ZooKeys 31: 105–117 (2009)
doi: 10.3897/zookeys.31.169
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

The biodiversity of the terrestrial malacofauna of Turkey – status and perspectives

Burçin Aşkım Gümüş[1], Eike Neubert[2]

1 *Gazi University, Biology (Zoology) Department, Ankara, Turkey* **2** *Naturhistorisches Museum der Burgergemeinde Bern, Bern, Switzerland*

Corresponding author: *Burçin Aşkım Gümüş* (burcinaskim@gmail.com, burcinaskim@gazi.edu.tr)

Guest editor: *Ruud Bank* | Received 13 April 2009 | Accepted 4 September 2009 | Published 28 December 2009

Citation: Gümüş BA, Neubert E (2009) The biodiversity of the terrestrial malacofauna of Turkey – status and perspectives. In: Neubert E, Amr Z, Taiti S, Gümüs B (Eds) Animal Biodiversity in the Middle East. Proceedings of the First Middle Eastern Biodiversity Congress, Aqaba, Jordan, 20–23 October 2008. ZooKeys 31: 105–117. doi: 10.3897/zookeys.31.169

Abstract

The status of knowledge of the terrestrial malacofauna of Turkey is briefly reviewed, and the perspectives for studies on the malacofauna of the country are discussed.

Keywords

Biodiversity, terrestrial malacofauna, Turkey

Introduction

Situated on the gateway between Europe and Asia, Turkey represents an important study area for biogeographical research (Demirsoy 1999). On its territory, several important biogeographic zones overlap, and thus species with close relationships to the European, Caucasian, Turanian, and Eremial malacocoenoses can be found. Additionally, the country is very rich in endemic taxa as well. The rich array of geomorphological structures supports a high rate of speciation and variation due to geographic isolation. The remarkable degree of climatological variation ranging from extremely humid subtropical to almost desert-like conditions offer a multitude of niches for terrestrial molluscs. Additionally, geological substrates considerably influence absence or presence of mollusc species, and also may have an impact on the size of living populations.

Orogenesis and orography of Turkey and its influence on the diversity of the terrestrial malacofauna

Turkey is a large rectangular piece of land with its main axis stretching in west-eastern direction. The main air-line distances comprise approx. 1500 km in length (W – E), and about 650 km in width (N – S). Today, its geomorphology is dominated by two large mountain chains following the main west-eastern axis, which are situated in the north and in the south. They belong to the large European Asian mountain belt, the alpine folded mountains, which were folded up at the boundary of the Late Cretaceous to Early Tertiary about 60 mil years ago. They embrace a large elevated plateau (the Anatolian Plateau) with an average altitude around 1000 m above sea level. Turkey is also heavily affected by the larger scaled tectonic activities of the Middle East. Currently, the country is shifted transversally from east to west, where it is slowly subducted under the European Plate. This long-lasting geological movement generated heavy earthquakes and enormous volcanic activities along the main fracture zones in the past. During the last Ice Age, the glaciation only covered small resticted areas in Turkey, a continous ice shield did not exist. However, findings of moraines in higher altitudes of larger mountain systems indicate that particularly in north-facing positions, smaller glaciers existed (very probably Würm Period), at least (Hütteroth and Höhfeld 2002).

Consequences for the malacofauna of Turkey are multifold. The prevailing direction of the mountains often leads to a delimitation of habitats as can be observed in the northeastern part of the country. Here, the humid, warm subtropical area on the northern slopes of the Pontus Mountains is sharply separated from the arid and winter-cold Anatolian Plateau, both areas are thus inhabited by remarkably different malacocoenoses. In the Mediterranean area, however, the same phenomenon has a different result: here, the mountains are quite low, and the valleys allow the warmer climate to penetrate more into the landmass. The subduction formed a diversified coast line in the Aegean area with many larger to smaller offshore islands which still are inhabited by a malacofauna closely related to that on the mainland. In historical times, Central Turkey was venue of enormous volcanic catastrophies, when large volcanoes like the Hasan Mountain and Erciyes Mountain covered the land with ashes and tuff in the Late Tertiary and the Pliocene. These landscapes have been re-colonised by molluscs, although the edaphic and climatic conditions are adverse. Assumably, glaciation did not play an important role as it did in Central Europe. However, it was never attempted to study possible effects on the diversification of microhabitats, where larger glaciers once existed.

