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The Zonitidae sensu lato of Turkey A distribution analysis (Gastropoda: Stylommatophora)

With 13 Maps and 1 Table

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Abstract. The paper contains a zoogeographic discussion on the fauna of the Zonitidae sensu lato (Gastropoda terrestria) of Turkey. The attempt at a zoogeographic division of Asia Minor, presented here, is more comprehensive than the preliminary one (RIEDEL, 1994). The analysis of the zonitid distribution was based on: 1) a comprehensive work on the zonitid fauna (RIEDEL, 1995) and species distribution maps contained therein; 2) distribution table included in the present paper; 3) author's earlier papers on the zonitid fauna of adjacent countries. Seven distinct regions of Asia Minor, differing in their zonitid fauna, were distinguished and characterized. Additional zoogeographic remarks on the fauna are also included.

Kurzfassung. Die Zonitidae sensu lato der Türkei. Eine Analyse der Verbreitung (Gastropoda: Stylommatophora). – Die Arbeit umfaßt eine zoogeographische Diskussion der Fauna der Zonitidae sensu lato (Gastropoda terrestria) der Türkei. Der Versuch einer zoogeographischen Gliederung von Kleinasiens, welcher hier vorgelegt wird, ist umfassender als der vorhergehende (RIEDEL, 1994). Die Analyse der Verbreitung der Zonitidae basiert auf: 1) einer zusammenfassenden Arbeit über die Zonitidenfauna (RIEDEL, 1995) und der darin enthaltenen Verbreitungskarten der Arten; 2) der Tabelle zur Verbreitung der Arten in der vorliegenden Arbeit; 3) den vorlaufenden Arbeiten des Verfassers über die Zonitidenfauna benachbarter Länder. Es werden sieben verschiedene Regionen Kleinasiens, welche sich in der Zusammensetzung ihrer Zonitidenfauna unterscheiden, gekennzeichnet und charakterisiert. Ergänzende zoogeographische Bemerkungen zur Fauna sind eingeschlossen.

Introduction and general remarks

The knowledge of the species composition and distribution of the fauna of Zonitidae s.l. (i.e. including Daudebardiidae and Gastrodontidae) of Turkey is still unsatisfactory, compared e.g. with Greece, with respect to malacological exploration and to the number of localities from which material is available for studies (cf. RIEDEL, 1992: 111 and map 3). Nonetheless, the state of knowledge of Asia Minor is not altogether bad, especially after the most recent summary of the known localities (cf. RIEDEL, 1995: e.g. maps 23 and 40 – widely distributed species; maps 22, 33, 38 and others – common, but narrowly distributed species), and permits definite and probably correct zoogeographic conclusions.

However, a possibility of discovering in Turkey further zonitid species, new to the science (see below) should be taken into account, as well as finding localities of already known species rather far from their presently known range. This will result in an array of corrections in the picture presented in this paper. Compare my own original opinions on the dis-

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tribution and later records of *Vitre a hattiana* (cf. NEUBERT & RIEDEL, 1993 and RIEDEL, 1995: map 3) and *Oxychilus paphlagonicus* (cf. RIEDEL, 1993 and 1995: map 26).

The Zonitidae, being mesophilic, constitute a poorer object of zoogeographic analysis than e.g. Enidae s.l., which are equally well studied (FORCART, 1940; GITTEMBERGER, 1967 and further smaller contributions of various authors) and which inhabit also dryer areas and habitats, most often avoided by the zonitids. At the same time, a high number of zonitid species, their often narrow (endemic) distributions, usually low lability and attachment to a particular type of locality and habitat (permanent occurrence deep in the litter, screes, under stones or in rock crevices)¹⁰, considering a reasonably good taxonomic knowledge of the group, make them a good object of zoogeographic considerations on the entire Asia Minor. This, however, pertains especially to coastal zones (around the Black, Aegean and Mediterranean Seas), with adjacent mountain ranges and massifs.

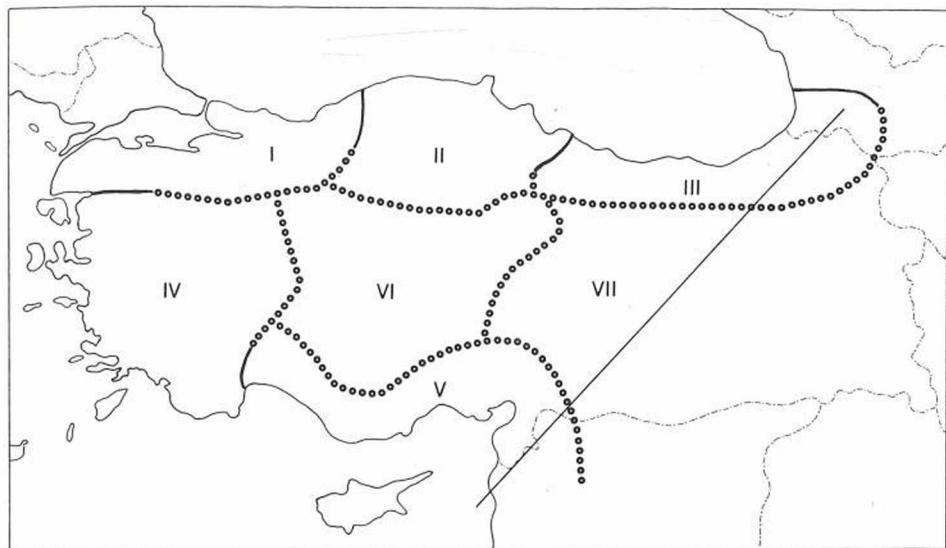
A preliminary zoogeographic division of Asia Minor, based on the distribution of the Zonitidae s.l., was presented briefly in April 1993 in Thessaloniki, during the VIth International Congress of the Zoogeography and Ecology of Greece and the Adjacent Regions (RIEDEL, 1994). Since then, because of examining new and abundant materials, species known from Turkey and its particular regions have increased in number. This has not changed significantly the general picture of distribution and the earlier adopted zoogeographic division.

A straight line running more or less from Artvin to Antalya (map 1) was arbitrarily adopted as the eastern border of Asia Minor; the remaining borders are determined by the Black, Aegean and Mediterranean Seas. However, in the analysis presented below, I have considered also the remaining areas of Turkey, zoogeographically included in the regions neighbouring to Asia Minor: European Turkey (as a part of my Region I) and the areas of eastern Turkey, bordering on Regions III and VII.

Till present, 79 zonitid s.l. species and subspecies have been recorded from Asia Minor and the whole Turkey, plus several probably new and still undescribed because of the very scanty material. Of these, 35 species, i.e. almost half, are known exclusively from Turkey and only very few of them can be expected to be found outside the borders of this country (e.g. *Oxychilus costatus* and *O. andronakii* - in Adzhariya). Their distribution ranges in Turkey are usually limited to small areas, wider distribution of Minor Asia endemics being rather exceptional (e.g. *Vitre a hattiana*, *V. ilgazdaglariensis*; RIEDEL, 1995: maps 3 and 4). Also further 28 species (over 30 %) should be regarded as narrowly distributed; they are known only from some small areas in Turkey and one of the adjacent countries. Only 16 species (ca. 20 %) can be regarded as widely or very widely distributed. However, even their distribution, except *Vitre a pygmaea* (cf. RIEDEL, 1995: map 5), does not cover the whole country, and reaches one of its borders in Asia Minor. Only some of them inhabit considerable areas of Asia Minor, e.g. *Eopolita derbentina* in the east (cf. RIEDEL, 1995: map 40), *Vitre a contracta* and *Oxychilus hydatinus* in the west and north (cf. RIEDEL, 1995: map 27), *O. delius* in the north and *O. cyprius* in the south (RIEDEL, 1995: map 23).

I expect further 15 known (i.e. already described) species to be found in Turkey, because of their presence in the borderlands of the adjacent countries, poor knowledge of the neigh-

¹⁰On numerous occasions in the NW African countries, Italy, the former Yugoslavia, Romania, Caucasian countries, Near East etc. I collected (refound) some species, often more than a hundred years after their original description, in their type localities, if those were possible to locate and if the character of the habitat had not changed in the meantime under the effect of human activities.



Map 1. Proposed zoogeographic division of Turkey, based on the distribution of Zonitidae s. l. (according to RIEDEL, 1994). Straight solid line: arbitrary eastern border of Asia Minor. I. Marmara Region, II. West Pontic Region, III. East Pontic-Adzharian Region, IV. Aegean Region, V. Taurus Mts Region, VI. Anatolian Upland Region, VII. Armenian Upland Region. The division results from plotting on the map (UTM grid system) known localities of particular species, determining their ranges and summarizing the results, compared with physical maps.

neighbouring areas of Turkey, and considering the lack of geographic-climatic barriers in those areas. This pertains mainly to European Turkey (border with a better studied malacofauna of SE Bulgaria and Greek Thrakia), and to a somewhat lesser extent to the Asian coast of the Aegean Sea (species known from the Greek Aegean Islands), to the north-eastern fringes of Turkey (species known from Georgia and Armenia), and finally to malacologically poorly explored areas of eastern and south-eastern Turkey.

For the list and distribution of species recorded and expected from Turkey see Table 1 at the end of this paper.

Zoogeographic division of Asia Minor (and whole Turkey)

Based on the present knowledge of the species composition and distribution of the Zonitidae s.l., the following zoogeographic regions can be distinguished in Asia Minor (and whole Turkey); their limits are to a great extent approximate and corrections will certainly be needed in the future.

I. Marmara Region. It comprises all the European Turkey, and Asian Turkey from Bosporus, roughly to the mouth of the Yenice Irmagi River in the east. Inland it reaches approximately to the line: Erdemir Gulf-Balikesir-Eskişehir-Nallıhan-Gerede-valley of the rivers Gerede/Soğanlı/Yenice (E Zonguldak).

II. West Pontic Region extends from the Yenice River valley (E Zonguldak) to Çarşamba Lowland and the Yeşilırmak River valley (E Samsun). Inland it reaches roughly to the line: Gerede-Ankara (?) in the south - mid section of the Kızılırmak River-Amasya-Çarşamba.

III. East Pontic-Adzhariyan Region includes the area from Çarşamba Lowland to the eastern border of Turkey (and beyond it). The southern limit is determined by the East Pontic mountain range or, at most (farthest inland), valleys of the rivers Kelkitçayı and Çoruh.

