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*Original article (Orijinal araştırma)*

# Oribatid mite fauna (Acari) of Çat Forest, Sivas Province, Turkey[1]

Çat Ormanlarının (Sivas, Türkiye) Oribatid akar faunası (Acari)

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## Summary

In this study, the oribatid mite fauna of Çat Forest, Sivas Province, Turkey extracting mites from soil, litter, moss, lichen and tree bark samples taken from 368 different localities in 2014 were investigated. Twenty-four species from 23 genera and 17 families of oribatid mites were found. Among them, two genera (*Bipassalozetes*, *Metabelba*) and eight species [*Licnodamaeus pulcherrimus* (Paoli, 1908), *Licnobelba latiflabellata* (Paoli, 1908), *Eupterotegaeus ornatissimus* (Berlese, 1908), *Metabelba (Metabelba) papillipes* (Nicolet, 1855), *Damaeolus bregetovae* Csiszár, 1962, *Passalozetes (Passalozetes) inlenticulatus* Mihelčič, 1959, *Camisia horrida* (Hermann, 1804) and *Bipassalozetes (Bipassalozetes) perforatus* (Berlese, 1910)] were new records for Turkey. For all new records, SEM pictures of morphological characters, as well as chorotypes for each species are provided.

**Keywords:** Çat Forest, fauna, new records, Oribatida, soil biodiversity

## Özet

Bu çalışmada, 2014 yılında 368 farklı lokaliteden alınan toprak, döküntü, yosun, liken ve ağaç kabuğu örneklerinden oribatid akarları seçerek Sivas İli Çat Ormanlarının Oribatid akar faunası araştırılmıştır. Oribatid akarlardan 17 familyaya ait 23 cinsten 24 tür tespit edilmiştir. Bunlardan, iki cins (*Bipassalozetes*, *Metabelba*) ve sekiz tür [*Licnodamaeus pulcherrimus* (Paoli, 1908), *Licnobelba latiflabellata* (Paoli, 1908), *Eupterotegaeus ornatissimus* (Berlese, 1908), *Metabelba (Metabelba) papillipes* (Nicolet, 1855), *Damaeolus bregetovae* Csiszár, 1962, *Passalozetes (Passalozetes) inlenticulatus* Mihelčič, 1959, *Camisia horrida* (Hermann,1804) ve *Bipassalozetes (Bipassalozetes) perforatus* (Berlese, 1910)] Türkiye için yeni kayıttır. Ayrıca tüm yeni kayıtlar için morfolojik özelliklerin tarama elektron mikroskobu fotoğraflarını korotipleriyle birlikte verilmiştir.

**Anahtar sözcükler:** Çat Ormanları, fauna, yeni kayıtlar, Oribatida, toprak biyoçeşitliliği

[1] This study is a part of the second author's MSc thesis, and was presented as an oral presentation at the 23rd National Biology Congress (5-9 September 2016, Gaziantep, Turkey).

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## Introduction

Oribatid mites (Acari) are saprophagous microarthropods inhabiting almost all types of soil ecosystems. With huge abundance, these creatures feed mainly on dead organic matter, fungi, algae and lichens, and have considerable potential as bioindicators (Ghilyarov, 1975; Weigmann, 2006; Krantz & Walter, 2009). Oribatid mites are mainly below ground animals that reach highest densities in acidic forest soils, e.g. up to 200,000 individuals per $m^2$ in a boreal forest (Maraun et al., 2007). They are important for litter decomposition, soil formation, nutrient cycling and the regulation of fungal and nematode populations. Mites consume various kinds of food and participate in numerous ways in the structure of the food web and found in almost every kind of habitat worldwide. Thus, they have significant interactions with their microenvironment. Given these features, Oribatid mites react to changes in environmental conditions, including chemical contamination, heavy metals and atmospheric pollutants. Therefore, they are considered useful indicators of specific soil parameters and quality (Gergócs & Hufnagel, 2009; Murvanidze et al., 2013; Vladislav et al., 2015). Oribatid mites (including Astigmata) are represented by 16 197 species and 2 399 genera within 249 families (Schatz et al., 2011) and this number is continuously increasing. More than 200 species of this suborder have been recorded from Turkey (Erman et al., 2007; Toluk & Ayyildiz, 2008a, 2009; Toluk et al., 2008). Research of the oribatid mites in Turkey goes back to the 1980s. Investigations on the oribatid diversity of Turkey are not completed for now. Taxonomic studies have been few and generally fragmentary. Despite, many studies on oribatid mites in various regions of Turkey (Özkan et al., 1994; Grobler et al., 2003, 2004), there are still regions to be investigated. One of these regions is Sivas. There is only a limited forest area (2.5%) in Sivas Province. Given the low rainfall, short vegetation season, low temperature and humidity, the forests do not grow fast and are not particularly healthy. As a result, this has a negative impact on their renewal. Within the borders of Sivas Province, the forests are generally found in the northern regions rather than western and eastern regions (Anon., 2015). There are no previously published records of oribatid mites from Çat Forest. The objective of this study was to contribute to the knowledge of the oribatid mite fauna of Turkey.

## Material and Methods

### The study area and sampling

Sivas Çat Forest (SÇO) is located in Gemerek District (39°28' N, 35°57' E; 1800 m a.s.l.), Sivas Province, in the north east of Central Anatolia. This area is dominated by the yellow pine tree (*Pinus sylvestris* L.). A total of 368 soil, litter, moss, lichen and tree bark samples were randomly taken from the study area on different dates in 2014 (Table 1). Mite samples were extracted using a Berlese funnel apparatus and stored in 70% ethanol for microscopic examination. Mites were sorted from the samples under a stereomicroscope and mounted on slides in modified Hoyer's medium or 35% lactic acid. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. The specimens examined are deposited in the Acarological Collection of the Zoological Museum, Erciyes University, Kayseri, Turkey.

Table 1. Details of collection sites under *Pinus sylvestris* in the Sivas Çat Forest (SÇO), Turkey

| Site code | Habitat | Elevation (m) | Sampling date |
|---|---|---|---|
| SÇO-1 to 46 | Litter | 1534-1550 | 04.II.2014 |
| SÇO-47 to 92 | Soil and litter | 1557-1664 | 01.III.2014 |
| SÇO-93 to 138 | Soil, tree bark, moss, lichen and litter | 1415-1638 | 05.V.2014 |
| SÇO-139 to 184 | Soil, tree bark, moss, lichen and litter | 1602-1639 | 04.VI.2014 |
| SÇO-185 to 230 | Soil, tree bark, moss, lichen and litter | 1602-1639 | 04.VI.2014 |
| SÇO-231 to 276 | Soil, tree bark, moss, lichen and litter | 1640-1686 | 05.VIII.2014 |
| SÇO-277 to 322 | Soil, tree bark, lichen and litter | 1614-1685 | 09.IX.2014 |
| SÇO-323 to 368 | Soil, tree bark, moss, lichen and litter | 1604-1627 | 06.X.2014 |

**Scanning electron microscopy**

The specimens for SEM were cleaned by soaking in Terg-a-zyme solution for 6-12 h, followed by brief (1-2 s) immersion in an ultrasonic bath. They were dried using critical point method, mounted on Al-stubs, and gold-coated in a Polaron sputter coater apparatus. Photographs were taken with an LEO 440 computer controlled digital SEM.

**Terminology**

The taxa were identified with reference to Woas (1986), Subías & Balogh (1989), Pérez-Íñigo, (1997) and Weigmann (2006). Terminology followed Norton & Behan-Pelletier (2009).

## Results and Discussion

Twenty-four species belonging to 17 families of oribatid mites from Çat Forest, Sivas Province, Turkey were determined. The diagnostic features of new records are given below.

**1. *Camisia (Camisia) horrida* (Hermann, 1804)**

Measurements: Body length, 836-952 µm and body width, 336-544 µm (n = 10).

Diagnostic characters (Figure 1): Lamellar setae barbed, situated on small apophyses. Interlamellar setae minute. Sensilli short, with globose club. Lateral notogastral setae short. Lateral notogastral margin with transverse ridges. Setae $h_1$ barbed, on apophyses. Setae $h_2$ on short apophysis near posterolateral corner of notogaster. Transverse ridge present between setae $e_1$. Dorsocentral ridges extending from bases of setae $d_1$, bifurcating at medial level of setae $f_2$, forming W-shaped posterior ridge. Epimeral setal formula, 3-1-2-3. Nine pairs of genital setae. All legs tridactylous.

