

# Three new soil mites of the genus *Epidamaeus* (Acari, Oribatida, Damaeidae) from Mongolia

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Bayartogtokh B. 2001. — Three new soil mites of the genus *Epidamaeus* (Acari, Oribatida, Damaeidae) from Mongolia. *Zoosystema* 23 (1) : 29-49.

## ABSTRACT

Three new species of oribatid mites belonging to the genus *Epidamaeus* are described from litter of birch forests and organic debris on soils in central and southern parts of Mongolia. *Epidamaeus aokii* n. sp. differs from closely related species in the very thick and densely barbed notogastral setae, the large and widely spaced postbothridial tubercles and spinae adnatae, the relatively short and finely barbed sensilli, the ratio in length of the solenidia  $\sigma$  to associated setae d of genera I-III, the presence of the enantiophysis E2, the number of the setae on the epimeral region and femur III, tarsus III, and the absence of the propodolateral apophysis. *Epidamaeus angustirostratus* n. sp. can be distinguished from its congeners by the conspicuously pointed rostrum, the absence of the propodolateral apophysis, the large spinae adnatae, the presence of the anteroventral projection on trochanter IV, the relatively long femur IV, which is far longer than tibia IV, the relatively short trochanter IV, which is much shorter than femur IV, and the length of setae d', l' and v' on genu IV. *Epidamaeus tenuisetosus* n. sp. is distinguishable from most other known congeners by the absence of tubercles Vp, E2a and E2p from the ventral plate, the extremely minutely barbed prodorsal and notogastral setae, the small body size, and the number of setae on tarsi I, II and femur III.

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## KEY WORDS

Arachnida,  
Acari,  
Oribatida,  
Damaeidae,  
*Epidamaeus*,  
Mongolia,  
new species.

## RÉSUMÉ

*Trois nouveaux acariens de sol du genre Epidamaeus (Acari, Oribatida, Damaeidae) de Mongolie.*

Trois nouvelles espèces d'acariens oribates appartenant au genre *Epidamaeus* sont décrites de la litière des forêts de bouleaux et des débris organiques sur des sols dans les régions centrales et méridionales de la Mongolie. *Epidamaeus aokii* n. sp. diffère des espèces les plus proches par les poils gastronomiques très épais et densément barbelés, les tubercules postbothridiques grands et largement espacés, les spinae adnatae, le sensillus relativement court et finement barbelé, la différence de longueur du solénidion  $\sigma$  et du poil associé d des génaux I-III, la présence des énantiophasis E2, le nombre différent de poils dans la région épimérale, le nombre différent de poils sur le fémur III, les tarsi III, l'absence de l'apophyse propodolatérale. *Epidamaeus angustirostratus* n. sp. peut être distinguée des espèces voisines par le rostre clairement aigu, l'absence de l'apophyse propodolatérale, les spinae adnatae plus grandes, la présence de la projection antéroventrale sur le trochanter IV, le fémur IV relativement long, bien plus long que le tibia IV, le trochanter IV relativement court, beaucoup plus court que le fémur IV, la longueur différente des poils d', l' et v' sur le génuat IV. *Epidamaeus tenuisetosus* n. sp. est distinguable de la plupart des autres espèces connues d'*Epidamaeus* par l'absence des tubercules Vp, E2a et E2p de la région ventrale, par les poils du prodorsum et du notogaster extrêmement petits et barbelés, par la taille de corps plus petite, le nombre différent de poils sur les tarsi I, II et le fémur III.

## MOTS CLÉS

Arachnida,  
Acari,  
Oribatida,  
Damaeidae,  
*Epidamaeus*,  
Mongolie,  
nouvelles espèces.

## INTRODUCTION

The members of the oribatid mite family Damaeidae Berlese, 1896 are typical inhabitants of forest litter and soil that primarily feed on decomposer fungi.

The genus *Epidamaeus* was proposed by Bulanova-Zachvatkina (1957a) within the family Damaeidae, but in a problematical way. In her three papers, which were published almost at the same time, Bulanova-Zachvatkina (1957a, b, c) repeatedly proposed *Epidamaeus* as a new genus. The first time she (Bulanova-Zachvatkina 1957a) provided only a brief diagnosis of the genus, but did not designate a type species and therefore, it might be considered a *nomen nudum*. In the same paper she mentioned the names of two new species, *E. pavlovskii* and *E. microspinus*, which should belong to her newly proposed genus, but no descriptions of the above species were presented in that work. In her subsequent paper, Bulanova-Zachvatkina (1957b) redefined *Epidamaeus* and

designated *Oribata bituberculata* Kulczynski, 1902 as the type species. In her another work (Bulanova-Zachvatkina 1957c) she repeated the previous diagnosis and described seven new species from the former Soviet Union, and recombined six previously known species to this genus.

The definition of *Epidamaeus* by Bulanova-Zachvatkina (1957a, b, c) was not adequate, and there has since been no fully acceptable diagnosis for this genus. Later, Norton (1978a, 1979c) defined the genera of Damaeidae including *Epidamaeus* on the basis of ontogenetic and phylogenetic studies, and he proposed a new subgenus *Akrodamaeus* Norton, 1978 with *Oribata longiseta* Banks, 1906 as the type species. The latter subgenus is distinguished from its nominate subgenus *Epidamaeus* in the absence of spinae adnatae.

*Epidamaeus* is one of the largest genera of Damaeidae, and more than 70 species have been included. On the basis of the present knowledge only a few species, such as *E. grandjeani* (Bulanova-Zachvatkina, 1957), *E. arcticolus* (Hammer,

1952), *E. fortispinosus* (Hammer, 1967), *E. tatricus* (Kulczynski, 1902), have wide distribution in the Holarctic region, and most other species seem to be distributed in restricted areas or are known only from the type localities.

Adults of *Epidamaeus* are unique among Damaeidae in having the following combination of character states: tibiae I-IV without setae d; setal formula of genua I-IV: 4-4-3-3; associated setal (setae d) formula of genua I-IV: 1-1-1-0; setal formula of trochanters I-IV: 1-1-2-1; spinae adnatae present (subgen. *Epidamaeus*) or absent (subgen. *Akrodamaeus*); propodolateral apophyses P rarely present.