IV. Aegean Region on the continent of Asia Minor reaches from the Erdemir Gulf, along the Aegean Sea almost to Antalya. Inland it extends more or less to the line Eskişehir-Afyon (Akşehir?)-Isparta-Korkuteli and somewhat west of Antalya.

V. Taurus Mts Region (Toros Dağları) extends from the eastern border of Region IV (Isparta-Korkuteli-Kemer SSE Antalya), along the Mediterranean coast to Vilayet Hatay (and slightly farther southwards, to NW Syria). The northern border of the region is very uncertain (there are no materials from higher, still not easily accessible parts of the Taurus Mts and from their northern slopes). It can be provisionally determined as the line Isparta-Beyşehir (? or at least Akseki)-roughly Ermenek-valley of the Göksu River northwards to the Sertavul Pass, farther along the main range of the Taurus Mts (Bolkar Dağları, Aydos Dağları) to Ulukişla, through Ala Dağ (or through Niğde to Kayseri-Erciyes Dağı!) to Feke and southwards through Bahçe to the state border and to Haleb in Syria.

VI. Anatolian Upland Region extends from the approximate inland borders of Regions I, II, IV and V eastwards roughly to Amasya-Tokat-Sivas-Kayseri.

VII. Armenian Upland Region extends south of the border of Region III, east of VI, north-east of V. A considerable part of this region, even in Turkey, is outside the accepted border of Asia Minor.

Note. Because of the only approximately determined borders of the regions distinguished above, assigning some of the known localities to particular regions in the distribution table is sometimes debatable. The doubts are noted under „Remarks“.

It is noteworthy that the proposed zoogeographic division of Turkey, based on the zonitid distribution, is strikingly similar to that adopted by SCHÜTT (1993) in his „Türkische Landschnecken“ and based on a „weather map“ (geoclimatic regions), presented on Turkish TV. I would like to stress that the preliminary regionalization of Asia Minor (RIEDEL, 1994), with a map which is also included here, was prepared at the end of 1992, before SCHÜTT's paper appeared, and it was not influenced by the „weather map“, though I saw it sometimes on Turkish TV. The congruence of these two independent divisions is much greater than any compatibility with the division into „zoogeographic provinces“, proposed by FORCART (1940)². This confirms my opinion that, besides historical reasons, climatic conditions have the greatest effect on the zonitid distribution. The distribution is further affected by the character of vegetation (depending on climatic conditions), orography, substratum and its structure (possibility to hide from drought and frost), finally the type, chemical composition and geological origin of the soil, rocks etc.

² It is also noteworthy that the division of Asia Minor into Regions I-V, proposed by me, is largely confirmed by the distribution of the Clausiliidae (cf. NORDSIECK, 1993: maps 3-5 - *Albinaria*; BANK & MENKHORST, 1994: maps 1-11 - *Clausiliidae excl. Albinaria*). They are, besides the Enidae s.l. and Zonitidae s.l. (BANK & MENKHORST, 1994: 86) among the most speciose land snail families in Turkey, with a strongly pronounced endemism. This makes them very suitable for zoogeographic analyses and regionalization of Asia Minor, though they still have not been more widely used for that purpose.

Obviously, abundance of soils and rocks of high calcium content, development of karstic formations, presence of rock crevices and screes e.g. in the Aegean Region, accompanied by an at least periodical effect of mild oceanic climate, favour the zonitid occurrence, survival of drought periods etc., i.e. existence of diverse and abundant fauna. However, deficiency of these factors (except mild climate) in the East Pontic-Adzhariyan Region is compensated for by an abundant rainfall and its more regular annual distribution (increasing eastwards), lush vegetation and abundant, humidity-preserving, leaf litter (cf. NEUBERT, 1993: 25). As a result, the zonitid fauna of Region III is at least as rich and diverse as that of Region IV.

In Turkey, and more precisely in Asia Minor, there are at least 3-4 regions – speciation centres, decidedly differing in the inhabiting zonitid fauna.

1. Region III - East Pontic-Adzhariyan, extends eastwards and northwards beyond the Turkish borders, including also the western part of Adzhariya and reaching the southern border of the Colchis Lowland. In Turkey it is the zonitid-richest region (33 species = 42 % known Turkish zonitid fauna, plus 5 species expected) and characterized by a very pronounced endemism (c. 50 % species).
2. Region IV - Aegean, reaching the farthest into Anatolia, zoogeographically includes also numerous Greek islands of the Aegean Sea. The number of species known from the continental part of the region is only slightly lower than that in Region III, and the specific-level endemism is even higher.
3. Region V - the Taurus Mts, almost entirely within the Turkish borders and Asia Minor. The number of species recorded (20) is clearly lower than that in Regions III and IV, but the degree of endemism is much higher (ca. 70 %).
4. Region I - Marmara, is no doubt zoogeographically distinct, closely related faunistically to the south-east of the Balkan countries, but its part included in European Turkey is almost unknown.

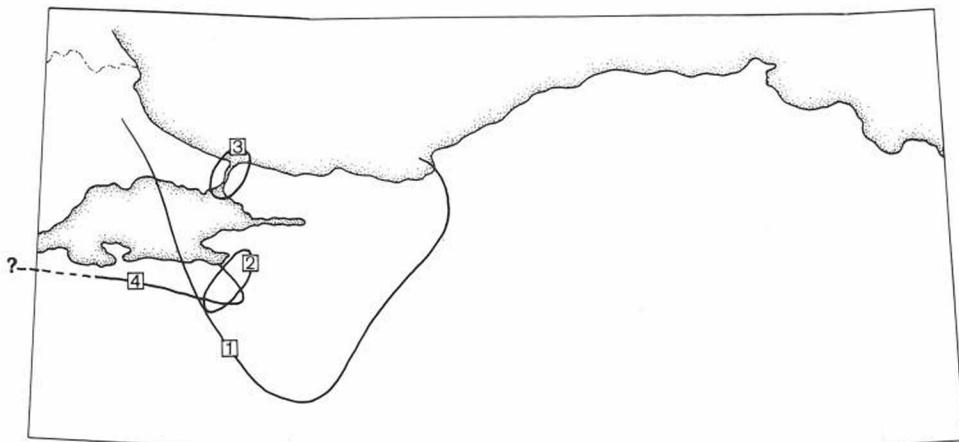
I think that at least the above 3-4 regions and their approximate borders may be taken into account and find confirmation in the distribution analysis of other snail groups and other taxa of terrestrial invertebrates.

Zonitidological characteristics of the distinguished regions

I. Marmara Region

Besides the north-western part of Asia Minor, marked on the map 1, with respect to the zonitid fauna it includes also European Turkey and the south-eastern part of Bulgaria (Stranja), and the influences of this fauna reach northwards to the eastern part of the Stara Planina Mts.

It should be stressed, as was already mentioned above, that the zonitids of European Turkey, in spite of the easy access to the area, are exceptionally poorly explored and scantly represented in the collections, contrary to the malacofauna of south-eastern Bulgaria. It can be assumed with a high probability that a few zonitid species, known from Bulgarian Stranja, will be recorded also at least from the European part of Turkey (*Aegopinella minor*, *Balcanodiscus frivaldszkyanus*, *Daudebardia wiktoria*, *Carpathica bielawskii*); as well as some species known from the eastern part of Greek Thrakia (e.g. *Balcanodiscus cerberus* RIEDEL, *Oxychilus glaber*).



Map 2. Distribution of some zonitids in Region I: 1 - approximate distribution border of *Oxychilus (Morlina) urbanskii*, besides inhabiting SE Bulgaria (cf. RIEDEL, 1975: map 3); 2 - known range of *Vitrea lodosi*; 3 - known range of *O. (M.) moussonii*; 4 - known range of *Carpathica wirthi*.

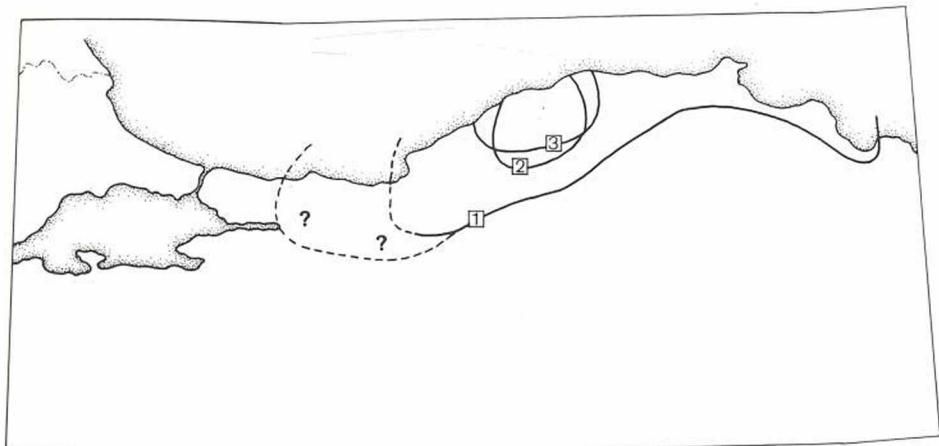
At present 20 zonitid species are known from this region (including 2 species introduced, synanthropic, and 2 species probably new, undescribed), plus 3 species, whose identification is not quite certain. The fauna bears distinctly „Balkan“ traits, most of the recorded species being shared with Bulgaria (cf. RIEDEL, 1975: among others maps 1 and 3), even some of those characteristic of the region and narrowly distributed (*Oxychilus investigatus*, *O. urbanskii* - RIEDEL, 1995: maps 28 and 39). A widely distributed Pontic species, *O. deilus*, is common and abundant. Four species (including 2 undescribed) might possibly be endemic to Region I; all are known from very few localities: *Vitrea lodosi*, *V. spec. (nova?) aff. lodosi*, *V. spec. (nova?) aff. sorella* - all the three only from the Asian part of the region, and *Oxychilus moussonii*, known only from a few localities grouped near Istanbul, on both sides of Bosphorus (map 2).