Material examined: SÇO-190, 2 exs.; SÇO-193, 7 exs.; SÇO-207, 4 exs.; SÇO-213, 2 exs.; SÇO-311, 4 exs.

Distribution: Holarctic region and the northern part of the Neotropical Region (Subías et al., 2012, updated 2017).

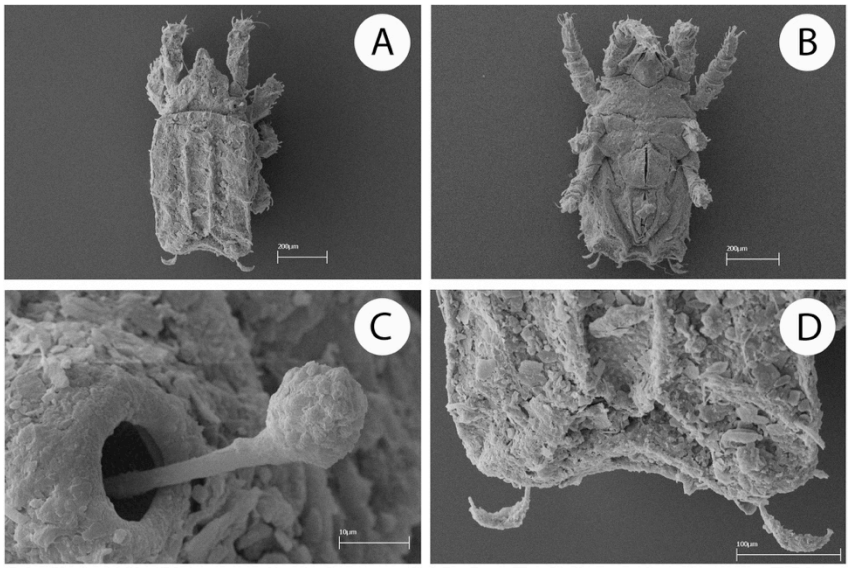


Figure 1. *Camisia (Camisia) horrida* (Hermann, 1804): A) dorsal view; B) ventral view; C) sensillum; D) posterior of notogaster.

Remarks: This species is a new record for Turkish fauna. Specimens belonging to this species have been extracted from the pine forest litter in Poland; bark and old wood from a tree stump, coniferous forest of cedar and hemlock in USA; mixed vegetation among rocks with *Silene, Antennaria, Saxifraga* and *Potentilla* in Canada; lichen on stone in Norway; moss and lichen in Austria and lichen in India; canopy samples in Georgia (Colloff, 1993; Murvanidze & Mumladze, 2014; Murvanidze & Arabuli, 2015; Murvanidze & Mumladze, 2016). Turkish specimens were collected in litter and soil. The body length of the species was given as 825 x 960 µm by Weigmann (2006). The dimensions for the Norway and Indian specimens were 796-998 x 431-522 and 819-866 x 437-451 µm, respectively (Colloff, 1993). The Turkish specimens (836-952 x 336-544 µm) examined were in the range of the known dimensions of the species. This species is well characterized by minute interlamellar setae, short lateral notogastral setae, seta $h_2$ on short apophysis near posterior edge of the notogaster and lateral notogastral margin with transverse ridges transverse carina between bases of setae $e_1$.

**2. *Licnodamaeus pulcherrimus* (Paoli, 1908)**

Measurements: Body length, 240-270 µm and body width, 122-136 µm (n = 10).

Diagnostic characters (Figure 2): Prodorsum, notogaster and ventral plate with reticulated cerotegument. Rostral and lamellar seta inserted on dorsal side of rostrum and covered by cerotegument. Sensilli with short stalk and expanded head. Four pairs of notogastral setae present, all of them covered by cerotegument. Notogastral lyrifissures *ia, im* and *ip* present. Five pairs of genital setae.

Material examined: SÇO-69, 17 exs.; SÇO-70, 2 exs.; SÇO-88, 1 ex.; SÇO-89, 7 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. According to Weigmann (2013), and is found in dry bush and meadows soil. Bayartogtokh & Smelyansky, (2004) found this species in steppe soils dominated by *Stipa* sp. and *Festuca valesiaca* Schleich. ex Gaudin. Turkish specimens were collected in litter and soil. The dimensions of the species were given as 271 µm (269-275) x 128 µm (122-134) by Bayartogtokh & Smelyansky (2004). In this regard, the Turkish specimens (240-270 x 122-136 µm) examined were in the range of the known dimensions of the species. This species is well characterized by body surface with reticulated cerotegument, the shape of sensilli and four pairs of notogastral setae covered with cerotegument.

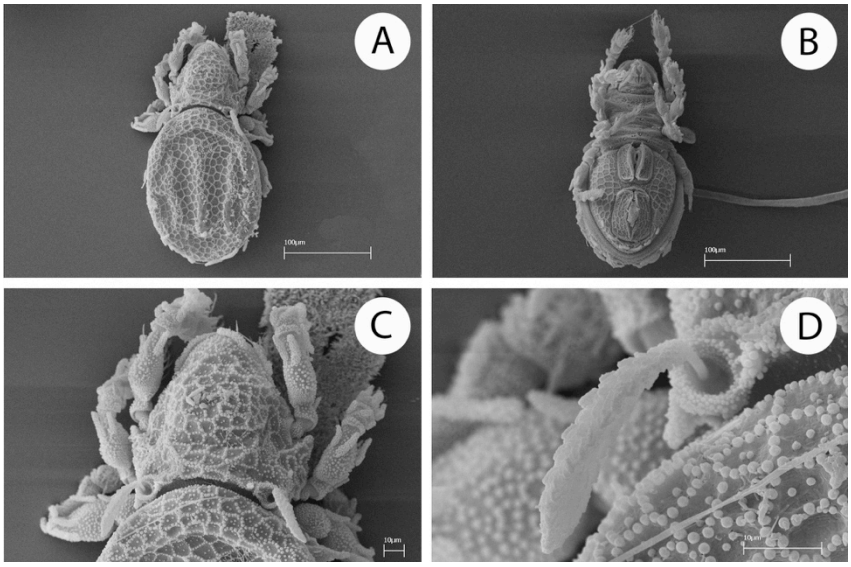


Figure 2. *Licnodamaeus pulcherrimus* (Paoli, 1908): A) dorsal view; B) ventral view; C) prodorsum; D) sensillum.

**3. *Licnobelba latiflabellata* (Paoli, 1908)**

Measurements: Body length, 280-320 µm and body width, 148-164 µm (n = 10).

Diagnostic characters (Figure 3): Adult with exuvial scalps of juveniles. Body covered by granules of cerotegument. Rostral and lamellar seta inserted on dorsal side of rostrum and covered by cerotegument. Sensilli spatulate, long and its head barbed. Anterior part of notogaster with transverse ridge. Four pairs of posterior notogastral setae present ($h_1$, $p_{1-3}$). Epimeral setal formula, 3-1-2-2. Six pairs of genital setae. All legs tridactylous.

Material examined: SÇO-86, 1 ex.; SÇO-97, 1 ex.; SÇO-114, 8 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017).

Remarks: This species is new record for Turkish fauna. According to Pérez-Íñigo (1993), this species lives in the soil under dry litter, especially of pine, juniper and box trees, but also mosses on soil. Grandjean (1934) found it to be very common in the forest litter. We found this species in soil and litter. The dimensions of this species have been reported in the range of 276-400 x 145-280 µm (Pérez-Íñigo, 1997). The Turkish specimens (280-320 x 148-164 µm) examined were in the range of the known dimensions of the species. This species is well characterized by long sensilli with a spatulate head, four pairs of posterior notogastral setae ($h_1$, $p_{1-3}$) and six pairs of genital setae.

