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The Tribe Spilomicrini Ashmead, 1893 (Hymenoptera: Diapriidae, Diapriinae) in Iran, with New Records for Iranian Fauna

Mohammad IZADIZADEH[1a] Ali Asghar TALEBI[1b*] Vasilisa G. CHEMYREVA[2]
Samira FARAHANI[3a] Farzaneh KAZERANI[3b] Ali AMERI[4]

[1]Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, IRAN
[2]Zoological Institute, Russian Academy of Sciences, St. Petersburg, RUSSIA
[3]Research Institute of Forests and Rangelands, Agricultural Research Education and Extension Organization, Tehran, IRAN
[4]Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Tehran, IRAN
e-mails: [1a]mohammad.izadizadeh@modares.ac.ir, [b]talebia@modares.ac.ir, [2]diapriidas.vas@gmail.com, [3a]s.farahani@rifr-ac.ir, [3b]farzane.kazerani@gmail.com, [4]ameri@iripp.ir
ORCID IDs: [1a]0000-0002-8724-0132, [1b]0000-0001-5749-6391, [2]0000-0002-6547-6259, [3a]0000-0002-6897-0631, [3b]0000-0003-1968-3350, [4]0000-0003-2372-8494
*Corresponding author

ABSTRACT

A faunistic study of the tribe Spilomicrini Ashmead, 1893 (Hymenoptera: Diapriidae, Diapriinae) has been carried out in Iran. This study is based on the material collected using Malaise traps in four provinces of Iran, including Guilan, Mazandaran, Golestan, and Markazi. The genus *Paramesius* with one species and *Spilomicrus* with four species are documented and illustrated for the first time from Iran: *P. rufipes* Westwood, 1832, *S. bipunctatus* Kieffer, 1911, *S. brevimalaris* Hübner & Chemyreva, 2024, *S. rufitarsis* Kieffer, 1911 and *S. stigmaticalis* Westwood, 1832. A key to the Iranian Spilomicrini is provided.

Keywords: diapriid wasps, parasitoids, *Spilomicrus*, *Paramesius*, Palaearctic, Western Asia, fauna.

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INTRODUCTION

The tribe Spilomicrini Ashmead, 1893, within the subfamily Diapriinae Haliday, 1833, comprises 27 genera worldwide (Masner & García, 2002; Chemyreva & Kolyada, 2013). Six genera, *Entomacis* Förster, 1856, *Idiotypa* Förster, 1856, *Paramesius* Westwood, 1832, *Pentapria* Kieffer, 1905, *Spilomicrus* Westwood and *Symphytopria* Kieffer, 1910 1832 are found in the Palearctic region (Johnson, 1992; Chemyreva & Kolyada, 2013; Chemyreva, 2024, in press). Prior to this study, there were no records of the tribe Spilomicrini from Iran.

Spilomicrus Westwood, 1832 is a large genus, with more than 170 recognized species worldwide, of which 32 species are recorded from the Western Palaearctic region (Johnson, 1992; Chemyreva, 2021, 2023; Hübner & Chemyreva, 2024). The known hosts of *Spilomicrus* species are mainly dipteran larvae and, possibly, species of the Coleoptera from the families Curculionidae (Scolytinae) and Staphylinidae (Honda, 1969; Masner, 1991; Notton, 1999; Masner & García, 2002). Several comprehensive studies of the genus *Spilomicrus* have been conducted in the Palaearctic region in the recent years (Kim & Lee, 2016; Chemyreva, 2015a, 2015b, 2016, 2018, 2021, 2023; Peeters, 2020; Hübner & Chemyreva, 2024). These studies have resulted to discovery of many new species and the documentation of new synonyms.

The genus *Paramesius* Westwood, 1832 comprises more than 50 species worldwide (Chemyreva & Kolyada, 2018). Johnson (1992), in his catalogue, listed 18 species of this genus in Europe. Nevertheless, due to subsequent synonymizations, the current count for this genus in Europe has been decreased to only seven species (Macek, 2001; Chemyreva & Kolyada, 2018). There is no information on the host association of the *Paramesius* species.

