The soil mite family Galumnidae of Iran (Acari: Oribatida)

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Although a few species have been recorded in Iran, many species from the family Galumnidae remained undiscovered, and in this work we describe six new species and redescribe one known species from the northern part of the country. They are Acrogalumna lanceolata sp. nov., Allogalumna dentirostrata sp. nov., Galumna granulimorpha sp. nov., Galumna triangulata sp. nov., Galumna iranensis Mahunka et Akrami, 2001, Pergalumna iunctiporosa sp. nov., Pergalumna micro-tuberculata sp. nov., and the description of each species is accompanied with detailed illustrations. We also present data on habitat and biogeography of Iranian species of Galumnidae, and a key is provided for identification of all recorded species in this country.

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Introduction

The family Galumnidae Jacot, 1925 is one of the largest groups of oribatid mites with a worldwide distribution; it comprises 33 genera with about 450 species (Balogh and Balogh 1992; Subías 2004, 2011). Members of this family are abundant in the litter or upper layer of forest soil as well as in pasture soil of open habitats; in particular, they are diverse in the tropical soil, litter and arboreal habitats in rain forests.

The adults of Galumnidae (together with those of the related family Galumnellidae Piffl, 1970) are unique among oribatid mites in having a pair of very large auriculate humeral tectum called a pteromorph, which conceals all or part of the retracted legs, the narrow lamellar (line L) and tutorial (line S) ridges, and the subcapitular mentum with complete tectum. The base of a pteromorph is completely or partially desclerotized to form a linear hinge and some of the dorsoventral musculature is modified to pull the resulting movable pteromorph against the body when the mite is disturbed. Ramsay and Wallwork (1972) speculated that larger pteromorphs, such as those in Galumnidae, might also restrict airflow to tracheae and thereby control water loss.

Members of the family Parakalummidae Grandjean, 1936 share the large, movable, auriculate pteromorphs with Galumnidae, and therefore, the former family is often confused with the latter. However, galumnids have a large subcapitular (mental) tectum as adults and large opisthonotal sclerites as immatures (Norton and...
Moreover, the members of Parakalummidae clearly differ from those of Galumnidae by the presence of true lamellae (absent in Galumnidae); notogastral seta $c_2$ arising on notogaster (in Galumnidae seta $c_2$ inserted on pteromorph), and well-developed custodium (custodium absent in Galumnidae) (Mahunka 1995). Hence, the members of Parakalummidae do not show a close relationship with those of Galumnidae, so they cannot be included within the same superfamily. Subías (2004) encompassed Parakalummidae in the superfamily Galumoidea Jacot, 1925, which is, however, in our opinion an incorrect attempt.

Some of the galumnid species exhibit sexual dimorphism in the structure of porose areas on notogaster, prodorsal setae, sensilli etc. (e.g. Travé 1955, 1981; Grandjean 1964, 1966; Norton and Alberti 1997; Bayartogtokh and Weigmann 2005). Immatures of Galumnidae are apheroderms, unideficient, with large opisthontal sclerites, often bearing an octotaxic system of porose areas, with a single circumgenital sclerite, and seta $d$ absent from tibiae and genua when the respective solenidion is present (Norton and Behan-Pelletier 2009). However, the morphology of immature stages is known for only a few species (Travé 1955; Grandjean 1956; Grishina 1982; Bernini 1984), and descriptions of the majority of species have been based on adults.

Some species of galumnid mites play an important role in the life cycle of cestode tapeworms of the family Anoplocephalidae, serving as their intermediate hosts in both natural conditions and experimental infections (Stunkard 1937; Kulijev 1962; Sengbusch 1977; Balakrishnan and Haq 1989; Denegri 1993; Schuster et al. 2000; McAloon 2004; Akrami et al. 2007).

The oribatid mites of the family Galumnidae of Iran are poorly known, although there is a great possibility for many species to occur in this country. In a few publications (Mahunka and Akrami 2001; Akrami 2007; Kheradpir et al. 2007; Lotfollahi and Irani-Nejad 2010; Mortazavi Lahijani Sh et al. 2010; Akrami et al. 2011) four new and six known species belonging to the genera Galumna Heyden, 1826, Pilogalumna Grandjean 1956 and Psammogalumna Balogh, 1943 were reported (see Discussion). In the present work, we describe six new species and redescribe one known species, and present an identification key to all known species of Galumnidae in Iran, with remarks on their geographical distribution and habitat ecology.

**Material and methods**

All materials used in this study were collected by the second author, and the specimens were mounted in permanent slides, hence some of the specimens were damaged or slightly pressed. Those slides were reopened to view the anterior, lateral and posterior aspects of studied specimens and the contents were then preserved in alcohol. All examined materials and data on their localities are given in the respective “Material examined” sections. Species studied here are represented as adults.

The morphological terminology used below is mostly that developed over many years by Grandjean (1956, 1957, 1966), and also that by Norton and Behan-Pelletier (2009). All measurements are given as a range, with the mean in parentheses. 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 length was also measured in lateral aspect (when the dorsosejugal groove is discernable), from the anterior to the posterior edge; notogastral width refers to the maximum width in dorsal aspect. Setal formulae of the legs are...
given as numbers per segment for appendages (from trochanter to tarsus) and as number per podosomal segment (I–IV) for epimeres.

Most species of Galumnidae show the same structure and setation of legs, palps and chelicerae. Therefore, in this work we made detailed description and illustration of legs, chelicera and palp for only one of the studied species, and for other species only supplementary characterizations are given. Short definitions of the genera studied here are given in parentheses, before the diagnosis of the first described species of each genus. Below, the descriptions are given not in alphabetical order of genera or species order, but starting with the species that is described in detail.

A differential interference contrast microscope (Olympus CX 31) was used for investigation in transmitted light. Line drawings were made using a camera lucida attached to the compound microscope. Micrographs were taken using a digital camera (Olympus Altra 20) attached to the microscope with single shot.

Results

*Allogalumna dentirostrata* sp. nov.
(Figures 1–3 and 4A–F)

**Diagnosis**
With typical characters of *Allogalumna* (lamellar line absent; sublamellar line present; notogastral median pore present; notogastral setae minute or represented by their alveoli); rostrum with three distinct teeth; interlamellar seta long, finely barbed; sensillus medium long, with finely barbed, very slightly dilated head; porose area *Aa* irregular elongate-oval, obliquely oriented, its lateral part conspicuously widened, but medial part narrowed; *A1* round on dorsal view, but oval in lateral view, *A2* oval, *A3* elongate oval; median pore present; genital plate with longitudinal striations; postanal porose area not evident.

**Measurements**
Holotype: body length 608 µm; width of notogaster 496 µm; paratypes (*n* = 3): body length 600–615 (607) µm, width of notogaster 505–530 (520) µm.

**Description**

**Integument.** Body colour yellowish-brown. Cuticle of body and legs nearly smooth, with minute granules, gnathosomal and epimeral regions with larger granules; pteromorph with radiated ridges; marginal part of notogaster with transverse ridges; genital plates with longitudinal striations (Figure 4C and F).

