Article

A study on the genus *Orthops* FIEBER (Hemiptera: Miridae: Mirinae) in Iran

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Abstract
This paper is the extension of a series of synoptic taxonomic treatments on the Miridae known from Guilan and other provinces in Iran. In the genus *Orthops* FIEBER five species are known from Iran, including *Orthops* (*Montanorthops*) *pilosulus* (Jakovlev, 1877), *Orthops* (*Orthops*) *frenatus* (Horváth, 1894), *Orthops* (*Orthops*) *basalis* (Costa, 1853), *Orthops* (*Orthops*) *campestris* (Linnaeus, 1758) and *Orthops* (*Orthops*) *kalmii* (Linnaeus, 1758). *Pinalitus cervinus* (Herrich-Schaeffer, 1841) as a similar species to *Orthops* group is included in this study. In this paper diagnoses, host-plant information, distribution data, and illustrated keys to the genera and species are provided. For all species, illustrations of the adults and selected morphological characters are provided to facilitate identification.

Keywords Miridae, *Orthops*; taxonomy; Guilan province.

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1 Introduction

Mirid bugs (Hemiptera: Heteroptera) are one of the most species rich families of insects, with approximately 11020 described species. This family comprising eight subfamilies which among them Mirinae subfamily has six tribes, including Herdoniini, Hyalopeplini, Mecistoscelini, Mirini, Resthenini and Stenodemini (Cassis and Schuh, 2012), however Schuh (2013) has added *Scutelliferini tribe* to the above list.

Species in *Orthops* genus belong to the tribe Mirini. So far, 35 species has been recognized in this genus belong to two subgenus *Orthops* and *Montanorthops* (Schuh, 2013). They have 3-6 mm body length. Vertex provided with a margin or border. Genitalia of the males and females distinctly small. Body color variable, but very seldom green, in that case the rostrum does not exceed the intermediate coxae (Wagner and Weber, 1964) So far a few taxonomic works has been done on Miridae bugs in Iran (Hosseini, 1997; Hosseini and Linnavuori, 2000; Hosseini et al., 2000, 2002a, b; Hosseini, 2013a, b, c; Hosseini, 2014; Linnavuori and Hosseini, 1998, 1999, 2000; Linnavuori and Modarres, 1999; Linnavuori, 1999, 2006, 2007, 2009, 2010;

Arkani et al., 2011; Lashkari et al., 2011; Lashkari and Hosseini, 2012; Ebrahimi et al., 2012).

In this genus five species are known from Guilan and other provinces in Iran, including, *Orthops (Montanorthops) pilosulus* (Jakovlev, 1877), *Orthops (Orthops) frenatus* (Horváth, 1894), *Orthops (Orthops) basalis* (Costa, 1853), *Orthops (Orthops) campestris* (Linnaeus, 1758) and *Orthops (Orthops) kalmii* (Linnaeus, 1758) (Linnavuori, 2007).

There is a lack of information for identification of Miridae species in Iran specially in Guilan province. This work is an extension of a series of synoptic taxonomic treatments and re-description on the Miridae known from Guilan and other provinces of Iran in order to fill this information gap. In this paper following information including diagnoses, host-plant information, distribution data, and illustrated keys for five species of *Orthops* and also *Pinalitus cervinus* (Herrich-Schaeffer, 1841) as a similar species to *Orthops* group are provided. For most species, illustrations of selected morphological characters are provided to facilitate identification.

2 Materials and Methods

2.1 Collection of specimens

The sweep net, bush net and light trap was used for collecting mirids on vegetation and trees. The bugs felt on the net were quickly picked off by an aspirator. Then collected specimens were killed promptly in a small tube contains Ethyl acetate. Specimens after transferring to the laboratory were mounted on rectangular cards. All specimens were examined using an Olympus SZX 12 stereomicroscope. A part of specimens examined in this study were used from the insects' collection available at the Natural History Museum of University of Guilan. Illustrations of genitalia were prepared using a drawing tube attached to the stereomicroscope. Photographs of specimens were taken using a Canon EOS 500D (Digital Rebel/Kiss X3 Digital) camera equipped by a Canon EF 100mm f/2.8 USM Macro Lens. Identification was done by relevant taxonomic keys (Wagner and Weber, 1964; Wagner, 1971). Identified species were confirmed by mirid specialist Dr. R.E. Linnavuori (Finland). All species are kept in the insect collection of the Natural History Museum of University of Guilan. For species collected from Guilan province information including altitude, latitude and longitude were provided for each collection site. The system and nomenclature follows the catalogue of Aukema and Rieger (1999).

3 Results

The following is the key to the species of *Orthops*.

1- Species with shallow punctures, collar hair much longer than width of collar, spines on tibia dark (Subgenus *Orthops*) ……...…….……2

- Species with deep punctures, suppressed hairs on pronotal collar, spines on tibia yellow, color golden yellow with reddish splashes and black markings (Subgenus *Motanorthops*) ……..……..……. 5

2- A brown line on external side of each tibia from its base to the middle ……. *O. (Orthops) frenatus*

- Rarely brown line is present, but if present, interrupted near the knee …….. ……..... 3

3- Side edge of the corium pale, concolorous. Apophysis of right paramere in the form of a punch .....…….. *O. (Orthops) campestris*

- Side edge of corium narrowly black. Apophysis of right paramere in the form of a hook 4

4- Length of 3rd antennal segment < 0.55 mm, Elongated species …… *O. (Orthops) basalis*

- Length of 3rd antennal segment > 0.5 mm, Scutellum usually with a triangular basal spot. Oval elongated species……..……..... *O. (Orthops) kalmii*

5- Species entirely orange-red ……..…. *O. (Montaorthops) pilosulus*

***Orthops (Orthops) frenatus* (Horváth, 1894) (Fig. 1A-C, 7A)**

Material examined

Guilan province: Deylaman (36°53'05" N, 49°54'26" E, elev. 141 m), 16.-20.vii.1996, 18.-20.vii.1998; Barasar (36°46'43" N, 49°45'31" E, elev. 1171 m), 23.vii.1996; Jirandeh (36°42'00" N, 49°47'28" E, 1343 m), 6.-8.vii.1996.