The Iranian Diapriidae are still poorly studied and few comprehensive papers have been published (Amini et al., 2014; Izadizadeh et al., 2020, 2021, 2023a, 2023b, 2023c, 2023d). According to the available literature, 26 species of Diapriidae have been reported from Iran, of which only three species belong to the subfamily Diapriinae (Amini et al., 2014; Izadizadeh et al., 2020). Previous records of the subfamily Diapriinae in Iran (Samin et al., 2018) are a matter of debate since no voucher specimens have been deposited, and the co-authors are unaware of the publication of these records in a local periodical. In order to follow the professional taxonomic approach, we ignored these suspicious records. All new records in this study are based on recently collected material from various parts of Iran, thoroughly examined and publicly accessible in designated depositories.

MATERIAL AND METHODS

All specimens examined in this study were collected from various localities in northern and central Iran using Malaise traps. The specimens were extracted from the traps, transferred to 70% ethyl-alcohol, and stored in a freezer for further studies. For sample preparation, the specimen was placed on a piece of absorbent paper

for drying. The dried specimens were card-mounted and labeled. Photographs were taken using an Olympus TM SZX9 stereomicroscope equipped with a 650D Canon digital camera. Image stacks were combined with Helicon Focus (Helicon Soft Ltd., Kharkiv, Ukraine). Identifications were mainly performed using reliable keys (Nixon, 1980; Chemyreva & Kolyada, 2018; Chemyreva, 2021; Hübner & Chemyreva, 2024). Morphological terminology and abbreviations follow Masner & García (2002) and Yoder (2004). Voucher specimens are deposited in the Department of Entomology, Tarbiat Modares University, Tehran insect collection (TMUC) and the Research Institute of Forests and Rangelands, Tehran (RIFR).

The following abbreviations are used: A1-A13 = antennomeres are numbered from the scape (A1) to the apical segment (A13). T2 = largest metasomal tergite past petiole or syntergite. S2 = largest metasomal sternite past petiole.

RESULTS

Taxonomy

Family Diapriidae Haliday, 1833

Subfamily Diapriinae Haliday, 1833

Tribe Spilomicrini Ashmead, 1893

Genus *Paramesius* Westwood, 1832

Type species: *Paramesius rufipes* Westwood, 1832

Diagnosis: Body length 1.5-5.0 mm; body color from black to brown, smooth and shining, usually with sparse and long setae; postgena often with hairy cushions; antenna with 13 antennomeres in both sexes, A13 in female the longest and the largest clavomere (Fig. 1d), A3 in male distinctly shorter than A4; A4 modified; anterior margin of pronotum with scattered pilosity or pilosity denser, forming a cushion; lateral side of pronotum posteriorly with a row of small foveae (Fig. 1f); mesoscutum flat to convex, with sparse setae; anterior mesoscutellar pit simple, usually large, deep, transversely oval, often with longitudinal carinae; fore wing with costal, submarginal and marginal veins, marginal vein distinctly elongate, at least 3.0 times as long as wide (Fig. 1g); petiole distinctly elongate, longitudinally carinate or, very rarely, smooth; metasoma behind petiole elongate, sharply conical-pointed apically in females, ovoid in males; anterior margin of T2 covers posterior end of petiole from outside, sometimes with short incision medially or laterally, sometimes with two very shallow and bare depressions anterolaterally (Fig. 1h).

Remarks. This diagnosis is appropriate for the Palaearctic species of the *Paramesius*. For an extended diagnosis, see Masner & García (2002). For a detailed description and key of the Palaearctic species of the genus *Paramesius*, see Chemyreva & Kolyada (2018).

***Paramesius rufipes* Westwood, 1832**

Syn.: *Paramesius claviscapus* Thomson, 1859; *P. elongatus* Thomson, 1859; *P. tenuicornis* Thomson, 1859; *P. inermis* Kieffer, 1910; *P. bifoveatus* Kieffer, 1911; *P. dentatus* Kieffer, 1911; *P. dolichocerus* Kieffer, 1911; *P. inchoatus* Kieffer, 1911; *P. longicornis* Kieffer, 1911; *P. nigricornis* Kieffer, 1911; *P. subinermis* Kieffer, 1911; *P. subspinosus* Kieffer, 1911; *Spilomicrus minor* Kieffer, 1911; *S. striatifoveatus* Szabó, 1960.

