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Original article (Orijinal araştırma)

New records of erythraeoid mites (Acari: Erythraeoidea) from northeastern Türkiye[1]

Türkiye'nin kuzeydoğusundan erythraeoid akarların (Acari: Erythraeoidea) yeni kayıtları

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Abstract

In this survey, soil samples obtained from Erzincan and Bayburt provinces (Türkiye) between 2013 and 2022 were evaluated. Eleven species of the superfamily Erythraeoidea Robineau-Desvoidy, 1828 are reported for the first time for the Turkish mite fauna. While 9 of the detected species [*Abrolophus artemisiae* (Schrank, 1803); *Abrolophus miniatus* (Hermann, 1804); *Abrolophus quisquiliarus* (Hermann, 1804); *Abrolophus rhopalicus* (Koch, 1837); *Abrolophus strojnyi* Gabryś, 1992; *Balaustium murorum* (Hermann, 1804); *Moldoustium haitlingeri* Noei, Saboori & Šundić, 2013; *Erythraeus* (*Erythraeus*) *cinereus* (Dugès, 1834) and *Erythraeus* (*Zaracarus*) *rupestris* (L., 1758)] belong to the family Erythraeidae Robineau-Desvoidy, 1828, and two species [*Fessonia papillosa* (Hermann, 1804) and *Smaris squamata* (Hermann, 1804)] belong to the family Smarididae Vitzthum, 1929. In addition, the diagnosis of the genus *Moldoustium* Haitlinger, 2008 is re-presented. Also, erythraeoid mites recorded from Türkiye so far are listed.

Keywords: Checklist, Erythraeidae, habitat, Parasitengona, Smarididae

Öz

Bu çalışmada 2013 ile 2022 yılları arasında Erzincan ve Bayburt illerinden (Türkiye) alınan toprak örnekleri değerlendirilmiştir. Türkiye akar faunası için, Erythraeoidea Robineau-Desvoidy, 1828 üstfamilyasına dahil onbir tür ilk kez kaydedilmektedir. Tespit edilen türlerden 9 tanesi [*Abrolophus artemisiae* (Schrank, 1803); *Abrolophus miniatus* (Hermann, 1804); *Abrolophus quisquiliarus* (Hermann, 1804); *Abrolophus rhopalicus* (Koch, 1837); *Abrolophus strojnyi* Gabryś, 1992; *Balaustium murorum* (Hermann, 1804); *Moldoustium haitlingeri* Noei, Saboori & Šundić, 2013; *Erythraeus* (*Erythraeus*) *cinereus* (Dugès, 1834) ve *Erythraeus* (*Zaracarus*) *rupestris* (L., 1758)] Erythraeidae Robineau-Desvoidy, 1828 familyasına dahil iken, ikisi [*Fessonia papillosa* (Hermann, 1804) ve *Smaris squamata* (Hermann, 1804)] Smarididae Vitzthum, 1929 familyasına aittir. Ek olarak, *Moldoustium* Haitlinger, 2008 cinsinin teşhis bilgileri yeniden sunulmuştur. Ayrıca, Türkiye'den şu ana kadar kaydedilmiş erythraeoid akarlar listelenmiştir.

Anahtar sözcükler: Kontrol listesi, Erythraeidae, habitat, Parasitengona, Smarididae

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Introduction

The terrestrial Parasitengona (Trombidia) is represented by about 2000 species (excluding chigger mites). Three active stages were generally observed in the life cycle of Trombidia; larva, deutonymph, and adult. The superfamily Erythraeoidea is represented by over 900 species (Beron, 2017) and consists of the families Erythraeidae and Smarididae, which are distributed worldwide except in Antarctica (Mąkol & Wohltmann, 2012, 2013; Sevsay, 2017). Free-living active postlarval instars of Erythraeoidea feed as predators, whereas heteromorphic larvae of this taxon are usually ectoparasites on various arthropods. The fauna of Erythraeoidea is poorly known in Türkiye. Until now, while thirty-two species of Erythraeidae and only two species of Smarididae have been collected from Türkiye (Mąkol & Wohltmann, 2012; Noei et al., 2017, 2019; Sevsay, 2017; Pamuk & Sevsay, 2020; Karakurt, 2021; Karakurt & Sevsay, 2021; Oner et al., 2021; Elverici et al., 2022; Karakurt, 2022). The present work, which aims to contribute to the Turkish mite fauna, contains 9 species of Erythraeidae and 2 species of Smarididae newly recorded from Türkiye. In addition, the diagnosis of the genus *Moldoustium* is re-presented. Also, in this paper, a list of erythraeoid mites of Türkiye is presented.

