

## Land mollusks of Chalki and Alimia (Dodecanese Archipelago, Greece)

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### ABSTRACT

A check list of land snails of the island of Chalki and the nearby islet of Alimia (South Aegean Greece, Dodecanese Archipelago) is given. The literature concerning the non-marine mollusks living on the two islands is critically reviewed. New data on morphology of some snails species are presented, with particular account to the genus *Rhabdoena* Kobelt et Mollendorff, 1902, *Zebrina* Held, 1838 and *Albinaria* Vest, 1864.

### KEY WORDS

Land snails; endemism; Dodecanese Islands; Chalki; Alimia.

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## INTRODUCTION

The malacological researches on Chalki Island and Alimia Islet began in 1887 with the naturalistic surveys of Eberhard Von Ortzen, carried out in the Aegean Islands and in the southwest corner of Asia Minor with the support of the Royal Prussian Academy of Sciences. The Von Ortzen's collections of terrestrial mollusks were later studied by the German malacologists Oscar Boettger and Eberh Von Martens.

Boettger (1889) published a monograph on Clausiliidae describing several new species, including a new subspecies of *Albinaria brevicollis* (L. Pfeiffer, 1850) endemic to Chalki *A. brevicollis chalcidensis* (O. Boettger, 1889).

In the same year Von Martens (1889) published the first comprehensive survey of the mollusks of the Aegean Islands and Asia Minor, reporting for

the island of Chalki nine species of terrestrial mollusks: *Hyalina aequata* Mouss., *Helix (Pseudocampylaea) pellita* Fer., *Helix (Iberus) spiriplana* Oliv., *Helix (Pomatia) aperta* Born, *Helix (Xerophila) cretica* Pfr., *Bulimus (Mastus) turgidus* Kobelt, *Pupa (Orcula) scyphus* Pfr., *Clausilia (Albinaria) brevicollis* Pf., *Clausilia (Albinaria) teres* (Oliv.) var. *extensa* Pfr.

Gude (1902) published a list of the Helicoid land snails of Asia, listing for the island of Chalki the Von Martens's data for this group: *Retinella aequata* Mouss., *Helicella (Helioamanes) cretica* Pfr., *Hygromia (Metafruticicola) pellita* Fér., *Helix (Levantina) spiriplana* Oliv., *Helix (Helicogena) aperta* Born.

Of particular significance is the work of Gamberetta (1929), as this was the first comprehensive study of the mollusks of the Dodecanese Islands as a whole. Her research was based on material result-

ing from extensive samples carried out by Festa (1913), Desio (1922–1924), Ghigi-Issel (1928–1929). Part of the specimens collected by Ghigi were complete with soft parts, and this material allowed Gambetta to study for the first time the anatomy of some species. Gambetta reviewed most of the previous literature on the Dodecanese non-marine mollusks and listed 106 species for the Dodecanese Islands and 11 species for Chalki Island:

*Hyalinia (Eopolita) aequata* Mousson, *Metafruticicola (Metafruticicola) pellita* Fér., *Eobania vermiculata* Müll., *Levantina spiriplana* var. *carinata* Bgt., *Helix (Cantareus) aperta* Born, *Helicella (Xerocrassa) cretica* Fér. Let., *Rumina decollata gracilis* Pfr. Let., *Ena (Mastus) turgida* Parr., *Clausilia (Albinaria) brevicollis* Pfr., *Clausilia (Albinaria) unicolor* Bttg. Let., *Clausilia (Albinaria) extensa* Pfr.

Other two faunistic and taxonomic works on land and freshwater mollusks of Aegean Islands were those of Fuchs & Käufel (1934, 1936) based on the material collected by Franz Werner in the year 1932. In these works special emphasis was reserved to the genital morphology and geographical distribution of species.

Fuchs & Käufel (1934) reported for Chalki Island only two species: *Helicella (Xerocrassa) cretica-cauta* Westerlund, and *Metafruticicola (M.) pellita-graphicotera* Bourguignat. Fuchs & Käufel (1936) report other three species *Mastus (M.) pupa turgidus*, *Albinaria (Albinaria) brevicollis chalcidensis* and *Retinella (Eopolita) protensa protensa*.

Frank (1997) in his work on land mollusks of Rhodes recorded *Xerocrassa cretica* (A. Férussac, 1821) and *Metafruticicola (M.) pellita* (A. Férussac, 1819) on Chalki and *Levantina spiriplana malziana* (L. Pfeiffer, 1861) on Alimia and Chalki.

Other data on land mollusks of Chalki and Alimia were published in papers concerning a single genus or species: Pfeiffer (1949) on *Levantina* Kobelt, 1871; Zilch (1977) and Nordsieck (2007) on *Albinaria*; Gittenberger & Hausdorf (2004) on *Orculella* Steenberg, 1925; Bank et al. (2013) on *Metafruticicola* Ihering, 1892; Neubert (2014) on *Helix* Linnaeus, 1758.

Until recently a total of 14 species was reported from Chalki and 2 from Alimia. In this paper we present the results of a land snail survey of Chalki and Alimia carried out in July–August 2014 and April 2015 by M. Grano and C. Cattaneo.

## MATERIAL AND METHODS

### Study area

The Dodecanese Archipelago is a group of 12 large islands plus 150 islets. The island of Chalki is located 13 km west of the island of Rhodes (Fig. 1), its approximate geographical coordinates are: latitude 36°13'51"N, longitude 27°34'35"E. It has an area of 28 square km and its maximum height is Maistros (593 m a.s.l.).

The most interesting aspect of the island is given by vertical cliffs of massive limestone and deep gorges along the coastline (Fig. 3). These vertical cliffs allowed the presence of a rare and highly specialized chasmophytic flora. Several species are endemic with a distribution area limited to the island and to the SE Aegean, including W Turkey (Cattaneo & Grano, 2015a, b). Recently was discovered a new species for science that seems to be restricted to Chalki and the nearby island of Tilos: *Seseli halkensis* Cattaneo, Tan et Biel (Cattaneo et al., 2016). Chalki is mostly constituted by rocky hills characterized almost exclusively by a phryganic vegetation with prevalence of chamaephytes and nano-phanerophytes, as *Sarcopoterium spinosum* (L.) Spach, *Salvia fruticosa* Mill., *Origanum onites* L., *Thymbra capitata* (L.) Cav., *Teucrium capitatum* L. A steppic vegetation is also present on exploited lands and the most representative species are *Hyparrhenia hirta* (L.) Stapf, *Andropogon distachyos* L., *Carlina corymbosa* L., *Picnomon acarna* (L.) Cass., *Echinops spinosissimus* Turra, *Asphodelus fistulosus* L. and *A. ramosus* L. On the hilly slopes of the valleys of Kania, Zies, Pondamos and Ghiali a characteristic floristic composition with *Anagyris foetida* L., *Euphorbia dendroides* L. and *E. characias* L. is developed. The site of Limenari (northwest of Chalki) is characterized by a low maquis whose distinctive elements are *Juniperus phoenicea* L. and *Pistacia lentiscus* L. The tree vegetation is almost exclusively represented by *Olea europaea* L. and *Pistacia terebinthus* L. subsp. *palestina* (Boiss.) Engl., the latter restricted to Pondamos and Ghiali bay. *Pinus brutia* Ten. grows in a small area near Kania. In Chalki there are also several alien species like *Anagyris foetida* (widespread), *Agave americana* L., *Carpobrotus edulis* (L.) N.E. Br., *Opuntia ficus-indica* (L.) Mill. and *Oxalis pes-caprae* L. (Cattaneo & Grano, 2015a, b).

The study area belongs to the Thermo-Mediterranean zone, with a long dry period from end of April to early October.

Alimia is an uninhabited islet located 6 km east of Chalki (Fig. 1). It has an area of 7.42 square km and a maximum height of 274 m a.s.l. Its approximated geographical coordinates are: latitude  $36^{\circ}16'26''\text{N}$ , longitude  $27^{\circ}42'24''\text{E}$ . It consists of limestone rock with steep cliffs on the northern side, lacks superficial hydrography; there's only a small retrodunal pond of brackish water in the bay of Agchos Georgios.

The islet vegetation is characterized by wide low shrubs with *Juniperus phoenicea* and *Pistacia lentiscus* (Fig. 2). Where shrubs become more thin and open, thrives a phrygana almost exclusively characterized by *Thymbra capitata*, to which sometimes is associated *Teucrium capitatum* and more sporadically *Salvia fruticosa*, *Origanum onites* and *Sarcopoterium spinosum*. Clusters of *Pinus brutia* are scarce and localized.

Alimia together with Chalki and the surrounding

small islands, is included in the European Network "Natura 2000" as SPA, Special Protection Area, with GR4210026 code.

### Sampling methods

The samples examined for this paper were collected by M. Grano and C. Cattaneo, from 30th July to 12th August 2014 and 23rd April 2015. The names of local places mentioned in the text and in the map (Fig. 1) follow the map of Chalki produced by Anavasi Ed. (2008). Specimens were collected chronologically from the following localities:

Chalki, Imborios,  $36^{\circ}13'23''\text{N}$  -  $27^{\circ}36'45''\text{E}$ , 22 m a.s.l., 30.VII.2014

Chalki, Kania,  $36^{\circ}14'02''\text{N}$  -  $27^{\circ}37'05''\text{E}$ , 48 m a.s.l., 31.VIII.2014

Chalki, Chorio,  $36^{\circ}13'13''\text{N}$  -  $27^{\circ}35'07''\text{E}$ , 268 m a.s.l., 01.VIII.2014

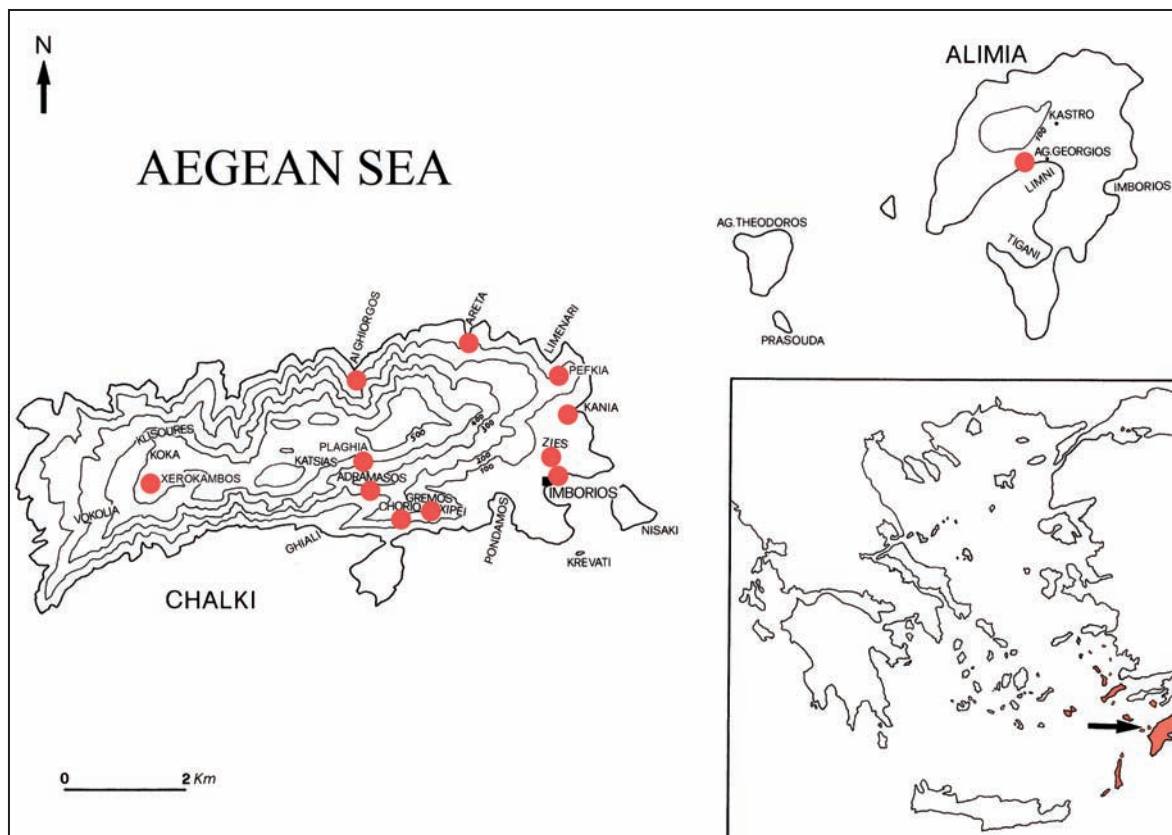


Figure 1. Map of Chalki Island and Alimia Islet.