This species has been reported from Korasan province: (70 km W of Darreh Gaz, , 14.VI.1994; Khalkanlod 30 kmE of Quchan, 7.VI. 1994; Khargh 70 km SW of Quchan, 8-9.VI. 1994; Mashhad, V-VII.1994) – collected from mountain meadows (Linnavuori and Modarres 1999); Ardabil province: (Khalkhal, 30.vii.1996, 20.vii.1998; 20-30 km E of Khalkhal, 1.-21.vii.1996; Majareh – Khalkhal, 28.vii.1996), Tehran province: (Azad Bar, 8.-10.vii.1995) and Alborz province: (Karaj, 12.-13.vii.2002) Linnavuori (2007); Khuzestan province: (Bagh Malek, 9.–11.v.2007); Esfahan province: (Shahreza – Semirom, 11.vi.2003); Fars province: (Dasht-e-Arzhan, 12.–13.vi.2003; Shul – Sangar, 17.–18.vi.2003); Ilam province: (Ilam, 8.–9.vi.2005); West Azerbaijan province (Kitkeh 50 km S of Mahabad, 19.–20.vii.2004, Marangalu near Urumiyeh, 15.–17.vii.2004) (Linnavuori 2009)

Diagnosis

O. fernatus has a different morphology from *O. kalmii* (Linnaeus, 1758), *O. campestris* (Linnaeus, 1758) and *O. basalis* (Costa, 1853). In this species there is a brown line on external side of each tibia from its base to the middle (Fig. 1B) while in other three species external side of tibia is entirely pale or with a brown spot at the knee and rarely the brown line is present but interrupted near the knee (Kerzhner, 1996). Apophysis of left paramere in the form a sharp curved hook. Sensory lobe with a strong hunch (Fig. 1C).

Specific taxonomical diagnostic characters are shown in Table 1.

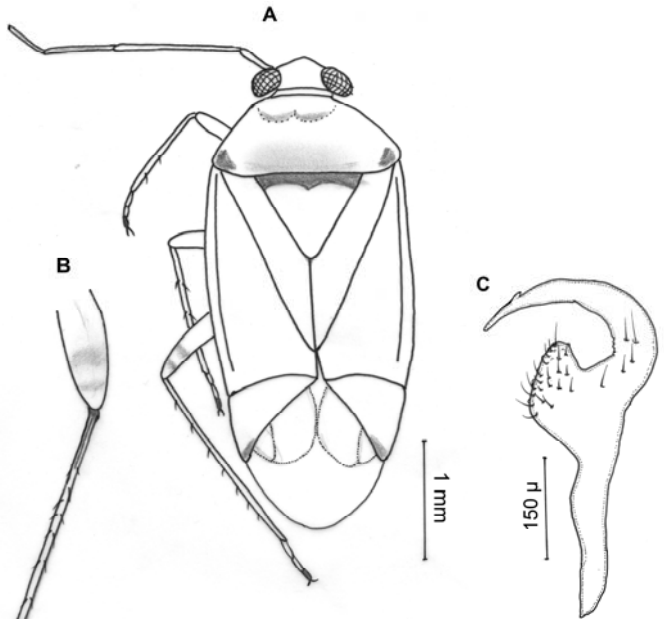

Fig. 1 *Orthops (Orthops) frenatus* (Horváth, 1894). (A): Adult; (B): Leg; (C): Left paramere.

Comments

Orthops frenatus Horvath, 1894 has been considered as a junior synonym of *Orthops kalmii* Linnaeus, 1758 in Schuh (2013). This species usually is found in mountain meadows and at light in gardens at riversides and in

hilly steppes. Recorded from Armenia, Iran (Tabriz), Afghanistan, and Middle Asia Kerzhner (1996), Irano-Turanian (Linnavuori, 2007).

Table 1 Diagnostic taxonomical characters in four species of *Orthops* (numbers are ratio or size (in mm).

Taxonomic characters	**Ratio/Size (in mm)**			
	O. campestris	***O. basalis***	***O. kalmii***	***O. frenatus***
Proportions among antennal segments	0.37-1-0.57-0.42	0.37-1-0.57-0.42	0.36-1.18-0.5-0.43	0.36-1-0.53-0.35
Diatone	0.87	0.9	0.93	0.88
Synthlipsis	0.37	0.37	0.32	0.38
Ocular index	1.48	1.48	1	1.65
Base of pronotum	1.5	1.5	1.45	1.55
Length of pronotum	0.75	0.77	0.81	0.78
1st antennal segment/ times as long as diatone	0.42	0.4	0.38	0.4
2nd antennal segment/ times as long as diatone	1.14	1.1	1.26	1.13
2nd antennal segment/ times as long as basal width of pronotum	0.66	0.66	0.81	0.64
Pronotum/ times as broad basally as long in middle	2	1.94	1.79	1.98

***Orthops (Orthops) campestris* (Linnaeus, 1758) (Fig. 2A-C, 7C)**

Material examined

Guilan province: Masuleh (37°09'14" N, 48°59'11" E, elev. 1023 m), 28.vii.1996.

