Biogeographia - vol. XX - 1999
(Pubblicato il 31 ottobre 1999)
Biogeografia dell'Anatolia

The scorpions of Anatolia: biogeographical patterns

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Key words: Scorpiones, Turkey, distribution, diversity.

SUMMARY

The Anatolian fauna of scorpions is relatively small, at least 12 species of 4 families being known with certainty: however, some have a certain biogeographical (owing to their restricted range) and ecological (owing to their size and abundance) interest. The main groups of chorotypes, based on the shape and the size of the range of each species, are as follows: European-Mediterranean taxa (Euscorpiidae, genus *Euscorpius*); Central Asian taxa and Saharo-Sindian taxa, the most important group of species (Buthidae, genera *Androctonus*, *Compsobuthus*, *Leiurus* and *Mesobuthus*; Scorpionidae, genus *Scorpio*); Aegean-Anatolian or endemic taxa with a distribution pattern difficult to explain (Iuridae; genera *Calchas* and *Iurus*). The present distribution is partially explained according to the existence of the so-called Anatolian diagonal, a mountain barrier from the Great Caucasus to the Taurus Mts, a boundary between two different, climatic and faunal, areas. However, the status of the knowledge about the scorpion fauna of the far east territories is unsatisfactory and remarkable surprise may be expected in the near future.

INTRODUCTION

The aim of this work is to analyze the main biogeographical patterns of the Anatolian scorpiofauna. The geographical area considered includes the Asian Turkey and Turkish Thrace. The scorpiofauna of this area have never been investigated in detail and mainly based upon specimens that were randomly collected and described by many Authors especially in the past 100 years. Present knowledge about systematic, faunal diversity and bionomy is fragmentary, especially with respect to the scorpion fauna of some neighbouring countries of the Near East, *e.g.*, the Palestine (Israel and Sinai) and the Jordan. In the framework of a more comprehensive work project on the scorpions of the area, this brief report is based mainly on bibliographical sources and the results of eight arachnological research trips planned and carried out by the Società Romana di Scienze Naturali (SRSN) in the years 1986-1989 and 1996-1999 in south and southeastern Anatolia (except for the 1987 Thrace expedition) during

which targeted material (over 1000 specimens) has been collected by the Author and his collaborators. Specimens are stored in the SRSN zoological collection, preserved in ethanol 75%.

HISTORICAL BACKGROUND

Before the World War II, few and sparcely data about the scorpions of Anatolia were published; some in more extensive studies, the first general works dedicated to the whole order Scorpiones (Kraepelin, 1899; Werner, 1934) and others in more specific studies of systematic/faunistic relevance (Birula, 1910, 1914, 1917). After the World War II, some contributions of the prominent French arachnologist Max Vachon, devoted exclusively to the scorpions of the area, came out (Vachon, 1947a,b, 1951, 1953). Vachon recorded 8 species, among which *Hottentotta judaicus* (Simon, 1872) has not been confirmed by more recent findings. Besides, Vachon recognizes all the major groups, the families Buthidae, Chactidae (now Euscorpiidae, because true Chactidae are currently limited to the South American fauna [Gantenbein *et al.*, 1999]), Iuridae and Scorpionidae, the existence of two faunistic territories separated by the so-called "Anatolian diagonal" and the peculiar distribution of the genus *Iurus* explained by the so-called "Hellenic arch". In the following years, some new data were added by Tolunay (1959) and Tulga (1960,1964) especially about species of medical interest. The first comprehensive account on the scorpions of the Middle East was presented by Vachon (1966). A thorough revision of the scorpions occurring in the countries around the Aegean Sea including therefore the Aegean region of Anatolia was presented by Kinzelbach (1975) who established that the population of *Mesobuthus gibbosus* (Brullé, 1832) of Turkey may be ascribed to *M.g.anatolicus* (Schenkel, 1947). Later on, Kinzelbach (1980) extends the range of *Calchas nordmanni* Birula, 1917 to some districts of south and southeastern Turkey; further on, the German Author presented the list of scorpions of Anatolia and the Middle East in the collection of the Natural History Museum of Mainz (Kinzelbach, 1982, 1984). At that moment, the species of scorpions listed for Turkey had raisen to 10. Francke (1981) and Francke and Soleglad (1981) established that *Iurus*, a genus of Iurinae, a monophiletic taxa of Iuridae, contains two valid species, one of which *Iurus asiaticus* Birula, 1903 has been restricted in its distribution to Southern Turkey and the islands of Rhodes and Karpathos. A supplement to Vachon (1966) was given by Vachon and Kinzelbach (1987) which added *Euscorpius mingrelicus phrygius* Bonacina, 1980. Finally, Kovarik (1998) lists the first locality of *Compsobuthus matthiesseni* (Birula, 1905) in Turkey. The same Author (Kovarik, 1999) compiles a synoptic table of European scorpions with a simple key to species including taxa that occur only in the Asian parts of