Climate and vegetation of Turkey and its influence on the malacodiversity

The basic climatological pattern of Turkey can be summarized as a gradual shift from semi-arid and winter-cold Central Turkey to a subtropical periphery with high humidity during winter. This generalised scheme shows many local variations like the Mediterranean climate regime in the southern coastal areas (rainy season in winter, dry and hot periods in summer) or the extreme euxinian climate regime in the northeast

(rainfall throughout the year with more than 2000 mm precipitation). These differing climatological types are mirrored by the potential vegetation of Turkey, which is composed by dense humid forests in the north and the Amanos Mountains, dry steppe forests in the center (embracing true steppes around Tuz Lake), supramediterranean dry forests in the Taurus Mountains, and a variety of Mediterranean dry forests in the west and the southern coast (Mayer and Aksoy 1986, Hütteroth and Höhfeld 2002).

The transition of human society from rambling hunters to sessile farmers and shepherds took place in southeastern Turkey in the contact zone to the Fertile Crescent some 12.000 yrs ago (Schmidt 2006). The impact on the potential vegetation caused by these human activities and several minor climatic changes throughout this period formed the fragmented vegetation we encounter in Turkey today.

Terrestrial molluscs in general are capable to adapt to almost all types of landscapes. Thus, a country like Turkey with a high relief energie and diversified climate and vegetation supports a similarly rich and diversified malacofauna. Consequently, changes of landuse and climate as described above immediately impact the malacofauna causing areal shifts following the changing environmental conditions, including depletion or even complete loss of populations. Increasing pasture farming leads to a loss of forest vegetation, and thus to a loss of molluscan species adapted to forest conditions.

The recent rise of average summer temperature due to Global Warming may particularly affect the Mediterranean species. During a field survey in May/June 2006 (Gümüş, Gosteli and Neubert) we visited the coastal area between Fethiye and Kas and observed a considerable decrease in numbers of dead shells, and living specimens were extremely rare. This observation is confirmed by many colleagues working in the eastmediterranean area, but a quantitative (and causal connective) analysis of the phenomenon is missing. However, it can be speculated that both, the average length of the dry summer period and the absolute temperature is rising, and that the aestivation period of species adapted to the Mediterranean type of drought is too long now. The animals die from starvation or desiccation, and several species or subspecies may already approach the verge of extinction.

Material and methods

We mainly used data collected by R.A. Bank and E. Neubert during their research for a critical checklist of the terrestrial Turkish malacofauna. This includes a bibliography containing almost 2000 articles relevant for Turkey, and a database for taxa. Literature informative enough to contribute to the subject like revisions of larger taxonomical groups, and catalogues like that of Schütt (2005), and lists where also used (Bank and Menkhorst 1994; Gümüş 2004; Hausdorf 2000, 2001; Loosjes 1963; Nemeth and Szekeres 1995; Neubert 1992, 1995; Neubert and Menkhorst 1994; Neubert et al. 2000; Nordsieck 1993, 1994, 2004; Örstan et al. 2005; Riedel 1989, 1995; Şeşen and Schütt 2005; Stojaspal 1986; Yıldırım 1997; Yıldırım et al. 2004).

Results and discussion

Some historical aspects

The first species from the Turkish terrestrial malacofauna were described by Guillaume-Antoine Olivier (1756–1814), who, amongst others, collected natural history objects in the Middle East. For example he named the following species (Figs 1–3): *Multidentula ovularis* (Olivier, 1801) and *Bulgarica denticulata* (Olivier, 1801) from "Ghemlek" [= Gemlik in the Bay of Mudanya] or *Assyriella guttata* (Olivier, 1804) from Urfa (for more information on Olivier and his famous collection we refer to Tillier and Mordan 1983). After Olivier, the area was visited by the German J. R. Roth and his party (Roth 1839), and then was target of other scientists, naturalists and collectors like Bellardi, Boissier, Dubois de Montpereux, Frivaldsky, Huet de Pavillon, Parreyss, Schläfli, Sievers and others. Their collections went to the most prolific malacologists interested in the area like Bourguignat, Charpentier, Küster, Mousson, L. Pfeiffer and Rossmässler. In the second half of the 19th century, the famous German malacologists O. Boettger and W. Kobelt from the Senckenberg Museum in Frankfurt intensified the malacological research in Turkey, with contributions by Nägele, Retowski and Westerlund. After Kobelt's death in 1916, the "Golden Age" of malacology was finished except for some contributions by P. Hesse, Lindholm and O. von Rosen. After almost 50 years of scientific silence, it was the "Netherlands biological expedition to Turkey 1959", which again shifted the focus of malacologists to Turkey (Anonymous 1963). Since then, the malacological science received an enormous boost and stimulated both international as well as Turkish scientists to deepen the knowledge of theTurkish malacofauna. During this period, which now lasts about 50 years, one third of the number of taxa accepted today as valid has been added! Some of the most active contributors to this success should be mentioned here (in alphabetic order of the surnames): Bank, R.A., Falkner, G., Forcart, L., Gittenberger, E., Gümüs, B.A., Hausdorf, B., Hudec, V., Menkhorst, H.P.M.G., Neubert, E., Nordsieck, H., Rähle, W., Riedel, A., Schütt, H., Şeşen, R., Szekeres, M.I., Wiktor, A. and Yıldırım, M.Z.