Carpathica wirthi may also be endemic (cf. RIEDEL, 1995: map 45), since its occurrence on a Greek (Thracian) island of Samothraki needs confirmation. From the east, Region I is penetrated by rather narrowly distributed species: *Vitrea ilgazdaglariensis* (cf. RIEDEL, 1995: map 4), *Oxychilus kobelti* (ibidem: map 29) and - surprisingly - a West Caucasian species *Daudebardia lederi* (on the lake Abant).

The southern and eastern borders of Region I are partly determined by the distribution ranges of *Vitrea riedeli* and *Oxychilus urbanskii* (map 2). According to approximate calculations, endemics and narrowly distributed species occurring mainly in the region discussed, constitute nearly 30 % of its potential(!) zonitid fauna.

II. West Pontic Region

The region is surprisingly poor in zonitid species, despite the apparently adequate habitat conditions and a fairly good knowledge of the malacofauna. It constitutes a distinct transition between Regions I and III, and more generally between the East Balkan and West Caucasian faunae. At the same time, there are no grounds to divide it into an eastern and a western part and include them in Regions I and III, respectively. Besides, only here



Map 3. Distribution of some zonitids in Region II: 1 - distribution of *Oxychilus (Schistophallus) kobelti*, occurring also on Crimea (?? - occurrence/identification uncertain, but likely); 2 - continuous distribution of *O. (Hiramia) paphlagonicus*; besides, isolated (?) localities are known from Ankara and environs of Aşkale near Erzurum; 3 - known distribution of *Vitrea sorella*.

„Crimean“ species are found, or more properly those shared only with Crimea (*Oxychilus kobelti*, reaching somewhat farther westwards, to Region I, and *Carpathica boettgeri*).

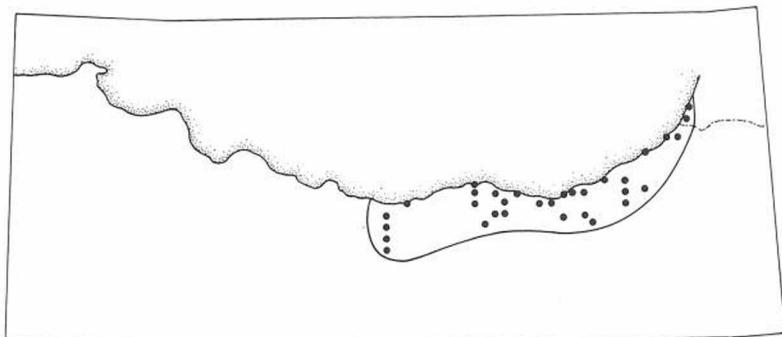
The number of species recorded is 15, and only very few further can be expected. Almost or quasi-endemic species are *Vitrea sorella* (cf. RIEDEL, 1995: map 7), *Oxychilus samsunensis* (its specific status and distribution need revision) and *Carpathica amisena*; characteristic, narrowly distributed species with their distribution centres in Region II, are *V. ilgazdaglariensis*, quasi-endemic *O. paphlagonicus* and above-mentioned *O. kobelti* (cf. RIEDEL, 1995: maps 4, 26 and 29). *O. deilus* is still very common (cf. Region I). From the west, the region is penetrated by widely distributed *V. contracta* and *O. hydatinus*, and perhaps also *V. riedeli*; from the east by *V. pygmaea*, *O. secernendus* – quasi-endemic to Region III and pan-Caucasian *O. subeffusus*. Caucasian species, such as *V. angystropha*, *Vitrinoxychilus suturalis* and *Daudebardia lederi* should also be expected. *Vitrea hattiana*, quasi-endemic to the inland, eastern Anatolia, reaches the region from the south-east.

The number of possibly endemic and other characteristic, narrowly distributed species probably does not exceed 25 % of the zonitid fauna of Region II.

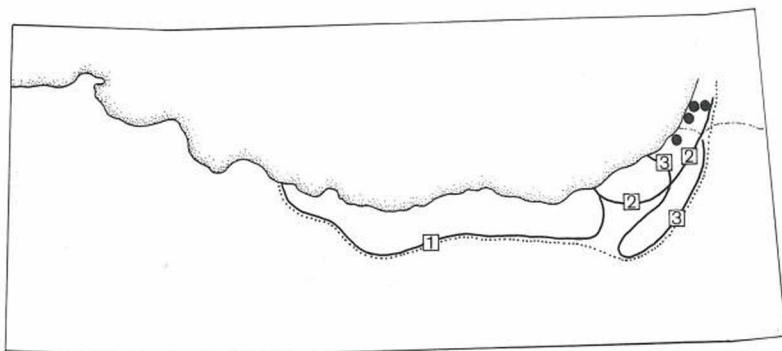
III. East Pontic - Adzhariyan Region

The region is situated mainly in Turkey, though it reaches eastern Adzhariya (cf. RIEDEL, 1966, 1989), and has the richest zonitid fauna in Turkey, with a pronounced endemism, not only at specific level. The monotypic genus *Nastia* RIEDEL (and the subfamily Nastiinae) (map 6), diverse subgenus *Retowskiella* RIEDEL (genus *Oxychilus* FITZINGER) (map 4), monotypic genus *Discoxychilus* RIEDEL (map 5) are endemic to the region; in addition there is a quasi-endemic subgenus *Forcartiella* RIEDEL (genus *Oxychilus*) (map 5)³⁾. The generic-level endemism is clearly manifest also in other land snail taxa, e.g. Clausiliidae and Enidae.

³⁾ Three species of the subgenus are endemic to the region, the fourth, *O. difficilis* (O. BOETTGER), inhabits western Abkhazia and western Ciscaucasia.

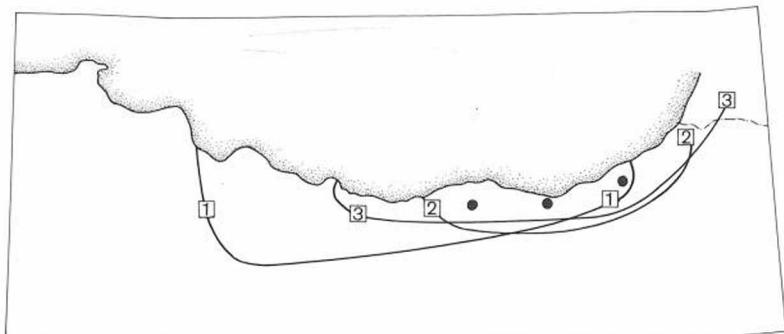


Map 4. Region III. Distribution of endemic subgenus *Oxychilus* (*Retowskella*), comprising 5 known species; discovery of further new species in the area is likely. Some are known from few, scattered localities and their distribution ranges coincide and overlap. On the map, localities of particular species are not distinguished; all the known records of *Retowskella* are marked as •.



Map 5. Distribution of some zonitids in Region III: 1–3 – distribution ranges of three of four known species of the subgenus *Oxychilus* (*Forcartiella*): 1 – *O. (F.) euxinus*, 2 – *O. (F.) discrepans*, 3 – *O. (F.) andronakii*; • – known localities of *Discoxychilus lindholmi*.

The number of species recorded from the Turkish part of the region is 33, i.e. 42 % of all zonitids known from Turkey. Further 5–6 species can be expected, most of which occur among others in Adzhariya and north-western Armenia. The following species are endemic to the region (some reach its Adzhariyan part): *Nastia viridula*, *Vitreanenia*, *V. praetermissa* (known at present only from the Adzhariyan part), *Oxychilus decipiens adsharicus*, *O. costatus*, *O. (Forcartiella) andronakii*, *O. (F.) discrepans*, *O. (F.) euxinus*, *O. (Retowskella) crenimargo*, *O. (R.) menkorsti*, *O. (R.) nautilus*, *O. (R.) sumelensis*, *O. (R.) zilchi* and *Discoxychilus lindholmi*; *O. secernendus* is quasi-endemic (reaching Region II). The most common species in the entire or nearly entire Turkish part of the region are: *O. costatus*, *O. secernendus* (map 6), *O. euxinus*, W Caucasian *O. koutaisianus*, *Vitrinoxychilus suturalis* (map 6) and *Daudebardia heydeni*, as well as wider distributed *D. wiktoria* (cf. RIEDEL, 1995: maps 22, 24, 25, 33, 41, 43, 44). Other species are less frequent or, when common, limited to very small ranges (e.g. species of the subgenus *Retowskella* – map 4; cf. RIEDEL, 1995: maps 34–38). *O. deilus*, penetrating the region from the west, becomes less frequent eastwards and occurs mostly synanthropically. The number of species endemic to Region III and narrowly distributed constitutes 50 % of the zonitid fauna.



Map 6. Distribution of some zonitids in Region III: 1 – distribution range of *Oxychilus (Longiphallus) secernendus*; 2 – *O. (L.) costatus*; 3 – *Vitrinoxychilus suturalis*, the remaining part of the range cf. RIEDEL, 1966: map 13; • – known localities of *Nastia viridula*.

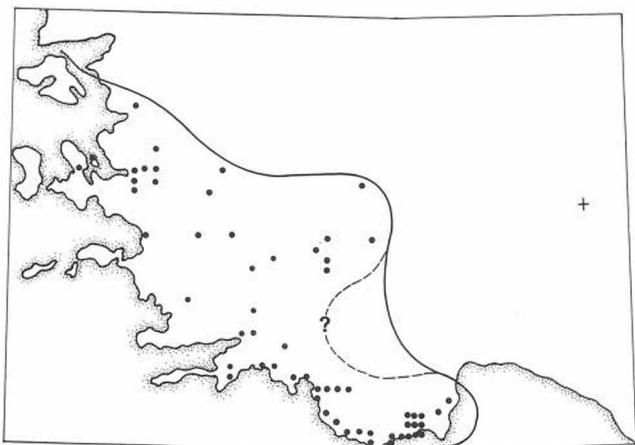
It should be stressed that the zonitid fauna of the East Pontic-Adzhariyan Region is rich not only qualitatively (number of species, endemism), but also quantitatively, which I had an opportunity to experience also in Adzhariya, during two short field trips in 1955 and 1958. The total abundance of all the zonitids found there (especially of live individuals), both absolute and relative, compared with the remaining terrestrial malacofauna, is distinctly higher than in other regions distinguished in Turkey (cf. RIEDEL, 1989: 364, 418). This results, no doubt, first of all from the wild, humid, almost subtropical climate and the lush vegetation of the northern slopes, valleys and foothills of the East Pontic Mts.