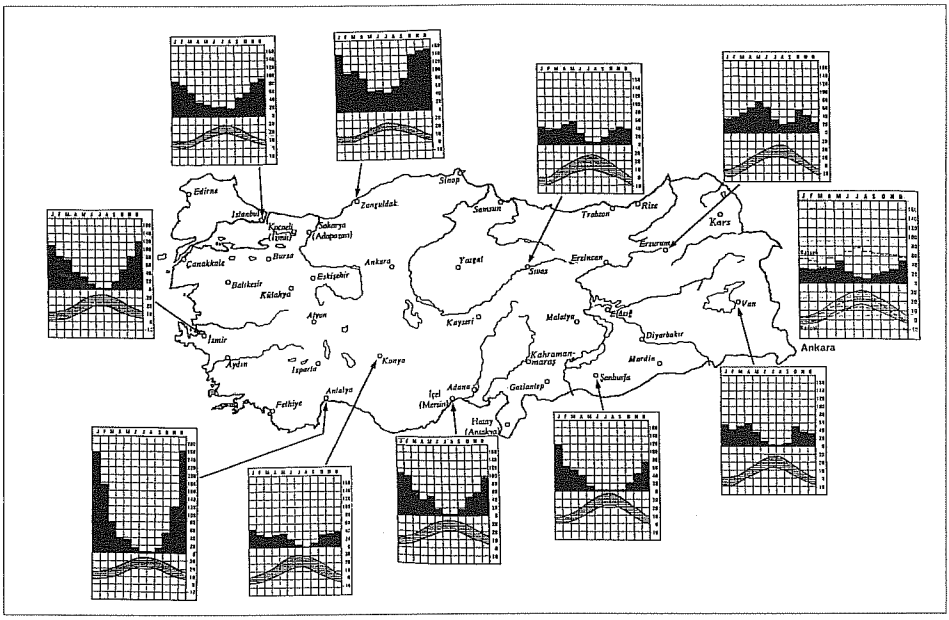

Fig. 1 - The climate of Turkey: each of the eleven diagrams is referred to a single station (town).

Turkey. More specific contributions will be discussed in the following checklist of species. Patterns of Turkish climate and the main orographical aspects of the land are explained in the chart of Fig. 1.

THE SPECIES

Family Buthidae C.L. Koch, 1837
Genus *Androctonus* Ehrenberg, 1828

1. *Androctonus crassicauda* (Olivier, 1807)

A. crassicauda, a widespread species in the Middle East (Braunwalder and Fet, 1999), is known with certainty from a few localities of southeastern Anatolia only. Vachon (1947a,b) recorded this species for the towns of Izmir Bornova and Icel (=Mersin) and the SE Massifs. The first two localities are not recorded in the map of Vachon (1951). The only reference to the Taurus Mts, the city of Icel, has been resumed by Tolunay (1959). However, the presence of stable populations of *A. crassicauda* in the Aegean and Mediterranean regions of Turkey is doubtful. The distribution of this species includes "Caucasus, Kurdistan, Turkey (southern Anatolia only), Iran, Iraq (Mosul), Syria (Palmyra, Homs, Damascus), Jordan ('Arabia Petraea';new records from the British Museum: Amman, Qasr Amra), Arabia (Muscat, Hadhramaut, Yemen)" (Levy

