

## Orijinal araştırma (Original article)

# Contributions to the Turkish oribatid mite fauna (Acari: Oribatida)

Türkiye oribatid akar faunasına katkılar (Acari: Oribatida)

Nusret AYYILDIZ<sup>1</sup>

Ayşe TOLUK<sup>1\*</sup>

## Summary

Seven known oribatid mite species viz. *Nothrus silvestris* Nicolet, *Hermanniella multipora* Sitnikova, *Licnobelba caesarea* (Berlese), *Jacotella frondeus* (Kulijev), *Adoristes (Gordeeviella) krivolutskyi* Shtanchaeva, Subías & Arillo, *Autogneta (Rhaphigneta) flagellata* (Mahunka) and *Phauloppia lucorum* (Koch), are recorded for the first time from Turkey. The morphological features of species mentioned here have been presented with SEM photographs, and their zoogeographical distributions are given. Key to the species for each genus is also given.

**Keywords:** *Nothrus*, *Hermanniella*, *Licnobelba*, *Jacotella*, *Adoristes*, *Autogneta*, *Phauloppia*, new records.

## Özet

Yedi oribatid akar türü, isim olarak *Nothrus silvestris* Nicolet, *Hermanniella multipora* Sitnikova, *Licnobelba caesarea* (Berlese), *Jacotella frondeus* (Kulijev), *Adoristes (Gordeeviella) krivolutskyi* Shtanchaeva, Subías & Arillo, *Autogneta (Rhaphigneta) flagellata* (Mahunka) ve *Phauloppia lucorum* (Koch), Türkiye'den ilk kayıttır. Adı geçen türlere ilişkin morfolojik özellikler tarama elektron mikroskobu fotoğrafları ile birlikte sunulmuş ve zoocoğrafik dağılımları verilmiştir. Aynı zamanda her bir cins için türlere teşhis anahtarı verilmiştir.

**Anahtar sözcükler:** *Nothrus*, *Hermanniella*, *Licnobelba*, *Jacotella*, *Adoristes*, *Autogneta*, *Phauloppia*, yeni kayıtlar.

<sup>1</sup> Erciyes University, Faculty of Science, Department of Biology, Kayseri, Turkey

\* Sorumlu yazar (Corresponding author) e-mail: [atoluk@erciyes.edu.tr](mailto:atoluk@erciyes.edu.tr)

Alınış (Received): 07.01.2016

Kabul ediliş (Accepted): 15.03.2016

Çevrimiçi Yayın Tarihi (Published Online): 18.03.2016

## Introduction

Oribatid mites (Acari) are often the dominant microarthropod group in forest soil-litter habitats. They are actively involved in decomposition of organic matter, in nutrient cycling and soil formation (Behan-Pelletier, 1999). Oribatid mites consist of 10.826 described species and subspecies worldwide (Subías, 2004, updated 2016) and the total species number is estimated to be up to 100000 (Schatz, 2002). The highest number of species is known from the Palaearctic region, followed by the Oriental and Neotropical regions (Schatz, 2004). The beginning of taxonomic works on oribatid mites in Turkey goes back to the 1980s (Ayyildiz, 1988 a-e, 1989; Ayyildiz & Luxton, 1989 a,b; Ayyildiz & Özkan, 1988). To date, the number of oribatid mite species and genera known from Turkey is about 200 and 90, respectively (Özkan et al., 1994; Bayartogtokh et al., 2000; Bayartogtokh et al., 2002; Grobler et al., 2003, 2004; Erman et al., 2007; Toluk & Ayyildiz, 2008). So, it is expected that continued researches on the Turkish oribatid mite fauna will significantly augment the known species diversity for the country.

In the present paper, seven known species belong to the genera *Nothrus* Koch, *Hermanniella* Berlese, *Licnobelba* Grandjean, *Jacotella* Banks, *Adoristes* Hull, *Autogneta* Hull, and *Phauloppia* Berlese are added to the Turkish fauna with remarks on the recorded species. Previous records of oribatid species belonging to the genera *Nothrus*, *Hermanniella*, *Autogneta* and *Phauloppia* mentioned here included *N. anauniensis* Canestrini & Fanzago (recorded as *N. biciliatus* Koch) from Erzurum, *H. punctulata* Berlese from Yozgat, *A. (Rhaphigneta) numidiana* (Grandjean) from Artvin and *P. rauschenensis* (Sellnick) (recorded as *P. saxicola* Travé) from Ankara (Ayyildiz, 1988a; Grobler et al., 2004; Toluk et al., 2006; Toluk & Ayyildiz, 2009). Prior to this study there was no record for the genera *Licnobelba*, *Jacotella* and *Adoristes* (*Gordeevilla*) from Turkey.

## Material and Methods

The mite specimens in soil, litter and moss taken from Artvin, Antalya and Bolu provinces of Turkey between 2008 and 2014, were extracted using Berlese funnels and preserved in 75% ethyl alcohol. Measurements and descriptions are based on specimens mounted in temporary cavity slides that were studied using a compound microscope. All measurements are presented in micrometers ( $\mu\text{m}$ ). Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. Notogastral width refers to the maximum width in dorsal aspect. For scanning electron microscope (SEM) investigations, the specimens were mounted on aluminum-stubs with double sided carbon tape and dried in a desiccator. Then the specimens were sputter-coated with 15 nm gold/palladium. SEM photographs were taken using a Zeiss/Leica LEO 440 scanning electron microscope at the Technology Research and Application Center of Erciyes University. The morphological terminology follows that of Norton & Behan-Pelletier (2009). The examined specimens are deposited in the Acarological Collection of the Zoological Museum, Erciyes University, Kayseri, Turkey.

## Results and Discussion

A total of seven species belonging to 7 genera of oribatid mites from Artvin, Antalya and Bolu provinces of Turkey were determined. These species are given below.

### Genus *Nothrus* Koch

Rostrum with median incision, bothridium present, genital and anal plate large, occupying entire ventral side posterior to epimeres, aggenital setae absent, epimeres I with 5–7 setae, legs with 1–3 claws.

Key to the species of the genus *Nothrus* of Turkey

1. Posterior notogastral setae rod like, long, not widened, barbed distally; leg tarsi with one claw, length = 710–810..... *N. silvestris* Nicolet

- Posterior notogastral setae widened distally, relatively short, not much longer than the others; leg tarsi with three claws, length = 700–810 ..... *N. anauniensis* Canestrini & Fanzago

*Nothrus silvestris* Nicolet

Measurements: Body length: 732–773  $\mu\text{m}$ , body width: 402–408  $\mu\text{m}$  (n=6).

Morphological features (Fig. 1A-F): Rostrum rounded. Rostral setae (*ro*) barbed. Lamellar setae (*le*) barbed and slightly curved, set on apophyses. Interlamellar setae (*in*) phylliform, barbed. Sensilli (*ss*) long, rod-like and barbed. The middle part of notogaster, between folds, covered with distinct, large, round pits. Lateral surface with small pits. Distance between setae  $c_1$ – $c_2$  shorter than between  $c_2$ – $c_3$ . Sixteen pairs of notogastral setae present, not widened, rod like. Epimeral setal formula 3-1-3-3. Genital plates with 9 pairs of setiform setae ( $g_{1-9}$ ); 2 pairs of short anal setae ( $an_{1-2}$ ); 3 pairs of adanal setae ( $ad_{1-3}$ ). All legs monodactylous.

