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ORIBATID MITES OF THE GENUS GHILAROVUS (ACARI: ORIBATIDA: ZETOMOTRICHIDAE) FROM RUSSIA AND MONGOLIA WITH REMARKS ON ECOLOGY AND BIOGEOGRAPHY OF KNOWN SPECIES

BY BADAMDORJ BAYARTOGTOKH1 and ILYA E. SMELYANSKY2

ACARI, ORIBATIDA, ZETOMOTRICHIDAE, GHILAROVUS, NEW SPECIES

SUMMARY: The present paper deals with the members of oribatid mites of the genus Ghilarovus. Three new species, Ghilarovus krivolutskyi sp. nov., Ghilarovus mongolicus, sp. nov. and Ghilarovus khentiicus sp. nov., collected from dry steppe, mountain-steppe and taiga forest habitats in southern Russia, and central, north and eastern parts Mongolia, are described on the basis of adults. In addition, an unknown species, Ghilarovus sp. is illustrated and characterized. Data on ecology and biogeography of the Ghilarovus-species known in the world, and the systematics of some genera of Zetomotrichidae are discussed. A key to the known species of Ghilarovus in the world is given.

Introduction

The oribatid mite genus Ghilarovus was proposed by KRIVOLUTSKY (1966) with Ghilarovus humeridens Krivolutsky, 1966 as type species. This genus is unique among the family Zetomotrichidae in having the following combination of characters: adults small to medium in size (312-540 µm); rostral margin denticulate; dorsosejugal suture absent; humeral region of notogaster with large prominent process; surface of notogaster not striated; ten pairs of notogastral setae; seta c2 much longer and thicker than other notogastral setae; four pairs of genital setae; one or two pairs of anal and two or three pairs of adanal setae.

Ghilarovus is a small genus of oribatid mites and until the present work, the genus comprised of 8 nominal species and one subspecies. There are relatively few features such as denticulation of rostrum, size and shape of sensilli, prodorsal and notogastral

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setae, number of epimeral and adanal setae, and the presence or absence of pyriform organs or humeral sac of notogaster that differentiate the species in this genus.

Representatives of this genus seem to be relatively rare, and most of the known species have been described from Europe (Subias, 1977; Subias & Pérez-Iñigo, 1977) and Asia (Krivolutsky, 1966, 1974; Wen, 1990; Krivolutsky & Smeljanski, 1997; Aoki & Hirauchi, 2000; Yamamoto & Aoki, 2000), and only single species is known from Central America (Mahunka, 1983).

In the course of our investigations on systematics and ecology of oribatid mites we found four unknown species belonging to Ghilarovus. One of them was found from Altaiskii Krai, Russia, and three others are from Mongolia.

**Descriptions**

**Ghilarovus mongolicus** sp. nov.  
(Figs. 1-3)

**Diagnosis.** Medium sized (393-427 µm in length) species with typical characters of *Ghilarovus*. Rostrum with 20 small teeth of similar size and spacing on anterior and lateral margins; sensilli short, nearly as long as rostral setae, thin, setiform, very finely barbed; lamellar and interlamellar setae relatively long, barbed; humeral sac well developed; a few small tubercles present between bothridia; three pairs of very short, thin adanal setae; posterior tectum of notogaster with overlapping lobes.

**Measurements.** Body length 393-427 (407) µm; width of notogaster 275-311 (296) µm.

**Prodorsum.** Rostrum rounded, but its margin medially and laterally dentate with 20 small teeth of similar size and spacing, but only few of them well visible in dorsal aspect (Figs. 1A, B & 2C). Rostral (ro), lamellar (le) and interlamellar (in) setae finely barbed; seta le about 1.5 times as long as seta ro; seta in 1.2 x as long as ro. Rostral and lamellar setae extending well beyond tip of rostrum. Exobothridial seta (ex) short and fine, inserted laterally to bothridium, its insertion pore situated under anterior part of notogaster. Sensillus (ss) relatively short and thin, its exposed portion approximately as long as rostral seta, finely barbed (Figs. 1C & 2B). Bothridium small, its posterior half covered by notogaster. Surface of prodorsum smooth, only few microtubercles present between two bothridia.