and Amitai, 1980:28-29). This scorpion was never collected during the SRSN field trips in the Taurus Mts (1989 and 1996) and the province of Hatay (1997). In the southeast territories, the species has been recorded for the districts of Urfa, Diyarbakir, Palu, Elazig and Mardin (Vachon 1947a; Tolunay, 1959). During the 1998 and 1999 SRSN field trips in the Nemrut Mt. National Park, this species has been collected in Cukurtas, near Kahta (Adiyaman) (Crucitti and Cicuzza, in press) (Fig. 2). Apparently, this large scorpion has never been recorded for the territories E of the Lake Van and the NE districts. Since it is considered a psammophile species, as many localities in Palestine (Levy and Amitai, 1980) and Jordan (Amr and El-Oran, 1994) suggest, its absence from most territories of south and southeastern Turkey may be due to unfavourable microedaphic conditions. All over Cukurtas, soils of close-packed sands prevail, nevertheless *A. crassicauda* has been found exclusively in the farm-houses of the village (Crucitti and Cicuzza, in press). A subspecific structure of this species was not revised (Fet, 1988).

Genus *Compsobuthus* Vachon, 1949

2. *Compsobuthus matthiesseni* (Birula, 1905)

C. matthiesseni is known from a number of localities in southwestern Iraq, Iran and southeastern Turkey all included in the Tigris-Euphrates drainage (Sissom and Fet, 1998). Levy and Amitai (1980) recorded *Compsobuthus* of the *acutecarinatus* group – to which *C. matthiesseni* belongs – for Turkey; nevertheless, no specimens or localities have been mentioned by these Authors. Kovarik (1996) recorded the species for Ergani, Diyarbakir Province, the first locality in Turkey (see also Kovarik, 1997). Specimens of this species have been recently collected in the Nemrut Mt. National Park, the second locality in Turkey (Crucitti and Cicuzza, in press). Since the genus *Compsobuthus* consists mainly of small species, less than 50 mm, it is probably that species of this genus, although common, were not collected because of their small size (Levy and Amitai, 1980). Therefore, remarkable surprise in this respect may be expected for the fauna of Anatolia.

Genus *Leiurus* Ehrenberg, 1828

3. *Leiurus quinquestriatus* Ehrenberg, 1828

Rather surprisingly, this large species is not still quoted for Turkey in Vachon's faunal checklist of 1966. Kinzelbach (1984) recorded this scorpion for two localities of Turkey next to the Syrian border: Hassa near Antakya and Kilis near Gaziantep. A new locality, probably the northernmost site in the whole range, has been recently discovered near Kahta, Nemrut Mt. National Park (Crucitti and Cicuzza, in press) (Fig. 2). *L. quinquestriatus* is a widely distributed species; its range extends from Tunisia to Egypt, Palestine, Jordan and Arabia; it is, often,

one of the commonest scorpion (Levy and Amitai, 1980; Amr and El-Oran, 1994). This species may be searched with particular attention in the district of Hatay, where few and scattered populations probably exist. The populations of Anatolia have been referred to *L.q. voelschoewi* (Werner, 1902) (Kovarik, 1996); the populations of Israel and Sinai have been referred to *L.q. hebraeus* (Birula, 1908) (Levy and Amitai, 1980).

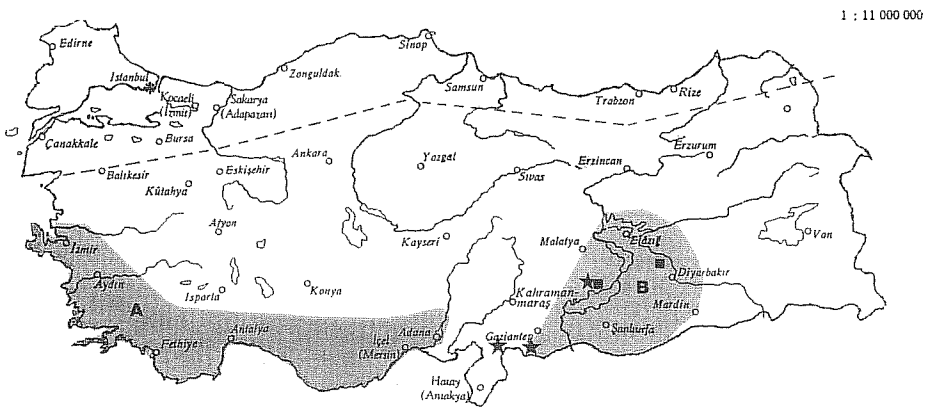

Fig. 2 - The presuntive distribution of some species of scorpions in Anatolia: *Iurus asiaticus* (A) ; *Androctonus crassicauda* (B). Stars: *Leiurus quinquestriatus*; squares: *Compsobuthus matthiesseni*. The sketched line represents the northern limit of the distribution of the genus *Mesobuthus*; the presence of *Mesobuthus gibbosus* outside this line (Istanbul) is marked with an asterisk.