IV. Aegean Region

A characteristic feature of the region is that it reaches farther inside Asia Minor than the regions distinguished in the north – along the Black Sea, and in the south – the Taurus Mts Region. This is understandable, since the mountain ranges in Asia Minor are essentially latitudinal; besides, in the north and south their altitudes are generally higher than in the west. As a result, the influence of the mild oceanic climate ceases soon on the barrier of the high mountain ranges in the north and south of Asia Minor, but it reaches far in the west-east direction (maps 1 and 7).

In the continental, Turkish part of the Aegean Region 27-28 species and subspecies of the Zonitidae were found, and the presence of a few further is likely. The following species are endemic or quasi-endemic to the continental part of the region: *Vitrea* spec. (nova?) aff. *ephesina*, *Lindbergia*? spec. (nova?), *L.*? *karainensis*, *Zonites beydaglariensis*, *Z. caricus*, *Z. ch. chloroticus*, *Z. festai anatolicus*, *Z. humilis*, *Z. osmanicus*. *V. ephesina*, *V. riedeliana*, *Z. casius*, *Z. f. festai*, *Z. rhodius* (subspec. *symius*?) and *Z. smyrnensis* are shared only with the eastern Aegean Islands. Further such species may be expected. *V. riedeli* and, perhaps, also *V. bulgarica* penetrate the area from the north, *Z. algirus*, *Oxychilus samius*, *Eopolita p. protensa* (map 8) and a few widely distributed species (*V. contracta*, *O. hydatinus*, *Daudebardia brevipes*, *D. rufa*) from the west. Like in Region I, *O. translucidus* and *O. camelinus* are found only in anthropogenic habitats. *O. deilus*, common on the Black Sea coast, on the Aegean and Mediterranean (also in Region V) coasts is replaced by a similar and similarly occurring, common species *O. cyprius* (cf. RIEDEL, 1995: map 23).

Endemic and quasi-endemic species of the continental part of the Aegean Region constitute over 50 % of its zonitid fauna; however, there are no endemic genera or subgenera.



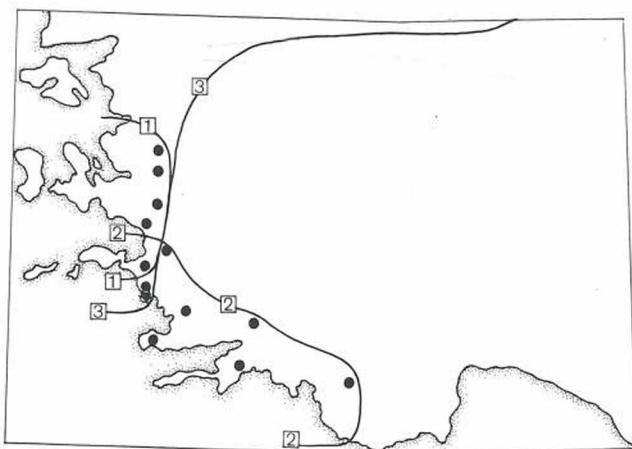
Map 7. Distribution of the genus *Zonites* and known localities (●) of its 11 members in Asia Minor, determining the approximate northern and eastern borders of Region IV. Records have been supplemented with new, previously unpublished data; + - records of extinct *Z. beckerplatteni*.

Zoogeographically, the region should probably comprise also a considerable part of the Greek Aegean Islands, including Greek Regions (RIEDEL, 1992) IX (NE Aegean Islands) and X (Dodecanese), and perhaps even a part of Region VIII (Kyklades). The richness of species and subspecies of the genus *Zonites* MONTFORT, whose distribution and diversity centre is situated here, is especially characteristic of the whole area (cf. RIEDEL, 1992: map VII). The eastern and north-eastern distribution border of this genus (map 7) approximately determines the border of the Aegean Region.

It should be noted that:

1. The distribution area of the genus *Zonites* in the south-east (eastern fringes of the Lykian Peninsula) closely borders with, or even narrowly overlaps, the western fringe of the distribution of the genus *Turcozonites* RIEDEL, endemic to Region V. I regard this zone as a distinct border between the Aegean and the Taurus Mts Regions.
2. *Z. osmanicus*, the only inland endemic member of the genus *Zonites*, reaching farthest eastwards (cf. RIEDEL, 1995: map 13) is at the same time the most plesiomorphous member of *Zonites* with respect to its genital structure, and constitutes a transition between the plesiomorphous *Turcozonites* and apomorphous *Zonites*. Still farther eastwards and in the inland Asia Minor, within the Anatolian Upland Region (VI), there is the only known locality of an extinct, Pliocene *Z. beckerplatteni* SCHÜTT, which conchologically is the closest to (was an ancestor of?) *Z. osmanicus* (cf. RIEDEL, 1987: 17, 1988: 505). In my opinion this is an additional, historical, argument in favour of separating Regions IV and V. In the Pliocene also the malacofauna of the western fringes of the Anatolian Upland was similar to that of the Aegean Region sensu lato (cf. SCHÜTT, 1985: 183), but with increasing aridization the distribution borders of mesophilic species (e.g. of the genus *Zonites*) moved gradually westwards.

NB. Differences between the Aegean and Taurus Mts. malacofauna (Regions IV and V) and their border, running along the eastern margin of the Lykian Peninsula, were overlooked and, thus, not considered by FORCART (1940: fig. 1) in his pioneer but rather formally and administratively accomplished zoogeographic regionalization of Turkey.



Map 8. Distribution of some zonitids in Region IV: 1 – distribution range and known records of Aegean *Oxychilus (Schistophallus) samius*; 2 – distribution and known records of Aegean *Eopolita protensa protensa*; 3 – approximate distribution border of SE Balkan *Vitrea riedeli*.

At the same time it appears that the distribution of species of the genus *Albinaria* VEST (Clausiliidae, cf. NORDSIECK, 1993: maps 3–5) and of the genus *Isaurica* KOBELT (Helicidae, cf. SUBAI, 1994: map 2) confirms the border between Regions IV and V, proposed by me.

The faunistic similarity of the Zonitidae between Regions IV and III is the lowest in the entire Asia Minor; it amounts to only 1.7 %, i.e. is practically non-existent.

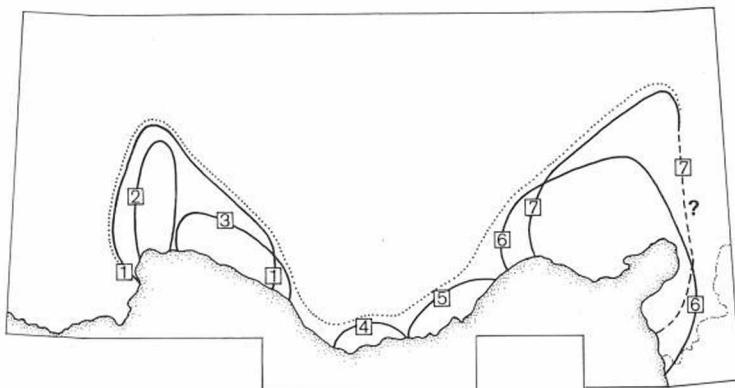
V. Taurus Mts Region

As was already mentioned above, the number of species found in that region is not high: 20–21, plus 5 uncertain or expected. However, their endemism is very much pronounced and reaches as much as 70 %. All the genus *Turcozonites*, with its at least 7 species: *T. anamurensis*, *T. corax*, *T. insignis*, *T. megistus* (perhaps a superspecies), *T. piratarum*, *T. silifkeensis* and *T. wandae*, is endemic to the Taurus Mts Region. Species vicariate to a large extent (map 9). Also *Vitrea* spec. (nova?) aff. *riedeliana*, *Gollumia filocincta* (the second species of the genus, still undescribed, occurs in Cyprus), *Oxychilus aliatahani*, and probably also *O. camelinus* (apart from the fact of its numerous human-caused introductions) are endemic to the region and probably very narrowly distributed. *Lindbergia karainensis* occurs only on the border with Region IV, *Daudebardia naegelei* is shared only with Region VI, and *V. cyprina* and *Eopolita protensa tenerrima* – with Cyprus (maps 10 and 11).

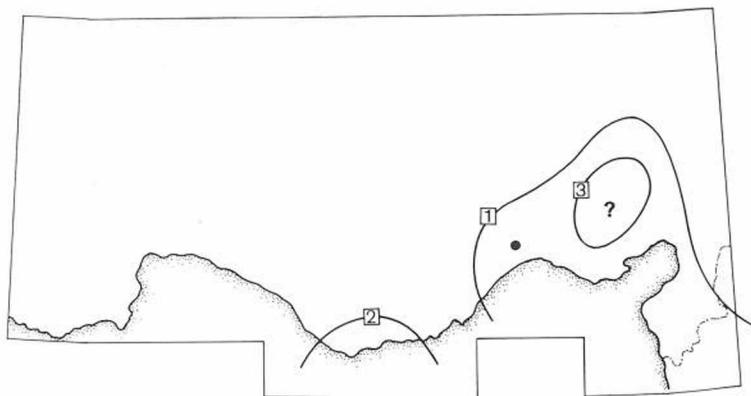
The most common species are *O. cyprius* (entire region) and *E. protensa tenerrima* (in its central and eastern part). Widely distributed species recorded from that region are: *V. contracta*, *V. pygmaea*, *O. hydatinus*, *D. brevipes* and *D. rufa*.

The Taurus Mts Region has only 2–3 species in common with the East Pontic-Adzhariyan Region (*V. contracta*, *V. pygmaea* and, possibly, *O. hydatinus* – faunistic similarity below 4 %) and only 5–6 shared with the neighbouring Aegean Region (faunistic similarity below 15 %).

For further remarks see Region IV.



Map 9. Distribution range of endemic genus *Turcozonites* (...), determining the approximate border of Region V, and particular species: 1 - *T. megistus* s.l., 2 - *T. wandae*, 3 - *T. piratarum*, 4 - *T. anamurensis*, 5 - *T. silifkeensis*, 6 - *T. corax*, 7 - *T. insignis*. No member of the genus (large shells, hard to overlook) was recorded from the neighbouring Cyprus. Cf. NORDSIECK, 1993: 22-24 - distribution analysis of the genus *Albinaria* VEST, Clausiliidae; BANK & MENKHORST, 1991: fig. 6 - distribution of *Pleurodiscus* WENZ, Pupilloidea.