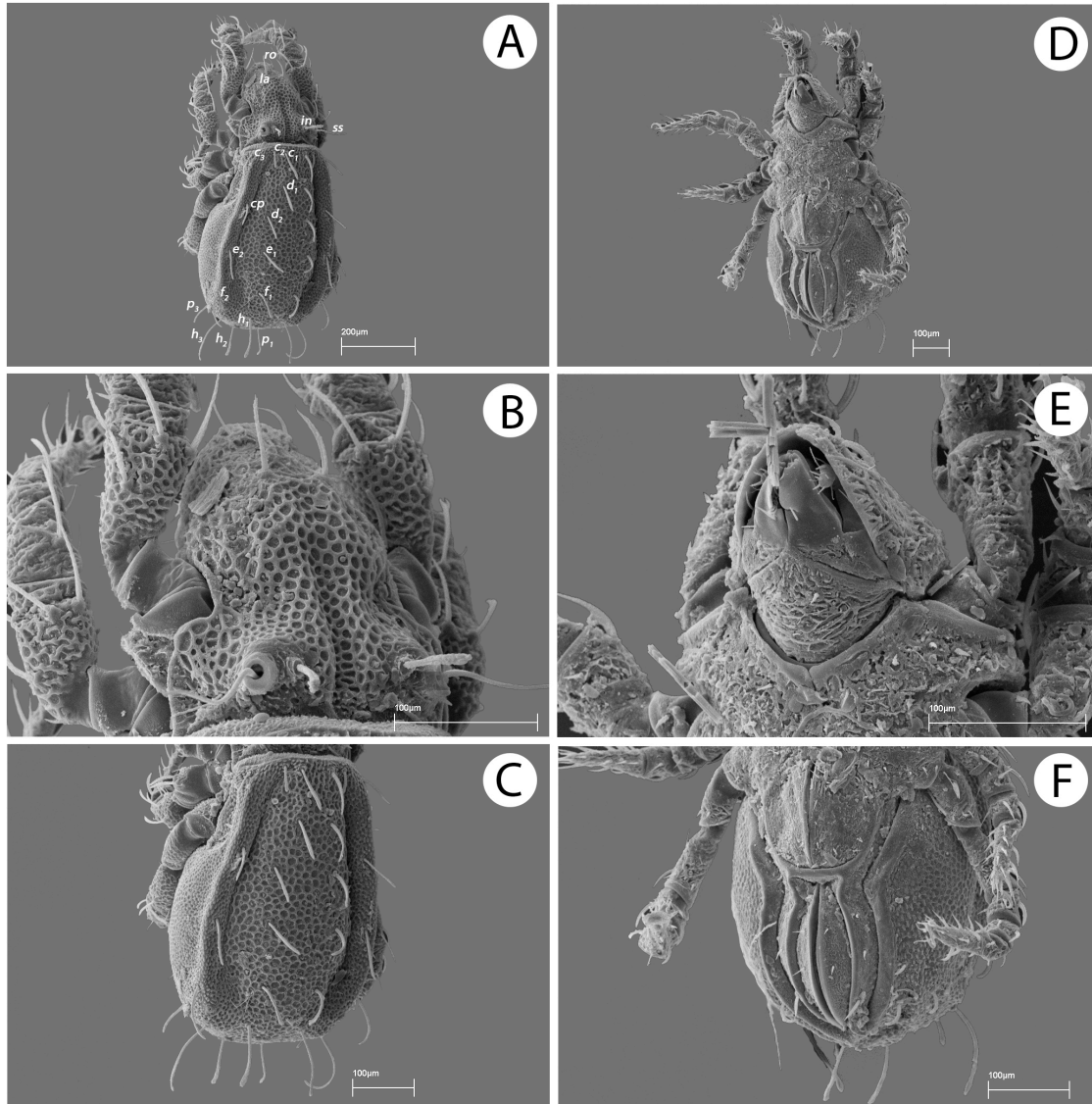


Figure 1. *Nothrus silvestris* Nicolet. A- Dorsal view; B- Prodorsum; C- Notogaster; D- Ventral view; E- Subcapitulum; F- Genito-anal region.

Material examined: Turkey, Bolu province, N: 40°56.447', E: 031°44.763', 784 m, 25.V.2014, collected in litter and soil, 6 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

Remarks: This species is new record for Turkish fauna. It is widespread in various acidophilous and mesophilic forests, also on drier peatlands (Weigmann, 2006). Turkish specimens are collected in soil and litter. The dimensions of the species are given as 710–810  $\mu\text{m}$  by Weigmann (2006). The Turkish specimens (732–773 x 402–408  $\mu\text{m}$ ) are in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli, phylliform barbed interlamellar setae, 16 pairs of notogastral setae, nine pairs of genital setae, number of claws and shape of posterior notogastral setae.

### Genus *Hermanniella* Berlese

Bothridia situated near prodorsal margins, notogaster with a pair of lateral, tube-like projections, notogastral setae usually of the same type (except  $f_1$  dilated leaf-shaped), aggenital setae absent.

#### Key to the species of the genus *Hermanniella* of Turkey

1. Interlamellar setae widened, strongly leaf-shaped and bent in the direction of the bothridia, much shorter than sensilli; notogastral plate without areolae, posterior notogastral setae rather widened strongly barbed, length= 516–582  $\mu\text{m}$  ..... *H. multipora* Sitnikova

- Interlamellar setae not widened, rod like and forward directed to the lamellar setae, almost the same length as sensilli; notogastral plate with areolae, posterior notogastral setae rod like, length= 510–700  $\mu\text{m}$ ..... *H. punctulata* Berlese

#### *Hermanniella multipora* Sitnikova

Measurements: Body length: 440–540  $\mu\text{m}$ , body width: 220–321  $\mu\text{m}$  (n=8).

Morphological features (Fig. 2A-F): Body surface covered with cerotegument. Rostrum widely rounded in dorsal view. Rostral and lamellar setae narrow, thickened barbed, curved inwards. Interlamellar setae strong, barbed, leaf shaped. Sensilli with long stalk (37  $\mu\text{m}$ ), short (13  $\mu\text{m}$ ) and weakly thickened head. Notogaster oval-shaped. Cerotegument forming papilliform granules. Sculpture of integument under cerotegument of dorsal part represented by a vast number of very small slitlike apertures. No areolae. Fifteen pairs of notogastral setae present, variable in length and thickness. The setae  $f_1$  and especially  $h_1$  and  $h_2$  dilated,  $h_3$  very small and barely perceptible in length. Epimeral setal formula 3:1:3:3. Seven pairs of genital setae, five pairs arising closer to inner margin than others and latter two pairs much larger than the inner pairs. One pair of aggenital setae; two pairs of anal setae; three pairs of adanal setae smooth, only adanal setae  $ad_1$  longer and thicker than others, with bent apices. All legs monodactylous.