Genus *Mesobuthus* Vachon, 1950

Scorpions of the genus *Mesobuthus*, a taxon of Central Asian distribution, are common and abundant in the Eastern Mediterranean and the Middle East (Vachon and Kinzelbach, 1987). They are orange or pale orange, yellow or pale yellow, middle-size species (50-90 mm), generally considered as errant xerophile scorpions (Crucitti and Marini, 1987) (Fig. 2).

4. *Mesobuthus caucasicus* (Nordmann, 1840)

A widely distributed species, its range extends from Turkey to China through some regions of the ex-USSR; the typical subspecies, the only to which Turkish populations are assigned, is known for Armenia, Azerbaidzhan, Georgia, Russia and Ukraine (Fet, 1988). Its distribution in Turkey is imperfectly known. Birula wrote: "Along the course of the Aras river, *B. caucasicus* can be followed from the frontiers of the Djevat district to the Eastern slope of the Kars plateau" (Birula, 1917: 72). However it is probably well distributed between the Lake Van and the Armenian border (cf. also Kinzelbach, 1984).

5. *Mesobuthus eupeus* (C.L. Koch, 1838)

As the previous taxon, *M. eupeus* has a wide range of distribution, from Turkey to Mongolia, with many subspecies but some of these are controversial (Farzanpay, 1988; Kovarik, 1996). Besides, in most parts of the Middle East, especially the Asian Republic of the ex-USSR, *M. caucasicus* and *M. eupeus* are sympatric (Fet, 1988). *M. eupeus* is recorded for some localities of eastern and southeastern Anatolia (Kinzelbach, 1984) where it is one of the most abundant scorpions. Large populations were found near Kahta, Nemrut Mt. National Park, probably the westernmost site in the range of the species (Crucitti and Cicuzza, in press), Gevas (Lake Van), Dogubayazit (Mount Ararat) and Susuz near Kars (Crucitti, 1993). Birula (1917) recorded this species for the district of Artvin (Coruh River basin) and Kars town. Populations of Anatolia are referred to the typical subspecies (Fet, 1988).

6. *Mesobuthus gibbosus* (Brullé, 1832)

M. gibbosus is the commonest Buthid in the Aegean, Central Anatolia and Mediterranean region of Turkey: it is the only scorpion that can be found in some districts of Central Anatolia whose conditions seem unfavourable to most scorpions. It is a ground-dwelling scorpion, occurring relatively dense populations mostly on red soils within territories deeply modified by human activities too. The Anatolian populations are referred to *M.g.anatolicus* (Schenkel, 1947) (Kinzelbach, 1975, 1982, 1984). In the eastern regions it is entirely replaced by other *Mesobuthus* (*M. caucasicus*, *M. eupeus*). The complete revision of the genus *Mesobuthus* in Turkey has never been made, for the volume of its species in this area remain uncertain.

Family Euscorpiidae Laurie, 1896

Genus *Euscorpius* Thorell, 1876

Scorpions of the genus *Euscorpius* are common and abundant in most of the Mediterranean countries. Hypotheses of speciation are controversial. According to Fet "Numerous primary data are published on *Euscorpius* species and forms from Italy, France, Austria and Yugoslavia; much less, from Greece and Turkey" (Fet, 1993: 1). *Euscorpius* are small (30-50 mm), reddish-brown or black, mesophile scorpions. Species of this genus belong to the ecomorphotype of lithophilic scorpions (Iasmi and Moysis, 1999).

7. *Euscorpius carpathicus* (Linnaeus, 1767)

E. carpathicus is a widely distributed taxon whose subspecific structure is extremely complicated (Caporiacco, 1950; Fet, 1988). It is known for Turkish Thrace, a small portion of the Ponto Region and a large portion of the Mediterranean Region (Kinzelbach, 1975). Further comparative studies should assess the criteria for subspecific structure of Turkish populations.