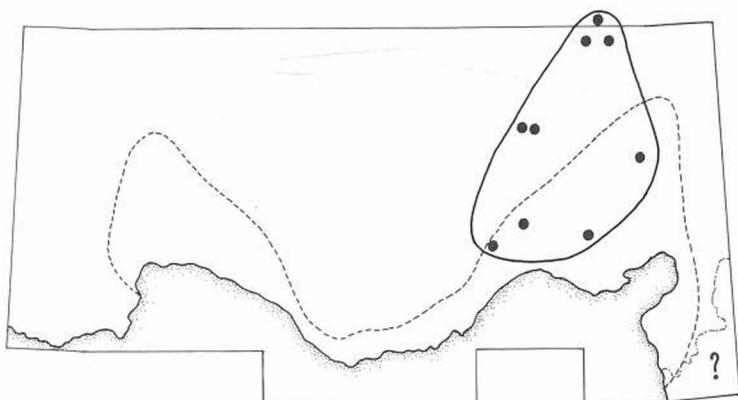


Map 10. Distribution of some zonitid species in Region V: 1 - border of continuous distribution of *Eopolita protensa tenerima*, known also from the north of Cyprus, NW Syria and isolated (?) sites in Region VII; 2 - known continental range of *Vitrea cyprina*, common in Cyprus; 3 - approximate range of *Gollumia filocincta* (till present only 2 records and 2 specimens are known); another species of the genus (only 1 specimen known) occurs in Cyprus; • - the only known record of endemic *Oxychilus aliatahani*.

VI. Anatolian Upland Region

I distinguish this region only based on negative evidence i.e. an extreme poverty of the fauna of the Zonitidae s.l. Its borders marked on map 1 are very approximate, forming a belt rather than a line, since it is unknown, how far the few recorded zonitids from Regions I, II, IV and V reach into the Anatolian Upland.

Only 5-6 species of the Zonitidae s.l. are known from Region VI, from few localities situated mainly on its margins: widely distributed *Vitrea pygmaea* and *Oxychilus hydatinus*, *O. paphlagonicus* found in Ankara (introduced?), *Vitrea* spec. (nova?) aff. *ephesina*, found on the potential border with Region IV, and probably belonging to this region, *V. hattiana*



Map 11. Known distribution range and localities of *Daudebardia naegelei*, mainly in the east of Region VI. Broken line denotes the range of the genus *Turcozonites*.

(provided that the environs of Boğazkale Vil. Çorum are included in the Anatolian Upland), a characteristic species of Region VII, and *Daudebardia naegelei*.

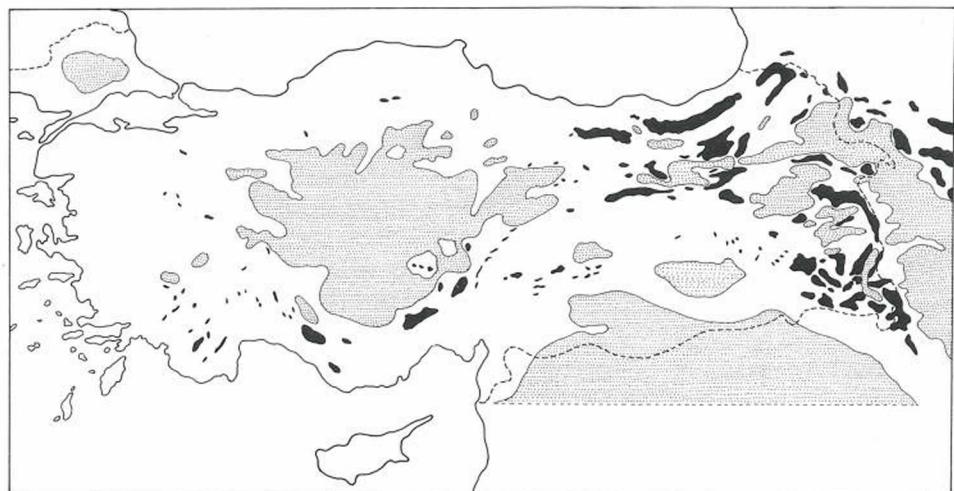
D. naegelei (map 11) with respect to its distribution is rather exceptional among the Daudebardiidae and the Zonitidae s.l. It seems to be the only quasi-endemic of Region VI. Judging from the hitherto records, it occurs mainly in the environs of Kayseri (N foothills of Erciyes Dağı) and Nigde in broad sense, on the southern edge of the Anatolian Upland on the border with the Armenian Upland (Region VII). It reaches the southern slopes of the Taurus Mts (Region V), but appears not to reach the Mediterranean coast. Thus, it would be a rather „continental“ species. It is not excluded, however, that *D. aleppoica* H. WAGNER from NW Syria is conspecific with *D. naegelei*; in such a case the distribution area would be wider than presently accepted.

A few more zonitid species may be expected on the Anatolian Upland, on the edges and isolated localities inside Region VI - in „oases“ and towns (there introduced, in anthropogenic habitats); e.g. *Oxychilus emmae* and *Eopolita derbentina* (from the east), *O. cypricus* and *E. protensa tenerrima* (from the south) etc. It should be also remembered that since the Plio-/Pleistocene the area has undergone a strong aridization (cf. notes on *Zonites becker-platteni* under Region IV). It can not be excluded that locally, especially in the few calcareous areas, even undescribed recent subterranean endemic species may be found, as well as further fossil forms.⁴⁾ However, when travelling in the Anatolian Upland along the main and many local roads, no habitats are seen that could suggest a possible presence of terrestrial snails in general and the zonitids in particular. At least the interior of Region VI seems to be a snail-less desert, which finds its explanation on map 12 (according to KOSSWIG).

VII. Armenian Upland Region

The region exceeds considerably not only the borders of Asia Minor accepted here, but also the borders of Turkey, reaching far into northern Iran (Kurdistan), NW Iran and including the southern part of the former Soviet Armenia.

⁴⁾ Cf. RIEDEL & NORRIS, 1987: 378 - data from the Santorini island; recently, unexpectedly, a fossil occurrence of the genus *Zonites* has been found also on Crete (MYLONAS, in litt.).



Map 12. „The Arboreal and the Eremial in modern Anatolia“ according to KOSSWIG (1955), slightly modified graphically (e.g. rivers and lakes omitted). Stippled areas – steppes, black – alpine areas. „The rest of Anatolia was originally covered by forests which persist even today in the form of single trees or small groups of trees in regions where forests were destroyed by men and goats ...“

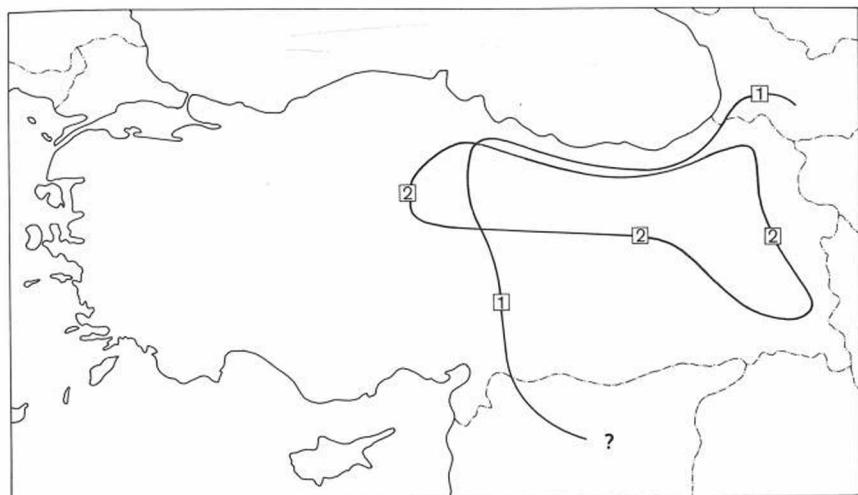
This is the only region whose Turkish part I have not visited (except a small fraction south of the East Pontic Mts) and, thus, had to base my conclusions almost entirely on collections of other authors. I know it only from short field trips in Armenia (1955) and N Iraq (1961).

Region VII is still poorly explored malacologically. The hitherto recorded zonitid fauna (6–8? species) is qualitatively poor, though richer, more evenly distributed and more distinct (specific) than that of the Anatolian Upland (Region VI). The region bears a clearly continental character, with predominance of upland steppes and stony semi-deserts, and, thus, by definition zonitid-poor. There are no narrow endemics. It is characterized, however, by the presence of a few characteristic, quasi-endemic species, common and rather widespread in the region (map 13): *Vitrea hattiana* (cf. RIEDEL, 1995: map 3), known only from Turkey, but expected also outside the country, *Eopolita derbentina* (cf. RIEDEL, 1966: map 5: A – the marked distribution area is today incomplete, 1995: map 40 – known distribution in Turkey). Probably also *Oxychilus emmae* should be added (cf. RIEDEL, 1995: map 21), a species known from the north of Region VII and perhaps entering Region III (but not reaching the Black Sea coast), which may be expected also near the eastern border of Turkey. Besides, in the mountains of eastern Turkey, a few further zonitid species may be expected, including some very widely distributed, such as *Nesovitrea hammonis*, *N. petronella*, and some Caucasian. In the south-east of Region VII *Daudebardia riedeli* can be expected, known hitherto only from its type locality in Iraq Kurdistan (another, besides *D. naegelei*, „continental“ member of the family Daudebardiidae).

The indices of faunistic similarity (cf. RIEDEL, 1992: 118), calculated for each pair of the regions distinguished above, are the following:

Regions I/II – 20.7 %; the index will decrease if expected species known from Bulgaria and/or Greece are found in Region I (mainly in European Turkey).

Regions I/III – 12.8 %; the index will decrease with discovery of further species in both regions.



Map 13. Distribution of some zonitids characteristic of Region VII: 1 – approximate western distribution border of *Eopolita derbentina*; 2 – presently known range of *Vitrea hattiana*. None of these species descends to the northern slopes of the East Pontic Mts.

Regions I/IV - 11.6-11.9 %; note as above.

Regions I/V - ca. 11 %, as above.

Regions II/III - 20 %; the index may rather tend to decrease, the same pertains to the next pairs.

