

Research Article

New records of species of the genera *Corynoppia*, *Ramusella* and *Rhinoppia* (Oribatida: Oppiidae) from Iran, with a key for Iranian oppiid mite species

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Abstract: Five oppiid mite species (Oribatida: Oppiidae) belonging to three genera (*Corynoppia*, *Ramusella* and *Rhinoppia*) are reported as new records for the mite fauna of Iran. Some of their morphological features and distributions in the world are presented. A key to the subfamilies, genera and species of all Iranian oppiid mites is given.

Keywords: Acari, Oribatida, Oppiidae, Fauna, key, Iran

Introduction

The family Oppiidae Sellnick, 1937 is the most species-rich family in the oribatid mites, comprising 134 genera, 39 subgenera and more than 1,000 described species over the world (Subías, 2014). Oppiid mites are characterized by the absence of prodorsal lamellae, tutorium, dorsophragma and pleurophragma; absence or presence of costula; diarthric subcapitulum; normal chelicerae; fused epimera III and IV; moniliform and monodactylous legs, 9-12 pairs of notogastral setae and 4-6 pairs of genital setae (Balogh and Balogh, 1992; Norton and Behan-Pelletier, 2009). Their body size is about 200 to 600 µm in length. They are most diverse in the tropics, although there are a great number of temperate species. They are common inhabitants of moss, humus, litter and pasture sod in both moist and dry situations. Some oppiid species have world-wide distribution. Fungi make up the bulk of oppiid diets and masses of fungal spores have been identified from the gut of some Oppiidae (Norton and Behan-Pelletier, 2009).

Comprehensive keys to oppiid genera of the world are presented in Subías and Balogh (1989) and Balogh and Balogh (1992). Up to now, 52 species of this family belonging to 20 genera have been recorded from Iran as follows: *Aeroppia* (one species), *Anomaloppia* (4 species; two described from Iran), *Austrooppia* (one unknown species), *Berniniella* (2 species; one described from Iran), *Brachioppia* (one unknown species), *Discoppia* (one species), *Dissorhina* (one species), *Graptoppia* (3 species), *Lasiobelba* (3 species), *Lauroppia* (5 species; two described from Iran), *Micropoppia* (one species), *Moritzoppia* (one species), *Multioppia* (4 species), *Oppia* (2 species), *Oppiella* (one species), *Oxyoppia* (2 species; one described from Iran), *Ramusella* (13 species; 4 described from Iran), *Rhinoppia* (4 species; one described from Iran), *Serratoppia* (one species; described from Iran) and *Striatoppia* (one unknown species) (Bayartogtokh and Akrami, 2000; Akrami and Subías, 2007a, b; Akrami and Subías, 2008a, b, c; Akrami, 2008, 2012; Akrami *et al.*, 2009, 2011; Haddad Irani-Nejad *et al.*, 2002, 2003; Behmanesh *et al.*, 2012; Mirzaie and Akrami, 2012).

In the present study, five species belonging to genera *Corynoppia*, *Ramusella* and *Rhinoppia* are presented as new records for the mite fauna

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of Iran. A key to the subfamilies, genera and species of Iranian oppiid mites is given.

Materials and Methods

The specimens were collected by taking soil samples in different years. Each sample contained 2-4 trowels of soil taken from a maximum depth of 20 cm, in areas with trees, crop plants and weeds. The mites were extracted using Berlese funnels and stored in 75% ethanol, cleared by Nesbitt's medium and mounted in Hoyer's medium on microscope slides. The slides were placed in an oven at 45-50°C for a week. The specimens were examined using a light microscope. All specimens were deposited in the Acarological Collection, Department of Plant Protection, Faculty of Agriculture, Shiraz University.

Results

In the present faunistic study of oppiid mites of different regions of Iran, five species are recognized as new records for the mite fauna of Iran.