8. *Euscorpius italicus* (Herbst, 1800)

According to Vachon (1981) and Bonacina (1982), *E. italicus* is quite homogeneous and cannot be easily splitted in subspecies. The Anatolian populations of this species, widely distributed in the Ponto – in Turkey as in Georgia and in Russia – have been referred to *E.i. awhasicus* (Nordmann, 1840) (Vachon, 1966) (Fig. 3).

9. *Euscorpius mingrelicus* (Kessler, 1874)

According to Bonacina (1980), *E. mingrelicus* is a well characterized species with respect to *E. germanus* (Schaeffer, 1776). Its distribution includes Italy (NE only), Croatia, Slovenia, Serbia, Bosnia, Moldova, Turkey, Georgia, Russia (Krasnodar region) and probably Greece (Fet, 1993). The populations of Turkey are referred to the following subspecies: *E.m. mingrelicus* (Kessler, 1874), north and east Turkey; *E.m. ciliciensis* (Birula, 1898), Cilician Taurus; *E.m. phrygius* Bonacina, 1980, West Anatolia and European Turkey (Bonacina, 1980; Fet, 1985, 1993). Near Artvin, along the Coruh River, it has been found quite abundant in pine forests (Crucitti, unpublished data).

Family Iuridae Thorell, 1876

Genus *Calchas* Birula, 1899

10. *Calchas nordmanni* Birula, 1899

Controversial aspects with regard to the generic name proposed for this taxon are discussed in Francke (1985), Fet (1988), Fet and Madge (1988). However, we follow these last Authors who considered *Calchas* Birula 1899 a valid name, and *Paraiurus* Francke (1985) its junior synonym. The "Caucasian scorpion" has been firstly collected near Artvin NE Turkey (Birula 1917a,b); afterwards, near Siirt (south of the Lake Van), Kumluca (near Antalya), Urfa, Tortum (between Artvin and Erzurum) (Kinzelbach, 1980, 1982). Finally, Vachon and Kinzelbach (1987) recorded Birecik (between Gaziantep and Urfa) and published a resumptive map of the distribution of *Calchas* and *Iurus* in Turkey. It has been recently found between Artvin and Yusufely (Crucitti, unpublished data). *C. nordmanni* has, up to now, an extremely scattered distribution in Turkey but it is probably more widespread. It is rarely collected due to its small size and specialized ecological demands.

Genus *Iurus* Thorell, 1876

11. *Iurus asiaticus* Birula, 1903

A long time considered as a subspecies of *I. dufoureius* (Brullé, 1832) (Vachon, 1947a,b, 1951), the populations of Turkey has been raised to the rank of a distinct species (Francke, 1981). However, the status of this taxon is still uncertain (Braunwalder and Fet, 1999). Its range extends to the south of the Aegean region and the whole Mediterranean region of Turkey, including the Chain of Taurus,

between the districts of Mugla and Tarsus (Kinzelbach, 1982; Vachon, 1953) (Fig. 2). *I. asiaticus*, probably the largest scorpion of the country – a male from Gungdogmus (Antalya) was over 100 mm and 7 g – is a strictly hygrophile scorpion that lives in dense, fir and maple, forests and oak groves, where it is fairly common (Crucitti and Malori, 1998).

Family Scorpionidae Latreille, 1802
Genus *Scorpio* Linnaeus, 1758

12. *Scorpio maurus* Linnaeus, 1758

S. maurus fuscus (Hemprich and Ehrenberg, 1829), the only subspecies of *S. maurus* found in Turkey, is restricted to the territories of the south east: "From Elazig to Mersin and to the Amanus Mt" (Levy and Amitai, 1980: 114) (Fig. 3). In some sites it is the most numerous scorpion with a density of more than one specimen within an area of 1 mq (Belen, near Iskenderun; Sincik, between Adiyaman and Malatya): it has been found very abundant in urban area too (Kirikhan, district of Hatay) (Crucitti, 1998). *S.m. fuscus* is a stoutly-built species (70-80 mm) and a fossorial (facultative/obligate) scorpion that often digs a burrow of 20-40 cm under a stone in rendzina or in the terra rossa soils.

