Cochlostoma gracile (L. Pfeiffer, 1849) in Italy (Architaenioglossa, Cochlostomatidae)

Willy De Mattia
Via di Monte San Giovanni 8, I-34147 Muggia, Italy; wdemattia@gmail.com

Enrico Zallot
Haagweg 29, 2681PA Monster, The Netherlands; ezallot@gmail.com

Massimo Prodan
Via dei Papaveri 3/10, I-34151 Trieste; maprodan@yahoo.it

Cochlostoma gracile (L. Pfeiffer, 1849) is recorded for the first time in Italy. An anatomical and a conchological description are given.

Key words: Gastropoda, Architaenioglossa, Cochlostomatidae, *Cochlostoma gracile*, anatomy, morphometry, distribution, Italy, Slovenia.

Introduction

A faunistic survey on the southern slopes of the Sabotino hill (province of Gorizia, Italy) yielded three species of the genus *Cochlostoma*. Two taxa are already known for the Italian fauna: *Cochlostoma henricae* (Strobel, 1851) and *C. septemspirale* (Razoumowsky, 1789). Anatomical and conchological studies revealed that the third taxon is *C. gracile* (L. Pfeiffer, 1849). *Cochlostoma gracile* has never been reported for the Italian malacofauna (Alzona, 1971; Boato et al., 1987; Bodon et al., 1995). This species is widely distributed in nearby Slovenia, in southern Austria (Edlinger & Mildner, 1979) and along the western Balkans from Croatia to Greece (but not in the nearby Istrian peninsula) (see Table 1). It may be subdivided into several subspecies whose validity still has to be investigated (Zilch, 1958). For a list of the northeastern Italian species of *Cochlostoma* see Bank (1988), who first conchologically revised the genus in the area. More recently Zallot (2002) reported an undescribed taxon for the same area and tried an anatomical approach. De Mattia & Prodan (2006) focused on the distribution in Italy of *C. tergestinum* (Westerlund, 1885) and *C. scalarinum* (Villa & Villa, 1841).

In this paper, a conchological and anatomical description of the Italian population of *C. gracile* and the syntopic populations of *C. henricae* and *C. septemspirale* of the Sabotino hill is given.

Materials and methods

All specimens have been collected by the first author. Samples have been deposited in the RMNH collection (Netherlands Centre for Biodiversity Naturalis, Leiden, The Netherland). For details on the anatomical examination, methodology and nomenclature, see Zallot (2002: 95-96). The following abbreviations are used: AG, albumen gland; BC, bursa copulatrix; CD, copulatory duct; CG, capsule gland; DBD, duct of the bursa copulatrix; DL, distal loop; DO, distal oviduct; dsp, dissected specimen[s]; IL, intermediate loops; OV, ovary; PL, proximal loop; SR, seminal

receptacle; UG, uterina gland; VO, visceral oviduct. Proximal side of RS = apex. Distal side of RS = basis.

In a first effort to separate the species of *Cochlostoma* in a quantitative, statistical way, we used landmark-based, distance multivariate morphometric analyses of the shells. Three male and three female specimens for each species (for localities, see Fig. 42) were photographed in a standardized orientation. The major axis of the shell has been placed parallel to the plane of the camera-lens and the aperture was rotated in order to obtain a frontal view. Thirty-eight landmarks have been pointed on the photographs (Fig. 41) in order to obtain their absolute coordinate, using tpsDig programme (Rohlf, 1996). Morphometrical analysis with graphs processing have been performed using MorphoJ (Klingenberg, 2008).