Material examined – Turkey, Artvin province, a forest in 7 km along Borçka-Muratlı town road, N: 41°22'39", E: 41°41'11", 210 m, 27.X.2008, collected in moss on tree, 10 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

Remarks – This species is distributed in Palaearctic region (Subías, 2004, updated 2016). It is new record for Turkish fauna. Holotype and paratypes were originally collected from litter under cypress tree and a rotten hornbeam trunk near footpath in Sochi, and litter from mixed woodland in Malesna River valley, Soviet Far East (Sitnikova, 1973). Turkish specimens are collected in moss on tree. The dimensions of the species are given as 552  $\mu\text{m}$  (516–582) x 325  $\mu\text{m}$  (282–382) by Sitnikova (1973). The Turkish specimens (440–540 x 220–321  $\mu\text{m}$ ) are in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli, the vast number of very small slit like apertures on notogaster, 15 pairs of notogastral setae, dilated setae  $f_1$ ,  $h_1$  and  $h_2$  and by the very small barely perceptible setae  $h_3$  and the lack of areolae on the notogaster.



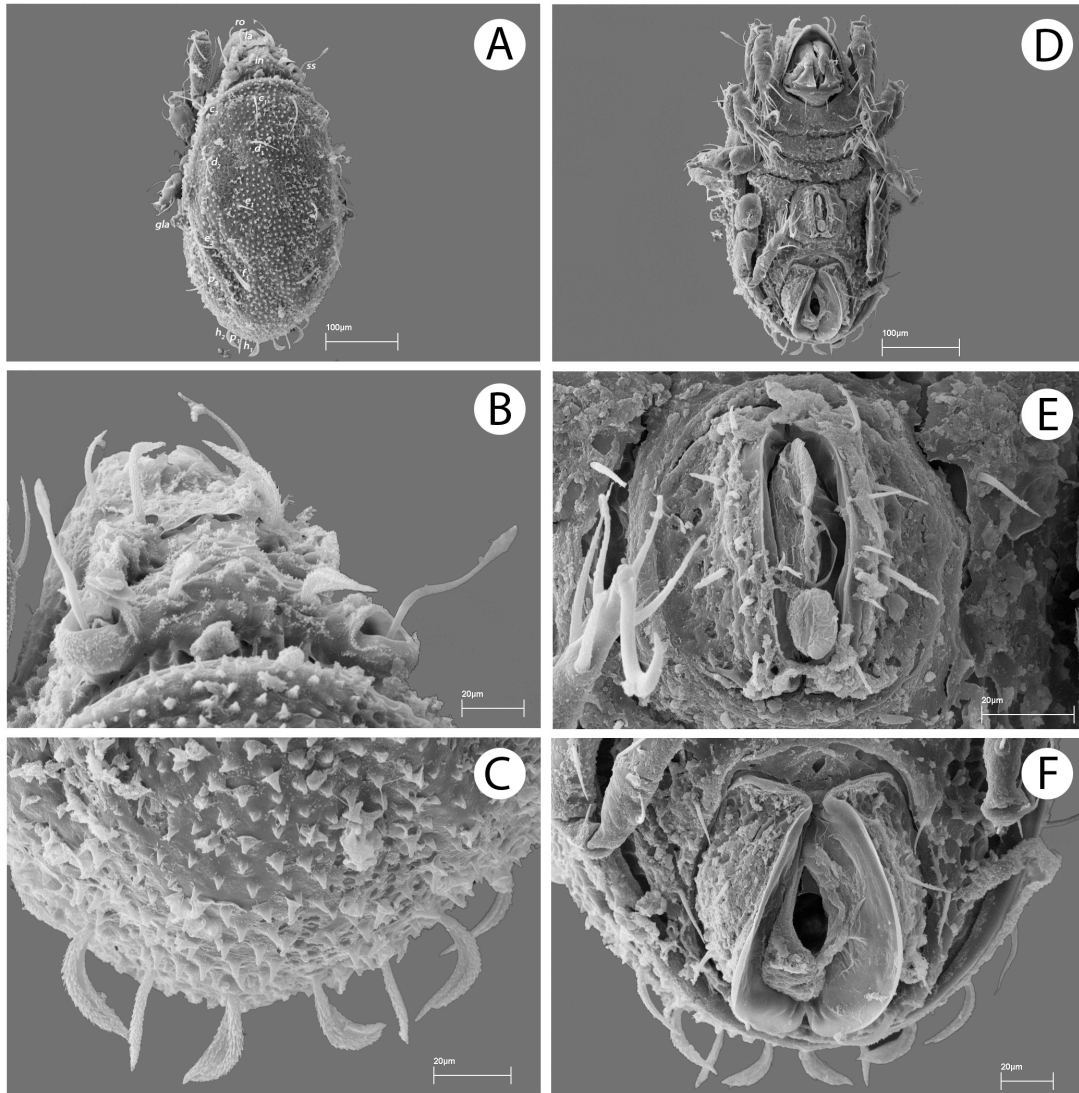


Figure 2. *Hermanniella multipora* Sitnikova. A- Dorsal view; B- Prodorsum; C-The posterior part of notogaster; D- Ventral view; E- Genital plate; F- Anal plate.

### Genus *Licnobelba* Grandjean

Adults with exuviae on dorsal; thick cerotegument formed by high polygonal pieces; notogastral surface smooth, shiny and with 4–6 pairs of setae; six pairs of genital setae present.

#### *Licnobelba caesarea* (Berlese)

Measurements – Body length: 250–280 µm, body width: 120–140 µm (n = 6).

Morphological features (Fig. 3A-F): Prodorsal surface covered by a thick reticulated cerotegumental layer, forming a web-like pattern. Rostrum rounded. Rostral setae inserted from ventral side. Lamellar setae inserted on small lateral apophyses. Both of them covered by thick cerotegument with small granules. Sensilli large, leaf-shaped, with a very short stalk. Notogaster covered with unclear tubercles. Five pairs of postero-lateral notogastral setae; Lyrifissures *ia* and *im* wide and very clear. Discidium weakly developed and rounded. Epimeral setal formula 3:1:3:3. Six pairs of short and thin genital setae, one pair of aggenital setae, two pairs of anal setae and three pairs of adanal setae. All legs tridactylous and covered by a thick cerotegumental layer. Tibia I with large and well developed apophysis.