- Chalki, Pefkia, 36°14'15"N - 27°36'53"E, 125 m a.s.l., 02.VIII.2014  
 Chalki, Ag. Ghiorgos, 36°14'21"N-27°34'43"E, 108 m a.s.l., 03.VIII.2014  
 Chalki, Plaghia, 36°13'38"N- 27°34'45"E, 423 m a.s.l., 03.VIII.2014  
 Chalki, Areta, 36°14'43"N-27°35'58"E, 95 m a.s.l., 04.VIII.2014  
 Chalki, Zies, 36°13'39"N-27°36'57"E, 54 m a.s.l., 05.VIII.2014  
 Chalki, Xipei, 36°13'11"N-27°35'37"E, 153 m a.s.l., 06.VIII.2014  
 Chalki, Xerokambos, 36°13'23"N-27°32'30"E, 401 m a.s.l., 07.VIII.2014  
 Chalki, Adramasos, 36°13'32"N-27°34'48"E, 32 m a.s.l., 12.VIII.2014  
 Alimia, 36°16'5"N-27°42'12"E, 31 m a.s.l., 09.VIII.2014  
 Alimia, 36°16'5"N-27°42'12"E, 31 m a.s.l., 12.VIII.2014

The land snails were collected by hand on the soil and under the rocks. Dry shells have been studied as regards size, colour, morphology, sculpture, aperture, plicae and lamellae, lunella and clausilium. Photographs were taken with a digital camera. The living snails were bred from September 2014 to March 2015. In the laboratory they were normally kept in plastic boxes containing damp tissue paper, lettuce or carrot. The contents were changed twice a week. In order to study and illustrate genital organs, the specimens were drowned in water and fixed in 75% ethanol. Reproductive apparatus was extracted by means of scalpel, scissors and needles. Height and maximum diameter of the shell along with some parts of genitalia were measured (in millimeters) with a digital gauge. Identification of the slug species was based on the photos, since no live slugs were sampled. All the shell lots and anatomical preparations are kept in the collection of the first author. Taxonomical references are based on the checklist of the land and freshwater Gastropoda of Greece (Bank, 2011).

ABBREVIATIONS AND ACRONYMS. D = diameter; H = height; moll. = mollusk; End = Endemic: species exclusive of Chalki Island; Dod = Dodecanese: species distributed only on the Dodecanese Islands; Aeg = Aegean: species which are

also present on other Aegean islands or/and nearby coastal mainland areas of Greece and Turkey; Grek = Greek: species distributed within the Greek mainland or/and islands; E Med = East Mediterranean: species which are found in the eastern part of Mediterranean region; Med = Mediterranean: species which are found around the Mediterranean; Eur = European: species found in various countries of Europe.

Anatomical acronyms: AG = albumen gland, AR = appendicular retractor muscle, BC = bursa copulatrix, BCD = diverticulum of bursa copulatrix, CD = copulatory duct, DBC = duct of bursa copulatrix, DE = distal epiphallus, E = epiphallus, F = flagellum, FO = free oviduct, G = penial papilla, GA = genital atrium, HD = hermaphrodite duct, O = ovotestis, OV = ovispermiduct, P = penis, PA = penial appendix, PC = penial caecum, PD = penial diverticulum, PDP = penial diverticulum pleat, PE = proximal epiphallus, PR = penial retractor muscle, T = talon, V = vagina, VD = vas deferens, VP = V-shaped pleat. Conchological acronyms: CL = columellar lamella, L = lunella, LPP = lower palatal plica (basal plica), PL = parietal lamella, PP = principal plica, PUPP = posterior upper palatal plica, SCL = subcolumellar lamella, SL = spiral lamella.

## RESULTS

The catalog lists the bibliographical references, including incorrect determinations; notes on distribution, biology, morphology and taxonomy are also given.

## SYSTEMATICS

Phylum MOLLUSCA Cuvier, 1795  
 Classis GASTROPODA Cuvier, 1795  
 Infraclassis PULMONATA Cuvier in Blainville, 1814  
 Ordo STYLOMMATOPHORA A. Schmidt, 1855  
 Familia ORCULIDAE Pilsbry, 1918  
 Genus *Orculella* Steenberg, 1983

*Orculella critica* (L. Pfeiffer, 1856)

*Pupa (Orcula) scyphus* - Von Martens, 1889: 200 - Chalki

*Orculella critica* - Gittenberger & Hausdorf, 2004: 119–120 - Chalki islet

DISTRIBUTION AND BIOLOGY. Greek and Aegean distribution, reported by Hausdorf (1996) also for two west coast localities in Turkey. *Orculella critica* occurs in plant litter at the base of stones and rocks in rocky limestone habitats.

REMARKS. *Orculella critica* was reported by Von Martens (1889, sub *O. scypus*) and Gittenberger & Hausdorf (2004) on Chalki Island, while we were unable to find specimens and shells. The populations of Chalki are characterized by comparatively large, especially broad, shells (height 6.2–7.6 mm; width 2.6–2.9 mm) than those from Peloponnese, with a parietalis still high at the ventral side, a prominent subangularis and a columellaris very high in left lateral position inside the body-whorl (Gittenberger & Hausdorf, 2004).

Familia PLEURODISCIDAE Wenz, 1923  
Genus *Pleurodiscus* Wenz, 1923

*Pleurodiscus balmei* (Potiez et Michaud, 1835)

EXAMINED MATERIAL. Chalki, Chorio, 01.VIII.2014, 36°13'13"N-27°35'07"E, 268 m a.s.l., 1 shell.

DISTRIBUTION AND BIOLOGY. Species with fragmentary East Mediterranean distribution, perhaps, partly due to passive dispersal. This xeroreistant species inhabits open environments, but it is frequent also in ruderal habitats.

REMARKS. *Pleurodiscus balmei* is known for Rhodes (Paget, 1976; Maassen, 1981) and we have found a shell on Chalki, among the ruins of the uninhabited houses of Chorio (Fig. 5).

Familia ENIDAE B.B. Woodward, 1903 (1880)  
Genus *Mastus* Beck, 1837

*Mastus emarginatus turgidus* (Kobelt, 1877)

*Bulimus (Mastus) carneolus* - Von Martens, 1889: 199 - Chalki

*Mastus (Mastus) pupa turgidus* - Fuchs & Käufel, 1936: 561 - Charki

EXAMINED MATERIAL. Alimia, 09.VIII.2014, 36°16'5"N-27°42'12"E, 31 a.s.l., 1 shell.

DISTRIBUTION AND BIOLOGY. Endemic species of the southern islands of the Dodecanese: Rhodes, Chalki, Karpathos, Saria, Kasos, Armathia (Fuks & Käufel, 1936; Gambetta, 1929). It occurs in open shrubland habitats, under stones.

REMARKS. We have sampled only a shell on the islet of Alimia (Fig. 6). *Mastus turgidus* is a species recognizable for its small shell with globular aspect, mouth square-shaped with reflexed peristome, weak parietal callus and a tubercle in the upper, right corner.

*Mastus* sp.

EXAMINED MATERIAL. Chalki, Xerokambos, 07.VIII.2014, 36°13'23"N-27°32'30"E, 401 a.s.l., 2 shells.

REMARKS. Two shells of a second species of *Mastus* were sampled by us at Xerokambos, Chalki (Fig. 7). They are elongate-ovoid, with a spire of 7 whorls, apical whorls convex, the lower ones more flattened; the surface is covered with irregular fine growth lines; sutures shallow; umbilicus open, small; thick palatal callus; a conspicuous angular denticle present; peristome slightly reflected. Dimensions: height 14.7 and 16.6 mm, diameter 6.5 and 6.6 mm.

It is similar to *M. cretensis* (L. Pfeiffer, 1846) from the island of Crete, having slender shell, with 7 whorls and irregular growth lines, but a definitive specific identification is impossible, due to the lack of specimens for genital dissection.

Genus *Rhabdoena* Kobelt et Möllendorff, 1902

*Rhabdoena cosensis* (Reeve, 1849)

*Zebrina (Rhabdoena) cosensis* (Reeve, 1849) - Bank & Menkhorst, 1992: 127–133, Fig. 37 - Insel Chalchi

EXAMINED MATERIAL. Chalki, Chorio, 01.VIII.2014, 36°13'13"N-27°35'07"E, 268 a.s.l., 1 moll., 1 shell.

DISTRIBUTION AND BIOLOGY. Aegean distribution: West Turkey and East Aegean Islands from Lésvos to Rhodes. *Rhabdoena cosensis* occurs on shaded, limestone walls with low vegetation. It seems to be obligate rock dwellers snail.

REMARKS. The shells (Fig. 8) and the examined

genital apparatus correspond fairly well to the description and drawings of Bank & Menkhorst (1992). The genitalia show only one retractor, which inserts in the branching point of the appendix from the penis, the caecum rises from the central part of the epiphallus and the central part of the penial appendix is relatively short (Fig. 9). The examination of the inner structure of the penis shows the walls with very low folds and a very short and slightly conical penial papilla (Fig. 10).

Genus *Zebrina* Held, 1837

***Zebrina fasciolata*** (Olivier, 1801)

EXAMINED MATERIAL. Chalki, Kania, 31.VIII.2014, 36°14'02"N-27°37'05"E, 48 a.s.l., 4 moll.

DESCRIPTION. Shell (Figs. 11, 12) dextral, ovoidal-oblong; spire with 7 slightly convex whorls; sutures shallow; umbilicus closed; blunt apex, white-yellowish in colour; teleoconch white or white yellowish, with longitudinal brown bands (one specimen without bands), on external surface microsculpture of fine longitudinal lines which disappear at the intersection with spiral lines; aperture oblique, semi-ovate with brown palatus; peristome interrupted, whitish, basal and palatal margin not or just reflected. Dimensions: height 18.4 mm (15.8–24.2), diameter 8.1 mm (6.3–12.7).

Genitalia (Figs. 13–17) (four specimens examined), characterized by: short vagina (2.27 mm); slightly longer copulatory duct (2.64 mm), ending in a branched bursa copulatrix complex: one branch consists of a long diverticulum of bursa copulatrix (7.2 mm), the other of a thin duct of the bursa copulatrix (2.55 mm) and oval bursa copulatrix (1.6 mm); penial complex consists of penis, penial appendix, epiphallus, and flagellum; penis cylindrical (2.8 mm); the penial appendix very long, it branches off from the proximal end of the penis and consists of three sections: first section short (2 mm), wide, cylindrical with a slightly constriction in its distal end; second section (1.9 mm) thinner, it widens slightly in its distal end; third section very long (7.7 mm), slender, slightly wider in its distal end; epiphallus cylindrical (3.83 mm), in its apex there are a rounded penial caecum and a short, conical flagellum; vas deferens enters laterally on the apex of epiphallus; there are two retractor muscles: a penial retractor

and an appendicular-retractor, which join shortly before the attach to the diaphragm. Spermatophore (Fig. 16) glossy, golden, with conical and amply curved anterior portion, central portion regularly tubular, posterior portion double S-shaped with a hook and some spiral ridges, posterior apex conical. The spermatophore was found with the anterior portion inside the diverticulum of the bursa copulatrix, the hook at the branch of the duct of the bursa copulatrix and the posterior portion inside the copulatory duct.

DISTRIBUTION AND BIOLOGY. *Zebrina fasciolata* has NE-Mediterranean chorotype and it is widespread from Greece (Rhodes, Megalo Zafrano), Cyprus, S-Turkey (from Izmir eastwards) to Syria and Palestine. This species lives usually in dry shrublands, and it is met under stones.