Systematic part

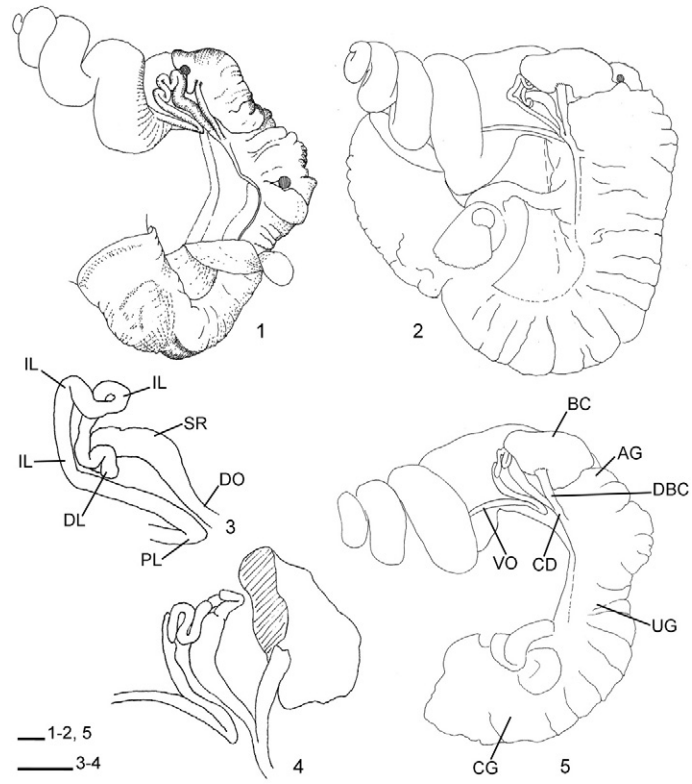
Cochlostoma gracile (L. Pfeiffer, 1849)

Material examined. — Italy: Friuli – Venezia Giulia, Gorizia, southern slope of the Sabotino Hill, 339 m alt., 45° 59′ 05′′N 13° 37′ 41′′ E, 1.iii.2009, 8 dsp. Slovenia: Nova Gorica, Solkan, western side of Sveta Gora hill along the Isonzo (Soča) riverside, 97 m alt., 46° 00′ 04′′ N 13° 37′ 57′′ E, 25.i. 2009, 4 dsp.

Shell (Figs 13-27, Tab. 2). — Protoconch with well spaced ribs. Teleoconch conical, ribbed, with rounded whorls and deep sutures. Female specimens have a yellowish shell with 7.5-8.5 whorls. Male specimens have a darker brownish shell, markedly on the first whorls, usually with 7.5 whorls. Ribs rather widely spaced, with a rounded prominent profile; on the penultimate and ultimate whorl more irregularly spaced and less prominent, although still present near the aperture. Rounded aperture with the columellar peristomatic lobe abruptly curved inside, covering the umbilicus. Peristome gradually widening, usually bilobate. Palatal surface flattened by the presence of a well developed callus.

Diagnostic characters of female genitalia (Figs 1-8). — Duct of bursa copulatrix with ventral junction. Seminal receptacle short, spindle-like, with defined, swollen apex and undefined basis, positioned on the ventral, proximal side of the BC (the apex being far below the dorsal side of the bursa copulatrix). The basis gradually turns into a narrow and short oviduct (distal oviduct) and changes in colour. Between the proximal loop and the distal loop there are 3-5 wide, U-shaped, intermediate loops.

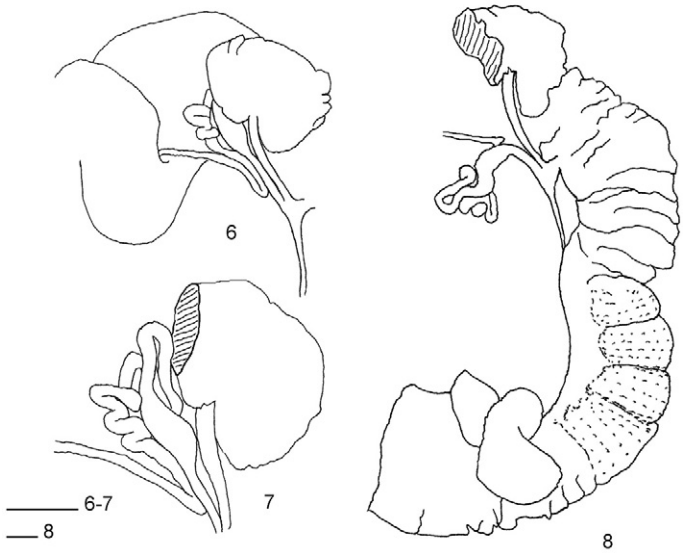
Distribution (Table 1). — The finding of *C. gracile* on the Sabotino hill (Gorizia, Italy) represents the first record for the Italian malacofauna (Fig. 40). The presence of *C. gracile* [as *C. gracile croaticum* (L. Pfeiffer, 1871)] at the Slovenian side of Sabotino hill has probably already been recorded by Bole (1994: 203), who did not cite directly the Slovenian side of Sabotino hill but landmarked the 33 T UL 99 square on a



Figs **1-5**. *Cochlostoma gracile* (L. Pfeiffer, 1849). Female specimens. Italy, Gorizia, southern slopes of Sabotino Hill. **1-2**, **5**, genitalia complex with whole proximal part of body; **3**, seminal receptacle with loops-complex; **4**, seminal receptacle with loop and bursa complexes. Scale bars 1 mm.

