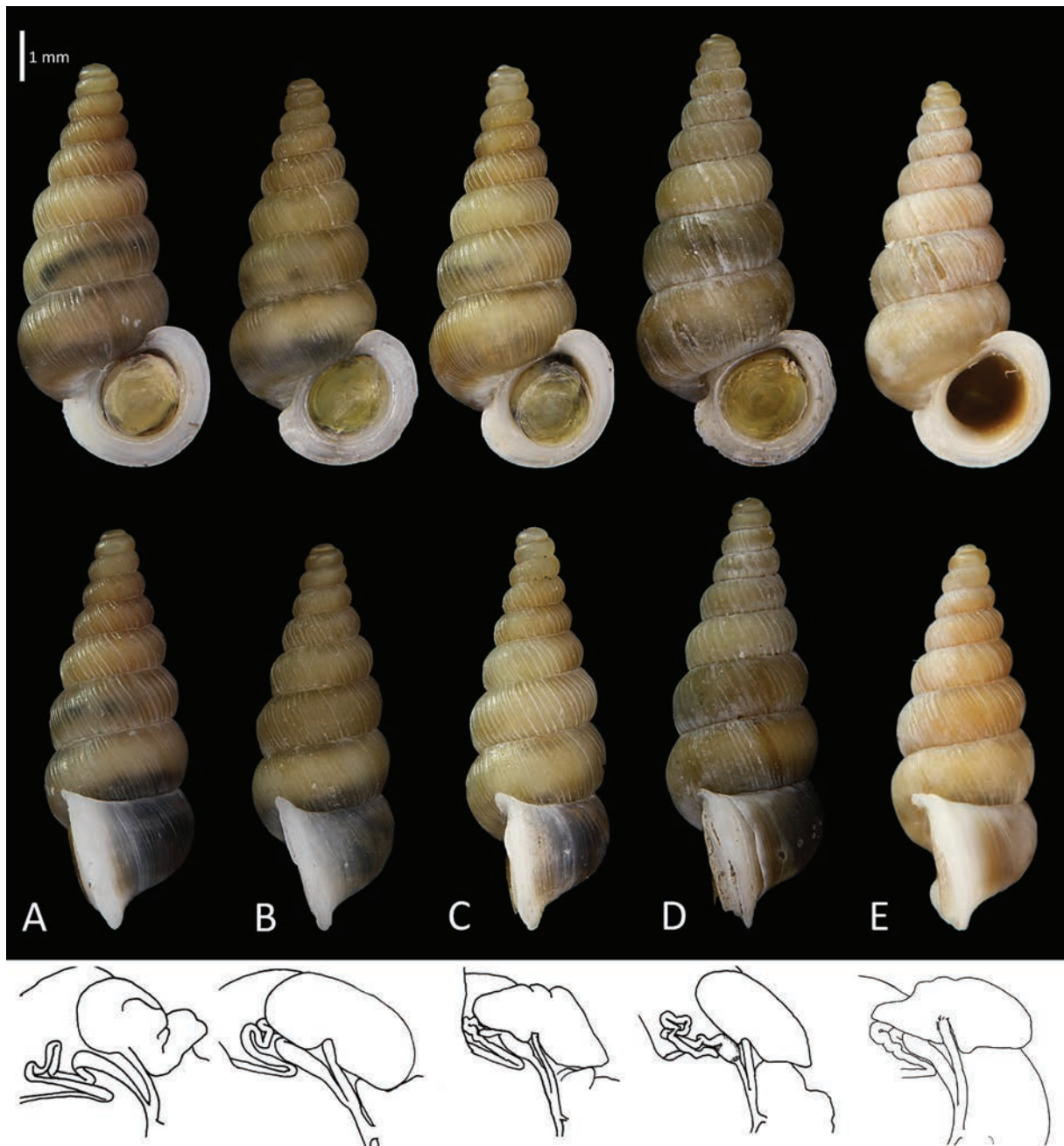
CROATIA • 15- 3 km SE of Oltari; 44.8591° N, 15.0067° E; 2014; Dusanek, Kundrata and Németh leg.; HNHM100381 • 16- Oltari; 44.8828° N, 14.9698° E; 2009; De Mattia leg.; WdM6892 • 17- Krasno Polje; 44.8158° N, 15.0742° E; 2009; De Mattia leg.; WdM6900.

### Description

**SHELL.** Closely spaced riblets on last part of protoconch. Teleoconch spotless, ribbed with rather strong ribs becoming weaker approaching aperture. Very strong and developed lip. Columellar lobe abruptly inwardly curved to cover umbilicus.

**MEASUREMENTS.** 5 ♀♀: whorls=7–8, H=7.0–7.6 mm, H/W=2. 6–2.57, roundness=0.12–0.27, ribs incl.=57–63°, apert. incl.=14–20°, ribs/mm 1<sup>st</sup> wh.=8–14, ribs/mm 4<sup>th</sup> wh.=8–12.

**FEMALE GENITAL ORGANS.** As in *C. (T.) stussineri*.



**Fig. 122.** NFS158. A–B. 2- Otlica, SLO WdM-6751). C. 3- Mejerija, SLO (WdM-6742). D. 4- Kovk, SLO (WdM-6738). E. 5- Farjev Vrh, Trnovski gozd, SLO (WdM-6741).

### Remarks

These samples are morphologically and geographically close to *C. (T.) reitteri* but their relative position in the phylogenetic trees and a high p-distance (3.8%) seems to exclude their conspecificity. They are also impossible to distinguish from NFS158.

