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Araştırma Makalesi / Research Paper

A Comparison of the Species Composition of *Arrenurus* Duges (Arrenuridae: Hydrachnidia: Acari) in Turkey and Some Countries in Palearctic Region

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ABSTRACT

This study aimed to determine the distributions, habitats and endemism rates of *Arrenurus* from Turkey. Similarity indices were determined between Turkey and some countries in the Palearctic Region. Sorensen and Jaccard similarity indices were used for the similarity comparisons. Both calculations show that *Arrenurus* fauna of Turkey has a high similarity with that of France, the Netherlands and Belgium, but the lowest similarity with Japan. It has also been reviewed the contributions made to the genus *Arrenurus* in Turkey. Additionaly, the female of *Arrenurus dileri* Boyacı and Özkan 2004 was misidentificated, it is determined *Arrrenurus walkanoffi* (Viets, 1926).

Keywords: Acari, endemic, biodiversity, taxonomy, Turkey

Türkiye ve Bazı Palearktik Bölge Ülkelerinin *Arrenurus* Duges (Arrenuridae: Hydrachnidia: Acari) Türlerinin Karşılaştırılması

ÖZ

Bu çalışmada, Türkiye'den kaydedilmiş *Arrenurus* türlerinin dağılım, habitat ve endemizm oranlarının verilmesi amaçlanmıştır. Türkiye ve bazı Palearktik Bölge ülkelerinin arasındaki benzerlik hesapları yapılmıştır. Bu amaçla, Sorensen ve Jaccard benzerlik endeksleri kullanılmıştır. Her iki hesaplama sonucunda Türkiye *Arrenurus* faunası Fransa, Hollanda ve Belçika ile yüksek oranda benzerlik gösterirken, en düşük benzerlik Japonya ile gözlenmiştir. Ayrıca Türkiye *Arrenurus* cinsine yapılan katkılar da gözden geçirilmiştir. *Arrenurus dileri* Boyacı ve Özkan 2004'nin dişisi yanlış teşhis edilmiş olup, teşhis edilen örneklerin *Arrrenurus walkanoffi* (Viets, 1926)'ye ait olduğu belirlenmiştir.

Anahtar Kelimeler: Acari, endemik, biyolojik çeşitlilik, taksonomi, Türkiye

INTRODUCTION

Water mites are known as Hydracarina, Hydrachnidia or Hydrachnellae. They are a polyphyletic group and belong to the Acari subclass (Sabatino et al., 2008). Free–living species are found in groundwater, hot and cold–water springs, backwater, marshes, ponds, lakes and seas, whereas parasitic forms inhabit the mantle cavity of mollusks and sponges.

While the genera *Pontarachna* Philippi, 1840 and *Litarachna* Walter, 1925 of Hydracnidia have well adapted to the marine environment, other genera can live in almost any type of freshwater habitats. Some researchers separate water mite fauna into five major synecologic groups: crenophiles, crenobionts, rheophiles, rheobionts and lenitobionts (Zawal et al., 2018).

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Goldschmidt (2016) reported that water mites can be used as indicator types in determining clear water sources due to their distributional characteristics, but they have been largely neglected. Because water mites are a group of animals that are very useful as bioindicators but are not evaluated. So, this group is not included in the European Commission Water Framework Directive (Zawal et al., 2018). However, when water mites are compared with other animal groups and plants in terms of bioindicator–properties specifically for spring water, it can be expressed that the water mites have a very high indicator value. Because spring waters have high stenotopism with water mites and their distribution probability depends on aquatic insects (Zawal et al., 2018).

Over 6000 species have been identified across the world, representing 8 superfamilies, 57 families, 81 subfamilies and more than 400 genera. Studies on many regions of the world, especially the Oriental and Afrotropical regions, are scarce. The number of water mites in the world is estimated to be more than 10,000 (Erman et al., 2010; 2019).

The first checklist of water mites in Turkey was compiled by Erman et al. (2010), includes 23 families, 52 genera and 236 species. The second checklist by Erman et al. (2019) includes 25 families, 62 genera and 335 species. Arrenuridae ranks first and is represented with 58 species, followed by Hygrobatidae (54 species) and Hydryphantidae (39 species), respectively. However, some families have only one species (Figure 1) (Erman et al., 2019).

