

**The land snails of the area between Kaş and Demre,
southwestern Turkey, with special reference to *Albinaria*
(Gastropoda, Pulmonata, Clausiliidae)**

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The 40 x 10 km region extending between Kaş and Demre (Vilayet Antalya, southwestern Turkey) provides an interesting area for studies on land snails. It is one of the less well-known regions of Turkey in terms of land snail distribution. Most of the landscape consists of limestone outcrops. In this area 32 species of land snails were found, 14 of which live exclusively in the coastal and suburban area of Demre, suggesting that they were introduced. Among the 18 autochthonous species are four species of *Albinaria*, one of which is described as *A. latelamellaris* spec. nov.; *A. anatolica* is very common and exhibits a considerable degree of geographical variation in shell characters.

Key words: Gastropoda, *Albinaria*, dispersal, introduced species, distribution, biogeography, morphological variation, Turkey.

INTRODUCTION

The last general approach to the land snails of Turkey was a monumental work by Schütt (1993, 1996), criticized mainly for the limited value of its systematic parts (Hausdorf, 1994; Riedel, 1995; Bank et al., 1997). These were claimed to have resulted in unreliable species numbers for many groups. Another objection concerned the poor quality of the distributional data.

Biogeographical evaluations of Turkish land snails based on Schütt (1996) (e.g. Cook, 1997) face the difficulty of combining the species compositions of better surveyed regions with those from poorly studied areas. For instance, the data concerning the southeastern regions of present-day Turkey largely represent our knowledge at the beginning of the 20th century, whereas western Turkey is much better surveyed. Analysing species numbers and distribution patterns of Schütt's different regions without consideration of these

shortcomings is expected to yield historically rather than biogeographically meaningful results. The only solid base for biogeographical and phylogeographical evaluations of Asia Minor and adjacent regions should be the complete regional and local ranges of the species involved. This knowledge is unlikely to be provided by one person's efforts; it will have to be achieved step by step, with contributions by many researchers (Bank et al., 1997).

The 40 x 10 km area extending between Kaş and Demre, Vilayet Antalya (fig. 1) is one of the poorest known regions in terms of mollusc distribution. The last surveys on the probably best-known land snail family of Turkey (Zonitidae) recorded several species at Kaş and west of Kaş, on the islands of Kastelórizo (Meis, Megisti) and Kekova, at Myra, Demre and east of Demre (Riedel, 1982, 1987, 1995), but nothing was reported from the hinterland between Kaş and Demre. Some of the data are based on expeditions conducted 100 or 150 years ago. The same situation is observed in *Albinaria* (Clausiliidae) and *Isaurica lycia* (Martens, 1889) (Helicidae) (Nordsieck, 1993; Subai, 1994). The Greek island group of Kastelórizo, which consists of seven small islands off Kaş, was investigated by Poulakakis, Vardinoyannis & Mylonas (1997), but apart from some general statements the results were not published, so that the study did not contribute much to our knowledge of the land snails of that region.

The present study was initiated after 36 shells of land snails were found in an excavation of a late Bronze age shipwreck off Uluburun, a rocky peninsula between Kaş and Demre. Since the interpretation of the shipwreck snail finds required a detailed knowledge of the distribution of the snails of the adjacent region, the area was thoroughly checked in 1998 for land snails. In fact, four shells of the shipwreck belonged to endemic

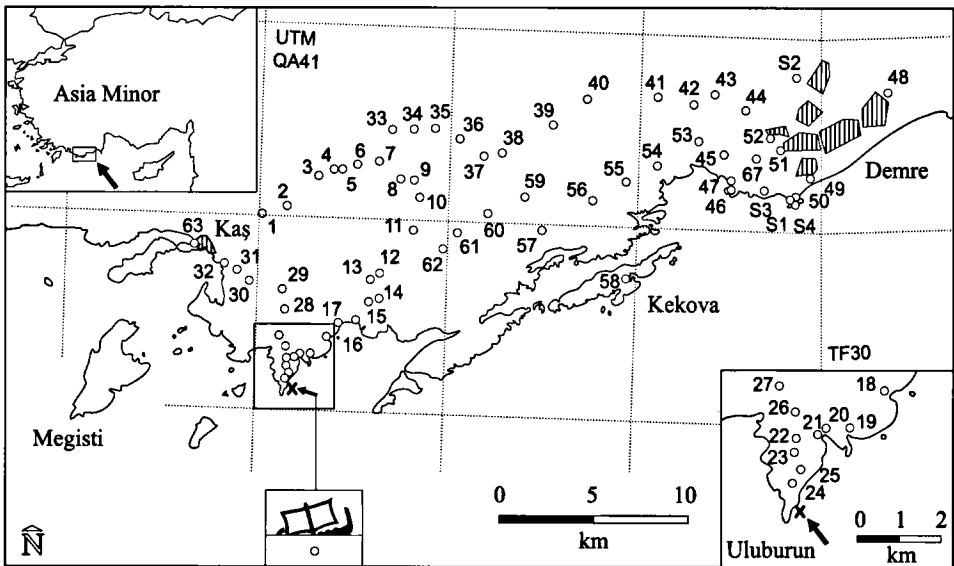


Fig. 1. Map of the study area with collection sites. The site of the Uluburun shipwreck is indicated.

and characteristic species of the Uluburun area, viz. *Metafruticicola* spec. of Megisti and *Zonites caricus* (Roth, 1839). They are considered not to have belonged to the ship's inventory, but to have reached the shipwreck site independently (Welter-Schultes, in press).

MATERIAL AND METHODS

In September 1998 F. Welter-Schultes collected land snail samples at the following 64 sites between Kaş and Demre (fig. 1). The material is stored in the Haus der Natur, Cismar, Germany.