All species reported here are well recognizable. It is not intended to give detailed redescriptions for them, but short diagnostic characterizations are provided, with notes on their geographic distribution. Also a key to the subfamilies, genera and species of all Iranian oppiid mites is given.

Family Oppiidae Sellnick, 1937

Genus *Corynoppia* Balogh, 1983

Corynoppia kosarovi (Jeleva, 1962) (Fig. 1)

Measurements: Length: 316 µm, width: 158 µm.

Material examined: One adult specimen (female), Firoozabad, Fars province, southern Iran, 1327 m above sea level, 36°52'N, 52°28'E, soil, 2006, M. J. Hajian leg.

Diagnostic characters: Rostrum rounded; sensilli almost short, S-shaped, aciculate, inclinate and proclinate apically; rostral setae long, blade-shaped, smooth; interlamellar setae minute, hardly visible; lamellar setae short, slightly fusiform, brush-like; dorsosejugal furrow protruding into blunt apex centrally; notogaster with 10 pairs of setae, nine brush-like, nearly equal in length, none of them reaching the insertion of the setae behind

them, setae c_2 poorly developed, minute; epimeral setal formula (I-IV) 3-1-3-3, anogenital formula: 5-1-2-3; fissure *iad* in paraanal position; all ventral setae, except brush-like ad_1 , simple and smooth; ad_3 preanal, inserted at level of *ag*.

Distribution: Mediterranean and Panama (Subías, 2014), Iran.

Subgenus *Ramusella* (*Ramusella*) Hammer, 1962

Ramusella (*Ramusella*) *confusa* Arillo & Subías, 1990 (Fig. 2)

Measurements: Length: 216 µm, width: 126 µm.

Material examined: One adult specimen (female), Nashtarood, Mazandaran province, northern Iran, 36°46'N, 51°03'E, soil, 2004, M. A. Akrami leg.

Diagnostic characters: Rostrum rounded with median protuberance; prodorsum with lamellar and translamellar lines; rostral setae long, barbulated unilaterally, their alveoli are very close together; interlamellar and lamellar setae smooth; sensilli fusiform with 7-8 relatively long barbs in the outer margin of its head, its stalk smooth; three pairs of muscle sigillae in the interbothridial region; notogaster with nine pairs of long, smooth setae, setae c_2 absent; anogenital formula: 5-1-2-3, epimeral setal formula (I-IV) 3-1-3-3; all ventral setae simple and smooth; ad_3 preanal; fissure *iad* in adanal position.

Distribution: Macaronesia (Madeira) (Subías, 2014), Iran.

Ramusella (*Ramusella*) *gyrata* (Mahunka & Paoletti, 1984) (Fig. 3)

Measurements: Length: 274 µm, width: 158 µm.

Material examined: One adult specimen (male), Arak, Markazi province, west-central Iran, 1800 m above sea level, 34°42'N, 49°29'E, soil, 2005, S. R. Bastan leg.

Diagnostic characters: Rostrum rounded; lamellar line developed; rostral setae long and thick, ciliated unilaterally, inserted on small chitinous tubercles, connected by a transversal line; interlamellar and lamellar setae smooth, nearly equal in length; sensilli asymmetrical, with a long stalk, gradually thickening fusiformly, its head with 7-8 long barbs in outer and 4-5 short barbs in inner margin; three pairs of muscle sigillae in the interbothridial region;

notogaster with nine pairs of long, ciliate setae, setae c_2 absent; anogenital formula: 5-1-2-3, epimeral setal formula (I-IV) 3-1-3-3; all ventral setae simple and smooth; ad_3 preanal; fissure *iad* in adanal position.

Distribution: Italy (Subías, 2014), Iran.

Subgenus *Ramusella* (*Rectoppia*) Subías, 1980
***Ramusella* (*Rectoppia*) *mihelcici* (Pérez-Íñigo, 1965) (Fig. 4)**

Measurements: Length: 258 μm , width: 110 μm .