This species has been reported from Ardabil province: (Khalkhal, 30.vii.1996; 20-30 km E of Khalkhal, 1.-12.vii.1996), Tehran province: (Azad Bar, 2410 m a.s.l., 8.-10.vii.1995), Mazandaran province: (Hassan Abad, 6.-7.vii.1995) (Linnavuori, 2007) and West Azerbaijan province (Marangalu near Urumiyeh, 15.–17.vi.2004) (Linnavuori, 2009).

Diagnosis

Color from a pale yellow or greenish, rarely green, with drawings or brownish black, with a fine pubescence and clear. *O. campestris* is the smallest and most oval *Orthops* species. This species has short antennae. Antennas variables color, usually black, with a yellow section, the 3rd segment is much shorter than the head width. Legs yellow, femora with two brown rings in the apical part. Oval elongated (Fig. 2A). 2nd antennal segment barely as thick as the first. The right paramere small, in form of a punch (Fig. 2C). In the left paramere (Fig. 2B) the sensory lobe very large, almost quadrangular, the apophysis acute, equipped with a small point, which is directed towards the rear. Specific taxonomical diagnostic characters are shown in Table 1.

Length: 3.6 to 4.6 mm male, female 3.85 to 4.7 mm.

Comments

On undergrowth in deciduous forests. West-Palaearctic (Linnavuori, 2007). Holopaléarctique species (Wagner and Weber, 1964). This species lives on Umbelliferae. Adults hibernate and are colored in green after hibernation.

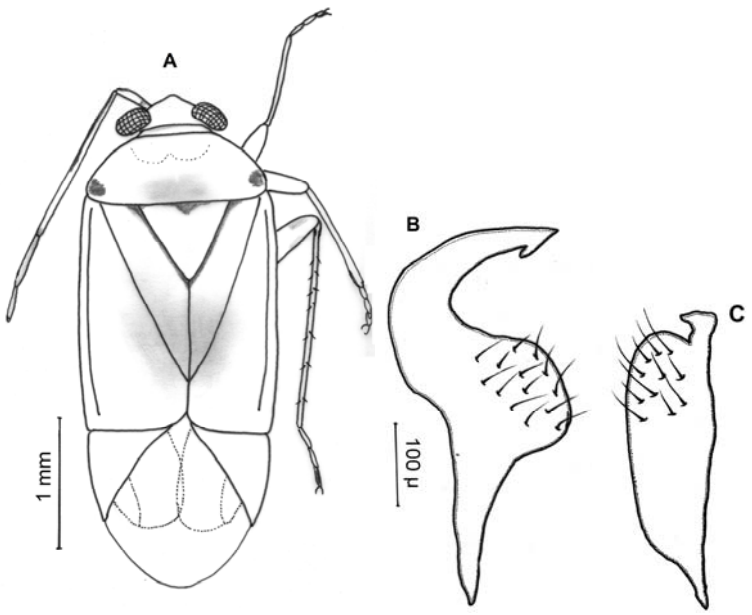

Fig. 2 *Orthops (Orthops) campestris* (Linnaeus, 1758). (A): Adult; (B): Left paramere; (C): Right paramere.

***Orthops (Orthops) basalis* (Costa, 1853) (Fig. 3A-C, 7B)**

Material examined

Guilan province: Deylaman (36°53'05" N, 49°54'26" E, elev. 141 m), 16.-20.vii.1996; Barasar (36°46'43" N, 49°45'31" E, elev. 1171 m), 23.vii.1996; Ganjeh (36°44'25" N, 49°24'03" E, elev. 302 m), 14.v.-13.vi.1995, Jirandeh (36°42'00" N, 49°47'28" E, elev. 1343 m), 6.-8.vii.1996; Masuleh (37°09'14" N, 48°59'11" E, elev. 1023 m), 6.-26.vi.1995, 3.-8.vii.1996.

This species has been reported from Ardabil province: (Khalkhal, 30.vii.1996; Khalkhal – Kivi, 4.viii.1996; Majareh – Kolur, 21.vii.1996), Zanjan province: (Gilankesh 15 km NW of Gilvan, 26.-27.vi.2004) (Linnavuori 2007), West Azerbaijan province: (50 km S of Mahabad, 19.–20.vii.2004), Markazi province (Tafresh, 7.–8.vi.2006) (Linnavuori, 2009).

Diagnosis

O. basalis is always dark in color and never green like *O. campestris* and is larger, more elongate. Sometimes in males three pale spots are seen on the scutellum.

Although this species is very similar to *O. kalmii*, the 3rd antennal segment is relatively long. The outer edge of the corium very narrowly black, forehead usually with two black spots. Body shape longer and narrower (Fig. 3A). Right paramere with a hook-shaped apophysis (Fig. 2C). Left paramere small, rounded sensory lobe, provided with small teeth, the curved apophysis, very wide at its apex (Fig. 2B). Specific taxonomical diagnostic characters are shown in Table 1.

Length: 4.1 to 5.2 mm male, female 4.2 to 5.3 mm.

