



# New data on land molluscs from Sicily and biogeographical considerations

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## Abstract

This paper is devoted to discussing new records of land molluscs from Sicily and the surrounding archipelagos (Italy) acquired during our survey in the field in the last twenty years (2004–2024). *Monacha parumcincta*, a species widespread in Kérkira Island (Greece) and Apennine Italy, is reported for the first time in northeastern Sicily; *Sardovitrina polloneriana*, up to now considered endemic to Sardinia Island (Italy), is recorded for the first time from Pantelleria Island and Linosa Island (Sicilian Channel); *Aegopinella pura*, a species with European distribution, is confirmed in Sicily on the summit part of the Madonie Mountains (northern Sicily); and *Milax lopadusanus*, recently described from Lampedusa Island (Pelagian Archipelago, Sicily), is here reported also for Marettimo Island (Aegadian Archipelago, Sicily). The species identification is based on morphological inspection of shells and genitalia. Taxonomy and biogeographic issues are discussed as well.

**Keywords** Biogeography · Distribution patterns · Land snail · Morphology · Semi-slug · Slug · Taxonomy

## Introduction

Sicily and its surrounding archipelagos are the natural habitat of a large number of land molluscs, many of which are endemic species and have peculiar biology (Reitano et al. 2007, 2009, 2012; Liberto et al. 2010, 2011, 2012; Colomba et al. 2025). The land molluscs of the Sicilian region have received deep attention since the first half of the 1800s by numerous taxonomists (Philippi 1836, 1844; Benoit 1857–1862, 1882; Monterosato 1892; Alzona 1961; Beckmann 1992, 2002, 2004), biogeographers (Sacchi 1955, 1956a; Giusti 1973; Giusti and Manganelli 1984) or evolutionary biologists (Pfenninger et al. 2010; Colomba et al. 2011, 2014; Manganelli et al. 2019; Fiorentino et al. 2008, 2010). Nevertheless, a relevant part of Sicily is still unresearched or insufficiently researched, so nowadays, there are broad gaps to fill to reach a more complete figure of the land

snail fauna of this island. The present paper provides some new records of land snails, contributing to a better knowledge of the biodiversity and biogeography of the Sicilian malacofauna.

## Study area

Sicily is an island in the central Mediterranean Sea, south of the Italian Peninsula. It is the largest island in the Mediterranean, with 25,711 km<sup>2</sup>. It is separated from Calabria (the southernmost part of the Italian Peninsula) by the Strait of Messina and from Tunisia by the Sicilian Channel. Archipelagos and smaller islands surround it: Aeolian Archipelago to the north, Aegadian Archipelago to the west, Pelagie Islands and Pantelleria to the south, and Maltese Islands to the southeast. Its most prominent landmark is Mount Etna, the tallest active volcano in Europe (3357 m above sea level). Along the northern coast, the mountain ranges of Peloritani (1300 m), Nebrodi (1800 m) and Madonie (2000 m) are an extension of the mainland Apennines. In the southeast lies the lower Hyblaean plateau (1000 m). The mountains of Sicily form a significant part of the island's landscape. The island has a typical Mediterranean climate with mild and wet winters, hot, dry summers, and a Continental Mediterranean climate in the interior mountains, especially

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Madonie, Nebrodi and Etna, with heavy snowfalls during winter. Total precipitation is generally increasing with elevation. The southern and southeastern coast generally receives less than 500 mm, and the northern and northeastern highlands over 1000 mm.

## Material and methods

Empty shells and living specimens were collected in the field on sight on the soil, between the grass, and under fallen leaves and rocks. Observations on the ecology of these organisms were made directly in the field. The shells were cleaned in water with a flat-tipped and hard bristles paintbrush. To study and illustrate genital organs, some specimens were put in water and fixed in 80% ethanol. The bodies were isolated from the shells and dissected under a stereomicroscope (Optika) using a fine-pointed scalpel, scissors and needles. Photos were taken with a Canon EOS 100D camera. The height and maximum diameter of the shell, along with some parts of the genitalia, were measured (in millimetres) by a digital calliper. Taxonomical references are based on the Italian land and freshwater mollusc checklist (Bodon et al. 2021) and MolluscaBase (2024). In the anatomical description, the proximal part is the part closer to the gonad, and the distal part is the part closer to the gonopore. The proximal female genitalia are not described because they are not informative. The collection localities are listed according to the following scheme: municipality, collecting station, geographic coordinates, altitude, the names of the collectors and the dates of collection, the number of specimens examined and the collections where the samples are stored. If not specified, the collector must be understood as the first author (FL). Toponyms are reported following the official IGM 1:25,000 cartography of Italy. The materials used for this study are preserved in the first author's collection (CL, Fabio Liberto collection).