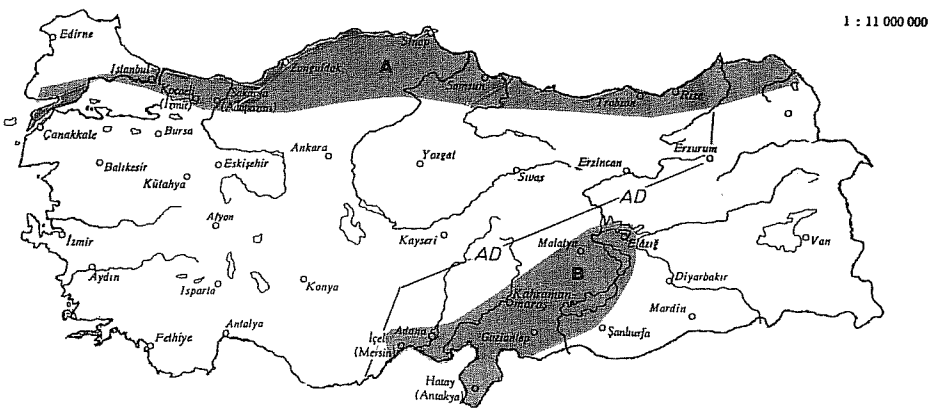

Fig. 3 - The presuntive distribution of some species of scorpions in Anatolia: *Euscorpius italicus* (A); *Scorpio maurus* (B). AD: Anatolian diagonal.

CONCLUSIONS

Present status of the knowledge

On the whole, despite the efforts of many workers, the amount of data about the distribution of Turkish scorpionfauna is unsatisfactory and an attempt of

synthesis is a far-off times goal. There are still unresolved taxonomic problems. The exact distribution of most taxa is uncertain. The Buthids – with the only exception of *M. gibbosus* – and *Calchas nordmanni* required more accurate investigations based on more abundant available materials. The unaware of data is a consequence of the scarcity of the knowledge about the fauna of the far east territories: from Adiyaman to Hakkari and from Van to Kars. Unfortunately, the richness of species of most territories is inverse to their political stability and the possibilities to promote further expeditions.

The number of taxa and its significance

Scorpion species of four families, Buthidae, Euscorpiidae, Iuridae and Scorpionidae, are represented in the region under consideration. Eight genera with 14 species and subspecies are listed: however, an increase of this number is to be expected in the near future. The only endemic taxon is *E.m. ciliciensis* (Birula, 1898) (Fet, 1993) while most genera are mono/oligotypic. The low number of species and subspecies is a pattern common to most Middle-East countries: territories of the ex-USSR (mainly Soviet Caucasus and Central Asia), 14 (Fet, 1988); Palestine, 19 (Levy and Amitai, 1980); Jordan, 14 (Amr and El-Oran, 1994); Irak, 15 (Vachon, 1966). More generally, in most territories of the Mediterranean Basin and the surrounding Middle East, the ratio between the number of families and the number of species is high (it is low in most territories of the Southern Hemisphere and the New World) and this is particularly true for Turkey if we consider that a relatively low number of species are assigned to four families while in most territories of the Middle East a similar number of species is assigned to only two or three families, because of the absence of Euscorpiidae and/or Iuridae.

Patterns of diversity

The diversity of scorpions (alfa diversity, the number of species in a given area) is very disomogeneous in the whole Anatolian countryside. In some territories of the Central Anatolian Plateau, *e.g.*, the Plain of Konia, 0-2 species may be expected, probably due to the continentality of the climate and increase of steppes after the most severe phase of the Wurm glaciation, 30000 yr BP and the marked modification (human pressures on ecosystems, *e.g.*, forest destruction and transformation) of the former landscapes. In the Black Sea, Aegean and Mediterranean regions, 3-4 species may be recognized, generally 1-2 Euscorpiidae, 1-2 Iuridae and 1 Buthidae. The "European- Mediterranean" facies of those territories is largely replaced with an "Asiatic" facies of the southeast territories. Vachon (1951) recognizes two faunal territories, western and eastern,