Materials and Methods

Mites were extracted by Berlese funnels from soil samples between May 2013 and June 2015 in Bayburt Province, Türkiye, and between October 2021 and June 2022 in Erzincan Province, Türkiye. Mite samples were preserved in 70% ethyl alcohol and mounted on microscope slides using Hoyer's medium (Walter & Krantz, 2009). Photographs were taken and measurements (given in micrometers) were calculated using an Olympus BX63 microscope. The morphological terminology follows Wohltmann et al. (2007). Measurements are given in micrometers (µm).

For comparison of species of *Moldoustium*, type species of this genus in Poland and Iran were re-examined by Prof. Ryszard Haitlinger and Prof. Alireza Saboori, respectively.

Specimens examined are deposited in Acarology Laboratory of Erzincan Binali Yıldırım University, Türkiye (EBYU).

Results and Discussion

Erythraeidae

Abrolophus artemisiae (Schrank, 1803)

Material examined. Bayburt, 40°21'N, 39°51'E, 2455 m a.s.l. (low humidity litter under the *Astragalus* sp. (Fabaceae)) 05 May 2014, 2♀♀; 40°34'N, 40°24'E, 1740 m a.s.l. (low humidity litter under the *Astragalus* sp.) 29 October 2014, ♀♂.

Remarks (Figures 1 a-c). Gabryś (2016) divided the active postlarval of *Abrolophus* species in Poland into two groups according to the shapes of the anus (except for *A*. *tardus* (Halbert, 1915)); '*norvegicus-passerinii-strojnyi*' group and '*quisquiliarus-miniatus-crassitarsus-rhopalicus-artemisiae*' group (op. cit. Figures 54-55). *Abrolophus artemisiae* belongs to the latter group. This species, distributed in Europe (Mąkol & Wohltmann, 2012; Roland & Gabryś, 2021), has been recorded for the first time from Türkiye.

Abrolophus miniatus (Hermann, 1804)

Material examined. Erzincan, Kemah, 39°47'N, 38°52'E, 1250 m a.s.l. (low humidity litter under the *Populus* sp. (Salicaceae)) 28 May 2022, ♀.

Remarks (Figures 1 d-f). According to Gabryś (2016) this species belongs to the '*quisquiliarus-miniatus-crassitarsus-rhopalicus-artemisiae*' group.

This species, distributed in Azerbaijan, Europe and Siberia (Russia) (Beron, 2008; Mąkol & Wohltmann, 2012; Stålstedt et al., 2019; Alizade, 2020; Roland & Gabryś, 2021), has been recorded for the first time from Türkiye.