## Abbreviations and Acronyms

a = genital atrium; aag = atrial accessory glands; bc = bursa copulatrix; dbc = duct of the bursa copulatrix; dg = digitiform gland; dv = distal vagina; e = epiphallus; ep = epiphallus pleats; f = flagellum; fo = free oviduct; g = penial papilla or gland; ga = glandula amatoria; p =

## Systematics

Class Gastropoda Cuvier, 1795

Order Stylommatophora A. Schmidt, 1855

Superfamily Helicoidea Rafinesque, 1815

Family Hygromiidae Tryon, 1866

Subfamily Trochulininae Lindholm, 1927

Tribe Monachaini Wenz, 1930

Genus *Monacha* Fitzinger, 1833

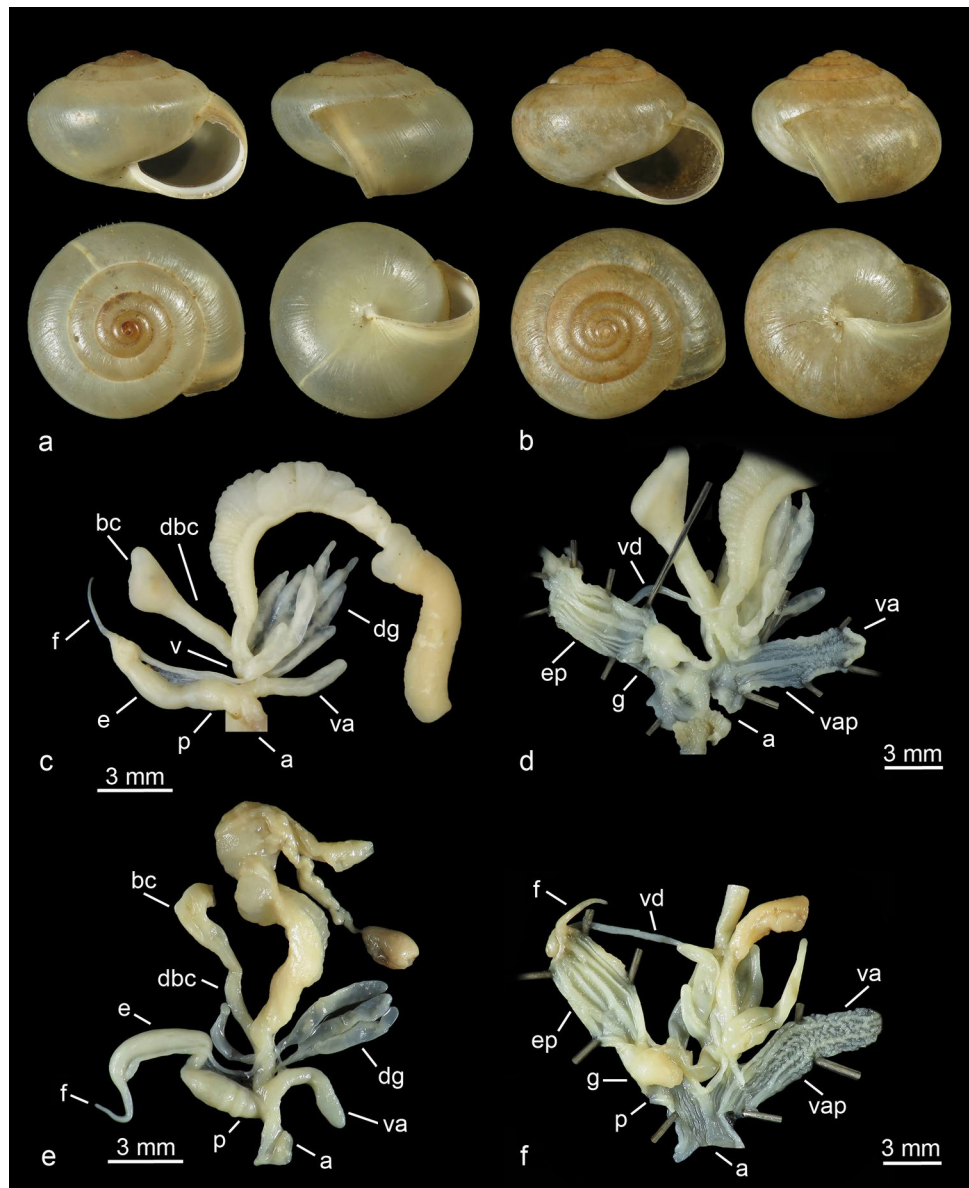
### *Monacha parumcincta* (Menke, 1828)

**Diagnosis.** Globose sub-globose shell; umbilicus closed or slit-like; medium to small size for the genus; yellowish with variably evident whitish peripheral and subsutural bands (Fig. 1a, b); genitalia (ten specimens examined) “*Monacha* s. str.”-like with vaginal appendix and digitiform gland, but without penis retractor muscle (Neiber and Hausdorf 2016), vaginal appendix rather short, with a rounded apex and without basal sac, internally with thin, tightly zig-zagging crests; 3 or 4 digitiform glands with very short or absent base and with on average 7 apices (Fig. 1c, e); penial papilla conical with an annular cingulum or a slight angle at the base; its central canal is internally slightly jagged, not connected to the external wall of penial papilla by connective strings (Pieńkowska et al. 2018); the internal wall of the epiphallus with 7 crests, of which 4 are thinner and closer together (Fig. 1d, f).