### NFS145

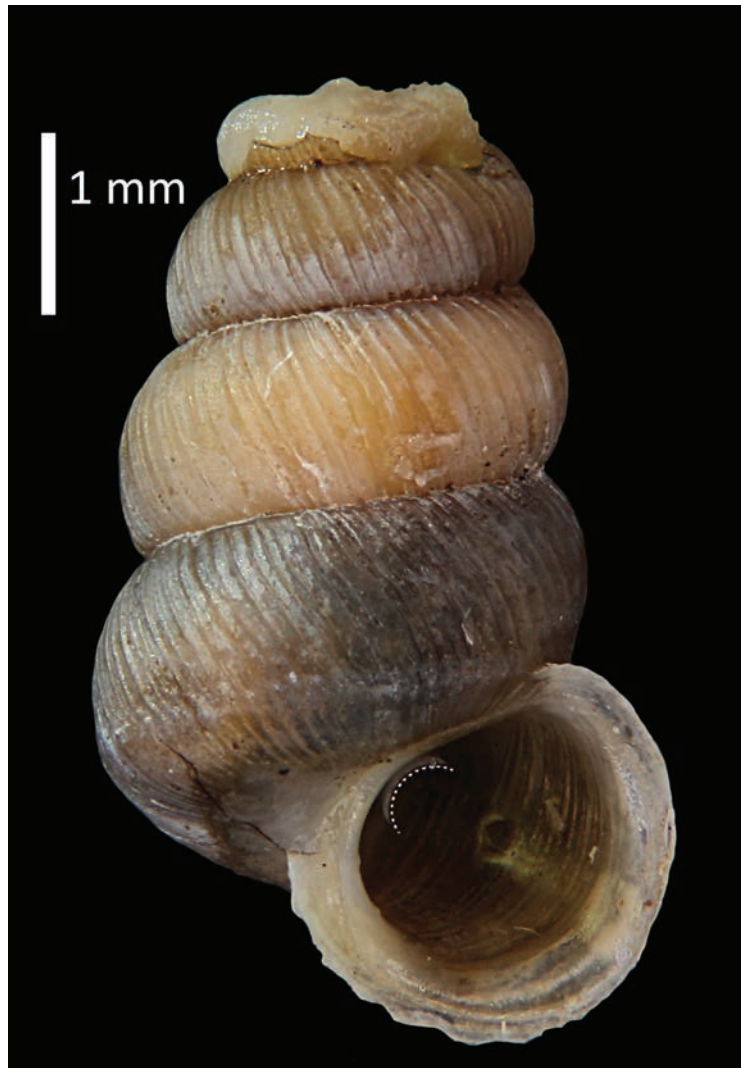
Figs 27F, 118 (blue dot), 123

### Material

MONTENEGRO • 1- 2 km S of Vilusi; 42.7194° N, 18.6024° E; 2008; Dányi, Fehér, Kontschán and Murányi leg.; HNHM99893.

### Description

SHELL. Only one broken shell available. Teleoconch seemingly spotless, ribbed with not prominent ribs. Moderately strong lip with abruptly inwardly bent columellar lobe.



**Fig. 123.** NFS145, 1- 2 km S of Vilusi, MONT HNHM-99893).

**Remarks**

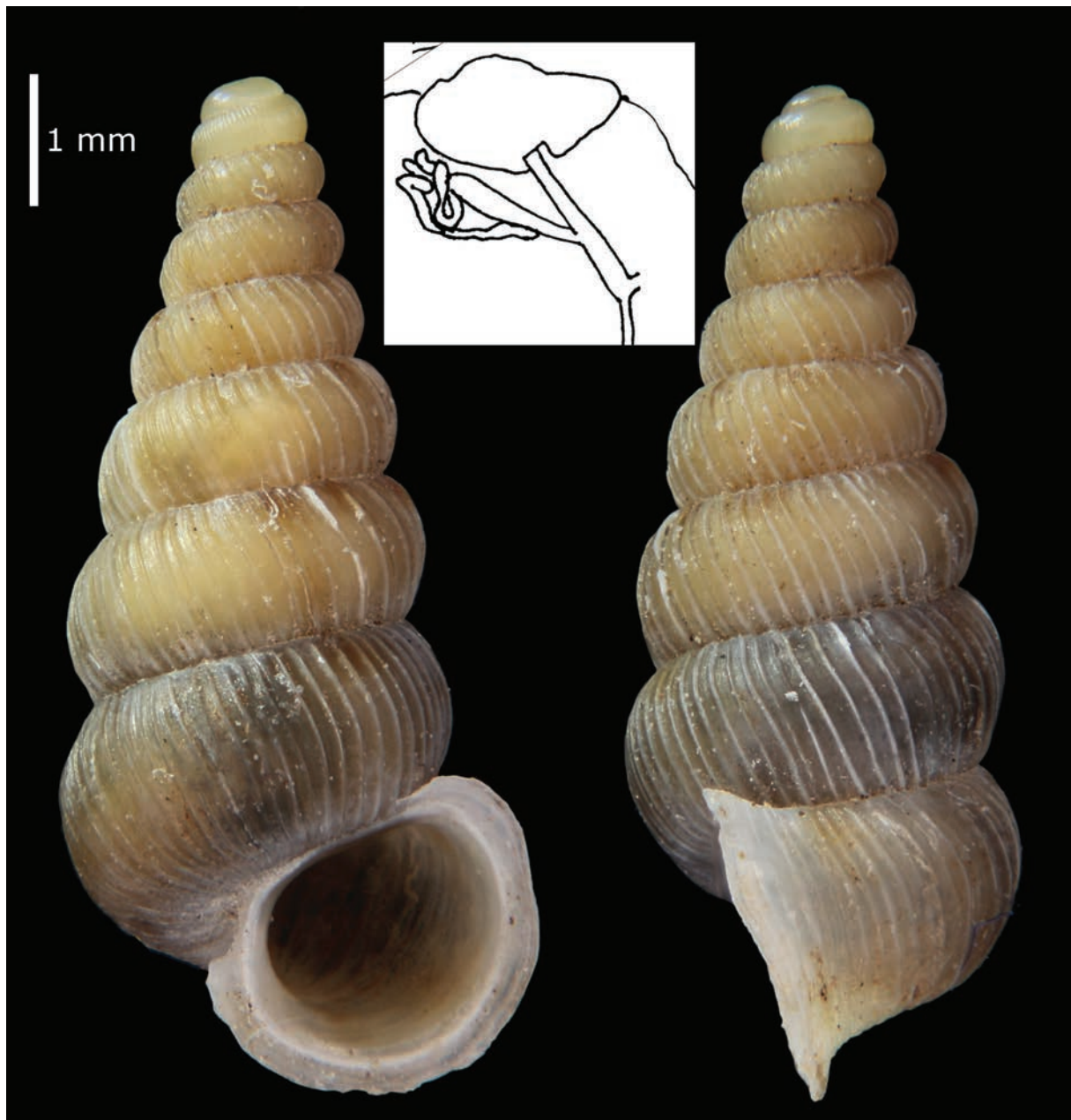
The specimen was preserved in 98% alcohol, with a broken tip. This allowed a good preservation of the ribosomal DNA.