**Prodorsum.** Rostrum with three distinct teeth of similar size, clearly seen in dorso-frontal and ventral aspects (Figures 1D, 2C and 4A). Rostral seta (*ro*) thin, 86–94 µm long, finely barbed, inserted ventrally. Lamellar seta (*le*) thin, 98–115 µm long, finely barbed. Interlamellar seta (*in*) thin, 106–124 µm long, finely barbed.
Sensillus narrow, 102–115 µm long, with finely barbed, very slightly dilated head (Figures 1B and 4D). Lamellar line absent, sublamellar line well developed (Figures 1A, 2C and 4A). Dorsosejugal porose area (Ad) elongate oval, located posterior to alveolus of seta in.

Figure 1. Allogalumna dentirostrata sp. nov. (A) Dorsal view of idiosoma; (B) sensillus and bothridium; (C) posteroventral view of opisthonotum; (D) gnathosomal, epimeral and genital regions, partial.
Notogaster. Notogaster distinctly widened posteriorly, dorsosejugal furrow well developed, widely arched. Notogastral setae vestigial, 10 pairs of alveoli clearly discernable. Porose area $A_a$ larger than others, irregular elongate-oval, obliquely oriented, its lateral part conspicuously widened, but medial part narrowed; $A_1$ round on dorsal view, but oval in lateral view, $A_2$ oval, $A_3$ elongate oval; centrodorsal
Figure 3. *Allogalumna dentirostrata* sp. nov. (A) Leg I, right, antiaxial view; (B) leg II, left, antiaxial view; (C) leg III, right, antiaxial view; (D) leg IV, right, antiaxial view. Trochanters are not illustrated in A, B and C.
Figure 4. Morphological characters of different species. (A–F) *Allogalumna dentirostrata* sp. nov. (A) Anterior part of prodorsum; (B) gnathosomal, epimeral and genital regions; (C) pteromorph showing ridges on its cuticle; (D) left side of humeral region; (E) porose area Aa; (F) transversal ridges on notogastral margin. (G–J) *Acrogalumna lanceolata* sp. nov. (G) Rorstrum (arrow indicates central carina); (H) humeral region; (I) pteromorph; (J) porose areas, lyrifussure and opisthontal gland opening. (K–N) *Galumna triangulata* sp. nov. (K) Lateral view of prodorsum; (L) lateral view of pteromorph and part of notogaster, showing transversal ridges; (M) rostrum (arrow indicates central carina); (N) lateral view of sensillus.
or median pore (mp) present. Lyrifissures ia, im, ih, ip, ips and opisthontal gland opening (gla) well developed (Figures 1A, C, 2A, C, D and 4D, E).

Gnathosoma. Subcapitulum longer than wide, hypostomal setae a, m and h 21–25 µm long, smooth. Palp typical for family as shown in Pergalumna iunctiporosa sp. nov., all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion ω on tarsus. Chelicera with few heavily sclerotized blunt teeth on fixed and movable digits; setae cha and chb long, barbed (Figures 1D, 2B and 4B).

Epimeral region. Apodemes apo.1, apo.2, apo.sj, apo.3, circumpedal carina and discidium well developed. Six pairs of epimeral setae observed, seta 3a vestigial, other setae well developed, setal formula: 1-0-2-3 (Figures 1D and 4B).

Ano-genital region. Anal aperture 143 µm long, 152 µm wide; genital aperture 90 µm long, 106 µm wide, genital plates with longitudinal striations. All ano-genital setae thin, smooth; genital setae (g1–g6) 20–41 µm long, aggenital seta (ag) 25 µm long, anal (an1, an2) and adanal setae (ad1–ad3) 20–24 µm long; adanal lyrifissure (iad) situated in paranal position, at level little posterior to seta ad3 (Figures 1C, D and 4B). Postanal porose area not evident.

Legs. All legs with stronger median and slender lateral claws. Structure and setation of legs typical for family as shown in Figure 3. All setae on podomerse barbed, especially some of ventral setae heavily barbed. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0). Homology of leg setae and solenidia shown in Table 1.

Material examined
Holotype (female): Asram village, Neka, Mazandaran province, Northern Iran, 36° 40’ N, 53°20’ E, 42 m above sea level (a.s.l.), 3 June 2004, Coll. M. A. Akrami; three paratypes (females): same data as holotype. The holotype and paratypes are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.

Table 1. Leg setation of Allogalumna dentirostrata sp. nov.

| Legs | Trochanter | Femur | Genu | Tibia | Tarsus |
|------|------------|-------|------|-------|--------|
| I    | v’         | d, (l), bv” (l), v’, σ (l), (v), φ1, φ2 (fi), (tc), (it), (p), (u), (a), s, (pv), ω1, ω2 |
| II   | v’         | d, (l), bv” (l), v’, σ (l), (v), φ (fi), (tc), (it), (p), (u), (a), s, (pv), ω1, ω2 |
| III  | v’         | d, ev” l”, σ l”, (v), φ (fi), (tc), (it), (p), (u), (a), s, (pv) |
| IV   | v’         | d, ev’ d, l’ l’, (v), φ fi”, (tc), (p), (u), (a), s, (pv) |
Remarks

*Allogalumna dentirostrata* sp. nov. is easily distinguishable from other known species of the genus by the combination of the following characters, namely: very narrow, slightly dilated sensillus; irregular elongate-oval porose area *Aa*; ridges on pteromorph and marginal part of notogaster; dentations of rostrum; longitudinal striations on genital plate and long interlamellar seta.

The Turkish species, *Allogalumna turkeyensis* described by Grobler et al. (2004) resembles the new species in slightly dilated sensillus. However, the former species is distinguished from the present new species by the shorter, but thicker interlamellar seta, not reaching the tip of rostrum as opposed to relatively long and thin interlamellar seta in the new species; round shape of porose area *Aa* rather than irregular elongate-oval porose area in the new species; incomplete dorsosejugal furrow in contrast to well-developed dorsosejugal furrow in the new species; smoothly rounded rostrum as opposed to the rostrum with dentation, and smooth genital plate rather than striated genital plate in the new species.

The European species, *Allogalumna alamellae* described by Jacot (1935) and redescribed by Pérez-Iñigo (1972) and Weigmann (2006) is different from the new species in the swollen head of the sensillus; incomplete dorsosejugal furrow; round or slightly oval porose area *Aa*; smooth pteromorph and much smaller body size.

Etymology

The specific epithet “*dentirostrata*” refers to the rostrum with distinct teeth in the new species.

Ecology

This species is an inhabitant of the lowland pasture soil, and it was found in sheep faeces.

*Acrogalumna lanceolata* sp. nov.

(Figures 4G–J, 5, and 6)

Diagnosis

With typical characters of *Acrogalumna* (lamellar line absent; sublamellar line present; females without notogastral median pore, males with group of minute median pores); rostrum with pronounced triangular central carina and lateral carina with blunt tip; rostral and lamellar setae thin, smooth; interlamellar seta minute, but clearly visible; sensillus medium long, with finely barbed lanceolate head; all porose areas nearly round, subequal in size; median pore absent; postanal porose area small, round.

Measurements

Holotype: body length 320 μm, width of notogaster 246 μm; paratypes (*n* = 4): body length 310–325 (319) μm, width of notogaster 245–265 (255) μm.
Figure 5. *Acrogalumna lanceolata* sp. nov. (A) Dorsal view of idiosoma; (B) lateral view of sensillus; (C) ventral view of idiosoma.
Description

**Integument.** Body colour dark brown. Cuticle of body and legs with minute granules; notogaster, gnathosomal and epimeral regions with micortubercles; pteromorph with fine striations.