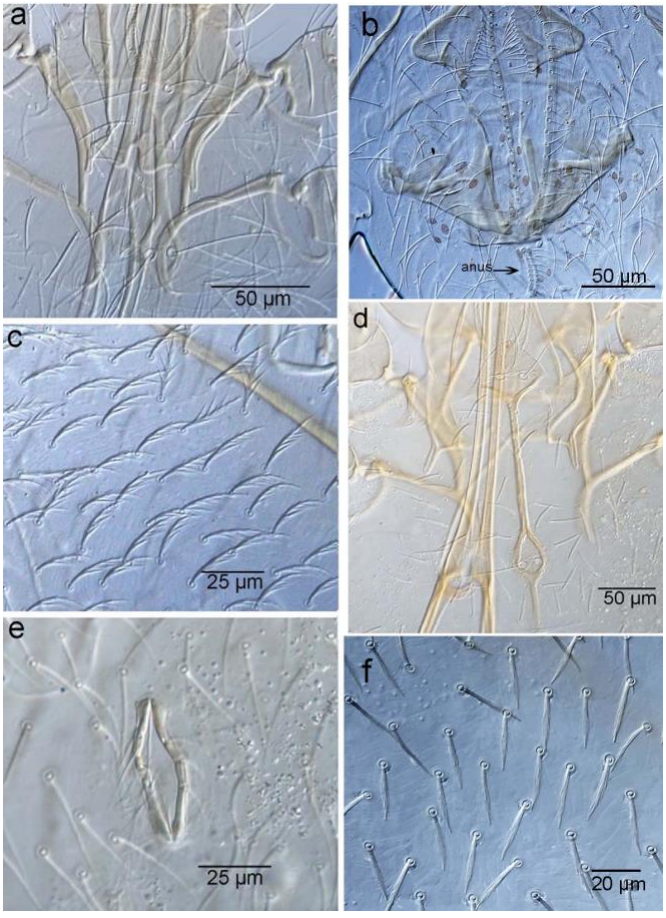

Figure 1. *Abrolophus artemisiae* (Schrank, 1803), adult, photomicrographs a) crista metopica, b) male genital sclerite and anus, c) dorsal setae; *Abrolophus miniatus* (Hermann, 1804), female, photomicrographs d) crista metopica, e) anus, f) dorsal setae.

Abrolophus quisquiliarus (Hermann, 1804)

Material examined. Bayburt, 40°07'N, 40°13'E, 1770 m a.s.l., (moist litter under the *Populus* sp.) 25 April 2015, 2 larvae.

Remarks (Figure 2 a). Łaydanowicz & Mąkol (2008) obtained a larva of *Abrolophus quisquiliarus* by rearing from its female and provided information on the taxonomy of this species. This species, distributed in Azerbaijan, Europe, Russia and Ukraine (Beron, 2008; Mąkol & Wohltmann, 2012; Roland et al., 2015; Stålstedt et al., 2019; Alizade, 2020; Roland & Gabryś, 2021), has been recorded for the first time from Türkiye.

Abrolophus rhopalicus (Koch, 1837)

Material examined. Bayburt, 40°09'N, 39°52'E, 1676 m a.s.l. (moist moss and grassland), 01 May 2014, ♀; 40°16'N, 39°52'E, 1694 m a.s.l. (moist moss), 05 May 2014, ♀♂; 40°07'N, 40°13'E, 1772 m. a.s.l. (low humidity litter under the *Astragalus* sp.), 25 April 2015, ♂.

Remarks (Figures 2 b-e). This species, distributed in Europe and Azerbaijan (Mąkol & Wohltmann, 2012; Stålstedt et al., 2019; Alizade, 2020), has been recorded for the first time from Türkiye.

