

Diversity and Conservation of Endemic Spiders (Arachnida: Araneae) in Turkey

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Abstract

The endemic spider in Turkey comprises 155 species belongs to 22 families, it represents nearly 14 % of all spider of Turkey. The largest number of endemic species is found in the Dysderidae with 41 species. Also, Leptonetidae and Hersiliidae are 100% endemic. The genus Harpactea which has the highest endemism with 23 species. The largest number of endemic species is distributed in BR and MER in Turkey. Most part of the endemic species in Turkey were distributed mainly in caves. Some remarks on Conservation of Endemic Spiders were also added.

Keywords: Biodiversity, Endemic spiders, Turkey, conservation

INTRODUCTION

Turkey is a very large country with rather heterogeneous countryside. Defining its spider fauna is a great challenge that will take long time to cover even a small part of it. So, identifying the spider fauna of Turkey is very difficult.

Short History of Research on Turkish Spiders

The first studies on the spider fauna of Turkey began at the end of the 19th century and the first work was written by Rossi (1846). The first datas on Turkish spiders were characterized by brief visits made by non-Turkish scientists, such as Simon 1878; Pickard-Cambridge 1874; Pavesi 1876; Dalmas 1920,1921; DiCaporiacco 1935, Rower 1960, Kulczyn'ski 1903, Nosek 1905, Reimoser 1913 [1]. The most comprehensive lists of Turkish spiders dates back to Karol (1967) who listed 302 species belonging to 119 genera with several subspecies, and Bayram (2002) who listed 520 species belonging to 162 genera from Turkey, based on the work of Karol. Most recently, Topçu et al. (2005) provided an updated checklist of spiders of Turkey, incorporating data

both from Karol (1967) and Bayram (2002). In this study, a total of 613 species and 2 subspecies from Turkey are listed by authors. In 2008, Bayram and co-worker updated all checklists and prepared a online list of Turkish spiders. According to this online list, the number of spiders in Turkey is 690 species in 44 families. After then, many recent authors in their papers made contributions to the spider fauna of Turkey and arenological studies in the country keep on expeditiously. All available literature records and new data makes it possible to critically review of the endemic spiders in Turkey

RESULTS and DISCUSSION

Analysis of Endemic Spiders

Turkey has 53 spider families [2-4, 8]. 22 families of them contain endemic species. According to all data available, 155 species are endemic for Turkey and it represents nearly 14 % of all spider of Turkey (Table 1).

Table 1. List of endemic Turkish spider species together with their references.

Species	Distribu- tion	References
Agelenidae		
Coelotes arganoi Brignoli, 1978	Turkey	Topçu et al., 2005
Coelotes coenobita Brignoli, 1978	Turkey	Topçu et al., 2005
Coelotes luculli Brignoli, 1978	Turkey	Topçu et al., 2005
Coelotes phthisicus Brignoli, 1978	Turkey	Danişman (2013b)
Coelotes rhododendri Brignoli, 1978	Turkey	Topçu et al., 2005
Coelotes sinopensis Danişman, Karanfil & Coşar, 2016	Turkey	Danişman et al. (2016)
Coelotes vignai Brignoli, 1978	Turkey	Topçu et al., 2005
Maimuna cariae Brignoli, 1978	Turkey	Topçu et al., 2005
Pireneitega armeniaca (Brignoli, 1978)	Turkey	Topçu et al., 2005
Pireneitega cottarellii (Brignoli, 1978)	Turkey	Topçu et al., 2005
Tegenaria agnolettii Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria anhela Brignoli, 1972	Turkey	Topçu et al., 2005
Tegenaria argaeica Nosek, 1905	Turkey	Topçu et al., 2005
Tegenaria averni Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria comnena Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria cottarellii Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria elysii Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria forestieroi Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria hamid Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria karaman Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria mamikonian Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria melbae Brignoli, 1972	Turkey	Topçu et al., 2005
Tegenaria pasquini Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria tekke Brignoli, 1978	Turkey	Topçu et al., 2005
Tegenaria vanensis Danişman & Karanfil, 2015	Turkey	Danişman & Karanfil (2015)
Tegenaria vignai Brignoli, 1978	Turkey	Topçu et al., 2005
Araneidae		
Hypsosinga pygmaea nigriceps (Kulczyński, 1903)	Turkey	Topçu et al., 2005
Cybaeidae		
Cybaeus brignolii Maurer, 1992	Turkey	Topçu et al., 2005
Dictynidae		
Cicurina paphlagoniae Brignoli, 1978	Turkey	Topçu et al., 2005
Lathys ankaraensis Özkütük, Marusik, Elverici & Kunt, 2016	Turkey	Özkütük et al. (2016)
Dysderidae		
Dasumia gasparoi Kunt, Özkütük & Elverici, 2011	Turkey	Kunt et al. (2011)
Dasumia mariandyna Brignoli, 1979	Turkey	Topçu et al., 2005
Dysdera akpinarae Varol, 2015	Turkey	Varol (2015)
Dysdera anatoliae Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
Dysdera argaeica Nosek, 1905	Turkey	Topçu et al., 2005
Dysdera asiatica Nosek, 1905	Turkey	Topçu et al., 2005
Dysdera enguriensis Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
Dysdera gruberi Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
Dysdera hattus Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
Dysdera mixta Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
Dysdera tezcani Varol & Akpinar, 2016	Turkey	Varol & Akpinar (2016)