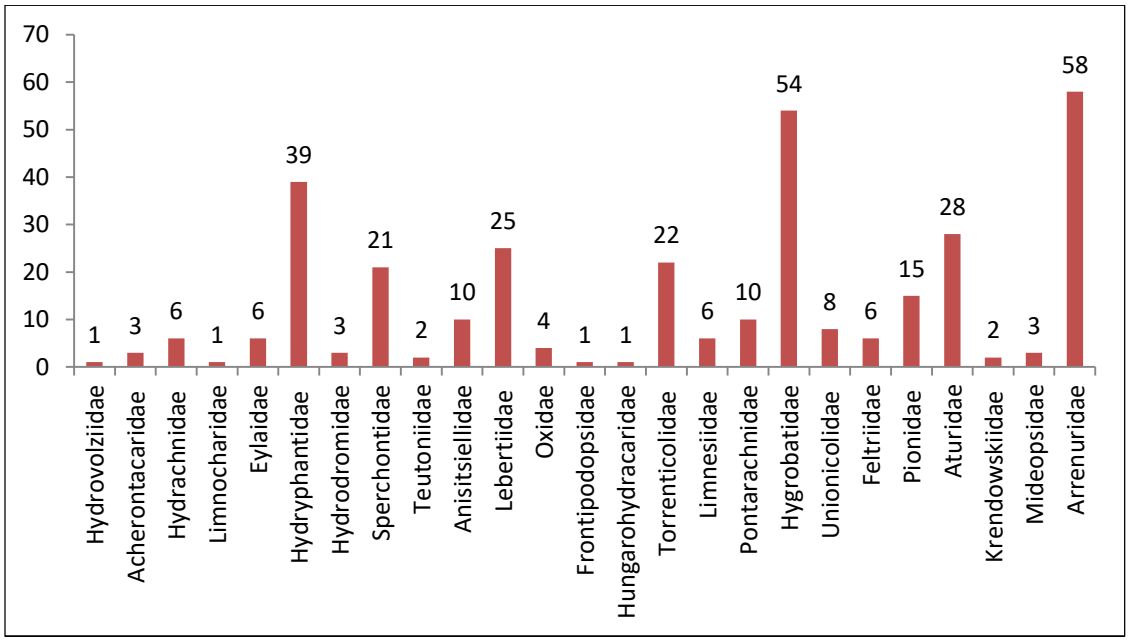

Figure 1. The number of species identified from Turkey according to the families (Erman et al., 2019).

Although species of the genus *Arrenurus* live in groundwater, springs, creeks, rivers, debris and marshes, and most of them prefer stagnant waters and lakes, they have spread throughout all continents except the Antarctic region. *Arrenurus*, which has a cosmopolitan distribution, is the richest genus of water mites in terms of species number (Gerecke et al. 2016). This genus is represented with around 950 species in the world (Smit 2012). More than 150 species belonging to its four subgenera have been recorded from Europe (Viets, 1956; Viets, 1987).

Arrenurus, represented with the most species, is among the most studied groups in terms of its biology. Larvae living on aquatic organisms confer substantial advantages that ensure dispersal and rapid exploitation of new habitats (Sabatino et al., 2008). Its larvae live as parasites on aquatic species of Culicidae, Ceratopagonidae, Dixidae, Chironomidae and Odonata. The nymphs and adults feed on Copepoda and Ostracoda species. *Arrenurus* species, which lay around 55–90 eggs a year, swim freely, they generally prefer to live in algae, detritus and alluvion. It is an important family of water mites in terms of biological control, as it causes to decline in egg production in mosquitoes (Gerson and Smiley, 1990).

This study was prepared based on the published studies on the distribution and habitats of *Arrenurus* species in

Turkey and worldwide. This study also focuses on *Arrenurus* species, which are determined from Turkey and contribute to their systematic problems and endemism rates. In addition, the similarity rates of *Arrenurus* species of some countries in the Palearctic Region were emphasized.

MATERIAL AND METHODS

Data from all publications which contain records of water mites from Turkey and Palearctic Region some countries are included in this paper. However, unpublished postgraduate theses and informal publications have not been evaluated. In the study, Sorensen and Jaccard similarity indices were calculated using the Past program. The following abbreviation is used: Cx–I–IV = first fourth coxae.