Material examined: One adult specimen (female), Arak, Markazi province, west-central Iran, 1800 m above sea level, 34°42'N, 49°29'E, soil, 2005, S. R. Bastan leg.

Diagnostic characters: Rostrum triangular, not pointed; rostral setae long, divergent at the base, situated near each other, inserted on small chitinous tubercles, distinctly barbed; lamellar setae longer than rostral ones, smooth; interlamellar setae shorter than lamellar and rostral setae, smooth; sensilli asymmetrically fusiform, head with nearly 12 long barbs on the outer margin; three pairs of muscle sigillae situated between the interlamellar setae; lamellar lines present; nine pairs of notogastral setae, smooth, seta c_2 not developed; epimeral setal formula (I-IV) 3-1-3-3; anogenital formula: 5-1-2-

3; all ventral setae simple and smooth; ad_3 preanal; fissure *iad* in adanal position.

Distribution: Palearctic and Venezuela (Subías, 2014), Iran.

Subgenus *Rhinoppia* (*Bipectinoppia*) Subías & Shtanchaeva, 2011

***Rhinoppia* (*Bipectinoppia*) *tasdemiri* Toluk & Ayyildiz, 2008 (Fig. 5)**

Measurements: Length: 337 μm , width: 184 μm .

Material examined: One adult specimen (male), Arak, Markazi province, west-central Iran, 1800 m above sea level, 34°42'N, 49°29'E, soil, 2005, S. R. Bastan leg.

Diagnostic characters: Prodorsum without costulae; rostrum elongate, projecting medially; rostral setae long, smooth; lamellar setae very short, smooth; interlamellar setae longer than lamellar, shorter than rostral setae, smooth; sensilli long with dilated head, its head ciliated bilaterally with short barbs; notogaster with 10 pairs of short and smooth setae; epimeral setal formula (I-IV) 3-1-3-3; anogenital formula: 6-1-2-3; all ventral setae simple and smooth; ad_3 preanal; fissure *iad* in adanal position.

Distribution: Turkey (Toluk and Ayyildiz, 2008; Subías, 2014), Iran.

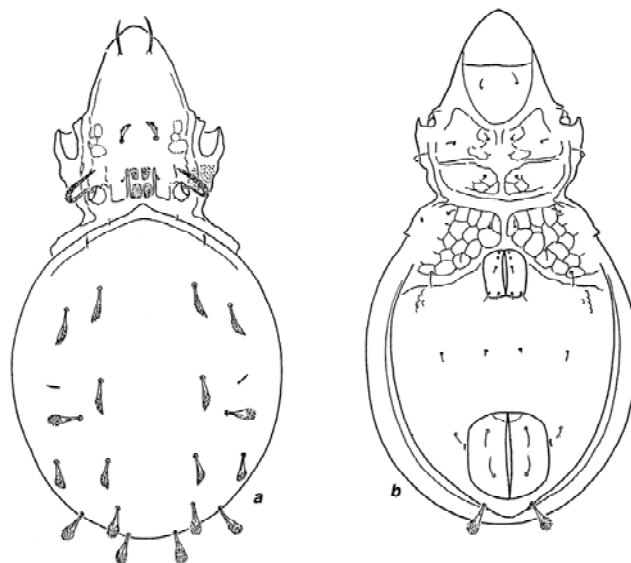


Figure 1 *Corynoppia kosarovi* (Jeleva, 1962), a: dorsal view, b: ventral view (after Csiszar and Jeleva, 1962).