<i>Dysdera topcui</i> Gasparo, 2008	Turkey	Gasparo (2008)
<i>Dysdera turcica</i> Varol, 2015	Turkey	Varol (2015)
<i>Dysdera yozgat</i> Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
<i>Dysderocrates regina</i> Deeleman-Reinhold, 1988	Turkey	Topçu et al., 2005
<i>Harpactea agnolettii</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea alanyana</i> Özkütük et al., 2015	Turkey	Özkütük et al. (2015)
<i>Harpactea arnedoi</i> Kunt et al., 2011	Turkey	Kunt et al. (2011a)
<i>Harpactea ballarini</i> Kunt, Özkütük & Elverici, 2013	Turkey	Kunt et al. (2013)
<i>Harpactea christodeltshevi</i> Bayram, Kunt & Yağmur, 2009	Turkey	Bayram et al. (2009)
<i>Harpactea colchidis</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea diraoi</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea dohati</i> Alicata, 1974	Turkey	Topçu et al., 2005
<i>Harpactea erseni</i> Kunt, Özkütük & Kaya, 2010	Turkey	Kunt et al. (2010)
<i>Harpactea galatica</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea isaurica</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea karaschkhan</i> Kunt, Özkütük, Elverici, Marusik & Karakaş, 2016	Turkey	Kunt et al. (2016)
<i>Harpactea kencei</i> Kunt et al., 2011	Turkey	Kunt et al. (2011a)
<i>Harpactea korgei</i> Brignoli, 1979	Turkey	Topçu et al., 2005
<i>Harpactea lazorum</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea lyciae</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea medeae</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea osellai</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea pisidica</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea pugio</i> Varol & Akpınar, 2016	Turkey	Varol & Akpınar (2016)
<i>Harpactea sanctaeinsulae</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea sbordonii</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactea vignai</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Harpactocrates troglophilus</i> Brignoli, 1978	Turkey	Topçu et al., 2005
<i>Hygrocrates deelemanus</i> Kunt & Yağmur, 2011	Turkey	Kunt et al. (2011)
<i>Hygrocrates kovblyuki</i> Kunt & Marusik, 2013	Turkey	Kunt et al. (2013)
Gnaphosidae		
<i>Berinda cooki</i> Logunov, 2012	Turkey	Logunov (2012)
<i>Berinda hakani</i> Chatzaki & Seyyar, 2010	Turkey	Panayiotou et al. 2010
<i>Berlandina pulchra</i> (Nosek, 1905)	Turkey	Topçu et al., 2005
<i>Drassodes bifidus</i> Kovblyuk & Seyyar, 2009	Turkey	Kovblyuk et al. (2009)
<i>Drassodes similis</i> Nosek, 1905	Turkey	Topçu et al., 2005
<i>Drassodes villosus</i> (Thorell, 1856)	Palearctic	Topçu et al., 2005
<i>Echemus levyi</i> Kovblyuk & Seyyar, 2009	Turkey	Kovblyuk et al. (2009)
<i>Gnaphosa lucifuga minor</i> Nosek, 1905	Turkey	Topçu et al., 2005
<i>Haplodrassus ponomarevi</i> Kovblyuk & Seyyar, 2009	Turkey	Kovblyuk et al. (2009)
<i>Nomisia orientalis</i> Dalmas, 1921	Turkey	Topçu et al., 2005
<i>Parasyrisca turkenica</i> Ovtsharenko, Platnick & Marusik, 1995	Turkey	Ovtsharenko et al. (1995)
<i>Pseudodrassus ricasolii</i> Caporiacco, 1935	Turkey	Topçu et al., 2005
<i>Turkozelotes microb</i> Kovblyuk & Seyyar, 2009	Turkey	Kovblyuk et al. (2009)
<i>Zelotes turcicus</i> Seyyar, Demir & Aktaş, 2010	Turkey	Seyyar et al. (2010)
<i>Zelotes turcicus</i> Wunderlich, 2011	Turkey	Wunderlich (2011)
Hahniidae		
<i>Cryphoea thaleri</i> Wunderlich, 1995	Turkey	Topçu et al., 2005