Material examined – Turkey, Antalya province, Güllük Mountain, N: 37°00'59.52", E: 30°00'59.52", 550 m, 26.VI.2010, soil and litter, 6 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

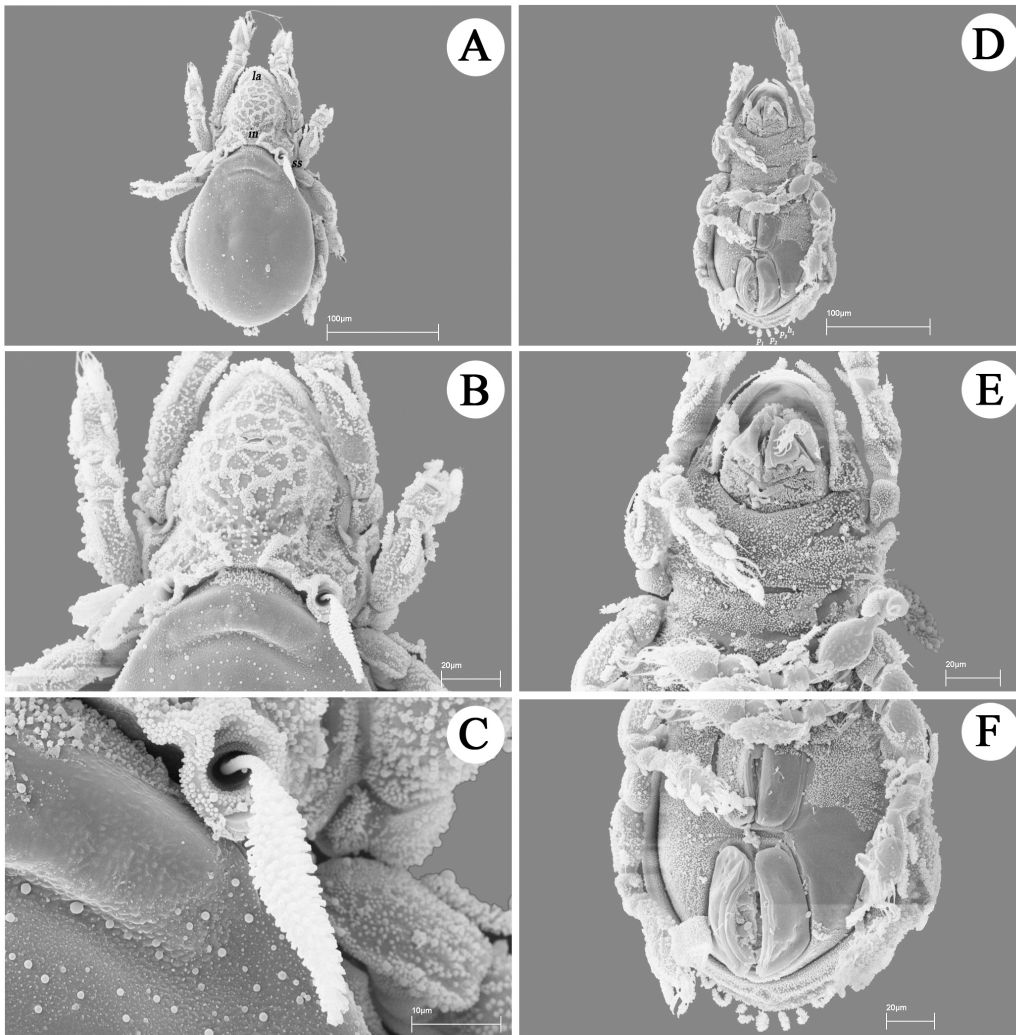


Figure 3. *Licnobelba caesarea* (Berlese). A- Dorsal view; B- Prodorsum; C- Sensillus; D- Ventral view; E- Subcapitulum and epimeral region; F- Genito-anal region.

Remarks – This species is distributed in Mediterranean (Subías, 2004, updated 2016). It is a new record for Turkish fauna. The body length is given as 270–285 µm by Grandjean (1931) and 260–302x120–160 µm by Pérez-Iñigo (1994), 275–281x125–137 µm and 270–302x125–160 µm by Kahwash et al., (1990). The Turkish specimens (250–280 x 120–140 µm) are in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli; prodorsum with a polygonal sculpture; five pairs of postero-lateral notogastral setae. Pérez-Iñigo (1994) who states that notogaster is completely smooth, without any kind of network pattern. However, notogastral surface covered with unclear tubercules in the Turkish specimens. The reason for this contrast, we believe that due to the microscopic examination.

#### **Genus *Jacotella* Banks**

Adults without exuviae on dorsal; sensilli with slightly dilated head; notogastral setae  $h_2$  absent; seven pairs of genital setae present, legs covered by a thin cerotegument layer; pedotectal tooth absent.

#### *Jacotella frondeus* (Kulijev)

Measurements: Body length: 332–392 µm, body width: 180–216 µm (n = 5).

Morphological features (Fig. 4 A-F): Body surface covered by polygonal cerotegument. Rostral setae well sclerotized. Lamellar setae inserted on short apophyses antero-dorsally on the rostrum. Interlamellar setae on small tubercle. Sensilli with broadly expanded head. Four pairs of notogastral setae ( $h_1$ ,  $p_1$ ,  $p_2$  and  $p_3$ ). Posterior notogastral setae  $h_1$  and  $p_1$  inserted on strong apophyses,  $h_2$  absent,  $h_1$  much longer than others. Epimeral setal formula 2:2:3:1. Seven pairs of genital setae, one pair of aggenital setae, two pairs of anal setae and three pairs of adanal setae. Genital and anal openings separated by a band of cuticle that covers the articulation of the preanal shield. Discidium absent. All legs tridactylous.