Regions III/IV - 1.7 % (!).

Regions III/V - below 4 % (!).

Regions IV/V - 13.9-14.6 %.

Regions VI/VII - 16.6-37.5 %; the considerable range of values depends on the number of species considered („liquid“ borders of the regions). For this reasons I do not compare them with Regions I-V; another reason is the incomparably lower number of the species occurring there. The percent similarity index, calculated with the formula used, would in my opinion give an incorrect picture. For example, the index calculated for Regions III/VI is ca. 5.5 %; this results not from qualitative, but from quantitative differences: in one of the regions 33 species were found, in the other only 5-6.

In the above calculations only species, whose records are certain, plus those potentially new to the science and endemic, have been taken into consideration. Expected species and uncertain records from particular regions, as well as undoubtedly introduced species, have been omitted. Species found approximately on the border between two regions have been included in both the regions concerned.

Generally speaking, the faunistic similarity index of the distinguished regions is very low, and in some cases even negligible.

Additional remarks

1. When constructing bio- or zoogeographic divisions of the world, the principle of hierarchy of distinguished categories has been accepted for a long time, analogous to zoological systematic classifications. This is understandable and simply necessary for each sys-

stematist and zoogeographer. Zoogeographic categories are as a rule the following: provinces, districts, regions etc., with additional sub- or infra-categories. The nomenclature of the categories is often different, depending on the division, but essentially comparable.

Long ago, analyzing zoogeographically the Zonitidae s.l. of the Caucasian countries (RIEDEL, 1966), I used a three-degree hierarchy of zoogeographic categories distinguished within the area. At that time my division was based mainly on the zoogeographic division proposed (based on entire malacofauna) by LIKHAREV & RAMMELMEIER (1952). At the same time I introduced some modifications into their division, among others with respect to the estimate of the distinctness of the Hyrkanian area. LIKHAREV & RAMMELMEIER treat it as a separate province, I (RIEDEL, 1966) – as one of the regions („Bezirk“) of the Caucasian Province. More recently NORDSIECK (1995), based on the Clausiliidae, treats Hyrkania as a province distinct from the Caucasian Province. I have equally good arguments (cf. RIEDEL, 1981) in favour of including the Zonitidae of at least NW Iran (Gilan, Mazandaran) in the Caucasian fauna s.l.; likewise, I treat the zonitids of the East Pontic-Adzhariyan Region as a „Caucasian“ fauna. These are, after all, very subjective views.

In this paper on Asia Minor and Turkey I do not use any hierarchy of the zoogeographic regions, trying only to demonstrate their greater or smaller distinctness (see above). It appears to me at present, the the hierarchization of zoogeographic units, based on one small group, even rather well studied with respect to phylogenetic relationships and distribution, and providing a good tool for zoogeographic considerations (like the zonitids or clausiliids), is not well grounded. However, I am convinced that a „specialized“ regionalization of this kind should be considered and used by zoogeographers summarizing the existing data of various animal groups, when creating hierarchical divisions.

2. There is a great difference between the frequency of finding live zonitid individuals between the Turkish Black Sea coast with the adjacent mountains (Regions I-III) on one hand, and the Aegean and especially Mediterranean coast (Regions IV and V) on the other.

On the Black Sea coast of the vilayets Samsun and Trabzon in Asia Minor the ratio of live zonitids, collected in November/December 1985, to empty shells was ca. 600 : 1700, i.e. almost 1 : 3. This does not depend in any significant way on the season. I obtained similar, though somewhat lower ratios in the East Pontic Mts in March 1993, in Adzhariya in September 1955 and in November 1958, and also in Abkhazia in November 1958 and September 1989, in Crimea in September 1991, in SE Bulgaria in June, August and September. In the West Pontic Mts in Turkey, in May 1992, I collected *Vitrea ilgazdaglarensis*, *Oxychilus deilus* and *O. paphlagonicus* at a ratio (live specimens/shells) roughly 1 : 1. Live zonitids occur there (Regions I-III) in adequate, humid habitats (forests with lush herb layer, bushes on numerous streams), generally abundantly and probably throughout the year; though obviously they are fewer in the middle of summer or in winter under the snow. They stay in litter, screes and under stones; they do not hide deep in the ground or in rock crevices. Their shells, however, probably decompose easily under the effect of humus acids. Because of this, empty shells are rarely preserved for a longer time and, as a result, when collecting snails, the shells do not predominate so significantly over live specimens.

The situation in the Aegean and Mediterranean coast Regions (IV and V) is quite different. The ratio of live specimens found there to empty shells is 1 : 25-50 or even 1 : 100. Some species, in spite of collecting dozens or hundreds of empty shells, have never been found alive. Examples. In the ruins of Perge near Antalya, during three visits (beginning of April

and end of September), I collected over 200 shells of *Turcozonites wandae* and a total of 2 plus 6 juvenile live snails. During two several hour searches near Denizli (in April and November), I found in rock crevices over 200 shells of *Zonites osmanicus*, and 1 adult plus 3 juvenile live specimens. I had at my disposal a material of nearly 200 shells of *T. silifkeensis*, though none of the four collecting malacologists could find a live snail. I do not know from Turkey a single live specimen of *Eopolita protensa tenerrima*, though the snail is common and in places abundant (shells). Similar examples are numerous. I think that there are two reasons for this:

- a. The zonitids there stay all or most of the time hidden, deep in crevices and cracks of calcareous rocks, half-subterranean, in places inaccessible to exploration. Perhaps, during the humid season of the year, only in the night, or sporadically after a rain, they crawl out, often falling prey to predacious small mammals.
- b. They are decidedly less abundant than on the Black Sea coast and in the adjacent mountains. Their apparently considerable abundance in Regions IV and V results from the fact that their shells do not decompose so easily, they become preserved and accumulate over dozens and even hundreds of years. There are most often hundreds of them in rock crevices and concavities at the base of rocks, mainly washed out by rains, sometimes accumulated in „lunch“ places, where they were devoured by small mammals (then they bear distinct traces of damage). Anyway, a considerable percentage of the shells found are old specimens, mostly damaged, bleached, eroded, sometimes covered with calcareous incrustation (external coating). Here we deal with thanatocenoses which - with some reservations (since the chances of preservation of a shell vary with the species and shell structure) - give a fairly correct picture of quantitative relations between particular species. However, they give almost no information on the actual abundance of a given species at a given time.

Considering what was said above, the available shell material, kept in museum and private collections and collected personally, from various areas and habitats, should be treated very cautiously and critically, when trying to estimate a species abundance.

3. Correction. SCHÜTT (1993: 201) mentions *Oxychilus syriacus* from „Ergani N Diyarbakir“. I (RIEDEL, 1995: 50, 52) doubted the correctness of the identification, based among others on shell photographs included by SCHÜTT. Thanks to Dr. H. SCHÜTT's (Düsseldorf) and Dr. R. JANSSEN's (Frankfurt a.M.) kindness, I had an opportunity to examine the photographed specimen (SMF 318804/1) and I found that it was a large shell of *Eopolita protensa tenerrima*. Besides, on the original label, „Egil N Diyarbakir“ is stated as the locality.

Because of this; a) I still maintain that till now there is no evidence of the occurrence of *O. syriacus* in Turkey; b) *E. protensa tenerrima* occurs on the Armenian Upland, east of the approximately accepted border (! - RIEDEL, 1995: map 40), separating the distribution ranges of *E. p. tenerrima* and *E. derbentina*. Perhaps, in border areas both species may occur alternatively.

4. Correction. Records of „*Zonitoides*“ [*Zonites*!] *chloroticus* from the ruins of Pisidia Adada near Isparta (STOJASPALE, 1986: 14) or Eğridir (original label) in my opinion did not agree with the distribution range of this species, or even the entire genus *Zonites* (cf. RIEDEL, 1995: 27). Dr. F. STOJASPALE has kindly sent me the voucher specimen. It is actually *Turcozonites megistus*, a large shell of a rather typical form, but with the last two whorls smooth and shiny. The locality fits within the known distribution of the species and genus.

Acknowledgements

In the zoogeographic considerations, presented above, I have quoted only a few of the malacological bibliographic positions pertaining to the studied area and used. I would like to stress, however, that, in order to form a general opinion on the land snail fauna and its distribution in Turkey, I tried to consider and use not only specialist publications, numerous in the eighties and nineties, but also the personal (oral and correspondence) information, kindly provided by many colleague-malacologists. I have also used information contained in still unpublished check lists, presented in January 1995 at the Symposium in Düsseldorf. For the help and cooperation, and for making their zonitid materials available to me, I owe my sincerest thanks first of all (but not only) to E. GITTEMBERGER, B. HAUSDORF, W. J. M. MAASEN, H. M. P. G. MENKHORST, E. NEUBERT, H. NORDSIECK, H. SCHÜTT, P. SUBAI and A. WIKTOR. I am grateful to Dr. B. M. POKRYSZKO, who has kindly provided the English translation and the necessary critical discussion.

References

BANK, R. A., MENKHORST, H. P. M. G. (1991): Bemerkungen über rezente Arten der Gattung *Pleurodiscus* (Gastropoda Pulmonata: Pupilloidea). - *Basteria*, Leiden **55**: 61-71, 6 figs.

- (1994): Katalog der rezenten Clausiliidae (exkl. Gattung *Albinaria*) der Türkei (Gastropoda, Pulmonata). - *Deinsea*, Rotterdam, **1**: 85-122, 11 maps, 4 pls.

FORCART, L. (1940): Monographie der türkischen Enidae (Moll., Pulm.). - *Verh. Naturf. Ges. Basel* **51**: 106-263, 13 figs, 3 pls.

GITTEMBERGER, E. (1967): Die Enidae (Gastropoda, Pulmonata) gesammelt von der Niedersächsischen Biologischen Expedition in die Türkei in 1959. - *Zool. Meded.*, Leiden **42**: 125-141, 7 figs.

KOSSWIG, C. (1955): Zoogeography of the Near East. - *Syst. Zool.*, Baltimore, Md., **4**: 49-73 + 96, 14 figs (maps).

LIKHAREV, I. M., RAMMELMEIER, E. S. (1952): Nazemnye molljuski fauny SSSR. Opred. po faune SSSR, 43. Moskva-Leningrad, 512 pp., 420 figs.