Country	Reference
Albania	Fehér, Eröss & Varga, 2001; Jaeckel et al., 1957; Polinsky, 1924; Welter-Schultes, 1996.
Austria	Edlinger & Mildner, 1979.
Bosnia in Herzegovina	Jaeckel et al., 1957; Wagner, 1897; Wagner, 1901; Zilch, 1958.
Croatia	Jaeckel et al., 1957; Wagner, 1897; Zilch, 1958.
Greece	Schütt, 1977.
Montenegro	Jaeckel et al., 1957; Wohlberedt, 1909.
Romania	Grossu, 1986.
Slovenia	Bole, 1994; Jaeckel et al., 1957; Wagner, 1897; Zilch, 1958.

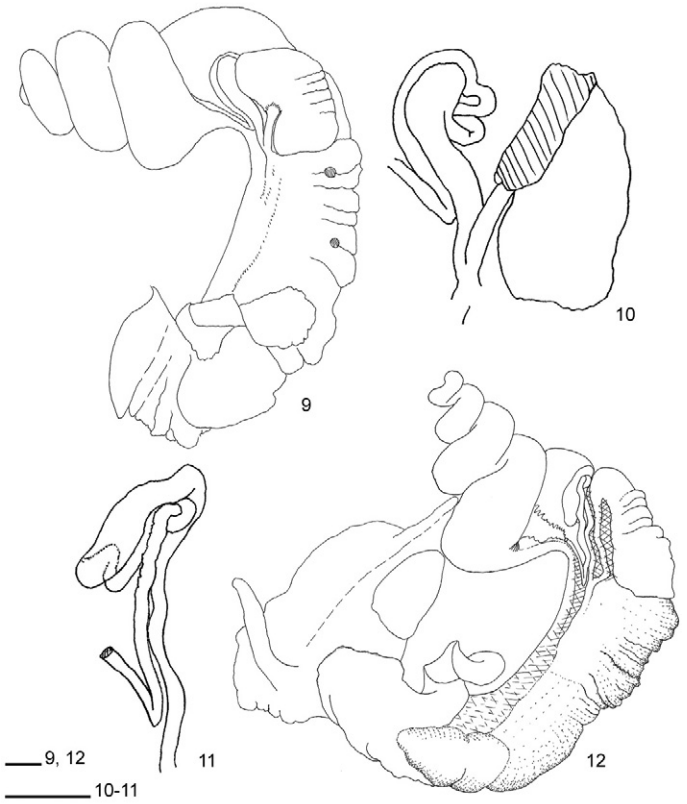
Table **1**. Distribution of *Cochlostoma gracile* (L. Pfeiffer, 1849), according to the main literature.



Figs **6-8**. *Cochlostoma gracile* (L. Pfeiffer, 1849). Female specimen. Slovenia, Nova Gorica, Solkan, western side of Sveta Gora hill. **6-7**, seminal receptacle with loops and bursa complexes; **8**, genitalia complex with whole proximal part of body. Scale bar 1 mm.

UTM map (Bole, 1994: 203). This 10X10 UTM square in fact includes the Italian and Slovenian slopes of Sabotino hill and the western side of Sveta Gora hill near Solkan. The real distribution of *C. gracile* is still to be defined by anatomical research, since its shell-features are similar to those of other species present in the western Balkans.