**Notogaster.** Oval, slightly narrowed posteriorly, dorsosejugal suture absent. Surface of notogaster with a number of granules scattered irregularly. Humeral projection accompanied posteriorly by a round or blunt triangular projection. Ten pairs of notogastral setae; humeral seta c2 very long and thick, but weakly barbed (Fig. 2B). Other notogastral setae short, thin and smooth (Figs. 1A & 2A). Humeral sac (hu) large, irregularly shaped, its opening at base of humeral projection. Notogastral lyrissure im almost as long as notogastral setae, situated posterior to seta la; lyrissure ip small, situated anterior to seta h2, both lyrissures well visible in dorsal view. Lyrissures ih and ips well developed, situated anterior to seta p3, but visible only in lateral view; ia not evident. Posterior tectum of notogaster with overlapping lobes (Figs. 1B & 2D).

**Gnathosoma.** Infracapitular mentum far wider than long, with few microtubercles. Hypostomal setae h and m long, barbed; seta a short, thin and smooth (Fig. 1D). Chelicera relatively large, fixed and movable digits with few blunt teeth. Trägårdh’s organ inconspicuous; setae cha and chb thin, smooth (Fig. 3D).

**Epimeral region.** With many muscle sigillae. Sejugal and II apodemes well developed, aligned obliquely and nearly parallel; other apodemes not evident. Epimeral setae relatively long, conspicuously barbed, setal formula 3-1-3-3. Custodium long, sharply pointed; pedotectum I relatively large, pedotectum II smaller, bearing setae 1c and 3c, respectively (Fig. 1D).

**Ano-genital region.** Genital aperture slightly narrowed posteriorly, anal aperture nearly rounded. Four pairs of genital, one pair of aggenital, two pairs anal and three pairs of adanal setae. Genital and aggenital setae relatively long, while anal and adanal setae very short, all of them smooth. Adanal lyrissure (iad) situated obliquely, at level a little anterior to anal setae an2 (Figs. 1D & 2D).

**Legs.** All legs heterotridactylous, median claw shorter, but thicker than lateral claws. Femora I-IV and trochanters III and IV with distinct porose areas. Tibia I with very large dorsodistal projection, while
Fig. 1. *Ghilarovus mongolicus* sp. nov. A. — Dorsal view; B. — Anterior part of prodorsum; C. — Sensillus and bothridium; D. — Ventral view (scale bar is same for A, D and B, C, respectively).
Fig. 2. *Ghilarovus mongolicus* sp. nov. A. — Lateral view; B. — Humeral region of notogaster; C. — Rostrum (after dissection); D. — Posterior part of ventral plate.
Fig. 3. *Ghilarovus mongolicus* sp. nov. A. — Leg I (right, antiaxial aspect); B. — Leg II (right, antiaxial aspect); C. — Leg III (right, paraxial aspect; trochanter separately shown); D. — Chelicera; E. — Leg IV (right, antiaxial aspect).
tibia II with relatively small dorsodistal projection. Ventral carina of femora I-IV poorly developed. Dorsodistal part of trochanter III with small projection and ventrodistal part of trochanter IV with small incision. Formula of leg setation (including famulus): I (1-5-2-4-20), II (1-5-2-4-16), III (2-3-1-3-15), 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). Structure and setation of legs I-IV as shown in Fig. 3.

Material examined. Holotype (female): Mt. Lkhachinvandad, District Erdenetsagaan, Province Sukhbaatar, Mongolia, mountain steppe, soils and plant debris accumulated between rocks, 45°40′46″N, 116°07′42″E, elevation 1242 m a.s.l., 01 June 2003, Col. B. BAYARTOGTOKH. Six paratypes (three males and three females): same data as holotype. One paratype (female): Mt. Shiliin Bogd, District Dariganga, Province Sukhbaatar, mountain steppe, mountain steppe soils under Leymus chinensis, 45°28′35″N, 114°35′03″E, elevation 1687 m a.s.l. 02 June 2003, Col. B. BAYARTOGTOKH. The holotype and five paratypes are deposited in the collection of the Department of Zoology, National University of Mongolia, Ulaanbaatar, Mongolia, and two paratypes are in the collection of the Zoological Museum, Institute of Animal Systematics and Ecology, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia. All specimens are preserved in alcohol.

Remarks. The new species, *Ghilarovus mongolicus* sp. nov. is easily distinguishable from the type species, *G. humeridens* Krivolotsky, 1966 by the 1) much shorter and finely barbed sensilli as opposed to the long and strongly barbed sensilli in *G. humeridens*; 2) rostral margin with smaller teeth of different number; 3) presence of pyriform organs on notogaster as opposed to lacking in *G. humeridens*; 4) much shorter, but distinctly barbed interlamellar setae, and 5) far smaller body size.