Hersiliidae		
Hersiliola bayrami Danisman et al., 2012	Turkey	Danıřman et al. (2012)
Hersiliola turcica Marusik, Kunt & Yagmur, 2010	Turkey	Yağmur et al. (2008)
Leptonetidae		
Cataleptoneta aesculapii (Brignoli, 1968)	Turkey	Topçu et al., 2005
Cataleptoneta sbordonii (Brignoli, 1968)	Turkey	Topçu et al., 2005
Leptonetela deltshevi (Brignoli, 1979)	Turkey	Topçu et al., 2005
Linyphiidae		
Abacoproeces topcui Türkeř et al., 2015	Turkey	Türkeř et al. (2015)
Centromerus turcicus Wunderlich, 1995	Turkey	Topçu et al., 2005
Centromerus unicolor Roewer, 1959	Turkey	Topçu et al., 2005
Gonatium cappadocium Millidge, 1981	Turkey	Topçu et al., 2005
Improphantes turok Tanasevitch, 2011	Turkey	Tanasevitch (2011)
Mansuphantes korgei (Saaristo & Tanasevitch, 1996)	Turkey	Topçu et al., 2005
Megalephyphantes globularis Tanasevitch, 2011	Turkey	Tanasevitch (2011)
Palliduphantes bayrami Demir, Topçu & Seyyar, 2008	Turkey	Demir et al. (2008b)
Saloca elevata Wunderlich, 2011	Turkey	Wunderlich (2011)
Scutpelecopsis media Wunderlich, 2011	Turkey	Wunderlich (2011)
Sintula cristatus Wunderlich, 1995	Turkey	Topçu et al., 2005
Stemonyphantes abantensis Wunderlich, 1978	Turkey	Topçu et al., 2005
Stemonyphantes montanus Wunderlich, 1978	Turkey	Topçu et al., 2005
Stemonyphantes serratus Tanasevitch, 2011	Turkey	Tanasevitch (2011)
Tallusia bicristata Lehtinen & Saaristo, 1972	Turkey	Topçu et al., 2005
Tapinopa gereade Saaristo, 1997 Turkey	Turkey	Topçu et al., 2005
Tenuiphantes wunderlichi (Saaristo & Tanasevitch, 1996)	Turkey	Topçu et al., 2005
Troglohyphantes gladius Wunderlich, 1995	Turkey	Topçu et al., 2005
Troglohyphantes karolianus Topçu, Türkes & Seyyar, 2008	Turkey	Topçu et al. (2008)
Troglohyphantes pisidicus Brignoli, 1971	Turkey	Topçu et al., 2005
Troglohyphantes turcicus Topçu et al., 2014	Turkey	Topçu et al. (2014)
Walckenaeria aksoyi Seyyar, Demir & Türkes, 2008	Turkey	Seyyar et al. (2008)
Walckenaeria alticeps (Denis, 1952)	Turkey	Tanasevitch (2011)
Lycosidae		
Arctosa simoni Guy, 1966	Turkey	Topçu et al., 2005
Pardosa ilgunensis Nosek, 1905	Turkey	Topçu et al., 2005
Nemesiidae		
Raveniola arthuri (Kunt & Yağmur, 2010)	Turkey	Kunt & Yağmur (2010)
Raveniola micropa (Ausserer, 1871)	Turkey	Topçu et al., 2005
Nesticidae		
Nesticus dimensis Lopez-Pancorbo, Kunt & Ribera, 2013	Turkey	Lopez-Pancorbo et al. (2013)
Typhlonesticus gocmeni Ribera et al., 2014	Turkey	Ribera et al. (2014)
Oonopidae		
Orchestina topcui Danisman & Cosar, 2012	Turkey	Danisman & Cořar (2012)
Silhouettella osmaniye Wunderlich, 2011	Turkey	Wunderlich (2011)
Philodromidae		
Philodromus bonneti Karol, 1968	Turkey	Topçu et al., 2005
Philodromus bucaensis (Logunov & Kunt, 2010)	Turkey	Logunov & Kunt (2010)
Philodromus krausi Muster & Thaler, 2004	Turkey	Topçu et al., 2005
Thanatus okayi Karol, 1966	Turkey	Topçu et al., 2005
Pholcidae		
		Topçu et al., 2005