**Prodorsum.** Rostrum with pronounced triangular central carina and lateral carina with blunt tip, clearly seen in dorsofrontal view (Figures 4G and 6A). Rostral seta thin, 36–41 µm long, smooth, inserted ventrally and clearly visible in dorsofrontal

Figure 6. *Acrogalumna lanceolata* sp. nov. (A) Dorsofrontal view of prodorsum, partial; (B) posterior view of opisthonotum (postanal porose area, *Ap* is visible through notogaster).
view. Lamellar seta thin, 37–45 µm long, smooth (Figure 6A). Interlamellar seta minute, 6–10 µm long. Sensillus 57–65 µm long, with narrow stalk and finely barbed lanceolate head (Figures 4H and 5A, B). Lamellar line absent, sublamellar line well developed (Figure 65A). Dorsosejugal porose area small, round, located posterolateral of seta in (Figure 5A).

**Notogaster.** Notogaster distinctly widened posteriorly, dorsosejugal furrow absent; pteromorph with fine striations. Notogastral setae short, thin, clearly discernable, 8–12 µm long. All porose areas nearly round, subequal in size; median pore absent. Lyrifissures ia, im, ih, ip, ips and opisthonotal gland opening (gla) well developed (Figures 4H–J, 5A and 6B).

**Gnathosoma.** Subcapitulum longer than wide, with few microtubercles; hypostomal setae a, m and h 8–11 µm long, smooth (Figure 5C). Palp typical for family as shown in *Pergalumna iunctiporosa* sp. nov., all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion ω on tarsus. Chelicera same as in *Allogalumna dentirostrata* sp. nov., with few heavily sclerotized blunt teeth on fixed and movable digits; setae cha and chb long, barbed; Trägårdh’s organ well developed, its proximal part clearly discernable.

**Epimeral region.** With few muscle sigillae; apodemes apo.1, apo.2, apo.sj, apo.3, circumpedal carina and discidium well developed. Only three pairs of epimeral setae of 6–8 µm length observed, setal formula: 1-0-1-1 (Figure 5C).

**Ano-genital region.** Anal aperture 61 µm long, 69 µm wide; genital aperture 45 µm long, 53 µm wide. Genital and aggenital setae well developed, thin, smooth, 12–16 µm long, aggenital seta (ag) 8 µm long; anal and adanal setae vestigial; adanal lyrifissure (iad) situated in paranal position, at level little posterior to seta an2 (Figure 5C). Postanal porose area small, round (Figures 5C and 6B).

**Legs.** Structure and setation of legs typical for family as shown in the description of former species. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-1-0), II (0-1-0).

**Material examined**

Holotype (female): Nashtarood, Mazandaran province, Northern Iran, 36°42' N, 51° 01' E, 20 m below sea level (b.s.l.), 9 April 2004, Coll. M. A. Akrami; four paratypes (females): same data as holotype; one paratype (female): Noor, Mazandaran province, Northern Iran, 36°47' N, 51°26' E, 17 m b.s.l., December 2001, Coll. A. Zahedi; one paratype (male): Nowshahr, beginning of the Kandeloos road, Mazandaran province, Northern Iran, 36°39' N, 51°30' E, 19 m a.s.l., 10 April 2004, Coll. M. A. Akrami. The holotype and paratypes are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.
Remarks

*Acrogalumna lanceolata* sp. nov. is easily distinguished from other species of *Acrogalumna* in combination of following characters, namely: rostrum with pronounced triangular central carina and lateral carina with blunt tip; very short interlamellar seta; finely barbed lanceolate head of sensillus; well-developed notogastral setae, and nearly round porose area *Aa*. Most of species of *Acrogalumna* are either with setiform sensillus or long interlamellar seta, vestigial notogastral setae and rounded rostrum, in which they clearly differ from the present new species.

Among the known species of *Acrogalumna*, only *Acrogalumna ventralis* described by Willmann (1932) from Sumatra, later redescribed by Hammer (1972) from Tahiti, and *Acrogalumna brevisetosa* described by Bayartogtokh and Weigmann (2005) from Mongolia have minute interlamellar setae and fusiform sensillus.

However, *Acrogalumna ventralis* differs from the present new species in the smooth head of sensillus in contrast to the finely barbed head of sensillus in the new species; very minute lamellar seta in contrast to long seta *le* in the new species; absence of carina on rostrum as opposed to the distinct carina in the new species; vestigial epimeral, genital, aggenital and notogastral setae of *l- and h-series* rather than well-developed setae in the new species, and relatively larger body size.

The Mongolian species, *Acrogalumna brevisetosa* is distinguishable from the new species in the very narrow and smooth head of sensillus as opposed to widely lanceolate, barbed sensillus in the new species; porose area *Aa* is divided into two small parts rather than complete round porose area *Aa* in the new species; vestigial notogastral setae in contrast to well-developed setae in the new species; elongate-oval porose areas *A2* and *A3* rather than round porose areas in the new species, and much larger body size. Before this study there was no record of the genus *Acrogalumna* from Iran.

Etymology

The specific epithet “*lanceolata*” refers to the lanceolate shape of sensilli.

Ecology

This species is an inhabitant of lowland and forest soil, and most specimens were found in the soil under citrus fruits.

*Galumna triangulata* sp. nov.

*(Figures 4K–N and 7)*

Diagnosis

With typical characters of *Galumna* (lamellar and sublamellar lines present; alveolus of lamellar seta inserted between lines *L* and *S*; anterior margin of notogaster distinctly developed, rarely interrupted; notogastral median pore present or absent); rostrum with small triangular central carina and larger subtriangular lateral carina; rostral and
Figure 7. Galumna triangulata sp. nov. (A) Dorsal view of idiosoma; (B) dorsofrontal view of prodorsum, partial; (C) posterior view of opisthonotum, partial; (D) ventral view of idiosoma.
lamellar setae thin, finely barbed; interlamellar seta long, thin, finely barbed; sensillus medium long, with finely barbed slightly dilated head; porose area $Aa$ large, irregular oval, $A_1$ smallest, nearly round or slightly oval, $A_2$ and $A_3$ elongate oval, subequal in size; median pore absent; postanal porose area large, elongate oval.

**Measurements**

Holotype: body length 512 µm, width of notogaster 381 µm; length of notogaster 414 µm; paratypes ($n = 5$): body length 475–540 (515) µm, width of notogaster 375–405 (393) µm.

**Description**

**Integument.** Body colour yellowish brown. Cuticle of body and legs with minute granules; prodorsum with faint striations and minute granules; notogaster nearly smooth, with very minute granules; gnathosomal and epimeral regions with small granules, sejugal area with faint longitudinal striations; pteromorph with radiated ridges and faint striations; marginal part of notogaster with radiating ridges.