REMARKS. In this paper, we report for the first time the presence of *Zebrina* on Chalki Island and this allowed us to make some taxonomic observations. *Zebrina fasciolata* varies in shape, size and coloration of the shell and are known different taxonomic interpretations also for the structure of the genitalia. The genital apparatus was studied by Gambetta (1929, 96–98, figs. 21) after specimens from Rhodes, Hesse (1933, 183–185, figs. 22 A, D) after specimens from Rhodes and Aleppo, Fuchs & Käufel (1936, 573–576, figs. 13–15) after specimens from Rhodes and Tartus, Maassen (1981, 28, Pl. 14, fig. 61) and Bank & Menkhorst (1992, 122–126, figs. 30, 31, 34, 35) after specimens from Rhodes. From their descriptions *Z. fasciolata* from Rhodes includes two well characterized forms. In the typical form the penial appendix branches off from the proximal end of the penis; there are two retractor muscles: a penial retractor and an appendicular-retractor, which join shortly before the attach to the diaphragm. In the second form the appendix stems from the distal end of the penis; there is only the penial-retractor and the proximal part of the appendix is very short.

Gambetta (1929) was the first author to identify the second form as a distinct taxon and she names it *Z. fasciolata candida* (L. Pfeiffer, 1848), although the description and the illustration are unclear. Hesse (1933) and Fuchs & Käufel (1936) note that the variation in the reproductive system of the two forms is not related to the variation in shell pattern and all others the above-mentioned authors consider

*fasciolata* a species with extremely variable genitalia structure (see also Heller, 1976; Maassen, 1981). However Paget (1976) considered *candida* a valid subspecies.

Four of the five specimens of *Zebrina* we had the opportunity to examine, belong to the typical *Z. fasciolata*, the fifth one, without bands on the shell, with the genital structure like that of *candida*. We have examined for the first time the internal structure of the penis and epiphallus. Both forms have the inner walls of the penis covered with large papillae and those of epiphallus with small papillae, plus some short folds originating from the apex of epiphallus (Figs. 14, 17, 21). However, *Z. fasciolata* has at the point of transition from epiphallus into the penis a conical penial papilla covered with very small tubercles (Figs. 14, 17), while our specimen of *Z. candida* has no penial papilla (Fig. 21).

Despite the few specimens observed, these new data, combined with the already known literature and the presence of two different sympatric populations in the same locality allow us to consider *Z. fasciolata* and *Z. candida* two distinct species.

### *Zebrina candida* (Westerlund, 1887)

EXAMINED MATERIAL. Chalki, Kania, 31.VIII.2014, 36°14'02"N-27°37'05"E, 48 m a.s.l., 1 moll.

DESCRIPTION. Shell (Fig. 18) very similar to that of the previous species, but white in colour, without bands.

Genitalia (Figs. 19, 21) (Gambetta (1929, 96–98), Hesse (1933, 183–185, figs. 22 B, C), Fuchs & Käufel (1936, 573–576, figs. 16, 17), Maassen (1981, 28, Pl. 14, fig. 62), Bank & Menkhorst (1992, 122–126, figs. 32, 33), characterized by: a penial appendix which stems from the distal end of the penis; the proximal part of the appendix very short (0.47 mm) and only a penial-retractor (appendicular retractor absent); penial papilla absent.

Spermatophore (Fig. 20) very similar to that of the previous species, only slightly smaller.

DISTRIBUTION AND BIOLOGY. At present *Z. candida* is known from Rhodes Island and Chalki Island, where it lives in sympatry with *Z. fasciolata*.

REMARKS. Many names were published by past authors for *Z. fasciolata*: *Bulimus fasciolatus* var.

*maior* Charpentier, 1847, locus typicus “*In Syrein, zumal zwischen Latakieh und Tripolis*”; *Bulimus hebraicus* L. Pfeiffer, 1854, without locus typicus, later used by Forcart (1940) for populations of *Z. fasciolata* of Turkey; *Bulimus fasciolatus* var. *piochardi* Heynemann, 1870; locus typicus “*Cypern*” [= Cyprus]; *Bulimus calverti* Bourguignat, 1876, locus typicus “*Ile de Rhodes*”; *Bulimus fasciolatus* forma *gracilis* Westerlund, 1887, locus typicus: Insel Rhodos (see Bank & Menkhorst, 1992); *Bulimus fasciolatus* forma *candidus* Westerlund, 1887, without locus typicus.

Gambetta (1929) was the first author to attribute the name *candida* Pfeiffer, 1848 to a *Zebrina* from Rhodes with white shell, characterized by a structure of the genitalia different from that of the typical *Z. fasciolata*. Subsequent authors have always used the name *candida* in the sense attributed by Gambetta (1929), both those who considered it a valid species (Paget, 1976) and the authors who have considered *candida* a synonym of *fasciolata* (Hesse, 1933; Fuchs & Käufel, 1936; Maassen, 1981; Bank & Menkhorst, 1992; Heller, 1976).

However it must be specified that Pfeiffer (1848) did not published a valid description of *candida*, since he used the word “*candidus*” as an adjective in the description of a variety “*β unicolor candidus*”. Westerlund (1887) was the first author to publish a valid description of *candida*: “*candidus* Pfr., *Einfarben weiss*”. From the context of the work of Westerlund (1887) it is also clear that the name hasn't infrasubspecific rank, because the author uses the word “*form*” (Art. 45.6.4. ICZN, 1999).

Familia SUBULINIDAE P. Fischer & Crosse, 1877  
Subfamilia RUMININAE Wenz, 1923  
Genus *Rumina* Risso, 1826

### *Rumina* cf. *saharica* Pallary, 1901

*Rumina decollata gracilis* - Gambetta, 1929: 94 - Calchi

EXAMINED MATERIAL. Alimia, 12.VIII.2014, 36°16'5"N-27°42'12"E, 31 m a.s.l., 3 shells.

Chalki, Kania, 31.VIII.2014, 36°14'02"N-27°37'05"E, 48 m a.s.l., 1 shell.

DISTRIBUTION AND BIOLOGY. East Mediterranean distribution. It often occurs in dry and open habitats

under stones or hidden in the soil, but also in shady habitats between plants and plant debris, and cultivated areas.

REMARKS. *Rumina saharica* is characterized by a shell decollate (in adult specimens), slender, sub-cylindrical (Fig. 22); animal whitish; genitalia with vagina internally decorated with longitudinal, not crenulate pleats (crenulate pleats in *R. decollata*) and penis internally with some sparsely distributed papillae towards the proximal end (abundant, prominent papillae in *R. decollata*). Prévot et al. (2013) based on a phylogenetic study of mtDNA and ITS sequence data, support the species level status of *R. saharica* and suggest that at least six clades in *R. decollata* s.l. are putative species: the dark (clade A) and light (clade E) color phenotypes from France and Spain, three North African species (clades B, C and D), and an Italian-Croatian species (Clade F). These putative species need further corroboration by an integrative taxonomic approach, combined with a more comprehensive geographic sampling. Clades A and E are also present in northern Africa, so this region shows a high degree of genetic and also morphological differentiation (Bourguignat, 1864).

Prévot et al. (2013) use the name “*saharica*” for the species widespread in the Eastern Mediterranean, but “*saharica*” was described by Pallary (1901) for populations from Algeria (locus typicus: *Dans les alluvions del’oued Keroua, près d’El Abiod Sidi cheikh et del’oued Sefra. Dans celles de l’oued Djelfa et del’O. Seguen*), therefore further molecular and morphological analysis are necessary to ascertain the conspecificity of the populations from eastern mediterranean region with the topotypical *R. saharica* from Algeria. For these reasons we prefer to name the *Rumina* from Chalki and Alimnia *R. cf. saharica*.

Familia CLAUSILIIDAE J.E. Gray, 1855  
Subfamilia ALOPIINAE A.J. Wagner, 1913  
Tribus MEDORINII H. Nordsieck, 1997  
Genus *Albinaria* Vest, 1867  
Subgenus *Albinaria* Vest, 1867

***Albinaria (Albinaria) brevicollis chalcidensis***  
(O. Boettger, 1889)

*Clausilia (Albinaria) brevicollis* - Von Martens,  
1889: 200 - Chalki

*Clausilia brevicollis* var. *chalcidensis* - O. Boettger,  
1889: 38 - insel Chalki

*Clausilia brevicollis* var. *chalcidensis* - Westerlund,  
1890: 61 - ins. Chalki

*Clausilia brevicollis* var. *chalcidensis* - Westerlund,  
1901: 43 - I. Chalki

*Albinaria (Albinaria) brevicollis chalcidensis* -  
Fuchs & Käufel, 1936: 591 - Charki

*Albinaria (Albinaria) brevicollis chalcidensis* - K.L.  
Pfeiffer, 1955: 127-128, Pl 9, fig. 16 - Chalchi  
an dem aus Kreidekalkfels

*Albinaria brevicollis chalcidensis* - Zilch, 1977: 326  
- Insel Calchi

*Albinaria brevicollis chalcidensis* - Nordsieck,  
2007: 45

EXAMINED MATERIAL. Chalki, Chorio, 01.VIII.2014,  
36°13'13"N-27°35'07"E, 268 m a.s.l., 14 shells, 5  
moll.; Chalki, Ag. Ghiorgos, 03.VIII.2014,  
36°14'21"N-27°34'43"E, 108 m a.s.l., 8 shells;  
Chalki, Plaghia, 03.VIII.2014, 36°13'38"N-  
27°34'45"E, 423 m a.s.l., 3 moll., 8 shells; Chalki,  
Areta, 04.VIII.2014, 36°14'43"N-27°35'58"E, 95  
m a.s.l., 3 moll., 11 shells; Chalki, Imborios,  
30.VII.2014, 36°13'23"N-27°36'45"E, 22 m a.s.l.,  
2 shells; Chalki, Xerokambos, 07.VIII.2014,  
36°13'23"N-27°32'30"E, 401 m a.s.l., 8 shells;  
Chalki, Pefkia, 02.VIII.2014, 36°14'15"N-  
27°36'53"E, 125 m a.s.l., 6 shells.

Type series. Lectotypus SMF 58307; Paratypes:  
SMF 58308/4, 58309/4 Sif. Moellendorff, 58310/6  
Sif. Naegel, 93464/5 Sif. O. Boettger.

Type locality. Greece: Chalki Islands, west of  
Rhodes Island.

DESCRIPTION. Shell (Figs. 23, 24) sinistral, fusi-  
form, slender; spire with 10–11.5 whorls, last whorl  
tapering downwards; apex usually black, the others  
whorls white-bluish with dark spots; sutures moder-  
ately deep; umbilicus closed; apical whorls (1.5)  
smooth, the following striated or smooth, last whorl  
ribbed, but in its first half the ribs start from the base  
and do not reach the suture, then gradually lengthen  
until reaching the suture; cervix with short basal  
and dorsal keels, dorsal as high as basal keel or  
slightly higher; aperture oval, inside brown-orange,  
peristome continuous, detached, thickened, slightly  
reflected. Inside aperture there are 3 plicae and  
lunella (on palatum) and 4 lamellae (on parietum  
and columellar side). On palatum starting from  
suture there are: a long and raised principal plica,  
slightly wider in its posterior portion; short posterior



upper palatal plica fused to lunella apex; lunella dorso-lateral, wider to its base; a rudiment basal plica present and fused to the base of lunella (Figs. 25, 26). On parietum starting from suture there are: non emerged spiral lamella in the centre of parietum, more raised in its posterior portion; (upper) parietal lamella reaching spiral lamella; low columellar lamella; non emergent subcolumellar lamella (Figs. 27, 28). Clausilium plugh-like, basal plate entire, subrectangular, sutural angle slightly bent up (Figs. 29, 30). Dimensions (16 shells measured): height 16.2 mm (14–18.1), diameter 3.83 mm (3.7–4.07).

Body. Animal narrow, posteriorly pointed, white grayish in color with darker tubercles, sole white grayish.

Genitalia. (Fig. 31) (4 specimens examined) are characterized by: variably long vagina (2–4.1 mm); short free oviduct and copulatory duct (1.6 mm), the last ending in a branched bursa copulatrix complex: one branch consists of a long diverticulum of bursa copulatrix (4.4 mm), the other of a very short duct of bursa copulatrix (1.3 mm) and oval bursa copulatrix. Penial complex consists of epiphallus, penial diverticulum and penis; epiphallus (3.4 mm) divided, by point insertion of penial retractor muscle, into proximal portion and very short distal portion; penis cylindrical (2.4 mm) and wider than epiphallus, large penial diverticulum (long and wide as much as the penis) arising on border between distal epiphallus and penis. Internal walls of penis with a V-shaped pleat; internal walls of penial diverticulum with some longitudinal pleats, one of which surrounds the opening of the epiphallus into the penis (Figs. 32, 33); penial retractor muscle simple, only a specimen has penial retractor divided into two branches shortly before the attachment on epiphallus.