In a recent classification of the oribatid mite genera, Balogh & Balogh (1992) considered that apophyses P are absent in *Epidamaeus*, but several species of both the subgenera of this genus (e.g., *E. longiseta* [Banks, 1906], *E. mackenziensis* [Hammer, 1952], *E. bakeri* [Hammer, 1952], *E. tecticola* [Michael, 1888], *E. nasutus* Behan-Pelletier & Norton, 1985, *E. verrucatus* Enami & Fujikawa, 1989, *E. fragilis* Enami & Fujikawa, 1989, *E. johnstoni* Tolstikov, 1997) have strongly or conspicuously developed apophyses P, which direct anteriorly or anterolaterad.

*Epidamaeus* is known to be widespread throughout the Northern Hemisphere, but the taxonomy of this genus is somewhat difficult. Representatives are known from Palaearctic and Nearctic regions and widespread in both (Michael 1885, 1888; Kulczynski 1902; Banks 1906; Sellnick 1925; Hammer 1952, 1953, 1955, 1967; Willmann 1953; Bulanova-Zachvatkina 1957b, c, 1964, 1967, 1973, 1975, 1979; Kunst 1961; Aoki 1966; Bernini 1970; Norton 1978a, 1979a; Behan-Pelletier & Norton 1983, 1985; Fujikawa & Fujita 1985; Marshall, Reeves & Norton 1987; Enami & Fujikawa 1989; Luxton 1989; Saloña & Iturrondobeitia 1989; Moraza, Moreno & Saloña 1990; Pérez-Iñigo Jr 1990; Lyashchew & Tolstikov 1993; Wang & Norton 1993; Enami, Aoki & Hu 1994; Pérez-Iñigo 1994; Tolstikov 1997). According to the present knowledge, the genus appears to be poorly represented in the southern Hemisphere, and only a few species have been described from the Neotropical

region (Balogh & Mahunka 1969; Norton 1979b; Palacios-Vargas 1984).

Although the family Damaeidae shows greatest taxonomic diversity in the whole European continent and some parts of Asia, the Mongolian damaeid fauna remains completely unknown. However, according to my collections from different regions of Mongolia, the country appears to be as species-rich as others in the Palaearctic region. This work is a part of the continuing study on the oribatid mite fauna of Mongolia, and it includes the descriptions of three new species of *Epidamaeus*. All three belong to the nominate subgenus *Epidamaeus*, since they have well-developed spinae adnatae. The results of study on the remaining species of this genus and other representatives of Damaeidae of Mongolia will be published in several future works.

## MATERIAL AND METHODS

All three species were collected between 1991 and 1996, from central (from litter of birch forest) and southern (organic debris on soils of dry semidesert habitat) parts of Mongolia. All type specimens are preserved in alcohol. The type locality and habitat characterization for each species are given in the "material examined" section after the description. Immatures are unknown for any of these species. Specific terminology used in this paper is based on that (with a few modifications) developed by Grandjean (1960), Norton (1977b, 1978b, 1979b) and Behan-Pelletier & Norton (1983, 1985). The nomenclature of leg setation was summarized by Norton (1977a).

All measurements are given in micrometres ( $\mu\text{m}$ ), and the average measurement values are given in parentheses after the range. Both sexes are included in the measurements. Body length is measured in lateral view from the tip of rostrum to the posterior edge of ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. Proterosomal length is measured in lateral aspect, from the tip of rostrum to the dorsosejugal groove, which is visible posterior to the bothridium. Proterosomal width is measured in dorsal

aspect, from the left edge to the right edge along the level of bothridia or just in front of acetabulum II. Hysterosomal length is measured from the dorsojugal groove to the posterior edge of ventral plate. Length of notogaster is measured in lateral aspect, from the anterior edge to the posterior one. Width of notogaster is refers to maximum width in dorsal aspect. Dorso-ventral thickness of hysterosoma is measured in lateral aspect, from the edge of ventral plate to the dorsal edge of notogaster in postgenital transect. Thickness of notogaster is measured from the dorsal to the ventral edge of notogaster. All measurements of body setae are made in lateral aspect. Length of leg segments measured in lateral aspect, including the portion inserted in the next segment.

## SYSTEMATICS

### *Epidamaeus aokii* n. sp. (Figs 1-3)

**TYPE MATERIAL.** — Holotype (♀) and 13 paratypes (9 ♂♂ and 4 ♀♀), Mont Khustai, District Altanbulag, Central Province, litter of birch forest (*Betula plataphylla*), 47°42'N, 106°25'E, 1680 m above sea level, 11.IV.1996, leg. B. Bayartogtokh, the holotype and nine paratypes are deposited in the collection of the Department of Zoology, National University of Mongolia, Ulaanbaatar, Mongolia (NUM DZ Ac 0035-0044); two paratypes in the collection of the Muséum national d'Histoire naturelle, Paris, France (MNHN Acariens 1073), and two paratypes in the collection of the National Science Museum, Tokyo, Japan NSMT Ac 11182, 11183).

**ETYMOLOGY.** — The specific name is dedicated to Dr Jun-ichi Aoki, professor of Yokohama National University, Yokohama, Japan, who very kindly guides and encourages me in the field of study on systematics of oribatid mites.

**DIAGNOSIS.** — Large species with general characters of *Epidamaeus*; propodolateral apophysis absent; postbothridial tubercle Ba present, tubercles Bp, Da and Dp absent; interlamellar and notogastral setae very thick, densely barbed, darkly pigmented; spinae adnatae large; enantiophyses E2, V and S developed; hypostomal setae h and m very long, thin; epimeral regions III and IV with four setae each; tarsus II with 17, III with 16 setae; leg I (1.2 time), III (1.2 time) and IV (1.4 time) longer than body length; solenidion  $\sigma$  of genu I equal in length to its associated seta d; solenidia  $\sigma$  of genera II and III half length of associated setae d.

## DESCRIPTION

### *Measurements*

Body length 732-742 (734.7)  $\mu\text{m}$ ; length of proterosoma 305-336 (315.3)  $\mu\text{m}$ ; width of proterosoma 305-315 (307.5)  $\mu\text{m}$ ; length of hysterosoma 447-498 (472.9)  $\mu\text{m}$ ; length of notogaster 508-544 (530.5)  $\mu\text{m}$ ; width of notogaster 437-473 (453.8)  $\mu\text{m}$ .