Status of knowledge

Calculation of the absolute number of taxa is somewhat arbitrary, because this number strongly correlates to the species concept favoured by the particular researcher. Traditionally, molluscs are an overdescribed group, at least on the species-level, and for Turkey an average of two to three additional synonym names for each taxon are available. This opens a large field for lumpers and splitters and explains partly differing numbers. The calculation presented here offers a balanced view over the majority of opinions regarding taxa numbers in particular groups published so far, and scrutinized by our own experience.

According to our files, the Turkish malacofauna currently comprises 730 valid species and subspecies of terrestrial snails belonging to 36 families. The degree of endemism for the area of Turkey is about 65 %. An analysis of the increase of species

Figures 1–3. Endemic molluscan species from Turkey described by G. A. Olivier: **1** *Multidentula ovularis* (Olivier, 1801), 20 km S of Küthaya, ex coll. Menkhorst, H = 5.1 mm **2** *Assyriella guttata* (Olivier, 1804), syntype MNHN (coll. Olivier), Urfa, D = 32.3 mm **3** *Bulgarica denticulata* (Olivier, 1801), syntype MNHN (coll. Olivier), "Ghemlek", H = 14.7 mm.

numbers since 1950 is presented in Table 1. It illustrates the enormous increase of taxonomical knowledge which was achieved during this relatively short period.

Still, the census of the malacobiodiversity of Turkey has to be continued, and large areas in the country remain white spots. Some of them, like the inneranatolian steppe areas, will not contribute essentially because of their relatively unsuitable habitats. However, the malacofauna of many of the densely forested mountain ranges are unsatisfactorily or almost completely unknown. Records of species new to science can be expected, and the knowledge about the ranges of already known taxa will be increased. Another increase in taxa numbers may be caused by the recovery of cryptic species with the help of DNA sequencing methods, the Barcoding Project and other related activities. We conclude that there are more species waiting to be recovered and described, and estimate the total number of species (including subspecies) will reach and probably surmount 1.000 taxa. It should be noted that Turkey also has a very rich freshwater malacofauna with an enormous degree of endemic species. Unfortunately, the scientific exploration of this interesting group still is in a quite unsatisfactory state, and reliable numbers for the content of species- and genus-level taxa are hardly to obtain. According to our unpublished catalogues, we estimate that Turkey is inhabited by 300 species of freshwater molluscs, at least.

The degree of endemism on species level is relatively high and is comparable to that of Greece, which houses the highest number of terrestrial snail taxa in Europe

Table 1. Increase of newly described taxa within the last 30 years*.

New taxa (species level)		New taxa (genus level)	
1950–1959	3	1950–1959	4
1960–1969	21	1960–1969	4
1970–1979	16	1970–1979	5
1980–1989	57	1980–1989	5
1990–1999	124	1990–1999	11
2000-present	37	2000-present	1 (not yet published)
Σ	258		30

*Numbers do not count taxa exclusively described as new from Turkey. This is particularly true for genera.

with a similarily high value of endemism (cf. CLECOM database). These eastmediterranean landscapes with their specialised types of vegetation have been inhabited by particularly prolific malacocoenoses, which could develop there without any major interruption since the Pliocene. This is a major difference to Central Europe, where sequences of long-lasting glaciations were interrupted by warmer ice-free periods causing a permanent destruction and re-settlement by molluscs. This may be one of the reasons for the high endemism on species- and genus-level in the eastmediterranean and Middle East region. In Turkey, several pulmonate families reach a maximum of biodiversity (Table 2, Fig. 4).

The prevalence of a few families was also reported by Cook (1997), who evaluated taxonomic and geographic patterns, endemism, and the relationship between shell dimensions, habitat requirements, niche occupancies and the competition bet-

Table 2. Comparison of species richness of important families between Turkey and Europe (based on Fauna Europaea).