Material examined: Golestan province, Shast Kola forest (36°45'29″ N, 54°23'12″ E, 424 m a.s.l.), 12.06.2016, 1 ♀ (TMUC); 04.07.2016, 1 ♂ (TMUC); Shast Kola forest (36º47'24″ N, 54º21'54″ E, 263 m a.s.l.), 12.06.2016, 1 ♀ (TMUC); 09.07.2017, 4 ♂♂ (TMUC); Loveh forest (37°20'43″ N, 55°40'40″ E, 753 m a.s.l.), 04.07.2016, 1 ♀ (TMUC), leg. S. Farahani. Mazandaran province, Kheyroud Kenar (36°34'36.23" N, 51°34'37.94" E, 722 m a.s.l), 24.07.2018, 1 ♂ (TMUC); Galanderoud (36°26'56″ N, 51°51'20″ E, 1407 m a.s.l), 24.07.2018, 1 ♀ (TMUC); Neka forest (36°30'00.4" N, 53°27'14.2″ E, 828 m a.s.l), 27.06.2018, 2 ♀♀ (RIFR); Neka forest (36°34'49.2″ N, 53°27'95.6″ E, 465 m a.s.l), 24.07.2018, 1 ♂ (RIFR); Guilan province, Shafaroud forest (37°28'18" N, 48°49'23" E, 1114 m a.s.l), 26.08.2018, 1 ♂ (RIFR); Rezvan Shahr (37°31'00″ N, 49°2'7″ E, 199 m a.s.l), 22.07.2018, 1 ♀ (TMUC), leg. F. Kazerani.

Diagnosis: Female. Body length 1.4-2.6 mm (Fig. 1a); head in dorsal view transverse, 1.25-1.35 times as wide as long, with sparse setae (Fig. 1c); occipital carina smooth in dorsal view; antenna thicker and darker towards the top (Fig. 1c), A13 2.2-2.4 times as long as wide; notauli absent anteriorly (Fig. 1e) to almost complete; pronotal cervical area poorly pubescent with a few long setae; mesoscutal suprahumeral sulcus absent (Fig. 1e); anterior mesoscutellar pit with four elongate carina inside (Fig. 1e); petiole 1.6-1.8 times as long as wide in dorsal view (Fig. 1f); anterior margin of T2 with a deep median notch (Fig. 1h); body color black, antennomeres in base yellowish brown, darker towards the top (Fig. 1d).

Remarks. The Iranian specimens show variation in several characters compared to those described by Chemyreva & Kolyada (2018): Female: Body length 2-2.6 mm., fore wing length 1.6-2.1 mm, anterior mesoscutellar pit with 3-4 carinae.

Distribution: Abkhazia, Austria, Czech Republic, France, Hungary, Georgia, Germany, Moldova, Poland, Russia, Slovakia, Sweden, Switzerland (Nixon, 1980; Macek, 2001; Chemyreva & Kolyada, 2018), Iran (new record).

Biology: Unknown.