NEUBERT, E. (1993): Zur Kenntnis der Mentissoideinae des ostpontischen Gebirges (Gastropoda: Clausiliidae). - *Arch. Moll.*, Frankfurt a.M. **122**: 25-47, 8 figs, 1 pl.

NEUBERT, E., RIEDEL, A. (1993): Über einige *Vitreola*-Arten (Gastropoda, Zonitidae) aus der Türkei nebst Beschreibung einer neuen Art. - *Basteria*, Leiden **57**: 155-160, 7 figs.

NORDSIECK, H. (1993): Türkische Clausiliidae, I: Neue Arttaxa des Genus *Albinaria* VEST in Süd-Anatolien (Gastropoda: Stylommatophora). - *Stuttgarter Beitr. Naturkd.*, Ser. A (Biol.), **499**, 31 pp., 5 figs (4 maps), 6 pls.

- (1995): Iranische Clausiliidae: Die Arten in Gilan und Mazandaran (mit Beschreibung neuer Taxa) (Gastropoda: Stylommatophora). - *Stuttgarter Beitr. Naturkd.*, Ser. A (Biol.), **527**, 27 pp., 5 figs, 2 pls.

RIEDEL, A. (1966): Zonitidae (exkl. Daudebardiinae) der Kaukasusländer (Gastropoda). - *Ann. Zool.*, Warszawa **24**: 1-303, 254 figs, 6 pls, 18 maps.

- (1975): Die Zonitiden-Fauna Bulgariens (Gastropoda), ihre Herkunft und Verbreitung. - *Fragm. Faun.*, Warszawa **20**: 157-177, 3 maps.

- (1981): Über einige Zonitidae aus dem Iran (Gastropoda: Pulmonata). - *Arch. Moll.*, Frankfurt a.M. **111** (1980): 181-189, 7 figs.

- (1987): Revision der Gattung *Zonites* MONTFORT (Gastropoda, Zonitidae): türkische Arten. Nebst Ergänzungen und Verzeichnis aller *Zonites*-Arten. - *Ann. Zool.*, Warszawa **41**: 1-42, 35 figs, 3 maps + 9 pls.

- (1988): Ergänzung zur Kenntnis einiger *Zonites*-Arten (Gastropoda, Zonitidae). - *Ann. Zool.*, Warszawa **41**: 503-513, 14 figs.

- (1989): Zonitidae (sensu lato) des Ostpontischen Gebirges in der Türkei (Gastropoda). - *Ann. Zool.*, Warszawa **42**: 363-424, 66 figs, 2 pls.

- (1992): The Zonitidae (sensu lato) (Gastropoda, Pulmonata) of Greece. *Fauna Graeciae*, V. Athens, VIII + 194 pp., 1 fig., VII + 39 maps.

- (1993): Eine neue *Oxychilus*-Art aus der Türkei (Gastropoda, Stylommatophora: Zonitidae). - *Malak. Abh. Mus. Tierkd. Dresden* **16**: 135-139, 10 figs.

- (1994): A preliminary zoogeographic division of Asia Minor, based on the distribution of Zonitid (s.l.) snails (Gastropoda terrestria). - *Bios. Thessaloniki* **2**: 171-176, 3 maps.

- (1995): Zonitidae sensu lato (Gastropoda, Stylommatophora) der Türkei. Übersicht der Arten. - *Fragm. Faun.*, Warszawa **38**: 1-86, I + 45 maps.

RIEDEL, A., NORRIS, A. (1987): An undescribed species of *Zonites* from the island of Santorini, Greece. - *J. Conch.*, London **32**: 377-378, pl. 31.

SCHÜTT, H. (1985): Känozoische Landschnecken der Türkei. (Känozoikum und Braunkohlen der Türkei, Nr. 25). - Arch. Moll., Frankfurt a.M. **115** (1984): 179-223, 1 fig., 4 pls, 1 map.

- (1993): Türkische Landschnecken. Prodromus Faunae Anatolicae Molluscorum Terrestrium Viventium Testaceorumque. Verlag Ch. Hemmen, Wiesbaden, 433 pp., figs.

STOJASPA, F. (1986): Ein Beitrag zur Molluskenfauna der Türkei. - Mitt. Dtsch. Malakozool. Ges., Frankfurt a.M. **38**: 11-20, 1 map.

SUBAI, P. (1994): Vergleich der mit *Levantina* verwandten großen Heliciden, sowie Revision der Gattung *Isaurica* (KOEBELT) (Gastropoda: Helicidae). - Arch. Moll., Frankfurt a.M. **123**: 49-87, 8 figs, 2 maps, 3 pls.

Table 1: Distribution of the Zonitidae sensu lato in the regions distinguished in Turkey:
 I - Marmara Region, II - West Pontic Region, III - East Pontic-Adzhariyan Region, IV - Aegean Region, V - Taurus Mts Region, VI - Anatolian Upland Region, VII - Armenian Upland Region. Explanations: X - recorded, Xs - recorded only synanthropically, X! - endemic shared with neighbouring region or country, X!! - narrow endemic (usually one region), ? - record (usually identification) uncertain or doubtful, O - expected occurrence. Eur. Tr. - European part of Turkey. Maps cited under „remarks“ are those from RIEDEL (1995).

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
1	<i>Zonitoides nitidus</i> (O. F. MÜLLER)	X	-	X	-	-	-	X	VII: new record (Vil. Elazığ: Gezin, 1995, SCHÜTT leg.)	Holarctic
2	<i>Nastia viridula</i> RIEDEL	-	-	X!!	-	-	-	-	Systematic position debatable. Map 1	-
3	<i>Vitrea angystropha</i> (O. BOETTGER)	?	O	X	O	-	-	-	I: + Eur. Tr. Map 2	Caucasian countries; Karpathos Is.
4	<i>Vitrea bulgarica</i> DAMJANOV et PINTÉR	X	-	-	?	-	-	-		Bulgaria, Greece
5	<i>Vitrea contortula</i> (KRYNICKI)	-	-	X	-	-	-	-		Caucasian countries
6	<i>Vitrea contracta</i> (WESTERLUND) + f. <i>zakynthia</i> HESSE	X	X	X	X	X	-	-		W Palaearctic
7	<i>Vitrea cyprina</i> WESTERLUND	-	-	-	-	X!	-	-	Map 8	Cyprus
8	<i>Vitrea ephesina</i> PINTÉR	-	-	-	X!	-	-	-		Chios Is.
	<i>Vitrea spec.</i> (nova?) aff. <i>ephesina</i>	-	-	-	-	-	X!!	-	On border with IV and V	-
9	<i>Vitrea hattiana</i> (RIEDEL)	-	X!	X!	?	-	X!	X!!	II: in SE; III: in S; VI: on border of II. Map 3	-
10	<i>Vitrea heniae</i> RIEDEL	-	-	X!!	-	-	-	-		-
11	<i>Vitrea ilgazda-gliariensis</i> NEUBERT et RIEDEL	X!	X!!	X!	-	-	-	-	Map 4	-

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
12	<i>Vitreola lodosi</i> RIEDEL	X!!	-	-	-	-	-	-	Map 7	-
	<i>Vitreola spec.</i> (nova?) aff. <i>lodosi</i>	X!!	-	-	-	-	-	-		-
-	<i>Vitreola praetermissa</i> RIEDEL	-	-	O	-	-	-	-		Adzhariya
13	<i>Vitreola pygmaea</i> (O. BOETTGER)	X	X	X	-	X	X	X	III: on border with VII. Map 5	From Adriatic coun- tries to Kopet-Dag
14	<i>Vitreola riedelii</i> DAMJANOV et PINTÉR	X	?	-	X	?	-	-	I: + Eur. Tr. Map 6	SE Bulgaria, Greece
15	<i>Vitreola riedeliana</i> PAGET	-	-	-	X!	-	-	-		Rhodos Is.
	<i>Vitreola spec. (nova?)</i> aff. <i>riedeliana</i>	-	-	-	-	X!!	-	-		-
-	<i>Vitreola schuetti</i> PINTÉR	O	-	-	-	-	-	-		Greece
16	<i>Vitreola sorella</i> (MOUSSON)	-	X!!	-	-	-	-	-	Map 7	- (cf. RIEDEL, 1995)
	<i>Vitreola spec. (nova?)</i> aff. <i>sorella</i>	X!!	-	-	-	-	-	-		-
-	<i>Vitreola sossellai</i> PINTÉR	-	-	-	O	-	-	-		Islands Symi, Kalymnos, ?Kos
17	<i>Lindbergia?</i> <i>karaeinensis</i> RÄHLE et RIEDEL	-	-	-	X!!	X!!	-	-	On border of IV and V	-
	<i>Lindbergia?</i> spec. (nova?)	-	-	-	X!!	-	-	-		-
18	<i>Gollumia filocincta</i> (HESSE)	-	-	-	-	X!!	-	-	Map 8	-
19	<i>Zonites algirus</i> (LINNAEUS)	-	-	-	X	-	-	-	IV: perhaps only Xs	Greece; S France introduced
20	<i>Zonites beydagla- riensis</i> RIEDEL	-	-	-	X!!	-	-	-	Map 9	-
21	<i>Zonites caricus</i> (ROTH)	-	-	-	X!!	-	-	-	Map 10	-
22	<i>Zonites casius</i> MARTENS	-	-	-	X!	-	-	-	Map 11	Kasos Is.
23	<i>Zonites chloroticus</i> <i>chloroticus</i> (L. PFEIFFER)	-	-	-	X!!	-	-	-		On Aegean Islands another subspecies
24	<i>Zonites festai</i> <i>anatolicus</i> RIEDEL	-	-	-	X!!	-	-	-		-
25	<i>Zonites festai festai</i> POLLONERA	-	-	-	X!	-	-	-		Rhodos Is.