Another Central Asian species, *G. turcmenicus* Krivolotsky, 1974 differs from the new species in the 1) very large teeth on the anterior margin of rostrum as opposed to the small and widely spaced teeth in *Ghilarovus mongolicus* sp. nov.; 2) far longer sensilli with a few, but long barbs in contrast of relatively short sensilli with more dense, but short barbs, and 3) smooth notogastral setae *c*₂ as opposed to the conspicuously barbed setae in *Ghilarovus mongolicus* sp. nov.

The Japanese species, *G. saxicola* Aoki & Hirauchi, 2000 is distinguishable from *Ghilarovus mongolicus* sp. nov. by the 1) presence of only two pairs of adanal setae as opposed to three pairs in the new species; 2) more strongly barbed sensilli as opposed to very finely barbed sensilli in the new species, and 3) rostral margin with teeth of different number and sizes.

The Mexican species, *G. elegans* Mahunka (1983) differs from the present new species in the 1) slender notogastral setae *c*₂ as opposed to very thick setae in the new species; 2) much longer sensilli in contrast of relatively short sensilli in the new species; 3) presence of pyriform organs on notogaster, and 4) rostral margin with teeth of different number and sizes.

The Chinese species, *G. changlingensis* Wen, 1990 is different from *Ghilarovus mongolicus* sp. nov. in the 1) relatively long and strongly barbed sensilli; 2) rostral margin with fewer teeth of different sizes, and 3) absence of notogastral pyriform organ.

Another Chinese species, *G. daliensis* described by YAMAMOTO and AOKI (2000) can be easily differentiated from *Ghilarovus mongolicus* sp. nov. in the 1) long and strongly barbed sensilli; 2) presence of pyriform organs on notogaster; 3) rostral margin with fewer teeth of different sizes; 4) presence of only two pairs of adanal setae, and 5) far smaller body size.

*G. stipatus* Krivolotsky & Smeljanski, 1997 described from Kazakhstan and later recorded from Russia can be distinguished from the present new species by the 1) smooth rostral, lamellar and interlamellar setae; 2) sensilli with few and sparse barbs; 3) smooth notogastral setae *c*₂; 4) rostral margin with fewer teeth, and 5) far smaller body size.

The Spanish species, *Ghilarovus hispanicus* Subias & Pérez-Iñigo, 1977 is distinguishable from *Ghilarovus mongolicus* sp. nov. by the 1) longer and stronger notogastral setae *c*₂; absence of notogastral pyriform organ; 3) not overlapping posterior tectum of notogaster, and 4) rostral margin with fewer teeth of different sizes. Another Spanish taxon, *G. hispanicus quadarramicus* Subias, 1977 is easily distinguished from the new species by the presence of only one pair of anal setae in contrast of two pairs in *Ghilarovus mongolicus* sp. nov.

Etymology. The specific name “*mongolicus*” refers to the name of country, which encompassing the type locality of this species.
**Ghilarovus khentiicus** sp. nov.  
(Fig. 4)

**Diagnosis.** Medium sized (348-396 μm in length) species with typical characters of *Ghilarovus*. Rostrum with 16 teeth; anterior six teeth conspicuously larger than those of lateral margins; there is deep incision on each side behind of fourth anterior teeth; sensilli medium long, longer than rostral setae, thin, setiform, finely barbed; lamellar and interlamellar setae relatively long, barbed; humeral sac well developed; a few longitudinal striations present between bothridia; two pairs of very short, thin adanal setae; posterior tectum of notogaster not overlapped.

**Measurements.** Body length 348-396 (372) μm; width of notogaster 220-244 (230) μm.

**Prodorsum.** Rostrum with 16 teeth, anterior six teeth conspicuously larger than lateral teeth; latter teeth small, similar in size and spacing; there is deep incision on each side behind of fourth anterior teeth (Fig. 4A, C & D). Rostral, lamellar and interlamellar setae finely barbed; seta *le* about 1.5 times as long as seta *ro*; seta *in* nearly as long as seta *ro*. Rostral and lamellar setae extending well beyond tip of rostrum. Exobothridial seta short and fine, inserted laterally to bothridium, its insertion pore situated under anterior part of notogaster. Sensillus medium long, thin, its exposed portion conspicuously longer than rostral seta, finely barbed (Fig. 4A & D). Bothridium small, its posterior half covered by notogaster. Surface of prodorsum smooth, only few longitudinal striations present between two bothridia.