Habitat and ecology. — On Sabotino hill, *C. gracile* colonizes rocky calcareous habitats, where it occurs on limestone cliffs



Figs **9-12**. *Cochlostoma* spp. Female specimens. Italy, Gorizia, southern slope of Sabotino Hill. **9-10**, *Cochlostoma henricae* (Strobel, 1851); **9**, genitalia complex with whole proximal part of body; **10**, seminal receptacle with loops and bursa complexes. **11-12**, *Cochlostoma septemspirale* (Razoumowsky, 1789); **11**, seminal receptacle with loops-complex; **12**, genitalia complex with whole proximal part of body. Scale bar 1 mm.

Fig **13**. Shell of *Cochlostoma gracile* (L. Pfeiffer, 1849). Female specimen. Italy, Gorizia, southern slopes of Sabotino Hill. Scale bar 1 mm.

and boulders in a thermophilous wood of *Quercus pubescens*, *Ostrya carpinifolia* and *Fraxinus ornus*.

Status and conservation. — In spite of its very limited distribution in Italy, the species occours in dense populations and seems to be not threatened by human activities.

	Shell height (mm)	**mean with s.d.**
Sabotino hill, female specimens	6.7 – 7.6	7.3 ± 0.3
Sabotino hill, male specimens	6.2 – 6.8	6.4 ± 0,2
Solkan, female specimens	6.9 – 7.7	7.2 ± 0.3
Solkan, male specimens	6.1 – 6.8	6.5 ± 0.2

Table **2**. Shell dimensions of *Cochlostoma gracile* (L. Pfeiffer, 1849) from Italy, Gorizia, southern slopes of Sabotino Hill and from Slovenia, Nova Gorica, Solkan, western side of Sveta Gora hill. n=15 for each locality and sex; mean with standard deviation (= s.d.).

Cochlostoma henricae (Strobel, 1851)

Material examined. — Italy: Friuli – Venezia Giulia, Gorizia, southern slope of Sabotino Hill, 339 m alt., 45° 58′ 55′′N 13° 37′ 46′′ E, 1.iii.2009, 8 dsp.

Shell (Figs 28-33, Tab. 3). — Protoconch smooth, without any visible ribbing. Teleoconch conical-elongated, ribbed, with rounded whorls and deep sutures. Both sexes almost equal in size and shape, with 8.5 whorls. Males darker in colour, markedly on the initial whorls. Ribs quite irregular in spacing and height, almost disappearing on last whorl. Rounded aperture with a quite often well developed lip. Peristomatic columellar lobe flat, well developed, often attached to the upper whorl. Umbilicus visible. Peristome white, quite abruptily widening. Well developed palatal callus, normally yellowish-brown.
Diagnostic characters of female genitalia (Figs 9-10). — Duct of bursa copulatrix with ventral junction. Seminal receptacle

	Shell height (mm)	mean with s.d.
Sabotino hill, female specimens	8.3 – 8.9	8.6 ± 0.2
Sabotino hill, male specimens	8.2 – 8.8	8.5 ± 0.1

Table **3**. Shell dimensions of *Cochlostoma henricae* (Strobel, 1851) from Italy, Gorizia, southern slopes of Sabotino Hill. n=15 for each sex; mean with standard deviation (=s.d.).

spindle-like, with undefined basis, much longer than in *C. gracile* and apex reaching to the dorsal edge of the BC. The seminal receptacle is positioned at the left (proximal side) of the BC (while in *C. gracile* below it). Apex abruptly narrowed in the oviduct, with a U-shaped loop and some short bends, normally positioned behind the SR, moving the oviduct on the right side of the SR. From here the oviduct presents a wide curve over the apex of the SR (this is a typical feature of *C. henricae*); after that the duct is linear until the proximal loop.

Table 3. Shell dimensions of Cochlostoma henricae (Strobel, 1851) from Italy, Gorizia, southern slopes of Sabotino Hill. n=15 for each sex; mean with standard deviation (=s.d.).

Cochlostoma septemspirale (Razoumowsky, 1789)

Material examined. — Italy: Friuli – Venezia Giulia, Gorizia, southern slope of Sabotino Hill, 339 m alt., 45° 58′ 55′′N 13° 37′ 46′′ E, 14.xi.2009, 8 dsp.

