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A SURVEY OF THE LAND SNAILS OF THE KARABURUN PENINSULA, TURKEY

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ABSTRACT: Thirty-three species of land snails were collected during a survey of the calcareous areas of the Karaburun Peninsula in western Turkey. The first record of *Pagodulina hauseri* for Turkey is given. Also given is the first record outside of Chios of a specimen identified tentatively as *Vitrea storchi*. Anatomies of *Microxeromagna lowei*, *Monacha ocellata* and *M. syriaca* are discussed. A comparison of the shell dimensions of the *Helix* species of western Turkey, including those from the Karaburun Peninsula, is presented. An unexpected result of the survey was the failure to find *Albinaria* on the peninsula.

KEYWORDS: Pulmonata, gastropod, anatomy, biodiversity

INTRODUCTION

Despite several surveys conducted in recent years (ÖRSTAN 2001, ÖRSTAN et al. 2005a, b, 2007), surprisingly large regions of western Turkey remain unexplored for their land snail faunas. One such area from where only five land snail records have been published before is the Karaburun Peninsula west of the city of Izmir (Fig. 1). These records are for *Vitrea contracta* from the town of Urla on the isthmus of the peninsula and *V. riedeli* from the town of Balikliova on the eastern peninsula (RIEDEL 1995), *Zonites smyrnensis* from Balikliova (RIEDEL 1988), *Helicigona matrella* from Balikliova the collector of which SUBAI (1996) gave as RIEDEL and *Cantareus apertus* also from Balikliova (SCHÜTT 2010). Although SCHÜTT (2010) did not cite the source of his record, the location suggests it was also from RIEDEL. It appears that the late ADOLF RIEDEL may have been the only malacologist who collected on the Karaburun Peninsula until recently. To alleviate the lack of information on the snail fauna of the peninsula and to contribute to the overall biodiversity of the country, I present here the results of a recent land snail survey conducted on the Karaburun Peninsula.

The peninsula spans an area approximately 1,200 km^2 with calcareous outcrops covering large sections of it (KALAFATÇIOĞLU 1961). Calcareous areas of southwestern Turkey are usually rich in the numbers of both land snail species and accumulated shells. The members of the speciose land snail genus *Albinaria* are also often present in such areas (ÖRSTAN 2001, ÖRSTAN et al. 2005b, WELTER-SCHULTES 2012). No records of *Albinaria* have been published from the Karaburun Peninsula, although two species have been found on the island of Chios (BAR & BUTOT 1986) directly across from the Karaburun Peninsula and separated from it at the narrowest crossing by only about 7 km. The complete mapping of the distribution of the *Albinaria* species would be expected to contribute to the understanding of the evolutionary history of the genus – a subject of much interest (UIT DE WEERD & GITTENBERGER 2005, NORDSIECK 2007). Therefore, one primary aim of this survey was to search for *Albinaria* on the peninsula.

MATERIAL AND METHODS

Preliminary collections took place in the summers of 2011 and 2012 and the actual survey was in June 2013. Collections were done at 18 stations from sea level up to 575 m. One station was assigned to the gardens and streets in the town of Ilica and another was at a seashore, while the remaining stations were all at locations where the rocks were either limestone or marble. The following list gives the description and coordinates of each station (Fig. 1):