DISTRIBUTION AND BIOLOGY. *Albinaria brevicollis chalcidensis* is endemic of Chalki Islands. It lives on rocky limestone outcrops and it is widespread and common all over Chalki.

REMARKS. *Albinaria brevicollis* s.l. is spreading in the Dodecanese Islands (Greece) and Resadiye peninsula (Turkey), with sixteen subspecies (Bank, 2011; Nordsieck, 2013). For Chalki Island Boettger (1889) described the subspecies *chalcidensis* based only on exterior shell characters. Westerlund (1890, 1901) redescribes the shell. Fuchs & Käufel (1936) describe and illustrate the genitalia of four subspecies: *brevicollis* (sub *rhodia* Pollonera, 1916), *astropalia* (O. Boettger, 1883), *casia* (O. Boettger, 1883),

and *superba* (O. Boettger, 1889) (sub *atavirensis* Pollonera, 1916). They show a substantial uniformity in the genital structure of these subspecies, but also a differentiation in the form of penial diverticulum. Pfeiffer (1955) revises the whole *brevicollis* group and describes the variability of the genitalia of *Albinaria brevicollis unio* (O. Boettger, 1883).

The structure of the genitalia of *Albinaria brevicollis chalcidensis* is similar to those of the other subspecies illustrated by Fuchs & Käufel (1936) and by Pfeiffer (1955). *Albinaria brevicollis chalcidensis* appears different for the larger size of the penial diverticulum with cylindrical shape and rounded apex. The subspecies *astropalia*, *casia* and *unio* have a diverticulum significantly smaller, while *Albinaria brevicollis brevicollis* and the subspecies *superba* have the diverticulum proportionately shorter compared to the penis, in addition *Albinaria brevicollis superba* also differs for the pointed tip. Also the recent molecular data of Douris et al. (2007) confirm a substantial genetic differentiation between the *Albinaria* of Chalki and other subspecies of *A. brevicollis*.

Gambetta (1929) reports for Chalki only *Clausilia (Albinaria) unicolor* Boettger, but this species later has not been confirmed on the island.

***Albinaria (Albinaria) brevicollis superba*** (O. Boettger, 1889)

*Albinaria (Albinaria) brevicollis superba* - K.L. Pfeiffer, 1955: 117–120, Pl. 8, f. 8. - insel Alinnia  
*Albinaria brevicollis superba* - Paget, 1976: 761, 762 - Insel Alinnia

EXAMINED MATERIAL. Alimia, 09.VIII.2014, 36°16'5''N-27°42'12''E, 31 m a.s.l., 12 shells.

DISTRIBUTION AND BIOLOGY. *Albinaria brevicollis superba* is endemic of Rhodes Island and the islet of Alimia. It lives on rocky limestone outcrops.

REMARKS. Boettger (1889) describes *C. brevicollis* var. *superba* for Rhodes near Kastello village, characterized by shell larger than typical *brevicollis*, lower lamella more developed and weaker or obsolete ribs on the median whorls. Pfeiffer (1955) examines both the type series of *superba*, and other specimens collected by himself on the Mountain Prophet Elias near Kastello (Rhodes). He considers *superba* a subspecies with larger dimensions, with lower lamella more perpendicular to the edge of the opening, but with vari-

able keel and rib. Pfeiffer (1955) reports *superba* for the first time on the islet of Alinnia (Alimia) with shells entirely ribbed, with dorsal keel and without black spots on the surface. Paget (1976) also considers *superba* a valid subspecies and he proposes the taxon *atavirensis* as synonym.

The shells examined in this study well correspond to Pfeiffer's description in size, ribs, keels, and lamellae (Figs. 34–36). Dimensions (7 shells measured): height 16.2 mm (17.2–14.5), diameter 3.4 mm (3.25–3.65); 11 ribs per 2 mm of the penultimate whorl. Whorls with some dark spots on the surface of shell. Clausilium plugh-like, basal plate entire, subrectangular, with rounded distal edge (Fig. 37).

Pfeiffer (1955) reports a population of *Albinaria brevicollis brevicollis* on the ruins of the small castle of Alimia, but we have not sampled this population.

Subgenus *Mirabellina* O. Boettger, 1878

*Albinaria (Mirabellina) teres nordsiecki* Zilch, 1977

*Clausilia teres* var. *extensa* - O. Boettger, 1889: 46–47 - insel Chalki

*Clausilia teres* var. *extensa* - Von Martens, 1889: 200 - Chalki

*Clausilia teres* - Kobelt, 1898: 313 - insel Chalki

*Clausilia (Albinaria) teres* var. *extensa* - Gambetta 1929: 101, 113 - Calchi

*Albinaria teres nordsiecki* - Nordsieck, 2013: 5 - Chalki Island

EXAMINED MATERIAL. Chalki, Zies, near the church Aghias Kiriakis, 05.VIII.2014, 36°13'39"N -27°36'57"E, 54 m a.s.l., 3 shells, 6 moll.

DESCRIPTION. Shell (Figs. 38, 39) sinistral, fusiform, spire with 11 whorls, last whorl tapering downwards, apex black and smooth, the other whorls whitish, ribbed, 6/7 ribs per 2 mm of the penultimate whorl, with fine lines between the ribs; cervix more coarsely ribbed than the upper whorls, basal keel visible, dorsal keel obsolete; umbilicus closed; aperture oval, peristome continuous, detached, slightly reflected. Inside aperture there are 2 plicae and lunella (on palatum) and 4 lamellae (on parietum and columellar side). On palatum starting from suture there are a long and raised principal plica, slightly wider in its posterior portion; short posterior upper palatal plica fused to lunella apex; lunella obsolete in its apical por-

tion, absent in its basal portion (Figs. 40, 41); on parietum starting from suture there are: non emerged spiral lamella in the centre of parietum; (upper) parietal lamella very short and toothlike, low columellar lamella; non emerged subcolumellar lamella (Figs. 42, 43). Clausilium plugh-like, basal plate entire with slightly curved palatal edge (Figs. 44, 45).

Dimensions (7 shells measured): height 17.4 mm (17–18.1), diameter 3.9 mm (3.86–4).

Genitalia (Fig. 46), 3 specimens examined, consisting of large ovotestis with many close acini; long convoluted hermaphrodite duct, entering base of small talon (Fig. 49); large albumen gland; well developed ovispermiduct, copulatory duct and free oviduct of the same length (2.4–2.6 mm); copulatory duct ending in a branched bursa copulatrix complex: one branch consists of a long diverticulum of bursa copulatrix (5.7–4.1 mm), the other of a very short copulatrix duct (1.1–1.9 mm) and oval bursa copulatrix (1.2–1.9); medium long vagina (2.6–4 mm). Penial complex consists of epiphallus, penial diverticulum and penis; epiphallus (2.6–3.8 mm) divided, by point insertion of penial retractor muscle, into proximal portion and very short distal portion; penis (2.5–2.85 mm) cylindrical and wider than epiphallus, short and conical penial diverticulum (0.8–1.3 mm), arising on border between distal epiphallus and penis. Internal walls of penis with a V-shaped pleat; internal walls of penial diverticulum with a pleat, which surrounds the opening of the epiphallus into the penis (Figs. 47, 48); in two specimens the penial retractor muscle is divided into two branches shortly before the attachment on epiphallus (Figs. 46–47), in the third specimen it is undivided with large attachment on epiphallus.

DISTRIBUTION AND BIOLOGY. *Albinaria teres nordsiecki* is native of Crete Island, where it is distributed from west of Sitia to south eastern Dikti mountains and east of Ierapetra, with region of Goudouras and Koufonisi Island. It is a rock dwelling snail, usually limestone rocks.

REMARKS. The presence of *A. teres nordsiecki* on Chalki Island only nearby the church of Aghias Kiriakis (Chalki), and nowhere else in the survey area, strongly suggests that it was introduced by man from the island of Crete (O. Boettger, 1889; Nordsieck, 2013).

Familia OXYCHILIDAE P. Hesse 1927 (1879)  
Subfamilia OXYCHILINAE P. Hesse, 1927 (1879)  
Genus *Eopolita* Pollonera, 1916

***Eopolita protensa protensa*** (A. Férussac, 1832)

*Hyalina aequata* - Von Martens, 1889: 190 - Chalki  
*Retinella aequata* - Gude, 1902: 124 - Kharki  
(Chalki)

*Retinella (Eopolita) protensa protensa* - Fuchs & Käufel, 1936: 614 - Charki

EXAMINED MATERIAL. Chalki, Chorio, 01.VIII.2014,  
36°13'13"N-27°35'07"E, 268 m a.s.l., 3 shells.

DISTRIBUTION AND BIOLOGY. *Eopolita protensa* has an East Mediterranean distribution, from Aegean region to South-East Turkey, North-West Syria, Lebanon, Israel, Jordan, Libya and Cyprus. It lives under stones and in rock crevices. *Eopolita protensa* is a carnivorous snail, and feeds on earth worms and snails.

Familia MILACIDAE Ellis, 1926  
Genus *Tandonia* Lessona et Pollonera, 1882

***Tandonia cf. pageti*** (Forcart, 1972)

EXAMINED MATERIAL. Chalki, Chorio, 23.IV.2015,  
36°13'13"N, 27°35'07"E, 268 m a.s.l.

DISTRIBUTION AND BIOLOGY. *Tandonia pageti* is known from Rhodes Island and SW Turkey.

REMARKS. In external appearance it resembles a limacide for the large dimensions, the poorly arched short keel and small skin sculpture. Through the photos the color appears brownish gray with dense small yellow and brown spots.

Only two photos, and size (length approximately 8 cm) were taken of this mollusk (Fig. 50). Further researches are needed for a definitive specific identification of *T. pageti* and the following species *D. cf. samium* on the island of Chalki.

Familia AGRILIMACIDAE H. Wagner, 1935  
Subfamilia AGRILIMACINAE H. Wagner, 1935  
Genus *Deroceras* Rafinesque, 1820  
Subgenus *Deroceras* Rafinesque, 1820

***Deroceras (Deroceras) cf. samium*** Rähle, 1983

EXAMINED MATERIAL. Chalki, Imborios, 23.IV.2015,  
36°13'23"N-27°36'45"E. 22 m a.s.l..

REMARKS. For this slug, as for the previous species, were taken by us just a picture (Fig. 51) and the dimensions. The dark-gray color and the size (length approximately 40 mm) allow us to tentatively classify this slug as *D. cf. samium*, a species with wide distribution in the Dodecanese.

Familia COCHLICELLIDAE Schileyko, 1972  
Genus *Cochlicella* A. Férussac, 1821  
Subgenus *Cochlicella* A. Férussac, 1821

***Cochlicella (Cochlicella) acuta*** (O.F. Müller, 1774)

EXAMINED MATERIAL. Chalki, Imborios, 30.VII.2014,  
36°13'23"N-27°36'45"E. 22 m a.s.l., 13 shells.

DISTRIBUTION AND BIOLOGY. This Holomediteranean-Atlantic species lives on retro dune habitats and internal drier biotopes. It is a very common species, which often occurs in large aggregations on plants and in crevices of trees. Our specimens were found on the walls of old abandoned houses in Imborios.

REMARKS. The population of Chalki has small dimensions like those of Rhodes (Frank, 1997): H: 9.1 mm, D: 4 mm (Fig. 52).