### *Integument*

Reddish-brown to dark brown in colour. Surface of body and basal part of leg segments with rather thick cerotegument. Conspicuously microtuberculate on all enantiophyses and tubercles, lateral part of podosoma and around leg acetabula. Very fine punctations present on the lateral part of prodorsum and ventral plate. Adherent debris or exuvial scalps absent.

### *Prodorsum*

Rostrum rounded in dorsal view, but slightly projected in lateral view. Rostral seta (ro) long (132-147 [137.1]  $\mu\text{m}$ ), finely barbed throughout. Lamellar seta (le) long (152-173 [162.6]  $\mu\text{m}$ ), slightly longer than ro. Interlamellar seta (in) shorter, but much thicker than ro or le (102-127 [115.5]  $\mu\text{m}$ ), densely barbed throughout, very dark. Exobothridial seta (ex) short (41-55 [48.2]  $\mu\text{m}$ ), thin, smooth. Sensillus (ss) thin, but long (239-254 [249.1]  $\mu\text{m}$ ), finely barbed. Bothridium irregular funnel-shaped, directed posterolateral. Tubercles Bp, Da and Dp absent; postbothridial tubercles Ba relatively large, widely spaced, situated posterolateral to the insertions of interlamellar setae. In the place of tubercles Bp integument slightly thickened and dark-coloured. Propodolateral apophysis P absent (Fig. 1A).

### *Notogaster*

Slightly ovate viewed perpendicular to circumgastric scissure; about 1.1 time as long as wide. Dorso-ventral thickness of hysterosoma 488  $\mu\text{m}$ ; thickness of notogaster 295  $\mu\text{m}$ . Spinae adnatae (sa) large (76-101 [89.2]  $\mu\text{m}$ ), curved ventral, with broad base and distally tapered to fine tip; distance between their bases shorter than that of tubercles Ba and almost equal to that between



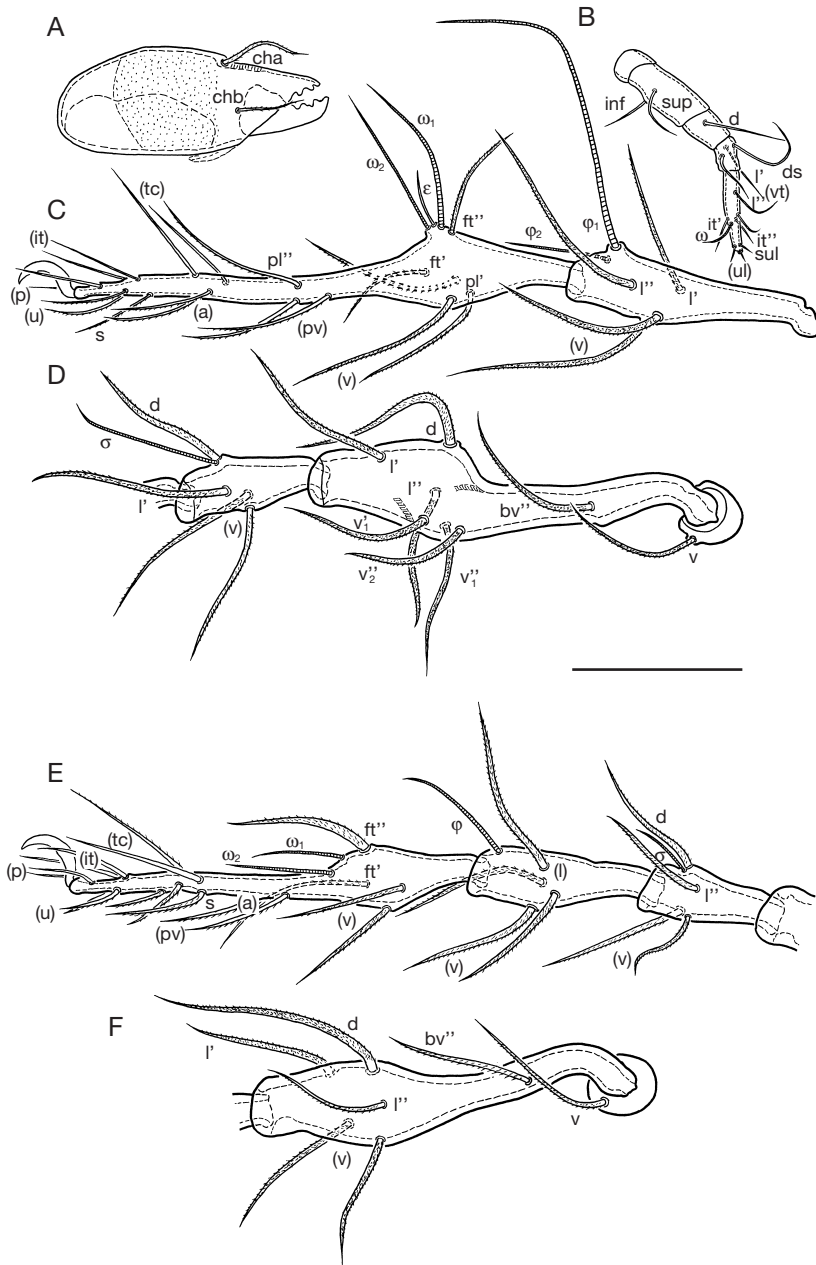


FIG. 2. — Paratype *Epidamaeus aokii* n. sp.; **A**, chelicera (left, antiaxial aspect); **B**, palp (left, antiaxial aspect); **C**, tibia and tarsus of leg I (left, antiaxial aspect); **D**, trochanter, femur and genu of leg I (left, antiaxial aspect); **E**, genu, tibia and tarsus of leg II (left, antiaxial aspect); **F**, trochanter and femur of leg II (left, antiaxial aspect). Abbreviations:  $\omega_1, \omega_2, \omega_3$ , tarsal solenidia;  $\sigma$ , solenidion of genu;  $\varphi_1, \varphi_2$ , solenidia of tibia; **a**, **a''**, anterolateral setae; **bv**, basiventral setae; **cha**, **chb**, cheliceral setae; **d**, dorsal seta of genu; **d**, dorsal seta; **f**, **ft'**, **ft''**, fastigial setae; **inf**, inferior seta of femur; **it'**, **it''**, lateral setae; **l**, **l'**, **l''**, lateral leg setae; **l**, **l'**, **l''**, **ds**, lateral and dorsal setae of tibiae; **p'**, **p''**, proral setae; **pl'**, **pl''**, posterolateral setae; **pv**, **pv'**, **pv''**, primiventral setae; **s**, subunguinal seta; **sul**, **ul**, eupathidia of tarsus; **sup**, superior seta of femur; **tc**, **tc'**, **tc''**, tectal setae; **u'**, **u''**, unguinal setae; **v**, **v'**, **v''**, ventral setae; **vt**, **it'**, **it''**, ventral and lateral setae of tarsus. Scale bar: 100  $\mu$ m.