Comments

On undergrowth in gardens and deciduous forests. Holomediterranean with a wide range in Europe. Usually reported on Apiaceae (Linnavouri, 2007).

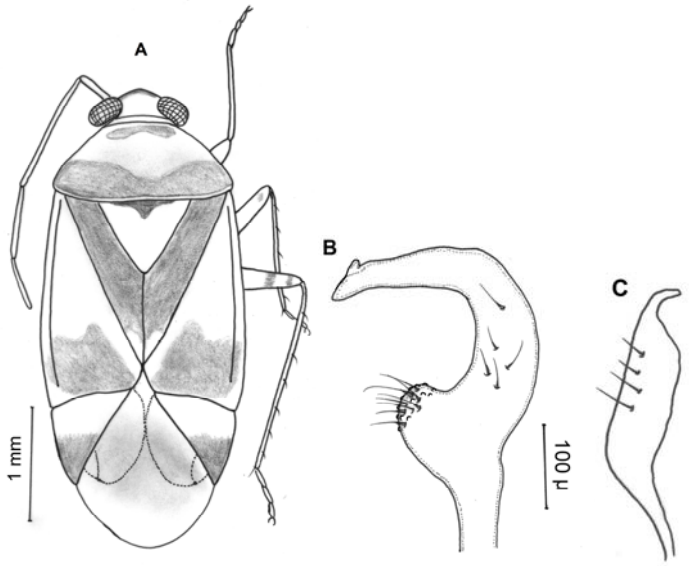

Fig. 3 *Orthops (Orthops) basalis* (Costa, 1853). (A): Adult; (B): Left paramere; (C): Right paramere.

***Orthops (Orthops) kalmii* (Linnaeus, 1758) (Fig. 4A-C, 7D)**

Material examined

Guilan province: Darreh Dasht (36°48'10" N, 49°38'24" E, elev. 1144 m), 18.-21.viii.1998; Dasht-e-Veel (36°50'48" N , 49°35'32" E, elev. 293 m), 20.viii.-11.ix.1998, 8.-10.ix.2000, 27.-29.vii.2002; Ganjeh (36°51'14" N, 49°28'09" E, elev. 212 m), 14.v.-13.vi.1995; Lowshan (36°38'09" N, 49°29'26" E, elev. 323 m), 18.-20.viii. 2002; Manjil (36°44'25" N, 49°24'03" E, elev. 302 m), 15.-17.ix.2000; Nasir Masaleh (37°05'41" N, 49°18'56" E, elev. 128 m), 14.-15.viii.2002; Sang Rud (36°39'59" N, 49°42'06" E, elev. 1338 m), 19.-20.viii.2002.

This species has been reported from Khorasan province: (Golestan Park 150 km W of Bojnurd, 14.VII.1994; Khargh 70 km SW of Quchan, 8-9.VI.1994; Lotfabad, 15.VI.1994; Mashhad, V-VII.1994; Nodeh 30-40 km ESE of Bojnurd, 1 1.VH.1994; Zaman Soofi 65 km W of Bojnurd, 12-13.VII.1994) (Linnavuori and Modarres 1999); Ardabil province: (20-30 km E of Khalkhal, 1.-21.vii.1996; Kivi, 9.-11.viii.2002); Zanjan province: (Gilankesh, 5.-6.vii.2004, Abbhar, 29.viii.-9.x.2000); Mazandaran province: (Qaehm Shahr, 1.-2.vii.2004), Golestan province: (Gorgan Mian Dareh, 13.-14.vii.2003; Talulestan, 15.-16.vii.2004) Linnavuori (2007) and West Azerbaijan province (Marangalu near Urumiyeh, 15.–17.vii.2004) (Linnavuori, 2009)

Diagnosis

O. kalmii is more elongate and often more extensively dark-marked. This species is very similar to *O. basalis*, however the 3rd antennal segment is slightly shorter.

Color like the preceding species. Lateral edge of the corium narrowly black. The drawings of the dorsal sharper (Fig. 4A). Smaller size. The right paramer higher, its apophysis shorter (Fig. 4B). Left paramer (Fig. 4C) more robust, the sensory lobe rounded, provided with small teeth, the smallest apophysis. Specific taxonomical diagnostic characters are shown in Table 1.

Length: male 4.1 to 4.7 mm, female 3.9 to 4.6 mm.

Comments

On undergrowth in deciduous forests and gardens and at light in gardens near salt marshes. Holopalaearctic (Linnavuori, 2007). This species is often found on Apiaceae.