Familia HYGROMIIDAE Tryon, 1866  
Subfamilia GEOMITRINAE C. Boettger, 1909  
Tribus TROCHOIDEINI H. NORDSIECK, 1987  
Genus *Xerocrassa* Monterosato, 1892  
Subgenus *Xerocrassa* Monterosato, 1892

***Xerocrassa (Xerocrassa) cretica*** (L. Pfeiffer, 1841)

*Helix (Xerophila) cretica* - Von Martens, 1889:  
196 - Insel Chalki

*Helicella (Heliomanes) cretica* - Gude, 1902:  
124 - Kharki (Chalki)

*Helicella (Xerocrassa) cretica* - Gambetta,  
1929: 92 - isola di Calchi

*Helicella (Xerocrassa) cretica cauta* - Fuchs & Käufel, 1934: 84 - Chalki

EXAMINED MATERIAL. Chalki, Xipei, 06.VIII.2014,  
36°13'11"N-27°35'37"E, 153 m a.s.l., 16 moll.  
juv.; Alimia, on limestone, 12.VIII.2014,  
36°16'5"N-27°42'12"E, 31 m a.s.l., 4 shells.

DISTRIBUTION AND BIOLOGY. Species with East Mediterranean distribution: East Greece, Ae-

gean Islands, West coast of Asia Minor, Cyprus, African coast from Egypt to Libya. It lives in every kind of habitats, from beaches to high mountains, but mainly on dry vegetation in coastal habitats.

REMARKS. A common species on Chalki Island.

Subgenus *Xeroclausa* Monterosato, 1892

*Xerocrassa (Xeroclausa) meda* (Porro, 1840)

EXAMINED MATERIAL. Chalki, Ag. Ghiorgos, 03.VIII.2014, 36°14'21''N-27°34'43''E, 108 m a.s.l., 2 shells.

DISTRIBUTION AND BIOLOGY. It is known for Malta, Sicily, southern Italy, Sardinia (Sassari) and Aegean Islands: Kos and Lesvos. It is common in anthropogenic habitat: gardens, on walls, under stones. These habitats suggest passive introduction by man.

REMARKS. Perhaps a native species of Sicily and Malta, where it lives in seminatural habitats, and probably introduced in southern Italy, Sardegna (Sassari) and Aegean Islands: Kos, Lesvos (Hausdorf & Sauer, 2009). In Chalki only two fresh death shells were sampled in seminatural habitats on the north side of the island (Fig. 53).

Subfamilia HYGROMIINAE Tryon, 1866

Tribus HYGROMIINI Tryon, 1866

Genus *Metafruticicola* Ihering, 1892

*Metafruticicola (Metafruticicola) pellitus pellitus* (A. Férussac, 1832)

*Helix (Pseudocampylaea) pellita* - Von Martens, 1889: 194 - insel Chalki

*Hygromia (Metafruticicola) pellita* - Gude, 1902: 124 - Kharki (Chalki)

*Metafruticicola (Metafruticicola) pellita graphycotera* - Fuchs & Käufel, 1934: 87 - Chalki

*Metafruticicola (Metafruticicola) pellita* - Bank et al., 2013: 70–76 - Island Chalki, surroundings Chorio; monastery Agios Johannis NW Chalki town.

EXAMINED MATERIAL. Chalki, Ag. Ghiorgos,

03.VIII.2014, 36°14'21''N-27°34'43''E. 108 m a.s.l., 1 shell.

DISTRIBUTION AND BIOLOGY. Aegean Distribution: East Crete, Cyclades, Dodecanese, Northern Sporades, Limnos and the Turkish Island of Gökceada (Bank et al., 2013).

*Metafruticicola pellitus* lives in limestone habitats.

Familia HELICIDAE Rafinesque, 1815

Subfamilia HELICINAE Rafinesque, 1815

Tribus HELICINI Rafinesque, 1815

Genus *Levantina* Kobelt, 1871

Subgenus *Levantina* Kobelt, 1871

*Levantina (Levantina) spiriplana malziana* (L. Pfeiffer, 1861)

*Helix (Iberus) spiriplana* - Von Martens, 1889: 195 - insel Chalki

*Helix (Levantina) spiriplata* - Gude, 1902: 124 - Kharki (Chalki)

*Levantina (Levantina) spiriplana* var. *carinata* - Gambetta, 1929: 64–72 - Chalchi

*Levantina spiriplana malziana* - K.L.Pfeiffer, 1949: 12–23 - Chalki, Alimia

*Levantina spiriplana malziana* - Frank, 1997: 113 - Alimía, Chalki

EXAMINED MATERIAL. Chalki, Chorio, 01.VIII.2014, 9 36°13'13''N-27°35'07''E, 268 m a.s.l., 2 shells juv; Chalki, Adramasos, VIII.2014, 36°13'32''N-27°34'48''E, 32 m a.s.l., 2 shells; Chalki, Pefkia, 02.VIII.2014, 36°14'15''N-27°36'53''E, 125 m a.s.l., 4 shells (3 juvenes).

DISTRIBUTION AND BIOLOGY. *Levantina spiriplana* s.l. has an Eastern Mediterranean distribution: Dodecanese (from Kálimnos to Rhodes and Kápathos), South-West Turkey, from Syria to Palestine and Cyprus, probably dispersed also by man. It lives mainly on rocks, but also in other habitats.

REMARKS. All the adult shells of *Levantina* collected on Chalki had closed umbilicus, therefore we classify them as subspecies *malziana* (Fig. 54), in the nominotypical subspecies the umbilicus is partially covered.

Genus *Eobania* P. Hesse, 1913

***Eobania vermiculata*** (O.F. Müller, 1774)

*Eobania vermiculata* - Gambetta, 1929: 57–64 - Calchi

*Eobania vermiculata* - Frank, 1997: 103 - Halki

EXAMINED MATERIAL. Alimia, VIII.2014, 36°16'5"N-27°42'12"E, 31 m a.s.l., 3 shells; Chalki, Adramasos, VIII.2014, 36°13'32"N-27°34'48"E, 32 m a.s.l., 3 shells.

DISTRIBUTION AND BIOLOGY. *Eobania vermiculata* has Mediterranean distribution, and lives on every island in the South Aegean (Gambetta, 1929). It occurs in a broad variety of habitats, also anthropized sites.

REMARKS. It is common on Chalki and Alimia, on the ground among the rocks, with shells characterized by thick and well reflected peristome.

Genus *Cantareus* Risso, 1826

***Cantareus apertus*** (Born, 1778)

*Helix (Pomatia) aperta* - Von Martens, 1889: 196 - Insel Chalki

*Helix (Helicogena) aperta* - Gude, 1902: 124 - Kharki (Chalki)

EXAMINED MATERIAL. Chalki, Pefkia, 02.VIII.2014, 36°14'15"N-27°36'53"E, 125 m a.s.l., 1 shell.

DISTRIBUTION AND BIOLOGY. *Cantareus apertus* has a Mediterranean distribution, from France in the west to Greece and Aegean islands in the east, and from Italy in the north to the Mediterranean Africa in the south. It is a thermophilic species more common in argillaceous and marly soils, where it estivates buried in the soil.

REMARKS. A shell was sampled up by us at Pefkia (Fig. 55) and few living specimens were observed at Imborios.

Genus *Cornu* Born, 1778

***Cornu aspersum*** (O.F. Müller, 1774)

EXAMINED MATERIAL. Chalki, Adramasos,

VIII.2014, 36°13'32"N-27°34'48"E, 32 m a.s.l., 2 shells.

DISTRIBUTION AND BIOLOGY. West European-Holomediterranean distribution, dispersed by man all over the world. *Cornu aspersum* occurs in many different kinds of biotopes, coastal retrodune, open grasslands, woods, rocky ground, anthropized sites.

REMARKS. This species is probably native of the south-western Mediterranean regions (Algeria, Tunisia, Sicily). In this area populations of *C. aspersum* from different locality show differences among the relative dimensions of some parts of the genitalia and also substantial genetic differences (Guiller & Madec, 2010; Colomba et al., 2015). Such differences point out the necessity of further taxonomic studies.

The past authors have not reported this big Helicidae for Chalki, therefore it is probably a recent introduction (Fig. 56). Few living specimens were observed at Imborios.

Genus *Helix* Linnaeus, 1758

Subgenus *Helix* Linnaeus, 1758

***Helix (Helix) pronuba*** Westerlund et Blanc, 1879

*Helix (Helix) pronuba* - Neubert, 2014: 120–126 - Chalki Island ( SMF/8, NMBE 528722/3)

DISTRIBUTION AND BIOLOGY. This species is known from Crete, Karpathos, Chalki Island, and Northern African coast, from Egypt to Tunisia (see Neubert, 2014).

Subgenus *Pelasga* Hesse, 1908

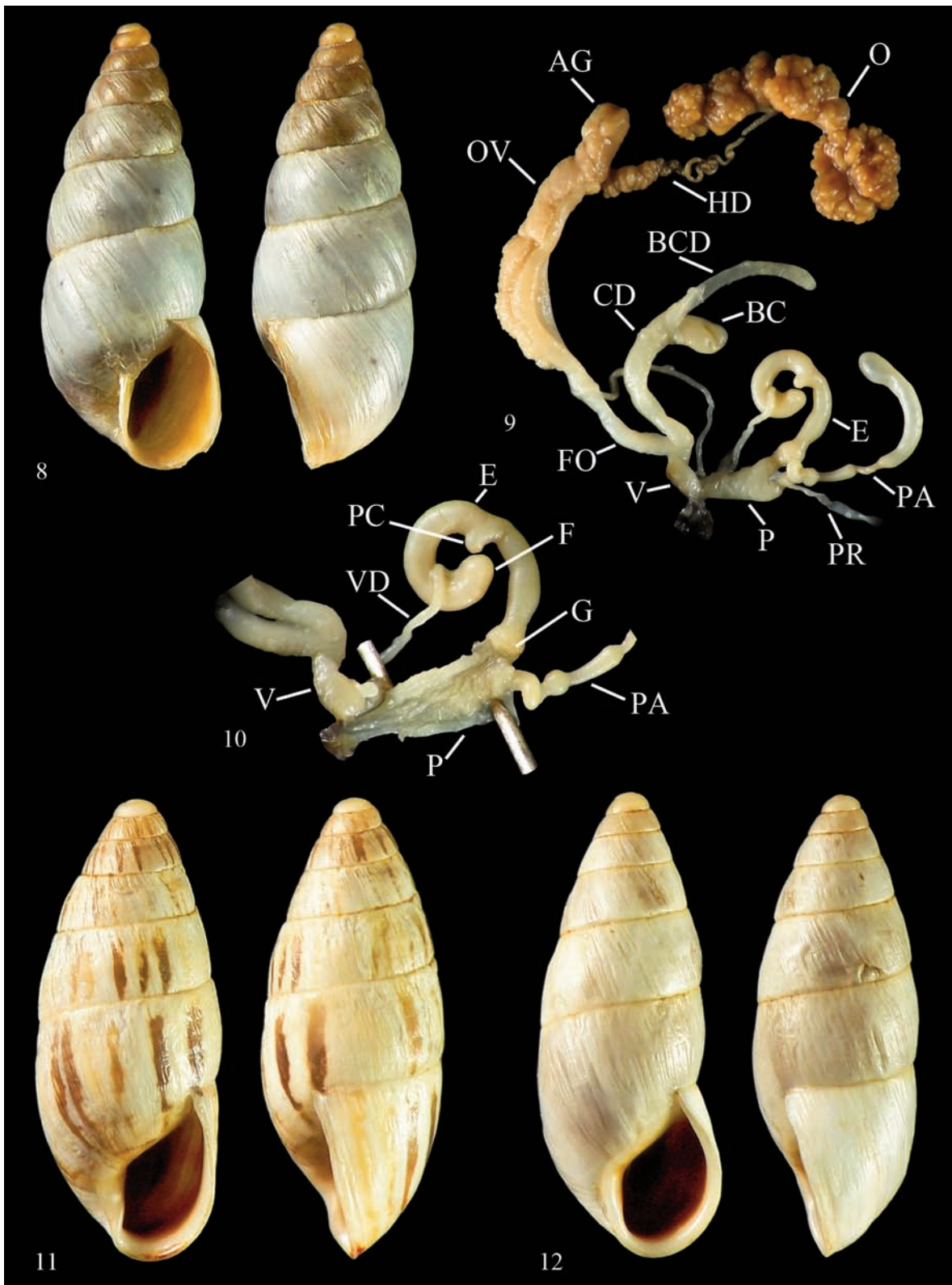
***Helix (Pelasga) nucula*** Mousson, 1854