Ce01 – Coast south of Alaçati; 38.25246°N, 26.39993°E; elevation – 0 m.
Ce40 – Gardens and streets in Ilica; 38.3030°N, 26.3704°E; elevation – 8 m.
Ce41 – Bottom of cliff at street corner, Çeşme; 38.32633°N, 26.30183°E; elevation – 24 m.
Ce42 – Hill south of Germiyan; 38.31963°N, 26.49201°E; elevation – 87 m.
Ce43 – Rocky slope north of Izmir-Çeşme road; 38.26708°N, 26.34402°E; elevation – 72 m.
Ce44 – Rocky hill east of Ilica; 38.30503°N, 26.38307°E; elevation – 50 m.
Ce45 – Rocky hill northeast of Ildir; 38.40039°N, 26.50784°E; elevation – 44 m.
Ce46 – Rocks along road to marble quarries; 38.43648°N, 26.52628°E; elevation – 178 m.
Ce47 – Calcareous and volcanic rocks along road, 5.5 km southwest of Karaburun; 38.59695°N, 26.48372°E; elevation – 500 m.
Ce48 – Rocky hill southwest of Karaburun; 38.63301°N, 26.48926°E; elevation – 575 m.
Ce49 – Cliff along road to Kösedere; 38.55629°N, 26.54962°E; elevation – 139 m.
Ce50 – Rocks above road south of Mordoğan; 38.47079°N, 26.59255°E; elevation – 21 m.
Ce51 – Rocky hill on southern peninsula; 38.19040°N, 26.50812°E; elevation – 53 m.
Ce52 – Rocks along road north of Zeytineli; 38.25885°N, 26.51575°E; elevation – 106 m.
Ce53 – Hill south of Alaçati; 38.26300°N, 26.39514°E; elevation – 55 m.
Ce54 – Hill, Çeşme; 38.32932°N, 26.30346°E; elevation – 49 m.
Ce55 – Cliff south of Mordoğan; 38.48218°N, 26.60031°E; elevation – 176 m.

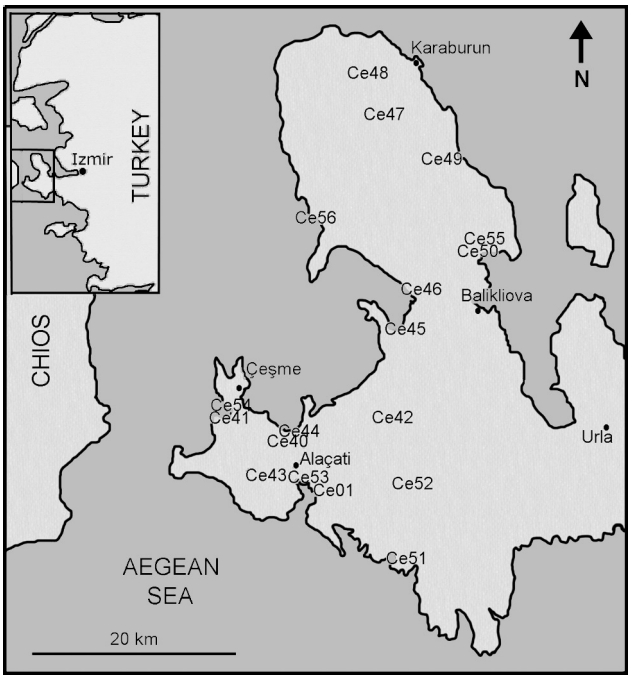


Fig. 1. Locations of the collection stations on the Karaburun Peninsula

Ce56 – Rocks along road on western peninsula; 38.50159°N, 26.40555°E; elevation – 23 m.

In addition to the visual search conducted at each site, a soil and litter sample was also taken at nine of the stations. These samples were sieved and sorted for smaller shells. Two species (*Microxeromagna lowei* and *Monacha ocellata*) were identified by dissection. In the descriptions of genitalia, the terms distal and proximal are relative to the ovotestis. The heights (parallel to the columella) and the diameters (perpendicular to height) of 121 adult *Helix* shells collected in the area extending from the Karaburun Peninsula to Fethiye in southwest Turkey were measured with dial calipers. The calipers were modified by fixing to the upper jaw a small glass plate parallel to the lower jaw. The plate increased the effective surface area of the upper jaw and made it easier to position a shell properly. Each measurement was taken twice on different days and the mean values used in the plot.

RESULTS AND DISCUSSION

The survey found 33 species of land snails (Table 1). At some stations on the peninsula shells were unusually scarce. For example, at stations Ce48 and Ce50 only three and two shells, respectively, were found. Moreover, certain species that are often widespread and abundant in calcareous areas to the south of the Karaburun Peninsula were either rare in the survey area, for example, *Monacha* species, *Oxychilus* species and *Rupestrella* species, or not found at all, for example, *Lindholmiola lens* (Férussac, 1832).