RESULT AND DISCUSSION

Family Arrenuridae Thor, 1900
Genus *Arrenurus* Duges, 1834

Distribution of *Arrenurus* in Turkey

A total of 58 *Arrenurus* species are known from Turkey. Of those, 34 belong to the subgenus *Arrenurus*, 5 to the subgenus *Megaluracarus*, 12 to the subgenus *Micruracarus* and 7 to the *Truncaturus. Arrenurus* species were recorded from 26 provinces in Turkey. Considering the distribution of *Arrenurus* species in Turkey, it is clearly seen that most species were recorded from Bingöl (31 species), followed by Afyonkarahisar (23 species), Elazığ (22 species) and Erzurum (20 species) (Table 1), respectively. *A. cuspidifer*, recorded from 10 provinces, is the most common species, followed by the species *A. abbreviator* Berlese, 1888, *A. affinis* Koenike, 1887*, A. bicuspidator* Berlese, 1885 and *A. walkanoffi*, which were recorded from 8 provinces (Table 1). The fact that these species have a considerable wide distribution suggests that they show great ecological tolerances. There has been no *Arrenurus* record in any of the provinces in the Aegean, Marmara, Eastern Black Sea and Southeastern Anatolia (except Siirt) regions in Turkey. The reason is that some regions have been well studied, while other regions have not been studied or the collected samples have not been published.

So far, 11 *Arrenurus* species have been described from Turkey for the World fauna (Table 2). Later, two of them (*A. ayyildizi* and *A. hasankalensis*) were recorded from Iran (Pešić and Saboori, 2007). According to current data, 9 *Arrenurus* species are endemic to Turkey and their endemism rate is 15.5%.

Habitats of *Arrenurus* species determined from Turkey

When considered the habitats, ponds rank first with 40 species, followed by stream pool with 32 species, lakes with 31 species, springs with 7 species, stream pondlets with 3 species, and streams with one species (Table 3).

Table 1. The distribution of *Arrenurus* species according to the provinces in Turkey

Species	Adana	Adıyaman	A.karahisar	Ağrı	Antalya	Artvin	Bayburt	Bingöl	Burdur	Denizli	Elazığ	Erzincan	Erzurum	Isparta	K.maraş	Kars	Kayseri	Konya	Malatya	Mersin	Muğla	Nevşehir	Rize	Siirt	Tokat	Yozgat
A. abbreviator		X	X					X		X	X						X		X					X		
A. affinis			X					X	X	X			X				X							X		X
A. afyonensis			X																							
A. albator		X						X			X								X					X		
A. antalyensis					X										X											
A. ayyildizi								X			X															
A. batillifer			X																							
A. berolinensis			X																							
A. bicuspidator			X					X		X	X		X	X					X					X		
A. bruzelii		X	X					X			X		X						X					X		
A. claviger			X					X		X			X													
A. crenatus								X								X										
A. cuspidator		X	X					X		X	X		X						X							
A. cuspidifer	X	X	X					X			X		X				X	X				X				X
A. demirsoyi								X			X															
A. dileri														X												
A. distans								X			X										X			X		
A. fimbriatus			X														X	X								
A. furcillatus			X		X					X	X			X			X		X							
A. hasankalensis													X													
A. kermanensis															X					X						
A. maculator			X								X		X	X												
A. neumani								X					X													
A. oezkani								X					X													
A. ovatipetiolatus															X											
A. papillator				X				X					X													
A. radiatus		X						X		X	X			X			X									
A. robustus								X		X	X	X		X												
A. rodrigensis			X					X		X	X			X										X		
A. suecicus			X					X									X									
A. tricuspidator			X					X			X															
A. turgidus								X					X													
A. vavrai								X			X															
A. virens								X					X													
A.anatolicus													X													
A. conicus													X													
A. cylindratus									X																	
A. globator		X	X					X		X	X						X	X								
A. latigenitalis						X																	X		X	
A. bifidicodulus			X																							
A. bipapillosus		X						X			X								X					X		
A. biscussus																		X								
A.bisulcicodulus													X													
A. cyprioticus									X																	
A. forpicatus												X														
A. integrator										X																
A. novus			X							X							X									
A. octagonus			X					X		X	X						X									
A. salmani								X		X	X						X		X							
A. sinuator											X															
A. walkanoffi		X						X	X	X	X						X	X	X							
A. corsicus			X						X	X				X			X	X								
A. fontinalis								X																X		
A. isikliensis					X			X	X				X	X					X							
A. nagysalloensis													X	X												
A. nodosus			X																							
A. stecki					X								X													
A. truncatellus			X					X		X			X	X			X									