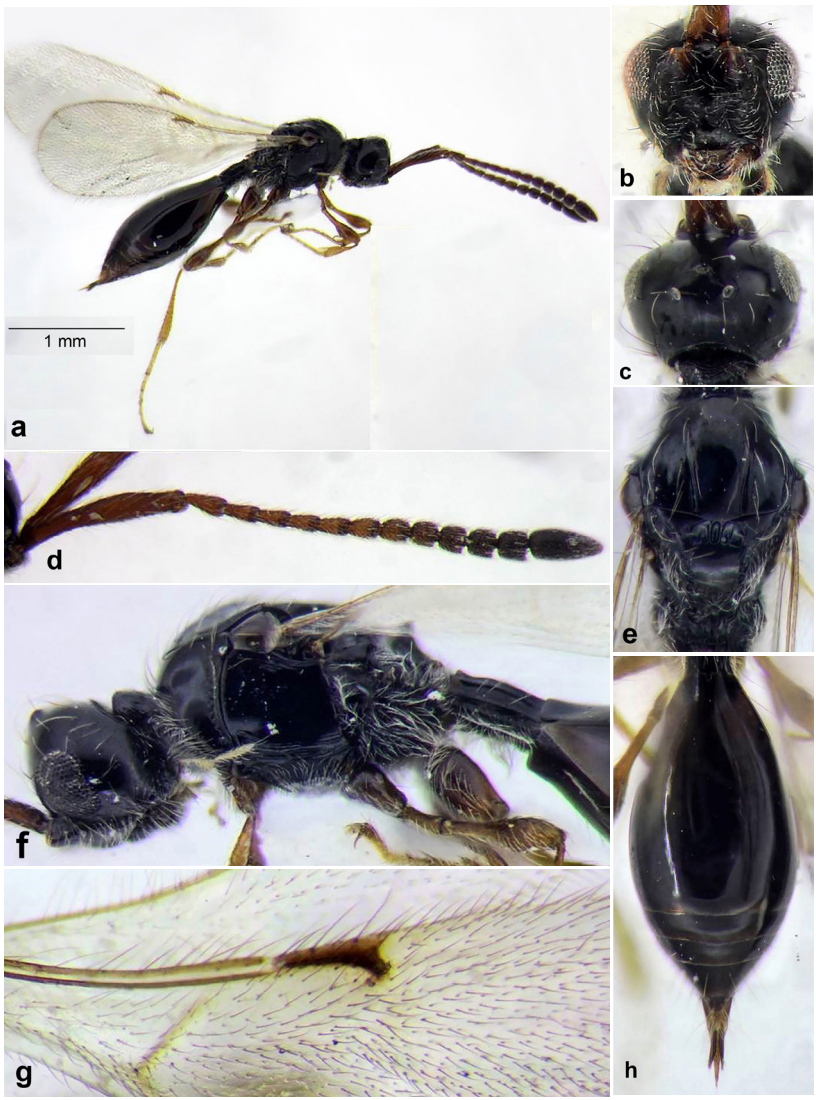

Figure 1. *Paramesius rufipes* Westwood, 1832, female: a) habitus in lateral view; b) head in frontal view; c) head in dorsal view; d) antenna in lateral view; e) mesosoma in dorsal view; f) head and mesosoma in lateral view; g) fore wing venation; h) metasoma in dorsal view.

Genus *Spilomicrus* Westwood, 1832

Type species: *Spilomicrus stigmaticalis* Westwood, 1832

Diagnosis: Body length 1.0-4.5 mm; body color black to brown, smooth and shining, usually with few sparse long setae; postgena with more or less hairy cushions (Figs 2a, 4a); antenna with 13 antennomeres in both sexes (Figs 2b, 3b); anterior margin of pronotum

with a cushion of hairs; lateral side of pronotum posteriorly without a row of small foveae; flat to mesoscutum convex and with sparse setae; anterior mesoscutellar pit bifoveate (Fig. 2d); metapleuron rugose and densely hairy; fore wing with costal, submarginal and marginal veins; marginal vein at most 2.5 times as long as wide (Fig. 2d); petiole elongate, usually with longitudinal carinae; anterior margin of T2 never notched medially or laterally (Figs 3d, 4d), rarely with two hairy depressions anterolaterally; S2 with deeply arched anterior margin and hairy cushion at base; apex of female metasoma only shortly pointed.

Remarks. This diagnosis is appropriate suitable for the Palaearctic species of *Spilomicrus*. For a more extended diagnosis of this genus, see Masner & García (2002). For a detailed description and key to European species of *Spilomicrus*, see Chemyreva (2021) and Hübner & Chemyreva (2024).