Another surprising result of the survey was the absence of *Albinaria* at all localities. BAR & BUTOT (1986) found *Albinaria caerulea* (Deshayes, 1835) and *A. puella* (Pfeiffer, 1850) at several locations on Chios.

Table 1. The land snail species collected on the Karaburun Peninsula and the stations where each was found

	Species name	Ce01	Ce40	Ce41	Ce42	Ce43	Ce44	Ce45	Ce46	Ce47	Ce48	Ce49	Ce50	Ce51	Ce52	Ce53	Ce54	Ce55	Ce56	Total
1	*Bulgarica erberi* (Frauenfeld, 1867)					×				×								×		3
2	*Cantareus apertus* (Born, 1778)		×				×									×	×			4
3	*Cecilioides acicula* (Müller, 1774)					×						×		×		×			×	5
4	*Cryptomphalus aspersus* (Müller, 1774)		×		×	×	×					×			×	×			×	8
5	*Eobania vermiculata* (Müller, 1774)		×	×										×		×	×			5
6	*Granopupa granum* (Draparnaud, 1801)					×	×		×					×		×	×		×	7
7	*Helicigona matrella* (Westerlund, 1898)									×		×						×		3
8	*Helix cincta* Müller, 1774					×				×						×		×		4
9	*Helix nucula* Mousson, 1854							×								×				2
10	*Jaminia loweii godetiana* (Kobelt, 1880)								×											1
11	*Lauria cylindracea* (Da Costa, 1778)														×					1
12	*Mastus rossmaessleri* (Pfeiffer, 1847)				×	×										×				3
13	*Microxeromagna lowei* (Potiez et Michaud, 1838)		×																	1
14	*Monacha ocellata* (Roth, 1839)		×																	1
15	*Metafruticicola redtenbacheri* (Pfeiffer, 1856)				×	×	×		×	×		×	×	×		×		×	×	11
16	*Orculella ignorata* Hausdorf, 1996				×	×	×		×	×		×		×	×	×	×	×	×	12
17	*Oxychilus cyprius* (Pfeiffer, 1847)					×														1
18	*Oxychilus hydatinus* (Rossmässler, 1838)					×														1
19	*Pagodulina hauseri* Gittenberger, 1978									×										1
20	*Paralaoma servilis* (Shuttleworth, 1852)														×					1
21	*Punctum pygmaeum* (Draparnaud, 1801)														×					1
22	*Pyramidula pusilla* (Vallot, 1801)									×					×					2
23	*Rumina saharica* Pallary, 1901			×		×											×			3
24	*Rupestrella rhodia* (Roth, 1839)						×													1
25	*Trochoidea pyramidata* (Draparnaud, 1805)					×					×					×	×			4
26	*Truncatellina callicratis* (Scacchi, 1833)														×					1
27	*Truncatella subcylindrica* (Linnaeus, 1767)	×																		1
28	*Vitrea pygmaea* (Boettger, 1880)																×			1
29	*Vitrea contracta* (Westerlund, 1871)					×				×	×	×		×	×	×				7
30	*Vitrea riedeli* Damjanov et Pintér, 1969																	×		1
31	*Vitrea* cf. *storchi* Pintér, 1978																	×		1
32	*Zebrina* (*Rhabdoena*) *cosensis* (Reeve, 1849)									×										1
33	*Zonites smyrnensis* (Roth, 1839)						×	×		×	×	×			×					6
Total number of species		1	5	2	4	13	7	2	4	10	3	7	1	6	9	12	7	7	5	

Both species also live, often in dense populations, on calcareous rocks around the town of Kuşadasi roughly 70 km southeast of the Karaburun Peninsula (ÖRSTAN 2001). A region of volcanic rocks that interpose between the calcareous areas of Kuşadasi and the Karaburun Peninsula may have been a barrier to the dispersal of these species if their point of origin was a southerly location. It is possible that the two *Albinaria* species of Chios are not native to the island, but were introduced by humans from the Turkish mainland.

Below are additional remarks on some of the species found during the survey.