Table 2. The *Arrenurus* Species Endemic to Turkey

Species
Arrenurus (s.str.) afyonensis Erman and Özkan, 1997
Arrenurus (s.str.) antalyensis Gülle, Boyacı and Gülle, 2011
Arrenurus (s.str.) demirsoyi Erman, 1993
Arrenurus (s.str.) dileri Boyacı and Özkan, 2004
Arrenurus (s.str.) oezkani Smit and Erman, 2003
Arrenurus (s.str.) ovatipetiolatus Esen and Erman, 2013
Arrenurus (Megaluracarus) anatolicus Smit and Erman, 2003
Arrenurus (Micruracarus) salmani Erman and Özkan, 1990
Arrenurus (Truncaturus) isikliensis Boyacı and Özkan, 2004

Table 3. The habitats of *Arrenurus* species determined from Turkey

Species	Lakes	Ponds	Streams	Stream pool	Stream pond-lets	Springs
A. (s.str.) abbreviator	X	X				
A. (s.str.) affinis	X	X				
A. (s.str.) afyonensis		X				
A. (s.str.) albator	X	X		X		
A. (s.str.) antalyensis		X		X		
A. (s.str.) ayyildizi				X		
A. (s.str.) batillifer	X	X				
A. (s.str.) berolinensis				X		
A. (s.str.) bicuspidator	X	X				
A. (s.str.) bruzelii	X	X		X		
A. (s.str.) claviger	X	X		X		
A. (s.str.) crenatus	X	X				
A. (s.str.) cuspidator	X	X		X		
A. (s.str.) cuspidifer	X	X		X		
A. (s.str.) demirsoyi				X		
A. (s.str.) dileri				X		
A. (s.str.) distans	X	X		X		
A. (s.str.) fimbriatus		X				
A. (s.str.) furcillatus				X		
A. (s.str.) hasankalensis		X				
A. (s.str.) kermanensis				X		
A. (s.str.) maculator	X	X				
A. (s.str.) neumani	X	X				
A. (s.str.) oezkani	X	X		X		
A. (s.str.) ovatipetiolatus		X		X		
A. (s.str.) papillator	X	X		X		
A. (s.str.) radiates	X	X		X		
A. (s.str.) robustus		X		X		
A. (s.str.) rodrigensis	X	X				
A. (s.str.) suecicus	X			X		
A. (s.str.) tricuspidator	X	X		X		
A. (s.str.) turgidus		X		X		
A. (s.str.) vavrai	X	X		X		
A. (s.str.) virens		X		X		
A. (Meg.) anatolicus			X			X
A. (Meg.) conicus		X				
A. (Meg.) cylindratus		X		X		X
A. (Meg.) globator	X	X		X		
A. (Meg.) latigenitalis	X					
A. (Mic.) bifidicodulus				X		
A. (Mic.) bipapillosus					X	X
A. (Mic.) biscussus				X		
A. (Mic.) bisulcicodulus		X				

A. (Mic.) cyprioticus				X		X
A. (Mic.) forpicatus	X	X				
A. (Mic.) integrator	X	X				
A. (Mic.) novus	X	X			X	
A. (Mic.) octagonus	X	X		X		
A. (Mic.) salmani				X		
A. (Mic.) sinuator	X	X		X		
A. (Mic.) walkanoffi		X				
A. (Trun.) corsicus					X	X
A. (Trun.) fontinalis				X		X
A. (Trun.) isikliensis	X					
A. (Trun.) nagysalloensis						X
A. (Trun.) nodosus	X	X				
A. (Trun.) stecki	X	X				
A. (Trun.) truncatellus	X	X				

Arrenurus species recorded from some countries in the Palearctic Region and similarity indices with Turkey

Similarity calculations were made for some countries in the Palearctic region that their list of *Arrenurus* species were given.

France with 65 *Arrenurus* species takes the first place, followed by the Netherlands with 59 species, Turkey with 58 species, Belgium with 35 species, Iran with 25 species, Bulgaria and Greece with 17 species each and Japan with 12 species (Table 4, Figure 3). *A. globator* (Müller, 1776), recorded from all the countries mentioned in the Palearctic Region, is the most common species, followed by *A. bruzelii* Koenike, 1885 and *A. bicuspidator* Berlese, 1885, recorded from 7 countries (Table 4).