insertions of interlamellar setae. Posterior three pairs of notogastral setae  $ps_1$ ,  $ps_2$  and  $ps_3$  very thin and smooth, slightly shorter (60-66  $\mu\text{m}$ ) than the others (Figs 1; 2); remaining notogastral setae very thick, very darkly pigmented and densely barbed throughout their length; setae  $c_2$ ,  $la$ ,  $lm$  and  $lp$  scarcely longer (76-91  $\mu\text{m}$ ) and thicker than  $c_1$ ,  $h_1$ ,  $h_2$  and  $h_3$  (66-74  $\mu\text{m}$ ). Lyrifissures  $ia$ ,  $im$ ,  $ih$ ,  $ips$  and  $ip$  and latero-opisthosomal gland opening  $gla$  well-developed, visible in lateral view, but all small (Fig. 1A, C).

#### *Gnathosoma*

Infracapitular mentum slightly wider than long, without noticeable microtubercles. Hypostomal setae  $h$  and  $m$  very long, but thin and smooth; setae  $a$  smooth, half length of  $h$  and  $m$  (Fig. 1B). Chelicerae elongate, fixed and movable digits with a few blunt teeth. Trägårdh's organ narrow; setae  $cha$  and  $chb$  conspicuously barbed; porose area present (Fig. 2A). Palp normal, palpal setation: 0-2-1-3-8 including solenidion  $\omega$  (Fig. 2B).

#### *Epimeral region*

Anterior tectum of podocephalic fossa not projected, but slightly curved inward under trochanter I. Epimeral enantiophysis E2 present, but not well-visible in ventral view, more conspicuous in lateral aspect. Parastigmatic enantiophysis S, ventrosejugal enantiophysis V strongly developed, broadly rounded to subtriangular; tubercle Vp bearing epimeral seta 3b. Discidium (di) well-developed, nearly triangular. Epimeral setae smooth, long, approximately equal in length. Epimeral setal formula: 3-1-4-4 (Fig. 1B, C).

#### *Ano-genital region*

Structure normal for genus; ano-genital setae long and smooth. Adanal lyrifissures  $iad$  situated obliquely, at level slightly anterior to anal setae  $an_2$  (Fig. 1B).

#### *Legs*

Length measurements of leg segments are shown in Table 1. Seta  $d$  on genu I just same length as solenidion  $\sigma$ , but on legs II and III setae  $d$  twice longer than  $\sigma$ . Porose areas of femora I-IV and

TABLE 1. — Length of leg segments of *Epidamaeus aokii* n. sp. (in  $\mu\text{m}$ ).

Legs	Trochanter	Femur	Genu	Tibia	Tarsus
I	-	300	107	152	305
II	-	229	86	112	249
III	127	224	91	147	290
IV	340	188	122	254	168

trochanters III and IV inconspicuous. Formula of leg setation (including famulus): I (1-7-4-4-20); II (1-6-4-4-17) III (2-4-3-3-16); IV (1-4-3-3-14); 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 Figs 2C-F; 3.

#### REMARKS

Only the following known species, *E. bituberculatus* (Kulczynski, 1902), *E. pavlovskii* Bulanova-Zachvatkina, 1957, *E. kodiakensis* Hammer, 1967 and *E. bakeri* (Hammer, 1952) resemble *E. aokii* n. sp. However, *E. bituberculatus* described from Poland and later reported from Europe is distinguishable from the present new species by 1) the much longer and smooth notogastral setae; 2) the widely spaced tubercles Ba and spinae adnatae sa; 3) the smooth prodorsal setae (ro, le, in); 4) the longer and more strongly barbed sensilli; 5) the longer and stronger apophysis Sp, which is larger than Sa (in *E. aokii* n. sp. Sa slightly stronger and longer than Sp); 6) the much longer seta l' on tibia IV, which is 1.5 time as long as other setae (seta l' of new species is less than 1.2 time as long as other setae); 7) the short solenidia  $\sigma$  of genera I-III which are always shorter than their associated setae d (solenidion  $\sigma$  on genu I of new species is just same in length as seta d). The original description and redescription of the compared species by Kulczynski (1902) and Bulanova-Zachvatkina (1957c, 1967, 1975), respectively, were inadequate, and only very short characterization and illustration of the dorsal view and part of leg IV are available. Therefore, it is impossible to compare the other features such as characters of leg setation, ventral and lateral aspects, which are now regarded as being important for the definition of *Epidamaeus* species.