respectively; the first includes Aegean and Mediterranean territories, the Central Anatolia and the Ponto district; the second, the volcanic terrains of Eastern Anatolia and the Caucasus. The border line, the so-called "Anatolian diagonal" (AD: Fig. 3), a mountain barrier which runs obliquely from the Great Caucasus in the Northeast to the Taurus Mts in the Southwest, a boundary between two different, climatic and faunal, areas, crosses the Anatolian Plateau leaving eastward Erzurum, Palu, Elazig, Malatya, Adana and Iskenderun. In a narrow belt between Mersin and Urfa, the highest number of species (8-9) and all the families and genera known for Turkey have been checked. In a still more restricted area, the Tigris-Euphrates drainage, all the genus and all but one species of Buthids have been checked; this and the neighbouring territories (provinces of Hatay, Gaziantep, Adiyaman, Urfa, Malatya, Diyarbakir, Mardin, Batman, Siirt, Sirnak) are at the highest hazard of scorpionism in the whole country. *A. crassicauda* and *L. quinquestriatus* are considered to be of medical importance, the first species of public health importance in the area under consideration (Keegan, 1980; Kasparek and Kasparek, 1993). The question suggested by Lourenco (1988, 1991): "Peut-on parler d'une biogeographie du scorpionisme?" appear to be useful if applied to the Turkish scorpiofauna.

Families and genera according to their zoogeographic affinities

It is difficult to distinguish the role of historical and ecological factors which affect the present distribution and diversity of this fauna. An attempt is largely imperfect considering, above all, that new species of Buthidae still can be discovered in the territory. We are able however, at a first step, to distinguish:

1 - Aegean-Anatolian or endemic taxa with a distribution pattern difficult to explain. They belong to the family Iuridae, genera *Calchas* and *Iurus*. The Iuridae explain a disjunct distribution that follows a well-known biogeographical track, the Tethys geosyncline (Francke and Soleglad, 1981); moreover, the present distribution of *Iurus* may be explained admitting the existence of the so-called "southern aegean arch" that originally joined the territories of Peloponnese, Crete, Karpathos and Rhodes. According to Vachon (1953), at the end of the Tertiary, a period of "explosion" allowed *Iurus* to spread its distribution in the mainland of southern Turkey too;

2 - Central Asian taxa. To this group belongs the species of the genus *Mesobuthus*; it reaches, in the northwest the Aegean Sea and the Balkans;

3 - Saharo-Sindian taxa. To this group belongs the species of the genera *Androctonus*, *Compsobuthus*, *Leiurus* and *Scorpio*; all are widespread both in North Africa and the Middle East;

4 - European-Mediterranean taxa. To this group belongs the species of the genus *Euscorpius* which have their centre of distribution outside the Middle