A simple arithmetical calculation reveals that the *Arrenurus* fauna of Turkey has a similarity with that of Greece, Iran, and Bulgaria in the ratio of 88%, 72%, and 71%, respectively. Japan has the lowest similarity rate with 8.33%. The Sorensen similarity index was found to be 0.63 for France, 0.56 for the Netherlands, 0.52 for Belgium, 0.45 for Greece, 0.43 for Iran, 0.32 for Bulgaria and 0.03 for Japan. According to the Jaccard similarity index, the *Arrenurus* fauna of Turkey has the highest similarity with that of France, the Netherlands and Belgium but the lowest similarity with Japan (Figure 2).

Table 4. The *Arrenurus* species recorded from some countries in the Palearctic Region (Turkey: Erman et al., 2010, 2019; Iran: Pešić and Saboori, 2007; Pešić et al., 2014; Greece: Pešić et al., 2010; Bulgaria: Pešić et al., 2010; France: Smit and Gerecke, 2010; The Netherlands: Smit and Hammen, 2000; Smit et al., 2007; Smit and Maanen, 2012; Belgium: Smit and Lock, 2016; Japan: Abé, 2005).

Species	Turkey	Iran	Greece	Bulgaria	France	Netherland	Belgium	Japan
A. (s.str.) abbreviator	X		X	X	X			
A. (s.str.) albator	X	X	X		X	X	X	
A. (s.str.) agrionicolus								X
A. (s.str.) affinis	X	X			X	X	X	
A. (s.str.) afyonensis	X							
A. (s.str.) angelieri					X			
A.(s.str.) antalyensis	X							
A. (s.str.) asiaticus								X
A.(s.str.) ayyildizi	X	X						
A.(s.str.) batillifer	X				X	X	X	
A. (s.str.) bharatensis		X						
A.(s.str.) berolinensis	X					X		
A.(s.str.) bicuspidator	X	X	X	X	X	X	X	
A. (s.str.) boruzkii						X		
A.(s.str.) bruzelii	X	X	X	X	X	X	X	
A. (s.str.) crassicaudatus			X		X	X	X	
A. (s.str.) compactus		X		X	X	X	X	
A. (s.str.) claviger	X			X	X	X	X	
A.(s.str.) crenatus	X	X			X		X	

A Comparison of the Species Composition of *Arrenurus* Duges (Arrenuridae: Hydrachnidia: Acari) in Turkey and Some Countries in Palearctic Region

Species	Turkey	Iran	Greece	Bulgaria	France	Netherland	Belgium	Japan
A.(s.str.) cuspidator	X				X	X	X	
A.(s.str.) cuspidifer	X	X		X	X	X		
A. (s.str.) daisetsuensis								X
A.(s.str.) demirsoyi	X							
A. (s.str.) denticulatus					X			
A.(s.str.) dileri	X							
A.(s.str.) distans	X	X			X			
A. (s.str.) duursemai						X		
A. (s.str.) falciger						X		
A. (s.str.) fimbriatus	X		X		X	X	X	
A.(s.str.) furcillatus	X		X		X	X		
A. (s.str.) hadai								X
A. (s.str.) iranicus		X						
A.(s.str.) hasankalensis	X	X						
A. (s.str.) japonicas								X
A.(s.str.) kermanensis	X	X						
A. (s.str.) latus					X	X	X	
A. (s.str.) leuckarti					X	X	X	
A.(s.str.) maculator	X				X	X	X	
A. (s.str.) mathiasi					X			
A. (s.str.) mitoensis								X
A. (s.str.) muenchbergi					X			
A. (s.str.) nielseni		X				X		
A.(s.str.) neumani	X			X	X	X	X	
A. (s.str.) nobilis						X		
A.(s.str.) oezkani	X							
A. (s.str.) ornatus			X		X	X		
A. (s.str.) ovatipetiolatus	X							
A. (s.str.) papillatorbicolor				X				
A. (s.str.) papillator	X		X	X	X	X		
A. (s.str.) petiospinus								X
A. (s.str.) postulator					X	X		
A. (s.str.) pyrenaeus					X			
A. (s.str.) radiatus	X	X			X	X		
A. (s.str.) robustus	X		X		X	X		
A. (s.str.) rodrigensis	X				X			
A. (s.str.) securifer					X			
A. (s.str.) suecicus	X	X	X		X	X		
A. (s.str.) tetracyphus					X	X		
A. (s.str.) tricuspidator	X				X	X	X	
A. (s.str.) turgidus	X							
A. (s.str.) uchidai								X
A. (s.str.) vavrai	X							
A. (s.str.) virens	X				X	X	X	
A. (Meg.) anatolicus	X							
A. (Meg.) buccinator				X	X	X	X	
A. (Meg.) clavatus						X		
A. (Meg.) cylindratus	X				X	X	X	
A. (Meg.) conicus	X				X			
A. (Meg.) coronator						X		
A. (Meg.) geminus						X		
A. (Meg.) globator	X	X	X	X	X	X	X	X
A. (Meg.) latigenitalis	X				X			
A. (Meg.) mediorotundatus					X	X		
A. (Meg.) muelleri						X	X	
A. (Meg.) securiformis					X	X	X	
A. (Meg.) spatiosus						X		
A. (Meg.) stijoerdalensis					X			
A. (Meg.) tubulator					X	X		
A. (Meg.) zachariae					X	X	X	
A. (Mic.) bifidicodulus	X	X	X		X	X	X	