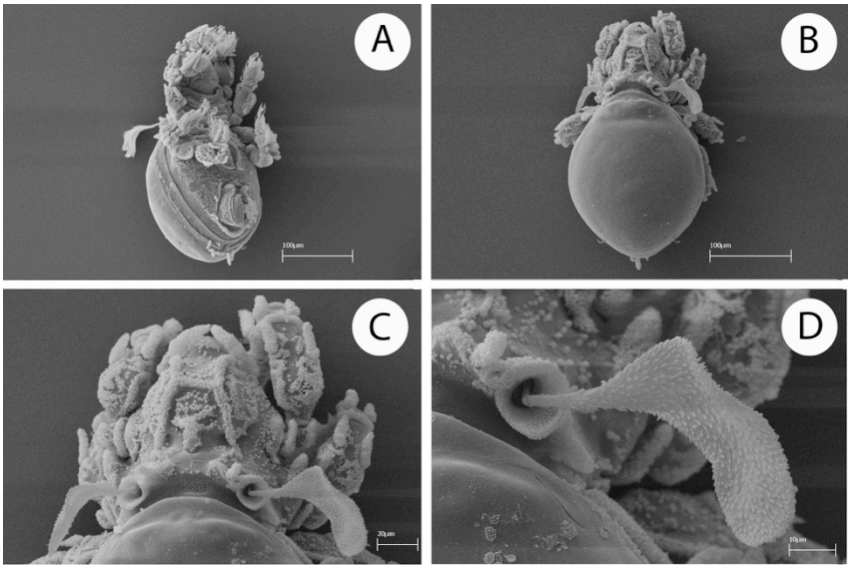


Figure 3. *Licnobelba latiflabellata* (Paoli, 1908): A) lateral view; B) dorsal view; C) prodorsum; D) sensillum.

**4. *Damaeolus bregetovae* Csiszár, 1962**

Measurements: Body length, 264-300 µm and body width, 140-156 µm (n = 7).

Diagnostic characters (Figure 4): Lamellar setae near rostral setae. Sensilli fusiform with an apical flagellum. Eleven pairs of notogastral setae present, all of them flagelliform. Dorsosejugal suture straight. Epimeral setal formula, 3-1-3-3. Six pairs of genital setae, three pairs of aggenital setae, two pairs of anal setae and three pairs of adanal setae present.

Material examined: SÇO-94, 3 exs.; SÇO-179, 4 exs.

Distribution: Mediterranean (Subías, 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. It is found in the soil and on grass (Pérez-Íñigo, 1997). We found this species abundant in soil and litter. The dimensions of this species were given as 347 x 162 µm by Csiszár & Jeleva (1962). The Turkish specimens (264-300 x 140-156 µm) examined

were smaller than the known body length of the species. These differences in dimensions are considered within the variation limits. This species is well characterized by fusiform sensilli, eleven pairs of flagelliform notogastral setae, straight dorsosejugal suture and six pairs of genital setae.

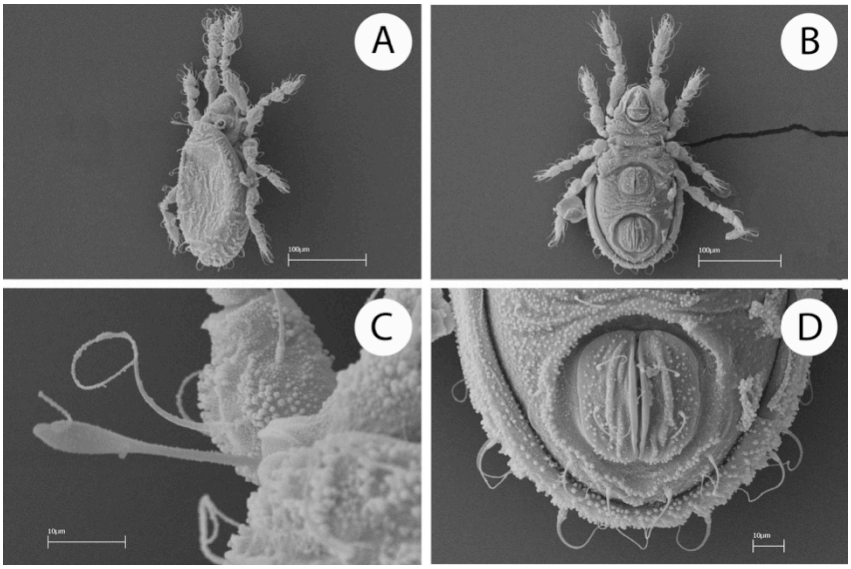


Figure 4. *Damaeolus bregetovae* Csiszár, 1962: A) laterodorsal view; B) ventral view; C) sensillum; D) anal plate.

**5. *Bipassalozetes (Bipassalozetes) perforatus* (Berlese, 1910)**

Measurements: Body length, 325-364 µm and body width, 200-205 µm (n = 2).

Diagnostic characters (Figure 5): Prodorsum structure with narrow, branched ridges. Notogaster with round knots. Sensilli setiform, apically pointed. Dorsosejugal suture not evident medially. Lenticulus circular. Four pairs of small porose areas. Ten pairs of small, smooth notogastral setae. Epimeral setal formula, 3-1-2-2. Four pairs of genital setae.

Material examined: SÇO-28, 2 exs.

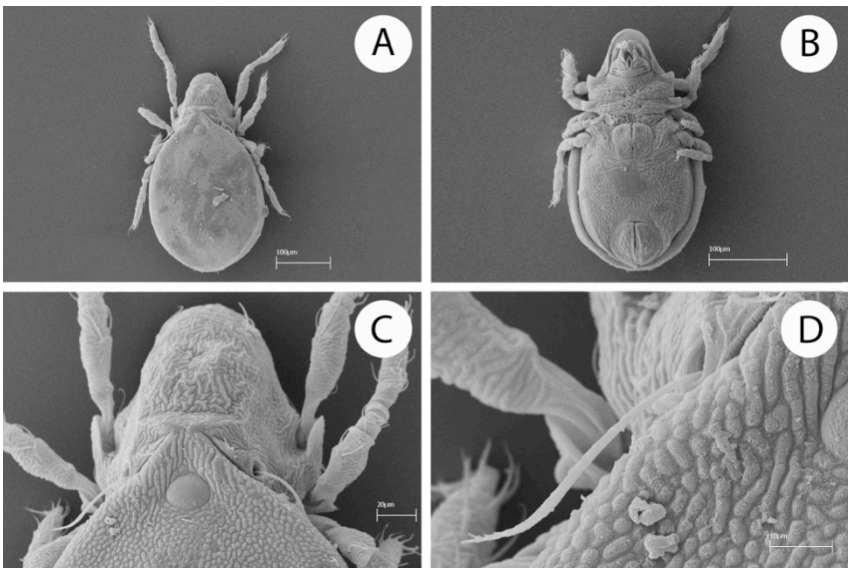


Figure 5. *Bipassalozetes (Bipassalozetes) perforatus* (Berlese, 1910): A) dorsal view; B) ventral view; C) prodorsum and lenticulus; D) sensillum.

Distribution: Palearctic region (Subías et al., 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. It is a xerothermophilous species (Lazarus & Krisper, 2014). The specimens belonging to this species are extracted from samples taken in salt marshes and dunes, in montane and subalpine meadows (Weigmann, 2006). It is also recorded from dry meadow in Tbilisi, Georgia (Murvanidze & Mumladze, 2016). Turkish specimens were collected in litter. The body length was given as 350 x 210 µm by Woas (1998) and 365 x 390 µm by Weigmann (2006). The Turkish specimens (325-364 x 200-205 µm) examined were in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli, narrow and branched ridges on the prodorsum and round knots on notogaster.

**6. *Passalozetes (Passalozetes) inlenticulatus* Mihelčič, 1959**

Measurements: Body length, 280-304 µm and body width, 140-148 µm (n = 10).

Diagnostic characters (Figure 6): The surface of prodorsum and notogaster with three or four branched linear ridges. Sensilli filiform, flat in section, with small barb on their posterior edge. Notogaster with humeral projection. Ten pairs of notogastral setae present. Lenticulus present anteriorly with indistinct borders. All legs tridactylous

Material examined: SÇO-9, 32 exs.; SÇO-114, 12 exs.

Distribution: Mediterranean (Subías et al., 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. The body length was given as 210-280 x 140-160 by Mihelčič (1959) and 234-243 x 112-125 µm by Gil & Subías (1990). The Turkish specimens (280-304 x 140-148 µm) examined were in the range of the known dimensions of the species. This species is well characterized by the filiform sensilli, notogaster with small humeral projection, narrow, branched ridges on the prodorsum, round knots on the notogaster and lenticulus with indistinct borders.