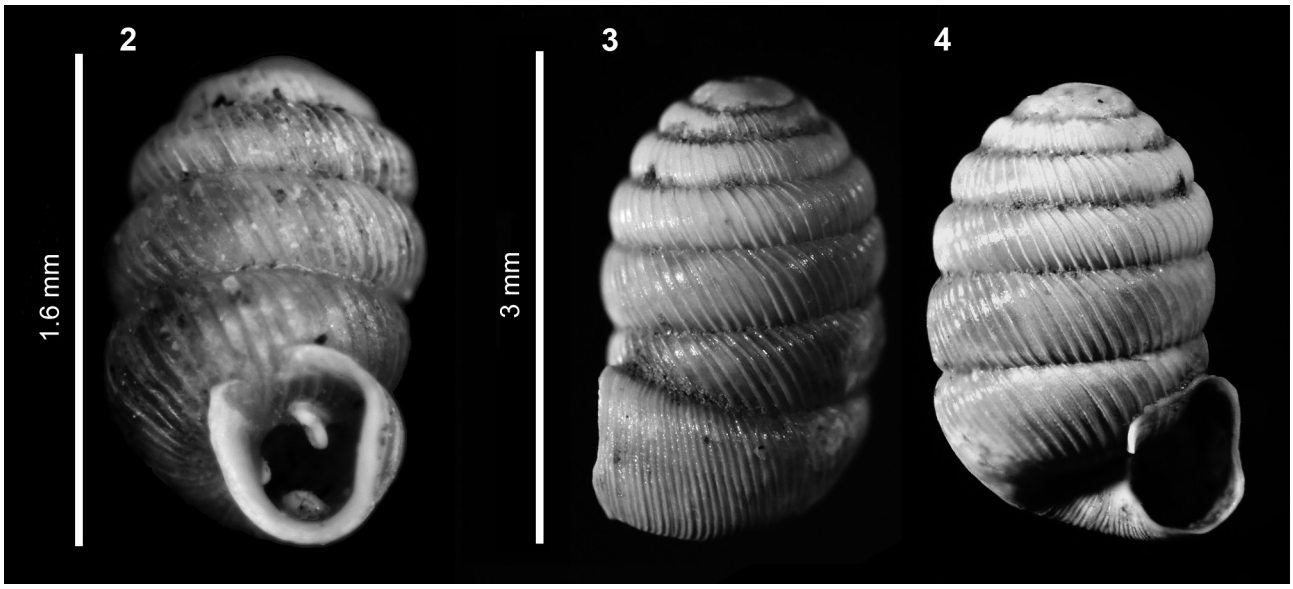
Truncatellina callicratis: This is the first record of this species from western Turkey. SCHÜTT (2010) gave records of it as *T. strobeli* from northeast Turkey. The present record represents a range extension within Turkey of more than 1,100 km. A similar European species, *T. costulata* (Nilsson, 1823), was discounted, because the present specimen (Fig. 2) does not have the characteristic thickened lip of that species (POKRYSZKO 1990).

Pagodulina hauseri: This is the first record of this species from Turkey. It was recorded previously from several Aegean islands close to the Turkish mainland, including Chios (GITTENBERGER 1978, BAR & BUTOT 1986, BANK & MAASSEN 1998). One adult shell with a broken lip (Fig. 4), one adult fragment and a juvenile shell were found at station Ce47. The adult shell (2.8 mm in height) has 13 ribs/mm on the ventral surface of its penultimate whorl. The gaps between the ribs become narrower behind the aperture on the last whorl (Fig. 3). There is one columellar lamella and one short palatal lamella inside the body whorl, but no parietal lamella, in agreement with the description of *P. hauseri*, although the number of ribs on the penultimate whorl of which was stated to be 14–17/mm (GITTENBERGER 1978). Its characteristics also distinguish the present specimen from the *Pagodulina* species previously recorded in Turkey: *P. pisidica* Schütt, 1993 has fewer ribs and a parietalis (SCHÜTT 2010); *P. subdola* (Gredler, 1856) has two palatal lamellae and a parietalis (HAUSDORF 1996); *P. sparsa* Pilsbry, 1924 has fewer ribs that remain widely spaced on the last half-whorl (PILSBRY 1924).