Shell (Figs 34-39, Tab. 4). — Protoconch with indistinct, narrowly spaced ribs at least on its last whorl. Teleoconch conical, prominently ribbed, with rounded whorls and deep sutures. Female shells slightly larger and more elongated than male ones. Shell yellowish with brown-red flammulae and dots, well visible all over the teleoconch. Ribs quite regular in spacing and height, with rounded profile, also present (although somewhat fading) on last whorl. Rounded aperture with well developed lip, mainly because of a strong, whitish, palatal callus. The lip more or less gradually narrows at the columellar side, so that there is no proper columellar lobe. Umbilicus open.

Diagnostic characters of female genitalia (Figs 11-12). —

	Shell height (mm)	mean with s.d.
Sabotino hill, female specimens	7.6 – 7.9	7.7 ± 0.1
Sabotino hill, male specimens	7.3 – 7.8	7.5 ± 0.1

Table **4**. Shell dimensions of *Cochlostoma septemspirale* (Razoumowsky, 1789) from Italy, Gorizia, southern slopes of Sabotino Hill. n=15 for each sex; mean with standard deviation (=s.d.).

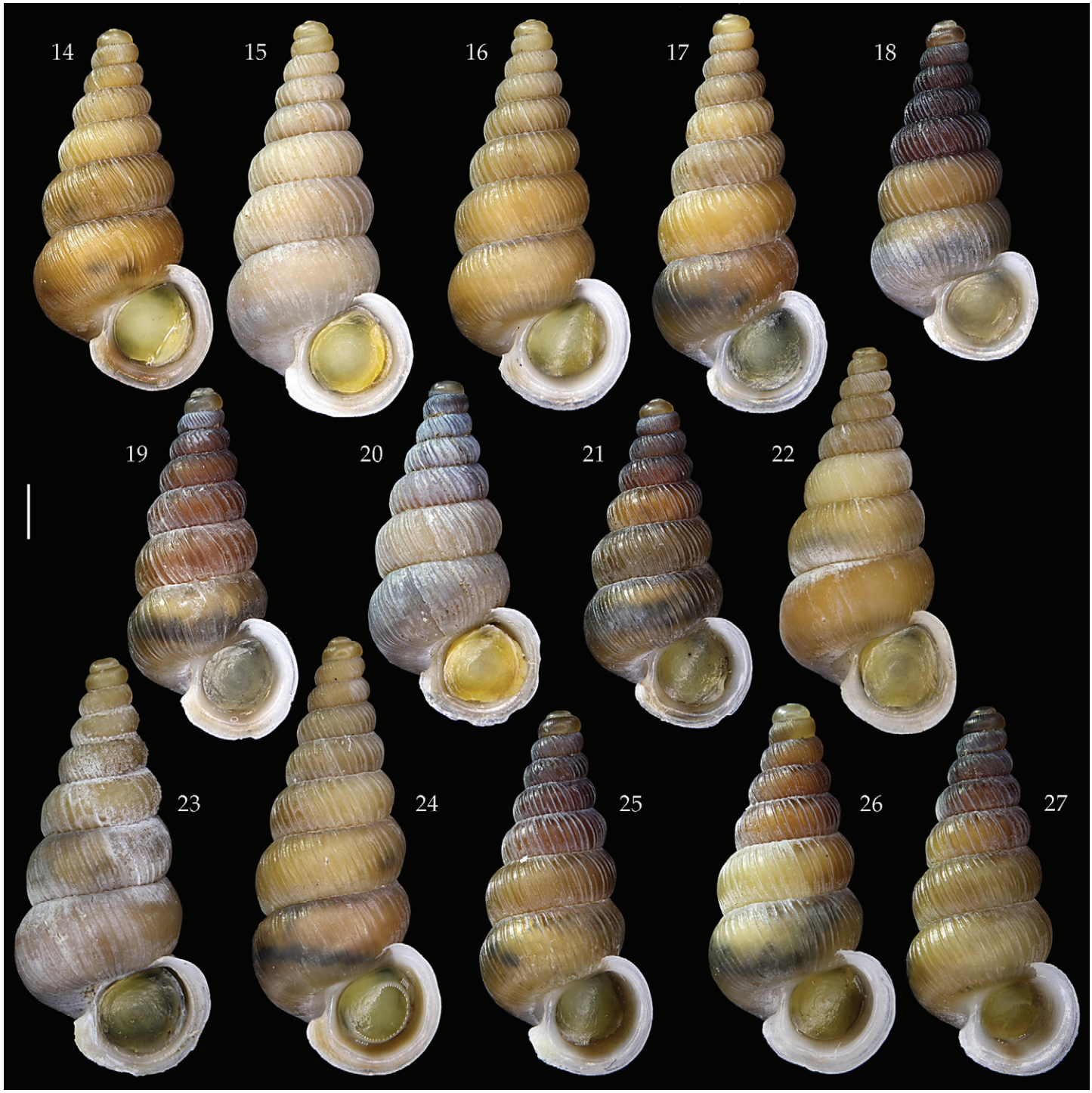
Duct of bursa copulatrix with posterior junction. Seminal receptacle sac-like, turned upside down (apex positioned at the ventral side of the body), therefore presenting a long distal oviduct, longer than the duct of the bursa copulatrix and running beside it. The seminal receptacle has a well defined apex and basis. The proximal oviduct between the apex of the seminal receptacle and the proximal loop is positioned in between the seminal receptacle and the BC.