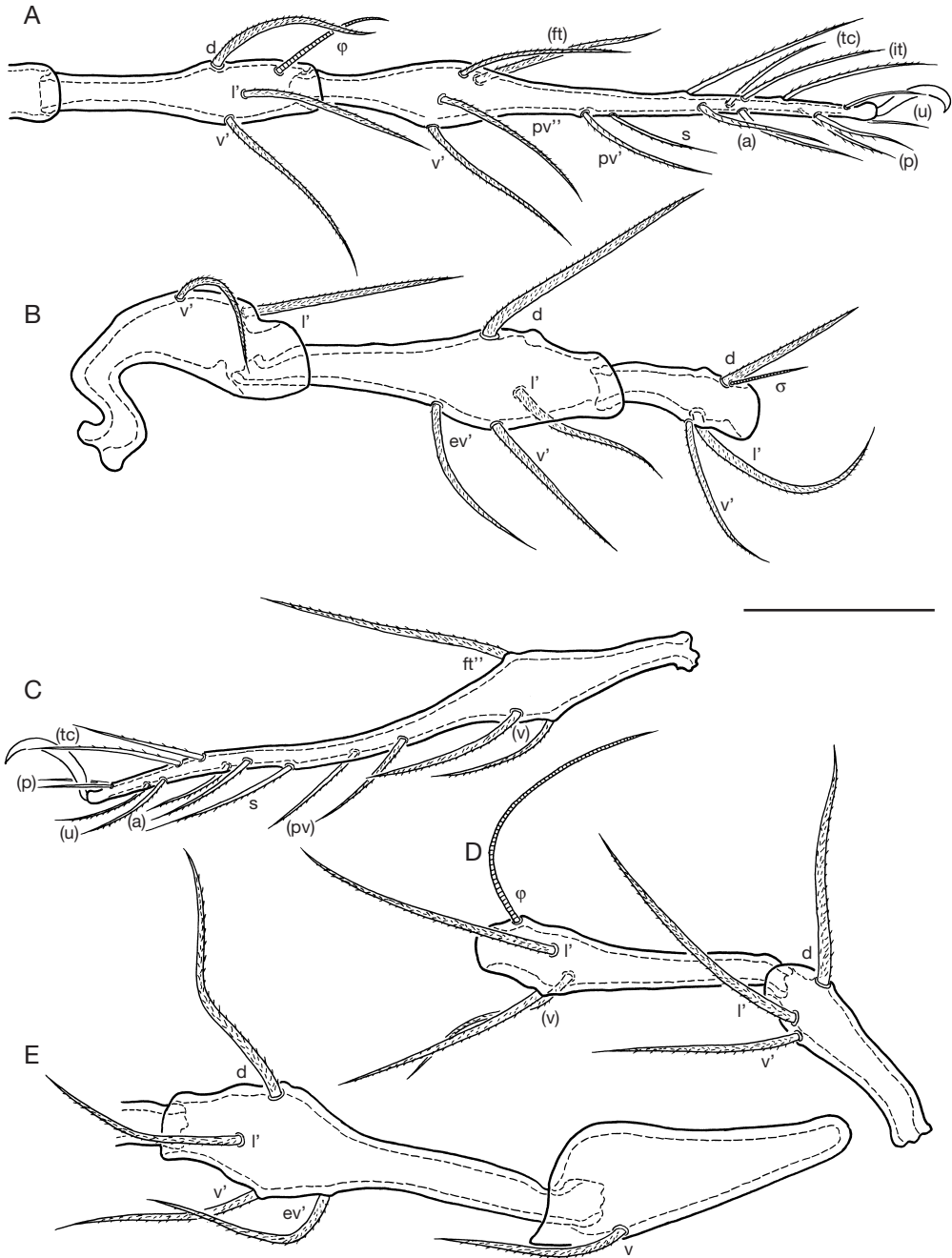


FIG. 3. — Paratype *Epidamaeus aokii* n. sp.; **A**, tibia and tarsus of leg III (left, antiaxial aspect); **B**, trochanter, femur and genu of leg III (left, trochanter twisted); **C**, tarsus of leg IV (right, antiaxial aspect); **D**, genu and tibia of leg IV (right, antiaxial aspect); **E**, trochanter and femur of leg IV (right, antiaxial aspect). Abbreviations:  $\phi$ , solenidia of tibia;  $\sigma$ , solenidion of genu; **a**, anterolateral setae; **d**, dorsal seta; **ft**, **ft''**, fastigial setae; **it**, iteral setae; **l'**, lateral setae of tibiae; **p**, proral setae; **pv**, **pv'**, **pv''**, primiventral setae; **s**, subunguinal seta; **tc**, tectal setae; **u**, unguinal setae; **v**, **v'**, ventral setae. Scale bar: 100  $\mu$ m.



The second species, *E. pavlovskii* described from central Asian part of Russia (Kirghizia) can be differentiated from the new species by 1) the very small and widely spaced spinae adnatae; 2) the very long and strongly barbed (only in median part) sensilli; 3) the short, but strongly barbed interlamellar and exobothridial setae; 4) the smooth rostral setae, which are situated just on the anterior margin of rostrum (seta ro of the new species bilaterally barbed and situated laterally); 5) the same length of the solenidia  $\sigma$  and associated setae d of genera I-III (in the new species solenidion  $\sigma$  and seta d are of same length only in genu I, but in genera II and III  $\sigma$  about half as long as d); 6) more lateral situation of notogastral setae  $c_2$ , la, lm and lp.

*E. kodiakensis* described and redescribed by Hammer (1967) and Behan-Pelletier & Norton (1983) from Alaska and Russia, respectively, can be distinguished from the new species by 1) the small and widely spaced spinae adnatae; 2) the short and distally barbed sensilli; 3) the smooth rostral and interlamellar setae; 4) the smooth or very weakly barbed notogastral setae c, l and h series; 5) the absence of the enantiophysis E2; 6) the strong and distinctly pointed tubercle Sa; 7) the number of setae on the epimeral region (setal formula of epimerata: 3-1-3-4); 8) the number of setae on femur III and tarsus III.

Another North American species, *E. bakeri* described by Hammer (1952) and redescribed by Behan-Pelletier & Norton (1983) is distinguished from *E. aokii* n. sp. by 1) the presence of the strongly developed propodolateral apophysis P; 2) the small spinae adnatae; 3) the smooth rostral, lamellar, notogastral setae and sensilli; 4) the absence of the enantiophysis E2; 5) the strong and long tubercle Sa; 6) the number of setae on femur III and tarsus III.

*Epidamaeus angustirostratus* n. sp.  
(Figs 4-6)

TYPE MATERIAL. — Holotype (♀) and 12 paratypes (6 ♂♂ and 7 ♀♀), Mont Ikh Gazryn Chuluu, District Gobi-Ugtaal, Middle Gobi Province, desert steppe (*Caragana microphylla* + *Stipa glareosa*), organic debris accumulated behind or between rocks,

45°50'N, 107°10'E, 1700 m above sea level, 15.IX.1991, leg. B. Bayartogtokh, the holotype and eight paratypes are deposited in the collection of the Department of Zoology, National University of Mongolia, Ulaanbaatar, Mongolia (NUM DZ Ac 0047-0055); two paratypes in the collection of the Muséum national d'Histoire naturelle, Paris, France (MNHN Acariens 1074) and two paratypes in the collection of the National Science Museum, Tokyo, Japan (NSMT Ac 11184, 11185).