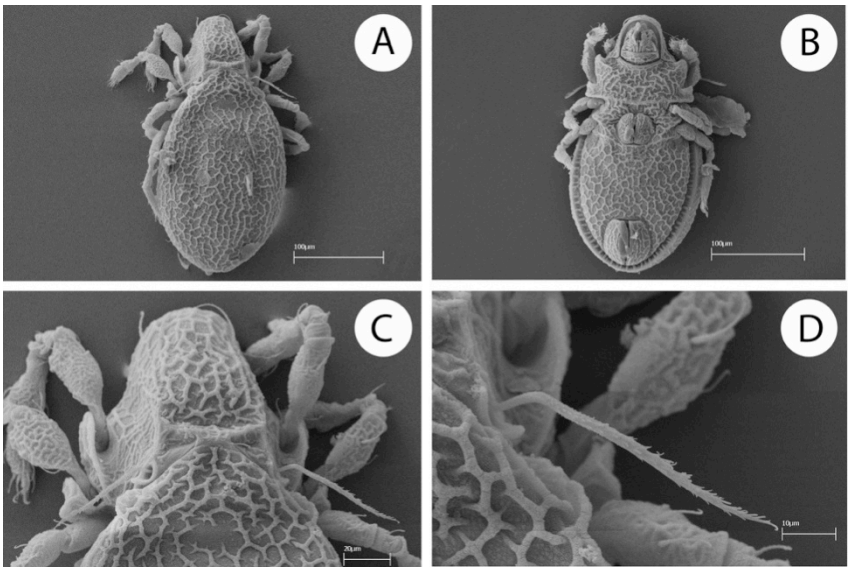


Figure 6. *Passalozetes (Passalozetes) inlenticulatus* Mihelčič, 1959: A) dorsal view; B) ventral view; C) prodorsum; D) sensillum.

**7. *Metabelba (Metabelba) papillipes* (Nicolet, 1855)**

Measurements: Body length, 448-452 µm and body width, 280-304 µm (n = 10).

Diagnostic characters: Anterior tubercle (Da) and posterior centrodorsal tubercle (Dp) present on prodorsum. Sensilli setiform, with flagelliform tips. Notogaster setae smooth and arranged radially. Six pairs of genital setae, one pair of aggenital setae, two pairs of anal setae and three pairs of adanal setae present.

Material examined: SÇO-49, 19 exs.; SÇO-69, 1 ex.; SÇO-109, 2 exs.

Distribution: Holarctic region (Subías et al., 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. It is known to inhabit lower layers of the forest litter (Weigmann, 2006). We found this species in the litter under *P. sylvestris*. The dimensions of this species were given as 410-520 µm by Weigmann (2006). The Turkish specimens (448-452 x 280-304 µm) examined were in the range of the known dimensions of the species. This species is well characterized by anterior tubercle (Da) and posterior centrodorsal tubercle (Dp) on the prodorsum, setiform sensilli, smooth notogastral setae arranged radially and six pairs of genital setae.

**8. *Eupterotegaeus ornatissimus* (Berlese, 1908)**

Measurements: Body length, 608-728 µm and body width, 360-480 µm (n = 10).

Diagnostic characters (Figure 7): Surface of body with foveolate cerotegument**.** Lamellar cusps projecting well beyond rostrum. Sensilli expanded distally. Humeral processes projected forwards to the level of bothridia. Eight pairs short, smooth notogastral setae present. Anterior margin of notogaster with a triangular projection. Epimeral setal formula, 3-1-3-3. Adanal setae $ad_1$ and $ad_2$ in postanal, $ad_3$ in adanal positions.

Material examined: SÇO-4, 8 exs.; SÇO-196, 5 exs.

Distribution: Holarctic region (Subías et al., 2004, updated 2017).

Remarks: This species is a new record for Turkish fauna. According to Trave (1982), this is a forest and mountain species and an inhabitant of litter, moss and decomposed wood. It is found at altitudes above 500 m, with an optimum between 500 and 1200 m. This species is also found in oak and chestnut, beech and pine (Pérez-Íñigo, 1997). We found this species in the litter under *P. sylvestris*. The dimensions of this species were given as 750 x 450 µm by Berlese (1908), 616-704 x 360-408 by Pérez-Íñigo (1990) and 629-713 x 365-425 by Kunst (1958). The Turkish specimens (608-728 x 360-480 µm) examined were in the range of the known dimensions of the species. This species is well characterized surface of body by with foveolate cerotegument, the shape of sensilli, anterior margin of the notogaster with a triangular projection and eight pairs of notogastral setae.

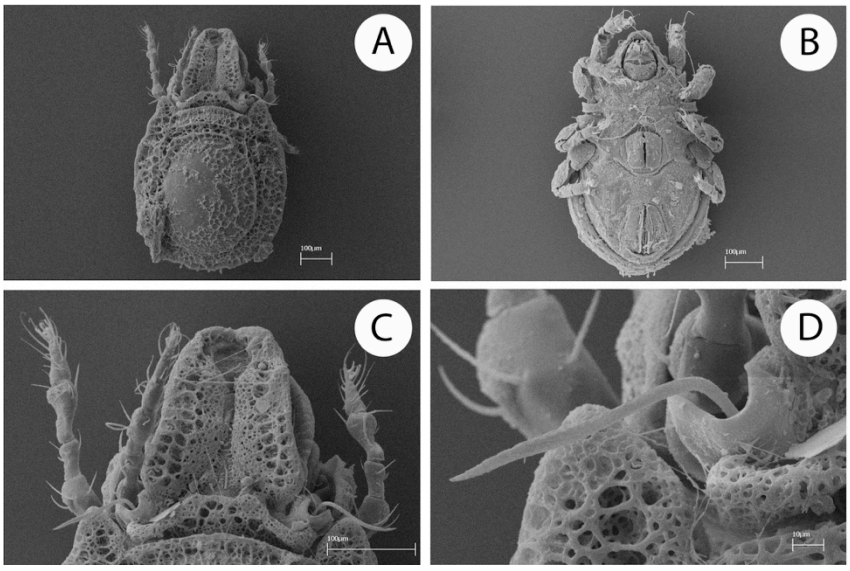


Figure 7. *Eupterotegaeus ornatissimus* (Berlese, 1908)*:* A) dorsal view; B) ventral view; C) prodorsum; D) sensillum.

**9. *Neoliodes ionicus* Sellnick, 1931**

Material examined: SÇO-59, 6 exs.; SÇO-76, 2 exs.; SÇO-119, 1 ex.; SÇO-192, 6 exs.; SÇO-238, 15 exs.

Distribution: Mediterranean (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Sevimli & Baran, 2016).

**10. *Gymnodamaeus barbarossa* Weigmann, 2006**

Material examined: SÇO-239, 2 exs.

Distribution: Central Europe (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Toluk & Ayyildiz, 2014).

**11. *Aleurodamaeus setosus* (Berlese, 1883)**

Material examined: SÇO-49,8 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Seniczak et al., 2012).

**12. *Eueremaeus oblongus oblongus* (Koch, 1835)**

Material examined: SÇO-59, 6 exs.; SÇO-94, 2 exs.; SÇO-165, 3 exs.; SÇO-344, 3 exs.; SÇO-355, 6 exs.

Distribution: Holarctic region (Subías et al., 2004, updated 2017). This subspecies was previously recorded from Turkey (Per & Ayyildiz, 2005).