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
26	<i>Zonites humilis</i> RIEDEL	-	-	-	X!!	-	-	-	Map 12	-
27	<i>Zonites osmanicus</i> RIEDEL	-	-	-	X!!	-	-	-	Map 13	-
28	<i>Zonites rhodius</i> ? <i>symius</i> PFEFFER	-	-	-	X!	-	-	-	Subspecific appurtenance uncertain	Symi Is.; also other subspecies on Dodecanese
29	<i>Zonites smyrnensis</i> (ROTH)	-	-	-	X!	-	-	-		Chios Is.
30	<i>Turcozonites anamurensis</i> NEUBERT et RIEDEL	-	-	-	-	X!!	-	-	Map 14	-
31	<i>Turcozonites corax</i> (L. PFEIFFER)	-	-	-	-	X!!	-	-	Map 15	-
32	<i>Turcozonites?</i> <i>insignis</i> (NAEGELE)	-	-	-	-	X!!	-	X!	VII: SW edge. Map 16	-
33	<i>Turcozonites megistus</i> (ROLLE)	-	-	-	?Xs	X!!	-	-	As 3 subspecies? IV: Efes. Map 17	-
34	<i>Turcozonites piratarum</i> (RIEDEL)	-	-	-	-	X!!	-	-	Map 18	-
35	<i>Turcozonites?</i> <i>silifkeensis</i> MENKHORST et RIEDEL	-	-	-	-	X!!	-	-	Map 19	-
36	<i>Turcozonites wandae</i> (RIEDEL)	-	-	-	-	X!!	-	-	Reaches border with IV/VI. Map 20	-
37	<i>Aegopinella pura</i> (ALDER)	O	-	X	-	-	-	-	I: at least in Eur. Tr.	Europe and Caucasian countries
-	<i>Aegopinella minor</i> (STABILE)	O	-	-	-	-	-	-	I: in Eur. Tr.	Mainly SE Europe
-	<i>Nesovitrea hammonis</i> (STRÖM)	-	-	O	-	-	-	-		Palearctic, reaches Little Caucasus
-	<i>Nesovitrea petronella</i> (L. PFEIFFER)	-	-	O	-	-	-	-		Boreo-alpine, reaching Little Caucasus
-	<i>Balcanodiscus frivaldszkyanus</i> (ROSSMÄSSLER)	O	-	-	-	-	-	-	I: in Eur. Tr.	SE Bulgaria, NE Greece
38	<i>Oxychilus (Ortizioides) decipiens</i> <i>adsharicus</i> RIEDEL	-	-	X!	-	-	-	-		Adzhariya
39	<i>O. (Ortizioides) emmae</i> (AKRAMOWSKI)	-	-	X	-	?	?	X	V and VI: if identification correct, then probably introduced. Map 21	S Georgia, N Armenia

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
40	<i>O. (Ortizioides) subeffusus</i> (O. BOETTGER)	-	X	X	-	-	-	O	II: new record (ca 10 km NE Amasya, 1992 MENKHORST leg.)	Caucasian countries
41	<i>O. (Ortizioides) translucidus</i> (MORTILLET)								In most localities synanthropic	Caucasian countries and Iran. Introduced in Israel, W Turkey, Bulgaria, Hungary, Poland
42	<i>O. (Longiphallus) costatus</i> RIEDEL	-	-	X!!	-	-	-	-	Map 22	Expected in Adzhariya
43	<i>O. (Longiphallus) deilus</i> (BOURGUIGNAT)	X	X	X	-	-	?O	?O	Displays considerable synanthropism. In VI and VII possibly introduced. Map 23	SE Romania, E Bulgaria, Crimea; in Georgia introduced
44	<i>O. (Longiphallus) koutaisianus</i> (MOUSSON)	-	-	X	-	-	-	-	Map 24	W Transcaucasia
45	<i>O. (Longiphallus) secernendus</i> (RETOWSKI)	-	X!!	X!!	-	-	-	-	Map 25	-
46	<i>O. (Hiramia) camelinus</i> (BOURGUIGNAT)	Xs	-	-	Xs	X!	-	-	Most known localities are synanthropic. V: SE edge	NW Syria, ?Cyprus. Introduced in other countries
47	<i>O. (Hiramia) cypricus</i> (L. PFEIFFER)	-	-	-	X	X	-	-	Many localities are synanthropic. Map 23	Cyprus, Greece, Albania, Dalmatia
48	<i>O. (Hiramia) paphlagonicus</i> RIEDEL	-	X!!	-	-	-	Xs?	X!	VI: Ankara; VII: isolated (?) locality. Map 26	-
-	<i>O. (Hiramia) syriacus</i> (KOBELT)	-	-	-	-	O?	-	O?	May happen to be found in the south of V and VII	Lebanon, ?NW Syria
49	<i>O. (Mediterranea?) aliatahani</i> RIEDEL	-	-	-	-	X!!	-	-		-
50	<i>O. (Mediterranea) hydatinus</i> (ROSSMÄSSLER)	X	X	O	X	X	X	O?	VII: on W edge. Map 27	Circummediterranean species
51	<i>O. (Mediterranea?) samsunensis</i> (RETOWSKI)	?	X!!	-	-	-	-	-	Specific status uncertain, requires revision	-
52	<i>O. (Schistophallus) investigatus</i> RIEDEL	X!	-	-	-	-	-	-	Map 28	SE Bulgaria
53	<i>O. (Schistophallus) kobelti</i> (LINDHOLM)	X	X!	-	-	-	-	-	I: E edge. Map 29	Crimea
54	<i>O. (Schistophallus) samius</i> (MARTENS)	-	-	-	X	-	-	-	Map 30	Westwards reaches Peloponnesus
55	<i>O. (Schistophallus) sucinacius</i> (O. BOETTGER)?	-	-	X!	-	-	-	-	Requires revision	W Transcaucasia

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
56	<i>O. (Forcartiella) andronakii</i> (LINDHOLM)	-	-	X!!	-	-	-	?	VII: on border with III. Map 31	Expected in Adzhariya
57	<i>O. (Forcartiella) discrepans</i> (RETOWSKI)	-	-	X!	-	-	-	-	Map 32	Adzhariya
58	<i>O. (Forcartiella) euxinus</i> RIEDEL	-	-	X!!	-	-	-	-	Reaches border with II. Map 33	-
59	<i>O. (Retowskella) crenimargo</i> (RETOWSKI)	-	-	X!	-	-	-	-	Map 34	SW Adzhariya
60	<i>O. (Retowskella) menkhorsti</i> RIEDEL	-	-	X!!	-	-	-	-	Map 35	-
61	<i>O. (Retowskella?) nautilus</i> RIEDEL	-	-	X!!	-	-	-	-	Map 36	-
62	<i>O. (Retowskella) sumelensis</i> RIEDEL	-	-	X!!	-	-	-	-	Map 37	-
63	<i>O. (Retowskella) zilchi</i> RIEDEL	-	-	X!!	-	-	-	-	Requires further taxonomic revision. Map 38	-
-	<i>O. (Conulopolita) sieversi</i> (O. BOETTGER)	-	-	-	-	-	-	O	VII: in NE of the region	Caucasian countries
-	<i>O. (Morlina) glaber</i> (ROSSMÄSSLER)	O	-	-	-	-	-	-	I: in Eur. Tr.	C and S Europe to Bulgaria and Greece
64	<i>O. (Morlina) moussonii</i> (KOBELT)	X!!	-	-	-	-	-	-		-
65	<i>O. (Morlina) urbanskii</i> RIEDEL	X!	-	-	X!	-	-	-	IV: NE edge. Map 39	SE Bulgaria
-	<i>O. (Subgenus?) retowskii</i> (LINDHOLM)	-	-	O?	-	-	-	O?		SW Georgia, Armenia
66	<i>Discoxychilus lindholmi</i> RIEDEL	-	-	X!	-	-	-	-		SW Adzhariya
67	<i>Eopolita derbentina</i> (O. BOETTGER)	-	-	X	-	?	-	X	III: on edge of VII, V: on edge of VII. Map 40	From Dagestan to Elburz and Zagros Mts. (Iran) and Iraq Kurdistan
68	<i>Eopolita protensa protensa</i> (FÉRUSSAC)	-	-	-	X	-	-	-	IV: mainly synanthropic. Map 40	Aegean subspecies reaching westwards to Attica and Crete
69	<i>Eopolita protensa tenerima</i> (HESSE)	-	-	-	X!	-	X	VII: Xs? Map 40		NW Syria, N Cyprus
70	<i>Vitrinoxychilus suturalis</i> (O. BOETTGER)	-	O?	X	-	-	-	-	II: on E edge. Map 41	W Transcaucasia

No	Species	I	II	III	IV	V	VI	VII	Remarks	Remaining distribution
71	<i>Daudebardia</i> (<i>Daudebardia</i>) <i>brevipes</i> (DRAPARNAUD)	?	-	-	X	X	-	-	V: on border with IV	Mainly S and SE Europe, N Africa
72	<i>D. (Daudebardia)</i> <i>rufa</i> (DRAPARNAUD)	X	-	-	X	X	-	-		Mainly S and SE Europe, N Africa, Cyprus
73	<i>D. (Libania)</i> <i>naegelei</i> O. BOETTGER	-	-	-	-	X!!	X!!	-	VI: SE edge, near Kayseri Map 42	? NW Syria
-	<i>D. (Libania) riedeli</i> FORCART	-	-	-	-	-	-	O	VII: outside accepted border of Asia Minor	Iraq Kurdistan
74	<i>D. (Libania) wiktoriae</i> RIEDEL	O	X	X	-	-	-	-	I: also in Eur. Tr. Map 43	SE Bulgaria
75	<i>D. (Sieversia)</i> <i>heydeni</i> O. BOETTGER	-	-	X	-	-	-	-	Map 44	Western Caucasian countries
76	<i>D. (Sieversia)</i> <i>lederi</i> O. BOETTGER	X	O?	X	-	-	-	-	I: isolated (?) locality on the lake Abant	Western Caucasian countries
77	<i>Carpaticha</i> <i>amisena</i> (FORCART)	-	X!!	-	-	-	-	-		-
-	<i>Carpaticha bie-</i> <i>lawskii</i> RIEDEL	O	-	-	-	-	-	-	I: in Eur. Tr.	SE Bulgaria
78	<i>Carpaticha</i> <i>boettgeri</i> (CLESSIN)	-	X	-	-	-	-	-	II: introduced?	Crimea; ?W Ciscaucasia
-	<i>Carpaticha cretica</i> (FORCART)	-	-	-	O?	O?	-	-	On border of IV and V	Crete, Dodecanese, Cyprus
79	<i>Carpaticha wirthi</i> FORCART	X!	-	-	-	-	-	-	Map 45	? Samothrake Is.

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