*Helix (Pelasga) nucula* - Neubert 2014: 151-160 - Chalki, 36.2234, 27.6114, 02.06.1996

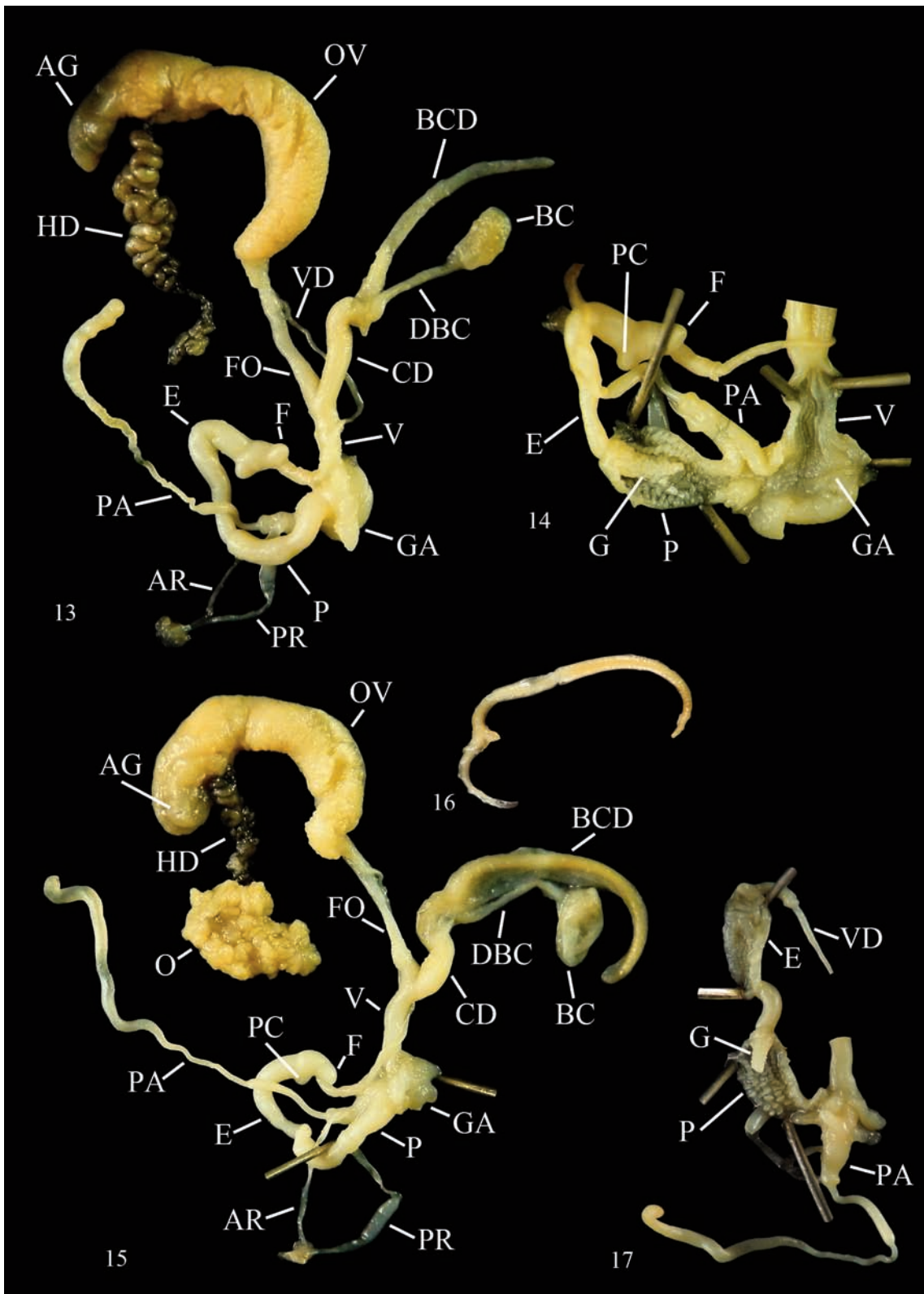
DISTRIBUTION AND BIOLOGY. East Mediterranean distribution: South-Eastern Aegean Islands, Mediterranean Turkish coast from Izmir to Manavgat, and Cyprus (Neubert, 2014). *Helix nucula* is widespread on the Aegean Islands, and Triantis et al. (2004) report it also as fossil. It is report for Chalki only by Bank (2011).



Figure 2. Coastal vegetation of the islet of Alimia. Figures 3, 4. limestone outcrops of Chalki Island. Figure 5. *Pleurodiscus balmei*, Chalki Island, Chorio, H: 4.76 mm, D: 7.9 mm. Figure 6. *Mastus emarginatus turgidus*, Alimia Islet, H: 11.33 mm, D: 5.9 mm. Figure 7. *Mastus* sp., Chalki Island, Xerokambos, H: 16.6 mm, D: 6.6 mm.

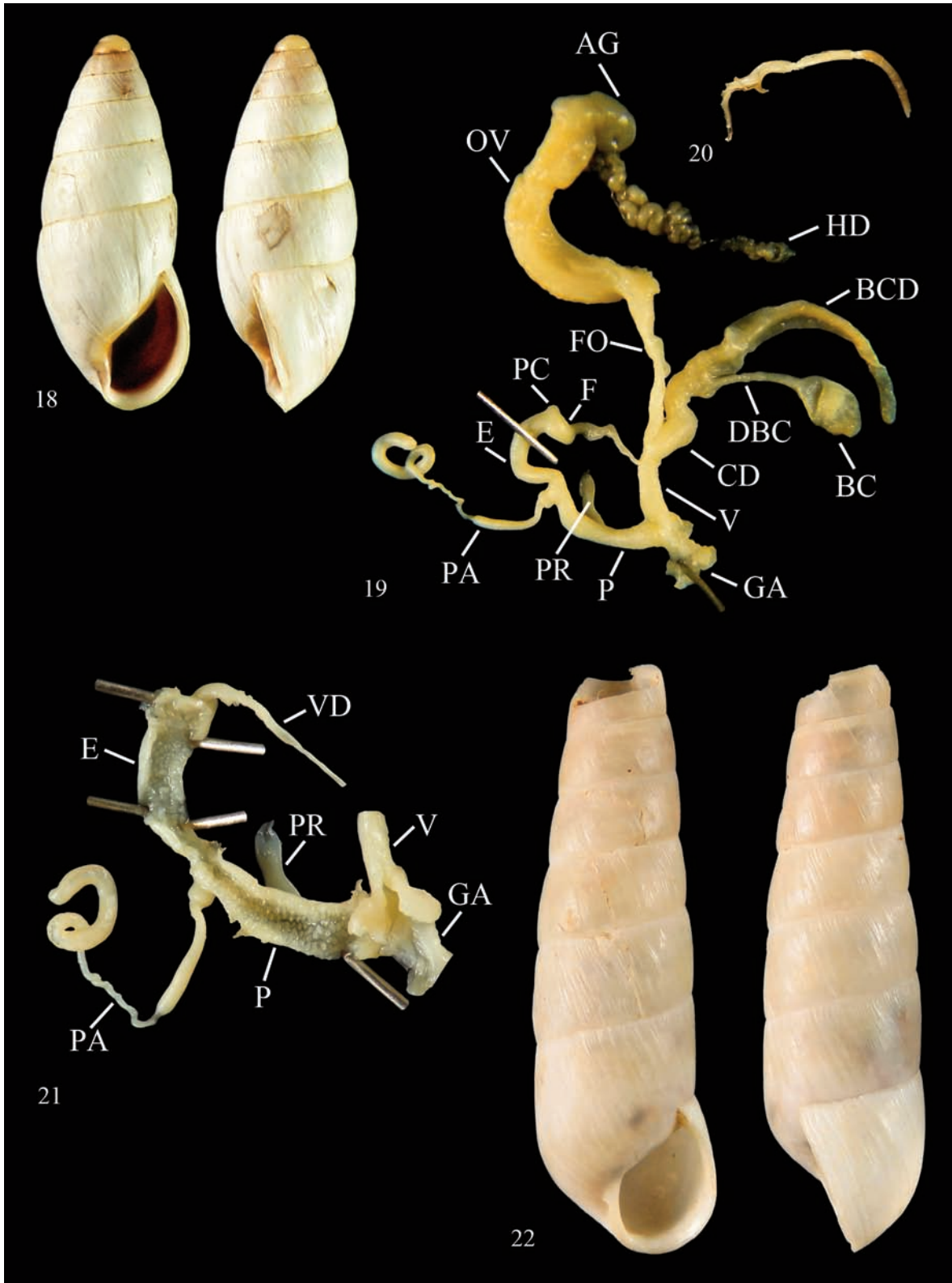


Figures 8–10. *Rhabdoena cosensis*, Greece, Dodecanese, island of Chalki, Chorio. Fig. 8: shell, H: 17.3 mm, D: 7.25 mm, Fig. 9: genitalia, Fig. 10: internal structure of penis. Figures 11, 12. *Zebrina fasciolata*, Greece, Dodecanese, island of Chalki, Kania: Fig. 11: shell, H: 15.8 mm, D: 6.32 mm. Fig. 12: shell, H: 24.2 mm, D: 12.7 mm.



Figures 13, 14. *Zebrina fasciolata*, (same specimen of figure 12), Fig. 13: genitalia, Fig. 14: internal structure of penis. Figures 15–17. *Zebrina fasciolata*, Greece, Dodecanese, island of Chalki, Kania. Fig.15: genitalia. Fig. 16: spermatophore. Fig. 17: internal structure of penis.





Figures 18–21. *Zebrina candida*, island of Chalki, Kania. Fig. 18: shell. H: 18.6 mm. D: 12.3 mm. Fig. 19: genitalia. Fig. 20: spermatophore. Fig. 21: internal structure of penis. Figure 22. *Rumina* cf. *saharica*, Greece, Dodecanese, Alimia Islet, H: 24.8 mm, D: 7.7 mm.



Figures 23, 24. *Albinaria (Albinaria) brevicollis chalcidensis*, island of Chalki, Chorio. Fig. 23: shell, H: 17 mm, D: 4 mm. Fig. 24: shell, H: 16 mm, D: 3.8 mm.