Family	Turkey	Europe
Orculidae	41	49
Enidae (enormous radiation of family on the Macaronesian Islands)	115	116
Oxychilidae (high number for Europe based on splitting of taxa in France and Italy)	45	122
Clausiliidae (Turkey is home to 95% of the subfamily Mentissoideinae)	175	500
Hygromiidae (Turkey is strong for several endemic genera)	112	490
Helicinae (high value for European Helicinae is caused by genus *Murella* from Sicily with > 100 taxa (to be merged to a single polymorphic species according to DNA-studies (Giusti and Manganelli, pers. comm. 2007))	52	283

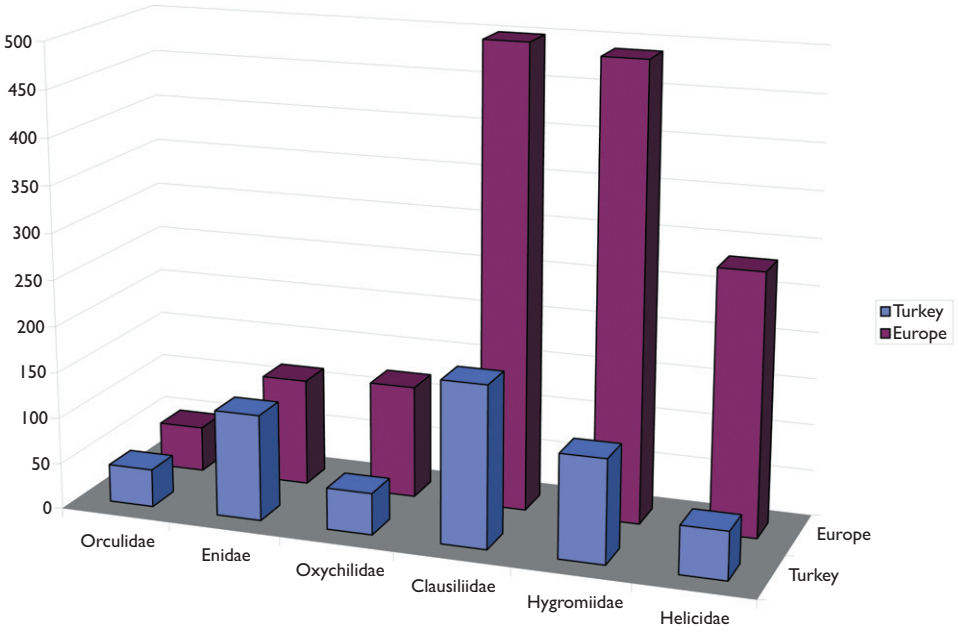

Figure 4. Histogram showing the relative species richness of selected pulmonate families from Turkey in comparison to Europe (partly after CLECOM or own investigation).

ween sympatric species. He concluded that the Turkish malacofauna is not that well balanced as that of (continental) Europe, and thus is more similar to that of island groups like for example the Madeiran Archipelago. He also suggested that the Turkish fauna still shows evidence of external penetration with some local radiation, and that Turkey has not been a major centre of evolutionary novelty. However, the study of Cook is based on the synopsis of Schütt (1993) using 336 species with several of them being wrongly identified. The considerable increase of our knowledge since 1993 with description of new endemic taxa, the large number of new records for species outside Schütt's "zones"and the presumed backlog of not yet discovered species surely would nowadays yield a differing result and cast the "similarity" with Madeira into some doubt.

Future research perspectives

The extinction of species is a worldwide process with an increasing anthropogenous contribution. On a global scale, terrestrial molluscs belong to the most vulnerable taxa (Lydeard et al. 2004). Next to the already well documented threats, Global Warming will heavily affect terrestrial malacocoenoses by increasing desertification of landscapes, aggradation of lakes, and decrease of water volumina available for wildlife. National and international strategies have to be developed to abate these effects as much as possible, but all efforts will fail if we do not understand the system which is the target for protection. For this reason, science has to provide the basic data to achive

sustained success for the protection of natural resources, which, last but not least, will protect mankind as well.