**Prodorsum.** Rostrum with small triangular central carina and larger lateral carina of subtriangular shape, clearly seen in dorsofrontal view (Figures 4M and 7B). Rostral seta thin, 57–65 µm long, finely barbed, inserted ventrally and visible in dorsofrontal view. Lamellar seta thin, 69–78 µm long, finely barbed. Interlamellar seta thin, 74–80 µm long, finely barbed (Figure 7B). Sensillus 90–102 µm long, with thin stalk and slightly dilated finely barbed head (Figures 4N and 7B). Lamellar and sublamellar lines well developed (Figures 4K and 7A and B). Dorsosejugal porose area large, elongate oval, located posterolateral to seta in (Figure 7B).

**Notogaster.** Notogaster slightly widened posteriorly, dorsosejugal furrow well developed, nearly straight. Pteromorph with radiated ridges and faint striations (Figures 4L and 7A). Notogastral setae vestigial, their alveoli clearly discernable. All porose areas poorly visible; $Aa$ large, irregular oval; $A_1$ smallest, nearly round or slightly oval; $A_2$ and $A_3$ elongate oval, subequal in size; median pore absent. Lyrifissures $ia$, $im$, $ih$, $ip$, $ips$ and opisthontal gland opening ($gla$) well developed (Figure 7A and C). Posterior and lateral margins with radiating ridges (Figures 4L and 7D).

**Gnathosoma.** Subcapitulum longer than wide, with few microtubercles; hypostomal setae $a$, $m$ and $h$ 9–12 µm long, smooth (Figure 7D). Palp typical for family as shown in *Pergalumna iunctiporosa* sp. nov., all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion $\omega$ on tarsus. Chelicera same as in *Allogalumna dentirostrata* sp. nov., with few heavily sclerotized blunt teeth on fixed and movable digits; setae $cha$ and $chb$ long, barbed; Trägårdh’s organ well developed, its proximal part clearly discernable.

**Epimeral region.** With small granules and faint striations in sejugal area; apodemes $apo.1$, $apo.2$, $apo.sj$, $apo.3$, circumpedal carina and discidium well developed. Five pairs of epimeral setae of 8–12 µm length observed, setal formula: 2-0-2-1 (Figure 7D).
Ano-genital region. Anal aperture 102 µm long, 118 µm wide; genital aperture 70 µm long, 78 µm wide. Genital, aggenital and anal setae well developed, thin, smooth; genital setae 12–20 µm long, aggenital seta 10–12 µm long; anal setae 6–9 µm long; adanal setae vestigial; adanal lyrifissure (iad) situated in paranal position, at level anterior to alveolus of seta ad3 (Figure 7D). Postanal porose area large, elongate oval (Figure 7C).

Legs. Structure and setation of legs typical for family as shown in the description of Allogalumna dentirostrata sp. nov. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined
Holotype (female): Poloor, Amol, Mazandaran province, Northern Iran, 35°57’ N, 52°07’ E, 2100 m a.s.l., 5 August 2004, Coll. M. A. Akrami; five paratypes (females): same data as holotype. The holotype and paratypes are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.

Remarks
Galumna triangulata sp. nov. is clearly differentiated from the other species of Galumna by the combination of following characters, namely: triangular carina of rostrum; very slightly dilated sensillus; large, irregular oval shape of porose area Aa; presence of radiating ridges or grooves on pteromorph and marginal part of notogaster, and elongate-oval shape and subequal size of porose areas A2 and A3.

Among the known species of Galumna, the following species, Galumna elimata (C. L. Koch, 1841), Galumna lanceata Oudmans, 1900, Galumna obvia (Berlese, 1915) and Galumna rossica Sellnick, 1926 resemble the new species in the structure of very narrow and slightly dilated sensillus. However, the first two species, G. elimata and G. lanceata are easily differentiated from the new species by the presence of notogastral median pore (absent in the new species), consisting of single or several small pores; smooth pteromorph and marginal part of notogaster (ridges present in new species), and absence of rostral carina (present in new species).

Another species, G. obvia is easily distinguished from the new species by the minute interlamellar seta as opposed to long seta in the new species; elongate-oval porose area Aa, and much larger body size. The Palaearctic species, G. rossica clearly differs from the new species in the different shape and size of porose areas Aa, A2 and A3; absence of rostral carina; smooth pteromorph and marginal part of notogaster and much larger body size.

Two Iranian species, Galumna iranensis Mahunka et Akrami, 2001 and Galumna karajica Mahunka et Akrami, 2001 can be differentiated from the new species by the characters given in the identification keys hereunder (see Discussion).

Etymology
The specific epithet “triangulata” refers to the triangular shape of rostral carina.
Ecology
This species is an inhabitant of the highland pasture soil.

*Galumna granulimorpha* sp. nov.
(Figures 8 and 9A–D)

**Diagnosis**
With typical characters of *Galumna*; rostrum with incision forming triangular central carina and slightly larger lateral carina with subtriangular shape; rostral and lamellar setae thin, finely barbed; interlamellar seta long, thin, finely barbed; sensillus medium long, with finely barbed, distally pointed fusiform head; porose area *Aa* nearly round or slightly oval, *A₁* and *A₂* smallest, nearly round, subequal in size, *A₃* elongate oval; median pore absent in male, but present in female; postanal porose area large, elongate oval.

**Measurements**
Holotype: body length 496 µm, width of notogaster 398 µm; paratype: body length 495 µm, width of notogaster 380 µm.

**Description**

**Integument.** Body colour yellowish brown. Cuticle of body and legs with minute granules; notogaster with few microtubercles, especially female with larger tubercles on humeral region; epimeral region with small granules, sejugal area with faint longitudinal striations; pteromorph with large granules.

**Prodorsum.** Rostrum with small triangular central carina and slightly larger lateral carina with subtriangular shape, well seen in dorsofrontal view (Figures 8B and 9A). Rostral seta thin, 52–59 µm long, finely barbed, inserted ventrally and well visible in dorsofrontal view. Lamellar seta thin, 62–73 µm long, finely barbed. Interlamellar seta thin, 64–75 µm long, finely barbed (Figure 8A and B). Sensillus 106–114 µm long, with thin stalk and finely barbed fusiform head distally pointed (Figures 8A and C and 9B). Lamellar and sublamellar lines well developed (Figure 8A and B). Dorsosejugal porose area large, oval, located posterolateral of seta *in*.

**Notogaster.** Notogaster slightly widened posteriorly, dorsosejugal furrow well developed, widely rounded. Pteromorph with radiated granules (Figures 8A and 9C). Notogastral setae vestigial, their alveoli clearly discernable. Porose area *Aa* nearly round or slightly oval, but that of a female paratype was more elongate triangular; *A₁* and *A₂* smallest, nearly round, subequal in size, *A₃* elongate oval poorly visible (Figures 8E and 9D); median pore absent in male, but present in female. Lyrifissures *ia, im, ih, ip, ips* and opisthontal gland opening well developed (Figure 8A and E).
Figure 8. *Galumna granulimorpha* sp. nov. (A) Dorsal view of idiosoma; (B) dorsofrontal view of prodorsum, partial; (C) lateral view of sensillus; (D) ventral view of idiosoma; (E) posterior view of opisthonotum.
Gnathosoma. Subcapitulum longer than wide, with few microtubercles; hypostomal setae a, m and h 9–12 µm long, smooth (Figure 8D). Palp typical for family as shown in Pergalumna iunctiporosa sp. nov., all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion ω on tarsus. Chelicera same as in Allogalumna dentirostrata sp. nov., with few heavily sclerotized blunt teeth on fixed.
and movable digits; setae cha and chb long, barbed; Trägårdh’s organ well developed, its proximal part clearly discernable.