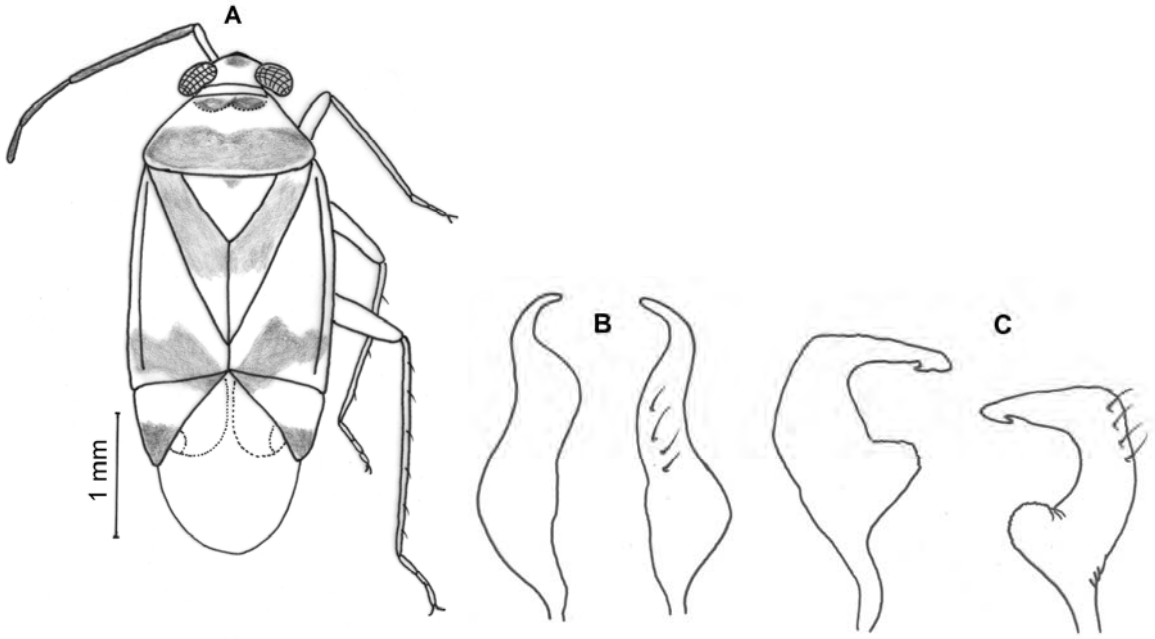

Fig. 4 *Orthops (Orthops) kalmii* (Linnaeus, 1758). (A): Adult; (B): Right paramere (different views); (C): Left paramere (different views).

***Orthops (Montanorthops) pilosulus* (Jakovlev, 1877) (Fig. 5A-C, 7E)**

Material examined

Guilan province: Manjil (36°44'25" N, 49°24'03" E, elev. 302 m), 8.-10.v.2000; Sang Rud (36°39'59" N, 49°42'06" E, elev. 1338 m), 21.ix.2000.

This species has been reported from Khorasan province: (Chan Chiroc 50 km S of Tabas, 17.V.1994; Deh Shor 25 km N of Tabas, 17.IV.1994; Parvand 70-80 km W of Sabzevar, 14-15.V.1996; Sorond and Modar 70 km S of Tabas, 18.V.1994; Tabas, 16-17.IV.1994) (Linnavuori and Modarres 1999); Zanjan province: (Abbhar, 28.ix.-9.x.2000; Gilankesh 9.-13.x.2000); Tehran province: (Evin near Tehran, 14.-16.vii.1995; 25 km NE of Firuzkuh, 9.vii.2003); Semnan province: (20 km SW of Biyarjomand, 13.-14.v.1996) Linnavuori (2007), and Kerman province (Caravanseray-e-Farhali, 20.v.1996; Raviz Shahabieh, 1800 m a.s.l., 24.v.1996) (Linnavuori, 2009).

Diagnosis

This species is entirely orange-red. Body size about 4 mm. Finely hairy with whitish densely punctured. Head smooth, shiny, collar thick, white. Rostrum reddish at the base, and brown at the end. Antenna orange yellow, where the 3rd and 4th segments fine brownish. Clavus, cuneus reddish-orange in the center.

Underneath of body white, orange-red. Clavus, cuneus in the center and a wide part at the end of the corium orange-red. Membrane pale, transparent. Legs yellowish, hind leg end red, yellow tibial spines. Specific taxonomical diagnostic characters are shown in Table 2.

Comments

On *Pteropyrum aucheri* in hilly steppes. Irano-Turanian (Linnavuori, 2007).

In the insect collection of University of Guilan, R.E. Linnavuori has labeled another species of *Orthops* in the subgenus *Montanorthops*, under title *O. sanguinolentus* (Reuter), however examining of this specimen did not show any significant differences with *O. pilosulus.* He never mentioned the presence of *O. sanguinolentus*

in Iran in any of his papers, a possible explanation is that he regarded the two species as synonyms.