NFS127

Figs 27C, 118 (white dot), 124

**Material**

ALBANIA • 1- Mt Shelegur; 40.1811° N, 20.6617° E; 2010; Barina, Pifkó and Pintér leg.; HNHM99880.



**Fig. 124.** NFS127, 1- Mt Shelegur, AL (HNHM-99880).

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch with barely visible reddish spots and ribbed with strong ribs. Moderately developed lip with inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 1 ♀: whorls=7.8, H=7.7 mm, H/W=2.58, roundness=0.16, ribs incl.=63°, apert. incl.=20°, ribs/mm 1<sup>st</sup> wh.=9, ribs/mm 4<sup>th</sup> wh.=7.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Short seminal receptacle confined to ventral side of body. 4–5 short loops clustered together and close to apex of seminal receptacle. Junction of uterus gland far from connection between distal oviduct and pedunculus of bursa copulatrix.

### Remarks

This sample is a close relative of *C. (T.) pageti*, but it differs in the morphology of the columellar lobe: gradually curved backward in NFS127 and indented in *C. (T.) pageti*. This shell morphological feature seems to be species-specific and therefore here NFS127 is not reported as conspecific of *C. (T.) pageti*.

#### NFS152

Figs 36F, 118 (orange dots), 125

### Material

ITALY • 1- Trecchina; 40.0055° N, 15.7783° E; 2013; Hallgass leg.; EZ1134 • 2- Gole del Raganello; 39.8316° N, 16.3187° E; 2010; Renda leg.; EZ1032 • 3- Orsomarzo; 39.7977° N, 15.9179° E; 1995; S. Cianfanelli and E. Talenti leg.; MZUFGC65117/25572.

### Description

SHELL. Closely spaced riblets on last part of protoconch. Teleoconch almost spotless (some reddish spots barely visible). Very strong and white ribs. Weak lip with gently inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 3 ♀♀: whorls=7–7.8, H=6.7–7.2 mm, H/W=2.31–2.62, roundness=0.09–0.13, ribs incl.=59–63°, apert. incl.=14–19°, ribs/mm 1<sup>st</sup> wh.=6–7, ribs/mm 4<sup>th</sup> wh.=7–7.

### Remarks

These samples have been collected in the surroundings of the Pollino national park, in the south of Basilicata and north of the Calabria region. The sample from Trecchina has the highest p-distance (1.7%–2.9%) from the other samples of the *adamii/cassiniacum* branch.