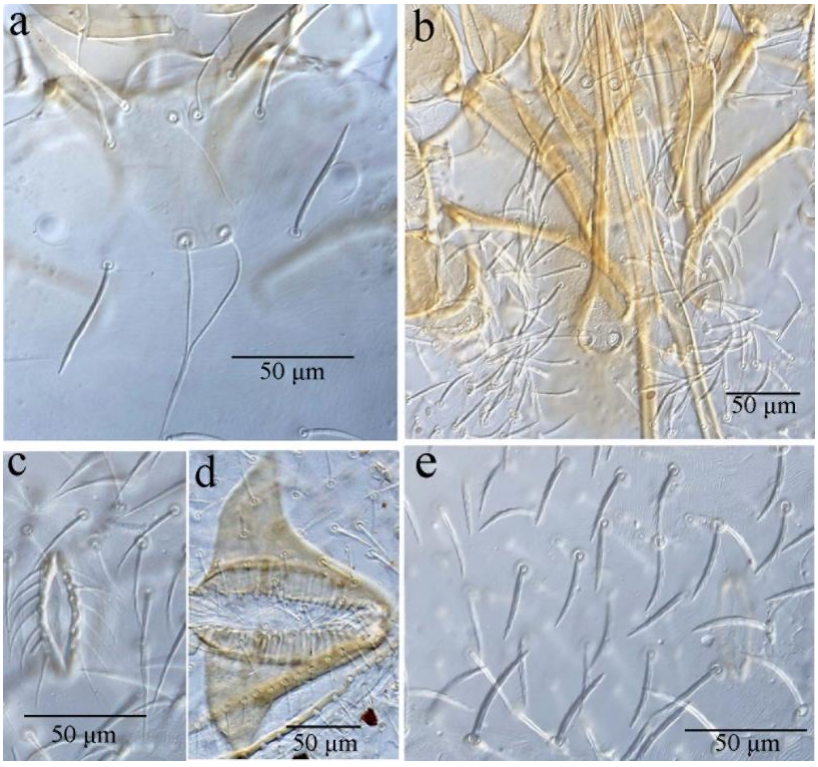

Figure 2. *Abrolophus quisquiliarus* (Hermann, 1804), larva, photomicrograph a) scutum; *Abrolophus rhopalicus* (Koch, 1837), adult, photomicrographs b) crista metopica, c) anus, d) anterior part of male genital sclerite, e) dorsal setae.

Abrolophus strojnyi Gabryś, 1992

Material examined. Bayburt, 40°11'N, 40°18'E, 1596 m a.s.l. (moist litter under the *Populus* sp.), 18 April 2014, ♂.

Remarks (Figures 3 a-c). Based on Gabryś (2016), this species belongs to '*norvegicus-passerinii-strojnyi*' group. This species, distributed in Azerbaijan, Hungary and Poland (Gabryś, 1992; Alizade, 2020), has been recorded for the first time from Türkiye.

Balaustium murorum (Hermann, 1804)

Material examined. Bayburt, Aygır lake, 40°39'N, 40°23'E, 2850 m a.s.l. (moist moss) 22 June 2013, 2 larvae.

Remarks (Figure 3 d). Mąkol (2010) redescribed *Balaustium murorum* and stated *bs* and *cs* setae of the larva of this species bear tiny setules. These setae also bear tiny setules in the examined species. This species, distributed in Japan, Tunisia and Western Palaearctic (Mąkol, 2010; Mąkol & Wohltmann, 2012; Roland et al., 2015; Roland & Gabryś, 2021), has been recorded for the first time from Türkiye.

Moldoustium Haitlinger, 2008

Diagnosis (After Haitlinger, 2008). Palp trochanter without seta. Palp femur and genu with two setae. Coxal setal formula: 2 (3 in *M. baltiensis*)-1-1. Scutum, weakly marked or absent. A pair of eyes with a single lens, located laterally at the level slightly above the posterior sensillary area. All tarsi with two claws and a slender normal empodium.

Distribution. Hungary, Iran, Moldova, Montenegro, Ukraine (Haitlinger, 2008; Noei et al., 2013; Haitlinger & Šundić, 2019) and Türkiye.

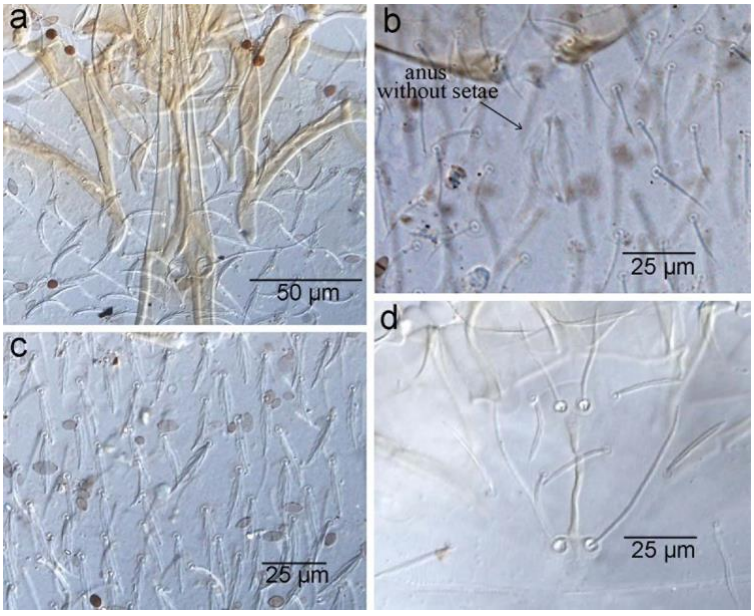

Figure 3. *Abrolophus strojnyi* Gabryś, 1992, male, photomicrographs a) crista metopica, b) anus, c) dorsal setae; *Balaustium murorum* (Hermann, 1804), larva, photomicrograph d) scutum.