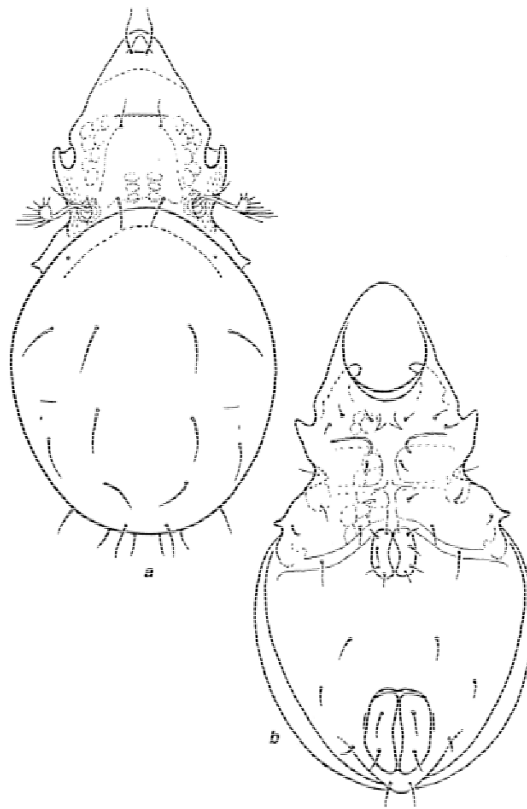


Figure 2 *Ramusella (Ramusella) confusa* Arillo & Subías, 1990, a: dorsal view, b: ventral view (after Arillo and Subías, 1990).

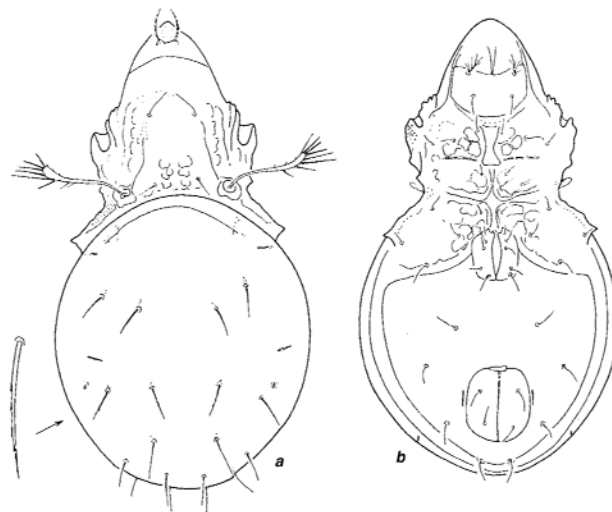


Figure 3 *Ramusella (Ramusella) gyrata* (Mahunka & Paoletti, 1984), a: dorsal view, b: ventral view (after Mahunka and Paoletti, 1984).

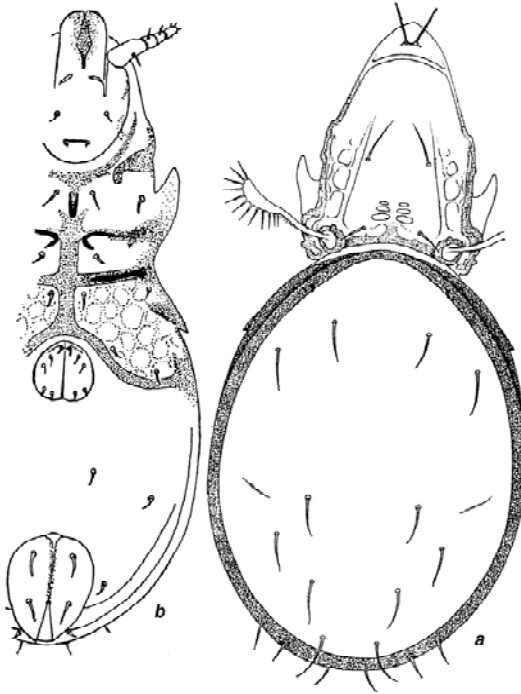


Figure 4 *Ramusella (Rectoppia) mihelcici* (Pérez-Íñigo, 1965), a: dorsal view, b: ventral view (after Pérez-Íñigo, 1965).