**Notogaster.** Oval, slightly narrowed posteriorly, dorsosejugal suture absent. Surface of notogaster with a number of granules scattered irregularly. Humeral projection accompanied posteriorly by a round or blunt triangular projection. Ten pairs of notogastral setae; humeral seta *c₂* very long and thick, but weakly barbed (Fig. 4B). Other notogastral setae short, thin and smooth (Fig. 4A & D). Humeral sac large, irregularly shaped, its opening at base of humeral projection. Notogastral lyrifissure *im* slightly smaller than length of notogastral setae, situated posterolaterad of seta *la*; lyrifissure *ip* small, situated posterolaterad of seta *h₃*, both lyrifissures well visible in dorsal view. Lyrifissures *ih* and *ips* well developed, situated anterior to seta *p₃*, but visible only in lateral view; *ia* not evident. Posterior tectum of notogaster not overlapped (Fig. 2B).

**Gnathosoma.** Infracapitular mentum far wider than long, without noticeable microtubercles. Hyposomal setae *h₁* long, thick, barbed; setae *a₁* and *m₁* short, thin, former seta finely barbed (Fig. 4B). Chelicera and palp typical for genus.

**Epimeral region.** Sejugal and II apodemes well developed, other apodemes not evident. Epimeral setae *Ib* and *Ic* longer and thicker than other epimeral setae, conspicuously barbed, setal formula 3-1-2-3; seta *3c* not evident. Custodium long, sharply pointed; pedotectum I relatively large, bearing setae *Ic*, pedotectum II small (Fig. 4B).

**Ano-genital region.** Genital and anal aperture slightly longer than wide. Four pairs of genital, one pair of aggenital, two pairs anal and two pairs of adanal setae (setae *ad₁* lacking). Genital and aggenital setae medium long, while anal and adanal setae short, all of them smooth. Adanal lyrifissure (*iad*) situated obliquely, at same level to anal setae *an₂* (Fig. 4B).

**Legs.** All legs heterotridactylous, median claw shorter, but thicker than lateral claws. Structure and setation of legs similar as that of former species. Formula of leg setation (including famulus): I (1-5-2-4-20), II (1-5-2-4-16), III (2-3-1-3-15), IV (1-2-3-12); formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

**Material examined.** Holotype (female): Minj Gol area, Mts. Khentii, District Batshireet, Province Khentii, Mongolia, mosses growing on the rocks in taiga larch forest (*Larix sibirica*), 49°15'20"N, 108°40'20"E, elevation 1420m a.s.l., 27 July 2002, Col. B. BAYARTOGTOKH. Two paratypes (one male and one female): same data as holotype. The holotype and a paratype are deposited in the collection of the Department of Zoology, National University of Mongolia, Ulaanbaatar, Mongolia, and one paratype is in the collection of the Zoological Museum, Institute of Animal Systematics and Ecology, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia. All specimens are preserved in alcohol.

**Remarks.** *Ghilarovus khentiicus* sp. nov. is easily distinguishable from most other known species of *Ghilarovus* by the presence of only two pairs of adanal setae. Most of the known species of *Ghilarovus*...
Fig. 4. _Gilarovus khentiicus_ sp. nov. A. — Dorsal view; B. — Ventral view; C. — Rostrum (dorso-frontal view); D. — Prodorsum.
have three pairs of adanal setae. Among them only *G. saxicola* Aoki & Hirauchi, 2000, *G. daliensis* Yamamoto & Aoki, 2000 being with two pairs of adanal setae as in the present new species.

However, the Japanese species, *G. saxicola* Aoki & Hirauchi, 2000 is different from *Ghilarovus khentiiicus* sp. nov. in the 1) rostral margin with teeth of different number and sizes; 2) sensilli with relatively long barbs as opposed to the very finely barbed sensilli in the new species, and 3) posterior tectum of notogaster with overlapping lobes in contrast of not overlapped posterior tectum in the new species.

The Chinese species, *G. daliensis* Yamamoto & Aoki, 2000 can be differentiated from *Ghilarovus khentiiicus* sp. nov. in the 1) rostral margin with fewer teeth of different sizes; 2) absence of humeral sac of notogaster as opposed to the well-developed humeral sac in the new species; 3) sensilli with relatively long barbs rather than very finely barbed sensilli in the new species, and 4) presence well-developed notogastral pyriform organ in contrast of lacking of pyriform organ in the new species.

**Etymology.** The specific name “*khentiiicus*” refers to the name of mountain range “Khentii”, which encompassing the type locality of this species.