Thus, the first step must be a complete survey of the species of molluscs living in Turkey, because only a species known by us can be protected! The hitherto malacological research and the revison of major groups of terrestrial snails resulted in a very detailed picture of the Turkish malacofauna. However, the potential backlog of 250 taxa (or even more) requires enormous efforts for the future research. For this reason, the authors are about to launch some short-term projects which will focus on the investigation of the malacofauna of smaller areas which have been ommitted so far. For the long-term perspective, the following research topics should be addressed:

1) A nationwide survey with a parallel documentation of habitats, possible threats, etc. has to be conducted. This should follow a small-scaled itinery to make sure that each habitat is de facto covered. These surveys should serve as a major source of specimens for all subsequent types of research.

2) Molecular studies on different terrestrial and freshwater gastropods are increasingly used to revise the systematic position of taxa. However, for Turkey, there is only one molecular study concerning the family Clausiliidae of the Aegean and the Mediterranean regions (Uit de Weerd and Gittenberger 2004). We think that using DNA-Sequenzing in parallel to morphological work will recover more cryptic taxa in Turkey. It will support the research on phylogeny, evolutionary trends, speed of speciation, and many other interesting details of the Turkish malacofauna.

3) Preparation of a Red Data List of endangeroued species for Turkey. Prerequisit for such an enterprise is an extraordinarily good knowledge of the malacofauna, but also a broad understanding of the biology of the species, particularly of their specific niches and habitat requirements. This scientific branch, the aut-, dem- and synecology, is widely ignored in malacology, although here enormous advances of knowledge can be expected. These data, once obtained, should be compiled and can be presented to the global community via organisations like IUCN and others.

4) Snails are excellent indicator organisms for any kind of environmental research, because I) they colonise almost every habitat, II) the group is speciose, but not in too great numbers like insects, III) they are highly sensitive against short, medium or long-scaled change of the environment, IV) they can be easily identified (once the survey is accomplished!), V) some species can be used as Flagship Species to raise public awareness for the protection of nature and the implementation of Nature Reserves.

5) A nation-wide independent institution like a Museum of Natural History is urgently needed to built up collections on the Turkish wildlife, to be used for comparison and to support further studies. Ideally, such an institution is accessible for anyone, who has a decided interest in snails, i.e. professionals as well as laymen. Today, Turkish malacologists keep their specimens in their private mollusk collections, and exchange of thoughts and specimens is cumbersome and ineffective. A Museum of Natural History presents a perfect platform capable to satisfy all these requirements as exemplified by many such museums in other countries.

6) Molluscs are one of the few groups that are well preserved in the fossil record, and for sure the most species-rich entity in excavations. Archaeomalacology — the study of molluscs in archaeological contexts — is a relatively new archaeological discipline. The field derived from archaeozoology, the study of animal remains from archaeological sites (Bar-Yosef Mayer 2008). Recently, archaeomalacology in Turkey has attracted the senior author and other Turkish colleagues like Dr. C. Çakırlar (Gümüş 2005, 2006; Mienis and Gümüş 2007). They have started to study recent and the subfossil shells from excavations in early human settlements like in Çatalhöyük (Çumra, Konya, in collaboration with Dr D. E. Bar-Yosef Mayer from Israel), in Şapinuva (Ortaköy, Çorum), and Troia (Çanakkale) (Çakırlar 2008). Subfossil shells have been collected from the walls of the archaeological sites (Fig. 5). An unusual finding of terrestrial snails in an Bronce-aged ship-wreck was recently recorded by Welter-Schultes (2001). Interestingly, snails have been used for various purposes by humans, and some of the species were identified as having served as ornaments or probably were used as food (Fig. 6) (Bar-Yosef Mayer and Gümüş 2008).

Next to these human-related fields, the taxonomic composition of these findings can be used as indicators for the prevailing climatic conditions at the time when these

Figure 5. The edge of a house wall where the freshwater and the terrestrial gastropods were collected from the excavation area in Catalhöyük archaeological site (Bar-Yosef Mayer and Gümüş 2008).