**Material examined.** Barcellona Pozzo di Gotto, Lando, 38°08'02"N 15°14'39"E, 200 m, 1 ex, X.2007, CL 1617; Mongiuffi, Trione Grotta, Franca, 37°55'06"N 15°16'17"E, 550 m, 21.X.2007, 1 sh, CL 2719; Castelmola, Monte Veneretta, 37°52'21"N 15°16'12"E, 750 m, 24.V.2008, 1 ex, 2 shs, CL 3407–3409; Santa Lucia del Mela, Monte Melia, 38°07'15"N 15°17'16"E, 670 m, 05.X.2008, 1 ex, 9 shs, CL 3973–3982; Patti, Iagheti di Marinello, 38°08'23"N 15°03'13"E, 10 m, 16.XI.2008, 7 shs, CL 4067–4073; Fiumedinisi, Pizzo Toscano, 38°04'17"N 15°23'07"E, 700 m, 16.VIII.2009, 11 ex, 9 shs, CL 5121–5140; Ali, Monte Scuderi, Portella del Monte, 38°03'44"N 15°24'13"E, 1170 m, 12.XII.2010, 1 ex, CL 9258; Messina, Mortelle, 38°16'30"N 15°36'15"E, 3 m, 23.X.2011, 1 ex, 11 shs, CL 10542–10553; Patti, Contrada Galice, 38°08'55"N, 15°00'16"E, 1 m, 23.X.2011, 1 ex, CL 10562; Tortorici, Filippelli, 37°58'30"N, 14°51'28"E, 1300 m, 04.XII.2011, 2 shs, CL 10909–10910; Messina, Portella Croce Cumia, 38°10'34.51"N 15°28'18.22"E, 845 m, legit A. Corso, IV.2014, 4 shs, CL 14732–14735; Milazzo, Castello, 38°13'58"N, 15°14'33"E, 28 m, 21.XI.2021, 2 shs, CL 19755–19756.

**Remarks.** The genus *Monacha* is widespread from Western Europe to North Africa, Iran and Arabia. In Sicily, it is represented by three endemic species: *M. consona* (Rossmässler, 1839) widespread in Sicily; *M. gregaria* (Rossmässler, 1839) present in western and southern Sicily, including the Aegadian Archipelago; and *M. rizzae* (Aradas, 1843) restricted to southeastern Sicily (Reitano et al. 2007; Liberto et al. 2010; Bodon et al. 2021; MolluscaBase 2024).

**Fig. 1** *Monacha parumcincta*: **a** shell (h: 6.1 mm, d: 8.4 mm), Fiumedinisi, Pizzo Toscano (CL 5133); **b** shell (h: 6 mm, d: 8 mm), Messina, Mortelle (CL 10543); **c** genitalia, Ali, Mount Scuderi (CL 9258); **d** internal view of distal genitalia, same specimen as in **c**; **e** genitalia, Patti, Galice (CL 10562); **f** internal view of distal genitalia, Santa Lucia del Mela, Mount Melia (CL 3974)



*Monacha parumcincta*, type locality “Corfu” = Kérkira Island (Greece) and “Dalmatien” (Croatia), is widespread on Kérkira Island and in Italy from the northeastern regions and across the Apennine up to Calabria (cf. Pieńkowska et al. 2018). The conspecificity of the Balkan populations is disputed (Forcart 1965; Manganelli et al. 1995; Welter-Schultes 2012). For the first time, we report *M. parumcincta* from northeastern Sicily (Fig. 2), where this species is quite widespread and common. Living specimens were found among the grass, under stones, or about 10 cm deep in the soil. The specimens reported as *Monacha gregaria* by Giusti (1973) from the island of Lipari (Aeolian Archipelago) and Tindari (northeastern Sicily) are here regarded as *M. parumcincta* due to the short vaginal appendix (longer

and with a thin-walled terminal portion in *M. consona* and *M. rizzae* and absent in *M. gregaria*).