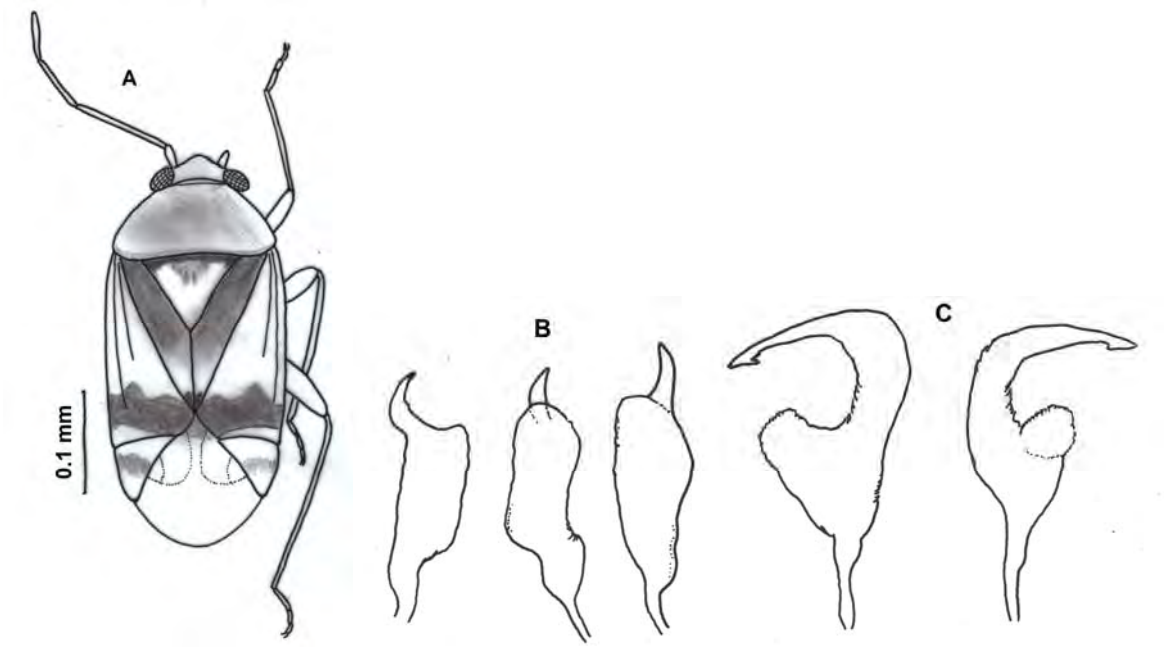

Fig. 5 *Orthops (Montanorthops) pilosulus* (Jakovlev, 1877). (A): Adult; (B): right paramere (different views); (C): left paramere (different views).

Table 2 Diagnostic taxonomical characters in *Orthops (Montanorthops) pilosulus*.

Taxonomic characters	**Ratio/Size (in mm)**
Proportions between 1st and 2nd antennal segments	0.22-1.06
Diatone	0.9
Synthlipsis	0.35
Ocular index	1.29
Base of pronotum	1.375
Lenght of pronotum	0.75
1nd antennal segment/ times as long as diatone	0.24
2nd antennal segment/ times as long as diatone	1.17
2nd antennal segment/ times as long as basal width of pronotum	0.77
Pronotum/ times as broad basally as long in middle	1.83

***Pinalitus cervinus* (Herrich-Schaeffer, 1841) (Fig. 6A-C, 7F)**

Syn: *Orthops cervinus* (Herrich-Schaeffer, 1841)

Material examined

Guilan province: Darreh Dasht (36°48'10" N, 49°38'24" E, elev. 1144 m), 27.v.-28.vi.1995, 20.-25.viii.1998; Dasht-e-Veel (36°50'48" N, 49°35'32" E, elev. 293 m), 20.-25.viii.1998; 40-50 km E of Khalkhal (37°37'57" N, 48°30'33" E, elev. 1765 m), 21.vii.1996; Manjil (36°44'25" N, 49°24'03" E, elev. 302 m), 16.v.-14.vi.1995, 30.x.-1.xi.2000; Nasir Mahaleh (Shaft) (37°05'41" N, 49°18'56" E, elev. 128 m), 14.-15.viii.2002; Rasht (37°15'37" N, 49°35'25" E, elev. 1.5 m), vi.-viii.1996; Salan Sar (36°54'36" N, 49°26'20" E, elev. 741 m), 23.viii.1998; Sang Rud (36°39'59" N, 49°42'06" E, elev. 1338 m), 19.-20.viii.2002; Sang Rud – Jirandeh (36°42'00" N, 49°47'28" E, elev. 1343 m), 31.v.1995 ; Tutkabon – Rudbar (36°53'30" N, 49°31'43" E, elev. 181 m), 6.-8.vi.2002.

This species has been reported from Ardabil province (20-30 km E of Khalkhal, 21.vii.1996; Majareh – Khalkhal, 21.vii.1996) (Linnavuori, 2007).

Diagnosis

Elongated oval species (Table 3). Color from a yellowish brown, reddish or grayish pubescence, thin and clear. Color of antenna yellow, the apical portion of 2^{nd} , 3^{rd} and 4^{th} segments of antenna blackish brown. Posterior margin of pronotum brown or black. Cuneus at its top brownish red or black. Length of species 2.5 to 3 times longer than the width of the pronotum. Second segment of antennae as long or only slightly shorter than the width of pronotum. Right paramere (Fig. 6C), the mastoid-shaped punch. Left paramere (Fig. 6B) small, sensory lobe very small.

Length: male 3.8 to 4.2 mm, female 3.9 to 4.4 mm.

Comments

On deciduous trees. West-Palaearctic (Linnavuori, 2007). This species lives on trees with foliage (*Tilia, Fraxinus, Sorbus*). Two types of color have been reported for this species: one color property grayish or grayish brown and the ventral surface greenish, the other one yellowish brown or reddish and yellowish ventrally (Wagner and Weber, 1964).

Table 3 Diagnostic taxonomical characters in *Pinalitus cervinus*.