Species	Turkey	Iran	Greece	Bulgaria	France	Netherland	Belgium	Japan
A. (Mic.) bipapillosus	X				X			
A. (Mic.) biscussus	X				X	X	X	
A. (Mic.) bisulcicodulus	X							
A. (Mic.) cyprioticus	X	X						
A. (Mic.) detruncatus					X			
A. (Mic.) dorieri					X			
A. (Mic.) forpicatus	X				X	X	X	
A. (Mic.) integrator	X		X		X	X	X	
A. (Mic.) inexploratus						X	X	
A. (Mic.) madaraszi								X
A. (Mic.) novus	X				X	X		
A. (Mic.) perforatus					X	X	X	
A. (Mic.) pygmaeus					X			
A. (Mic.) octagonus	X	X			X	X		
A. (Mic.) sagaensis								X
A. (Mic.) salmani	X							
A. (Mic.) sinuator	X		X	X	X	X	X	
A. (Mic.) soochowensis								X
A. (Mic.) sculptus					X	X		
A. (Mic.) walkanoffi	X	X		X	X			
A. (Trun.) fontinalis	X				X	X	X	
A. (Trun.) corsicus	X	X		X	X			
A. (Trun.) knauthei		X				X	X	
A. (Trun.) haplurus				X				
A. (Trun.) isikliensis	X							
A. (Trun.)minutus		X						
A. (Trun.) nagysalloensis	X					X		
A. (Trun.) nodosus	X				X	X	X	
A. (Trun.) stecki	X		X	X	X	X	X	
A. (Trun.) troglobius					X			
A. (Trun.) truncatellus	X	X	X		X	X	X	
A. (?) longispinus				X				