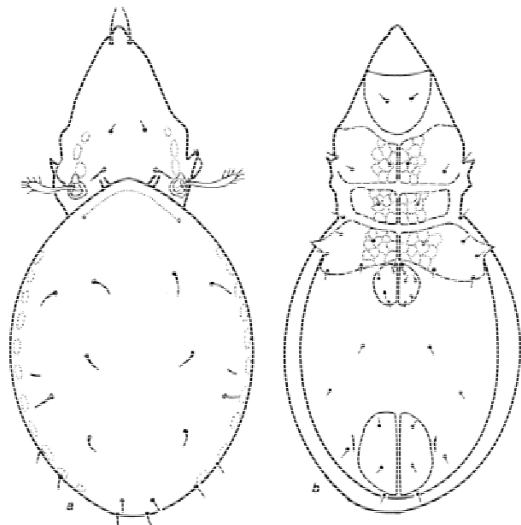


Figure 5 *Rhinoppia (Bipectinoppia) tasdemiri* Toluk & Ayyildiz, 2008, a: dorsal view, b: ventral view (after Toluk and Ayyildiz, 2008).

A key to the subfamilies, genera and species of oppiid mites of Iran

- 1- Crista present, setae c_2 mostly well developed. Sometimes with one pair of interbothridial tubercles 2
- Crista absent, setae c_2 either absent or less developed than the remaining notogastral setae, interbothridial tubercles usually absent 19
- 2- Lamellar costulae absent [**Medioppiinae**] 3
- Lamellar costulae present [**Oppiellinae**] 10
- 3- Anterior margin of notogaster either with posteriorly directed crests or lines, or sclerotized apophyses running from the dorsosejugal furrow to the basal part of the prodorsum 4
- Anterior margin of notogaster without posteriorly directed crests, lines or sclerotized apophyses running from the dorsosejugal furrow to the basal part of the prodorsum.....
- Discoppia* (*Cylindroppia*) *cylindrica* (Pérez-Íñigo, 1965)
- 4- Anterior margin of notogaster with posteriorly directed crests or lines [*Rhinoppia*] 5
- Anterior margin of notogaster with two sclerotized apophyses running from the dorsosejugal furrow to the basal part of the prodorsum 9
- 5- Sensillus bipectinate [*Rhinoppia* (*Bipectinoppia*)] 6
- Sensillus not bipectinate [*Rhinoppia* (*Rhinoppia*)] 7
- 6- Sensillar head dilated, with short cilia *Rhinoppia* (*Bipectinoppia*) *tasdemiri* Toluk & Ayyildiz, 2008
- Sensillar head not dilated, with long cilia *Rhinoppia* (*Bipectinoppia*) *bipectinata* (Akrami & Subías, 2007)
- 7- Rostrum tridentate *Rhinoppia* (*Rhinoppia*) *ordunensis* (Iturrondobeitia & Saloña, 1988)
- Rostrum not dentate 8
- 8- Sensillus fusiform *Rhinoppia* (*Rhinoppia*) *obsoleta* (Paoli, 1908)
- Sensillus pectinate *Rhinoppia* (*Rhinoppia*) *subpectinata* (Oudemans, 1900)
- 9- Sensillus fusiform, ciliate; rostrum tridentate *Serratoppia iranica* Akrami, Subías & Saboori, 2009
- Sensillus globular; rostrum not dentate *Microppia minus* (Paoli, 1908)
- 10- Dorsosejugal furrow straight or slightly arched, anterior part of notogaster not penetrating into the basal part of the prodorsum 11
- Dorsosejugal furrow convex, parabolic or semicircular, penetrating deeply into the basal part of the prodorsum 16
- 11- Anterior margin of notogaster without protruding humeral processes, with 5-6 pairs of genital setae [*Lauroppia*] 12
- Anterior margin of notogaster with protruding humeral processes, with 5 pairs of genital setae *Oppiella nova* (Oudemans, 1902)
- 12- Sensillus fusiform, ciliate 13
- Sensillus with a pectinate or bipectinate fusiform head 15
- 13- Sensillus with long branches *Lauroppia falcata marginedentata* (Strenzke, 1951)
- Sensillus with short branches 14
- 14- Interlamellar setae very long, longer than lamellar ones *Lauroppia doris* (E. Pérez-Íñigo, 1978)
- Interlamellar setae of similar length to lamellar ones *Lauroppia tenuipectinata* Subías & Rodríguez, 1988
- 15- Sensillus with a bipectinate fusiform head and 7 medium long barbs *Lauroppia iranica* Akrami & Subías, 2008
- Sensillus with a pectinate head and 6 long barbs *Lauroppia persiangulfa* Akrami & Subías, 2008
- 16- Setae c_2 poorly developed, sensillus fusiform lanceolate and smooth or ciliate, rostrum with naso bearing rostral setae *Dissorhina ornata* (Oudemans, 1900)
- Setae c_2 well developed, as long as the remaining notogastral setae; sensillus fusiform, globular or radiate 17
- 17- Sensillus radiate; rostrum tridentate [*Berniniella*] 18
- Sensillus globular and aciculate; rostrum usually not dentate *Moritzoppia unicarinata* (Paoli, 1908)