*Ghilarovus krivolutskyi* sp. nov. (Figs. 5-7)

**Diagnosis.** Medium sized (332-372 𝜇m in length) species with typical characters of *Ghilarovus*. Rostrum with 18-22 teeth; anterior third and fourth teeth slightly larger than other teeth; there are deep incisions on each side behind of second, third and fourth anterior teeth (Figs. 5A, C, D & 7A). Rostral, lamellar and interlamellar setae finely barbed; seta *le* about 1.5 times as long as seta *ro*; seta *in* nearly as long as *ro*. Rostral and lamellar setae extending well beyond tip of rostrum. Exobothridial seta short and fine, inserted laterally to bothridium, its insertion pore situated under anterior part of notogaster. Sensillus medium long, thin, its exposed portion conspicuously longer than rostral seta, with 9-11 relatively long barbs (7-9 on upper side and 2 on lower side). Bothridium small, its posterior half covered by notogaster (Figs. 5A, D & 6A). Surface of prodorsum smooth, only few microtubercles present between two bothridia.

**Notogaster.** Nearly circular, slightly narrowed posteriorly, dorsosejugal suture absent. Surface of notogaster with a number of granules scattered irregularly. Humeral projection accompanied posteriorly by a round or blunt triangular projection. Ten pairs of notogastral setae; humeral seta *c₂* very long and thick, but weakly barbed (Figs. 5A, C, 6A & 7C). Other notogastral setae short, thin and smooth (Fig. 5A & B). Humeral sac large, irregularly shaped, its opening at base of humeral projection. Pyriform organ (*py*) well developed, situated (inside of body) at anterolateral level of lyrifissure *im* (Figs. 5A & 6A). Notogastral lyrifissure *im* slightly smaller than length of notogastral setae, situated posterior to seta *la*; lyrifissure *ip* approximately same in size as *im*, situated anterolateral of seta *h₁*, both lyrifissures well visible in dorsal view. Lyrifissures *ih* and *ips* well developed, situated anterior to seta *p₂*, but visible only in lateral view; *ia* not evident. Posterior tectum of notogaster with overlapping lobes (Figs. 5B, 6C & 7D).

**Gnathosoma.** Infraocular mentum far wider than long, without noticeable microtubercles. Hypostomal setae *h* and *m* long, thick, barbed; setae *a* shorter and thinner than two former setae, finely barbed. Chelicera and palp typical for genus (Fig. 5B, 6B &7B).

**Epimeral region.** Anterior part of epimeral region with very fine longitudinal striations (Fig. 7C). Sejugal and II apodemes well developed, other apodemes not evident. Epimeral setae *1a, 1b* and *1c* longer and thicker than other epimeral setae, conspicuously...
Fig. 5. *Ghilarvus krivolutskyi* sp. nov. A. — Dorsal view; B. — Ventral view; C. — Prodorsum and anterior part of notogaster; D. — Sensillus and bothridium; E. — Rostrum.
Fig. 6. *Ghilarovus krivolutskyi* sp. nov. A. — Humeral region of notogaster; B. — Gnathosoma (right palp not shown); C. — Posterior part of ventral plate; D. — Genital region (scale bar is same for A, B and C).
Ghilarovus krivolutskyi sp. nov. A. — Rostral region (dorso-frontal view); B. — Humeral region of notogaster; C. — Hypostomal region; D. — Posterior part of ventral plate.

Fig. 7. Ghilarovus krivolutskyi sp. nov. A. — Rostral region (dorso-frontal view); B. — Humeral region of notogaster; C. — Hypostomal region; D. — Posterior part of ventral plate.

barbed, other setae thin, smooth; setal formula 3-1-3-3. Custodium long, sharply pointed; pedotectum I relatively large, pedotectum II smaller, bearing setae 1c and 3c, respectively (Fig. 5B).

Ano-genital region. Genital aperture slightly longer than wide, while anal aperture nearly as long as wide. Four pairs of genital, one pair of aggenital, two pairs anal and three pairs of adanal setae. All ano-genital setae medium long, smooth. Adanal lyrifissure (iad) situated obliquely, at level a little anterior to anal setae an2 (Fig. 5B, 6C & D).

Legs. All legs heterotridactylous, median claw shorter, but thicker than lateral claws. Structure and setation of legs similar as that of Ghilarovus mongo-
Ghilarovus sp. (Figs. 8)

**Diagnosis.** Medium sized (415 µm in length) species with typical characters of *Ghilarovus*. Rostrum with 4-5 very small teeth on each side of anterolateral margin; sensilli medium long, longer than rostral setae, very thin, setiform, with only 7 minute and sparse barbs; rostral setae medium long, more strongly barbed than setae le and in; lamellar setae long, interlamellar setae almost twice shorter than setae le, both pairs finely barbed; humeral sac and pyriform organ not developed; three pairs of adanal setae; posterior tectum of notogaster not overlapped, but separated.