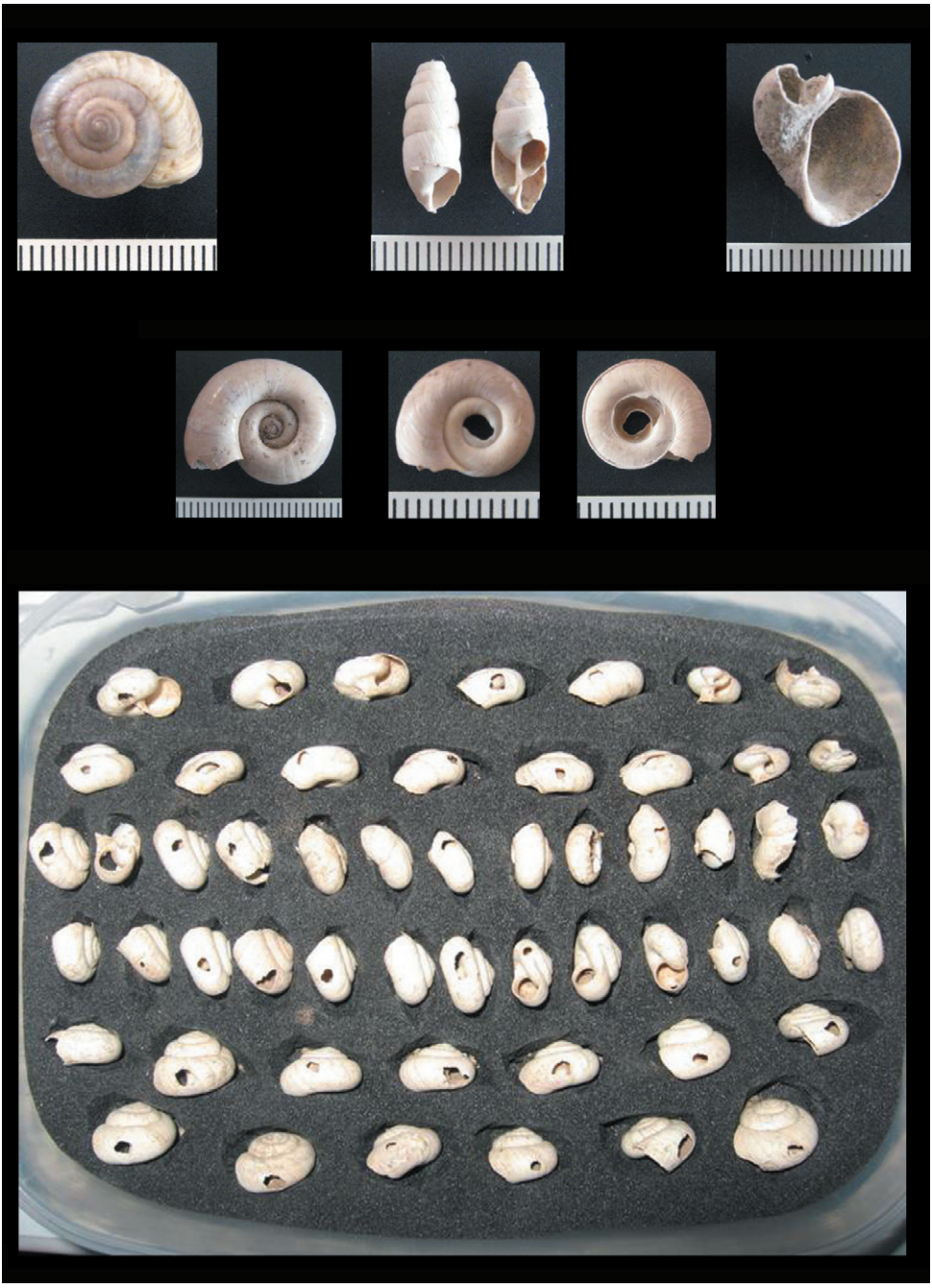

Figure 6. An assemblage of native pulmonate species found at Çatalhüyük (ca. 10.000 y bp). Note the holes in the shells of a small terrestrial snail species on the bottom. They probably were used as a necklace (Bar-Yosef Mayer and Gümüş 2008; Catalhoyuk Research Project Archives, Photographed by Burçin Aşkım Gümüş).

places have been settled by humans. Standardised comparisons with the recent malacofauna of the area may help to understand shifts in micro- and macroclimate.

Acknowledgments

Thanks are due to our families, who always encouraged us, our many colleagues, who supported us and made this study possible due to their many valuable contributions, and the input made by two anonymous reviewers. This work is dedicated to our friend, the late Dr Margret Gosteli (Natural History Museum Berne), who was team member of our joined survey trip in western Turkey in 2006. Her memory will always be kept in our minds and hearts.

References

Anonymus (1963) Concise survey of localities and collection numbers of zoological and botanical specimens, collected by the Netherlands biological expedition to Turkey 1959. Zoologische Mededelingen, 38 (8): 129–151, Leiden.

Bank RA, Menkhorst HPMG (1994) Katalog der rezenten Clausiliidae (exkl. Gattung *Albinaria*) der Türkei (Gastropoda, Pulmonata). Deinsea, 1: 85–122, Rotterdam.