Hoplopholcus asiaeminoris Brignoli, 1978	Turkey	Topçu et al., 2005
Hoplopholcus patrizii (Roewer, 1962	Turkey	Topçu et al., 2005
Pholcus spasskyi Brignoli, 1978	Turkey	Topçu et al., 2005
Pholcus turcicus Wunderlich, 1980	Turkey	Topçu et al., 2005
Salticidae		
Aelurillus alboclypeus Azarkina & Komnenov, 2015	Turkey	Azarkina & Komnenov (2015)
Euophrys fucata (Simon, 1868)	Turkey	Topçu et al., 2005
Habrocestum nigristernum Dalmás, 1920	Turkey	Topçu et al., 2005
Heliophanus feltoni Logunov, 2009	Turkey	Logunov (2009)
Heliophanus konradthaleri Logunov, 2009	Turkey	Logunov (2009)
Salticus resslı Logunov, 2015	Turkey	Logunov (2015)
Yllenus zaraensis Logunov, 2009	Turkey	Logunov (2009)
Theraphosidae		
Chaetopelma turkesi Topçu & Demircan, 2014	Turkey	Topçu & Demircan (2014)
Theridiidae		
Robertus brachati Wunderlich, 2011	Turkey	Wunderlich (2011)
Thomisidae		
Heriades pilosus Nosek, 1905	Turkey	Topçu et al., 2005
Ozyptila ankarensis Karol, 1966	Turkey	Topçu et al., 2005
Ozyptila clavidorsa Roewer, 1959	Turkey	Topçu et al., 2005
Ozyptila spirembola Wunderlich, 1995	Turkey	Topçu et al., 2005
Synema anatolica Demir, Aktas & Topçu, 2009	Turkey	Demir et al. (2009b)
Xysticus anaticus Demir, Aktas & Topçu, 2008	Turkey	Demir et al. (2008b)
Xysticus demirsoyi Demir, Topçu & Türkes, 2006	Turkey	Demir et al. (2006)
Xysticus pseudolanio Wunderlich, 1995	Turkey	Topçu et al., 2005
Xysticus tenuiapicalis Demir, 2012	Turkey	Demir (2012)
Zodariidae		
Zodarion bigaense Bosmans et al., 2014	Turkey	Bosmans et al. (2014)
Zodarion deltshevi Bosmans, 2009	Turkey	Bosmans (2009)
Zodarion korgei Wunderlich, 1980	Turkey	Topçu et al., 2005
Zodarion van Bosmans, 2009	Turkey	Bosmans (2009)
Zodarion varoli Akpınar, 2016	Turkey	Akpınar (2016)
Zoropsidae		
Zoropsis beccarii Caporiacco, 1935	Turkey	Topçu et al., 2005

The largest number of endemic species is found in the Dysderidae, with 41 species, followed by Agelenidae (26) and Linyphiidae (23). Leptonetidae and Hersiliidae are

100% endemic, followed in decreasing numbers by Dysderidae, Agelenidae, Linyphiidae and Gnaphosidae so on (Fig 1).