**Measurements.** Body length 415 µm; width of notogaster 257 µm.

**Prodorsum.** Rostrum 4-5 very small teeth on each side of anterolateral margin, which very poorly visible in dorsal and ventral views (Fig. 8D). Rostral seta conspicuously barbed; lamellar and interlamellar setae finely barbed; seta le almost twice as long as setae ro and in. Rostral and lamellar setae extending well beyond tip of rostrum. Exobothridial seta short and fine, inserted laterally to bothridium, its insertion pore situated under anterior part of notogaster. Sensillus medium long, very thin, its exposed portion slightly longer than rostral seta, with only 7 minute and sparse barbs. Bothridium small, its posterior half covered by notogaster (Fig. 8A & C). Surface of prodorsum smooth.

**Notogaster.** Oval, gradually narrowed posteriorly, dorsosejugal suture absent. Surface of notogaster with a number of granules scattered irregularly. Humeral projection accompanied posteriorly by a round or blunt triangular projection. Ten pairs of notogastral setae; humeral seta c2 very long and thick, but weakly barbed (Figs. 8A & C). Other notogastral setae short, thin and smooth (Fig. 8A & B). Humeral sac or pyriform organ absent. Notogastral lyri fissure im slightly smaller than length of notogastral setae, situated laterad of seta ln; lyri fissure ip approximately same in size as im, situated posterior to seta h3, both lyri fissures well visible in dorsal view. Lyri fissures ih and ips well developed, situated anterior to seta p3, but visible only in lateral view; ia not evident. Posterior tectum of notogaster not overlapped, but well separated (Fig. 8B).
Fig. 8. *Ghilarovus* sp. A. — Dorsal view; B. — Ventral view; C. — Prodorsum and anterior part of notogaster; D. — Rostrum.
Gnathosoma. Infraocapitular mentum far wider than long, without noticeable microtubercles (Fig. 8B). Hypostomal setae h and m long, thick, barbed; setae a shorter and thinner than two former setae, nearly smooth. Chelicera and palp typical for genus.

Epimeral region. Sejugal and II apodemes well developed, other apodemes not evident. Epimeral setae 1a, 1b, 1c, 2a and 3a longer and thicker than other epimeral setae, conspicuously barbed, setal formula 3-1-3-3. Pedotectum I relatively large, pedotectum II smaller, bearing setae 1c and 3c, respectively (Fig. 8B).

Ano-genital region. Genital aperture slightly longer than wide, while anal aperture nearly as long as wide. Four pairs of genital, one pair of aggenital, two pairs anal and three pairs of adanal setae. All ano-genital setae medium long, smooth. Adanal lyrifissure (iad) situated obliquely, at level anterior to anal setae an2 (Fig. 8B).

Legs. All legs heterotridactylous, median claw shorter, but thicker than lateral claws. Structure and setation of legs similar as that of Ghilarovus mongolicus sp. nov. Formula of leg setation (including famulus): I (1-5-2-4-20), II (1-5-2-4-16), III (2-3-1-3-15), 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).


Remarks. In July 2004, when the first author met with Prof. D. A. Krvolutschy in Ulaanbaatar, the capital city of Mongolia, he gave two mounted slides. One of them contained a specimen of known oribatid species, Sphaerochthonius splendidus (Berlese, 1904), and another slide contained a single specimen of Ghilarovus, with short label data.

The latter specimen is studied here, and according to the features given in the above description and figures, it seems to be a new species. However, currently only single specimen is available for us from central Mongolia. Unfortunately we could not get the full data on collection locality of this single specimen. So, until the collection of additional material we remain this species as an unknown taxon.

Discussion

As we mention above that the representatives of this genus are relatively rare and most of species have restricted distribution. According to the present data, only the type species, G. humeridens Krvolutschy shows relatively wide distribution, and it has been recorded before in Uzbekistan, Turkmenistan, and in eastern part of China (Anhui province). This species is a typical inhabitant of the desert pistachio and nut thickets (Juglans regia, J. fallax, Acer turkestanicum and Pirus kirgisorum) and mountain soils in the arid environments (Krivolutschy, 1966, 1975; Karpinnen et al., 1986 and Wang et al., 2003).