Taxonomic characters	**Ratio/Size (in mm)**
Proportions among antennal segments	0.38-1.52-0.56-0.48
Diatone	0.88
Synthlipsis	0.27
Ocular index	0.84
Base of pronotum	1.37
Lenght of pronotum	0.63
1nd antennal segment/ times as long as diatone	0.43
2nd antennal segment/ times as long as diatone	1.72
2nd antennal segment/ times as long as basal width of pronotum	1.1
Pronotum/ times as broad basally as long in middle	2.17

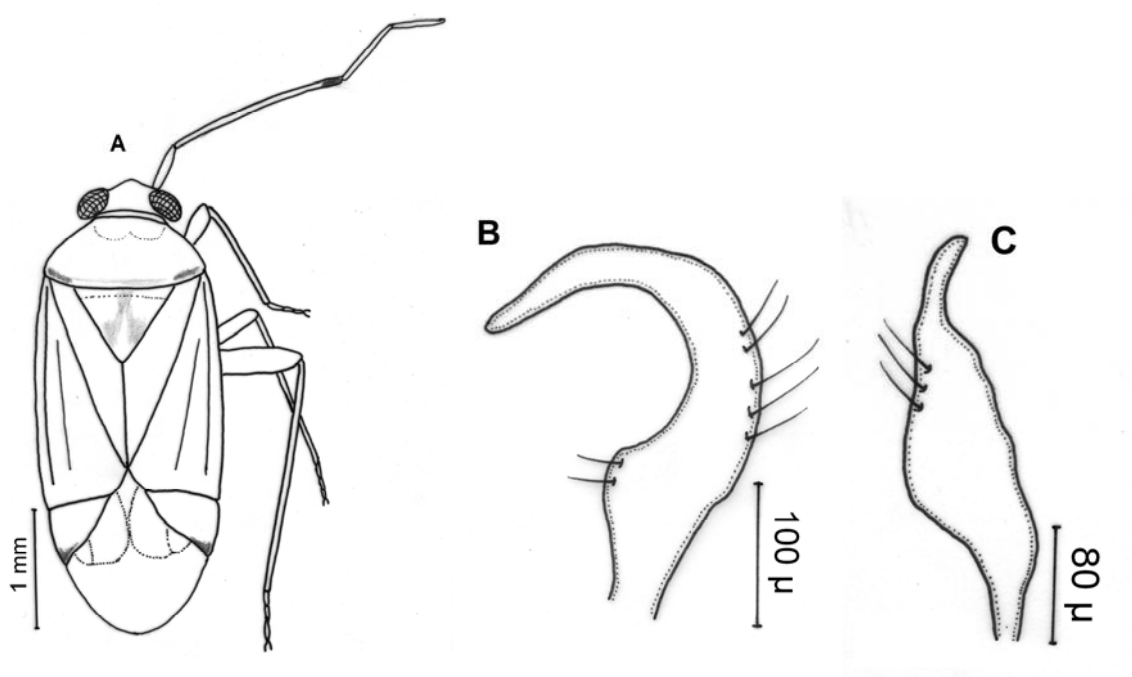

Fig. 6 *Pinalitus cervinus* (Herrich-Schaeffer, 1841), , (A), Adult, (B), Left paramere, (C), Right paramere.