Moldoustium haitlingeri Noei, Saboori & Šundić, 2013

Material examined. Bayburt, Aygır lake 40°39'N, 40°23'E, 2850 m a.s.l. (moist moss) 22 June 2013, larva.

Remarks (Figures 4 a-c). The genus *Moldoustium*, only known from the larval stage, is represented by two species: *Moldoustium baltiensis* Haitlinger, 2008 and *Moldoustium haitlingeri* Noei, Saboori & Šundić, 2013. The absence of seta on palp trochanter of its members supports this taxon to remain at the genus level (Fuentes Quintero et al., 2014). Noei et al. (2013) stated coxae I of this species have three setae. However, the examination of Iranian and Turkish samples reveals that the coxa I of *M*. *haitlingeri* bears two setae instead of three (a third seta is present between the coxal plates I and II). This species, distributed in Iran and Montenegro (Noei et al., 2013), has been recorded for the first time from Türkiye.

Erythraeus (Erythraeus) cinereus (Dugès, 1834)

Material examined. Erzincan, Refahiye, 39°50'N, 38°49'E, 1850 m a.s.l. (humidity litter under the *Pinus* sp. (Pinaceae)) 15 October 2021, ♂; 39°47'N, 38°52'E, 1580 m a.s.l. (low humidity litter under the *Populus* sp.), 18 June 2022, ♀.

Remarks (Figures 4 d-e). Stålstedt et al. (2016) redescribed *Erythraeus* (*Erythraeus*) *cinereus* and provided neotype designation of this species. This species, distributed in Western Palaearctic (Stålstedt et al., 2016), has been recorded for the first time from Türkiye.

Erythraeus (Zaracarus) rupestris (L., 1758)

Material examined. Erzincan, Refahiye 39°42'N, 39°35'E, 1100 m a.s.l. (low humidity litter under the *Populus* sp.), 28 May 2022, larva.

Remarks (Figure 4 f). Karakurt et al. (2022) provided the first correlation between larval *Erythraeus* (*Zaracarus*) *rupestris* and its postlarval instars by laboratory rearing. This species, distributed in Western Palaearctic (Mąkol & Wohltmann, 2012; Karakurt et al., 2022), has been recorded for the first time from Türkiye.

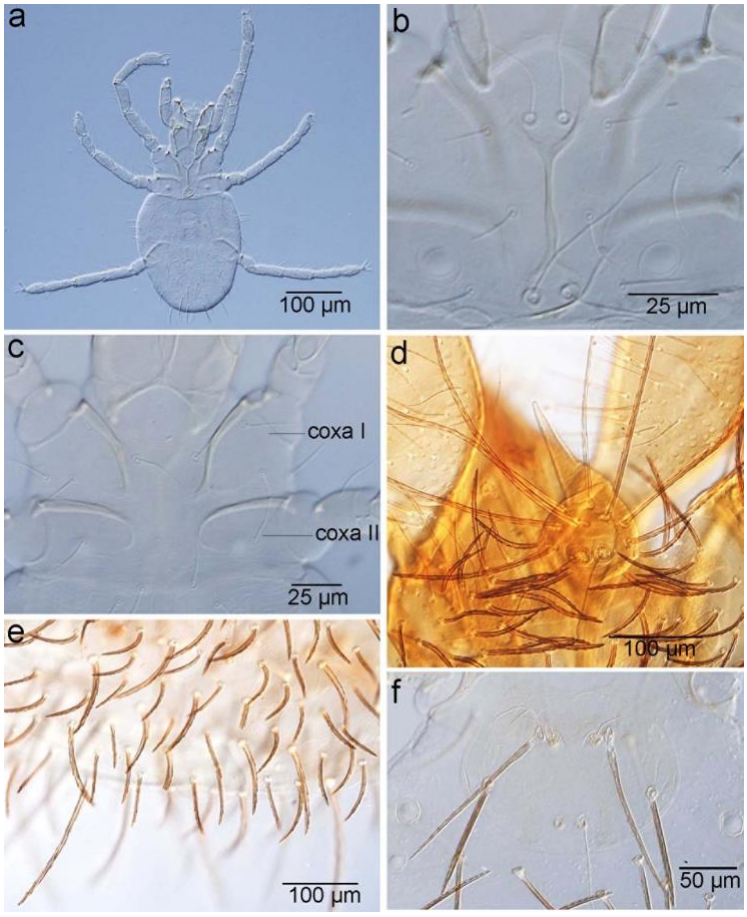

Figure 4. *Moldoustium haitlingeri* Noei, Saboori & Šundić, 2013, larva, photomicrographs a) general view, b) scutum, c) coxae I-II; *Erythraeus (Erythraeus) cinereus* (Dugès, 1834), male, photomicrographs d) anterior sensillary area, e) dorsal setae; *Erythraeus* (*Zaracarus*) *rupestris* (L., 1758), larva, photomicrograph f) scutum.