**13. *Ramusella (Insculptoppia) insculpta* (Paoli, 1908)**

Material examined: SÇO-6, 8 exs.; SÇO-12, 3 exs.; SÇO-54, 15 exs.; SÇO-60, 29 exs.; SÇO-62, 86 exs.; SÇO-68, 21 exs.; SÇO-70, 8 exs.; SÇO-83, 14 exs.; SÇO-85, 11 exs.; SÇO-86, 63 exs.; SÇO-88, 24 exs.; SÇO-89,14 exs.; SÇO-90, 21 exs.; SÇO-91, 67 exs.; SÇO-97, 26 exs.; SÇO-114, 31 exs.; SÇO-141, 53 exs.; SÇO-142, 37 exs.; SÇO-143, 123 exs.; SÇO-144, 214 exs.; SÇO-146, 92 exs.; SÇO-147, 96 exs,; SÇO-148, 69 exs.; SÇO-149, 66 exs; SÇO-150, 76 exs.; SÇO-152, 54 exs.; SÇO-153, 12 exs.; SÇO-154, 121 exs.; SÇO-155, 33 exs.; SÇO-157, 24 exs.; SÇO-158, 24 exs.; SÇO-159, 207 exs.; SÇO-161, 93 exs.; SÇO-166, 72 exs.; SÇO-167,13 exs.; SÇO-170, 30 exs.; SÇO-172, 56 exs.; SÇO-173, 91 exs.; SÇO-176, 137 exs.; SÇO-177, 41 exs.; SÇO-178, 24 exs.; SÇO-180, 84 exs.; SÇO-182, 37 exs.; SÇO-183, 72 exs.; SÇO-186, 72 exs.; SÇO-189, 45 exs.; SÇO-190, 32 exs.; SÇO-196, 11 exs.; SÇO-197, 9 exs.; SÇO-199, 64 exs.; SÇO-200, 61 exs.; SÇO-201, 60 exs.; SÇO-205, 121 exs.; SÇO-211, 82 exs.; SÇO-212, 48 exs.; SÇO-213, 38 exs.; SÇO-215, 13 exs.; SÇO-216, 9 exs.; SÇO-218, 62 exs.; SÇO-220, 66 exs.; SÇO-221, 62 exs.; SÇO-223, 34 exs.; SÇO-225, 27 exs.; SÇO-226, 23 exs.; SÇO-227, 69 exs.; SÇO-228, 13 exs.; SÇO-229, 63 exs.; SÇO-231, 2 exs.; SÇO-240, 152 exs.; SÇO-242, 13 exs.; SÇO-243, 13 exs.; SÇO-245, 8 exs.; SÇO-248, 21 exs.; SÇO-264, 16 exs.; SÇO-265, 61 exs.; SÇO-272, 12 exs.; SÇO-273, 8 exs.; SÇO-279, 28 exs.; SÇO-284, 10 exs.; SÇO-289, 36 exs.; SÇO-291, 21 exs.; SÇO 296, 26 exs.; SÇO-299. 11 exs.; SÇO-301, 61 exs.; SÇO-304, 11 exs.; SÇO-305, 9 exs.; SÇO-309, 56 exs.; SÇO-310, 17 exs.; SÇO-312, 46 exs.; SÇO-313,11 exs.; SÇO-314,120 exs.; SÇO-315, 10 exs.; SÇO-316, 12 exs.; SÇO-318, 11 exs.; SÇO-322, 11 exs.; SÇO-333, 102 exs.; SÇO-335, 21 exs.; SÇO-336, 31 exs.; SÇO-353, 38 exs.; SÇO-363, 86 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Toluk & Ayyildiz, 2008b).

**14. *Rhinoppia (Rhinoppia) obsoleta obsoleta* (Paoli, 1908)**

Material examined: SÇO-4, 3 exs.; SÇO-13, 9 exs.; SÇO-21, 1 ex.; SÇO-22. 8 exs.; SÇO-94, 24 exs.; SÇO-114, 9 exs.; SÇO-155, 7 exs.; SÇO-221, 2 exs.; SÇO-322, 3 exs.; SÇO-335, 8 exs.; SÇO-336, 6 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This subspecies was previously recorded from Turkey (Toluk & Ayyildiz, 2008b).

**15. *Rhinoppia (Bipectinoppia) tasdemiri* Toluk & Ayyildiz, 2008**

Material examined: SÇO-16, 5 exs.; SÇO-20, 2 exs.; SÇO-49, 4 exs.; SÇO-55, 1 ex.; SÇO-57, 6 exs.; SÇO-70, 2 exs.; SÇO-74, 3 exs.; SÇO-91, 3 exs.; SÇO-94, 24 exs.; SÇO-106, 2 exs.; SÇO-107, 2 exs.; SÇO-114, 9 exs.; SÇO-115, 6 exs.; SÇO-116, 4 exs.; SÇO-118, 41 exs.; SÇO-129,1 ex.; SÇO-131, 2 exs.; SÇO-152, 4 exs.; SÇO-155, 7 exs.; SÇO-163, 2 exs.; SÇO-172, 2 exs.; SÇO-185, 9 exs.; SÇO-190, 4 exs.; SÇO-197, 2 exs.; SÇO-199, 6 exs.; SÇO-200, 4 exs.; SÇO-201, 2 exs.; SÇO-221, 2 exs.; SÇO-223, 7 exs.; SÇO-227, 4 exs.; SÇO-240, 3 exs.; SÇO-273, 3 exs.; SÇO-322, 3 exs.; SÇO-335, 8 exs.; SÇO-336, 6 exs.

Distribution: Turkey and Iran (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Toluk & Ayyildiz, 2008d).

**16. *Berniniella (Berniniella) serratirostris hauseri* (Mahunka, 1974)**

Material examined: SÇO-16, 8 exs.; SÇO-28, 9 exs.; SÇO-54, 41 exs.; SÇO-56, 5 exs.; SÇO-57, 14 exs.; SÇO-58, 120 exs.; SÇO-59, 17 exs.; SÇO-60, 72 exs.; SÇO-62, 46 exs.; SÇO-68, 34 exs.; SÇO-76, 15 exs.; SÇO-77, 9 exs.; SÇO-79, 16 exs.; SÇO-80, 45 exs.; SÇO-81, 8 exs.; SÇO-86, 33 exs.; SÇO-89, 12 exs.; SÇO-90, 27 exs.; SÇO-91, 92 exs.; SÇO-94, 162 exs.; SÇO-98, 14 exs.; SÇO-99, 8 exs.; SÇO-107, 65 exs.; SÇO-108, 19 exs.; SÇO-109, 76 exs.; SÇO-111, 32 exs.; SÇO-116, 1 ex.; SÇO-118, 24 exs.; SÇO-123, 7 exs.; SÇO-131, 60 exs.; SÇO-136, 72 exs.; SÇO-139, 7 exs.; SÇO-148, 196 exs.; SÇO-158, 18 exs.; SÇO-166, 44 exs.; SÇO-193, 6 exs.; SÇO-196, 6 exs.; SÇO-198, 6 exs.; SÇO-199, 17 exs.; SÇO-201, 82 exs.; SÇO-203, 6 exs.; SÇO-206, 48 exs.; SÇO-209, 11 exs.; SÇO-211, 7 exs.; SÇO-221, 41 exs.; SÇO-223, 5 exs.; SÇO-227, 13 exs.; SÇO-265, 6 exs.; SÇO-282, 8 exs.; SÇO-283, 48 exs.; SÇO-284, 63 exs.; SÇO-285, 54 exs.; SÇO-287, 9 exs.; SÇO-288, 7 exs., SÇO-289, 47 exs.; SÇO-290, 27 exs.; SÇO-291, 28 exs.; SÇO-292, 57 exs.; SÇO-294, 30 exs.; SÇO-296, 34 exs.; SÇO-297, 18 exs.; SÇO-299, 91 exs.; SÇO-300, 27 exs.; SÇO-301, 26 exs.; SÇO-303, 9 exs.; SÇO-304, 32 exs.; SÇO-307, 8 exs.; SÇO-309, 21 exs.; SÇO-310, 13 exs.; SÇO-311, 13 exs.; SÇO-312, 16 exs.; SÇO-314, 45 exs.; SÇO-315, 14 exs.; SÇO-316, 18 exs.; SÇO-320, 330 exs.; SÇO-333, 27 exs.; SÇO-336, 21 exs.

Distribution: Holarctic region and U.S.A (Subías et al., 2004, updated 2017). This subspecies was previously recorded from Turkey (Toluk & Ayyildiz, 2008c).

**17. *Lauroppia fallax* (Paoli, 1908)**

Material examined: SÇO-48, 1 ex.; SÇO-49, 16 exs.; SÇO-93, 9 exs.; SÇO-95. 19 exs.; SÇO-96, 16 exs.; SÇO-97, 11 exs.; SÇO-98, 5 exs.; SÇO-114, 11 exs.; SÇO-118, 34 exs.; SÇO-121, 4 exs.; SÇO-123, 5 exs.; SÇO-127, 2 exs.; SÇO-139, 3 exs.; SÇO-154, 9 exs.; SÇO-212, 26 exs.; SÇO-263, 2 exs.

Distribution: Semicosmopolitan (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Baran, 2003).