#### Superfamily Limacoidea Batsch, 1789

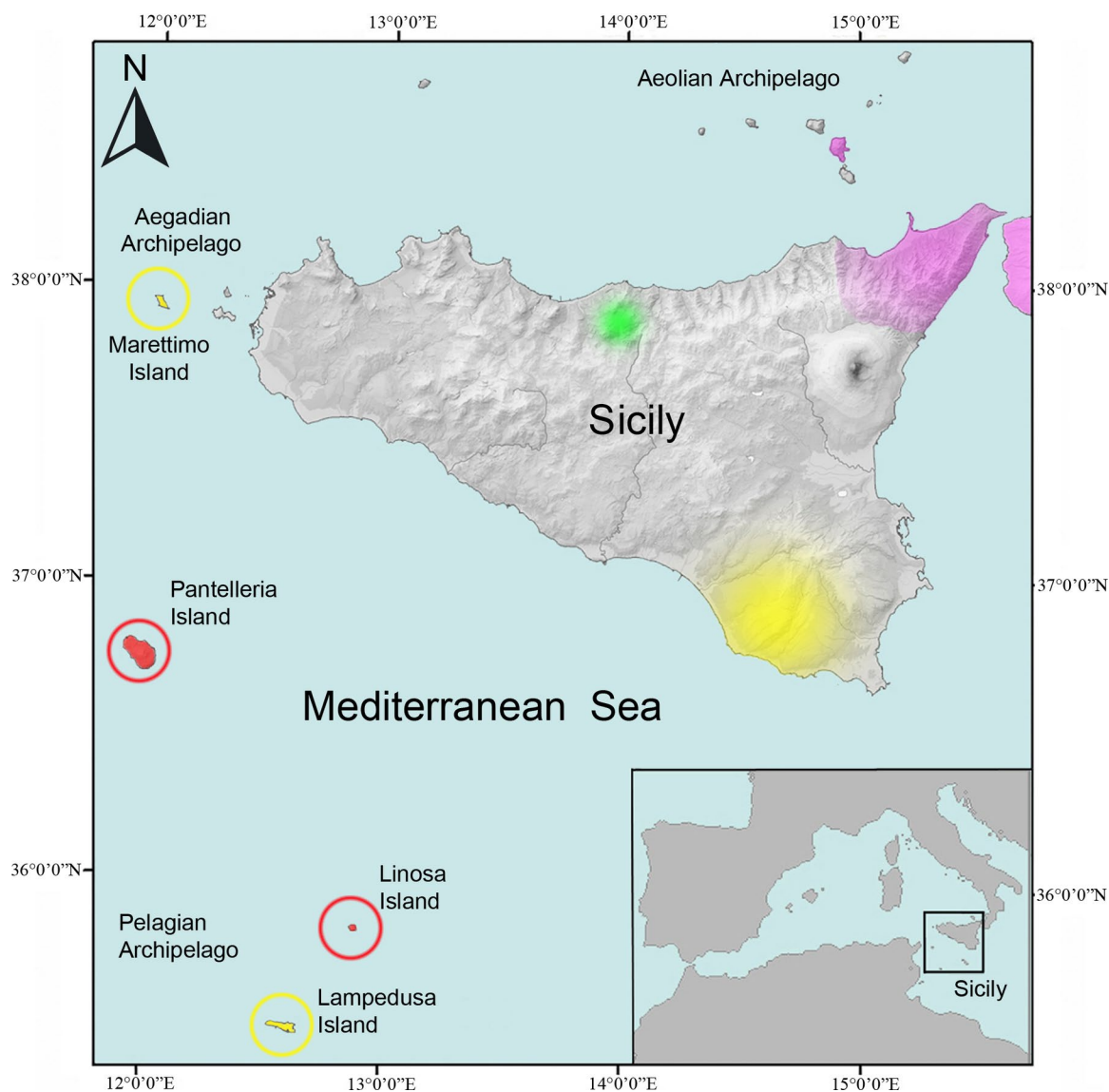
Family Vitrinidae Fitzinger, 1833

Subfamily Plutoniinae T. D. A. Cockerell, 1893

Genus *Sardovitrina* Manganelli & Fo. Giusti, 2005

#### *Sardovitrina polloneriana* (Fra' Piero, 1897)

**Diagnosis.** Shell vitriniform, glossy, thin and fragile, with approximately three whorls, slightly prominent protoconch, last whorl expanded; aperture moderately wide, umbilicus slit-like (Fig. 3a); protoconch with very small pits and blunt radial ribs; teleoconch smooth (Fig. 3b-d).



**Fig. 2** Distribution area in Sicily of the studied species: *Monacha parumcincta*, purple areas; *Sardovitrina polloneriana*, red areas; *Aegopinella pura*, green area; *Milax lopadusanus*, yellow areas

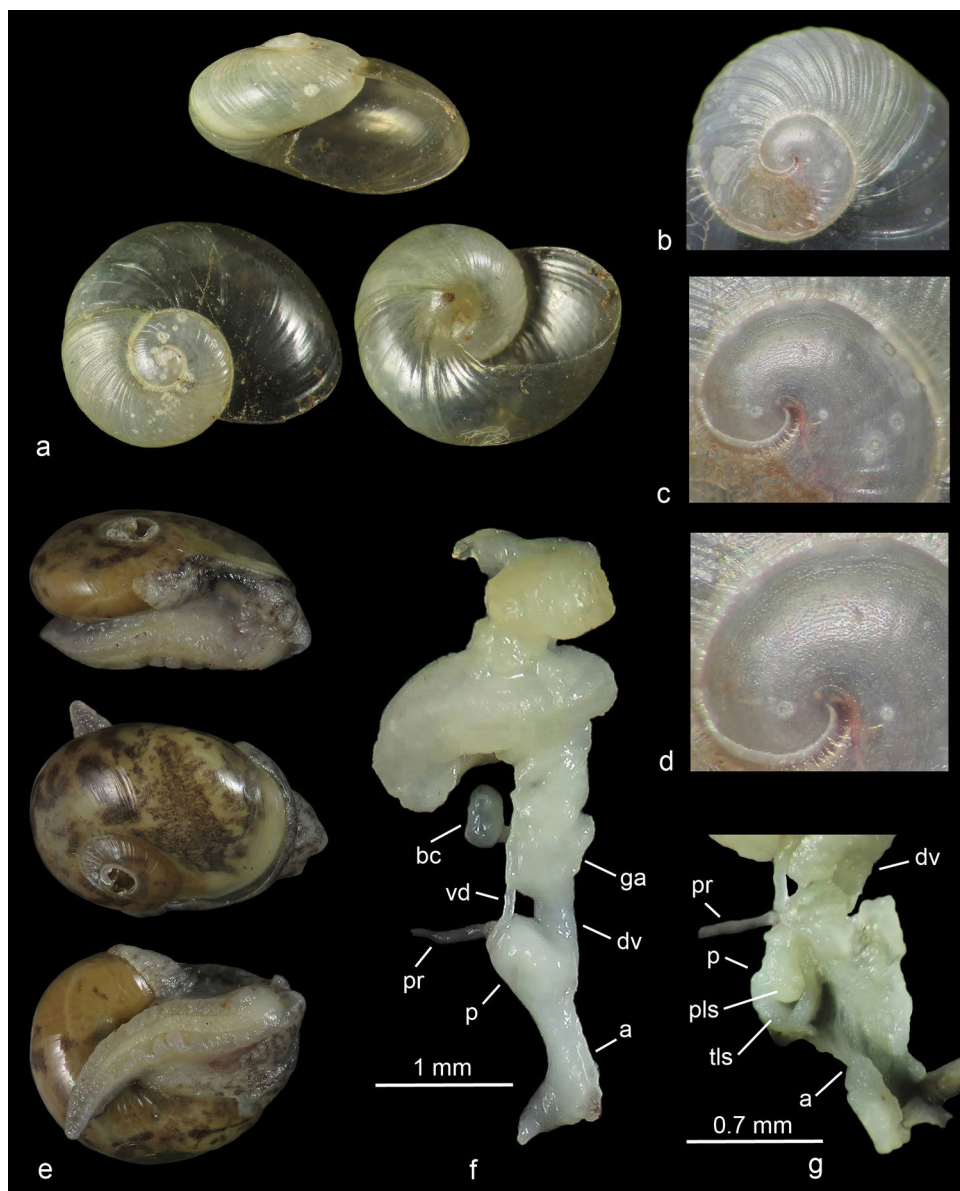
The body (vitrid-like) cannot be completely withdrawn into the shell; the right shell lobe covers a limited portion of the shell and is longer and slenderer than the left one (Fig. 3e).