- 18- Dorsosejugal furrow with two long apophyses; sensillar barbs very long
Berniniella iranica Akrami, 2012
 - Dorsosejugal furrow with two small projections; sensillar barbs short
Berniniella bicarinata (Paoli, 1908)
- 19- Anterior margin of notogaster with one pair of protruding humeral processes; interbothridial region with costulae or with lamellar and translamellar crests 20
 - Anterior margin of notogaster without protruding humeral processes; interbothridial region without costulae or lamellar and translamellar crests (lamellar and / or translamellar lines usually present) 23
- 20- Interbothridial region with costulae [**Mystroppiinae**] 21
 - Interbothridial region without costulae [**Oxyoppiinae**] [*Oxyoppia*] 22
- 21- Prodorsum with prolamellar ridge; notogaster with fine longitudinal lines
Striatoppia niliaca (Popp, 1960)
 - Prodorsum without prolamellar ridge; notogaster without fine longitudinal lines
Corynoppia kosarovi (Jeleva, 1962)
- 22- Sensillus lanceolate pectinate; notogastral and ventral setae ciliate *Oxyoppia* (*Dzarogneta*) *iranensis* Akrami & Subías, 2008
 - Sensillus setiform pectinate; notogastral and ventral setae smooth *Oxyoppia* (*Dzarogneta*) *intermedia* Subías & Rodríguez, 1986
- 23- Fissure *iad* inverse apoanal [**Brachyoppiinae**] 24
 - Fissure *iad* either paraanal or direct apoanal 25
- 24- Sensillus fusiform ciliate *Austrooppia* sp.
 - Sensillus pectinate or radiate
Brachiooppia sp.
- 25- Lamellar and translamellar lines absent; sensillus never pectinate, radiate or ciliate [**Oppiinae**] 26
 - Lamellar and/or translamellar lines present; sensillus pectinate, radiate or ciliate [**Multioppiinae**] 30
- 26- Sensillus globular or clavate
Aeroppia adjacens Mahunka, 1985
- Sensillus setiform, lanceolate or elongately fusiform 27
- 27- Sensillus setiform or setiform and lanceolate [*Lasiobelba*] 28
 - Sensillus elongately fusiform or lanceolate [*Oppia*] 29
- 28- Sensillus widened distally, being narrow fusiform or lanceolate *Lasiobelba* (*Lasiobelba*) *neonominata* Subías, 2004
 - Sensillus setiform *Lasiobelba* (*Antennoppia*) *heterosa* (Wallwork, 1964)
- 29- Sensillus and notogastral setae shorter or nearly as long as lamellar setae *Oppia nitens* Koch, 1836
 - Sensillus and notogastral setae nearly twice as long as lamellar setae *Oppia denticulata* (G. & R. Canestrini, 1882)
- 30- Fissure *iad* direct apoanal *Graptoppia* (*Apograptoppia*) *foveolata* (Paoli, 1908)
 - Fissure *iad* paraanal 31
- 31- Notogaster with 9 pairs of setae 32
 - Notogaster with 10 or 12 pairs of setae 49
- 32- With 2 pairs of sigillae in interbothridial region [*Graptoppia* (*Graptoppia*)] 33
 - With 3 pairs of sigillae in interbothridial region [*Ramusella*] 34
- 33- Translamellar line present *Graptoppia* (*Graptoppia*) *sundensis acuta* Ayyildiz, 1989.
 - Translamellar line absent *Graptoppia* (*Graptoppia*) *neonominata* Subías, 2004.
- 34- Rostral setae straight, their apical halves divergent [*Ramusella* (*Rectoppia*)] 37
 - Rostral setae slightly arched or geniculate, their apical halves converging 35
- 35- Rostral setae geniculate, their alveoli near each other [*Ramusella* (*Ramusella*)] 40
 - Rostral setae slightly arched, their alveoli slightly far from each other 36
- 36- Sensillus fusiform or lanceolate, laterally ciliate [*Ramusella* (*Insculptoppiella*)]
Ramusella (*Insculptoppiella*) *varians* (Wallwork, 1961)
 - Sensillus fusiform, either unilaterally ciliate or pectinate [*Ramusella* (*Insculptoppia*)] 46
- 37- Rostral setae heavily plumose; sensillus clavate with short barbs *Ramusella*