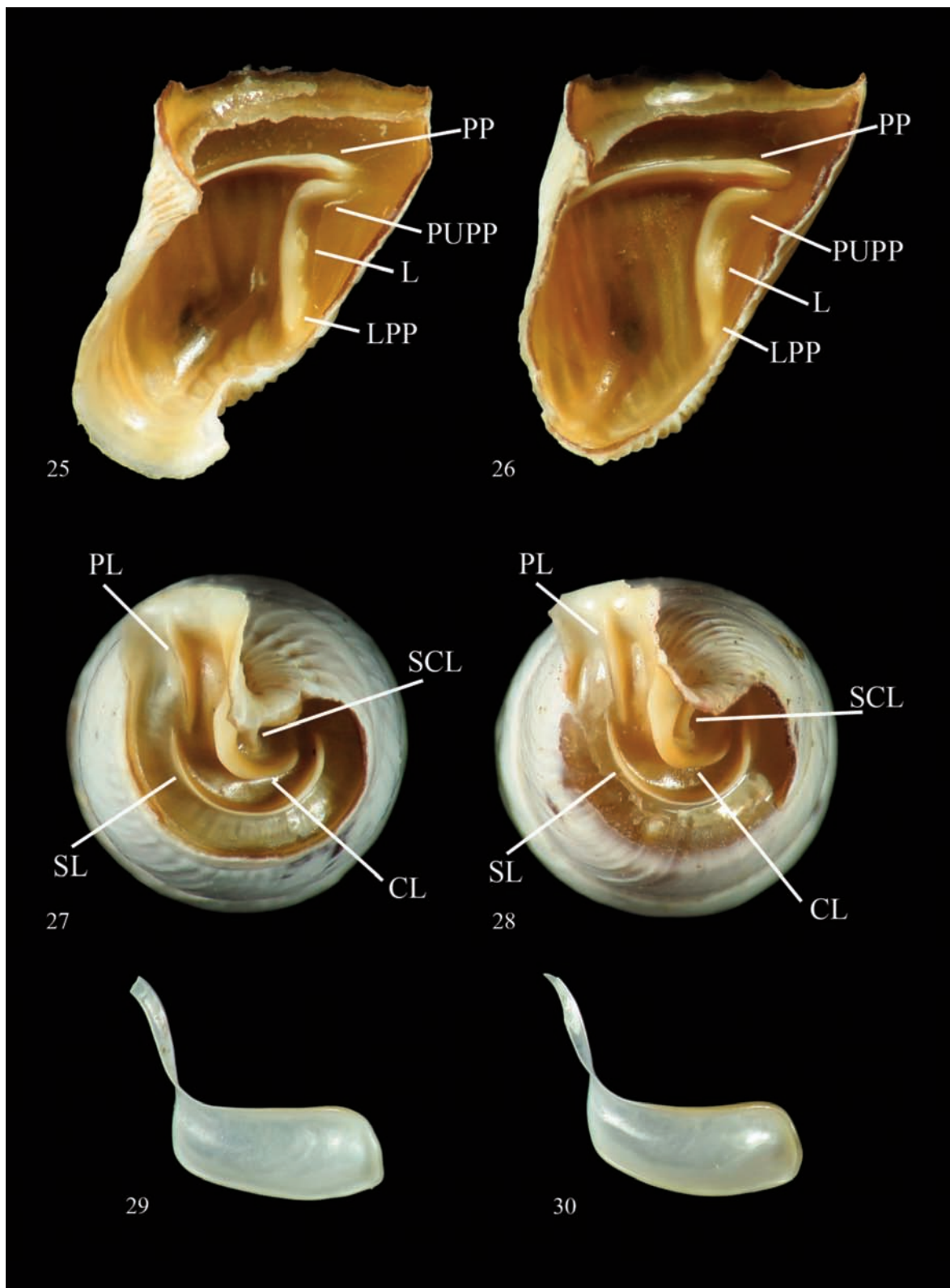
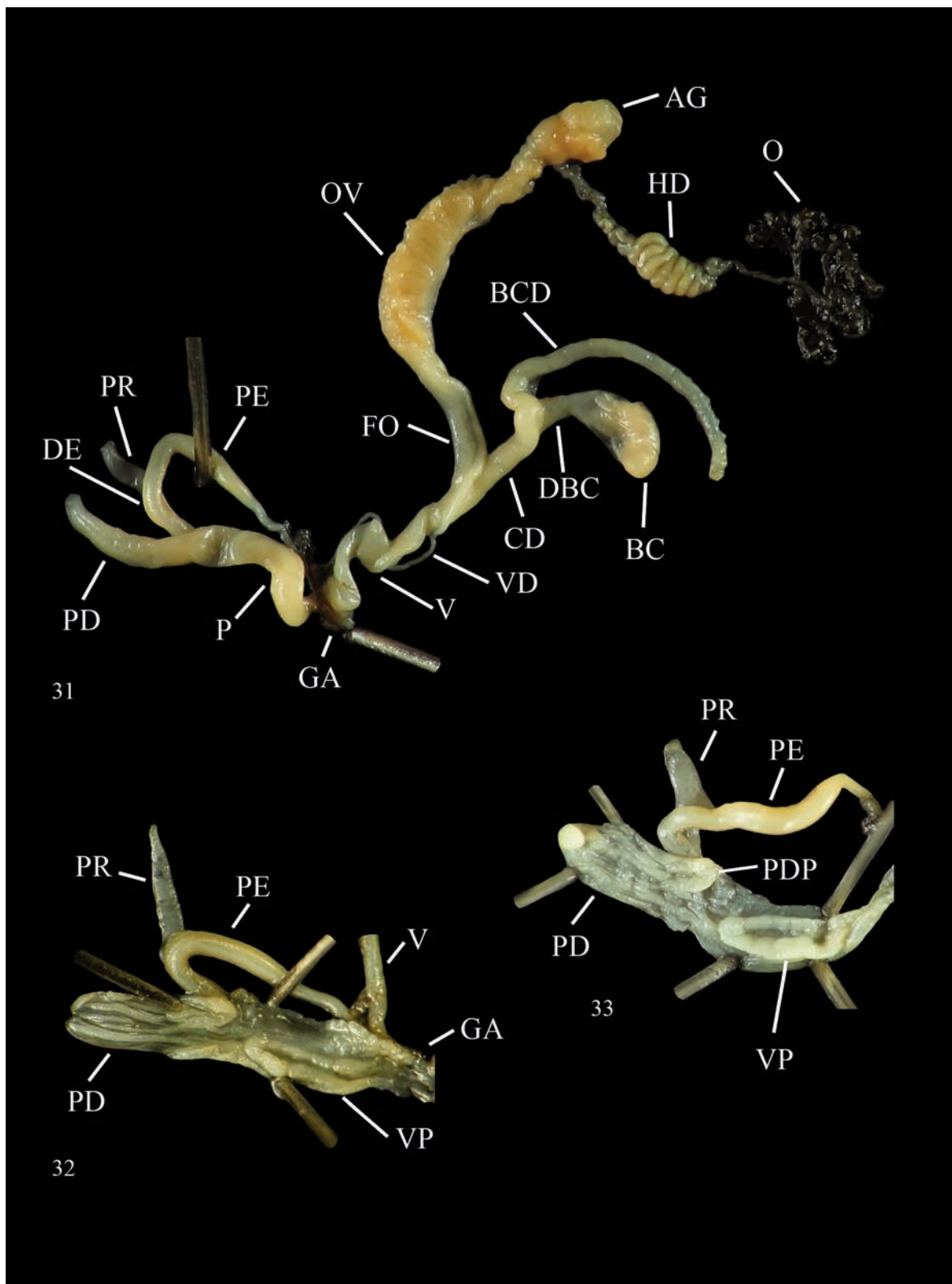


Figure 25–30. *Albinaria (Albinaria) brevicollis chalcidensis*, island of Chalki, Chorio. Figs. 25-26: palatum. Figs. 27, 28: parietum. Figs. 29, 30: clausilium.



Figures 31–33. *Albinaria (Albinaria) brevicollis chalcidensis*, island of Chalki, Fig. 31: Chorio, genitalia. Fig. 32: Plaghia, internal structure of penis. Fig. 33: Chorio, internal structure of penis.

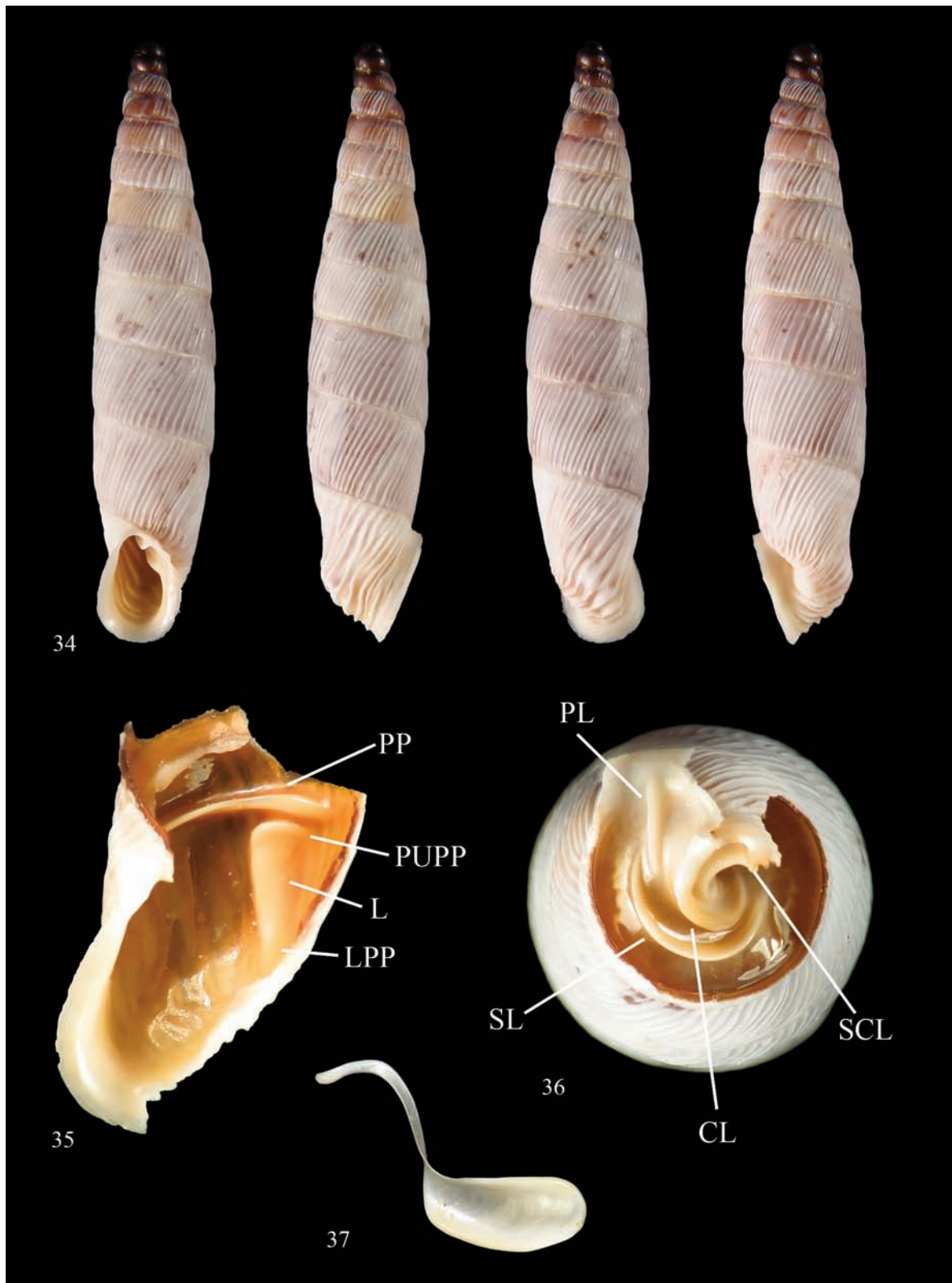
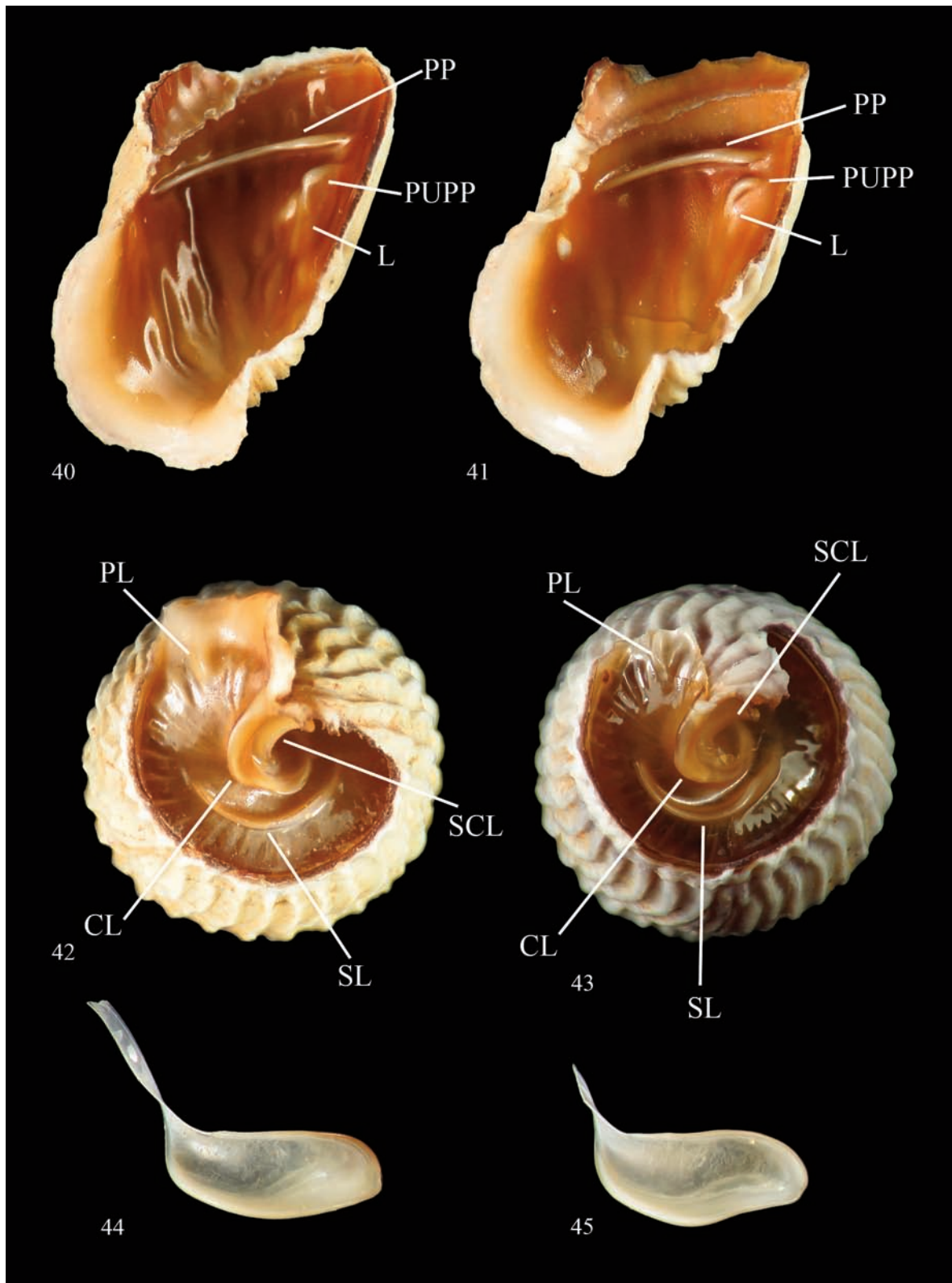