Epimeral region. With small granules and faint striations on sejugal area; apodemes apo.1, apo.2, apo.sj, apo.3, circumpedal carina and discidium well developed. Only four pairs of epimeral setae of 4–6 µm length observed, setal formula: 1-0-2-1 (Figure 8D).

Ano-genital region. Anal aperture 95 µm long, 104 µm wide; genital aperture 66 µm long, 73 µm wide for holotype. All ano-genital setae well developed, thin, smooth; genital setae 10–16 µm long, aggenital seta 8–11 µm long; anal and adanal setae 4–8 µm long; adanal lyrifissure (iad) situated in paranal position, at level anterior to seta ad3 (Figure 8D). Postanal porose area large, elongate oval (Figures 8E and 9D).

Legs. Structure and setation of legs typical for family as shown in the description of Allogalumna dentirostrata sp. nov. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined
Holotype (male): Nowshahr, Mazandaran province, Northern Iran, 36°39' N, 51° 30' E, 19 m a.s.l., 4 June 2004, Coll. M. A. Akrami; one paratype (female): same data as holotype. The holotype and a paratype are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.

Remarks
Galumna granulimorpha sp. nov. is unique among the other known species of Galumna in the combination of the following characters, namely: rostrum with incision forming triangular central carina and two slightly larger lateral carina; narrow fusiform sensillus; granular structure of pteromorph, and different structure of notogastral porose areas.

Among the known species of Galumna, the following Palaearctic species, Galumna tarsipennata Oudemans, 1914, Galumna gibbula Grandjean, 1956, Galumna lanceata Oudemans, 1900, Galumna europea (Berlese, 1914) and Galumna dimorpha Krivolutskaja, 1952 resemble the new species in the structure of fusiform sensillus. However, G. tarsipennata, G. gibbula and G. lanceata differ from the present new species in the smoothly rounded rostrum and interrupted dorsosejugal furrow. Only the Mediterranean species, G. gibbula has rostrum with a pair of small lateral carina, but the median part of rostrum is rounded.

The other Palaearctic species, G. europea is distinguishable from the present new species by the oval shape of porose areas Aa and A2; nearly smooth prodorsal setae and pteromorph, and larger body size. Galumna dimorpha differs from the present new species in the smoothly rounded rostrum; much narrower and smooth rostral, lamellar and interlamellar setae; smooth pteromorph; presence of notogastral median pore in both sexes, and far larger body size.
Etymology
The specific epithet “granulimorpha” refers to the granulated pteromorphs in this species.

Ecology
This species is an inhabitant of the mosses and litter of forest.

Galumna iranensis Mahunka et Akrami, 2001
(Figures 10 and 11A–D)

Galumna iranensis Mahunka et Akrami, 2001, p. 232, Figures. 1, 2.
Galumna iranensis: Subías, 2004, p. 216.

Diagnosis
With typical characters of Galumna; rostrum with incision forming triangular central carina; rostral and lamellar setae thin, finely barbed; interlamellar seta long, finely barbed; sensillus medium long, with finely barbed, distally pointed lanceolate head; anterior margin of notogaster slightly concave medially; all porose areas round or slightly oval, Aa large, others smaller, subequal in size, median pore well developed in both sexes; Ap oval.

Measurements
Body length 420–586 (503) µm, width of notogaster 287–410 (348) µm.

Description
Integument. Body colour yellowish brown to deep reddish brown. Cuticle of body and legs with minute granules; notogaster with few microtubercles, especially female with larger tubercles on humeral region; epimeral region with small granules; pteromorph nearly smooth, with minute granules.

Prodorsum. Rostrum with incision forming triangular central carina, clearly seen in dorsofrontal view (Figures 10D and 11B). Rostral seta thin, finely barbed, inserted ventrally and well visible in dorsofrontal view. Lamellar seta thin, very slightly longer than ro, finely barbed. Interlamellar seta thin, nearly as long as le, finely barbed (Figures 10A–D and 11B). Sensillus with thin stalk and finely barbed lanceolate head distally pointed (Figures 10C and 11D). Lamellar and sublamellar lines well developed (Figures 10A, B, and D, and 11A). Dorsosejugal porose area medium in size, oval, located postero-lateral to seta in.

Notogaster. Notogaster slightly widened posteriorly, dorsosejugal furrow well developed, slightly concave medially. Pteromorph nearly smooth, with minute granules. Notogastral setae vestigial, their alveoli well discernable. Porose area Aa nearly round, distinctly larger than other porose areas; A1, A2 and A3 small, nearly round,
subequal in size; median pore well developed in both sexes, consisting of many small pores. Lyrifissures \textit{ia}, \textit{im}, \textit{ih}, \textit{ip}, \textit{ips} and opisthonotal gland opening well developed (Figures 10A and 11C).

Figure 10. \textit{Galumna iranensis} Mahunka et Akrami, 2001. (A) Dorsal view of idiosoma; (B) lateral view of prodorsum; (C) lateral view of sensillus; (D) dorsofrontal view of prodorsum, partial; (E) ventral view of idiosoma.
Figure 11. Morphological characters of different species. (A—D) *Galumna iranensis* Mahunka et Akrami, 2001. (A) Lateral view of proterosoma (arrow indicates dorsosejugal porose area *Ad*); (B) dorsal view of prodorsum (arrow indicates central carina of rostrum); (C) lateral part of notogaster; (D) lateral view of sensillus. (E–H) *Pergalumna microtuberculata* sp. nov. (E) Posterior view of notogaster showing porose areas *A*3 and *Ap*; (F) porose area *Aa*; (G) posterior part of notogaster; (H) pteromorph.
**Gnathosoma.** Subcapitulum wider than long, nearly smooth; hypostomal setae \(a\), \(m\) and \(h\) short, smooth (Figure 10E). Palp typical for family as shown in *Pergalumna iunctiporosa* sp. nov., all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion \(\omega\) on tarsus. Chelicera same as in *Allogalumna dentirostrata* sp. nov., with few heavily sclerotized blunt teeth on fixed and movable digits; setae \(cha\) and \(chb\) long, barbed; Trägårdh’s organ well developed, its proximal part clearly discernable.

**Epimeral region.** With small granules and few microtubercles on sejugal area; apodemes \(apo.1\), \(apo.2\), \(apo.sj\), \(apo.3\), circumpedal carina and discidium well developed. Only three pairs of epimeral setae observed, setal formula: 1-0-1-1 (Figure 10E).

**Ano-genital region.** Anal aperture slightly larger than genital aperture. Most of ano-genital setae well developed, thin, smooth; only setae \(g_5\) and \(g_6\) vestigial; adanal lyrifissure (iad) situated in paranal position, at level anterior to seta \(ad_3\). Postanal porose area large, oval (Figure 10E).

**Legs.** Structure and setation of legs typical for family as shown in the description of *Allogalumna dentirostrata* sp. nov. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

**Material examined**

One specimen (female): Amol, beginning of the Haraz road, Mazandaran province, Northern Iran, 36°25’ N, 52°21’ E, 76 m a.s.l., 10 April 2004, Coll. M. A. Akrami; one specimen (male): Behshahr, beginning of the Zaghmarz road, Mazandaran province, Northern Iran, 36°41’ N, 53°32’ E, 20 m a.s.l., 29 September 2004, Coll. M. A. Akrami.