- (*Rectoppia*) *damavandica* Akrami & Subías, 2008
- Rostral setae sparsely ciliate; sensillus fusiform or narrowly clavate with long barbs 38
 - 38- Notogastral setae short and smooth; interlamellar setae shorter than lamellar setae... *Ramusella* (*Rectoppia*) *mihelcici* (Pérez-Íñigo, 1965)
 - Notogastral setae long and ciliate; interlamellar setae nearly as long as lamellar setae 39
 - 39- Sensillar head with 7-9 radiating barbs..... *Ramusella* (*Rectoppia*) *fasciata fasciata* (Paoli, 1908)
 - Sensillar head with 12-13 barbs *Ramusella* (*Rectoppia*) *strinatii* (Mahunka, 1980)
 - 40- Sensillus pectinate, with 6 long branches ... *Ramusella* (*Ramusella*) *puertomontensis* Hammer, 1962
 - Sensillus clavate or fusiform 41
 - 41- Sensillus claviform, with rounded end 42
 - Sensillus fusiform, with sharp end 45
 - 42- Sensillar head entirely rounded with 6-7 short barbs..... *Ramusella* (*Ramusella*) *clavipectinata* (Michael, 1885)
 - Sensillar head narrowly rounded with long barbs 43
 - 43- Rostral setae situated far from each other, entirely ciliate; notogastral setae ciliate *Ramusella* (*Ramusella*) *persica* **Akrami, Behmanesh, & Subías, 2015**
 - Rostral setae situated close to each other, proximally ciliate; notogastral setae smooth 44
 - 44- Sensillar head with 6 long and 3 shorter barbs; rostral setae not connected by a transverse line; translamellar line absent *Ramusella* (*Ramusella*) *curtipilus* Hammer, 1971
 - Sensillar head with 7 medium long barbs; rostral setae connected by a transverse line; translamellar line developed *Ramusella* (*Ramusella*) *confusa* Arillo & Subías, 1990
 - 45- Rostral setae entirely ciliate; translamellar line absent; sensillar head with 6-7 medium long barbs *Ramusella* (*Ramusella*) *gyrata* (Mahunka & Paoletti, 1984)
 - Rostral setae proximally ciliate; translamellar line developed; sensillar head with 9-13 long barbs *Ramusella* (*Ramusella*) *sengbuschi* Hammer, 1968
 - 46- Sensillus pectinate, with 5-6 very long branches *Ramusella* (*Insculptoppia*) *insculpta* (Paoli, 1908)
 - Sensillus fusiform, with short to medium long barbs 47
 - 47- Notogastral setae short and ciliate *Ramusella* (*Insculptoppia*) *iranica* Akrami & Subías, 2008
 - Notogastral setae long and smooth 48
 - 48- Translamellar line developed; setae *lm* anterior to *la* *Ramusella* (*Insculptoppia*) *farsi* Akrami, Subías & Behmanesh, 2011
 - Translamellar line not developed; setae *lm* at the same transverse level as *la* *Ramusella* (*Insculptoppia*) *elliptica* (Berlese, 1908) [= *Ramusella* *abarkouhiensis* Bayartogtokh & Akrami, 2000]
 - 49- Notogaster with 10 pairs of setae [*Anomaloppia*] 50
 - Notogaster with 12 pairs of setae [*Multioppia*] 53
 - 50-** Rostral setae situated close to each other, hence distance between insertions less than half their length 51
 - Rostral setae situated far from each other, hence distance between insertions more than half their length *Anomaloppia* *dispariseta* (Hammer, 1958)
 - 51-** Rostral setae conspicuously longer than lamellar setae, extending for 2/3 of its length beyond the tip of the rostrum *Anomaloppia* *ozkani* Ayyildiz, 1989
 - Rostral setae nearly as long as or slightly longer than lamellar setae, extending for 1/3 of its length beyond the tip of the rostrum 52
 - 52-** Notogastral setae smooth *Anomaloppia* *iranica* Bayartogtokh & Akrami, 2000
 - Notogastral setae ciliate *Anomaloppia* *mazandaranica* Akrami & Subías, 2007
 - 53-** Rostral setae strongly elbowed *Multioppia* (*Hammeroppia*) *wilsoni wilsoni* Aoki, 1964
 - Rostral setae gently curved medially 54