Spilomicrus bipunctatus Kieffer, 1911

Material examined: Qazvin Province, Loshan (36°40′14.58″ N, 49°25′38.52″ E, 295 m a.s.l.), 25.05.2011, 2 ♀♀ (TMUC), leg. A. Nadimi. Mazandaran Province, Neka Forest (36°30'00.4" N, 53°27'14.2″ E, 828 m a.s.l), 16.05.2018, 2 ♀♀ (RIFR), leg. F. Kazerani. Guilan Province, Rezvan Shahr (37°31'00″ N, 49°2'7″ E, 199 m a.s.l), 13.05.2018, 2 ♀♀ (TMUC), leg. F. Kazerani.

Diagnosis: Female. (Fig. 2a). Body length 3.1-3.4 mm, head in dorsal view transverse, 1.28-1.35 times as wide as long; malar sulcus distinct near mandible; clypeus semi-circular, 1.8 times as wide as high; pleurostomal distance 1.1 times as long as shortest distance between eyes; eye small, 0.4-0.45 times as high as head and with few long setae; neck pubescent and with longitudinal grooves; notauli distinct and small, 0.11-0.15 times as long as mesoscutum (Fig. 2d); propodeum coarsely rugose, entirely covered with pale pilosity; all legs with long femoral stalk; petiole in dorsal view 0.9-1.2 times as long as wide (Fig. 2d); T2 bare (Fig. 2d) and with micro-punctures posteriorly. Body black, legs brown, scape and pedicel black, A3-A7 brown, A8-A13 dark brown (Fig. 2b).

Distribution: Azerbaijan, Czech Republic, Estonia, France, Germany, Hungary, Italy, Moldova, Netherlands, Poland, Slovakia, Russia, Ukraine, U. K. (European part) (Nixon, 1980; Peeters, 2020; Chemyreva, 2021), Iran (new record).

Biology: Unknown.

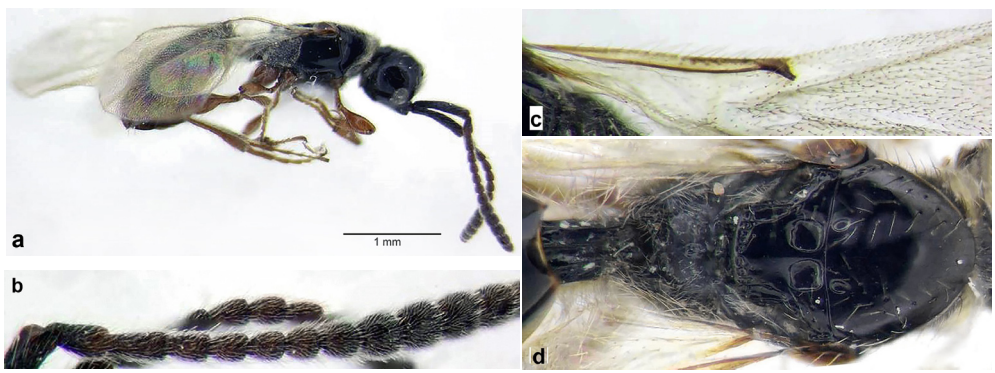

Figure 2. *Spilomicrus bipunctatus* Kieffer, 1911, female: a) habitus in lateral view; b) antenna; c) fore wing venation; d) mesosoma and base of metasoma in dorsal view.

Spilomicrus brevimalaris Hübner & Chemyreva, 2024

Material examined: Golestan Province, Tuskestan forest (36°46'33″ N, 54°34'58″ E, 500 m a.s.l.), 12.06.2016, 1 ♂ (TMUC), leg. S. Farahani.