Smarididae

Fessonia papillosa (Hermann, 1804)

Material examined. Erzincan, Refahiye, 39°47'N, 38°52'E, 1580 m a.s.l. (low humidity litter under the *Populus* sp.), 18 June 2022, ♀.

Remarks (Figures 5 a-c). Wohltmann (2010) provided the first correlation between larval *Fessonia papillosa* and its postlarval instars by laboratory rearing. This species, distributed in Europe (Croatia, France, Germany, Greece, Hungary, Italy) and Iran (Beron, 2008; Wohltmann, 2010; Noei et al., 2013), has been recorded for the first time from Türkiye.

Smaris squamata (Hermann, 1804)

Material examined. Bayburt, 40°24'N, 40°07'E, 2014 m a.s.l. (low humidity litter under the *Astragalus* sp.), 05 April 2014, ♀; 40°29'N, 40°15'E, 1848 m a.s.l. (moist moss and grassland) 09 May 2015, ♀.

Remarks (Figures 5 d-f). This species, distributed in Europe (Algeria, Bulgaria, France, Germany, Greece, Italy, Monaco, Romania, Spain) (Mąkol & Wohltmann, 2012), has been recorded for the first time from Türkiye.

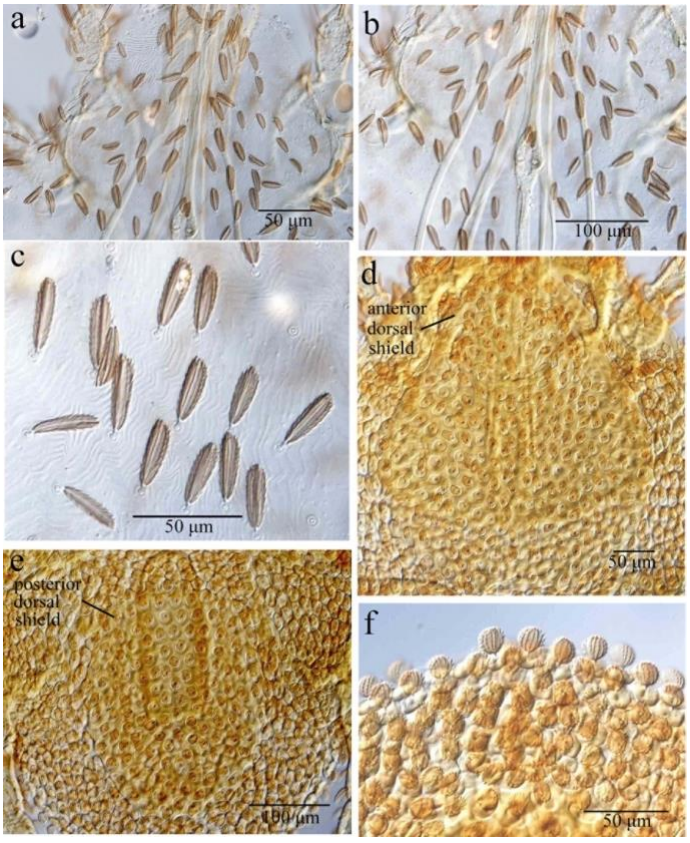

Figure 5. *Fessonia papillosa* (Hermann, 1804), adult, photomicrographs a) anterior part of crista, b) anterior sensillary area, c) dorsal setae; *Smaris squamata* (Hermann, 1804), female, photomicrographs d) anterior dorsal shield, e) posterior dorsal shield, f) dorsal setae.