Vitrea cf. *storchi*: This species has previously been recorded from only one location on Chios (PINTÉR 1978, BAR & BUTOT 1986). The only available description and drawings of it are those of PINTÉR (1978), which were used to identify provisionally the one adult shell (Fig. 5) and two juveniles found at station Ce55. If confirmed, this will be the first record of the species outside of Chios and in Turkey.

Microxeromagna lowei: The genitalia of one dissected specimen (Fig. 6) agree with the published accounts of the anatomy of *M. lowei* (HAUSDORF 1988, 1990). The species is anatomically different from the conchologically similar *Xerotricha conspurcata* (Draparnaud, 1801); the latter has two dart sacs and its mucus gland inserts at the stalk of the bursa copulatrix (REISCHÜTZ 1983). The known range of *M. lowei*, also called *M. armillata* (Lowe, 1852), extends from Spain to Israel, but it is believed not to be native to Turkey and the other eastern Mediterranean countries (WELTER-SCHULTES 2012). I found this species only on the walls of a house in the town of Ilica during the summers of 2012 and 2013. This habitat strongly implies that the species was introduced to the location, although how it may have been brought there is not known.

Monacha ocellata: I have identified the specimens from the town of Ilica on the Karaburun Peninsula as *M. ocellata* (Fig. 7). Two of the *Monacha* species of



Figs 2–4. Two new records for Turkey: 2 – *Truncatellina callicratis* from station Ce52, 3–4 – *Pagodulina hauseri* from station Ce47

Fig. 5. *Vitrea* cf. *storchi* from station Ce55

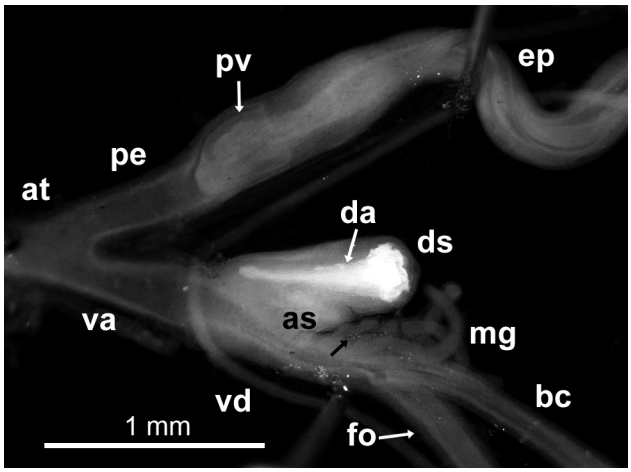
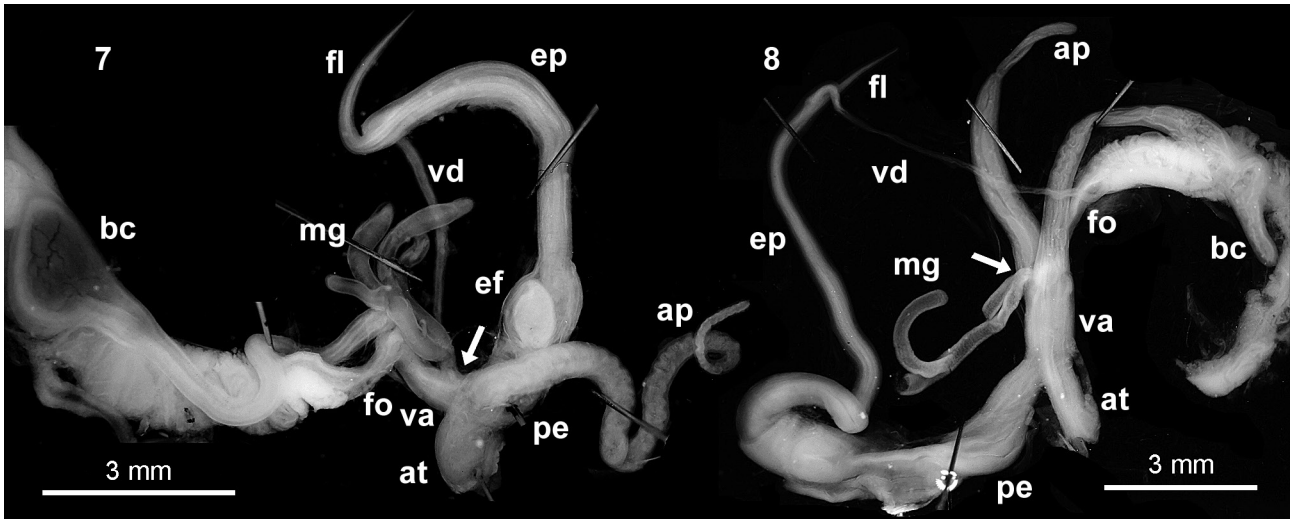