Discussion

The authors realize that the above presented, conchological descriptions could fit many other *Cochlostoma* species. However, in *Cochlostoma* only a few shell characters are available, which do not allow a clear qualititative definition and discrimination. Here we draw attention to the differences between the three syntopic taxa found on the Sabotino hill, because these species are quite easily distinguishable by the differences in the shape of the columellar lobe. As regards *C. septemspirale*, the lip is gradually narrowed so that there is no proper columellar lobe and the umbilicus is clearly visible, not covered. *Cochlostoma henricae*, instead, has a well developed columellar lobe, flat or slightly curved, quite often reaching the upper whorl. In spite of the presence of this lobe, the umbilicus is open and also not covered. In *Cochlostoma gracile* there is a well developed but abruptly

(next page)

Figs **14-27**. Shells of *Cochlostoma gracile* (L. Pfeiffer, 1849).**14-21**, Italy, Gorizia, southern slopes of Sabotino hill; **22-27**, Slovenia, Nova Gorica, Solkan, western side of Sveta Gora hill. **14-17** and **22-24**, female specimens; **18-21** and **25-27**, male specimens. Scale bar 1 mm.


14
15
16
17
18
19
20
21
22
23
24
25
26
27


28
30
35
29
36
34
31
38
33
32
37
39

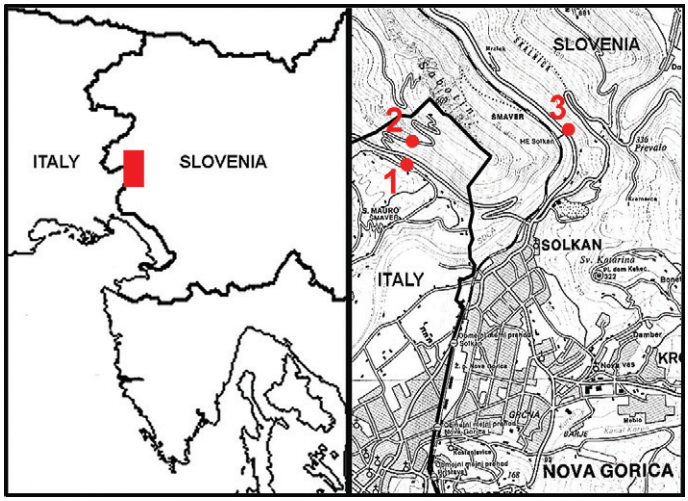


Fig **40**. Distribution of *Cochlostoma gracile* (L. Pfeiffer, 1849) in Italy and the examined material from Slovenia. Dot **1**, . 45° 58′ 55′′N 13° 37′ 46′′; dot **2**, 45° 58′ 55′′N 13° 37′ 46′′; dot **3**, 46° 00′ 04′′ N 13° 37′ 57′′.

curved columellar lobe which covers the umbilicus. *Cochlostoma gracile* can also be easily distinguished from *C. henricae* and *C. septemspirale* on the basis of the FSA morphology. *Cochlostoma septemspirale* is characterized by a posterior junction of the BC and an upside down SR. *C. henricae* has a ventral junction of the BC and a longer SR, which reaches with its apex the dorsal edge of the BC and it is positioned on the proximal side of the BC. *Cochlostoma gracile* has a much shorter SR, positioned below (ventral side) the CB. As regards the subgeneric subdivision of the genus *Cochlostoma* so far accepted, *C. gracile* belongs to the subgenus *Turritus* Westerlund, 1883, while *C. henricae* and *C. septemspirale* belong to *Cochostoma* (Jan, 1830) s. str. The validity of the subgenera has been questioned by Giusti (1971). We prefer not to apply or discuss the validity of the subgenera since more detailed studies are needed here (W. de Mattia, Z. Fehér & E. Zallot, in progress).