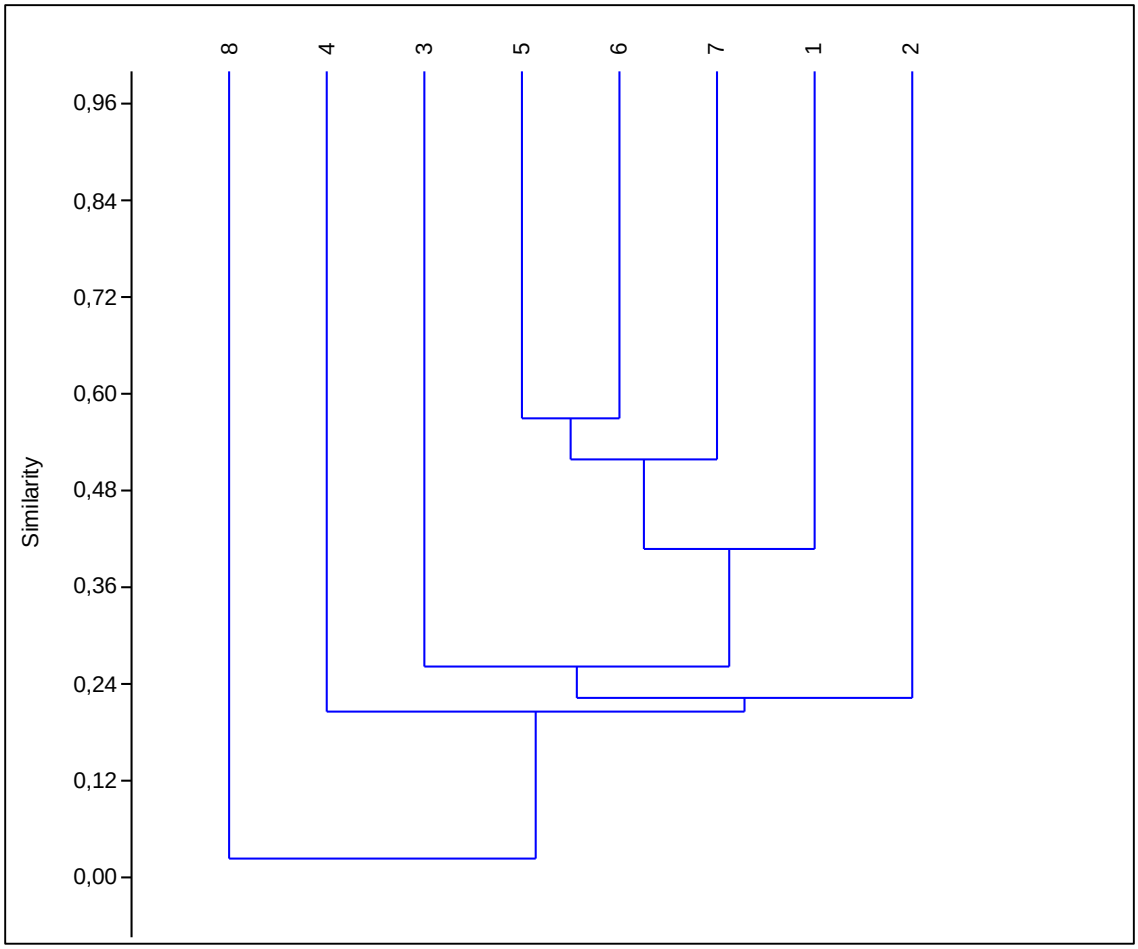

Figure 2. Similarity diagram of *Arrenurus* species in some countries in the Palearctic Region (1. Turkey, 2. Iran, 3. Greece, 4. Bulgaria, 5. France, 6. Netherlands, 7. Belgium, 8. Japan)

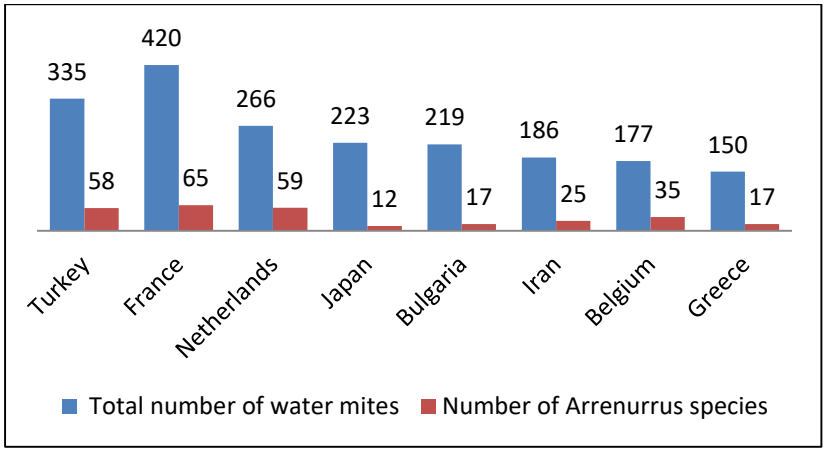

Figure 3. The total number of water mites and of *Arrenurus* species of some countries in Palearctic Region.

Scientific contributions related to *Arrenurus* from Turkey

Arrenurus (s.str.) antalyensis Gülle, Boyacı and Gülle, 2011 was identified based on two male specimens from Yaman wetland (Antalya) (Gülle et al., 2011). Later, three male and one female specimens were collected from Bağlama pond in Pazarcık, Kahramanmaraş. Its description was reviewed. Its female individual was firstly described. Therefore, its deficiencies were completed (Esen et al., 2013b).

Arrenurus (s.str.) berolinensis Protz, 1896, collected and identified near Berlin, Germany, was later reported from East Prussia and it was limited to these data only until 2007. Smit et al. (2007) collected four male and two female individuals from the Netherlands and gave the first definition of its female. Aşçı et al. (2014) collected four male individuals from Ayfonkarahisar, Turkey, gave its definition and made its drawing. It is considered that the distribution area of this species, which has a rare record and a small number of samples, can be much wider than known.

Arrenurus (s.str.) demirsoyi Erman, 1993 was collected from Elazig–Karakocan–Kalecik creek. Its definition was given using a male individual (Erman, 1993). Later, male and female individuals were caught from Elazig–Maden–Behramaz creek. The first definition of its female was given (Erman et al., 2006). The occurrence of Bingöl (Esen and Erman, 2013b) and Kemaliye, Erzincan (Esen et al., 2013a) shows that this species may have a wider distribution area in Eastern Anatolia.