**18. *Moritzoppia escotata escotata* (Subías & Rodríguez, 1986)**

Material examined: SÇO-50, 2 exs.; SÇO-53, 1 ex.; SÇO-54, 5 exs.; SÇO-55, 1 ex.; SÇO-56, 1 ex.; SÇO-59, 42 exs.; SÇO-60, 57 exs.; SÇO-66, 1 ex.; SÇO-68, 18 exs.; SÇO-69, 5 exs.; SÇO-74, 1 ex.; SÇO-75, 7 exs.; SÇO-77, 2 exs.; SÇO-80, 30 exs.; SÇO-81, 108 exs.; SÇO-84, 1 ex.; SÇO-86, 94 exs.; SÇO-97, 3 exs.; SÇO-100, 6 exs.; SÇO-116, 1 ex.; SÇO-119, 7 exs.; SÇO-136, 52 exs.; SÇO-173, 4 exs.; SÇO-189, 2 exs.; SÇO-193, 42 exs.; SÇO-195, 1 ex.; SÇO-203, 4 exs.; SÇO-209, 4 exs.; SÇO-218, 14 exs.; SÇO-226, 18 exs.; SÇO-256, 1 ex. SÇO-260, 2 exs.; SÇO-286, 2 exs.; SÇO-298, 11 exs.

Distribution: Mediterranean (Subías et al., 2004, updated 2017). This subspecies was previously recorded from Turkey (Toluk & Ayyildiz, 2008c).

**19. *Oppiella (Oppiella) nova nova* (Oudemans, 1902)**

Material examined: SÇO-20, 4 exs.; SÇO-49, 45 exs.; SÇO-57, 4 exs.; SÇO-59, 42 exs.; SÇO-70,16 exs.; SÇO-71, 2 exs.; SÇO-76, 4 exs.; SÇO-88, 10 exs.; SÇO-93, 51 exs.; SÇO-94, 44 exs.; SÇO-95, 121 exs.; SÇO-96, 17 exs.; SÇO-97, 5 exs.; SÇO-98, 34 exs.; SÇO-99, 5 exs.; SÇO-102, 18 exs.; SÇO-108, 7 exs.; SÇO-109, 44 exs.; SÇO-111, 21 exs.; SÇO-113, 1 ex.; SÇO-118, 13 exs.; SÇO-119,18 exs.; SÇO-123, 13 exs.; SÇO-125, 17 exs.; SÇO-127, 21 exs.; SÇO-128, 61 exs.; SÇO-129, 34 exs.; SÇO-132, 37 exs.; SÇO-133, 1 ex.; SÇO-134, 1 ex.; SÇO-136, 540 exs.; SÇO-137, 46 exs.; SÇO-141, 32 exs.; SÇO-142, 18 exs.; SÇO-143, 138 exs.; SÇO-144, 193 exs.; SÇO-147, 62 exs.; SÇO-148, 122 exs.; SÇO-149, 38 exs.; SÇO-150, 52 exs.; SÇO-152, 35 exs.; SÇO-153, 9 exs.; SÇO-154, 80 exs.; SÇO-155, 25 exs.; SÇO-157, 21 exs.; SÇO-161, 27 exs.; SÇO-166, 15 exs.; SÇO-167, 7 exs.; SÇO-170,15 exs.; SÇO-172, 16 exs.; SÇO-176, 48 exs.; SÇO-177, 36 exs.; SÇO-178, 7 exs.; SÇO-180, 142 exs.; SÇO-182, 12 exs.; SÇO-183, 43 exs.; SÇO-185, 28 exs.; SÇO-186, 29 exs.; SÇO-193, 8 exs.; SÇO-219, 26 exs.; SÇO-220, 19 exs.; SÇO-223, 11 exs.; SÇO-225, 6 exs.; SÇO-227, 52 exs.; SÇO-228, 19 exs.; SÇO-229, 96 exs.; SÇO-240, 154 exs.; SÇO-243, 14 exs.; SÇO-245, 14 exs.; SÇO-246, 19 exs.; SÇO-264, 12 exs.; SÇO-282, 28 exs.; SÇO-283, 26 exs.; SÇO-284, 14 exs.; SÇO-288, 18 exs.; SÇO-291, 56 exs.; SÇO-293,8 exs.; SÇO-294, 16 exs.; SÇO-296, 18 exs.; SÇO-301, 12 exs.; SÇO-309, 50 exs.; SÇO-314, 72 exs.; SÇO-318, 13 exs.; SÇO-320, 220 exs.; SÇO-321, 22 exs.; SÇO-322, 14 exs.; SÇO-336, 34 exs.; SÇO-363, 51 exs.

Distribution: Cosmopolitan (Subías et al., 2004, updated 2017). This subspecies was previously recorded from Turkey (Toluk & Ayyildiz, 2008b).

**20. *Coronoquadroppia nasalis* Gordeeva, 1983**

Material examined: SÇO-94, 12 exs.; SÇO-97, 8 exs.; SÇO-114, 13 exs.; SÇO-141, 6 exs.; SÇO-144, 56 exs.; SÇO-146, 6 exs.; SÇO-147, 26 exs.; SÇO-148, 7 exs.; SÇO-150, 11 exs.; SÇO-161,19 exs.; SÇO-166, 23 exs.; SÇO-172, 6 exs.; SÇO-176, 14 exs.; SÇO-180, 32 exs.; SÇO-185, 13 exs.; SÇO-206, 26 exs.; SÇO-240, 40 exs.; SÇO-248, 6 exs.; SÇO-309. 9 exs.; SÇO-310, 6 exs.; SÇO-311, 7 exs.; SÇO-312, 6 exs.; SÇO-313, 6 exs.; SÇO-314, 19 exs.; SÇO-315, 30 exs.; SÇO-316, 8 exs.; SÇO-318, 10 exs.; SÇO-321, 9 exs.; SÇO-333, 7 exs.; SÇO-363, 32 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Toluk & Ayyildiz, 2008b).

**21. *Tectocepheus alatus* Berlese, 1913**

Material examined: SÇO-69,17 exs.; SÇO-86, 11 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Per et al., 2015).

**22. *Scutovertex sculptus* Michael, 1879**

Material examined: SÇO-10, 2 exs.; SÇO-24,1 ex.

Distribution: Palearctic region and New Zealand (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Baştürk & Toluk, 2016).

**23. *Eupelops acromios* (Hermann, 1804)**

Material examined: SÇO-19, 1 ex.; SÇO-213, 2 exs.; SÇO-266, 2 exs.

Distribution: Semicosmopolitan (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Taşdemir et al., 2010).

**24. *Oribatula (Zygoribatula) cognata* (Oudemans, 1902)**

Material examined: SÇO-78,7 exs.

Distribution: Palearctic region (Subías et al., 2004, updated 2017). This species was previously recorded from Turkey (Taşdemir et al., 2010).

## Conclusion

In total, 13151 individual oribatid mite were extracted from the samples collected. They represented by 24 species belonging to 23 genera and 17 families (Table 2). Among them, two genera, (*Bipassalozetes* and *Metabelba*) and eight species (*L. pulcherrimus*, *L. latiflabellata*, *E. ornatissimus*, *M.* (*M.*) *papillipes*, *D. bregetovae*, *P.* (*P.*) *inlenticulatus*, *C. horrida* and *B.* (*B.*) *perforatus*) were new records for the Turkish fauna.

Of the whole fauna picnonotic oribatids represented 79% and poronotic oribatids 21%. The faunistic analysis shows that picnonotic oribatids are the dominant major group. Oribatid mites can be found in almost every kind of habitat worldwide, most importantly in the layers of soil containing organic materials, but they also occur in several other kinds of microhabitat (e.g. lichen, moss and tree bark) (Gergócs & Hufnagel, 2009). In our findings, the 24 species were recorded in litter samples and 14 species from soil samples. In the other three habitats, species numbers were seven in lichen, seven in moss and six in tree bark samples. Oppiidae species were found in all microhabitats. They were abundant in soil and litter microhabitats with a higher number of individuals (12428) and species (7). According to Maraun & Scheu (2000), Oppiidae species are abundant because they have a wider food spectrum, and reproduce and develop rapidly. Also, they are generally abundant in forest soils, whereas their density is usually low in heavily disturbed habitats. Four oppiid species, *R.* (*I.*) *insculpta, B.* (*B.*) *serratirostris hauseri*, *O.* (*O.*) *nova nova* and *Q.* (*C.*) *nasalis,* were found in all microhabitats. The subspecies *O.* (*O.*) *nova nova* is cosmopolitan and parthenogenetic (thelytokous), known from many habitats (Von Saltzwedel et al., 2014). Ten species, *D. bregetovae*, *B.* (*B.*) *perforatus, P.* (*P.*) *inlenticulatus*, *M.* (*M.*) *papillipes*, *E. ornatissimus*, *G. barbarossa*, *A. setosus*, *E. oblongus oblongus*, *S. sculptus*, *O.* (*Z.*) *cognata,* were found only in litter samples. Passalozetidae species are commonly found in arid environments (desert valleys and hills) of Holartic, Ethiopian and Neotropical regions (Martínez & Herrero, 2006)**.** The species *G. barbarossa* inhabits warm and dry litter layer (Weigmann & Mourek, 2008). According to Steiner (1990), the species *E. oblongus oblongus* and *S. sculptus* are indicators of air pollution. The presence of these species in the study area gives us some information about the environmental conditions of these habitats. According to Murvanidze & Mumladze (2014) finding of the species *E. ornatissimus* in litter samples indicates an organic matter decay process is operating. Similarly, we found this species only in litter samples.