Distal genitalia (Fig. 3f): free oviduct short and wide; bursa copulatrix sac-like, with short, slender duct; vagina long, with the small cylindrical glandula amatorial (stimulator) constituting half its length; penial complex very small and globular, penial retractor inserted apically, vas deferens entering penial complex subapically; internal structures of the penial complex with short, rolled tongue-like structure embracing cylindrical papilla-like structure (Fig. 3g); genital atrium very long and cylindrical.

**Material examined.** Pantelleria Island, Montagna Grande, Cala Tre Tacche, 36°46'N 12°00'E, legit A. Corso, May 2009, 1 ex, 1 sh, CL 13202–13203; Linosa Island, Monte Bandiera, 35°51'47"N 12°51'48"E, 51 m, legit A. Corso, X.2018, 1 ex, CL 17877; Linosa Island, Monte Bandiera, 35°51'47"N 12°51'48"E, 51 m, legit A. Corso, XI.2019, 3 shs, CL 18301–18303.

**Remarks.** *Sardovitrina polloneriana* was known until now only from Sardinia (Italy). On this island, it lives in Holm Oak forests and Mediterranean scrub on calcareous soil; however, in the same localities, Aleppo Pine and Stone Pine have been introduced for reforestation purposes (M. Doneddu personal communication, 31 December 2023). The present new findings expand the known distribution of

**Fig. 3** *Sardovitrina polloneriana* Linosa Island, Mount Bandiera: **a** shell (h: 2 mm, d: 3.7 mm) (CL 18301); **b-d** microsculpture of the shell apex (CL 18302); **e-g** *Sardovitrina polloneriana* Linosa Island, Mount Bandiera (CL 17877); **e** semi-slug preserved in alcohol, the shell apex is damaged; **f** genitalia; **g** internal structure of penis and atrium



the species to the Pelagian Islands (Linosa) and Pantelleria Island. In Linosa, *S. polloneriana* was found under stones in Aleppo Pine reforestation; in Pantelleria, it was found in the undergrowth among brushwood of Aleppo Pine, Maritime Pine and Holm Oak, under medium or small-sized volcanic stones covered with moss in humid areas.