Diagnosis: Male. (Fig. 3a). Body length 2.1 mm, head in dorsal view transverse, 1.5 times as wide as long (Fig. 3d); malar sulcus absent; malar distance 0.2 times as long as largest diameter of eye and 0.25 times as long as pleurostomal distance; clypeus semi-circular, 1.7 times as wide as high; eye oval, 0.7 times as high as head and with few long setae; A4 with deep excavation and keel running from base to 0.6 of segment length (Fig. 3c); A3 slightly longer than A2 (Fig. 3b); neck bare, with shallow longitudinal grooves; notauli distinct, 0.6 times as long as mesoscutum (Fig. 3d); propodeum entirely pubescent and coarsely rugose; all legs with long femoral stalk; petiole in dorsal view 1.9 times as long as wide; T2 with two bunches of setae at anterior margin, bare and smooth posteriorly. Body black, metasoma dark brown; scape black; A1-A13, legs and wing veins yellowish brown (Fig. 3a).

Distribution: Germany, Russia (European part) (Hübner & Chemyreva, 2024), Iran (new record).

Biology: Unknown.

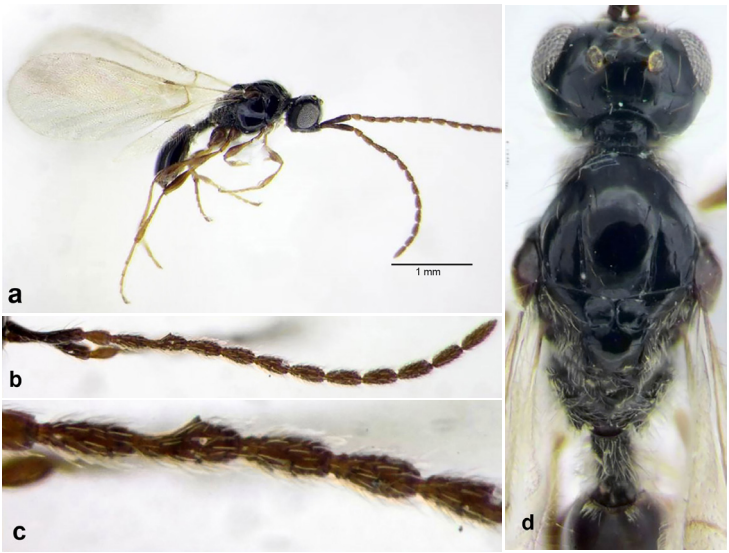

Figure 3. *Spilomicrus brevimalaris* Hübner & Chemyreva, 2024, male: a) habitus; b) antenna; c) basal antennomeres of antenna; d) mesosoma and base of metasoma in dorsal view.

Spilomicrus rufitarsis Kieffer, 1911 (Fig. 4)

Syn.: *Spilomicrus pseudocursor* Szabó, 1974

Material examined: Markazi Province, Haftad Qolleh Protected Area (34º05′38.7″ N, 50º14′22″ E, 2088 m a.s.l), 08.05.2018, 1 ♀ (TMUC), leg. M. Parchami-Araghi and E. Gilasian.

Diagnosis: Female. Body length 3.2 mm (Fig. 4a), head in dorsal view transverse, 1.3 times as wide as long; malar sulcus absent; clypeus 2.5 times as wide as high; eye oval and with few long setae; neck with sparse setae and with short longitudinal grooves; notauli distinct and small, 0.3 times as long as mesoscutum (Fig. 4d); propodeum entirely pubescent and coarsely rugose (Fig. 4d); all legs with short femoral stalk (Fig. 4c); petiole in dorsal view 1.1 times as long as wide; T2 smooth and bare (Fig. 4d). Body black; scape black, pedicel and A3-A7 brown, A8-A13 dark brown (Fig. 4b); trochanters, tibiae and tarsus brown (Fig. 4a).

Distribution: Algeria, Austria, Czech Republic, France, Hungary, Ireland, Italy, Netherlands, U. K. (Nixon, 1980; Peeters, 2020; Chemyreva, 2021), Iran (new record).

Biology: Unknown.

Figure 4. *Spilomicrus rufitarsis* Kieffer, 1911, female: a) habitus in lateral view; b) antenna; c) trochanter and femur of hind leg; d) mesosoma and base of metasoma in dorsal view.