- #1 Road Kaş-Finike, 0.5 km W. Ağullu (crossroads Yeniköy), = 8 km E Kaş, 21.9.1998
- #2 Road Kaş-Finike, 1 km E. crossroads Yeniköy, 21.9.1998
- #3 Road Kaş-Finike, 0.7 km E. crossroads Kasaba-Akçay-Elmalı 21.9.1998
- #4 Road Kaş-Finike, 2 km E. crossroads Kasaba = 2.5 km W crossroads Kılıçlı-Üçağız, 22.9.1998
- #5 Road Kaş-Finike, 2 km W. crossroads Kılıçlı-Üçağız, 22.9.1998
- #6 Road Kaş-Finike, 1 km W. crossroads Kılıçlı-Üçağız, 22.9.1998
- #7 Road Kaş-Finike, 0.4 km S. crossroads Kılıçlı-Üçağız, 22.9.1998
- #8 Road Kaş-Kılıçlı-Üçağız, 4.5 km SE. crossroads road Kaş-Finike, 22.9.1998
- #9 Road Kaş-Kılıçlı-Üçağız, 6 km SE. crossroads road Kaş-Finike, 22.9.1998
- #10 Road Kaş-Kılıçlı-Üçağız, 8 km SSE. crossroads road Kaş-Finike, 22.9.1998
- #11 1.5 km NNW Kılıçlı, = 10.5 direct km E. Kaş, 22.9.1998
- #12 2 km SW Boğazcık, = 9 direct km ESE. Kaş, 22.9.1998
- #13 3 km SW Boğazcık, = 8.5 direct km ESE. Kaş, 22.9.1998
- #14 Ruins 2.5 km SSW Boğazcık, = 8.5 direct km south ESE. Kaş, 22.9.1998
- #15 0.8 km W of ruins 2.5 km SSW Boğazcık, = 8 direct km south ESE. Kaş, = 1.5 km S. Çam Dağı-Mountain, 22.9.1998
- #16 W outlet of a valley 8 km SE. Kaş at the coast, = 1.5 km NE. Körmen Adası, 22.9.1998
- #17 7.5 km SE. Kaş, rocks at the coast, = 1 km N Körmen Adası, 22.9.1998
- #18 W fringe of the bay 7.5 km SE. Kaş at the coast, = 1 km W Körmen Adası, = 1 km N. Cılpacık Adası, 23.9.1998
- #19 Bay E. of Ince Burun, 7.5 km south SE Kaş, 1.5 km E Uluburun peninsula ridge, 23.9.1998
- #20 Bay immediately E. of the Uluburun peninsula, = 7 km SSE Kaş, 23.9.1998
- #21 Ruins W of the bay immediately E. of the Uluburun peninsula, = 7 km SSE Kaş, 23.9.1998
- #22 Uluburun peninsula ridge, summit SW. of the eastern bay, 6.5 km SSE Kaş, 23.9.1998
- #23 Uluburun peninsula ridge, 7 km SSE. Kaş, 23.9.1998
- #24 Uluburun peninsula ridge, southernmost high rocks in dark maccia, 7.5 km SSE. Kaş, 23.9.1998
- #25 Eastern slopes of the Uluburun peninsula, 7.2 km SSE. Kaş, at two thirds ridge altitude, 23.9.1998
- #26 Road S. Bayındır, 0.8 km N. end of the road, = 5.5 km SSE. Kaş, 23.9.1998
- #27 Village ruins 4 km S. Bayındır, = 5 km SE. Kaş, Okçuöldüğü, 24.9.1998
- #28 2.5 km S. Bayındır, = 4.5 km SE. Kaş, wall alongside the backroad, 24.9.1998
- #29 S. end of the village of Bayındır, = 3 km ESE. Kaş, 24.9.1998
- #30 Road Kaş-Bayındır, 2 direct km SE. Kaş, 24.9.1998
- #31 Road Kaş-Bayındır, 1.2 direct km SE. Kaş, 24.9.1998
- #32 0.4 km S. Kaş, rocks at Büyük Çakıl Beach, 24.9.1998
- #33 Road Kaş-Finike, 2 km NE. crossroads Kılıçlı-Üçağız, 25.9.1998
- #34 Road Kaş-Finike, 3.5 km ENE. crossroads Kılıçlı-Üçağız, = 0.5 km W. Sarılar, = 1 km E. crossroads Gökçeyazı, 25.9.1998

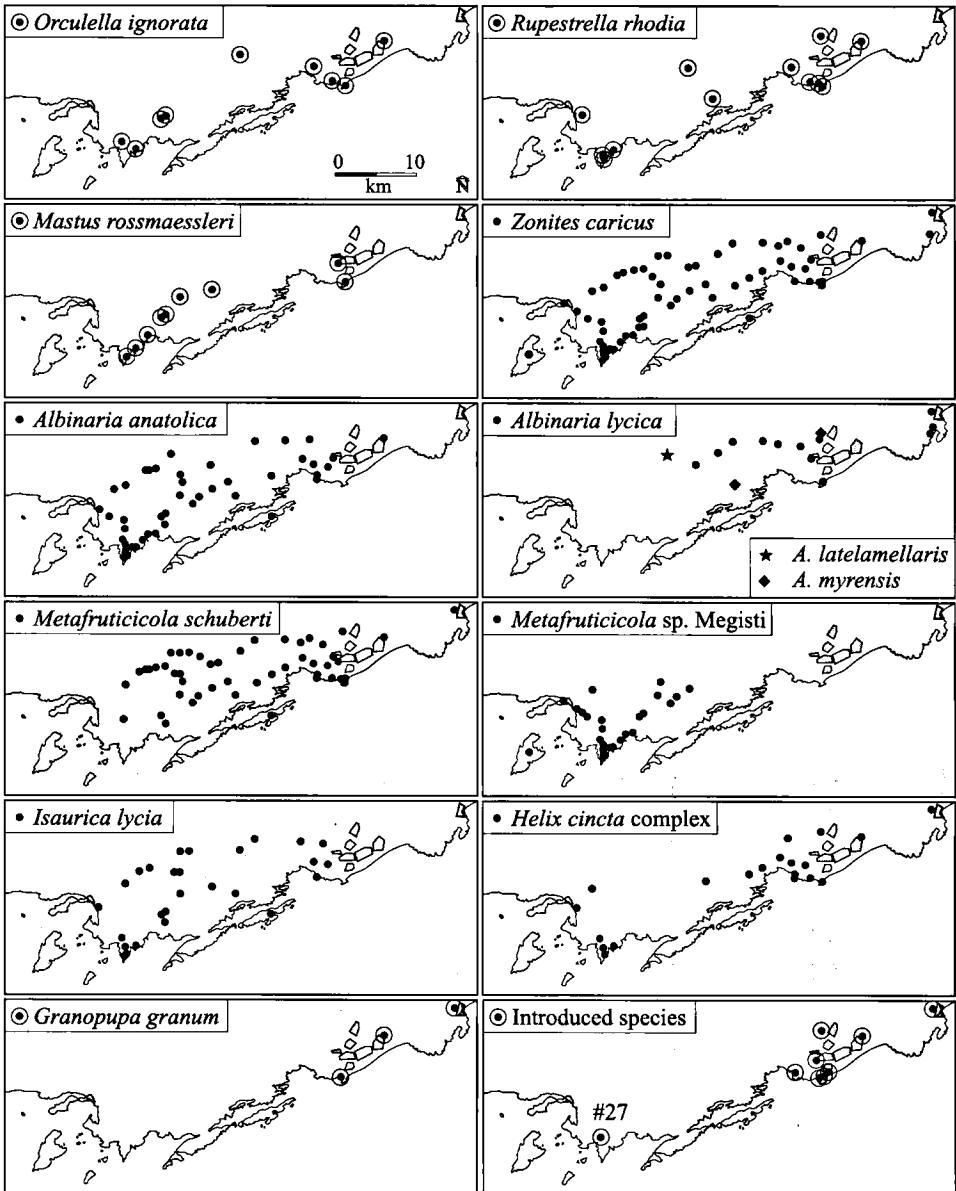


Fig. 2. Distribution of some land snail species between Megisti and Finike.