#### Clade B

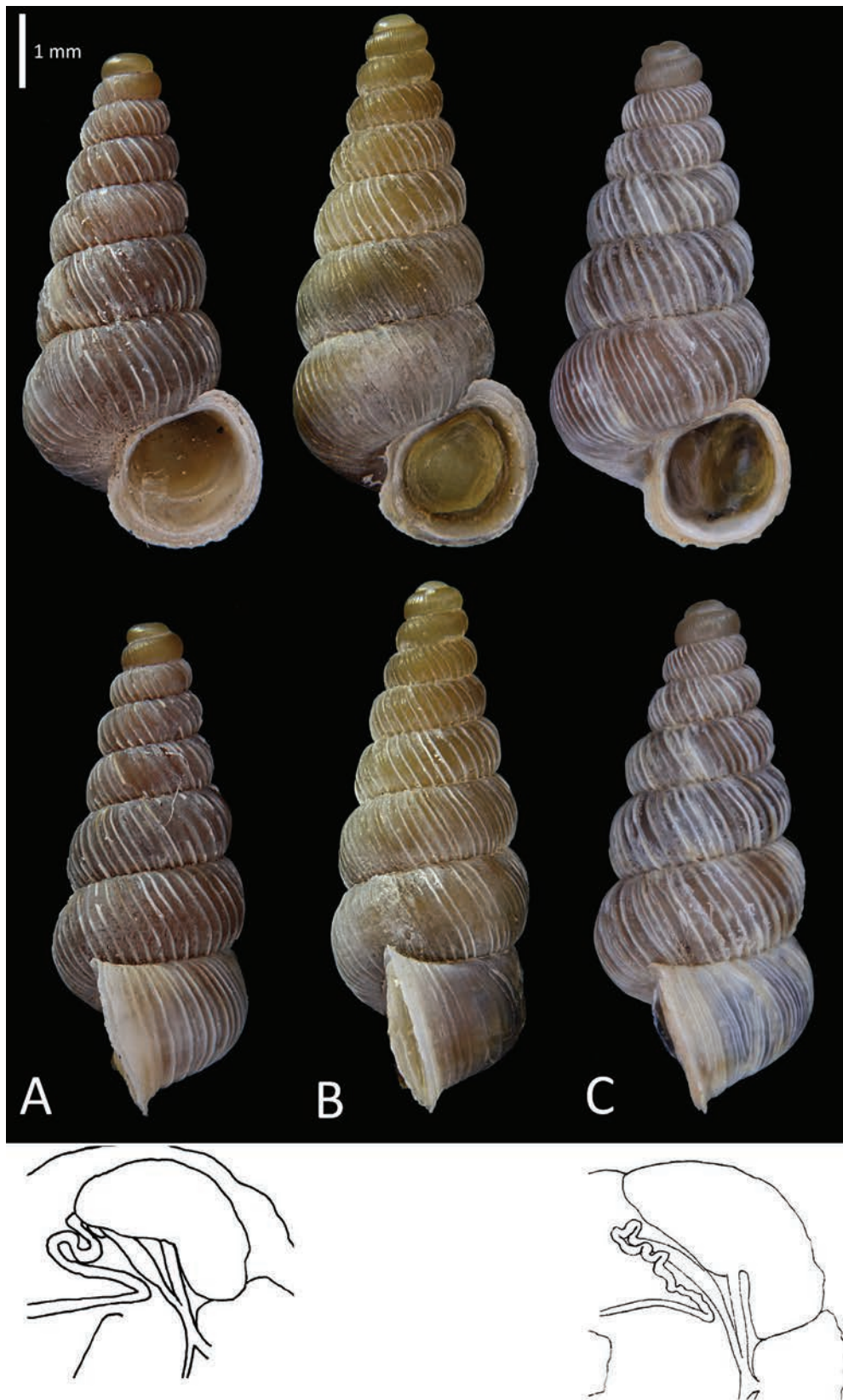
#### NFS154

Figs 56I, 126 (white dots), 127A

### Material

ITALY • 1- Equi terme 1; 44.1696° N, 10.1528° E; 2009; Margelli leg.; EZ0783 • 2- Equi terme 2; 44.1696° N, 10.1528° E; 2009; Margelli leg.; EZ1117 • 3- Strada per Campo Cecina; 44.1151° N, 10.1191° E; 2013; Hallgass leg.; EZ1149.





**Fig. 125.** NFS152. **A.** 1- Trecchina, I EZ-1134). **B.** 2- Gole del Raganello, I (EZ-1032). **C.** 3- Orsomarzo, I (MZUF-GC65117/25572).

## Description

SHELL. Closely spaced riblets on last part of protoconch. Very pronounced two lines of reddish spots on whorls. Moderately strong ribs, regular in size and spacing. Moderately strong lip with gently inwardly bent columellar lobe partially covering umbilicus.

MEASUREMENTS. 10 ♀♀: whorls=7.9–8.6, H=7.7–9.1 mm, H/W=2.61–2.85, roundness=0.14–0.19, ribs incl.=59–69, apert. incl.=15–25°, ribs/mm 1<sup>st</sup> wh.=8–18, ribs/mm 4<sup>th</sup> wh.=9–15.

## Remarks

The sample from Equi Terme resulted as a close relative of *C. (T.) montanum* in the phylogenetic trees. However, the different ribbing and the spotted whorls induce to present it as a subject of inquiry.