Spilomicrus stigmaticalis Westwood, 1832 (Fig. 5)

Syn.: *Spilomicrus nigripes* Thomson, 1858; *S. armatus* Ashmead, 1893; *S. tripartitus* Kieffer, 1911; *Spilomicrus pilicornis* Szabó, 1977; *Spilomicrus barbatus* Szabó, 1983; *Spilomicrus mediofurcatus* Szabó, 1983; *Spilomicrus basalyformis* Marshall, 1868.

Material examined: Mazandaran Province, Galanderoud (36°26'56″ N, 51°51'20″ E, 1407 m a.s.l), 28.08.2018, 1 ♀ (TMUC), leg. F. Kazerani.

Diagnosis: Female. Body length 2.5 mm (Fig. 5a), head in dorsal view transverse, 1.2 times as wide as long; malar sulcus absent; clypeus semi-circular, 2.0 times as wide as high (Fig. 5b); eye oval and with few long setae; neck with sparse setae and with

short longitudinal grooves; notauli long, 0.9 times as long as mesoscutum (Fig. 5d); propodeum entirely pubescent and coarsely rugose; all legs with long femoral stalk; petiole in dorsal view 2.0 times as long as wide; T2 smooth and bare. Body black; scape and pedicel black, A3-A13 dark brown (Fig. 5c); tegula, wing veins and legs dark brown.

Distribution: Algeria, Austria, Azerbaijan, Canada, Czech Republic, Finland, France, Georgia, Germany, Hungary, Italy, Kazakhstan, Moldova, Poland, Sweden, Switzerland, Slovakia, Russia, Ukraine, U. K., USA (Hellen, 1963; Kozlov, 1978; Masner, 1991; Chemyreva, 2021), Iran (new record).

Biology: It has been recorded as a parasitoid of the rove beetles belonging to the genera *Quedius* and *Philonothus* (Coleoptera: Staphylinidae) (Nixon, 1980; Masner, 1991).

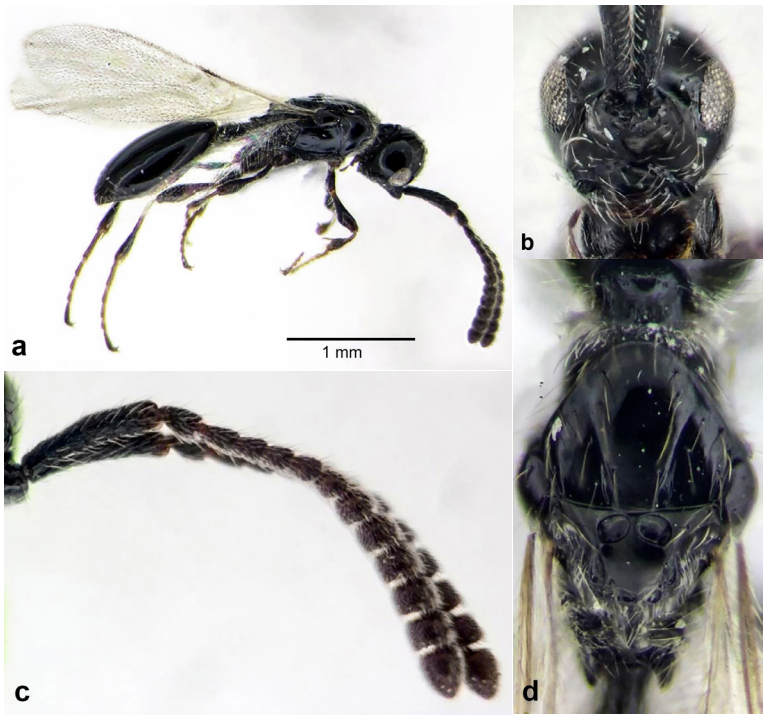

Figure 5. *Spilomicrus stigmaticalis* Westwood, 1832, female: a) habitus in lateral view; b) head in frontal view; c) antenna in lateral view; d) mesosoma in dorsal view.