Fig. 6. Distal genitalia of *Microxeromagna lowei* photographed in glycerol to reveal the dart. Abbreviations: as – auxiliary sac, at – atrium, bc – bursa copulatrix (stalk), da – dart, ds – dart sac, ep – epiphallus, fo – free oviduct, mg – mucus gland, pe – penis, pv – penile verge, va – vagina, vd – vas deferens. Black arrow marks the insertion point of the mucus gland

western Turkey, *M. ocellata* and *M. syriaca* (Ehrenberg, 1831), have identical shells and can be separated from each other only by their genitalia (HAUSDORF 2000). The main differences between their genitalia are the following: (1) In *M. ocellata* the mucus gland and the appendix insert at the junction of the penis and the vagina (Fig. 7), while in *M. syriaca* the mucus gland and the appendix insert at the proximal beginning of the vagina where the duct of the bursa copulatrix and the free oviduct unite (Fig. 8). (2) In *M. syriaca* the penis is clearly demarcated from the epiphallus and the penis plus epiphallus is longer than the bursa copulatrix plus its stalk (Fig. 8). In contrast, in *M. ocellata* there is no obvious external demarcation between the penis and the epiphallus and the penis plus epiphallus is shorter than the bursa copulatrix plus its stalk (Fig. 7). (3) In *M. ocellata* the distal epiphallus forms a prominent fold over itself within the sheath (ef in Fig. 7), which is lacking in *M. syriaca*. According to anatomically verified records, *M. syriaca* is widespread in western and southern Turkey, while the range of *M. ocellata* is more northwestern with only a few records from around



Figs 7–8. Genitalia of *Monacha* species: 7 – *M. ocellata* from station Ce40, 8 – *M. syriaca* from the Bodrum Peninsula, Turkey. Abbreviations: ap – appendix, at – atrium, bc – bursa copulatrix, ef – epiphallic fold, ep – epiphallus, fl – flagellum, fo – free oviduct, mg – mucus gland, pe – penis, va – vagina, vd – vas deferens. Arrows mark the insertion points of the mucus glands

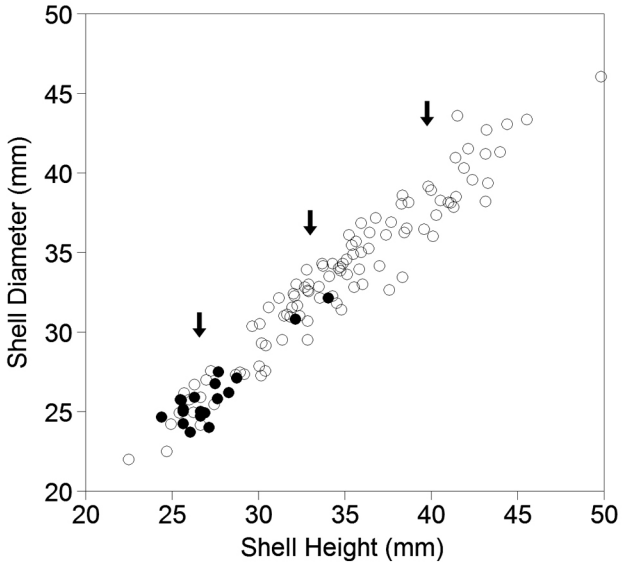


Fig. 9. Plot of shell diameter against shell height for 121 adult *Helix* shells from western Turkey (solid circles are the shells from the Karaburun Peninsula). Arrows mark the three clusters assigned to *H. nucula*, *H. cincta* and *H. asemnis* from the smallest to the largest, respectively

Izmir on the west coast (HAUSDORF 2000, ÖRSTAN et al. 2005a, b). Dormant *M. ocellata* were abundant on the garden walls in parts of Ilica. This species was probably also introduced to the location.