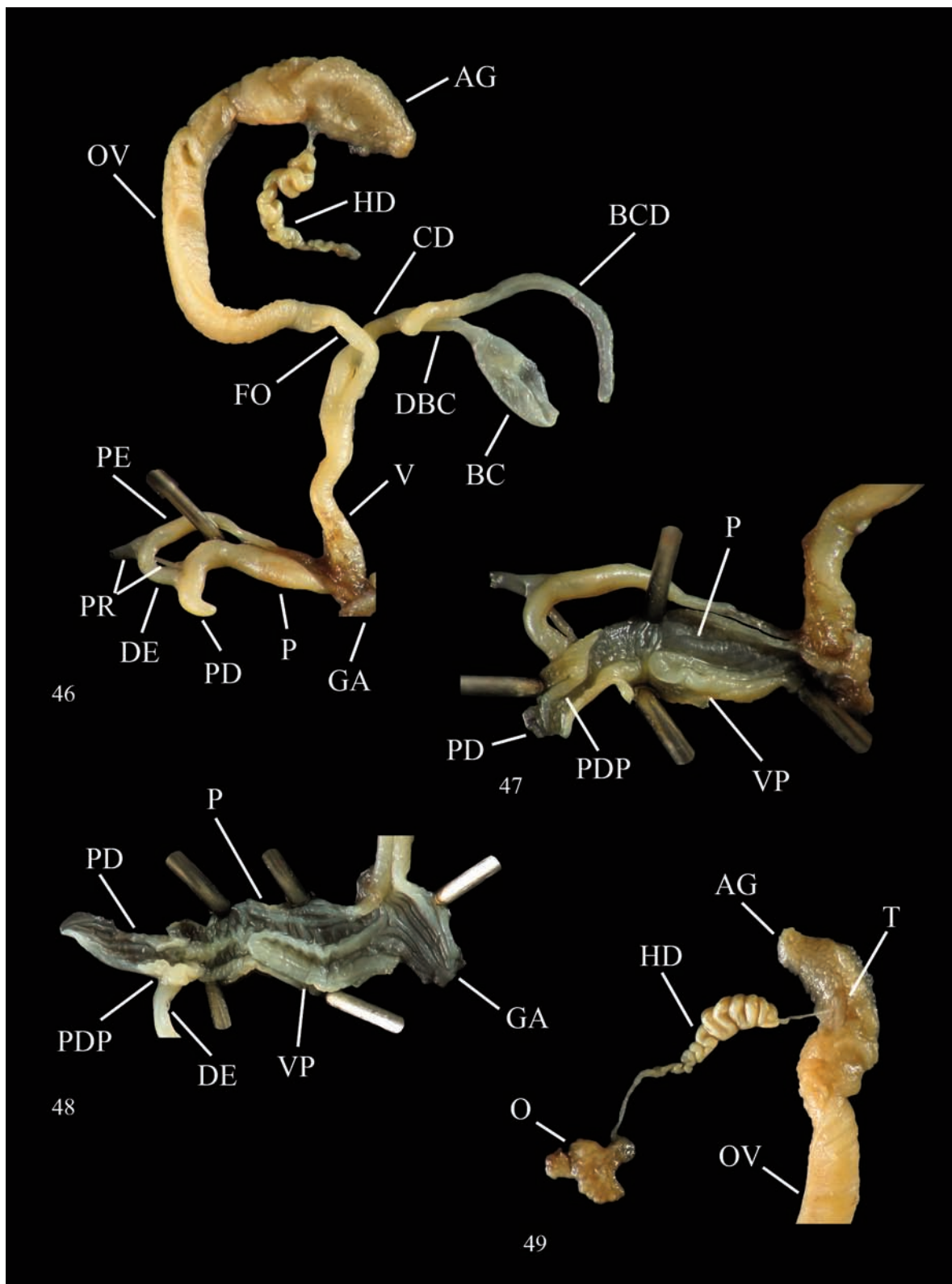
Figure 34–37. *Albinaria (Albinaria) brevicollis superba*, Alimia Islet. Fig. 34: shell, H: 17 mm, D: 3.4 mm. Fig. 35: palatum. Fig. 36: parietum, Fig. 37: clausilium.



Figures 38, 39. *Albinaria (Mirabellina) teres nordsiecki*, island of Chalki, Zies, Fig. 38: shell, H: 17.03 mm, D: 3.9 mm. Fig. 39: shell, H: 17 mm, D: 3.9 mm.



Figures 40–45. *Albinaria (Mirabellina) teres nordsiecki*, island of Chalki, Zies, Figs. 40, 41: palatum, Figs. 42, 43: parietum, Figs. 44, 45: clausilium.



Figures 46–49. *Albinaria (Mirabellina) teres nordsiecki*, island of Chalki, Zies, Fig. 46: genitalia. Fig. 47: internal structure of penis (same specimen of figure 46), Fig. 48: internal structure of penis. Fig. 49: proximal female genitalia.





Figure 50. *Tandonia* cf. *pageti*, island of Chalki, Chorio, length: 8 cm. Figure 51. *Deroceras* (*D.*) cf. *samium*, island of Chalki, Imborios, length: 40 mm. Figure 52. *Cochlicella* (*C.*) *acuta*, island of Chalki, Imborios, H: 8.5 mm, D: 3.8 mm. Figure 53. *Xerocrassa* (*X.*) *meda* (Porro, 1840), island of Chalki, Ag. Ghiorgos, H: 5.1 mm, D: 8.3 mm. Figure 54. *Levantina* (*L.*) *spiriplana malziana*, island of Chalki, Pefkia, H: 27.5, D: 16.5 mm. Figure 55. *Cantareus apertus*, island of Chalki, Pefkia, H: 25.5 mm, D: 26.3 mm. Figure 56. *Cornu aspersum*, island of Chalki, Adramasos, H: 32 mm, D: 39 mm.

## CONCLUSIONS

Based on our own findings and the results from previous molluscan studies, the malacofauna of Chalki comprises 23 extant taxa and that one of Alimia 6.

Twenty-one species of land snails were collected during our surveys in the two islands, however three species recorded by past authors have not been found by us (*Orculella cretica*, *Helix nucula* and *H. pronuba*).

Ten species are new records for Chalki and four for Alimia (Table 1). Among the new records *Pleurodiscus balmei* is represented only as an empty ju-

venile shell, therefore further researches are needed to confirm the presence of a living population. Two shells of an unidentified *Mastus* are reported as *Mastus* sp.

From all localities sampled in Chalki, the richest was Chorio with five species, followed by Adramasos, Ag. Ghiorgos and Kania with three species.

As far as endemic species are concerned there's only a strict endemic species, *Albinaria* (A.) *brevicollis chalcidensis*. Two species are endemic of Rhodes and respectively also of Chalki: *Zebrina candida* and of Alimia *Albinaria* (A.) *brevicollis superba*. An endemic species of the Dodecanese, *Mastus emarginatus turgidus* is present both on Chalki and Alimia. Five species are endemic for the Aegean

SPECIES	CHOROTYPE	CHALKI	ALIMIA
<i>Orculella critica</i>	Aeg-Grek	L	
<i>Pleurodiscus balmei</i>	E-Med		NR
<i>Mastus emarginatus turgidus</i>	Dod	X	NR
<i>Mastus</i> sp.	---		NR
<i>Rhabdoena cosensis</i>	Aeg	X	
<i>Zebrina fasciolata</i>	E-Med		NR
<i>Zebrina candida</i>	Dod		NR
<i>Rumina</i> cf. <i>saharica</i>	E-Med	X	NR
<i>Albinaria</i> ( <i>Albinaria</i> ) <i>brevicollis chalcidensis</i>	End	X	
<i>Albinaria</i> ( <i>Albinaria</i> ) <i>brevicollis superba</i>	Dod		X
<i>Albinaria</i> ( <i>Mirabellina</i> ) <i>teres nordsiecki</i>	Aeg	X	
<i>Eopolita protensa protensa</i>	Aeg	X	
<i>Tandonia</i> cf. <i>pageti</i>	Aeg		NR
<i>Deroceras</i> ( <i>Deroceras</i> ) cf. <i>samiuum</i>	Aeg		NR
<i>Cochlicella</i> ( <i>Cochlicella</i> ) <i>acuta</i>	Eur		NR
<i>Xerocrassa</i> ( <i>Xerocrassa</i> ) <i>cretica</i>	E-Med	X	NR
<i>Xerocrassa</i> ( <i>Xeroclausa</i> ) <i>meda</i>	Med		NR
<i>Metafruticicola</i> ( <i>Metafruticicola</i> ) <i>pellitus pellitus</i>	Aeg	X	
<i>Levantina</i> ( <i>Levantina</i> ) <i>spiriplana malziana</i>	E-Med	X	L
<i>Eobania vermiculata</i>	Med	X	NR
<i>Cantareus apertus</i>	Med	X	
<i>Cornu aspersum</i>	Eur-Med		NR
<i>Helix</i> ( <i>Helix</i> ) <i>pronuba</i>	E-Med	L	
<i>Helix</i> ( <i>Pelasga</i> ) <i>nucula</i>	E-Med	L	
<b>TOTAL</b>		14	9
			2
			4

Table 1. List of species of Chalki and Alimia and their chorotype. L = data of literature, NR = new record, X = our findings.

region, and *Orculella critica* for the Greek-Aegean regions. Moreover, eight species present a wide eastern Mediterranean distribution, either Mediterranean (three species), or Mediterranean European (two species) (Table 1). Therefore the Eastern Mediterranean elements is the most represented chorotype in Chalki (34.8 %).

We consider *Cornu aspersum* to be of recent introduction for Chalki, since this large Helicidae was not sampled by past authors and it has on Chalki limited ranges restricted to stations near present or past human dwellings. To the list of non-native species we tentatively added also *Xerocrassa meda*, which is known in Aegean region only for Kos and Lesvos as an introduced species.

These findings show a close relationship of the molluscan fauna between Chalki, Alimia and that of the nearby island of Rhodes. All sampled species in Alimia are also present in Rhodes, while of the twenty-three species listed for Chalki only four are not present in Rhodes: *A. brevicollis chalcidensis* endemic species of Chalki, *A. teres nordsiecki* species native to the island of Crete, *X. meda* perhaps introduced in Chalki, and *Mastus* sp. whose status remains uncertain. We have redescribed the shell of *A. brevicollis chalcidensis* and for the first time we have described and illustrated its genitalia. For the first time we have also described in detail the internal genitalia of *R. cosensis*, *Z. fasciolata*, *Z. candida* and *A. (M.) teres nordsiecki*. Further investigations are nevertheless necessary to ascertain the specific status both of the slugs and of *O. critica*.

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