- #35 Road Kaş-Finike, 4.5 km E. crossroads Kılıçlı-Üçağz, = 7.5 km W. Yavı, = 0.5 km E. Sarılar, 25.9.1998
- #36 Road Kaş-Finike, 7 km E. crossroads Kılıçlı-Üçağz, = 5 km W. Yavı, = 0.3 km E Kızılören, 25.9.1998
- #37 Road Kaş-Finike, 1 km W. crossroads Kyaneai, = 3 km W. Yavı, 25.9.1998
- #38 Road Kaş-Finike, crossroads Kyaneai, = 2 km W. Yavı, = 8 km W. Davazlar, 25.9.1998
- #39 Road Kaş-Finike, 3 km W. Davazlar, 25.9.1998
- #40 Road Kaş-Finike, 1.5 km W. Davazlar, 26.9.1998
- #41 Road Kaş-Finike, pass 3 km E. Davazlar, 26.9.1998
- #42 Road Kaş-Finike, 5 km E Davazlar, = 1.5 km W. Gürses, = 0.5 km E Çakalbayat, 26.9.1998
- #43 Road Kaş-Finike, W.-entrance of village Gürses, 10 road-km NW Demre, 26.9.1998
- #44 Road Kaş-Finike, 2 km ESE. Gürses, = 8 road-km NW Demre, 26.9.1998
- #45 New Road Kaş-Finike, 4 road-km W. Demre (crossroads Cayagzı), = 2 km SW. Sura, = 0.3 km S ruins, 26.9.1998
- #46 Rocks at the port of Cayagzı, near Demre = Kale, = 18.5 direct km WSW. Finike, 26.9.1998
- #47 Ruins at the beach of Cayagzı, near Demre = Kale, = 18.5 direct km WSW. Finike, 26.9.1998
- #48 Rocks NW. inland lake near Beymelek, at the margin of the Demre = Kale plain, = 9 direct km WSW. Finike, 27.9.1998
- #49 Beach of Demre = Kale, 1 km E. rocky peninsula, dunes, = 14.5 direct km WSW. Finike, 27.9.1998
- #50 Rocky peninsula S Demre, = 15.5 direct km WSW. Finike, 27.9.1998
- #51 Demre, 3 km NE. port of Cayagzı, 27.9.1998
- #52 Demre, Karabucak, = 7 km NE. Kapaklı, 27.9.1998
- #53 Dirt-track Demre-Kapaklı-Üçağz, 5 km E. Kapaklı, = 20 direct km WSW. Finike, 27.9.1998
- #54 Dirt-track Demre-Kapaklı-Üçağz, 1.5 km E. Kapaklı, = 22 direct km WSW. Finike, 27.9.1998
- #55 Dirt-track Demre-Kapaklı-Üçağz, 1 km W. Kapaklı, = 22 direct km E. Kaş, 27.9.1998
- #56 Dirt-track Demre-Kapaklı-Üçağz, 4 km W. Kapaklı, = 3 km E Cevreli, = 19 direct km E. Kaş, 27.9.1998
- #57 1 direct km N. Üçağz, = 18 direct km E. Kaş, 28.9.1998
- #58 Kekova Adası, bay at the southern coast, 2 km SW of the eastern cape of the island, 28.9.1998
- #59 Road Kaş-Kılıçlı-Üçağz, 4.5 km NW Üçağz, = 1 km WNW. Cevreli, = 16 direct km E. Kaş, 28.9.1998
- #60 Road Kaş-Kılıçlı-Üçağz, 6 km NW. Üçağz, = 2.5 km W. Cevreli, = 14.5 direct km E. Kaş, 28.9.1998
- #61 Road Kaş-Kılıçlı-Üçağz, mountain ridge 2 km E. Kılıçlı, = 12.5 direct km E. Kaş, 29.9.1998
- #62 Road Kaş-Kılıçlı-Üçağz, 1 km E. Kılıçlı, = 11.5 direct km E. Kaş, 29.9.1998
- #63 Kaş, W. end of the city in direction to Kalkan, 30.9.1998
- #67 New road Kaş-Finike, W. end of the city of Demre, 0.7 km W. crossroads Cayagzı, 26.9.1998

Results of an expedition conducted in 1987 by P. Subai are also incorporated here; this material is from the following localities. It is in the Colln Subai.

- #S1 Beach some km S. of Demre, at rocks at the right hand of river Demre, 5.6.1987
- #S2 Myra near Demre, at rocks near the rock tombs in the valley on the right hand of the amphitheatre, and in a dry creek bed, 6.6.1987
- #S3 Approximately 2 km NW. Demre beach, hill slope with macchia and calcarous rocks, 7.6.1987
- #S4 Approximately 500 m S. Demre beach, karst hill with macchia, 7.6.1987
- #S7 Finike, at rocks above the city, 7.6.1987

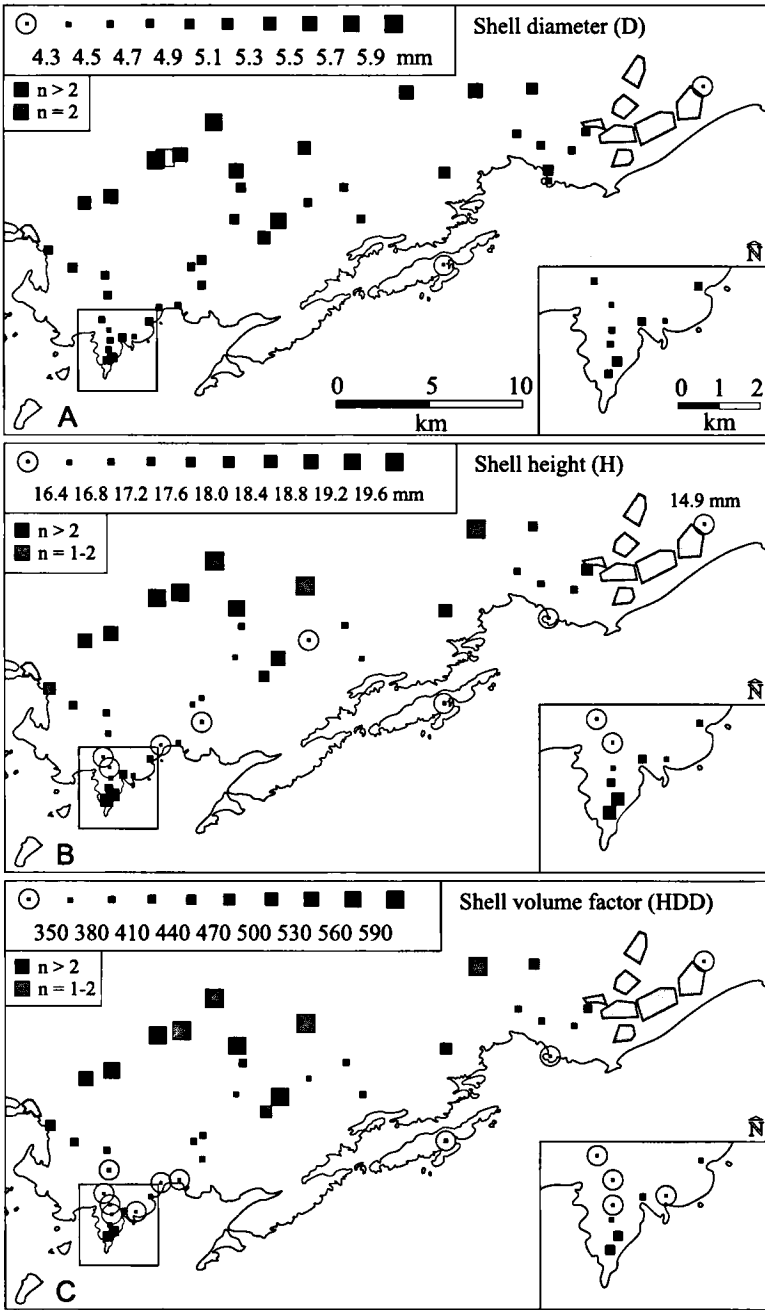


Fig. 3. Geographical variation of *Albinaria anatolica*, shell parameters.

The locations were not thoroughly checked for minute species. Shell size was determined with calipers (accuracy 0.1 mm).

Neubert composed the systematic part of the *Albinaria* descriptions and provided the photos. Örstan and Welter-Schultes contributed the analyses of the shell parameters of *Albinaria anatolica* (Roth, 1839). Welter-Schultes composed the faunal lists and the maps.

Abbreviations. — For shell characters: H, shell height; D, shell diameter; AH, apertural height; AD, apertural diameter; W, number of whorls; # refers to the site number (see 'Material and Methods' and fig. 1). For collections: HNC, Haus der Natur, Cismar; SMF, Naturmuseum und Forschungsinstitut Senckenberg, Frankfurt; ZSM, Zoologische Staatssammlung, München.

RESULTS

The following species were found in the region between Kaş and Demre. Sites in brackets indicate field observations of living animals which were not collected.