Helix species: *Helix cincta* and *H. nucula* are the most commonly encountered *Helix* species in western Turkey in the coastal area bounded by Izmir in the north and Fethiye in the south; a third species, *H. asemnis* Bourguignat, 1860, has an overlapping distribution range, but it is somewhat rarer than the other two (WELTER-SCHULTES 2012). The shells of these three species, particularly those of *H. cincta* and *H. nucula*, do not seem to be distinguishable from each other in color patterns and microsculpture, especially if they are weathered. The only conchological differences between them are their respective size ranges (height × diameter) (WELTER-SCHULTES 2012): 22–28 × 22–28 mm for *H. nucula*, 30–42 × 28–40 mm for *H. cincta* and 39–45 × 39–45 mm for *H. asemnis*. The plot of shell diameter against shell height for 121 adult *Helix* shells from western Turkey shows three overlapping clusters, but there is no significant difference in shell shapes in terms of the ratio of diameter to height (Fig. 9). The genus *Helix* is in need of a revision and which species these clusters actually represent may be subject to different interpretations (PSONIS et al. 2014). For my present purpose, I have assigned the cluster of the smallest shells to *H. nucula*, the middle cluster to *H. cincta* and the cluster of the largest shells to *H. asemnis*. Obviously, the specimens falling in between these clusters cannot be assigned definitely to any one of the species using only shell size as a criterion. Seventeen specimens from one locality on the Karaburun Peninsula that fall into the cluster of the smallest shells and one small, but damaged shell that could not be measured from another locality are assigned to *H. nucula*. The two shells in the middle cluster (Fig. 9), and two large but broken shells that could not be measured are assigned to *H. cincta*. One shell in the middle cluster assigned to *H. cincta* was found at the same locality as the 17 *H. nucula* shells. Since the shell height of that specimen (32.15 mm) was more than 6 standard deviations away from the mean of the heights of the 17 *H. nucula* shells (mean = 25.42 mm, standard deviation = 1.07), it is unlikely to be an unusually large *H. nucula*. This finding shows that the two species may coexist at some locations.

Truncatella subcylindrica: This species lives on land but always within a few metres of the sea. Almost nothing is known about the means of dispersal of the snails and the extent and the longevity of their colonies. Empty shells were found in beach debris at a few spots around the Karaburun Peninsula, but such finds are not reliable records because empty shells may get transported over the sea. The present record is based on live individuals observed in what appeared to be a very small colony established in sand and debris accumulated in a crevice among rocks on the shore at station Ce01 in June 2011. When I revisited the locality in June 2013, the crevice had been filled with large pebbles and no snails were present.

All five species that had been recorded on the Karaburun Peninsula in previous publications, *V. contracta*, *V. riedeli*, *Z. smyrnensis*, *H. matrella* and *C. apertus*, were also found during the present survey. In addition, in the online catalogue of the Field Museum (Chicago, Illinois, U.S.A.), I found the following species RIEDEL collected near Balikliova in 1985 and donated to the museum: *G. granum*, *C. aspersus*, *L. cylindracea*, *M. rossmaessleri*, *M. redtenbacheri*, *M. ocellata*, *O. ignorata*, *Pagodulina* sp., *R. rhodia* and *Trochoidea trochoides* (Poiret, 1789). My survey also recorded all of these species except *T. trochoides*. The last species is rare in Turkey (SCHÜTT 2010) and RIEDEL's specimens may actually be misidentified *T. pyramidata* found in the present survey. Unfortunately, it is not possible to pinpoint RIEDEL's location, because it dates from a time when geographical coordinates were not recorded as easily and routinely as they are now.

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