ETYMOLOGY. — The specific epithet "*angustirostratus*" refers to the conspicuously projected rostrum, the tip of which is conspicuously pointed.

DIAGNOSIS. — Large species; propodolateral apophysis absent; tubercle Ba present, tubercles Bp, Da and Dp absent; rostrum distinctly projected and conspicuously pointed; notogastral setae relatively thin, but very long, densely barbed, darkly pigmented; spinae adnatae medium in size; enantiophyses E2, V and S well-developed; epimeral regions III and IV with three and four setae, respectively; tarsus II with 17, III with 16 setae; leg I (1.03 time), III (1.02 time) and IV (1.4 time) longer than body length; all solenidia  $\sigma$  of genera I-III half long as their associated setae d.

DESCRIPTION

*Measurements*

Body length 753-803 (772.9)  $\mu\text{m}$ ; length of proterosoma 288-298 (294.9)  $\mu\text{m}$ ; width of proterosoma 305-376 (340.7)  $\mu\text{m}$ ; length of hysterosoma 519-549 (533.9)  $\mu\text{m}$ ; length of notogaster 559-600 (579.6)  $\mu\text{m}$ ; width of notogaster 509-539 (525.4)  $\mu\text{m}$ .

*Integument*

Yellowish-brown to reddish-brown in colour. Surface of body and basal part of leg segments with thin cerotegument. Conspicuously microtuberculate on all enantiophyses and tubercles, lateral part of prodorsoma and around leg acetabula. Very fine punctations present on the lateral part of prodorsum and on the ventral plate. Notogaster and leg segments with adherent debris; exuvial scalps absent.

*Prodorsum*

Rostrum distinctly projected and conspicuously pointed in both dorsal and lateral views. Rostral seta long (132-147 [135.2]  $\mu\text{m}$ ), but thin, finely barbed. Lamellar seta thick, long, longer than ro (173-183 [177.7]  $\mu\text{m}$ ). Interlamellar seta much



FIG. 4. — Holotype *Epidamaeus angustirostratus* n. sp.; **A**, dorsal aspect; **B**, ventral aspect; **C**, lateral aspect. Scale bar: 100  $\mu$ m.

shorter (81-106 [94.0]  $\mu\text{m}$ ) and thinner than ro or le, finely barbed throughout length. Exobothridial seta (ex) very thin, smooth (61-66 [63.5]  $\mu\text{m}$ ). Sensillus (ss) very thin, but long (254-269 [261.6]  $\mu\text{m}$ ), densely barbed throughout its length. Tubercles Bp, Da and Dp absent, postbothridial tubercles Ba relatively small, widely spaced from each other, situated posterolateral to the insertions of interlamellar setae. Propodolateral apophysis P absent (Fig. 4A).

#### *Notogaster*

Almost circular, viewed perpendicular to circumgastric scissure; very slightly longer than wide, ratio of length to width 1.05:1.0. Dorso-ventral thickness of hysterosoma 427-442 (434.3)  $\mu\text{m}$ ; thickness of notogaster 244-252 (248.5)  $\mu\text{m}$ . Spinæ adnatae medium in size (76.2  $\mu\text{m}$ ), but thinner and slightly shorter than that of the former species, curved ventrad; distance between their bases almost equal to that of tubercles Ba and slightly longer than that between insertions of interlamellar setae. Notogastral setae very long (193-218 [208]  $\mu\text{m}$ ), relatively thin, densely barbed throughout their length and darkly pigmented; posterior three pairs of setae  $ps_1$ ,  $ps_2$  and  $ps_3$  slightly shorter (140-147 [143.2]  $\mu\text{m}$ ) than others, also conspicuously barbed (Fig. 4A, B). Lyrifissures ia, im, ih, ips and ip and latero-opisthosomal gland opening gla well-developed, clearly visible in lateral view (Fig. 4A, C).

#### *Gnathosoma*

Infracapitular mentum almost as long as wide, without noticeable microtubercles. Hypostomal setae h, m and a very thin, relatively short (Fig. 4B). Chelicera elongate, fixed and movable digits with three blunt teeth. Setae cha and chb conspicuously barbed; porose area present (Fig. 5B). Palp normal, femur, genu, tibia and tarsus slightly slender and shorter than those of the former genus. Palpal setation: 0-2-1-3-8 including solenidion  $\omega$  (Fig. 5A).

#### *Epimeral region*

Anterior tectum of podocephalic fossa not projected, but slightly rounded under trochanter I.

TABLE 2. — Length of leg segments of *Epidamaeus angustirostratus* n. sp.

Legs	Trochanter	Femur	Genu	Tibia	Tarsus
I	-	279	96	147	279
II	-	223	86	107	152
III	122	208	86	132	244
IV	178	269	127	198	320

Enantiophyses E2, S and V well-developed; tubercle Vp bearing epimeral seta 3b. Discidium well-developed, nearly triangular. Epimeral setae smooth, thin, long; setae 1a widely spaced from each other; epimeral setal formula: 3-1-4-4 (Fig. 4B, C).

#### *Ano-genital region*

Normal for genus; ano-genital setae long, smooth. Adanal lyrifissures iad situated obliquely, at level slightly anterior to adanal setae  $ad_3$  (Fig. 4B, C).

#### *Legs*

Length measurements of leg segments are shown in Table 2. Associated setae d on genua I-III about twice as long as their coupled solenidia  $\sigma$ . Porose areas of femora I-IV and trochanters III and IV inconspicuous. Formula of leg setation (including famulus): I (1-7-4-4-20), II (1-6-4-4-17), III (2-4-3-3-16), IV (1-4-3-3-14); 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 Figs 4C-F; 5A-E.