Bar Yosef-Mayer DE, Gümüş BA (2008) Çatalhöyük 2008 Shell Archive Report. pp. 160–166. http://www.catalhoyuk.com/downloads/Archive_Report_2008.pdf.

Bar-Yosef Mayer DE (2008) Archaeomalacological research in Israel: The current state of research. Israel Journal Earth Sciences; 56: 191–206.

Çakırlar C (2008) Investigations on archaeological *Cerastoderma glaucum* population from Troia (Turkey) and their potential for palaeoeconomical reconstruction. Archaeofauna, 17: 91–102.

Cook LM (1997) Geographic and ecological patterns in Turkish land snails. Journal of Biogeography, 24 (4): 409–418.

Demirsoy A (1999) Genel ve Türkiye Zoocoğrafyası "Hayvan Zoocoğrafyası". Meteksan A. Ş., Üçüncü Baskı, 965 s., Maltepe-Ankara, ISBN: 975–7746–26–6.

Gümüş BA (2004) Taxonomic studies on the Clausiliidae (Gastropoda: Pulmonata) species distributed in Western Anatolia. PhD thesis, University of Süleyman Demirel, Isparta, Turkey.

Gümüş BA (2005) The land snails (Gastropoda: Pulmonata: Stylommatophora: Clausiliidae) of the ancient cities in the Marmara, the Ege (Aegean) and the Akdeniz (Mediterranean) regions of Turkey. The Archaeo+Malacology Group Newsletter, 7: 1–4. http://triton.anu.edu.au/issue_7.htm.

Gümüş BA (2006) Additional data to the distribution of *Papillifera papillaris* (O. F. Müller, 1774) (Gastropoda: Pulmonata: Stylommatophora: Clausiliidae) in Istanbul, Turkey. The Archaeo+Malacology Group Newsletter, 10: 4–6. http://triton.anu.edu.au/issue_10.htm.

Hausdorf B (2000) The genus *Monacha* in Turkey (Gastropoda: Pulmonata: Hygromiidae). Archiv fur Molluskenkunde, 128 (1/2): 61–151, Frankfurt am Main.

Hausdorf B (2001) The genus *Ena* in Turkey, with remarks on its phylogenetic relationships (Gastropoda: Buliminidae). Journal of Natural History, 35 (11): 1627–1638, London.

Hütteroth WD, Höhfeld V (2002) Wissenschaftliche Länderkunden Türkei. – 380 pp.; Darmstadt (Wissenschaftliche Buchgesellschaft).

Loosjes FE (1963) Clausiliidae (Gastropoda, Pulmonata) collected by the Netherlands biological expedition to Turkey in 1959. Zoologische Mededelingen, 38 (15): 243–260, pl. 18–20, Leiden.

Lydeard C, Cowie RH, Ponder WF, Bogan AE, Bouchet P, Clark SA., Cummings KS, Frest TJ, Gargomıny O, Herbert DG, Hershler R, Perez KE, Roth B, Seddon M, Strong EE, Thompson GG (2004) The global decline of nonmarine mollusks. BioScience, 54 (4): 321–330.

Mayer H, Aksoy H. (1986) Wälder der Türkei. – 290 pp; Stuttgart / New York (G. Fischer).

Mienis H, Gümüş BA (2007) More notes on the extra-territorial distribution of *Papillifera papillaris*, a species often associated with archaeological sites. The Archaeo+Malacology Group Newsletter, 11: 4–7. http://triton.anu.edu.au/issue_11.htm.

Nemeth L, Szekeres, M (1995) The systematic position of some new and little-known species of Clausiliidae from Turkey (Mollusca, Stylommatophora). Zoology in the Middle East, 11: 93–108, Heidelberg.

Neubert E (1992) Descriptions of new taxa of the Clausiliidae from Turkey (Mollusca: Stylommatophora). Zoology in the Middle East, 7: 65–86, Heidelberg.

Neubert E (1995) Note on some genera of Clausiliidae from Turkey (Mollusca, Stylommatophora). Zoology in the Middle East 11: 101–1-8, Heidelberg.

Neubert E, Menkhorst HPMG (1994) New taxa of *Armenica* (Mollusca, Stylommatophora, Clausiliidae) from Turkey. Zoology in the Middle East, 10: 139–159, Heidelberg.