Zoogeographical analysis of the oribatid fauna of Çat Forest shows that Palearctic species are the most numerous, representing 50%, followed by the Holarctic species at 20.8%, cosmopolitan and semicosmopolitan species at 12.5% and Mediterranean species at 16.6%.

Table 2. The distribution of the microhabitats of the oribatid species determined from the study area

| Family | Taxa | Microhabitats | | | | |
|---|---|---|---|---|---|---|
| | | Soil | Litter | Moss | Lichen | Tree bark |
| Crotoniidae | *Camisia (Camisa) horrida* (Hermann, 1804) | 2 | 17 | | | |
| Licnodamaeidae | *Licnodamaeus pulcherrimus* (Paoli, 1908) | 8 | 17 | | | |
| Licnobelbidae | *Licnobelba latiflabellata* (Paoli, 1908) | 9 | 1 | | | |
| Damaeolidae | *Damaeolus bregetovae* Csiszár, 1962 | | 7 | | | |
| Passalozetidae | *Bipassalozetes (Bipassalozetes) perforatus* (Berlese, 1910) | | 2 | | | |
| | *Passalozetes (Passalozetes) inlenticulatus* Mihelčič, 1959 | | 44 | | | |
| Damaeidae | *Metabelba (Metabelba) papillipes* (Nicolet, 1855) | | 22 | | | |
| Compactozetidae | *Eupterotegaeus ornatissimus* (Berlese, 1908) | | 13 | | | |
| Neoliodidae | *Neoliodes ionicus* Sellnick, 1931 | 2 | 21 | 7 | | |
| Gymnodamaeidae | *Gymnodamaeus barbarossa* Weigmann, 2006 | | 2 | | | |
| Aleurodamaeidae | *Aleurodamaeus setosus* (Berlese, 1883) | | 11 | | | |
| Eremaeidae | *Eueremaeus oblongus oblongus* (Koch, 1835) | | 14 | | | 6 |
| Oppiidae | *Ramusella (Insculptoppia) insculpta* (Paoli, 1908) | 918 | 2959 | 82 | 381 | 258 |
| | *Rhinoppia (Rhinoppia) obsoleta obsoleta* (Paoli, 1908) | 7 | 59 | | 14 | |
| | *Rhinoppia (Bipectinoppia) tasdemiri* Toluk & Ayvildiz, 2008 | 75 | 155 | | 25 | 10 |
| | *Berniniella (Berniniella) serratirostris hauseri* (Mahunka, 1974) | 830 | 1647 | 39 | 182 | 98 |
| | *Lauroppia fallax* (Paoli, 1908) | 54 | 93 | 26 | | |
| | *Moritzoppia escotata escotata* (Subías & Rodríguez, 1986) | 143 | 1388 | 7 | 11 | |
| | *Oppiella (Oppiella) nova nova* (Oudemans, 1902) | 596 | 2875 | 39 | 46 | 18 |
| Quadroppiidae | *Coronoquadroppia nasalis* Gordeeva, 1983 | 63 | 357 | 6 | 7 | 40 |
| Tectocepheidae | *Tectocepheus sarekensis* Berlese, 1913 | 11 | 17 | | | |
| Scutoverticidae | *Scutovertex sculptus* Michael, 1879 | | 3 | | | |
| Phenopelopidae | *Eupelops acromios* (Hermann, 1804) | 4 | 1 | | | |
| Oribatulidae | *Oribatula (Zygoribatula) cognata* (Oudemans, 1902) | | 7 | | | |

## References


Anonymous, 2015. Sivas Valiliği Çevre ve Şehircilik İl Müdürlüğü Sivas İli 2015 Yılı Çevre Durum Raporu. Çed ve Çevre İzinleri Şube Müdürlüğü, Sivas, 189 s.

Baran, Ş., 2003. Erzurum ili Oppiid Türleri (Acari, Oribatida, Oppiidae) Üzerine Sistematik Araştırmalar. Atatürk Üniversitesi Fen Bilimleri Enstitüsü, (Basılmamış) Doktora Tezi, Erzurum, 68 s.

Baştürk, V. & A. Toluk, 2016. Oribatid mites and their Associated fungi from Erciyes mountain, Turkey. Fresenius Environmental Bulletin, 25 (12a): 5722-5728.

Bayartogtokh, B. & I. E. Smelyansky, 2004. Oribatid mites of the superfamilies Gymnodamaeoidea and Plateremaeoidea (Acari: Oribatida) from Steppe of Russia. Mongolian Journal of Biological Sciences, 2(1): 3-17.

Berlese, A., 1908. Elenco di generi e specie nuovi diAcari. Redia, 5: 1-15.

Colloff, M. J., 1993. A taxonomic revision of the oribatid mite genus *Camisia* (Acari: Oribatida). Journal of National History, 27: 1325-1408.

Csiszár, J. & M. Jeleva, 1962. Oribatid mites (Acari) from Bulgarian soils. Acta Zoologica Academiae Scientiarum Hungaricae, 8 (3-4): 273-301.

Erman, O., M. Özkan, N. Ayyildiz & S. Doğan, 2007. Checklist of the mites (Arachnida: Acari) of Turkey. Second supplement. Zootaxa, 1522: 1-21.

Gergócs, V. & L. Hufnagel, 2009. Application of Oribatid Mites as Indicators. Applied Ecology and Environmental Research, 7 (1): 79-98.

Ghilyarov, M. S., 1975. An Identification Keys of Soil Living Mites (Sarcoptiformes). Science, Moscow. 491 pp.

Gil, J. & L. S. Subías, 1990. Oribatidos del cabo de San Vicente (Portugal) (Acari, Oribatida). Boletín de la Asociación Española de Entomologiá, 14: 137-151.

Grandjean, F., 1934. Oribates de l'Afrique du Nord (2me série). Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord, 25: 235-252.

Grobler, L., S. Bayram & S. Çobanoğlu, 2004.Two new species and new records of oribatid mites from Turkey. International Journal of Acarology, 30 (4): 351-358.

Grobler, L., S. K. Ozman & S. Çobanoğlu, 2003. The genera *Liacarus*, *Stenoxenillus* and *Xenillus* (Oribatida: Gustavioidea) from Turkey. Acarologia, 43 (1): 133-149.

Krantz, G. W. & D. E. Walter, 2009. A Manual of Acarology. Third Edition. Texas Tech University Press, Lubbock, Texas, 807 pp.

Kunst, M., 1958. Bulgarische Oribatiden (Acarina) II. Acta Universitatis Carolinae. Biologica, 5: 13-31.

Lazarus, S. & G. Krisper, 2014. Diversity of the oribatid mite fauna (Acari, Oribatida) in two dry meadows in Styria (Austria). Soil Organisms 82: 117-124.

Maraun, M. & S. Scheu, 2000. The structure of oribatid mite communities (Acari, Oribatida): Patterns, mechanisms and implications for future research. Ecography, 23: 374-383.

Maraun, M., H. Schatz & S. Scheu, 2007. Awesome or ordinary? Global diversity patterns of oribatid mites. Ecography, 30: 209-216.

Martínez, P. A. & A. C. Herrero, 2006. A new species of *Passalozetes* (Acari: Oribatida) from the Andes Mountains of Argentina. Zootaxa, 1160: 49-55.