Conclusions

Members of Erythraeoidea are known to adapt to usually xeric environments (Wohltmann, 2000). Likewise, the habitats of the species recorded in the present study have xeric and meso-xeric conditions. The superfamily of Erythraeoidea is distributed worldwide except for Antarctica (Mąkol & Wohltmann, 2012, 2013). The number of recorded erythraeoid mites has reached 45 in Türkiye (see Table 1) with the present paper.

Table 1. List of erythraeoid mites recorded from Türkiye (After Sevsay, 2017)

Taxa	References
Erythraeidae Robineau-Desvoidy, 1828	
Abrolophinae Witte, 1995	
Abrolophus Berlese, 1891	
Abrolophus artemisiae (Schrank, 1803)	Present paper
Abrolophus miniatus (Hermann, 1804)	Present paper
Abrolophus quisquiliarus (Hermann, 1804)	Present paper
Abrolophus rhopalicus (Koch, 1837)	Present paper
Abrolophus silesiacus (Haitlinger, 1986)	Haitlinger (2010) (as *Hauptmannia amilberti*); synonymized by Haitlinger & Łupicki (2015)

Table 1. Continued

Taxa	References
Abrolophus strojnyi Gabryś, 1992	Present paper
Abrolophus viburnicolus (Fain & Çobanoğlu, 1998)	Fain & Çobanoğlu (1998) (as *Hauptmannia viburnicola*); synonymized by Mąkol & Wohltmann (2012)
Abrolophus viticolus (Fain & Çobanoğlu, 1998)	Fain & Çobanoğlu (1998) (as *Hauptmannia viticola*); synonymized by Mąkol & Wohltmann (2012)
Marantelophus Haitlinger, 2011	
Marantelophus rudaensis (Haitlinger, 1986)	Fain & Çobanoğlu (1998) (as *Hauptmannia viticola*); Haitlinger (2000) (as *Rudaemannia rudaensis*); Mąkol & Wohltmann (2012) (as *Abrolophus rudaensis*); synonymized by Haitlinger & Šundić (2014) Note: *Hauptmannia viticola* was synonymized by Haitlinger (2000) with *Rudaemannia rudaensis* without any evidence. Because of this uncertainty, Mąkol & Wohltmann (2012) listed both species separately.
Marantelophus emanueli (Haitlinger, 2010)	Haitlinger (2010) (as *Grandjeanella emanueli*); Mąkol & Wohltmann (2012) (as *Grandjeanella emanueli*); synonymized by Kamran & Altawi (2015)
Marantelophus multisetosus (Zhang & Goldarazena, 1996)	Goldarazena et al. (2000) (as *Grandjeanella multisetosa*); synonymized by Haitlinger (2011); Mąkol & Wohltmann (2012)
Nagoricanella Haitlinger, 2009	
Nagoricanella bella (Zhang, 1996)	Saboori & Çobanoğlu (2010) (as *Grandjeanella bella*); Mąkol & Wohltmann (2012) (as *Marantelophus bella*); synonymized by Saboori et al. (2016); Maral (2021) (as *Grandjeanella bella*)
Balaustiinae Grandjean, 1947	
Balaustium von Heyden, 1826	
Balaustium akramii Noei, 2017	Noei et al. (2017)
Balaustium izmirensis Noei & Ersin, 2019	Noei et al. (2019)
Balaustium murorum (Hermann, 1804)	Present paper
Bursaustium Haitlinger, 2000	
Bursaustium gaspari Haitlinger, 2000	Haitlinger (2000); Mąkol & Wohltmann (2012)
Moldoustium Haitlinger, 2008	
Moldoustium haitlingeri Noei, Saboori & Šundić, 2013	Present paper
Callidosomatinae Southcott, 1957	
Charletonia Oudemans, 1910	
Charletonia cardinalis (Koch, 1837)	Haitlinger (2000); Beron (2008); Mąkol & Wohltmann (2012)
Charletonia cilissa (Cooreman, 1955)	Cooreman (1955) (as *Cavannea cilissa*); synonymized by Beron (2008); Mąkol & Wohltmann (2012)
Charletonia krendowskyi (Feider, 1954)	Elverici et al. (2022)
Erythraeinae Robineau-Desvoidy, 1828	
Curteria Southcott, 1961	
Curteria duzgunesae (Saboori, Çobanoğlu & Bayram, 2007)	Saboori et al. (2007) (as *Zhangiella duzgunesae*); synonymized by Saboori et al. (2009); Mąkol & Wohltmann (2012)
Curteria curticristata (Willmann, 1951)	Karakurt (2021)