Most other species seem to be distributed only in restricted areas or are known only from the type localities. Another Central Asian species, G. turemnicus Krvolutschy is known only from the type locality in Turkmenistan. It is an inhabitant of the litter of juniper thickets in desert ecosystem (Krivolutschy, 1974, 1975). The other species, G. stipatus Krvolutschy & Smeljanski is an inhabitant of the stony soils of steppe landscapes in Western and Eastern Kazakhstan, and South Ural Mountains in Southern Russia (Krivolutschy, 1995; Krivolutschy & Smeljanski, 1997 and Andrievsky et al., 2002).

Two Spanish taxa, G. hispanicus hispanicus Subias & Pérez-Iñigo and G. hispanicus guadarramicus Subias are saxicolous mites, distributed in the mountainous area in semi-arid environments of the Iberian Peninsula (Subias, 1977; Subias & Pérez-Iñigo, 1977; Pérez-Iñigo, 1993 and Subias & Gil-Martín, 1997). G. saxicola Aoki & Hirauchi is known from the litter of Tsuga sieboldii forest on the cliff of Kurobe River valley in Central Japan (Aoki & Hirauchi, 2000).

The Chinese species, G. changlingensis Wen and G. daliensis Yamamoto & Aoki are recorded from the north-eastern (Jilin province) and southern (Yunnan province) parts of this country, respectively. The first species is an inhabitant of the grassland soils, while second species inhabits the alpine zone of high mountains (Wen, 1993; Aoki et al., 1997; Yamamoto & Aoki, 2000 and Wang et al., 2003).

The Mexican species, G. elegans Mahunka was found in the high mountains of southern Mexico (Mahunka, 1983).
One of the new species described here, *Ghilarovus krivolutskyi* sp. nov. is an inhabitant of the dry stony soils under junipers (*Juniperus sabina*) growing on the granite rocks of small hills covered with steppe grassland in southern Russia.

As most of the other known members of *Ghilarovus*, the Mongolian species, *G. mongolicus* sp. nov. occurs in the arid habitats, i.e. in the dry mountain-steppe soils of eastern part of the country. Alternatively, another species, *G. khentiicus* sp. nov. was found in the mosses growing on the rocks in taiga forest (*Larix sibirica*) of the northern Mongolia. The last species, *Ghilarovus sp.* is an arboricolous mite and inhabits the lichens growing on elm tree trunk in central Mongolia.

Thus, the representatives of *Ghilarovus* appears to be distributed mostly in the Palaearctic region, except only a single Neotropical and Indomalayan species in each, and not represented in the Nearctic, Ethiopian, Oceanian or Australian regions (Fig. 9).

It seems to be that the range of this genus well in accordance with area of the Old Mediterranean Region by the concept evolved by Popov (1927, 1963). According to him the Old Mediterranean is an area around the old Tethys Ocean, which dried up during Palaeogene and Neogene (modern remnants of the Tethys are Mediterranean, Black and Caspian Seas, and Sea of Azov as well as Aral and Balkhash Lakes), and it covers the modern Mediterranean region, South Russia and Central Asia (except high mountains) to East Mongolia.

Though the ecology and habitat preference of few of the known species are not well known, it is remarkable to note that most of *Ghilarovus*-species are saxicolous or arboricolous, and mostly inhabit the arid or semi-arid environments like desert, semi-desert, dry steppe, mountain-steppe or dry mountain areas (in association with juniper vegetation is common).

Concerning the systematics of the genera belonging to *Zetomothrichidae*, Coetzee (1993) discussed the systematics and diagnosis of the genera of this family, and she considered that the presence or absence of dorsosejugal suture and pyriform organ, placement of the acetabulum and structure of leg IV, and the number of ano-genital setae as main diagnostic characters distinguishing different genera if this family. However, in our opinion the generic status of some genera such as *Mabulatrixichus* Coetzee, 1993, *Pallidacarus* Krivolutsky, 1975, *Ghilarovus* Krivolutsky, 1966, *Oglasacarus* Bernini, 1978 and *Mikizetes* Hammer, 1958 is still problematic, and might be questioned as suggested by Subias and Pérez-Iñigo, (1977), and Mahunka (1983). For instance, according to the classification of Coetzee (1993) the genus *Mabulatrixichus* differs from *Ghilarovus* and *Pallidacarus* in the presence of the one pair of anal and two pairs of adanal setae instead of two pairs of anal and three pairs of adanal setae in the latter two genera. However, there are some species in these genera which involved “mixed” characters in sense of the number of anal and adanal setae. Thus the species, *G. saxicola* Aoki & Hirauchi, *G. daliensis* Yamamoto & Aoki and *G. khentiicus* sp. nov. are being with only two pairs of adanal setae as *Mabulatrixichus*-species, but all of them have two pairs of anal setae. In the meantime, *G. hispanicus guadarramicus* Subias, 1977 bearing only one pair of anal setae as the members of *Mabulatrixichus*, but the number adanal setae (three pairs) is different than that of the latter genus.