#### Superfamily Gastrodontoidea Tryon, 1866

Family Gastrodontidae Tryon, 1866

Genus *Aegopinella* Lindholm, 1927

#### *Aegopinella pura* (Alder, 1830)

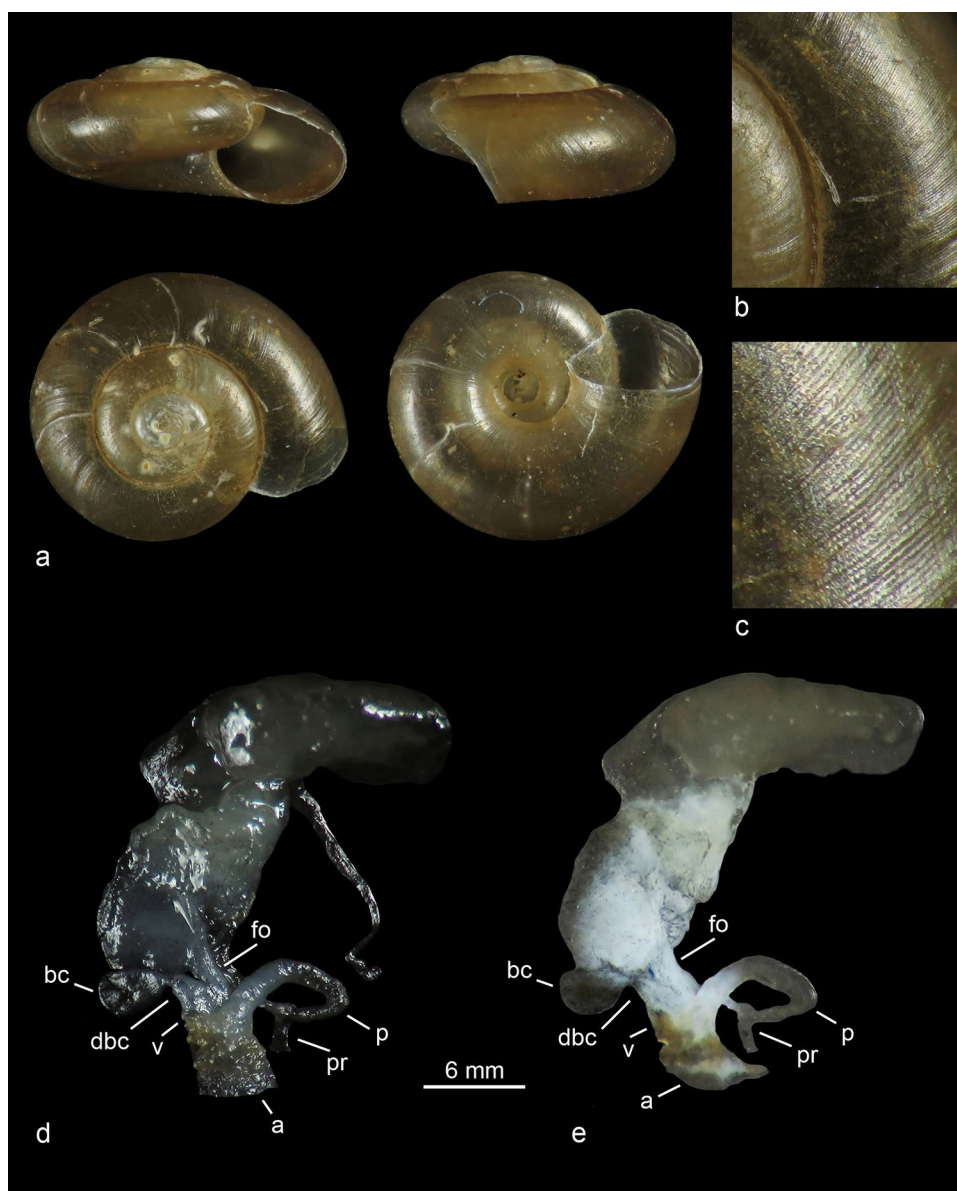
**Diagnosis.** Shell small, translucent, depressed, with 3 1/2 whorls; last whorl larger in proportion to the remaining spire; wide umbilicus; oval, oblique aperture (Fig. 4a);

external surface crossed by a characteristic regular microsculpture of growth lines crossed by very minute spiral striae (Fig. 4b, c).

Distal genitalia characterised by short free oviduct, same width as the penis; duct of bursa copulatrix broadened at base; very short vagina; cylindrical penis, without flagellum and with retractor muscle; vagina and penis open into a very large genital atrium (Fig. 4d, e).

**Material examined.** Scillato, 37°52'N 13°55'E, 750 m, 02.V.2004, 1 sh, CL M1404; Scillato, Vallone Nipitalva, 37°52'56"N 13°58'01"E, 1600 m, 17.VII.2005, 3 exx, CL M1922-1924; Petralia Sottana, northern slopes of Mount Mufara, 37°52'23"N 14°01'08"E, 1600 m, 27.IV.2008, 1 sh, CL M3702; idem 37°52'30"N 14°01'35"E, 1620 m,

**Fig. 4** *Aegopinella pura* Petralia Sottana, Mount Mufara: **a** shell (CL M7793); **b, c** microsculpture of the last whorl, same specimen as in **a**; **d** genitalia (CL M7822); **e** genitalia immersed in alcohol, same specimen as in **(a)**



23.IV.2012, 1 sh, CL M7792; idem, 15.V.2012, 4 exx, 10 shs, CL M7822-7835.

**Remarks.** The occurrence of *A. pura* in the summit area of the Madonie Mountains (Sicily, Italy) was known to Sicilian malacologists in the 1800s. However, they reported *A. pura* with wrong names, such as *Helix nitens* (see Pirajno 1840) or *H. hammonis* (see Benoit 1882). Alzona (1971) lists *A. pura* from Sicily, while Forcart (1959) and Riedel (1983) regard the presence of *A. pura* on the island as doubtful. In recent checklists, the presence of *A. pura* in Sicily was excluded (Manganelli et al. 1995; Welter-Schultes 2012; Bodon et al. 2021; MolluscaBase 2024). On the contrary, the finding discussed here confirms the presence of *A. pura* in Sicily, representing its southern distribution limit. In the

