

## 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-<br>tion | References                 |
|--|-------------------|----------------------------|
| <b>Agelenidae</b>  |                   |                            |
| 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         |
| <b>Araneidae</b>   |                   |                            |
| Hypsosinga pygmaea nigriceps (Kulczyński, 1903)            | Turkey            | Topçu et al., 2005         |
| <b>Cybaeidae</b>   |                   |                            |
| Cybaeus brignolii Maurer, 1992                             | Turkey            | Topçu et al., 2005         |
| <b>Dictynidae</b>  |                   |                            |
| Cicurina paphlagoniae Brignoli, 1978                       | Turkey            | Topçu et al., 2005         |
| Lathys ankaraensis Özkütük, Marusik, Elverici & Kunt, 2016 | Turkey            | Özkütük et al. (2016)      |
| <b>Dysderidae</b>  |                   |                            |
| 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 & Yagmur, 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)        |
| <b>Gnaphosidae</b>  |            |                           |
| <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)         |
| <b>Hahniidae</b>  |            |                           |
| <i>Cryphoea thaleri</i> Wunderlich, 1995                                      | Turkey     | Topçu et al., 2005        |

|   |        |                              |
|---|--------|------------------------------|
| <b>Hersiliidae</b>                                      |        |                              |
| Hersiliola bayrami Danisman et al., 2012                | Turkey | Danişman et al. (2012)       |
| Hersiliola turcica Marusik, Kunt & Yagmur, 2010         | Turkey | Yağmur et al. (2008)         |
| <b>Leptonetidae</b>                                     |        |                              |
| 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           |
| <b>Linyphiidae</b>                                      |        |                              |
| Abacoproeces topcui Türkeş et al., 2015                 | Turkey | Türkeş 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, Türkeş & 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 & Türkeş, 2008        | Turkey | Seyyar et al. (2008)         |
| Walckenaeria alticeps (Denis, 1952)                     | Turkey | Tanasevitch (2011)           |
| <b>Lycosidae</b>  |        |                              |
| Arctosa simoni Guy, 1966                                | Turkey | Topçu et al., 2005           |
| Pardosa ilgunensis Nosek, 1905                          | Turkey | Topçu et al., 2005           |
| <b>Nemesiidae</b>                                       |        |                              |
| Raveniola arthuri (Kunt & Yağmur, 2010)                 | Turkey | Kunt & Yağmur (2010)         |
| Raveniola micropa (Ausserer, 1871)                      | Turkey | Topçu et al., 2005           |
| <b>Nesticidae</b>                                       |        |                              |
| Nesticus dimensis Lopez-Pancorbo, Kunt & Ribera, 2013   | Turkey | Lopez-Pancorbo et al. (2013) |
| Typhlonesticus gocmeni Ribera et al., 2014              | Turkey | Ribera et al. (2014)         |
| <b>Oonopidae</b>  |        |                              |
| Orchestina topcui Danisman & Cosar, 2012                | Turkey | Danisman & Coşar (2012)      |
| Silhouettella osmaniye Wunderlich, 2011                 | Turkey | Wunderlich (2011)            |
| <b>Philodromidae</b>                                    |        |                              |
| 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           |
| <b>Pholcidae</b>  |        |                              |
|   |        | 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         |
| <b>Salticidae</b>                                |        |                            |
| 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)             |
| <b>Theraphosidae</b>                             |        |                            |
| Chaetopelma turkesi Topçu & Demircan, 2014       | Turkey | Topçu & Demircan (2014)    |
| <b>Theridiidae</b>                               |        |                            |
| Robertus brachati Wunderlich, 2011               | Turkey | Wunderlich (2011)          |
| <b>Thomisidae</b>                                |        |                            |
| 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)               |
| <b>Zodariidae</b>                                |        |                            |
| 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)             |
| <b>Zoropsidae</b>                                |        |                            |
| 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).

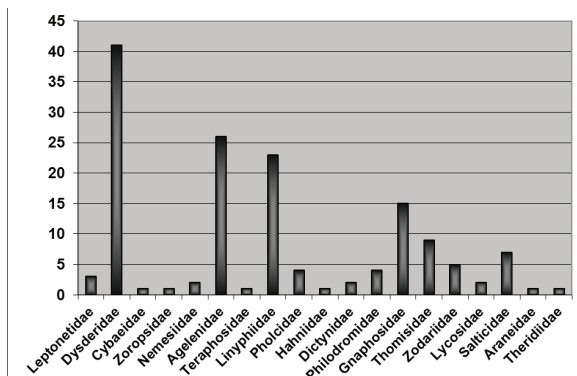


Figure 1. Species numbers of endemic species per family in Turkey

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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