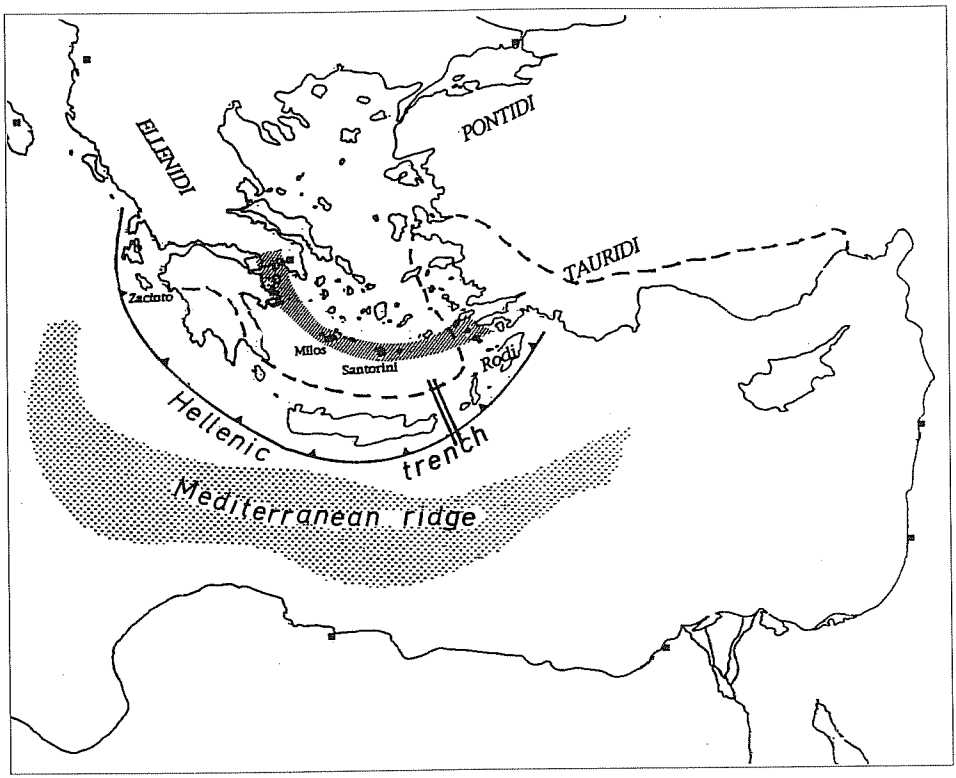

Fig. 4 - The sketched line represents the northern limit of the distribution of the genus *Iurus* in the Aegean-Anatolian area according to the existence of the Hellenic arch between the Hellenic trench and the volcanic front (dotted area). The double bar divides the known range of *Iurus dufoureius* from the known range of *Iurus asiaticus* (tectonic map of the Aegean area redrawn, with some modifications, from: Gaspari G., 1995 Geologia Regionale - Pitagora, Bologna, 464 pp.).

East; however, Turkey is the only territory of the Middle East in which three and quite widespread species of the genus *Euscorpius* (along the coasts and the mainland of the Black Sea, the Aegean and the Mediterranean districts) occur (Fig. 4).

Groups 2 and 3 included the highest number of taxa (genera/species), practically all the members of the family Buthidae and Scorpionidae. Finally, it is worthy mentioning that a recent stocks of populations may be emerged from the development of arid and semiarid conditions of the landscape during the postglacial times, as a consequence of their geographic separation and genetic isolation (Vachon and Kinzelbach, 1987); under this aspect, the taxonomic status of some populations at the border of its range (*A. crassicauda*, *L. quinquestriatus*, *S. maurus*) need further investigations.

On the whole, the Anatolian Peninsula shows its nature of crossroads of different faunistic stocks, as highlighted by its scorpion fauna too (Fig. 5).

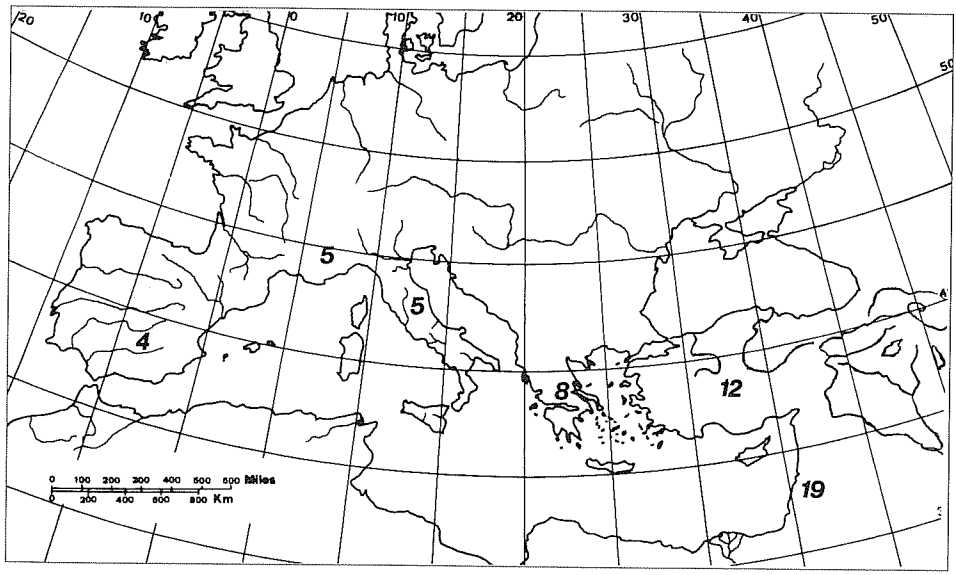

Fig. 5 - The number of species of Scorpions in the main regions of Western Europe and Turkey.

ACKNOWLEDGEMENTS

Thanks are due to Paola Marcari and Maurizio Sforza for the revision of the English text and to Francesco Bubbico, Claudia Calvani, Alfredo Ingrosso, Paolo Moscatelli, Giovanni Rotella and Mario Torchia, of the Società Romana di Scienze Naturali, for the skilful technical assistance.

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