## NFS155

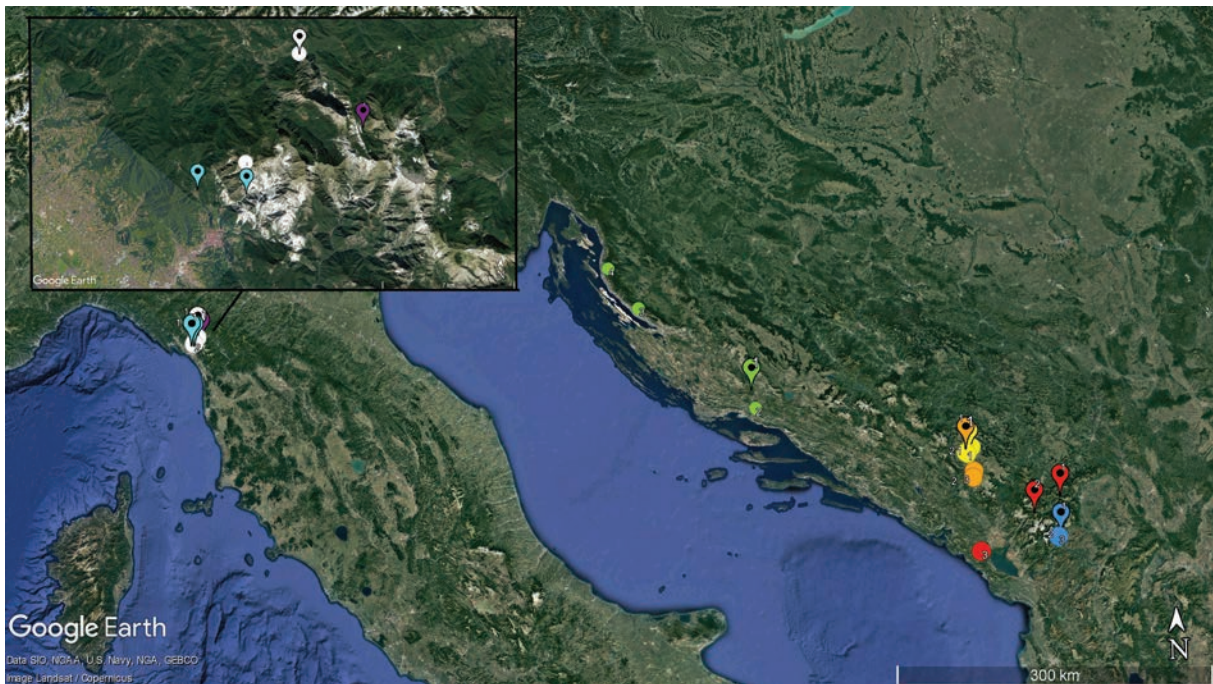
Figs 56D, 126 (cyan dots), 127B–C

## Material

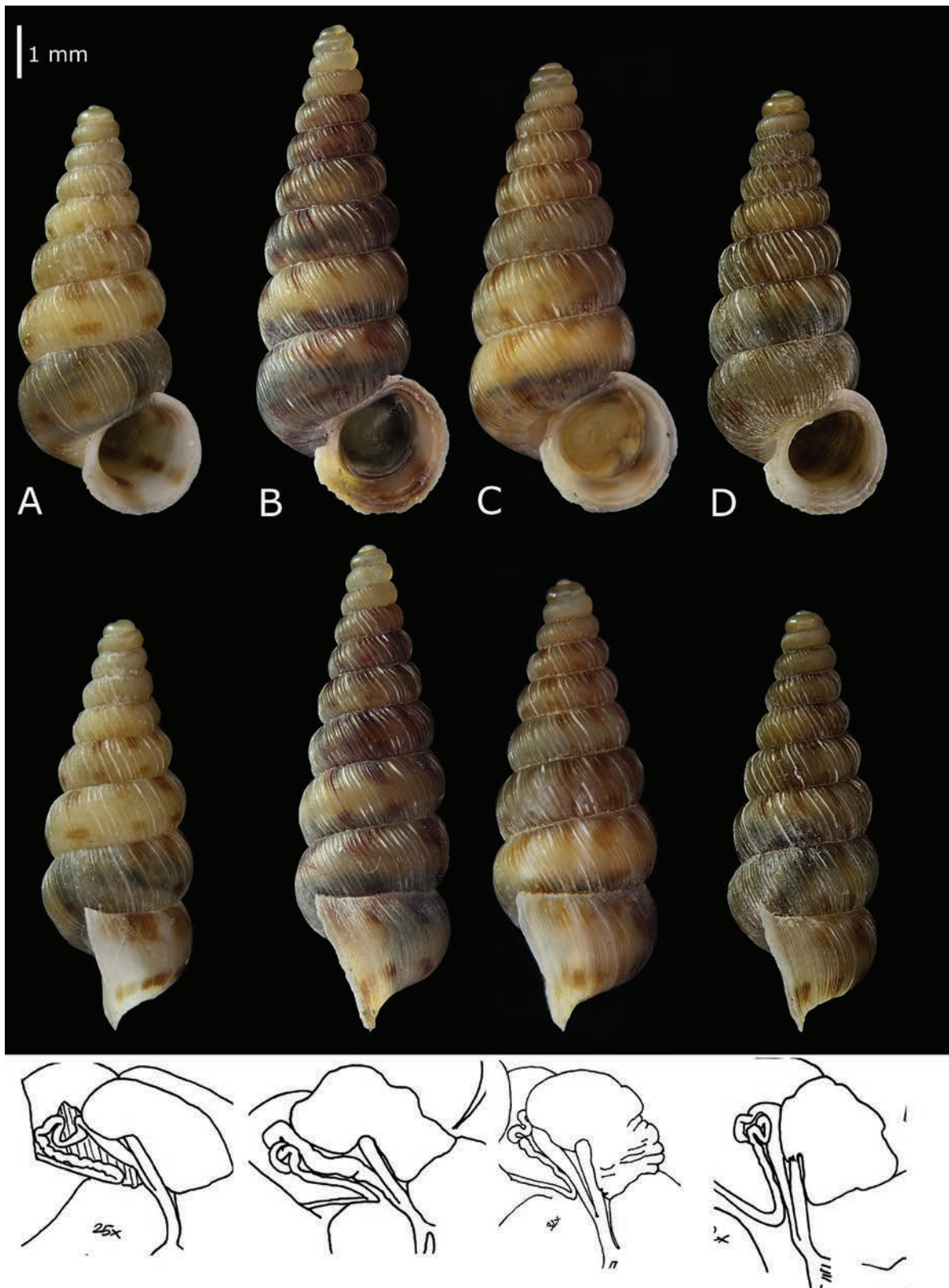
ITALY • 1- Piastra; 44.0999° N, 10.1204° E; 2013; Hallgass leg.; EZ1150 • 1- Gagnana; 44.1015° N, 10.0875° E; 2004; De Mattia leg.; WdM4143.

## Description

SHELL. Very pronounced two lines of reddish spots on whorls of teleoconch. Strong ribs, here and there whitish, very regularly closely spaced not fading toward aperture. Rather weak lip with abruptly inwardly curved columellar lobe covering umbilicus.



**Fig. 126.** Distribution of samples of clade B which will need further studies: white=NFS154; cyan=NFS155; purple=NFS159; orange=NFS142; red=NFS128; green=NFS108; yellow=NFS 143; blue=NFS018.