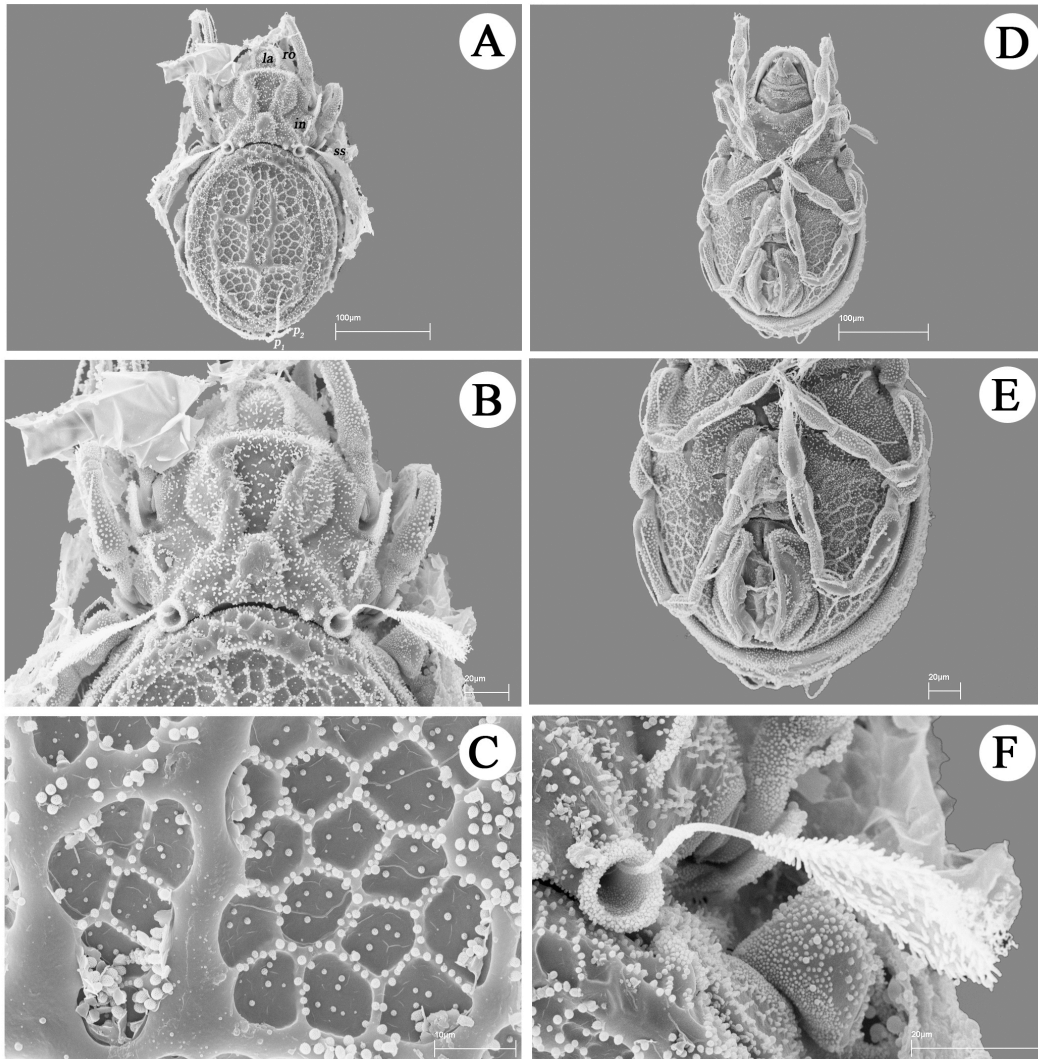


Figure 4. *Jacotella frondeus* (Kulijev). A-Dorsal view; B-Prodorsum; C- Notogastral ornamentation; D-Ventral view; E- Genito-anal region; F- Sensillus.

Material examined – Turkey, Antalya province, Güllük Mountain, N: 37°00'59.52", E: 30°00'59.52", 550 m, 26.VI.2010, soil and litter, 5 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

Remarks – This species is distributed in Eastern Mediterranean (Subías, 2004, updated 2016). It is new record for Turkish fauna. The dimensions of the type specimen are given as 422 x 266 µm by Kulijev (1979). The Turkish specimens (332–392 x 180–216 µm) are in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli, notogaster with a polygonal sculpture; four pairs of notogastral setae. In this regard, the Turkish specimens closely resemble the species in all features.

**Genus *Adoristes* Hull**

Lamellae separated, with or without cusps, without translamellae; sensilli clavate or sharply pointed at tip; notogaster without long humeral process and with 11 pairs of setae; five pairs of genital setae present; legs with 3 claws.

**Subgenus *Adoristes* (*Gordeeviella*) Shtanchaeva, Subías & Arillo**

*Adoristes* (*Gordeeviella*) *krivolutskyi* Shtanchaeva, Subías and Arillo

Measurements: Length: 480–648 µm, width: 256–344 µm (n = 6).

Morphological features (Fig. 5 A-E): Rostrum truncate swelling at middle and forward-projected. Rostral setae smooth. Lamellae long and same width over the entire length, without translamella and lamellar cusps less obvious. Lamellar setae smooth and inserted on distal edge of lamellae. Interlamellar setae smooth and long. Bothridium hidden by anterior margin of notogaster. Sensilli spindle-form, slightly barbed, apical part longer than length of head. Anterior margin of notogaster slightly concave. Eleven pairs of very small, smooth and thin notogastral setae. Lyrifissures *im* present but difficult to see. Epimeral setae short, smooth and thin. Epimeral setal formula 3:1:3:3. Five pairs of genital setae, three anterior pairs very close to each other and longer than two posterior pairs. One pair of aggenital setae, two pairs of anal setae and three pairs of adanal setae. Adanal lyrifissures *iad* situated in paranal position. All legs tridactylous.

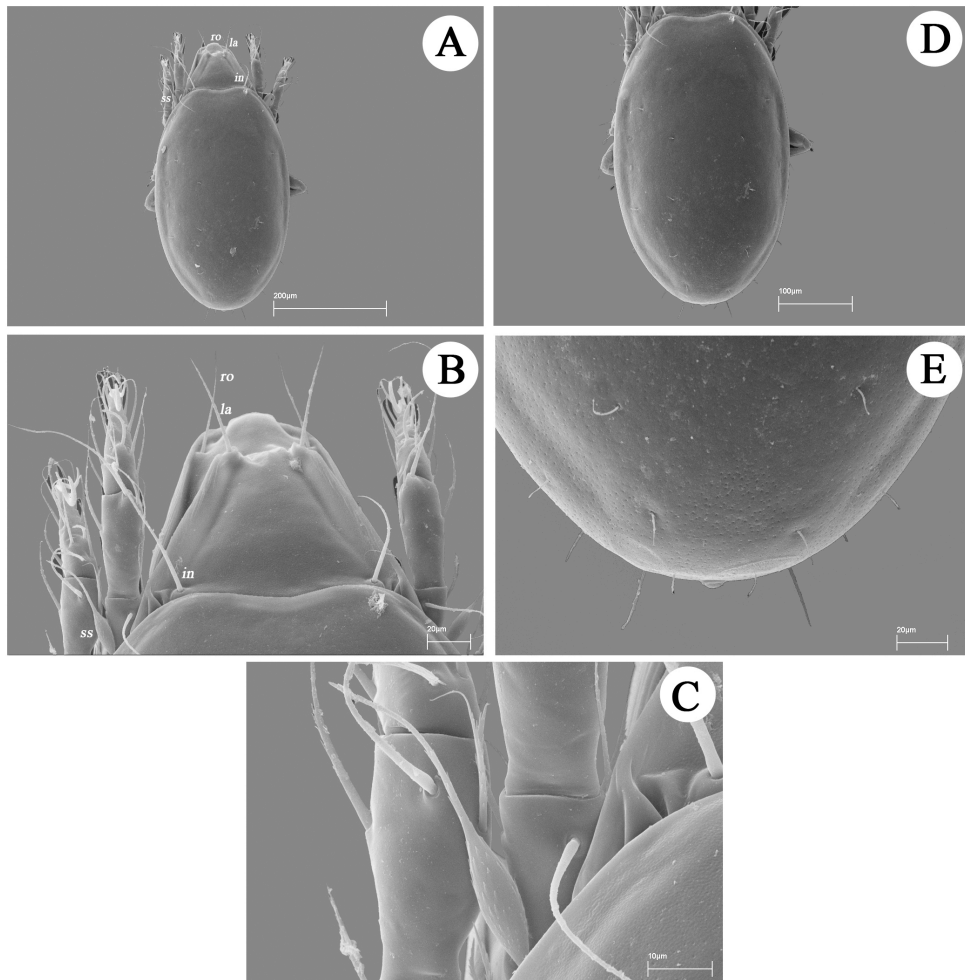


Figure 5. *Adoristes* (*Gordeeviella*) *krivolutskyi* Shtanchaeva, Subías & Arillo. A-Dorsal view; B-Prodorsum; C-Sensillus; D- Notogaster; E- The posterior part of notogaster.