Key to species of the tribe Spilomicrini Ashmead, 1893 occurring in Iran

1. Marginal vein more than 3 times as long as wide (Fig. 1g); posterior margin of pronotum with a row of small foveae (Fig. 1f); T2 with tiny median and lateral notches at base (Fig. 1h). .....*Paramesius rufipes* Westwood

- Marginal vein at most 2.5 times as long as wide (Fig. 2c); lateral surface of pronotum without such a row of fovea; T2 smooth and without notches at base (Figs 2d, 3d, 4d) (*Spilomicrus* Westwood)..... 2

2. T2 pubescent at base (Fig. 3d); malar space 0.2 times as long as the largest diameter of eye. .....*Spilomicrus brevimalaris* Hübner & Chemyreva

- T2 bare at base (Figs 2d, 4d); malar space at least 0.5 times as long as the largest diameter of eye. 3

3. A13 of female not narrower than A12 in dorsal and lateral views (Fig. 5c); A9 as wide as A10 in dorsal view; male A4 longer than A3, with deep emargination and small projection at base of A4. .....*Spilomicrus stigmaticalis* Westwood

- A13 of female narrower than A12 in dorsal and lateral views (Fig. 4b); A9 narrower than A10 in dorsal view; male A4 shorter than A3, with shallow emargination and without projection at base of A4. 4

4. Pleurostomal distance distinctly longer than distance between eyes in front view; clypeus 1.7-1.8 times as wide as long; all femora of female slender, with long stalks. ..... *Spilomicrus bipunctatus* Kieffer

- Pleurostomal distance distinctly shorter than distance between eyes in front view; clypeus 2.2-2.7 times as wide as high; all femora of female broad, with very short stalks. ..... *Spilomicrus rufitarsis* Kieffer

DISCUSSION

All species identified in this study are reported for the first time from Iran. *Paramesius rufipes* is widely distributed in the Siberia and Western Palaearctic region and is dispersed throughout Europe (Chemyreva & Kolyada, 2018). In this research, it was collected from northern Iran. The genus *Spilomicrus* is distributed worldwide and comprises 32 species found in the Western Palaearctic region (Chemyreva, 2021; Hübner & Chemyreva, 2024). The males of *S. bipunctatus* and *S. rufitarsis* are scarce and quite rare in Europe, respectively (Chemyreva, 2021) and were not collected in this study. *Spilomicrus stigmaticalis* is very common in Europe, but in this study, only one specimen was collected. Possibly, northern Iran is the southernmost border of this species distribution and therefore it is rare here. Previously, only one species of this genus*, S. formosus* Jansson*,* had been reported from the Ardabil Province of Iran (Samin et al., 2018). Still, we did not collect specimens of this species in the studied locations.

With the current research, the number of known Iranian species of this genus has increased to five. All specimens were collected using Malaise traps; therefore, their hosts are unknown. No information is currently available regarding the biology of *Paramesius* species (Macek, 2001; Chemyreva & Kolyada, 2018). Nevertheless, earlier studies have demonstrated that some *Spilomicrus* species act as parasitoids for various dipteran species of the families Bibionidae, Syrphidae, Tachinidae, Sciomyzidae, Pipunculidae, Heleomyzidae and Muscidae (Thompson, 1955; Honda, 1969; Masner, 1991). Numerous species of the families Syrphidae (Gilasian,van Steenis, & Parchami-Araghi, 2022; Dousti, 2023), Tachinidae (Seyyedi-Sahebari, Khaghaninia, & Talebi, 2019, 2021, 2023), Sciomyzidae (Kazerani, Talebi, & Mortelmans, 2017) and Pipunculidae (Majnon Jahromi, Gheibi, Fallahzadeh,

Kehlmaier, & Hesami, 2018) have been reported from northern Iran, potentially serving as hosts for *Spilomicrus* species. *Spilomicrus stigmaticalis* is known as a larval parasitoid of the rove beetles (Coleoptera: Staphylinidae) (Nixon, 1980; Masner, 1991). Many species of the family Staphylinidae are also documented in Iran (Assing, 2011; Tabadkani, Nozari, & Hosseininaveh, 2015). Further research is essential to explore the relationship between *Spilomicrus* species and their hosts, and to improve our understanding of their host associations and ecological roles.

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