**Fig. 127.** Samples from the Apuane Alps not assigned to described taxa. **A.** NFS154, 1- Equi Terme (EZ-0783). **B.** NFS155, 1- Piastra (EZ-1150). **C.** NFS155, 1- Gragnana (WdM-4143). **D.** NFS159, 1- Val Serenaia (EZ-0937).

MEASUREMENTS. 3 ♀♀ from Piastra: whorls=9.1–10, H=8.2–9.3 mm, H/W=2.77–3.16, roundness=0.16–0.18, ribs incl.=61–65°, apert. incl.=22–26°, ribs/mm 1<sup>st</sup> wh.=10–11, ribs/mm 4<sup>th</sup> wh.=7–10. 2 ♀♀ from Gragnana: whorls=8.3–8.3, H=8.5–8.9 mm, H/W=2.69–2.77, roundness=0.14–0.15, ribs incl.=64–66°, apert. incl.=18–26°, ribs/mm 1<sup>st</sup> wh.=6–9, ribs/mm 4<sup>th</sup> wh.=8–8.

### Remarks

The shell is characterized by the evident reddish spots on the whorls and the strong, closely spaced ribs.

### NFS159

Figs 56F, 126 (purple dots), 127D

### Material

ITALY • 1- Val Serenaia; 44.1339° N, 10.1973° E; 2009; Pocaterra leg.; EZ0937.

### Description

SHELL. Two lines of reddish spots on whorls. Strong ribs often whitish. Ribs become weaker and less spaced toward aperture. Moderately strong lip with inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 1 ♀: whorls=8.2, H=8 mm, H/W=2.78, roundness=0.14, ribs incl.=64°, apert. incl.=19°, ribs/mm 1<sup>st</sup> wh.=13, ribs/mm 4<sup>th</sup> wh.=9.

### Remarks

This sample has been collected in Val Serenaia, the same valley where *C. (T.) sospes* has been found. We do not know how far one from the other were collected. It seems anyway a reasonable proof that more than one species inhabits the Apuane Alps.

### NFS018

Figs 66C, 126 (blue dot), 128

### Material

ALBANIA • 1- Marbicit Mt; 42.3648° N, 20.0174° E • 2- Bajram Curri; 42.3487° N, 19.9947° E; 2009; Barina, Lunk, Pifkó and Schmidt leg.; HNHM 99881 • 3- Mt Cukali; 42.3520° N, 19.9930° E; 2009; Barina, Lunk, Pifkó and Schmidt leg.; HNHM 99870.

### Description

SHELL. Closely space riblets on last part of protoconch. Teleoconch spotless, ribbed with moderately strong and rounded ribs, weakening toward aperture. Moderately strong lip with inwardly curved columellar lobe covering umbilicus.

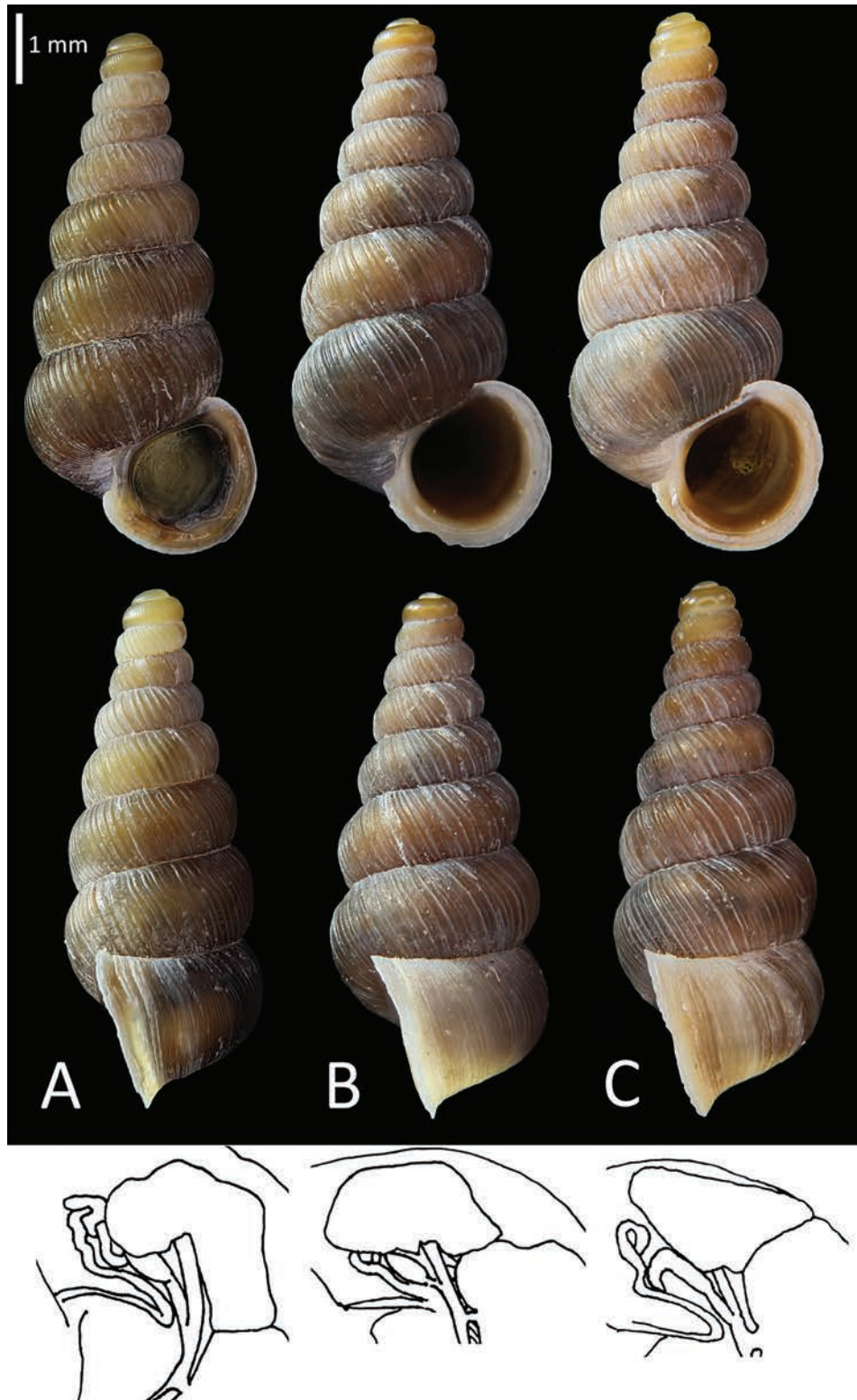
MEASUREMENTS. 4 ♀♀: whorls=7.2–8, H=7.4–7.6 mm, H/W =2.44–2.62, roundness=0.13–0.14, ribs incl.=57–63°, apert. incl.=17–21°, ribs/mm 1<sup>st</sup> wh.=7–13, ribs/mm 4<sup>th</sup> wh.=8–9.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus of bursa copulatrix. Short, oval seminal receptacle confined to ventral part of body, distinct distal oviduct. 2–3 relaxed loops situated over apex of seminal receptacle. Junction of uterus gland moderately far from distal oviduct-pedunculus connection.