#### REMARKS

Among the known species of *Epidamaeus*, *E. tecticola* (Michael, 1888) described from Great Britain, *E. longisetosus* (Willmann, 1953) from eastern Alps, *E. tatricus* (Kulczynski, 1902) from Poland and *E. kamaensis* (Sellnick, 1925) from Sweden resemble the new species. The first species, *E. tecticola* described by Michael (1888) and redescribed by Luxton (1989) is distinguishable from *E. angustirostratus* n. sp. by 1) the presence of the conspicuously developed propodolateral apophysis P; 2) the broadly rounded tip of the rostrum; 3) the smaller spinæ adnatae;

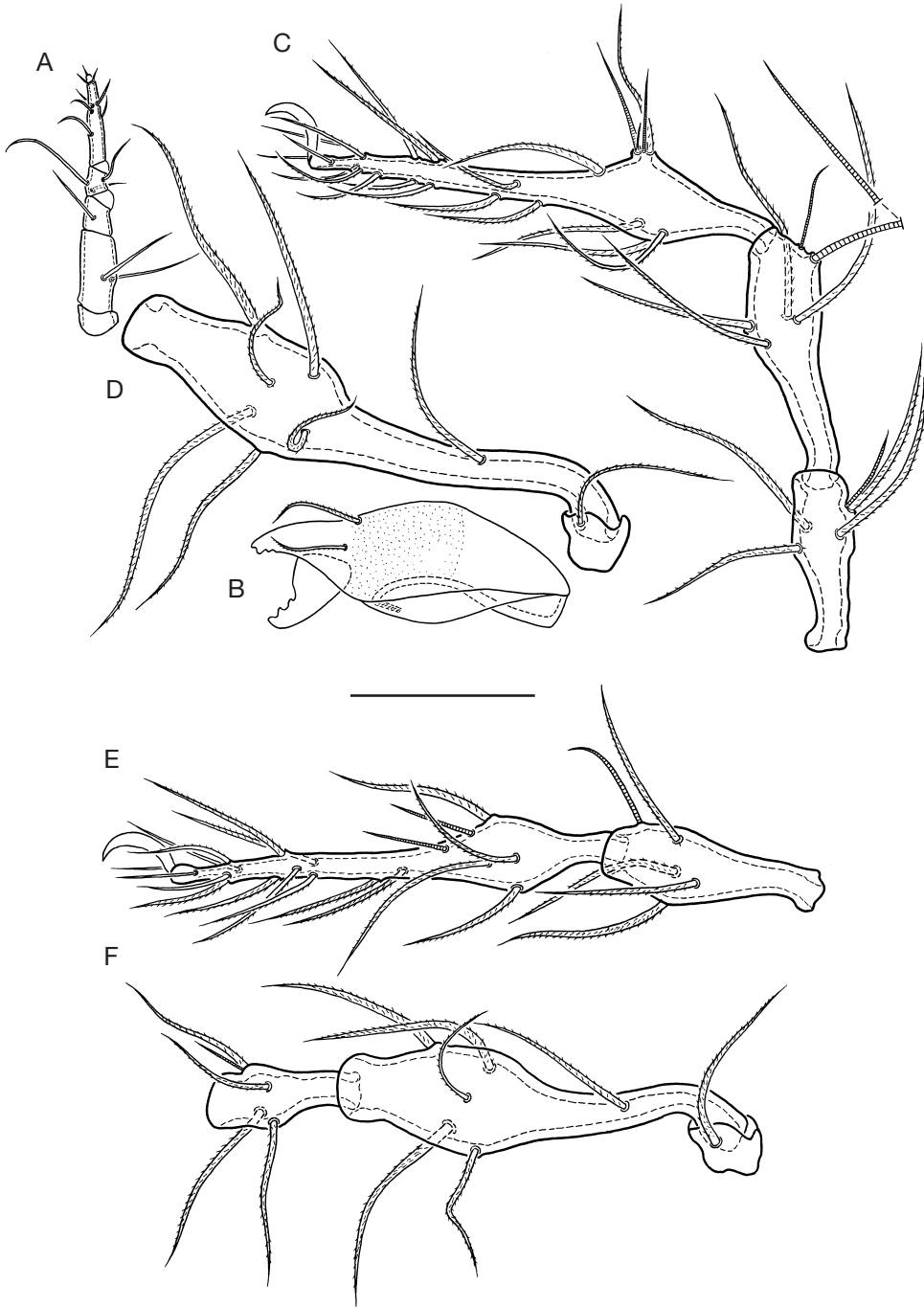


FIG. 5. — Paratype *Epidamaeus angustirostratus* n. sp.; **A**, palp (left, antiaxial aspect); **B**, chelicera (left, antiaxial aspect); **C**, genu, tibia and tarsus of leg I (left, antiaxial aspect); **D**, trochanter and femur of leg I (left, antiaxial aspect); **E**, tibia and tarsus of leg II (left, antiaxial aspect); **F**, trochanter, femur and genu of leg II (left, antiaxial aspect). Scale bar: 100  $\mu$ m.