Material examined – Turkey, Bolu province, Gölcük lakeside, N: 40°39'38", E: 31°37'598", 1225 m, 10.V.2008, litter, 6 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

Remarks – This species is distributed in Caucasus and Portugal (Subías, 2004, updated 2016). It is new record for Turkish fauna. It is currently known only from type locality, Batumi (Georgia) and southern Portugal. The specimens belonging to this species were extracted from soil under *Eucalyptus* and relict forest of conifers in Batumi (Georgia), and soil under *Quercus suber* in Luzianes (Portugal) (Shtanchaeva et al., 2010, 2012). The dimensions of the type specimen are given as 500–640 x 250–330 µm by Shtanchaeva et al. (2010). The Turkish specimens (480–648 x 256–344 µm) are in the range of the dimensions of the type specimen. This species is well characterized by the shape of sensilli and lamellae without translamella; eleven pairs of notogastral setae; five pairs of genital setae

### Genus *Autogneta* Hull

Rostrum with a median incision; costulae long, narrow, far from each other; prodorsum laterally without granula (with granula in *Rhaphigneta*); legs with one claw.

### Subgenus *Autogneta (Rhaphigneta)* Grandjean

Key to the species of the subgenus *Autogneta (Rhaphigneta)* of Turkey

1. Distal apex of notogastral setae curved like a hook, length= 456–504 µm..... *A. (R.) flagellata* (Mahunka)

- Distal apex of notogastral setae smooth, length= 350–445 µm..... *A. (R.) numidiana* (Grandjean)

### *Autogneta (Rhaphigneta) flagellata* (Mahunka)

Measurements: Body length: 488–504 µm, body width: 268–272 µm (n=5).

Morphological features (Fig. 6 A-F): Rostrum divided by a deep incision. Costulae long, reaching near the bothridia. Lamellar setae arising at the distal end of the costulae and reaching beyond insertion points of rostral setae. Interlamellar setae long and ciliate. Apex of sensillus weakly thickening bearing slightly dentate. Bothridia well developed. Prodorsum laterally with granula. Notogaster with a pair of prominent humeral processes. Ten pairs of notogastral setae present. Distal apex of notogastral setae curved like a hook. Epimeral setal formula 3-1-3-3. Six pairs of genital setae; one pair of aggenital; two pairs of anal; three pairs of adanal. Lyrifissures *iad* in paraanal position. The adanal setae are situated as follows:  $ad_1$  - postanally,  $ad_2$  - paraanally,  $ad_3$  - preanally. All legs monodactylous.

Material examined – Turkey, Bolu province, N: 40°56'443", E: 031°44'816", 795 m, 25.V.2014, collected in soil and litter, 5 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

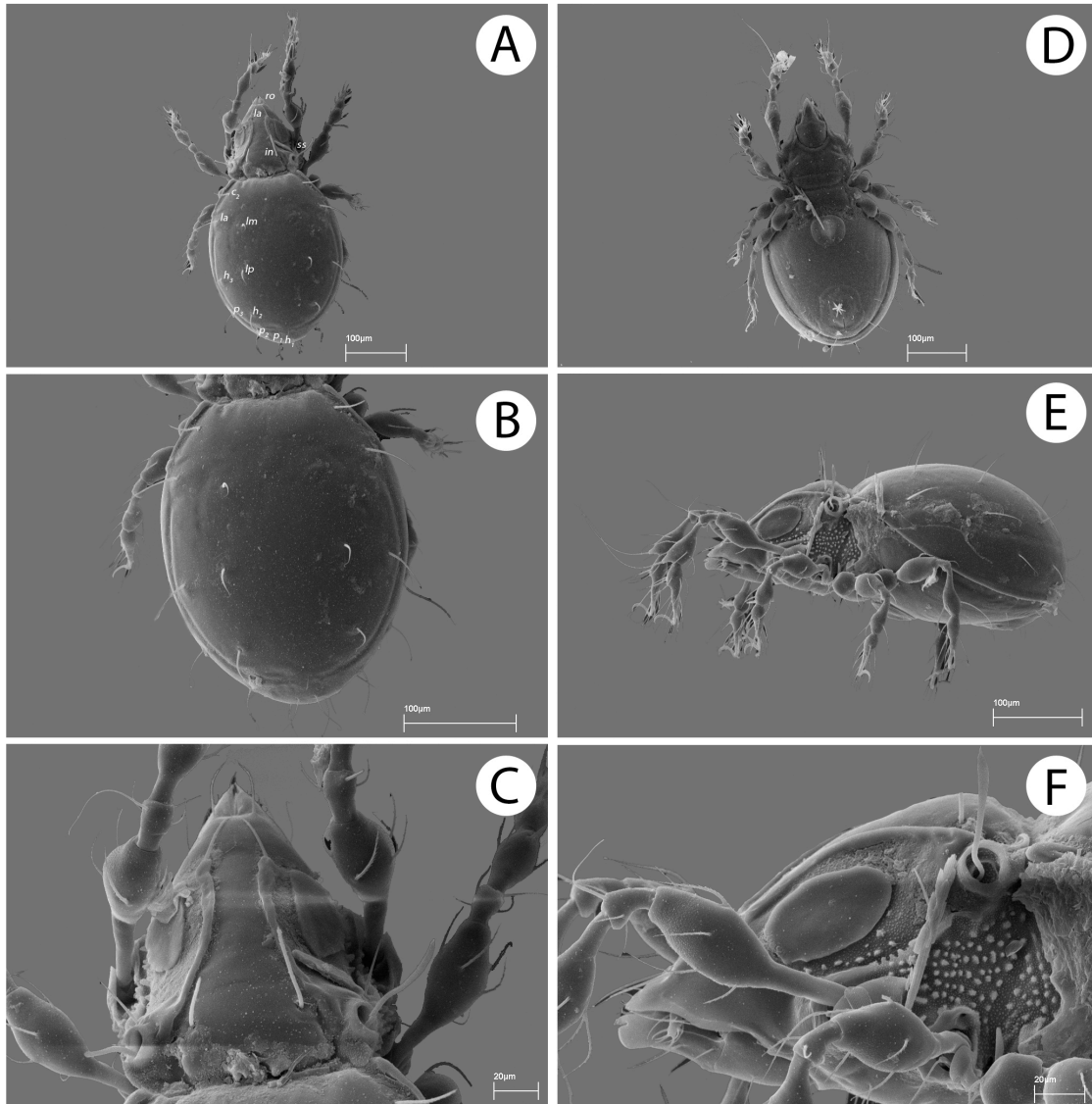


Figure 6. *Autogneta (Rhaphigneta) flagellata* (Mahunka). A-Dorsal view; B- Notogaster; C-Prodorsum; D- Ventral view; E- Lateral view of body; F- Lateral view of prodorsum. .

Remarks – This species is new record for Turkish fauna. Holotype and paratypes were originally collected from soil under *Pinus* and *Quercus coccifera* tree, ground near the summit of Mount Gournis (Mahunka, 1977). Turkish specimens are collected in litter and soil. The dimensions of the species are given as 456–483 x 249–272 µm by Mahunka (1977). The Turkish specimens (488–504x 268–272µm) are in the range of the known dimensions of the species. This species is well characterized by the shape of sensilli and costulae, 10 pairs of distal apex of notogastral setae recurving like a hook notogastral setae.