**Remarks**

The main character states of the present material accord well with those of the type materials, described by Mahunka and Akrami (2001). The only observed differences are that the interlamellar seta was conspicuously thicker than seta \(le\) in the type materials, but in the specimens studied here these setae were of similar thickness. The porose areas \(Aa\), \(A_1\), \(A_2\) and \(A_3\) of the type specimens were nearly equal in size, but in our materials \(Aa\) was far larger than other porose areas. Mahunka and Akrami (2001) illustrated the distinct incision on the lateral part of sublamellar lines, but our specimens did not show this structure. Notogastral median pore was represented as single pore in the type specimens, but it consisted of many small pores in our studied material. We consider the mentioned differences of all these characters as intraspecific variations. It is worth noting that the body size of the female studied here was much larger than that of the male.
Distribution
Geographical range of this species is restricted to Iran. It had been found in central (Yazd province) and northwestern (East Azerbaijan province) areas of the country (Mahunka and Akrami 2001; Lotfollahi and Irani-Nejad 2010), and is now recorded in the northern part of the country.

Ecology
This species is a typical inhabitant of the mosses and litter of forest, but recently, it was found in the soil of pasture under Poaceae (*Cynodon dactylon*).

*Pergalumna iunctiporosa* sp. nov.
(Figures 9E–H, 12, and 13)

Diagnosis
With typical characters of *Pergalumna* (lamellar and sublamellar lines present; alveolus of lamellar seta inserted mediad of line L; anterior margin of notogaster mostly interrupted; notogastral median pore present or absent); rostrum with small triangular central carina and minute lateral carina of subtriangular shape; rostral and lamellar setae thin, finely barbed; interlamellar seta long, thin, finely barbed; sensillus medium long, setiform, finely barbed at distal half; porose area Aa nearly round or slightly oval, A1 and A2 joined together, forming a large irregular oval porose area, A3 oval; median pore present, consisted of three to five small pores; postanal porose area nearly round in shape.

Measurements
Holotype: body length 592 µm, width of notogaster 464 µm, length of notogaster 496 µm; paratypes (*n* = 5): body length 555–610 (584) µm, width of notogaster 490–540 (512) µm.

Description
*Integument.* Body colour dark brown. Cuticle of body and legs with minute granules; epimeral region few microtubercles; pteromorph with large granules.

*Prodorsum.* Rostrum with small triangular central carina and minute lateral carina of subtriangular shape, clearly seen in dorsofrontal view (Figures 9E, 12B, and 13A). Rostral seta thin, 72–78 µm long, finely barbed, inserted ventrally and visible in dorsofrontal view. Lamellar seta thin, 98–106 µm long, finely barbed. Interlamellar seta thin, 102–107 µm long, finely barbed (Figures 12A and B and 13A). Sensillus 125–136 µm long, setiform, finely barbed at distal half (Figures 9H and 12A). Lamellar and sublamellar lines well developed. Dorsosejugal porose area small, oval, located posterolateral of seta in (Figure 13A).
Notogaster. Notogaster widened posteriorly, dorsosejugal furrow interrupted medially. Pteromorph with elongate oval ridges (Figures 9F and 12). Notogastral setae vestigial, their alveoli clearly discernable. Porose area *Aa* nearly round or slightly

Figure 12. *Pergalumna iunctiporosa* sp. nov. (A) Dorsal view of idiosoma; (B) ventral view of idiosoma; (C) anal plates.
Figure 13. *Pergalumna iunctiporosa* sp. nov. (A) Dorsofrontal view of prodorsum, partial; (B) palp, left, antiaxial view; (C) posterodorsal view of notogaster, partial.
oval (in male more oval); \(A_1\) and \(A_2\) joined together, forming a large irregular oval porose area; \(A_3\) oval; median pore present, consisting of three to five small pores (Figures 9G, 12, and 13). Lyrifissures \(ia, im, ih, ip, ips\) and opisthonotal gland opening well developed (Figures 12A and 13C).

**Gnathosoma.** Subcapitulum longer than wide, with few microtubercles; hypostomal setae \(a, m\) and \(h\) 16–21 \(\mu\)m long, smooth (Figure 12C). Palp typical for family, all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion \(\omega\) on tarsus (Figure 13B). Chelicera same as in *Allogalumna dentirostrata* sp. nov., with few heavily sclerotized blunt teeth on fixed and movable digits; setae \(cha\) and \(chb\) long, barbed; Trägårdh’s organ well developed, its proximal part clearly discernable.

**Epimeral region.** With small granules and few microtubercles; apodemes \(apo.1, apo.2, apo.sj, apo.3\), circumpedal carina and discidium well developed. Only four pairs of barbed epimeral setae of 22–25 \(\mu\)m length observed, setal formula: 1-0-2-1 (Figure 12C).

**Ano-genital region.** Anal aperture 111 \(\mu\)m long, 139 \(\mu\)m wide; genital aperture 78 \(\mu\)m long, 94 \(\mu\)m wide for holotype. All genital and aggenital setae well developed, thin, smooth; genital setae 20–26 \(\mu\)m long, aggenital seta 19–24 \(\mu\)m long; anal and adanal setae barbed, 16–20 \(\mu\)m long; adanal lyrifissure situated in paranal position, at level anterior to seta \(ad_3\) (Figure 12C and D). Postanal porose area large, nearly round in shape (Figure 13C).

**Legs.** Structure and setation of legs typical for family as shown in the description of first species. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

**Material examined**

Holotype (female): Noor, Mazandaran province, Northern Iran, 36°47’ , 51°26’ E, 17 m b.s.l., 11 April 2004, Coll. M. A. Akrami; five paratypes (females): same data as holotype; one paratype (male): Nowshahr, Mazandaran province, Northern Iran, 36°39’ N, 51°30’ E, 19 m a.s.l., 17 July 2003, Coll. M. A. Akrami. The holotype and paratypes are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.

**Remarks**

*Pergalumna iunctiporosa* sp. nov. is characterized among the known species of *Pergalumna* by the notogastral porose areas \(A_1\) and \(A_2\) joined together forming a large irregular oval porose area; setiform sensillus with fine barbs at distal half; rostrum with small triangular central carina and minute lateral carina of subtriangular shape, and barbed epimeral, anal and adanal setae.

Among the known species of *Pergalumna*, *Pergalumna capillaris* Aoki, 1961, *Pergalumna clericata* (Berlese, 1914), *Pergalumna frater* Balogh, 1960, *Pergalumna*
intermedia Aoki, 1963, Pergalumna longisetosa Balogh, 1960, Pergalumna myrmophila (Berlese, 1915), Pergalumna nuda Balogh, 1960 and Pergalumna pterinervis (Canestrini, 1898), resemble the new species in the structure of setiform sensillus. However, all these species are with separate porose areas $A_1$ and $A_2$, without median pore on notogaster, with oval porose area $A_a$, and without rostral carina, in which they clearly differ from the new species. Only the African species, $P. nuda$ has round porose area $A_a$ as in new species, but the former is different from the latter in the minute rostral, lamellar and interlamellar setae; smooth sensillus; well-developed dorsosejugal furrow, and much smaller size of notogastral porose areas.