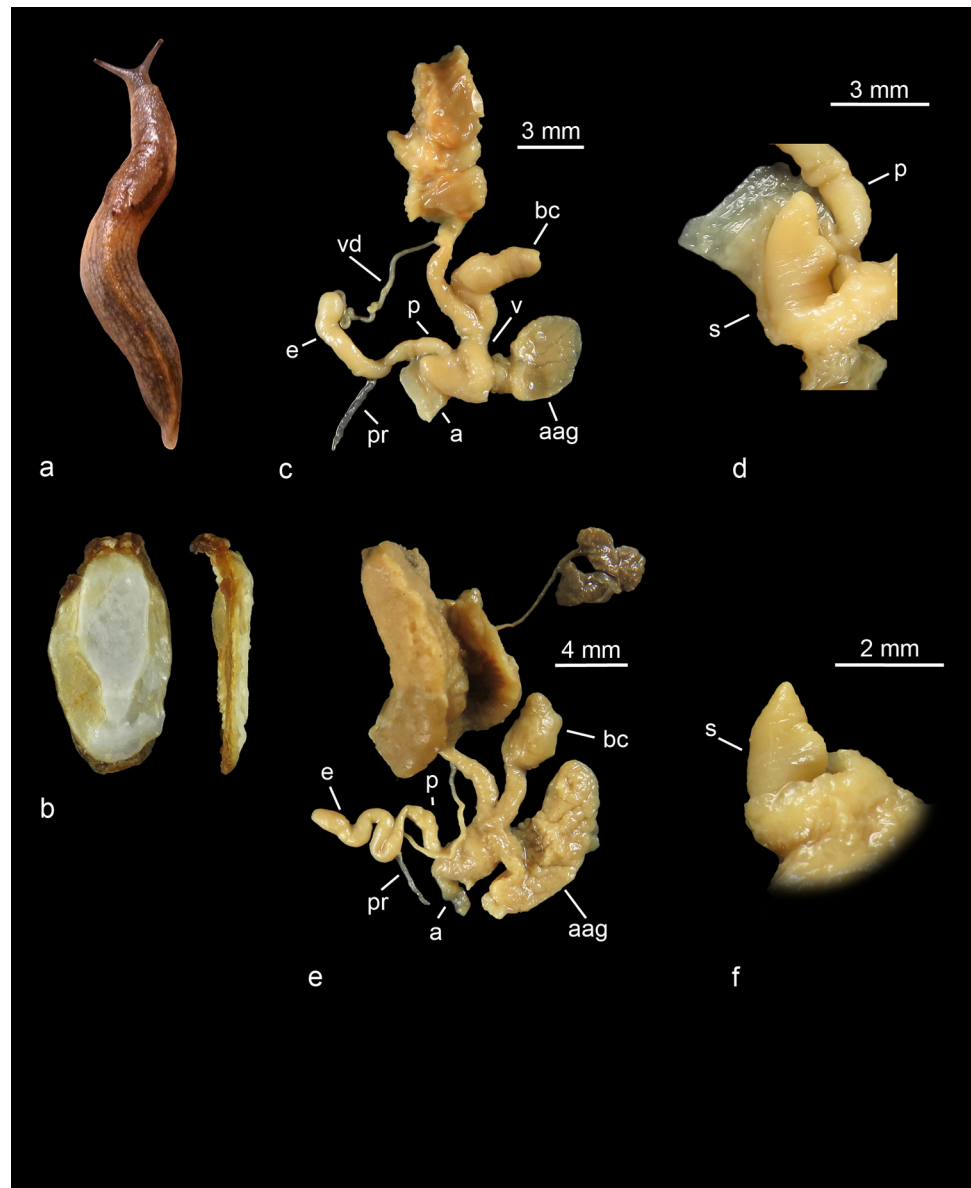
Madonie Mountains *A. pura* was found in damp leaf litter of beech woods, above 1600 m.

Family Milacidae Ellis, 1926  
Genus *Milax* J. E. Gray, 1855

***Milax lopadusanus* Liberto, Corso, R. Viviano, Colomba & Sparacio, 2017**

**Diagnosis.** Slug (Fig. 5a) milacid-like (Wiktor 1987), medium-small sized (length 36 mm); body greyish with yellowish anterior sides and yellowish dorsal carina; clypeus with a dark band on the groove. Shell (limacella) (Fig. 5b) milacid-like: oval, with nucleus posterior and on the major axis, ventrally slightly convex.

**Fig. 5** *Milax lopadusanus* Marettimo Island. **a-d** Marettimo, Caprarizza (CL 16388): **a** living specimen; **b** shell (h: 4 mm, d: 2.5 mm); **c** genitalia; **d** stimulator. **e-f** Marettimo, Mount Falcone (CL 16389): **e** genitalia; **f** stimulator



Distal male genitalia characterised by long (5.5–6 mm) cylindrical epiphallus with a slight lateral swelling at its tip; a slight constriction separates the epiphallus from the penis; penis fusiform (3.6–5.5 mm), penial retractor muscle ending laterally at the transition of the epiphallus to the penis; vagina and penis open into a wide genital atrium; mass of atrial accessory glands communicating via multiple ducts with atrium (Fig. 5c, e). The stimulator is conical, with a base oval in section, a pointed apex, and an evident crest that rises to half the stimulator's length along one side (Fig. 5d, f).