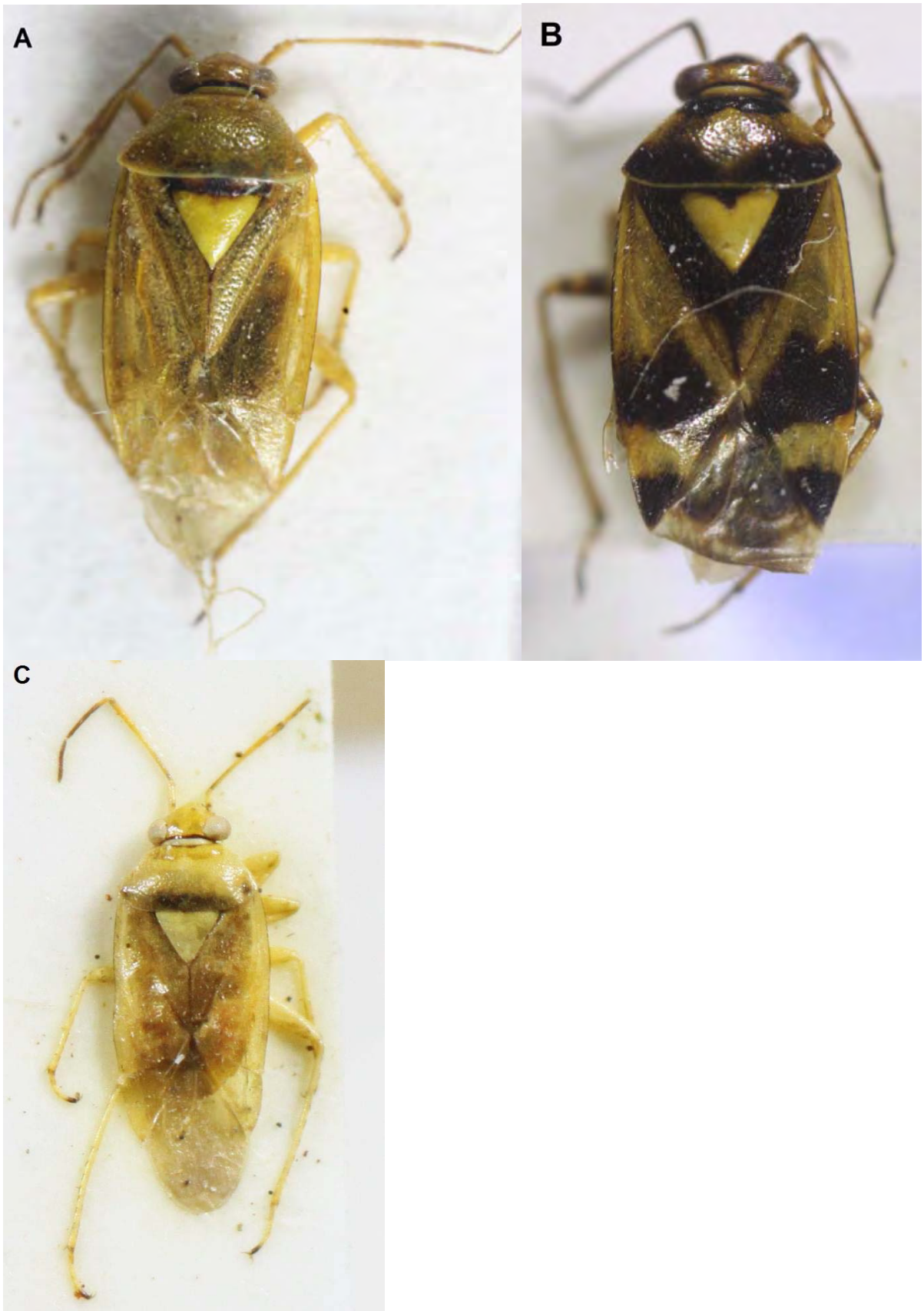

Fig. 7 (A-C): (A): *Orthops (Orthops) frenatus* (Horváth, 1894), (B): *Orthops (Orthops) basalis* (Costa, 1853), (C): *Orthops (Orthops) campestris* (Linnaeus, 1758).

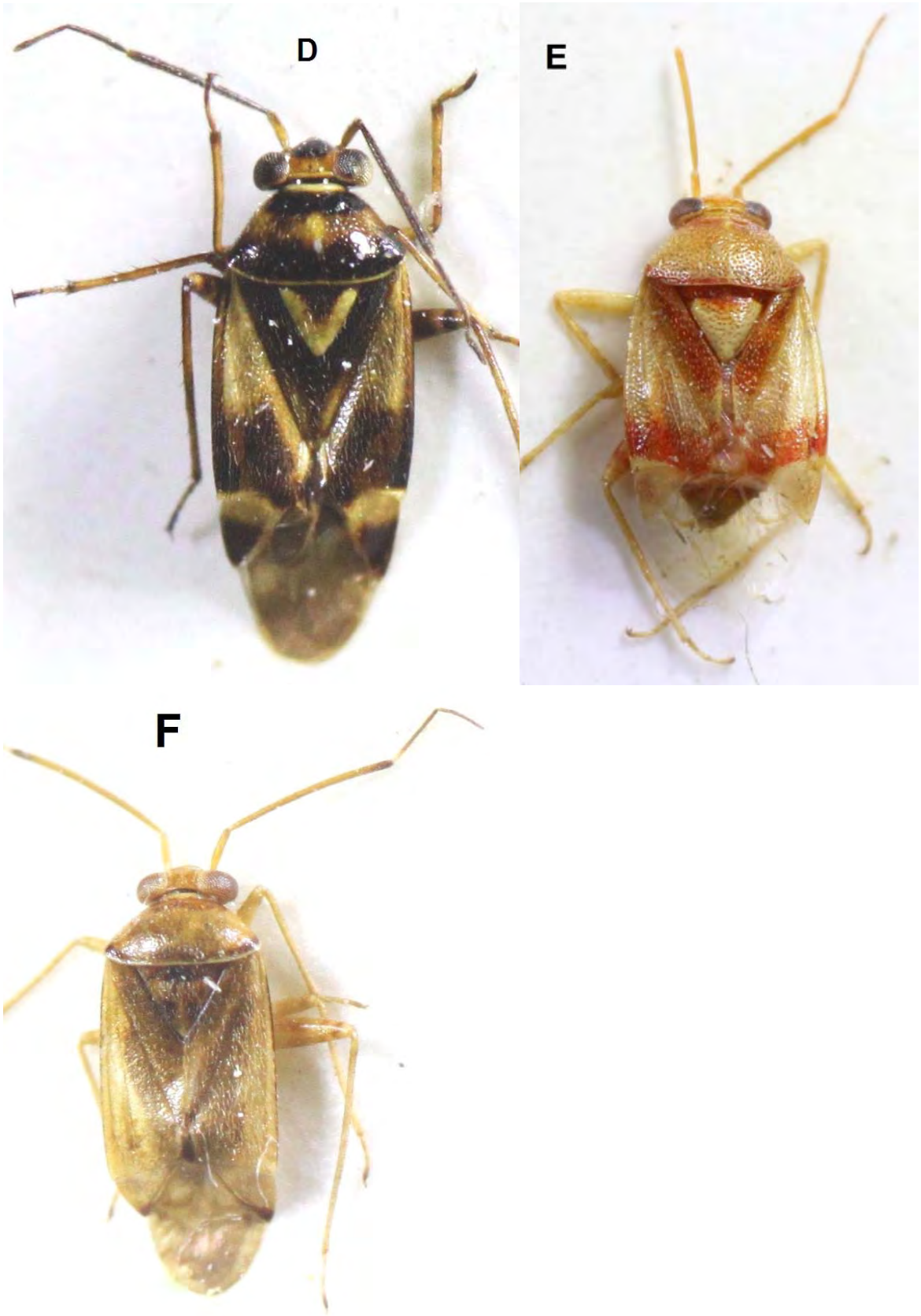

Fig. 7 (D-F): (D): *Orthops (Orthops) kalmii* (Linnaeus, 1758), (E): *Orthops (Montanorthops) pilosulus* (Jakovlev, 1877), (F): *Pinalitus cervinus* (Herrich-Schaeffer, 1841).

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