(previous page)
Figs **28-33**. Shells of *Cochlostoma* spp., Italy, Gorizia, southern slopes of Sabotino hill. **28-33**, *C. henricae* (Strobel, 1851). **34-39**, *C. septemspirale* (Razoumowsky, 1789). **28-30** and **34-36**, female specimens; **31-33** and **37-39**, male specimens. Scale bar 1 mm.

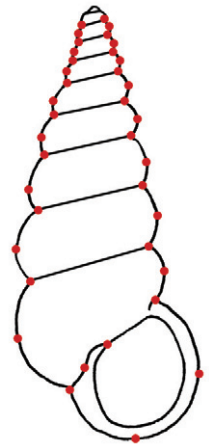


Fig **41**. Landmark locations on the shell of the morphometrically studied *Cochlostoma* species.

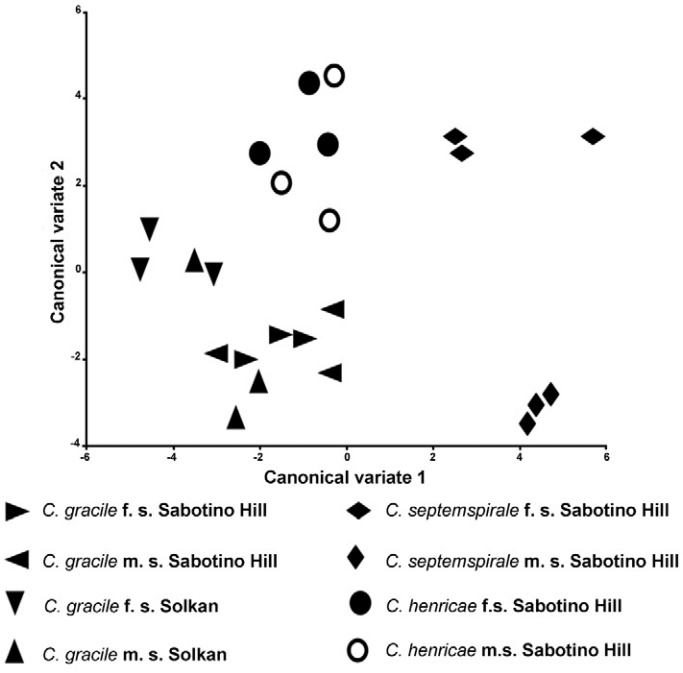


Fig **42**. Canonical variate graph showing the results of the morphometrical analysis for the *Cochlostoma* species.

Morphometry

The graphical results of the canonical variate analysis are shown in Fig. 42. The three species seem to be clearly distinguished. A remarkable situation characterizes *C. septemspirale*, where male and female specimens are clearly separated on the graph. The statistical value of this brief, preliminary morphometrical analysis has not been tested yet.

Acknowledgements

The authors thank Zoltán Fehér for providing literature and giving advice and Jessica Macor for helping during the field collecting.

References

Alzona, C., 1971. Malacofauna italica, catalogo e bibliografia dei molluschi viventi, terrestri e d'acqua dolce. — Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale di Milano 111: 1-433.

Bank, R.A., 1988. Revision der nordostitalienischen Arten und Unterarten der Gattung *Cochlostoma* Jan, 1830 (Gastropoda Prosobranchia: Cyclophoridae). — Basteria 52: 151-174.

Boato, A., Bodon, M., Giovannelli, M.M. & Mildner, P. 1987. Molluschi terrestri delle Alpi sudorientali. — Biogeographia 13: 429-528.