Mihelčič, F., 1959. Zur Kenntnis der Milben (Acarina) aus Südkärnten und Osttirol. Zoologischer Anzeiger, 162: 362-371.

Murvanidze, M. & L. Mumladze, 2014. Oribatid mite (Acari: Oribatida) diversity in different forest stands of Borjom-Kharagauli national park (Georgia). Persian Journal of Acarology, 3 (4): 257-276.

Murvanidze, M. & L. Mumladze, 2016. Annotated checklist of Georgian oribatid mites. Zootaxa. 4089 (1): 1-81.

Murvanidze, M. & T. Arabuli, 2015. Oribatid mite diversity in *Rhododendron ponticum* L. canopy along an altitudinal gradient in Mtirala National Park. Acarologia, 55 (2): 219-230.

Murvanidze, M., L. Mumladze, T. Arabuli & E. Kvavadze, 2013. Oribatid mite colonization of sand and manganese tailing sites. Acarologia, 53 (2): 203-215.

Norton, R. A. & V. M. Behan-Pelletier, 2009. "Oribatida, 430-564". In: A Manual of Acarology (Eds. G. W. Krantz & D. E. Walter). Lubbock, TX, USA, Texas Tech University Press, 807 pp.

Özkan, M., N. Ayyildiz & O. Erman, 1994. Check list of the Acari of Turkey. First supplement. EURAAC News Letter, 7: 4-12.

Per, S. & N. Ayyildiz, 2005. Erciyes Dağı'nın (Kayseri) epifitik oribatid akarları üzerine sistematik araştırmalar I, Türkiye Entomoloji Dergisi*,* 29 (1): 69-80.

Per, S., A. Taşdemir & N. Ayyildiz, 2015. Türkiye faunası için yeni oribatid akarlar (Acari, Oribatida). Türkiye Entomoloji Bülteni*,* 5 (1): 29-34.

Pérez-Íñigo, C., 1990. Acaros oribátidos (Acari, Oribatei) de la Provincia de Huesca, I. Prepirineo. Eos, 65: 109-163.

Pérez-Íñigo, C., 1993. Redescription of *Licnobelba latiflabellata* (Paoli, 1908) (Acari, Oribatei, Licnobelbidae). Redia. 76 (2): 317-326.

Pérez-Íñigo, C., 1997. "Acari, Oribatei, Gymnonota I, 1-374". In: Fauna Iberica, Vol. 9 (Eds. M. A. Ramos, J. A. Tercedor, X. B. Ros, J. G. Noguera, A. G. Sierra, E. Macpherson Mayol, F. M. Piera, J. S. Marino & J. T. Gonzáles) Museo Nacional de Ciencias Naturales, CSIC, Madrid, 374 pp.

Schatz, H., V. M. Behan-Pelletier, B. M. OConnor & R. A. Norton, 2011. "Suborder Oribatida van der Hammen, 1968, 141-148". In: Animal Biodiversity: An Outline of Higher-Level Classification and Survey of Taxonomic Richness (Ed. Z.-Q. Zhang). Zootaxa, Special volume 3148, Magnolia Press, Auckland, NZ, 237 pp.

Seniczak, S., N. Ayyildiz & A. Seniczak, 2012. Setal losses in the dorsal hysterosoma of Plateremaeoidea (Acari: Oribatida) in the light of ontogenetic studies. Journal of Natural History, 46: 411-451.

Sevimli, A. & Ş. Baran, 2016. Neoliodid (Acari: Oribatida) species of Şamlar forest, İstanbul. Acta Turcica Biologica, 29 (3): 78-82.

Subías, L. S. & P. Balogh, 1989. Identification keys to the genera of Oppiidae Grandjean, 1951 (Acari: Oribatei). Acta Zoologica Scientiarum Hungaricae, 35 (3-4): 355-412.

Subías, L. S., 2004. Listado sistemático, sinonímico y biogeográfico de los ácaros oribatidos (Acariformes: Oribatida) del Mundo (Excepto fósiles). Graellsia 60: 3-305 (actualizado en junio de 2006, en abril de 2007, en mayo de 2008, en abril de 2009, en julio de 2010, en febrero de 2011, en abril de 2012, en mayo de 2013 y en febrero de 2014, en marzo de 2015, en febrero de 2016 y en febrero 2017) http://escalera.bio.ucm.es/usuarios/bba/cont/docs/RO_1.pdf. (Date accessed: 07.07 2017).

Taşdemir, A., E. Sarı & N. Ayyildiz, 2010.Yozgat Çamlığı Milli Parkı'ndan *Zygoribatula* Berlese, 1916 ve *Eupelops* Ewing, 1917 (Oribatida: Oribatulidae, Phenopelopidae) türleri üzerine sistematik ve ekolojik araştırmalar. Süleyman Demirel Üniversitesi Fen Dergisi, 5 (1): 47-59.

Toluk, A. & N. Ayyildiz, 2008a. New and unrecorded oppioid mites (Acari: Oribatida) from Yozgat Pine Grove National Park, Turkey. Acarologia, 68 (3-4): 209-223.

Toluk, A. & N. Ayyildiz, 2008b. Yozgat Çamlığı Milli Parkı'nın oppioid oribatid akarları (Acari: Oribatida) üzerine sistematik çalışmalar. Erciyes Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 24 (1-2): 52- 81.

Toluk, A. & N. Ayyildiz, 2008c. New and Unrecorded Oppioid Mites (Acari: Oribatida) from Yozgat Pine Grove National Park, Turkey. Acarologia, 68 (3-4): 209-223.

Toluk, A. & N. Ayyildiz, 2008d. Two new species of the genus *Rhinoppia* Balogh, 1983 (Acari: Oribatida) from Turkey. Entomological News, 119 (3): 263-270.

Toluk, A. & N. Ayyildiz, 2009. New records of the oppioid mites (Acari: Oribatida) for the Turkish fauna from Artvin province. Turkish Journal of Zoology, 33 (1): 13-21.

Toluk, A. & N. Ayyildiz, 2014. *Gymnodamaeus* Kulczynski, 1902 (Acari, Oribatida, Gymnodamaeidae) türleri üzerine bir çalışma. Bitki Koruma Bülteni, 54 (3): 171-179.

Toluk, A., N. Ayyildiz & Ş. Baran, 2008. Two new species of *Epimerella* Kulijev, 1967 (Acari, oribatida, Epimerellidae) from Turkey. Journal of Natural History, 42 (39-40): 2537-2546.

Trave, J., 1982. Sur la présence d' *Eupterotegaeus ornatissimus* (Berlese, 1908) (Acarien, Oribate) en Catalogne et sa répartition géographique. Vie et Milieu, 32 (2): 101-104.

Vladislav, S. A., A. B. Pavel & N. Vladimir, 2015. Bashkin Application of Soil Oribatid Mites as Bioindicators in Impact Areas of the Gas Industry in the West Siberian Tundra. The Open Ecology Journal, 8 (Suppl 1-M4): 32-39.

Von Saltzwedel, H., M. Maraun, S. Scheu & I. Schaefer, 2014. Evidence for frozen-niche variation in a cosmopolitan parthenogenetic soil mite species (Acari, Oribatida). PLoS One, 9:e113268.

Weigmann, G. & J. Mourek, 2008. Contribution to the Central European *Gymnodamaeus* species *G. barbarossa* and *G. bicostatus* (Acari, Oribatida, Gymnodamaeidae). Zoosystematics and Evolution, 84: 255-264.

Weigmann, G., 2006. Hornmilben (Oribatida), Die Tierwelt Deutschlands, Begründet 1925 von Friedrich Dahl, 76. Teil. Goecke & Evers, Keltern, 520 pp.

Weigmann, G., 2013. Ecology and biogeography of oribatid mites (Acari: Oribatida) from the coastal region of Portugal. Soil Organisms, 85 (3): 147-160.

Woas, S., 1986. Beitrag zur Revision der Oppioidea sensu Balogh, 1972 (Acari, Oribatei), Andrias, 5: 21-224.

Woas, S., 1998. "Mosaikverteilung der Merkmale basaler Höherer Oribatiden - Die Gattungen *Passalozetes* und *Scutovertex* (Acari, Oribatei), 291-313". In: Arthropod Biology: Contributions to Morphology, Ecology and Systematics, Biosystematics and Ecology Series, 14 (Ed. E. Ebermann), Austrian Academy of Sciences Press, Vienna, 384 pp.