- Cochlostoma mienisi* Schütt, 1968: #58
Pomatias glaucum (Sowerby, 1842): #48, S7
Truncatellina cylindrica (Férussac, 1807): #S1, S2, S4
Orculella ignorata Hausdorf, 1996: #12, 13, 19, 27, 39, 45, 48, S3, S4
Granopupa granum (Draparnaud, 1801): #48, S1, S2
Rubestrella rhodia (Roth, 1839): #19, 22, 25, 31, 37, 45, 48, 57, S1, S2, S3, S4
Mastus rosmaessleri (Pfeiffer, 1846): #11, 12, 13, 17, 19, 25, 50, 51, 60
Rumina saharica Pallary, 1901: #S2
Ceciloides acicula (Müller, 1774): #S1, S2
Ceciloides michoniana (Bourguignat, 1864): #19, 32, 45, S1, S2, S3, S4
Ceciloides tumulorum (Bourguignat, 1856): #19, 40, S1, S2
Vitrea contracta (Westerlund, 1871): #37, 41
Zonites caricus (Roth, 1839): #1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 48, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 67, S1, S2, S3, S4, S7
Albinaria anatolica (Roth, 1839): #1, 2, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 37, 40, 41, 43, 45, 46, 47, 48, 52, 53, 55, 57, 58, 59, 60, 61, 62, 67
Albinaria lycica Nordsieck, 1993: #38, 39, 40, 41, 42, 44, 50, 52
Albinaria myrensis Nordsieck, 1993: #56
Albinaria latelamellaris spec. nov.: #35
Helicodonta gyria (Roth, 1839): #48
Xeropicta krynickii (Krynicky, 1833): #51, S1
Trochoidea pyramidata (Draparnaud, 1805): #47, 50, S1, S2
Monacha syriaca (Ehrenberg, 1831): #51, S1
Metafruticicola schuberti (Roth, 1839): #2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 29, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 67, S1, S2, S3, S4, S7
Metafruticicola spec. of *Megisti* (sensu Welter-Schultes in press): #1, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 60, 61, 62, 63
Cermuella virgata (Da Costa, 1778): #47, 51

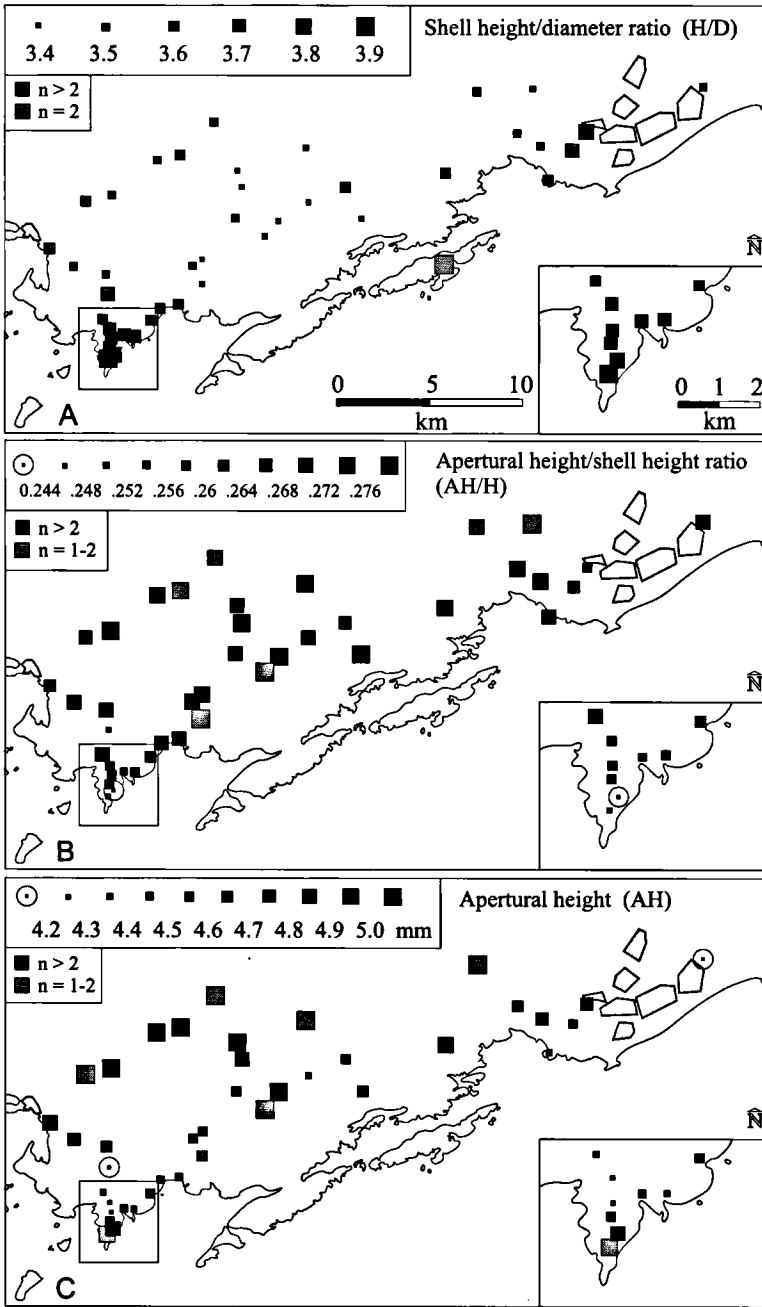


Fig. 4. Geographical variation of *Albinaria anatolica*, shell parameters.

- Caracollina lenticula* (Michaud, 1831): #27, 51, S1, S2
Cochlicella acuta (Müller, 1774): #49
Theba pisana (Müller, 1774): #47, 49, 50, S1
Eobania vermiculata (Müller, 1774): #50
Isaurica lycia (Martens, 1889): #2, 3, 5, (8), (9), 11, 12, 13, 14, (19), 22, 24, 25, 27, 32, (34), 35, 39, 40, (42), (44), 45, 46, 57, 58, 60, 67
Helix aspersa Müller, 1774 (= *Cornu aspersum*): #51
Helix cincta Müller, 1774 (sensu lato): #(19), (54), (67), S2, S3, S4, S7
Helix cincta borealis Mousson, 1859: #1, 22, 27, 43, 44, 45, 59
Helix cincta cf. *anatolica* Kobelt, 1891: #53
Helix nucula Mousson, 1854: #1, 25, 47, 48, 50, 51, 53, 55
Helix asemnis Bourguignat, 1860: #32

The *Vitrea* species was determined as *Vitrea contracta* f. *zakynthia* (Hesse, 1882). A continuous gradient between the shell characters of *Zonites* suggests that *Z. beydaglariensis* Riedel, 1982, and *Z. caricus* are conspecific (Welter-Schultes, in press). Sympatrically occurring populations of different *Zonites* species or forms were not observed at any of the localities studied.

Albinaria anatolica (Roth, 1839) (figs 3-4, 7-8)

Clausilia anatolica Roth, 1839: 21, pl. 2 fig. 5 (In sepulcris Cacamo) (= in tombs, island of Kekova, 36° 10' N, 29° 51' E). Lectotype (fig. 7), **design. nov.** (ZSM): H, 20.03 mm; D, 5.15 mm; AH, 4.5 mm; AD, 3.55 mm; W, 11.25.

Clausilia anatolica var. *apicalis* Boettger, 1883: 326 (Arsa, valley of Xanthus, Asia Minor, 36° 28' N, 29° 27' E). Holotype (fig. 8) (SMF 66481): H, 14.15 mm; D, 4.25 mm; AH, 3.8 mm; AD, 3.0 mm; W, 8.25.

Material. — #1, 2, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 37, 40, 41, 43, 45, 46, 47, 48, 52, 53, 55, 57, 58, 59, 60, 61, 62, 67.

Sympatric occurrence of *A. anatolica* and *A. lycia lycia*: #40, 41, 52.

Type specimens and synonymy. *Albinaria anatolica* is one of the first species of Clausiliidae described from Turkey. It was encountered by Roth and his colleagues during an expedition to the eastern Mediterranean area. The collected material is stored in the ZSM. This institution houses one lot of *A. anatolica* which contains three specimens, two of which are semiadult and one adult with a damaged aperture.

Due to collection management, the original label of Roth is not present any more. The present label contains the information „Kleinasien“. This is in accordance with the handwritten catalogue of Roth (he was curator of the museum), where the locality of *A. anatolica* is given as „Asia Minor“. As evidenced in other parts of Roth's collection, his labels have generally been translated, re-typed and usually added to the lot. Obviously, the original label was lost during this process (personal communication J. Gerber, 1999). We here accept this ZSM lot to contain the type material of *Clausilia anatolica* Roth and herewith designate the specimen with the damaged aperture as the lectotype.