Bodon, M., Favilli, L., Giannuzzi Savelli, R., Giovine, F., Giusti, F., Manganelli, G., Melone, G., Oliverio, M., Sabelli, B. & Spada, G., 1995. Gastropoda Prosobranchia, Heterobranchia Hetetrostropha. — In: Minelli A., Ruffo S. & La Posta S. (eds), Checklist delle specie della fauna italiana, 14: 1-60. Calderini, Bologna.

Bole, J., 1994. Rod *Cochlostoma* (Gastropoda Prosobranchia) v Sloveniji. — Slovenska Akademia Znanosti in Umetnosti, Razprave 35: 187-217.

De Mattia, W. & Prodan, M., 2006. Nuovi dati sulla distribuzione di *Cochlostoma* (*Turritus*) *tergestinum tortivum* (Westerlund, 1885) e *Cochlostoma* (*Cochlostoma*) *scalarinum scalarinum* (Villa & Villa, 1841) in Italia (Gastropoda: Prosobranchia: Cochlostomatidae). — Atti del Museo civico di Storia Naturale di Trieste 52: 205-213.

Edlinger, K. & Mildner, P., 1979. Monographie der in Kärnten lebenden Prosobranchiengattung *Cochlostoma*. — Carinthia II 169/89: 281-304.

Fehér, Z., Erőss, Z. & Varga, A. 2001. Contributions to the knowledge of the Albanian *Cochlostoma* fauna (Gastropoda: Cyclophoridae) . — Schriften zur Malakozoologie 18: 71-78.

Giusti, F., 1971. Primo contributo alla revisione del genere *Cochlostoma* Jan e descrizione di *Toffolettia* n. gen. Notuale malacologicae XIII (Gastropoda Prosobranchia Cychlophoridae). — Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale di Milano 112/3: 353-380.

Grossu, A.V., 1986. Gastropoda Romaniae. 1. I. Caractere generale, istoricul si biologia gastropodelor II. Subclasa Prosobranchia si Opistobranchia: 1-524. Editura Litera, Bucuresti.

Jaeckel, S.G., Klemm, W. & Meise, W. 1957. Die Land- und Süsswassermollusken der nördlichen Balkanhalbinsel. — Abhandlungen und Berichte des Staatlichen Museums für Tierkunde Dresden 23: 141-205.

Klingenberg, C.P., 2008. MorphoJ. Faculty of Life Sciences, University of Manchester, UK. http://www.flywings.org.uk/MorphoJ_page.htm.

Polinski, W., 1924. Contributions a l'étude systématique et zoogéographique des mollusques de l'Albanie et des régions limitrophes. — Annales Zoologici Musei Polonici Historie Naturalis 3 (3/4): 127-151

Rohlf, F.J., 1996. Morphometric spaces, shape components and the effects of linear transformations. In: Marcus, L.F., Corti, M. Loy, A., Naylor, G., Slice, D.E., eds, Advances in Morphometrics: 117-129. NATO Advance studies Institute on Morphometrics in II Ciocco, Italy. Plenum Publishing Corp, New York.

Schütt, H., 1977. Revision der griechischen *Cochlostoma*. — Archiv für Molluskenkunde 108: 17-35.

Wagner, A.J., 1897. Monographie der Gattung *Pomatias* Studer. — Denkschriften der kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Classe 64: 565-632.

Wagner, A.J., 1901. Neue Formen und Fundorte des Genus *Pomatias* Studer. — Annalen des K. u. K. naturhistorischen Hofmuseums 16: 63-65.

Welter-Schultes, F.W., 1996. Non-marine molluscs recently collected in Albania. — Schriften zur Malakozoologie 9: 21-31.

Wohlberedt, O., 1909. Zur Fauna Montenegros und Nordalbaniens (Mollusken, Käfer, Isopoden, Chilopoden, Diplopoden). — Wissenschaftliche Mitteilungen aus Bosnien und der Herzegowina 11: 586-711.

Zallot, E., 2002. Alcune note sul genere *Cochlostoma* Jan, 1830 (Gastropoda, Prosobranchia) in Friuli (Italia nord-orientale). — Gortania 24: 93-113.

Zilch, A., 1958. Die Typen und Typoide des Natur-Museums Senckenberg, 21: Mollusca, Cyclophoridae, Craspedopominae-Cochlostominae. — Archiv für Molluskenkunde 87: 53-76.