Arrenurus (s.str) kermanensis Pešić, Smit and Asadi, 2011, which has significant deficiencies in the description and drawings due to fully–unchitinized samples and described from Iran, was collected from Mersin–Tarsus and Kahramanmaraş–Çağlayançerit in Turkey. Its definition was revised and original drawings were made. Systematic problems of both sexes were reviewed and completed (Esen et al., 2013b).

Arrenurus (s.str.) turgidus Koenike, 1911, was collected from stagnant waters in the Daudorfer bay in Mecklenburg, Germany, and was identified using a male individual. This species has not been recorded from any country until 1997. The information and figures given by Koenike (1911) and Viets (1936) for this species are very limited. Erman and Özkan (1997) examined the numerous samples they collected from Erzurum, and identified the female of this species that has not been known so far. So, they contributed the systematic problems of this species by giving a detailed description of both male and female.

One male and one female individual of *Arrenurus (s.str.) vavrai* Thon, 1899, were caught from the town of Schlan in the north of Prague in the Czech Republic. Descriptive characteristics and sizes of male and female individuals were presented briefly. The only dorsal view of the male individual was provided. However, other drawings were not performed. Erman (1993) defined the samples from Elazığ as *Arrenurus (s.str) kurui*. Then, Esen et al. (2013b) made this species the synonym of *Arrenurus (s.str.) vavrai*. Thus, they have contributed significantly to the systematic problems of this species, which has not been caught since 1899 and has significant deficiencies in its definitions and drawings.

Arrenurus (*Micruracarus*) *cyprioticus* Smit and Pesic 2006 was caught from Cyprus and Iran, and (Smit and Pešić, 2006). Its third record was given by Gülle et al. (2014) from Burdur Lake. They caught two male and two female individuals, and revised it by giving the definition and drawings. The fact that it is caught from the province of Burdur with high alkalinity and sulfur content suggests that it has a limited distribution area.

Arrenurus (*Micruracarus*) *walkanoffi* Viets, 1926, was previously caught from only Bulgaria and France (Viets 1956) and the only male individuals were described. Many samples were collected from Kayseri–Sultan Marsh in Turkey. Its female was firstly defined by Özkan et al. (1993). Considerable contributions were made to the systematic problems of the species by giving structural characteristics, measurements, and drawings of both male and female (Özkan et al., 1993).

Arrenurus (s.str.) dileri Boyacı and Özkan, 2004 were defined over both sexes individuals. The female of *A. dileri* was misidentificated (Boyacı and Özkan, 2004). In fact, the figures, characteristics and measurements given for this sex are belong to *A. walcanoffi* females. In the females of *A. walcanoffi*; frontal marjin rounded, posterolateral corners not developed, medial marjin of Cx–III and IV equal in length. Medial separation of Cx–IV wider than half gonopore field. Gonopore membranes with large, semicircular sclerotized patches (Gerecke et al., 2016). As a result, the female of *A. dileri* is unknown.

CONCLUSION

Arrenurus species were recorded from 26 provinces in Turkey. Bingöl with 31 *Arrenurus* species takes the first place. Consistent with previous studies, it is observed that members of *Arrenurus* prefer ponds and stream pool as the habitat (Smith and Cook 1991). According to current data, 9 *Arrenurus* species are endemic to Turkey and their endemism rate is 15.5%.

Similarity indices were calculated between Turkey and some countries in the Palearctic Region. Sorensen and Jaccard similarity indices were used for the similarity comparisons. Both calculations show that the water mite fauna of Turkey has a high similarity with that of France, the Netherlands and Belgium, but the lowest similarity with Japan. Additionally, the female of *A. dileri* was misidentificated, it is determined *A. walkanoffi*. As a result, the female of *A. dileri* is unknown.

Aquatic ecosystems are been rapidly deteriorated and the habitats of water mites are gradually been decreased, due to urbanization, the unconscious use of water resources for agriculture, excessive evaporation depending on global warming and re–mixing of the vast majority of pollutants in air and soil with water. Many species disappear as a result of the destruction of habitats. The European fauna of water mite exemplifies one of these disappearances. Species that were recorded only once in the catalogues and not found later are also the best evidence of these disappearances (Viets, 1956).

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