The specimen described by Boettger under the variety name *apicalis* (SMF 66481) is considerably smaller than the lectotype of *A. anatolica* and the additional material from the area between Finike and Kaş. The differences between *A. anatolica* var. *apicalis* and

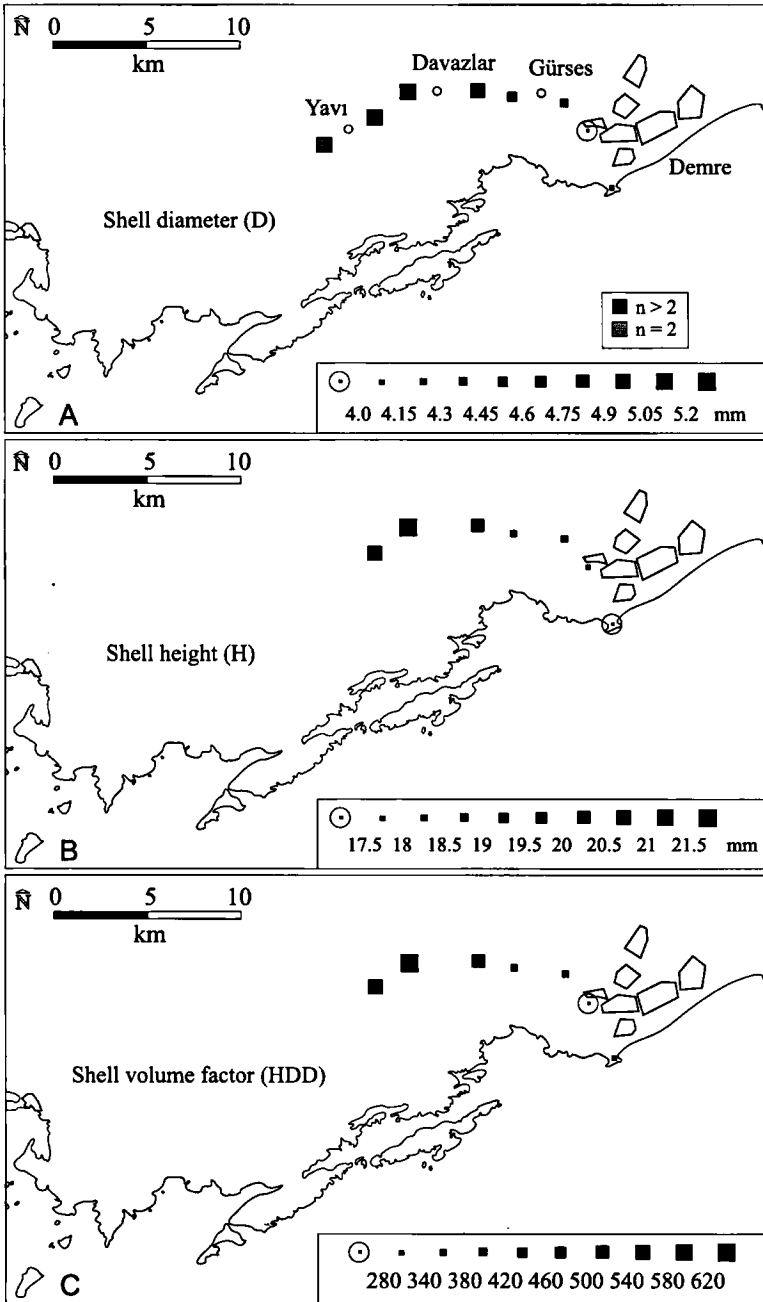


Fig. 5. Geographical variation of *Albinaria lycica*, shell parameters.

A. anatolica s. s., indicated by Boettger (1883: 326, „the short form and the very thick apex distinguish this variety easily from the typical *C. anatolica* of Cacamo in Caria“) are not sufficient to justify a separation as different taxa. The protoconch of the *A. anatolica*-group is generally submammillate and cannot be used for differentiation. Comparing the populations of Arsa (*A. anatolica* var. *apicalis*) and Kekova (*A. anatolica* s. str.) yielded no differences in taxonomically useful characters such as the size of the lamellae, rugosity of the cervical region, rib density of the teleoconch, or presence of a lamella parallelis. In agreement with Nordsieck (1977: 296, 301), we conclude that *Clausilia anatolica* var. *apicalis* has to be regarded as a junior synonym of *A. anatolica*.

Variation. — The geographical variation of shell size parameters (D, H, HDD) is striking in the region between Kaş and Demre (fig. 3). There is a general trend towards larger shell sizes in the interior and smaller sizes in the coastal regions, albeit with some exceptions (stations 10, 24-25, 55, 61-62). The values of the stations at the Uluburun peninsula document the smooth transition between small sizes at the (northern) root of the peninsula towards relatively large sizes in the south. If the lectotype derives from the ruins in the western parts of the island of Kekova, it appears to be unusually large.

Relative shell height (H/D) exhibits relatively small values (3.4-3.6) in most parts of the study area. At Demre, on the island of Kekova and at the Uluburun peninsula the values become gradually higher (fig. 4A). The relative apertural height (AH/H) values range at 0.26-0.275 at most sites, and become smaller at Uluburun and at Demre (fig. 4B). The geographical variation of absolute apertural height (AH, fig. 4C) follows the patterns observed in shell size. This conforms with the observation that in *Albinaria* apertural height is correlated with shell size (Kemperman, 1992).

Albinaria lycica lycica Nordsieck, 1993 (figs 5-6)

Albinaria lycica lycica Nordsieck, 1993: 16-17, pl. 3 figs 1-2 (Finike, 4 km in direction to Kaş, 36°17' N, 30°08' E).

Material. — #38, 39, 40, 41, 42, 44, 50, 52. Additional sites in the study area: S2, S7, and at 4 km from Finike to Demre (Nordsieck 1993). Sympatric occurrence of *Albinaria lycica* and *A. anatolica*: #40, 41, 52.

Variation. — The shell parameters exhibit smooth transitions in the area between Yavi and the coastal region of Demre (figs 5-6). The overall ranges of the variation are not always as wide as those of *A. anatolica*. The shells in the coastal areas are smaller than in the hinterland between Davazlar and Yavi.

Albinaria myrensis Nordsieck, 1993

Albinaria myrensis Nordsieck, 1993: 7, 19, fig. 4, pl. 6 fig. 2 (valley of Demre at Kale, shore left of the river's mouth, 36° 18' N, 29° 58' E).

Material: #56. Only a few shells were found. The species is rare, perhaps restricted to higher altitudes. Additional site in the study area: S2 (Nordsieck, 1993).