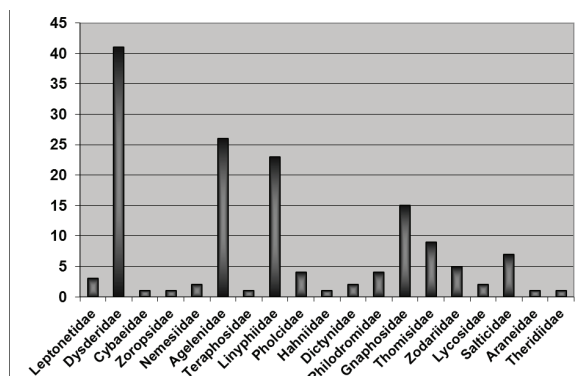


Figure 1. Species numbers of endemic species per family in Turkey

According to Deltshv (2000), the largest endemic species have usually found in the restricted area such as islands, caves, high altitude zone and woodland. The largest number of endemic species is distributed in Black Sea Region (BR) and Mediterranean Region (MER) in Turkey. The findings of endemic spider in two regions, mainly distributed on range of mountains and in many caves (especially MER), have increased proportion of endemic spiders [5]. In the same literature, the endemic taxa of spider in the Balkan peninsula are represented by 348 species included in 30 families. The highest endemic spider number of countries in this peninsula is found in Greece (115), Croatia (68), Bulgaria (55), Bosnia (41) and Crete (46) [5]. When Turkey is compared with Greece from these countries, it has nearly equal number of endemic spider. We think that the endemic spider fauna of Turkey is considerably larger, as there are a variety of environments, different both in geomorphology and vegetation. Research on spider is still in progress as a large part of Turkey is still to be investigated.

Remarks on Conservation of Endemic Spiders

Turkey has a remarkably rich and diverse flora and fauna. This has been catalogued and documented by local and foreigner researchers for more than a century but biodiversity survey and conservation activities in Turkey have generally been carried out on vertebrates, such as mammals, birds and reptiles [6].

Defining species distribution in accordance with the variable topography and climate of Anatolia has special importance for understanding contemporary biodiversity and developing conservation strategies. Anatolia has many mountain ranges, great variability in topography and climate, thus Anatolia is fragmented into many small parts which may have their own faunal identity. This study evaluates the distribution of spiders with reference to this fragmentation and identifies 'hotspots' in Anatolia, especially in caves and on mountain ranges in Mediterranean Region.

Turkish spider has nearly 16 % degree of endemism. The endemic species show restricted local distributions and are present especially at high altitudes or in mountain ranges and in caves. This kind of distribution indicates the importance of topography in the evolution and distribution of spider.

According to datas in 2017 of The IUCN Red List of Threatened Species, only 199 spider species have been included in the IUCN Red List or suggested for inclusion. This is mainly because (i) there are no ecological studies on Turkish spider that include data on population densities, geographical ranges, habitat preference, etc.; (ii) Anatolia

occupies a large land area, so faunistic and taxonomical studies are limited.

The majority of endemic species in Turkey are inhabit in caves, especially Mediterranean Region. Most of the 61 species are known from Turkish caves are endemic [7]. Turkey has a great deal of the caves due to its different geological structures and formations. According to the datas of M.T.A. (Directorate of the Institute of Mineral Research), the caves in Turkey which are thought to be 40.000 but only 1250 of them were discovered. The number of examined caves on an araneological base are restricted in Turkey. However, cave dwelling spiders are sensitive creatures like other cave organisms. Anthropological effects such as: opening the cave for tourism and pollution in underground water affect cave dwelling spiders like other cave organisms. For example, during our recent studies, we did not encounter the endemic species *Cataleptoneta aesculapii* that was described by the great Italian arachnologist Brignoli (1968) from the Damlataş Cave in Alanya [7]. So, various conservation strategies should be developed for cave spiders.

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