**Etymology**
The specific epithet “iunctiporosa” refers to the notogastral porose areas $A_1$ and $A_2$, which joined together.

**Ecology**
This species is an inhabitant of the moss, litter under trees and forest soil.

*Pergalumna microtuberculata* sp. nov.  
(Figures 11 and 14)

**Diagnosis**
With typical characters of *Pergalumna*; rostrum with small triangular central tooth, lateral carina absent; rostral and lamellar setae thin, finely barbed; interlamellar seta long, thin, finely barbed; sensillus medium long, with finely barbed, slightly dilated head; porose area $A_a$ large, nearly elongate triangular, its lateral part wide, but medial part narrowed, $A_1$ small, round, $A_2$ and $A_3$ elongate oval, subequal in size; median pore present, consisted of single pore; notogastral lyrifissure $im$ positioned far anterior from seta $lp$; postanal porose area large, elongate oval.

**Measurements**
Holotype: body length 552 µm, width of notogaster 400 µm, length of notogaster 464 µm; paratypes ($n = 2$): body length 545–570 (558) µm, width of notogaster 380–470 (425) µm.

**Description**
*Integument.* Body colour dark brown. Cuticle of body and legs with minute granules; humeral region, posterior part of notogaster and epimeral region with few small tubercles.

*Prodorsum.* Rostrum with small triangular central tooth, which is easily seen in dorsofrontal view, lateral carina absent (Figure 11B and C). Rostral seta thin, 71–76 µm long, finely barbed, inserted ventrally and clearly visible in dorsofrontal view.
Figure 14. *Pergalumna microtuberculata* sp. nov. (A) Dorsal view of idiosoma; (B) dorsofrontal view of prodorsum, partial; (C) ventral view of idiosoma; (D) posterior view of notogaster, partial.
Lamellar seta thin, 82–88 µm long, finely barbed. Interlamellar seta thin, 86–93 µm long, finely barbed. Sensillus 82–86 µm long, with finely barbed, slightly dilated head (one specimen showed finely barbed setiform sensillus). Lamellar and sublamellar lines well developed (Figure 14A and B). Dorsosejugal porose area large, elongate oval, located posterolaterad of seta in.

Notogaster. Notogaster widened posteriorly, dorsosejugal furrow well developed. Pteromorph nearly smooth, with small granules. Notogastral setae vestigial, their alveoli well discernable. Porose area Aa large, nearly elongate triangular, its lateral part widened, but medial part narrowed; A1 round, A2 and A3 elongate oval; median pore present, consisting of single pore. Lyrifissures ia, im, ih, ip, ips and opisthontonal gland opening well developed (Figures 11E–H and 14).

Gnathosoma. Subcapitulum longer than wide, with few microtubercules; hypostomal setae a, m and h 8–11 µm long, smooth (Figure 14D). Palp typical for family, all setae except on tarsus finely barbed, formula of setation: 0-2-1-3-10 including solenidion ω on tarsus. Chelicera with few heavily sclerotized blunt teeth on fixed and movable digits; setae cha and chb long, barbed; Trägårdh’s organ well developed, its proximal part well discernable.

Epimeral region. With large granules and longitudinal striations; apodemes apo.1, apo.2, apo.sj, apo.3, circumpedal carina and discidium well developed. Six pairs of short epimeral setae of 12–18 µm length observed, setal formula: 2-0-2-2 (Figure 14D).

Ano-genital region. Anal aperture 110 µm long, 131 µm wide; genital aperture 77 µm long, 86 µm wide for holotype. Genital and aggenital setae well developed, 14–19 µm long, thin, smooth; anal and adanal setae vestigial; adanal lyrifissure situated in paranal position, at level little posterior to seta ad3 (Figure 14D). Postanal porose area large, elongate oval, narrowed bilaterally (Figure 14E).

Legs. Structure and setation of legs typical for family as shown in the description of Allogalumna dentirostrata sp. nov. Formula of setation, including famulus: I (1-4-3-4-20), II (1-4-3-4-15), III (1-2-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined
Holotype (female): Babol, Mazandaran province, Northern Iran, 36°35′ N, 52°40′ E, approximately at the sea level, 28 September 2004, Col. M. A. Akrami; two paratypes (females): same data as holotype. The holotype and paratypes are deposited in the collection of the Department of Plant Protection, College of Agriculture, Shiraz University, Iran.

Remarks
Pergalumna microtuberculata sp. nov. is unique among the known species of Pergalumna by the combination of following features, namely: large, nearly elongate
triangular porose area Aa, the outer part of which is widened, but inner part is
narrowed; very slightly dilated head of sensillus; presence of small central tooth of
rostrum; dense granules and longitudinal striations on epimeral region; far anterior
position of notogastral lyrifissure im, and microtubercles on humeral region and
posterior part of notogaster.

Among the known species of Pergalumna, Pergalumna altera (Oudemans, 1915),
Pergalumna comparanda (Berlese, 1920), Pergalumna formicaria (Berlese, 1914),
Pergalumna minoricana Pérez-Iñigo, 1990 and Pergalumna nervosa (Berlese, 1914)
are similar to the new species in the structure of porose area Aa and sensillus. However, two common species in the Palaearctic region, P. altera and P. nervosa
are different from the new species in the slightly widened outer part of porose area
Aa; round porose area A2; reticulate structure of pteromorph; smoothly rounded
rostrum, and far larger body size.

Two other species, P. comparanda and P. formicaria, are distinguishable from the
new species by the different size of interlamellar seta (seta in is far longer in
P. comparanda, but much shorter in P. formicaria); swollen head of sensillus; rela-
tively posterior position of notogastral lyrifissure im, and smoothly rounded rostrum.

The Mediterranean species, P. minoricana differs from the new species in the
structure of porose area Aa, conspicuously widened in both inner and outer parts;
relatively longer interlamellar seta, extending well beyond tip of rostrum; relatively
posterior position of notogastral lyrifissure im; smoothly rounded rostrum, and much
larger body size.

Etymology
The specific epithet “microtuberculata” refers to the presence of small tubercles on
humeral region and posterior part of notogaster.

Ecology
This species is an inhabitant of the lowland pasture soil, and the specimens were
found under graminoid grasses (Poaceae).

Discussion
As mentioned above, there are 16 species of Galumnidae currently known from Iran
(including the new species described here), and most of them have been described
recently. Distributions of Galumna karajica Mahunka et Akrami, 2001, Galumna
iranensis Mahunka et Akrami, 2001, Pilogalumna saboori Mahunka et Akrami,
2001, Psammogalumna iranica Akrami, Irani-Nejad et Mirzaie, Akrami et al. 2011,
and all new species described here are restricted to Iran. However, there is a strong
possibility that these species will be found outside Iran, especially in adjacent regions,
the oribatid mite faunas of which are almost completely unknown.

The first three species mentioned above (G. karajica, G. iranensis and Pilogalumna
saboori) have been found in the central part (Yazd province) of Iran (Mahunka and
Akrami 2001), but later G. karajica was recorded in northern, northwestern and
central-western regions (Mazandaran, East Azerbaijan and Markazi provinces).
Moreover, *G. iranensis* was found in the northwestern region (East Azerbaijan province) of the country (Lotfollahi and Irani-Nejad 2010). We found *G. iranensis* in the northern part of Iran (Mazandaran Province). The last species, *Psammogalumna iranica*, is known only from northwestern areas (East Azerbaijan province) of the country (Akrami et al. 2011).