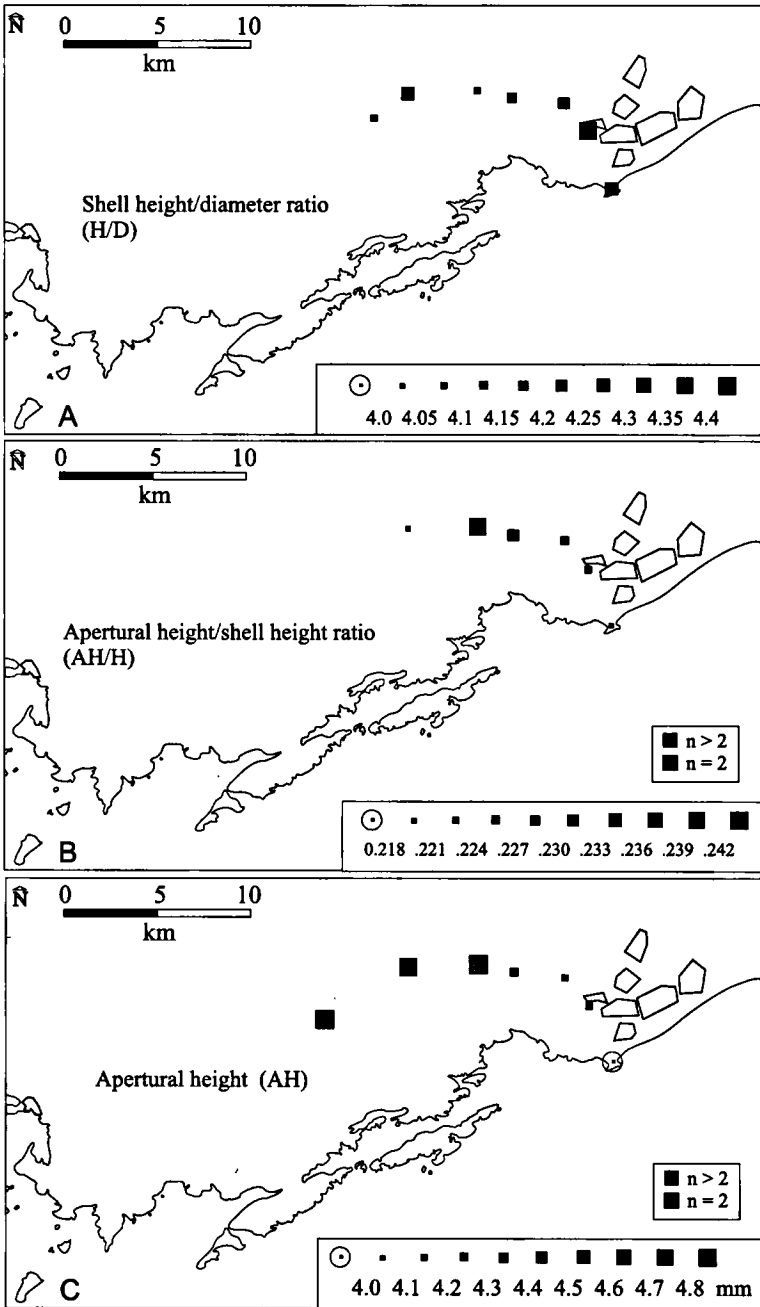


Fig. 6. Geographical variation of *Albinaria lycica*, shell parameters.

Albinaria latelamellaris spec. nov. (fig. 9)

Material. — Road Kaş-Finike, 4.5 km E crossroads Kılıçlı-Üçağız, = 7.5 km W Yavı, = 0.5 km E Sarılar, 36° 15' N, 29° 46' E (#35); SMF 311952/holotype. Paratypes, type locality: SMF 311953/1; HNC 51236/>10; E. Neubert/2; H. Nordsieck/2; A. Örstan/1.

Diagnosis. — Shell large, with a ventricose teleoconch; aperture with very broad columellaris, basalis and frontal upper palatal fold (FUP).

Description. — The protoconch is mammillate, glossy and smooth. It consists of 2.5 whorls. The teleoconch is ventricose with finely ribbed whorls. It is grey-yellowish to light brown. The shell is remarkably thin and fragile. The upper teleoconch whorls are rounded with an impressed suture, the lower whorls are flattened and the suture is shallow. The sculpture consists of fine, somewhat oblique ribs. On the last whorl, particularly on the cervix, the ribs are widely spaced. On the cervix, the basal keel is short but prominent and the dorsal keel is flat; the area between both is a shallow furrow.

The aperture is subquadrate and disconnects from the last whorl. The rim is somewhat broadened and slightly reflected. The lunellar is situated dorsally. It consists of an evenly curved lunella, connected to a strong basalis. The principalis is long, extending almost to the apertural rim. Below there is a strong but short frontal upper palatal fold (FUP) running parallel to the principalis. Spiralis and parietalis disconnect and overlap. The columellaris is extremely high and prominent, nearly perpendicularly situated in the aperture. The subcolumellaris is broadly S-shaped and relatively short. The clausilial plate is narrow, with somewhat arched rims and a pointed apex, correlated with the broadened part of the subcolumellaris.

Measurements (n=16). — H, 22.4-28.5 mm; D, 6.0-7.05 mm. Holotype: H, 23.8 mm; D, 6.35 mm; AH, 5.95 mm; AD, 4.8 mm; W, 11.

Distribution. — This species is known only from the type locality, 0.5 km E. Sarılar (#35). It is expected to occur also more to the north, where molluscs have never been collected.

Derivatio nominis. — The name is derived from Latin *latus* (= broad) and *lamella*, referring to the prominent columellaris characterising this species.

Affinities. — This species resembles *Albinaria anatolica* in several shell characters, like colour and fragility, the mode of ribbing and the submammillate protoconch. Both species are similar in the overall shape of the teleoconch and the subquadrate aperture. They differ profoundly in their lunellar (which is dorsolateral in *A. anatolica*), the lunella (short and straight in *A. anatolica*), basalis and FUP (not present in *A. anatolica*), the subcolumellaris (a thin and simply curved thread in *A. anatolica*), the lower lamella (a narrow oblique plate in *A. anatolica*), the parallel lamella (present in *A. anatolica* but not in *A. latelamellaris*) and the cervical ribs (rugose in *A. anatolica*).

The differences between *Albinaria latelamellaris* and *A. basalis* Neubert, 1993 (which also has a basalis) from Vilayet Muğla (western Turkey) are striking. Shells of *A. basalis* are elongate subcylindrical in shape, with a nearly smooth teleoconch, a strong white surface layer, strong basal and dorsal keels and a shorter subcolumellaris. *A. myrensis* is much smaller and differs in the mode of ribbing (somewhat coarser than in *A. latelamellaris*), the dorsal keel (stronger in *A. myrensis*), position of lunellar (dorsolateral to lateral in *A. myrensis*), and the FUP (absent in *A. myrensis*).

Albinaria latelamellaris is added to the *A. anatolica*-group sensu Nordsieck (1993: 6). The diagnosis of this group has to be supplemented by „upper palatalis sometimes present“.

Now there are two groups of *Albinaria* in Turkey sharing this character state. Presence of palatal folds, including the basalis, is widely accepted as representing the plesiomorphic character state. One evolutionary tendency within the clausilial apparatus of the N-(normal)-type is directed towards partial or complete reduction of the lunellar. This is evident for example in *Albinaria argynnis* (Westerlund, 1898) from eastern Peloponnisos (Greece), which seems to be a species conserving some basic conditions of a group of *Albinaria*-species including the eastern Peloponesian *Albinaria solicola* Neubert, 1998, with affinities to the *Albinaria grisea*-group (Nordsieck, 1977; Neubert, 1998). Another example in the subfamily Mentissoideinae is *Galeata (Plistoptychia) cilicica* (Nägele, 1902), which is characterized by a plesiomorphic lunellar including an upper palatalis and a subclausalis (basalis absent). It represents the sister-group of *Galeata* s. str., which has several striking conchological and anatomical characters in common but its lunellar is much more simple (Neubert, 1992).

DISCUSSION

Autochthonous and introduced species. — Xerophilous hygromiid species do not live in the region between Kaş and Kekova. This is in agreement with the statement of Poulakakis et al. (1997) where this group was referred to as *Trochoidea*. They reported that xerophilous hygromiid species do not inhabit any island of the Kastelórizo group.

Demre (= Kale) is an agglomeration of several rapidly growing villages or towns that will develop sooner or later into suburbs of one big city. Contemporary maps of Turkey do not reflect this development. *Rumina saharica*, *Cochlicella acuta*, *Caracollina lenticula*, *Ceruella virgata*, *Xeropicta krynickii*, *Trochoidea pyramidata*, *Monacha syriaca*, *Theba pisana* and *Helix aspersa* were found in the coastal and suburban area of Demre (fig. 2). These species do not live in natural habitats there, suggesting that they were introduced to the study area by human agency.