**Genus *Phauloppia* Berlese**

Lamellae linear; translamella absent; 14 pairs of notogastral setae present; four pairs of porose areas present; dorsosejugal suture medially interrupted or continuous; genital plates with four pairs of setae; legs with 3 claws.



Key to the species of the genus *Phauloppia* of Turkey

1. Areae porosae *Aa* significantly long, tape-shaped the others (*A<sub>1</sub>-A<sub>3</sub>*) oval; notogastral setae long (about 150 µm); dorsosejugal suture medially interrupted; length 600-900 µm ..... *P. lucorum* (C. L. Koch)

- All areae porosae (*Aa*, *A<sub>1</sub>-A<sub>3</sub>*) oval; notogastral setae short (about 25 µm); dorsosejugal suture not medially interrupted; length 310-390 µm ..... *P. rauschenensis* (Sellnick)

*Phauloppia lucorum* (C. L. Koch)

Measurements: Body length: 720–890 µm, body width: 440–570 µm (n= 3).

Morphological features (Fig. 7A-F): Rostrum rounded. All prodorsal setae setiform and barbed. Lamella indicated as a weak line. Sensillus with short stalk and claviform head with some small spines. Dorsosejugal suture medially interrupted. Fourteen pairs of smooth notogastral setae present, variable in length. Four pairs of porose areas present. *Aa* significantly long, tape-shaped. *A<sub>1-3</sub>* roundish oval. Epimeral setal formula 3-1-3-3. Four pairs of genital setae, one pair of agenital setae, two pairs of anal setae, three pairs of adanal setae. All legs tridactylous.

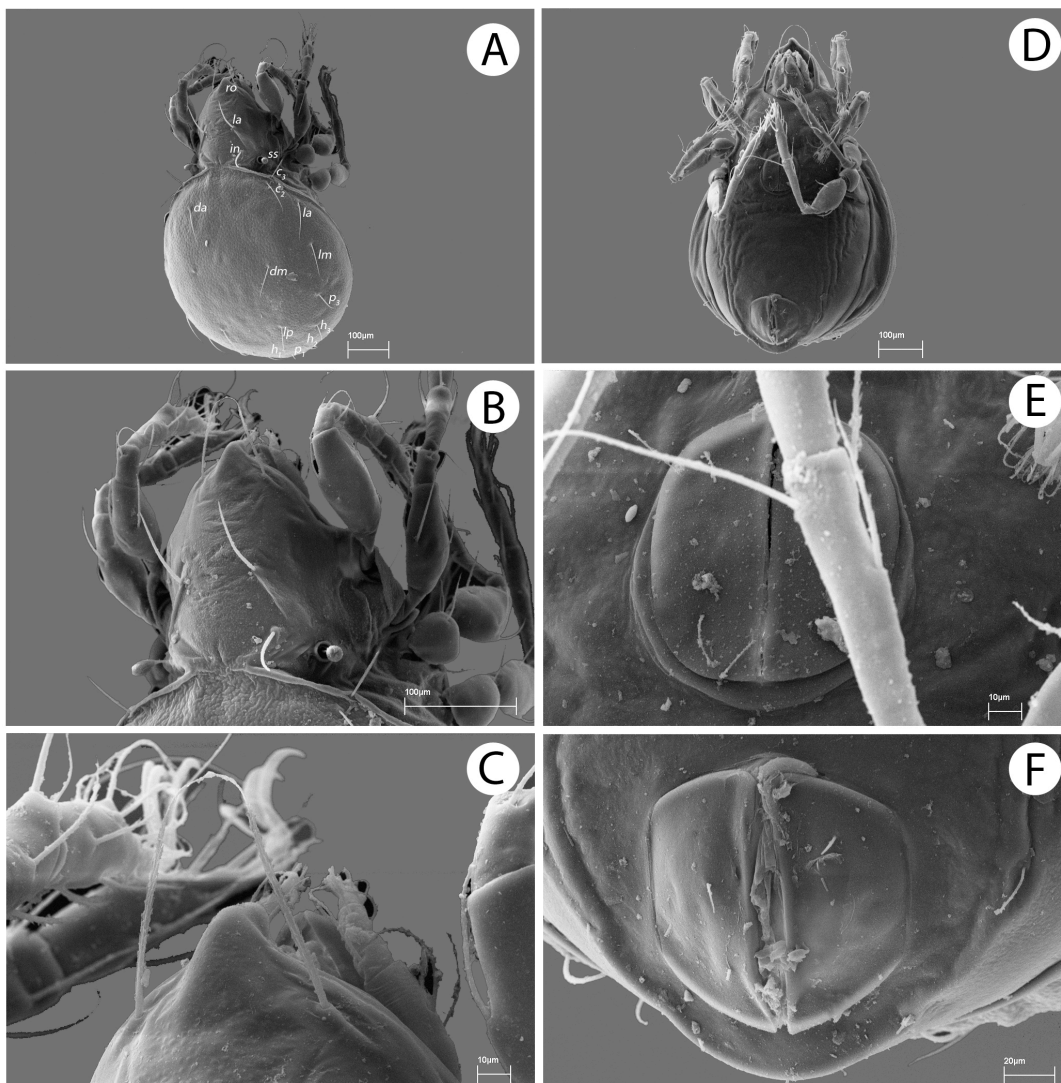


Figure 7. *Phauloppia lucorum* (Koch). A- Dorsal view; B- Prodorsum; C- Rostrum; D- Ventral view; E- Genital plate; F- Anal plate.

Material examined – Turkey, Artvin - Kafkasör road, N: 41°10'13", E: 41°48'42", 860 m, 20.IX.1992, moss on *Quercus* sp., 3 exs. (2 of them were mounted on aluminum stubs and gold-coated for scanning electron microscopy).

Remarks – This species is new record for Turkish fauna. It is a common in moss and lichen coatings on trees and on stones, rocks (Weigmann, 2006). Turkish specimens are collected in moss on tree. The dimensions of the species are given as 600 x 900 µm by Weigmann (2006). The Turkish specimens (720–890 x 440–570 µm) are in the range of the known dimensions of the species. This species is well characterized by the pattern shape of prodorsum and notogaster, dorsosejugal suture open in the middle, the claviform sensilli, fourteen pairs of smooth notogastral setae, four pairs of porose areas (*Aa* the longest, *A*<sub>7-3</sub> roundish oval).

## Conclusion

The present study added seven species new to the oribatid fauna of Turkey. The genera *Licnobelba* and *Jacotella*, and the subgenus *Adoristes* (*Gordeeviella*) are reported for the first time from Turkey. For *Autogneta* (*Rhaphigneta*) *flagellata* (Mahunka, 1977) and *Adoristes* (*Gordeeviella*) *krivolutskyi* Shtanchaeva, Subías & Arillo, 2010, Turkey are the first locality record outside its type locality (Greece) and the third locality record outside its type locality (Georgia) and Portugal, respectively.