Two species of *Pilogalumna*, *Pilogalumna saboorii* Mahunka et Akrami, 2001 and *Pilogalumna tenuiclava* (Berlese, 1908) are reported only from the central part (Yazd province) of the country (Mahunka and Akrami 2001; Akrami 2007). *Pilogalumna tenuiclava* has been recorded under the name *Pilogalumna boevi* (Krivolutskaja, 1952). However, according to Subías (2009), *Pilogalumna boevi* is a junior synonym of *Pilogalumna tenuiclava*, the species widely distributed in the Holarctic region. According to redescriptions by Shaldybina (1975) and Mahunka (1992), these species share similar characters, such as short interlamellar setae, interrupted anterior margin of notogaster, and porose area *Aa*, which is divided into two smaller porose areas. However, they seem to be different in the structure of the sensillus, size and shape of posterior notogastral porose areas, and presence or absence of median pore. Without examining the type material, it is difficult to judge whether the synonymy of these two species is correct, so further additional study of type specimens is required.

Two Palaearctic species of *Galumna*, *G. rossica* Sellnick, 1926 and *G. tarsipennata* Oudemans, 1913, as well as two African species, *Galumna dimidiata* Engelbrecht 1969 and *Galumna discifera* Balogh, 1960 were recorded in the northwestern and central regions (East Azerbaijan, Tehran and Yazd provinces) of the country (Akrami 2007; Kheradpir et al. 2007; Lotfollahi and Irani-Nejad 2010). The latter authors also reported an unidentified species belonging to *Pergalumna* from central, western and northwestern regions (Esfahan, Hamadan and East Azerbaijan provinces). The latter finding might represent one of the *Pergalumna* species described here, since all new species discovered by us are from the northern Iran (Mazandaran province).

Mortazavi Lahijani Sh et al. (2010) reported an Oriental species, *Galumna divergens* Mahunka, 1995, from Guilan province, northern Iran. This species has been described from Sabah (Borneo island), eastern Malaysia (Mahunka 1995), and is still known only from the type locality. In our opinion, there is little likelihood of finding this tropical species in Iran. In the structure of sensilli, concave dorsosejugal furrow and notogastral porose areas, *G. divergens* is similar to *G. iranensis*. Therefore, we suspect that Mortazavi Lahijani et al. (2010) might have misidentified the latter species as *G. divergens*. So, we suggest a further careful examination of their collected materials.

Most Galumnidae species (10 spp. or more than 60%) found in Iran are endemics, and only a few species with Holarctic or Palaearctic (three spp.), Afrotropical (two spp.) or Oriental (one sp.) distributions are represented there.

As for their habitat ecology, all species of Galumnidae found in Iran are typical inhabitants of soil under different types of vegetation including grasses, bushes, tree stands, mosses, litter of various forest types, and herbivore faeces. In conclusion, the following key can be used to identify the adults of all known species of Galumnidae in Iran.
A key to the adults of known species of Galumnidae of Iran

1. Prodorsum with lamellar and sublamellar lines .......................................... 2
   Lamellar line absent, sublamellar line present or absent ............................. 3

2. Alveolus of lamellar seta inserted laterad of lamellar line (Galumna) .......... 6
   Alveolus of lamellar seta inserted mediad of lamellar line (Pergalumna) ................................................................. 14

3. Sublamellar line present ... ................................................................. 4
   Sublamellar line absent ... .................................................................... 5

4. Notogaster with median pore; interlamellar seta long, reaching tip of rostrum; porose area Aa very large, irregular elongate oval, A3 elongate oval; rostrum with three small teeth; sensillus narrow, very slightly dilated .......... Allogalumna dentirostrata sp. nov.

5. Anal and adanal neotrichy present ............................................................ 21

6. Lamellar seta long, extending beyond tip of rostrum; sensillus with setiform, fusiform, lanceolate or slightly dilated head ............................................... 7

7. Interlamellar seta long, rarely short; lamellar seta mostly finely barbed, very rarely smooth; porose area Aa nearly round or slightly oval ........................... 8
   Interlamellar seta minute; lamellar seta smooth; porose area Aa elongate oval, obliquely oriented ................................. Galumna dimidiata Engelbrecht, 1969

8. Notogaster with median pore; rostrum smoothly rounded ......................... 9
   Notogaster without median pore; rostrum incised, with triangular carina ... 13

9. Sensilli long, narrow fusiform or setiform; dorsosejugal furrow convex... 10
   Sensilli short, with dilated lanceolate head; dorsosejugal furrow slightly concave ............................................................ Galumna karajica Mahunka et Akrami, 2001

10. Sensillus fusiform; porose area A3 regular oval ........................................ 11
   Sensillus setiform; porose area A3 narrowly elongate-oval ..........................

11. Dorsosejugal furrow well developed; lamellar lines short; rostral setae indistinct; sexual dimorphism present: in females porose area A3 regular oval, in males porose areas A2 and A3 joined together forming a very long elongate oval porose area ................................................. Galumna rossica Sellnick, 1926

12. Dorsosejugal furrow interrupted medially; lamellar lines long; rostral setae well developed; sexual dimorphism absent, porose areas A2 and A3 not
12. Sensillus with dense barbs; interlamellar seta long, reaching alveolus of rostral setae; all prodorsal setae barbed; body larger than 420 µm in length .................................................. Galumna iranensis Mahunka et Akrami, 2001

Sensillus with eight or nine long cilia on lateral margin; interlamellar seta short; all prodorsal setae smooth; body smaller than 365 µm in length ......... .................................................. Galumna divergens Mahunka, 1995

13. Lateral carina of rostrum larger than central carina; sensillus with slightly dilated head, its distal end not pointed; porose area $A_2$ elongate oval; pteromorph and marginal part of notogaster with transversal ridges .......... .................................................. Galumna triangulata sp. nov.

Lateral carina of rostrum subequal in size with central carina; sensillus with fusiform head, its distal end pointed; porose area $A_2$ slightly oval; pteromorph and marginal part of notogaster without ridges .................................................. Galumna granulimorpha sp. nov.

14. Sensillus setiform; dorsosejugal furrow interrupted medially; porose area $Aa$ round, porose areas $A_1$ and $A_2$ joined together .................................................. Pergalumna iunctiporosa sp. nov.

Sensillus with slightly dilated head; dorsosejugal furrow well developed; porose area $Aa$ elongate triangular, porose areas $A_1$ and $A_2$ separate .......... .................................................. Pergalumna microtuberculata sp. nov.

15. Interlamellar seta long, barbed; sensillus setiform, strongly barbed; porose area $A_3$ regular oval; porose area $Aa$ not divided into two parts; body size small, 372–395 µm long .................................................. Pilogalumna saboorii Mahunka et Akrami, 2001

Interlamellar seta minute; sensillus with slightly dilated, minutely barbed head; porose area $A_2$ elongate oval; porose area $Aa$ divided into two parts; body size large, 560–690 µm long .................. Pilogalumna tenuiclava (Berlese, 1908)

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