### Remarks

This Marbicit sample is worth further studying because of the position in the phylogenetic trees. The shell morphology is very similar to that of *C. (T.) lacazei* and *C. (T.) mnelense*. It differs from these

taxa in the female genitals where there is a shorter seminal receptacle. The lowest observed p-distance is 4.5% with *C. (T.) lacazei* sp. nov. The three samples here considered conspecific come from nearby localities (2–3 km apart). The surrounding areas have not been explored yet.



**Fig. 128.** NFS018. **A.** 1- Mount Marbicit, AL (HNHM-99878). **B.** 2- Bajram Curri, AL (HNHM-99881). **C.** 3- Mt Cukali, AL (HNHM-99870).

**NFS108**

Figs 66D, 126 (green dots), 129

**Material**

CROATIA • 1- Lučane; 43.7100° N, 16.5800° E; 1999; Eröss, Fehér and Kovács leg.; HNHM92278  
• 2- Vrnjača, Mosor Mts; 43.5696° N, 16.6352° E; 2006; De Mattia leg.; WdM6671 • 3- Visočica



**Fig. 129.** NFS108. **A.** 1- Lučane, HR (HNHM-92278). **B.** 2- Vrnjača, Mosor mts, HR (WdM-6671). **C.** 3- Visočica peak 1150, HR (HNHM-97144). **D.** 4- Rossijev Kuk, HR (HNHM-DL243).

peak 1150; 44.4248° N, 15.3310° E; 2008; Nádai leg.; HNHM 97144 • 4- Rossijev Kuk; 44.7642° N, 14.9881° E; 2007; L. Dányi and Á. Vári leg.; HNHMDL243.

### Description

SHELL. Teleoconch almost spotless (here and there reddish hue on whorls). Strong ribs, very regular in size and spacing, becoming become weaker and less spaced toward aperture. Strong lip with abruptly inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 6 ♀♀; whorls=7.5–8.1, H=7.2–8.3 mm, H/W=2.50–2.74, roundness=0.12–0.17, ribs incl.=55–71°, apert. incl.=15–19°, ribs/mm 1<sup>st</sup> wh.=5–13, ribs/mm 4<sup>th</sup> wh.=6–10.

FEMALE GENITAL ORGANS. Only one female (sample from Lučane), probably not mature, analyzed. Pedunculus of bursa copulatrix is ventral. Seminal receptacle short, confined to ventral side of body.

### Remarks

The samples localities from the coastal mountain of Croatia are distant one from another. It is therefore possible that they are not all conspecific.

## NFS128

Figs 126 (red dots), 130

### Material

ALBANIA • 1- Qafa e Predeleci; 42.5671° N, 19.7384° E; 2016; Eröss, Fehér, Szekeres and Grego leg.; HNHM99860.

KOSOVO • 2- Rugovo Gorge; 42.6849° N, 20.0545° E; 2016; Eröss, Fehér, Szekeres and Grego leg.; HNHM99866.

MONTENEGRO • 3?- N-edge of Tara Canyon; 42.2831° N, 19.0943° E; 2017; Njunjić and Schilthuizen leg.; TxExDU0099.

### Description

SHELL. Two lines of reddish spots on whorls of teleoconch. Rather strong ribs. Moderately strong lip with inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 3 ♀♀: whorls =7.6–8.2; H=7.5–7.6 mm; H/W =2.65–2.77; roundness=0.16–0.18; ribs incl.=64–66; apert. incl.=15–24°; ribs/mm 1<sup>st</sup> wh.=7–9; ribs/mm 4<sup>th</sup> wh.=8–10.

FEMALE GENITAL ORGANS. Ventral connection of pedunculus to bursa copulatrix. Relatively short, club shaped, seminal receptacle with apex positioned at middle of body (seminal receptacle not reaching dorsal side but not confined to ventral side). Few clustered loops just below apex of seminal receptacle. Junction of uterus gland far from connection between pedunculus of bursa copulatrix and distal oviduct.