Table 1. Continued

Taxa	References
Eatoniana Cambridge, 1898	
Eatoniana plumipes (Koch, 1856)	Mąkol & Sevsay (2015)
Erythraeus Latreille, 1806	
Erythraeus (***Erythraeus*****)** Latreille, 1806	
Erythraeus (*Erythraeus*) *adanaensis* Saboori & Çobanoğlu, 2010	Saboori & Çobanoğlu (2010); Mąkol & Wohltmann (2012)
Erythraeus (*Erythraeus*) *ankaraicus* Saboori, Çobanoğlu & Bayram, 2004	Saboori, Çobanoğolu, et al. (2004); Bayram & Çobanoğlu (2005); Gencsoylu (2007); Mąkol & Wohltmann (2012); Oner et al. (2021)
Erythraeus (*Erythraeus*) *elmalicus* Haitlinger, 2010	Haitlinger (2010); Mąkol & Wohltmann (2012)
Erythraeus (*Erythraeus*) *hilariae* Haitlinger, 2010	Haitlinger (2010); Mąkol & Wohltmann (2012)
Erythraeus (*Erythraeus*) *kresnensis* Beron, 1982	Haitlinger (2000); Mąkol & Wohltmann (2012); Haitlinger (2016)
Erythraeus (*Erythraeus*) *cinereus* (Dugès, 1834)	Present paper
Erythraeus (*Erythraeus*) *phalangoides* (De Geer, 1778)	Oner et al. (2021)
Erythraeus (*Erythraeus*) *uhadi* Kamran & Alatawi, 2014	Oner et al. (2021)
Erythraeus (*Erythraeus*) *sifi* Haitlinger, 2000	Haitlinger (2000); Mąkol & Wohltmann (2012)
Erythraeus (***Zaracarus*****)** Southcott, 1995	
Erythraeus (*Zaracarus*) *aydinicus* Saboori, Çakmak & Nouri-Gonbalani, 2004	Saboori et al. (2004); Mąkol & Wohltmann (2012)
Erythraeus (*Zaracarus*) *budapestensis* Fain & Ripka, 1998	Haitlinger (2010); Mąkol & Wohltmann (2012); Karakurt et al. (2022)
Erythraeus (*Zaracarus*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012	Oner et al. (2021)
Erythraeus (*Zaracarus*) *kurdistaniensis* Khanjani & Ueckermann, 2005	Oner et al. (2021)
Erythraeus (*Zaracarus*) *passidonicus* Haitlinger, 2006	Haitlinger (2010); Mąkol & Wohltmann (2012)
Erythraeus (*Zaracarus*) *rupestris* (L., 1758)	Present paper
Leptinae Billberg, 1820	
Leptus Latreille, 1796	
Leptus (***Leptus*****)** Latreille, 1796	
Leptus (Leptus) *esmailii* Saboori & Ostovan, 2000	Pamuk & Sevsay (2020)
Leptus (Leptus) *molochinus* (Koch, 1837)	Karakurt & Sevsay (2021)
Leptus (Leptus) *rosellae* Haitlinger, 1999	Haitlinger (1999); Mąkol & Wohltmann (2012)
Smarididae Vitzthum, 1929	
Hirstiosomatinae Southcott, 1946	
Hirstiosoma Womersley, 1934	
Hirstiosoma latreillei (Grandjean, 1947)	Karakurt & Sevsay (2021) (as *Hirstiosoma ampulligera*)
Hirstiosoma ampulligera (Berlese, 1887)	Karakurt (2022)

Table 1. Continued

Taxa	References
Smaridinae Vitzthum, 1929	
Fessonia von Heyden, 1826	
Fessonia papillosa (Hermann, 1804)	Present paper
Smaris Latreille, 1796	
Smaris squamata (Hermann, 1804)	Present paper

Considering the number of recorded species from Türkiye for this taxon, it can be expressed that the potential of species or records of erythraeoid mites in this country is high. Future systematic or taxonomic studies will contribute to the evaluation of this potential.

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