**Material examined.** Marettimo, Mount Falcone, 37°58'43"N 12°03'08"E, 590 m, 13.XII.2015, 1 ex, CL 16388; Marettimo, Caprarizza, 37°58'26"N 12°03'27"E, 470 m, 13.XII.2015, 1 ex, CL 16389.

**Remarks.** *Milax lopadusanus* has been described as an endemic species to the island of Lampedusa (Pelagie Islands, Sicily) (Liberto et al. 2017), nevertheless Bodon et al. (2021) recently reported this species from the Ragusa province (southeastern Sicily). This paper reports the presence of *M. lopadusanus* also on the island of Marettimo, the westernmost part of the Aegadian Archipelago (western Sicily). The specimens examined from Marettimo show a longer penis and epiphallus compared to the specimens from Lampedusa (2 mm and 2.5–3 mm, respectively); this character is regarded here as intraspecific variability. The specimens were found under stones among the Mediterranean scrub in the highest part of the island (470–600 m).

## Discussion

The restricted distribution of *Aegopinella pura* to the summit of the Madonie Mountains suggests that this species may have reached Sicily from the Apennines during the last Pleistocene glaciations. The subsequent phase, characterised by a trend towards climate warming, determined its present isolation on the more humid and cooler slopes of the highest Sicilian peaks, with a continental Mediterranean climate. The distribution in Sicily of *M. parumcincta*, limited to the northeastern sector, might suggest a late Pleistocene glacial origin from the Apennines when a land bridge connected Calabria to Sicily. Nevertheless, a more recent (i.e., during the Holocene) long-distance dispersal over the sea, mediated or not by humans, cannot be ruled out. The spread of *Milax lopadusanus* on the island of Lampedusa, the island of Marettimo, in southeastern Sicily and the lack of findings in northern Sicily (Liberto et al. 2017) seem to indicate a closer relationship between this taxon and the milacid species of the southern Mediterranean (Algeria, Tunisia) rather than the Apennine ones. A similar Sicilian-North African chorotype is shown by other genera of land molluscs such as *Tudorella* P. Fischer, 1885 (Pfenninger et al. 2010), *Siciliaria* Vest, 1867 (Colomba et al. 2025), *Schileykiella* Manganelli, Sparacio & Fo. Giusti, 1989 (Abbes et al. 2023; Liberto et al. 2024) and *Orculella* Steenberg, 1925 (Hausdorf 1988). These genera have representatives in North Africa and southern and western Sicily, while they are missing in the Italian peninsula and the northeastern sector of Sicily. The origin of *S. polloneriana* in the islands of the Sicilian Channel (Pantelleria and Linosa) is more uncertain. Pantelleria Island and the Pelagian islands have been investigated since the first half of the 19<sup>th</sup> century, and no references to vitrinids can be found in available literature (see Calcara 1851, 1853; Sacchi 1956b, 1957; Alzona 1961; Beckmann 1992; Cianfanelli 2002; Bodon et al. 2021; MolluscaBase 2024). Moreover, Linosa and Pantelleria are volcanic islands and have never directly connected with another landmass, including Sardinia. However, during the Pleistocene glacial cycles, they were separated by narrow channels from Sicily and Tunisia, facilitating jump dispersals (Flemming et al. 2003). It is reasonable to assume that *S. polloneriana* has recently been introduced into Linosa through reforestation by Man; nevertheless, a more ancient origin cannot be ruled out, at least in Pantelleria due to the persistence of a native forest of Aleppo Pine, Maritime Pine and Holm Oak (Agostini 1973) where *S. polloneriana* lives.

## Conclusion

The present findings show how Sicily is a crossroad between Europe and Africa, where processes of taxa invasion, isolation, diversification and speciation were driven by paleoclimatic events that occurred in the Mid-Mediterranean areas since the end of the Miocene (Sacchi 1955, 1956a; Giusti and Manganelli 1984; Pfenninger et al. 2010; Colomba et al. 2012). Sicily appears as a natural laboratory of evolution made up of islets, islands, archipelagos and ecological islands, i.e. discrete patches of habitat surrounded by strongly contrasting habitats, such as the peaks of the Madonie Mountains, reaching nearly 2000 m a.s.l. just 16 km from the Mediterranean Sea (Dubey et al. 2008; Linares 2011). This combination of topographic features and paleoclimatic events makes Sicily and the surrounding archipelagos an interesting subject for biogeographic and evolutionary studies. In this view, the present new findings provide a contribution to understanding the processes of colonisation and diversification of the Sicilian and Mid-Mediterranean fauna. This biodiversity heritage must be protected, and the present findings can help identify the most relevant Sicilian areas and the most appropriate measures and acts for its protection.

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**Authors' contributions** Fabio Liberto: Data collection; Conceptualization; Data curation; Writing - original draft and final version of the manuscript; Andrea Corso: Data collection; Armando Gregorini: Funding acquisition; Mariastella Colomba: Supervision; Writing - original draft and final version of the manuscript, review & editing.

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**Data Availability** The authors confirm that the data in support of the findings of this study are available after contact with the first author (FL).

## Declarations

**Conflict of interest** The authors have no competing financial or non-financial interests to declare.

**Consent to publish** All authors agree to publish the paper.

**Research content** The research content is original and has not been published or submitted for publication elsewhere.

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