## References

- Ayyildiz, N., 1988a. Türkiye faunası için yeni oribatid (Acari) türleri. Türkiye Entomoloji Dergisi, 12: 49-54.
- Ayyildiz, N., 1988b. Türkiye faunası için yeni üç *Schelorbates* Berlese (Acari, Schelorbatiidae) türü. Türkiye Entomoloji Dergisi, 12: 171-177.
- Ayyildiz, N., 1988c. Erzurum ovası oribatid akarları (Acari, Oribatida) üzerine sistematik araştırmalar. II. Yüksek oribatidler. Doğa- Türk Zooloji Dergisi, 12: 131-144.
- Ayyildiz, N., 1988d. Erzurum ovası oribatid akarları (Acari, Oribatida) üzerine sistematik araştırmalar. III. Yüksek oribatidler. Doğa- Türk Zooloji Dergisi, 12: 145-155.
- Ayyildiz, N., 1988e. Türkiye faunası için yeni *Zygoribatula* Berlese (Acari, Oribatulidae) türleri. Doğa- Türk Zooloji Dergisi, 12: 204-209.
- Ayyildiz, N., 1989. Mites of the family Oppiidae (Acari, Oribatida) from Turkey. Journal of Natural History, 23 (6): 1373-1379.
- Ayyildiz, N. & M. Luxton, 1989a. Epimerellidae (Acari, Oribatida) a new mite family. Journal of Natural History, 23 (6): 1381-1386.
- Ayyildiz, N. & M. Luxton, 1989b. New and unrecorded oribatid mites (Acari) from Turkey. Zoologischer Anzeiger, 222 (5/6): 294-300.
- Ayyildiz, N. & M. Özkan, 1988. Erzurum ovası oribatid akarları (Acari, Oribatida) üzerine sistematik araştırmalar. I. İlk oribatidler. Doğa- Türk Zooloji Dergisi, 12: 115-130.
- Bayartogtokh, B., L. Grobler & S. Çobanoğlu, 2000. A new species of *Punctoribates* (Acari: Oribatida: Mycobatiidae) collected from mushrooms in Turkey, with remarks on the taxonomy of the genus. Navorsing van die Nasionale Museum Bloemfontein, 16(2): 17-32.
- Bayartogtokh, B., S. Çobanoğlu & S.K. Ozman, 2002. Oribatid Mites of the Superfamily Ceratozetoidea (Acari: Oribatida) from Turkey. Acarina, 10(1): 3-23.
- Behan-Pelletier, V. M., 1999. Oribatid mite biodiversity in agroecosystems: role for bioindication. Agriculture, Ecosystems and Environment, 74: 411-423.
- Erman, O., M. Özkan, N. Ayyildiz & S. Doğan, 2007. Checklist of the mites (Arachnida: Acari) of Turkey. Second supplement. Zootaxa, 1522: 1-21.
- Grandjean, F., 1931. Le genre *Licneremaeus* Paoli (Acariens). Bulletin de la Société zoologique de France, 56: 221-250.



- Grobler, L., S. K. Ozman & S. Çobanoğlu, 2003. The genera *Liacarus*, *Stenoxenillus* and *Xenillus* (Oribatida: Gustavioidea) from Turkey. *Acarologia*, 43(1): 133-149.
- 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.
- Kahwash, M. A., E. Ruiz, & L. S. Subías, 1990. Oribátidos (Acari, Oribatida) de Murcia (Sureste De Espana) (y II). Oribátidos superiores. Descripción de *Hypovortex lenticulatus* n. sp. *Anales de Biología*, 16: 7-16.
- Kulijev, K. A., 1979. New species of oribatid mites from genera *Plesiodamaeus*, *Allodamaeus*, *Carabodes*, *Hermanniella*. *Doklady Akademii Nauk, Azerbaidjanskoy SSR*, 35 (12): 78-83.
- Mahunka, S., 1977. Neue und interessante Milben aus dem Genfer Museum XXXIII. Recent data on the Oribatid fauna of Greece (Acari: Oribatida). *Revue suisse de Zoologie*, 84 (3): 541-556.
- Norton, R. A. & V. M. Behan-Pelletier, 2009. Oribatida. In: Krantz GW, Walter DE, editors. *A Manual of Acarology*. Lubbock, TX, USA: Texas Tech University Press, pp. 430-564.
- Özkan, M., N. Ayyıldız & O. Erman, 1994. Check list of the Acari of Turkey. First supplement. *EURAAC News Letter*, 7: 4-12.
- Pérez-Iñigo, C., 1994. Redescriptions of *Licnobelba caesarea* (Berlese, 1910) and *Flabellobelba almeriensis* (Ruiz, Kahwash and Subías, 1990). The genus *Flabellobelba* n. g. and redefinition of the family Licnobelbidae (Acari, Oribatei). *Redia*, 77: 241-250.
- Schatz, H., 2002. Die Oribatidenliteratur und die beschriebenen Oribatidenarten (1758- 2001) - Eine Analyse. *Abhandlungen und Berichte des Naturkundemuseums Görlitz*, 74(1): 37-45.
- Schatz, H., 2004. Diversity and global distribution of oribatid mites (Acari, Oribatida) – evaluation of the present state of knowledge. *Phytophaga*, 14: 485-500.
- Shtanchaeva, U. Ya., L. S. Subías & A. Arillo, 2010. New taxa of oribatid mites of the family Liacaridae (Acariformes: Oribatida) from the Caucasus. *Entomologica Fennica*, 20 (4): 245-248.
- Shtanchaeva, U. Ya., L.S. Subías, S.G. Ermilov & J. Orobítg, 2012. Collections of oribatid mites from southern Portugal, with description of a new species of *Oribatula* (Acari: Oribatida: Oribatulidae). *Acarina*, 20: 8-19.
- Sitnikova, L.G., 1973. New species of mites of the genus *Hermanniella* Berlese, 1908 (Oribatei, Hermanniellidae) of the Fauna of the USSR. *Entomologicheskoe Obozrenie*, 52 (4): 953-963.
- Subías, L. S., 2004. Listado sistematico, sinonimico y biogeografico de los acaros oribatidos (Acariformes: Oribatida) del Mundo (Excepte fosiles). *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 y en febrero de 2016) [http://escalera.bio.ucm.es/usuarios/bba/cont/docs/RO\\_1.pdf](http://escalera.bio.ucm.es/usuarios/bba/cont/docs/RO_1.pdf). (Access date: 26 February 2016).
- Toluk, A. & N. Ayyıldız, 2008. New and unrecorded oppioid mites (Acari: Oribatida) from Yozgat Pine Grove National Park, Turkey. *Acarologia*, 48 (3-4): 209-223.
- Toluk, A. & N. Ayyıldız, 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., E. Koçoğlu, A. Taşdemir, S. Per & N. Ayyıldız, 2006. Yozgat Çamlığı Milli Parkı'ndan Türkiye faunası için yeni bir oribatid akar (Acari, Oribatida) türü: *Hermanniella punctulata* Berlese, 1908. *Türkiye Entomoloji Dergisi*, 30 (4): 275-283.
- Weigmann, G. 2006. Hornmilben (Oribatida), *Die Tierwelt Deutschlands, Begründet 1925 von Friedrich Dahl*, 76. Teil. Goecke & Evers, Keltern, 520 pp.