- 54- Notogastral setae ciliated unilaterally; setae *dm* situated at level of *lm*..... *Multioppia* (*Hammeroppia*) *wilsoni laniseta* Moritz, 1966
- Notogastral setae smooth; setae *dm* situated anteromedial of *lm* 55
- 55- Notogastral setae *la* situated at level of *dm*; *dm* situated closer to *da* than to *dp*
Multioppia (*Multioppia*) *stellifera* Hammer, 1961
- Notogastral setae *la* situated almost mid-distance between *da* and *dm*; *dm* situated mid-distance between *da* and *dp* 56
- 56- Sensillar head with 11 cilia; the second transverse row of interbothridial muscle sigilla with three sigilla *Multioppia* (*Multioppia*) *pakistanensis* Hammer, 1977
- Sensillar head with 16-17 cilia; the second transverse row of interbothridial muscle sigilla with two sigilla *Multioppia* (*Multioppia*) *radiata* Hammer, 1961

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گزارش جدید چند گونه از کنه‌های اریباتید متعلق به جنس‌های *Ramusella*, *Corynoppia* و *Rhinoppia* از ایران، همراه با کلید شناسایی تمام گونه‌های خانواده *Oppiidae* ایران

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چکیده: ۵ گونه کنه اریباتید از خانواده *Oppiidae* متعلق به جنس‌های *Ramusella*, *Corynoppia* و *Rhinoppia* برای اولین بار از ایران گزارش می‌شوند. برخی از ویژگی‌های ریخت‌شناسی همراه با پراکنش گونه‌ها و هم‌چنین کلید شناسایی زیرخانواده‌ها، جنس‌ها و تمام گونه‌های متعلق به این خانواده که از ایران گزارش گردیده، ارائه شده است.

واژگان کلیدی: کنه‌ها، نهان استیگمایان، *Oppiidae*، فون، کلید شناسایی، ایران