Two other genera, *Mikizetes* and *Oglasacarus* are also very similar to each other. Only a single principal difference between them is presence of humeral sac in *Oglasacarus* in contrast of lacking in *Mikizetes*. However, in our opinion the development of humeral sac is also variable character within the species of some genera of *Zetomothrichidae*. For instance, some species of *Ghilarovus* are being with well-developed humeral sac e. g. *Ghilarovus saxicola* Aoki & Hirauchi, *G. khentiicus* sp. nov. *G. mongolicus* sp. nov., while some other species without humeral sac (e. g. *G. daliensis* Yamamoto & Aoki, *G. hispanicus* Subias & Pérez-Iñigo, *G. stipatus* Krivolutsky & Smeljanski etc.). Moreover, the presence or absence of notogastral pyriform organ is also variable within the genus *Ghilarovus*. Therefore, we suppose that the above phenomenon might be occurred in species of *Mikizetes*, *Papillacarus* and *Oglasacarus* as well. So, further studies are, necessary on above mentioned genera of *Zetomothrichidae* to show whether these are independent genera.

In conclusion, the following key could be used for the identification of the adults of world known species of the genus *Ghilarovus*. 

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Fig. 9. Distribution map of Ghilarovus species in the world.

KEY TO ADULTS OF WORLD SPECIES OF THE GENUS GHIAROVUS KRIVOLUTSKY, 1966

1 Notogastral pyriform organ present ................. 2
   — Notogastral pyriform organ absent............. 4
2 Humeral sac absent; two pairs of adanal setae .......... G. daliensis Yamamoto & Aoki, 2000
   — Humeral sac present; three pairs of adanal setae . 3
3 Posterior tectum of notogaster with overlapping lobes; relatively small species, body length 332-372 µm, width 244-262 µm (Figs. 5-7) .......... G. krivolutskyi sp. nov.
   — Posterior tectum of notogaster not overlapped; relatively large species, body length 441-510 µm, width 281-368 µm ................. G. elegans Mahunka, 1983
4 Two pairs of adanal setae present ...................... 2
   — Three pairs of adanal setae ...................... 5
5 Rostrum with 16 teeth, anterior six teeth conspicuously larger than lateral teeth (there is deep incision on each side behind of fourth anterior teeth); posterior tectum of notogaster not overlapped (Fig. 4) .......... G. khenticus sp. nov.
   — Rostrum with about 23 teeth of similar size and spacing; posterior tectum of notogaster overlapped ................. G. saxicola Aoki & Hirauchi, 2000
6 Humeral sac absent ................................ 7
   — Humeral sac present (Figs. 1-3) .......... G. mongolicus sp. nov.
7 Rostrum with more than 10 relatively large teeth; posterior tectum of notogaster continuous .......... 8
   — Rostrum with 8-10 very small teeth; posterior tectum of notogaster separated (Fig. 8) .......... Ghiarovus sp.
8 Rostral teeth of similar size and spacing .......... 9
   — Anterior teeth of rostrum conspicuously larger than lateral teeth ......................... 11
9 Prodorsal and epimeral setae 1a, 1b, 1c, 3c and 4c conspicuously barbed ................. 10
   — Prodorsal and epimeral setae smooth ................. G. stipatus Krivolutsky & Smeljanski, 1997
10 Two pairs of anal setae present ................. G. hispanicus hispanicus Subias & Perez-Inigo, 1977
   — One pair of anal setae present ................. G. hispanicus guadarramicus Subias, 1977
11 Prodorsal setae and sensilli either with few barbs or smooth ................. 12
   — Prodorsal setae and sensilli with very dense barbs .......... G. changlingensis Wen, 1990
12 Anterior six teeth of rostrum much larger than lateral teeth; prodorsal setae sparsely barbed; small species, body length 370 µm .... G. turemenicus Krivolutsky, 1974
   — Anterior four teeth of rostrum slightly larger than lateral teeth (there is deep incision on each side behind of fourth anterior teeth); prodorsal setae smooth; medium sized species, body length 482 µm .......... G. humeridens Krivolutsky, 1966

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