Neubert E, Örstan A, Welter-Schultes F (2000) The land snails of the area between Kaş and Demre, Southwestern Turkey, with special reference to *Albinaria* (Gastropoda: Pulmonata: Clausiliidae). Basteria, 64: 105–123, Leiden.

Nordsieck H (1993) Türkische Clausiliidae, I: Neue Arttaxa des Genus *Albinaria* Vest, 1867 in Süd-Anatolien (Gastropoda: Stylommatophora). Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie), 499: 1–31, Stuttgart.

Nordsieck H (1994) Türkische Clausiliidae, II: Neue Taxa der Unterfamilien Serrulininae und Mentissoideinae in Anatolien (Gastropoda: Stylommatophora). Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie), 513: 1–36, Stuttgart.

Nordsieck H (2004) Türkische Clausiliidae, III: Neue Arttaxa der Unterfamilien Alopiinae und Mentissoideinae aus Anatolien (Gastropoda: Stylommatophora). Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie), 670: 1–28, Stuttgart.

Olivier GA (1801–1807) Voyage dans l'Empire Othoman, l'Egypte et la Perse, fait par ordre du Gouvernement, pendant les six premières années de la République. Tome premier: 432 pp. (1801); Atlas, 1st. livraison: VII pp., pl. 1–17 (1801); Tome second: 466 pp. (1804); Atlas, 2d livraison: VII pp., pl. 18–32 (1804); Tome troisième: 566 pp. (1807); Atlas, 3d livraison: VIII pp., pl. 34–50 (1807). Paris (Agasse).

Örstan A, Yıldırım MZ, Gümüş BA, Welter-Schultes F (2005) The land snails of the Bodrum. Mitteilungen der Deutschen Malakozoologischen Gesellschaft, 73/74:1–15, Frankfurt am Main.

Riedel A (1995) Wenig bekannte und neue Zonitidae aus der Türkei (Gastropoda: Stylommatophora). Malakologische Abhandlungen Staatliches Museum für Tierkunde Dresden, 17 (10): 121–136, Dresden.

Riedel A (1989) Zonitidae (sensu lato) des Ostpontischen Gebirges in der Türkei (Gastropoda). Ann. Zoologici, 42: 363–424, Warszawa.

Roth JR (1839) Molluscorum species, quas in itinere per Orientem facto comites clariss. Schubert doctores M. Erdl et J.R. Roth collegerunt. Dissertatio inauguralis. – München (Wolf): 26 pp., pl. 1–2.

Schmidt G (2006) Sie bauten die ersten Tempel. Das rätselhafte Heiligtum der Steinzeitjäger. 282 pp; München (C.H. Beck).

Schütt H (2005) Turkish land snails 1758–2005. 4th, revised and enlarged edition. Verlag Natur & Wissenschaft Solingen, 559 p.

Şeşen R, Schütt H (2005) The clausilioid genus *Idyla* in Turkey (Gastropoda: Pulmonata: Clausiliidae). Club Conchylia Informationen 37 (1/2): 3–5, Ludwigsburg.

Stojaspal F (1986) Ein Beitrag zur Molluskenfauna der Türkei. Mitteilungen der Deutschen Malakozoologischen Gesellschaft, 38: 11–20, Frankfurt am Main.

Tillier SP, Mordan P (1983) The conchological collections of Bruguière and Olivier from the Ottoman Empire (1792–1798). Journal of Conchology, 31 (3): 153–161, pl. 5–7. London.

Uit De Weerd DR, Gittenberger E (2005) Towards a monophyletic genus *Albinaria* (Gastropoda, Pulmonata): the first molecular study into the phylogenetic position of eastern *Albinaria* species. Zoological Journal of the Linnean Society, 143: 531–542, London.

Welter-Schultes FW (2001) Land snails from an ancient shipwreck: The deed to detect wreck-independent finds in excavation analysis. Journal of Archaeological Science, 28: 19–27.

Yıldırım MZ (1997) A new subspecies of *Sprattia sowerbyana* O. Boettger, 1883 from Eğirdir (Turkey): *Sprattia sowerbyana aksoylari* nov. subsp. (Mollusca, Pulmonata, Clausiliidae). Turkish Journal of Zoology, 21: 219–221, Ankara.

Yıldırım MZ, Kebapçı Ü, Gümüş BA (2004) Edible Snails (Terrestrial) of Turkey. Turkish Journal of Zoology, 28: 329–335, Ankara.

CLECOM Project: http://www8.vgregion.se/gnm/clecom/clecom.asp?res=1280.