Rumina saharica is widespread in the Mediterranean (Bank & Gittenberger, 1993). In the study area it was exclusively found at the ruins of Myra, so artificial human-based dispersal seems to be likely. *Caracollina lenticula*, possibly of western Mediterranean origin, is considered to have been introduced to quite a number of localities in Crete and the Aegean islands (Mylonas, 1982; Welter-Schultes, 1998a). In the island of Gávdos it lives together with *Theba pisana* and *Cochlicella acuta* exclusively in synanthropic habitats in the north of the island (Welter-Schultes, 1998b). Apart from Demre, *C. lenticula* was also found at the ruins of an abandoned Greek village north of Uluburun (#27).

The original range of *Xeropicta krynickii* extends from the Black Sea region to Azerbaidzhan and Iran. It was introduced to Crete, Gávdos, Páros, Andíparos and other areas (Mylonas, 1982; Welter-Schultes, 1998a, b). *X. krynickii* was frequently spread by humans in ancient times. Several specimens of this species were determined among the land snails of the Uluburun shipwreck (C. Pulak & F. Welter-Schultes, unpublished data). They were found in amphoras originally containing terebinth resin from the Near East, destined for Egypt, and among *Sarcopoterium spinosum* shrubs that were used to cushion the freight. It was the first time that land snails had been looked for in an excavation of an ancient shipwreck, strengthening the idea that (1) human-based dispersal of snails must have been common, and (2) that *X. krynickii* must have belonged to the most frequently dispersed species.

Monacha syriaca is not known to have been artificially introduced to the eastern



Figs 7-9. *Albinaria* spec. 7-8, *A. anatolica*. 7, lectotype (ZSM), in frontal (a), dorsal (b) and lateral view (c), H 20.03 mm; 8, holotype of *Clausilia anatolica* var. *apicalis* Boettger, 1883 (SMF 66481), in frontal (a) and dorsal view (b), H 14.15 mm; 9, *Albinaria latelamellaris* spec. nov., holotype (SMF 311952), in frontal (a) and dorsal view (b), H 23.8 mm.

Mediterranean, but its exclusive occurrence near Demre cannot be explained by presence of agricultural habitats alone. Cultivated fields are also present in the hinterland. Also, the records are identical with those of *X. krynickii*. *Cermea virgata* which occurs at the European Atlantic coasts and in the Mediterranean area is one of the most common species in the Balkans (Dhora & Welter-Schultes, 1996). In our study area it lives only at Cayagzı and Demre, most likely localities of land snails introduced by humans. *Trochoidea pyramidata* may have come from southern Italy or Sicily, and lives at a number of distinct localities in the eastern Mediterranean including two distinct localities in Crete (Welter-Schultes, 1998a). This species lives at the ports of Cayagzı and Demre (southern cape), and at the ruins of Myra.

Theba pisana and *Cochlicella acuta* were found only at the southern margin of Demre. Belonging to the most common snails in sandy habitats along coasts, these species have frequently been introduced to many localities in Greece (Welter-Schultes, 1998a). *C. acuta* is expanding its range in the eastern Mediterranean and at the Turkish Black Sea coast (Hudec, 1973; Falkner, 1990). Finally, *Helix aspersa* is one of the most commonly dispersed snails, in Crete it is sold on local markets and exported (Welter-Schultes, 1998a). It was found in a suburb of the city of Demre.

In contrast to *Rupestrella rhodia* which was found, besides Kaş and Demre, also at five stations between the two towns that were not disturbed by humans (fig. 2), *Granopupa granum* was not found in natural habitats and therefore could have been introduced. *G. granum* was found at Beymelek near Demre (#48), Myra and at the ancient port of Demre in the south. The same conclusion applies to *Pomatias glaucum*, which lives at Beymelek and at Finike (#S7). In the natural habitats at Kaş, Uluburun, Kekova, and in the hinterland between Kaş and Demre, no introduced species were found. The city of Kaş does not harbour any introduced species. The sites where *Helix nucula* was found accumulate at Demre and at the village of Ağullu near Kaş (#1). But there were also some natural habitats (#25 at Uluburun, #53 and #55 between Demre and Kekova).

The following 18 species of land snails can be considered to be autochthonous: *Cochlostoma mienisi*, *Truncatellina cylindrica*, *Orculella ignorata*, *Mastus rosmaessleri*, *Cecilioides* (3 species), *Vitrea contracta*, *Zonites caricus*, *Albinaria* (four species), *Helicodonta gryia*, *Metafruticicola* (two species), *Isaurica lycia*, *Helix cincta* complex. *Albinaria*, *Metafruticicola* and *Zonites* were found at almost every station. They are the most common land snails of the region. Two *Metafruticicola* species live between Kaş and Demre, one of which is still undescribed (R. Bank, in prep.). *Isaurica lycia*, *Mastus rosmaessleri*, *Orculella ignorata*, *Rupestrella rhodia* and *Helix cincta* are also common and occur throughout the region. The smaller species were not found at every locality. This may be attributed to the collection method which was focussed on *Zonites* and *Metafruticicola*.

Zonites Montfort, 1810. — In the region between Kaş and Demre we observed considerable geographical variation in shell characters such as the height and keeling of the outer whorls, the number of whorls, and the sculpture of the embryonic shell (Welter-Schultes, in press). These features were thought to separate (Riedel, 1982) *Z. caricus* and *Z. beydaglariensis*. Our analysis of *Zonites* shells suggests that the previously observed geographic variation of *Z. beydaglariensis* populations east of Demre (Riedel, 1982) actually continues uninterrupted from there westward to Kekova and Kaş, where it merges gradually into *caricus* populations. This observation suggests the presence of a single genetic entity, that of a polytypic species which must be identified as *Zonites caricus* (Roth, 1839). Most of the differences in anatomical characters between *caricus* and *beydaglariensis*

are gradual (Riedel, 1982). The internal structure of the penis is expected to provide interesting results in the area 5-10 km east of Kaş; however, in September 1998 no living specimens could be found.

The geographical differences in shell morphology and anatomy may be attributed to the low degree of mobility of the *Zonites* populations in the area. A low mobility hypothesis is strengthened by the observation that *Zonites* is relatively rare and during its lifetime mostly stays hidden in crevices, under stones and rocks, and in the soil under roots, and appears at the surface only after rain (Riedel, 1996, 1997; Riedel & Mylonas, 1997).

Cecilioides Férussac, 1814. — The determination of Ferussaciidae in southern Europe and the eastern Mediterranean is difficult. A preliminary approach on Greek *Cecilioides* is given in Welter-Schultes (1998b). The species (or at least, forms) can be separated conchologically by the relation between apertural height and shell height (graphic plots: AH/H plotted against H, or LH/H against H; LH = last whorl height). It is very important to note that this relation is not constant but depends on H (for example, $H = 0.643 \times LH^2 + 0.7$ for *C. acicula*). For H = 4.4 mm (5.0 mm), AH/H ranges between 0.33 and 0.40 (0.30-0.38) in *C. acicula*, between 0.40 and 0.47 (0.38-0.44) in *C. tumulorum*; it exceeds 0.47 (0.45) in *C. michoniana*. For LH/H and H = 4.4 mm (5.0 mm) the corresponding limits are 0.46-0.56 (0.44-0.54) for *C. acicula*, 0.57-0.68 (0.54-0.62) for *C. tumulorum*, and 0.66-0.83 (0.60-0.78) for *C. michoniana*. The nominal taxon *Caecilianella subsaxana* Bourguignat, 1856, does not represent a separate species; the type sample consists of juvenile *Cecilioides acicula* and *C. tumulorum*. The three species or forms found at Demre are widely distributed in Turkey and Greece.