### Remarks

Despite the relatively large geographic distance between “Rugovo gorge” and “Qafa e Predeleci”, the related p-distance is zero. There is not enough material to properly describe it. We do not have genital data of the sample “N-edge Tara Canyon” (3? in Fig. 130), but it has a similar shell morphology and for this reason is here reported.



**Fig. 130.** NFS128. **A.** 1- Rugovo Gorge, K (HNHM-99866). **B.** 2- Qafa e Predelicit, AL (HNHM-99860). **C.** 3?- N edge of Tara Canyon, MONT (TxEx-du0099).



**NFS143**

Figs 126 (yellow dots), 131

**Material**

MONTENEGRO • 1- Dobri Do; 43.0997° N, 19.0485° E; 2008; Erőss and Hunyadi leg.; HNHM99884 • 1- Dobri Do; 43.094° N, 19.03° E; 2017; Njunjić and Schilthuizen leg.; TxExDU0094 • 1- Dobri Do; 43.1037° N, 19.0196° E; 2019; M. Schilthuizen leg.; TxExDU0114 • 2- Crno Jezero; 43.14327° N, 19.08379° E; 2018; M. Schilthuizen and I. Njunjić leg.; TxExDU0001.

**Description**

SHELL. Spotless teleoconch ribbed with regularly-sized and spaced ribs, becoming weaker and less spaced toward aperture. Strong and wide lip with abruptly inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 3 ♀♀: whorls=7.2–7.5; H=7.1–7.6 mm; H/W=2.5–2.6; roundness=0.12–0.17; ribs incl.=65–69; apert. incl.=13–16°; ribs/mm 1<sup>st</sup> wh.=9–9; ribs/mm 4<sup>th</sup> wh.=7–11.

FEMALE GENITAL ORGANS. Ventral connetion of pedunculus to bursa copulatrix. Relatively short, club shaped, seminal receptacle with apex positioned at middle of body (seminal receptacle not reaching dorsal side but not confined to ventral side). Few clustered loops just below apex of seminal receptacle. Junction of uterus gland far from connection between te pedunculus of bursa copulatrix and distal oviduct.

**Remarks**

Despite the low p-distance (0.5%) from the samples of NFS128, the shell morphology is different enough to present it as a subject of further inquiry.



**Fig. 131.** NFS143, 1- Dobri Do, MONT (TxEx-du0114).

**NFS142**

Figs 73H, 126 (orange dots), 132

**Material**

MONTENEGRO • 1- Škrčko Jezero; 43.1361° N, 19.0119° E; 2018; Taxon Expeditions participants leg.; TxExDU0044 • 1- Škrčko Jezero; 43.1361° N, 19.0119° E; 2018; Taxon Expeditions participants leg.; TxExDU0124a • 2- 10 km S of Šavnik; 42.8945° N, 19.0751° E; 2018; M. Schilthuizen leg.; TxExdu0047 • Mokro; 42.9476° N, 19.0910° E; 2008; Dányi, Fehér, Kotschán and Murányi leg.; HNHM.99875.

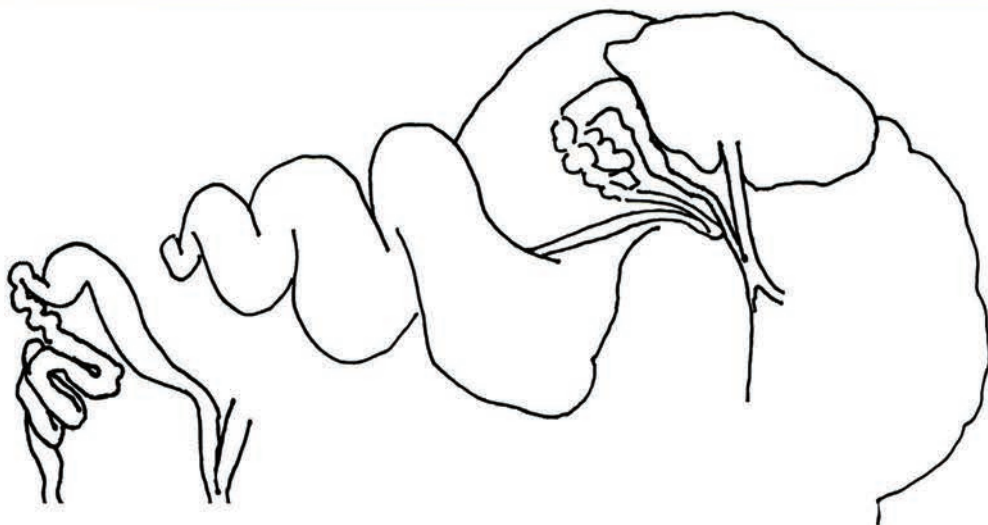
**Description**

SHELL. Spotless teleoconch, moderately strong and well-spaced ribs. Moderately strong lip with inwardly curved columellar lobe covering umbilicus.

MEASUREMENTS. 5 ♀♀: whorls=7.1–7.4, H=6.8–8.4 mm, H/W=2.45–2.59, roundness=0.1–0.15, ribs incl.=61–66°, apert. incl.=14–19°, ribs/mm 1<sup>st</sup> wh.=8–11, ribs/mm 4<sup>th</sup> wh.=8–12.

**Remarks**

There is a very low p-distance (0.2%) from the Italian *C. (T.) hallgassi* sp. nov., but the ribbing of the shell is different and it has spotless whorls (marked spots in the Italian sample).



**Fig. 132.** NFS142, 1- Škrčko Jezero, MONT TxEx-du0044).