Albinaria Vest, 1867. — The significance of the discovery of *A. latelamellaris* is discussed in Nordsieck (1999). The species is believed to strengthen the idea that the *A. anatolica*-group represents an independent *Albinaria* lineage, and appears to support Nordsieck's (1977, 1999) approach of subdividing the extremely speciose genus *Albinaria* in smaller units ('groups') of possibly monophyletic origin. Since the grouping is not always supported by biochemical and molecular genetical data (Schilthuizen & Gittenberger, 1996; Douris et al., 1998), more research is necessary to test this theory.

ACKNOWLEDGEMENTS

We are grateful to H. Nordsieck (Villingen-Schwenningen) for discussions and helpful comments on the manuscript, to J. Gerber (Munich) for information about the Roth collection, to A. Liebegott (Frankfurt) for providing *Albinaria anatolica* material from Xanthus, and to C. Pulak (College Station, Texas) for initiating the study by placing at our disposal the finds of the Uluburun shipwreck. P. Subai (Aachen) is acknowledged for providing material and results of a collection conducted in 1987. B. Hausdorf (Hamburg) identified the Hygromiidae and Orculidae, A. Riedel (Warszawa) the *Vitrea*. The 1998 expedition by F. W.-S. was supported by the Evangelisches Studienwerk Villigst.

REFERENCES

- BANK, R.A., K.-H. BECKMANN, G. FALKNER, M. FALKNER, E. GITTENBERGER, B. HAUSDORF, W.J.M. MAASSEN, H.P.M.G. MENKHORST, E. NEUBERT, H.-J. NIEDERHÖFER, H. NORDSIECK, W. RÄHLE & P. SUBAI, 1997. The second edition of Schütt's book (1996, „Landschnecken der Türkei“): a declaration from the „Arbeitsgruppe Türkische Binnenmollusken“. — *Mitteilungen der Deutschen Malakozologischen Gesellschaft* 59: 37-38.
- BANK, R.A., & E. GITTENBERGER, 1993. Neither *Rumina truncata*, nor *R. gracilis*, but *R. saharica* (Mollusca Gastropoda Pulmonata: Subulinidae). — *Zoologische Mededelingen* 67: 525-527.
- BOETTGER, O., 1883. On new Clausiliæ from the Levant, collected by Vice-Admiral T. Spratt R. N. — *Proceedings of the Zoological Society of London* 1883: 324-344.
- COOK, L.M., 1997. Geographic and ecological patterns in Turkish land snails. — *Journal of Biogeography* 24: 409-418.
- DHORA, D., & F.W. WELTER-SCHULTES, 1996. List of species and atlas of the non-marine molluscs of Albania. — *Schriften zur Malakozoologie* 9: 90-197.
- DOURIS, V., R.A.D. CAMERON, G.C. RODAKIS & R. LECANIDOU, 1998. Mitochondrial phylogeography of the land snail *Albinaria* in Crete: long-term geological and short-term vicariance effects. — *Evolution* 52: 116-125.
- FALKNER, G., 1990. Binnenmollusken. In: R. FECHTER & G. FALKNER, Weichtiere. Europäische Meeres- und Binnenmollusken. — *Steinbachs Naturführer* 10: 112-280. München.
- HAUSDORF, B., 1994. [Buchbesprechungen]. Schütt, H. (1993): Türkische Landschnecken. - 433 S., zahlreiche Abbildungen. Wiesbaden (Hemmen). — *Mitteilungen der Deutschen Malakozologischen Gesellschaft* 53: 47-48.
- HUDEC, V., 1973. Helicidae (Gastropoda, Pulmonata) gesammelt von der niederländischen biologischen Expedition in die Türkei in 1959. II. — *Zoologische Mededelingen* 46: 231-259.
- KEMPERMAN, Th.C.M., 1992. Systematics and evolutionary history of the *Albinaria* species from the Ionian islands of Kephallinia and Ithaka (Gastropoda Pulmonata: Clausiliidae): 1-251. Leiden.
- MYLONAS, M., 1982. Meléti páno sti zoogeografia ke ikologia ton cherséon malakíon ton Kikládou. — *Ergastiriou Genekis Zoologias Panepistimiou Athinou* [Ph. D. Thesis]: 1-236. Athina.
- NEUBERT, E., 1992. Descriptions of new taxa of the Clausiliidae from Turkey (Mollusca: Stylommatophora). — *Zoology of the Middle East* 7: 65-86.
- , 1998. New data on the fauna of Clausiliidae of Greece, in particular on *Albinaria* from Attica and the Peloponnese (Gastropoda Pulmonata: Clausiliidae). — *Basteria* 62: 125-155.
- NORDSIECK, H., 1977. Zur Anatomie und Systematik der Clausilien, XVII. Taxonomische Revision des Genus *Albinaria* Vest. — *Archiv für Molluskenkunde* 107: 285-307.
- , 1993. Türkische Clausiliidae, I: Neue Arttaxa des Genus *Albinaria* Vest in Süd-Anatolien (Gastropoda: Stylommatophora). — *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)* 499: 1-31.
- , 1999. Annotated check-list of the species of the *Albinaria-Isabellaria* group (Gastropoda: Stylommatophora: Clausiliidae). — *Mitteilungen der Deutschen Malakozologischen Gesellschaft* 62/63: 1-21.
- POULAKAKIS, N., K. VARDINOYANNIS & M. MYLONAS, 1997. Biogeographic analysis of the malacofauna of the Kastelorizo island group. — *Heldia* 4: 115.
- RIEDEL, A., 1982. Die Gattung *Zonites* Montfort in Südwest-Kleinasien (Gastropoda: Zonitidae). — *Annales Zoologici* 36: 391-423.
- , 1987. Revision der Gattung *Zonites* Montfort (Gastropoda: Zonitidae): türkische Arten. Nebst Ergänzungen und Verzeichnis aller *Zonites*-Arten. — *Annales Zoologici* 41: 1-42.
- , 1995. Zonitidae sensu lato (Gastropoda, Styommatophora) der Türkei. Übersicht der Arten. — *Fragmenta Faunistica* 38: 1-86.

- , 1996. The Zonitidae sensu lato of Turkey. A distribution analysis (Gastropoda: Stylommatophora). — *Malakologische Abhandlungen* 18: 1-24.
- , 1997. Die in West-Paläarktis unterirdisch lebenden Zonitidae sensu lato (Gastropoda, Stylommatophora). — *Fragmenta Faunistica* 39: 363-390.
- & MYLONAS, M., 1997. The Zonitidae of the south-east Aegean islets (Gastropoda: Pulmonata). — *Genus* 6: 229-245.
- ROTH, J.R., 1839. Molluscorum species, quas in itinere per orientem facto comites clariss. Schuberti Doctores M. Erdl et J. R. Roth collegerunt: 1-26. Monachii [München].
- SCHILTHUIZEN, M., & E. GITTENBERGER, 1996. Allozyme variation in some Cretan *Albinaria*: paraphyletic species as natural phenomena. In: J. TAYLOR, ed., *Origin and evolutionary radiation of the Mollusca*: 301-311. Oxford.
- SUBAI, P., 1994. Vergleich der mit *Levantina* verwandten großen Heliciden, sowie Revision der Gattung *Iaurica* (Kobelt) (Gastropoda: Helicidae). — *Archiv für Molluskenkunde* 123: 49-87.
- WELTER-SCHULTES, F.W., 1998a. Human-dispersed land snails in Crete, with special reference to *Albinaria* (Gastropoda: Clausiliidae). — *Biologia Gallo-hellenica* 24 (2): 83-106.
- , 1998b. Die Landschnecken der griechischen Insel Gávdos, der südlichsten Insel Europas. — *Schriften zur Malakozoologie* 12: 1-120.
- , in press. Land snails from an ancient shipwreck: the need to detect wreck-independent finds in excavation analyses. — *Journal of Archaeological Science*.