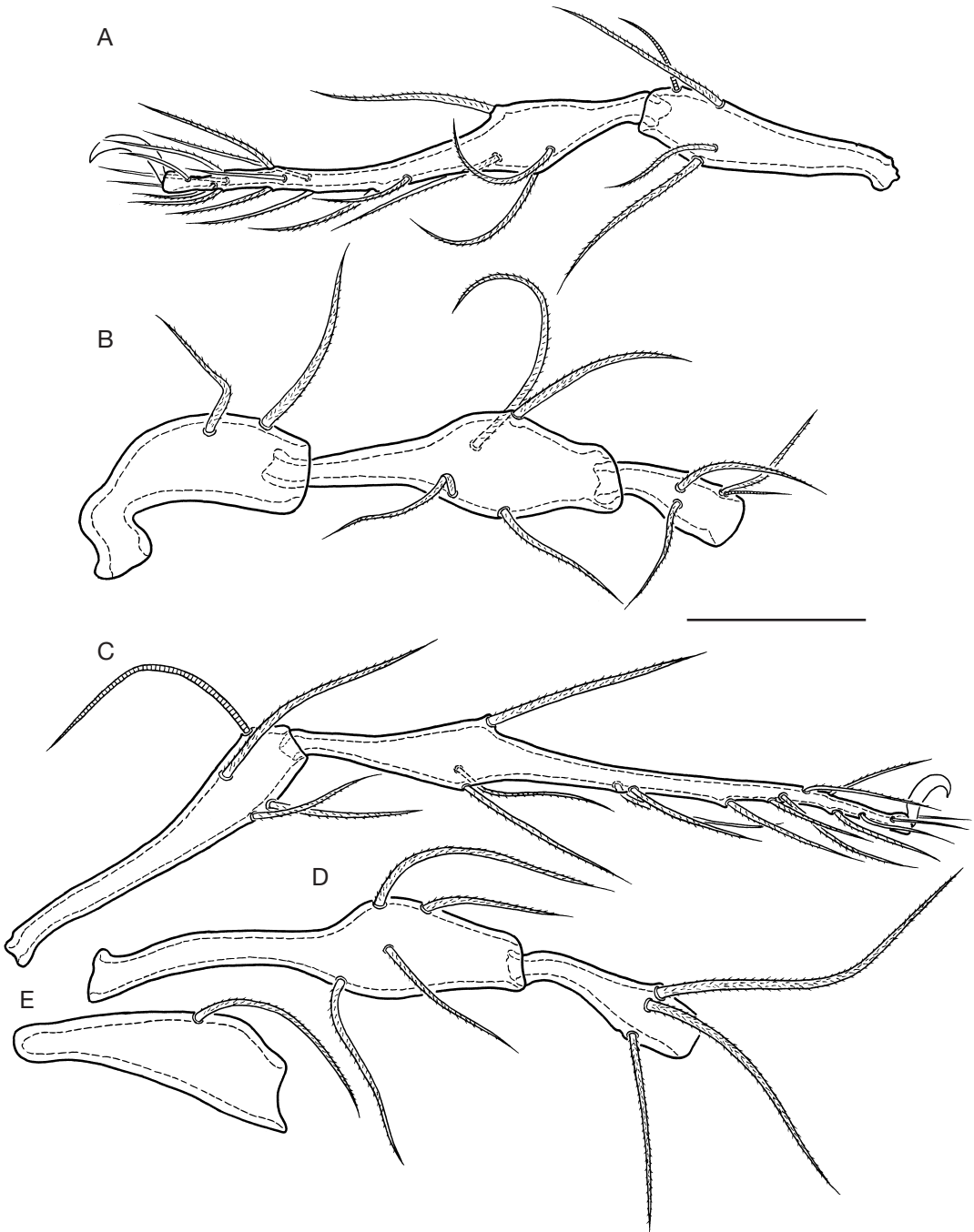


FIG. 6. — Paratype *Epidamaeus angustirostratus* n. sp.; **A**, tibia and tarsus of leg III (right, antiaxial aspect); **B**, trochanter, femur and genu of leg III (left, trochanter twisted); **C**, tibia and tarsus of leg IV (left, antiaxial aspect); **D**, femur and genu of leg IV (left, antiaxial aspect); **E**, trochanter of leg IV (left, twisted). Scale bar: 100  $\mu$ m.

4) the rostral setae inserted on the dorsal side of rostrum (in new species ro situated on lateral side); 5) the lamellar setae situated rather marginally as opposed to more central situation of le in the new species; 6) the absence of anteroventral projection on trochanter IV (anteroventral end of trochanter IV of *E. angustirostratus* n. sp. with distinctly pointed projection).

The second European species, *E. longisetosus*, described by Willmann (1953) and redescribed by Bulanova-Zachvatkina (1957c, 1967, 1975) is distinguished from *E. angustirostratus* n. sp. by 1) the longer and smooth sensilli and notogastral setae; 2) the short and smooth interlamellar setae; 3) the narrow basal part of the spinae adnatae; 4) the relatively short femur IV, which is shorter than tibia IV (femur IV of *E. angustirostratus* n. sp. is far longer than tibia IV); 5) the smaller body size. Both the original description and redescriptions are incomplete and inadequately illustrated, therefore it is possible to compare only the dorsal aspect.

The third European species, *E. tataricus*, described by Kulczynski (1902), can be distinguished from new species by 1) the absence of the tubercles Ba; 2) the more thick sensilli; 3) the smooth notogastral setae; 4) the very long trochanter IV, which is twice longer than femur IV (trochanter IV of *E. angustirostratus* n. sp. is much shorter than femur IV); 5) the broadly rounded rostrum; 6) the presence of the short seta  $v'$  on genu IV, which is shorter than the segment (seta  $v'$  on genu IV of *E. angustirostratus* n. sp. is slightly longer than segment's length).

The last species from Europe, *E. kamaensis* described by Sellnick (1925), can readily be distinguished from *E. angustirostratus* n. sp. by 1) the presence of the tubercles Ba and Da; 2) the long and relatively narrow tubercle Sp as opposed to short and broadly rounded Sp in *E. angustirostratus* n. sp.; 3) the thick, but sparsely barbed sensilli; 4) the smooth interlamellar setae; 5) the presence of very long setae  $d'$  and  $l'$  on genu IV, which are twice as long as the segment, and short seta  $v'$ , which is shorter than genu's length; 6) the solenidia  $\sigma$  on genera I-III equal in length with their associated setae  $d$  as opposed to very short solenidia  $\sigma$  (about twice shorter than their associated setae) on respective segments in *E. angustirostratus* n. sp.

### *Epidamaeus tenuisetosus* n. sp. (Figs 7-9)

TYPE MATERIAL. — Holotype ( $\varnothing$ ) and 1 paratype ( $\sigma$ ), Mont Bulgan, District Erdenebulgan, Arkhangai Province, litter of birch forest (*Betula plataphylla*), 48°20'N, 101°25'E, 1700 m above sea level, 18.V.1996, leg. B. Bayartogtokh, the holotype is deposited in the collection of the Department of Zoology, National University of Mongolia, Ulaanbaatar, Mongolia (NUM DZ Ac 0056), and 1 paratype in the collection of the Muséum national d'Histoire naturelle, Paris, France (MNHN Acariens 1075).

ETYMOLOGY. — The specific epithet "*tenuisetosus*" refers to the thin and minutely barbed prodorsal, dorsal and ventral setae of body.

DIAGNOSIS. — Relatively small and flat species; propodolateral apophysis absent; tubercle Ba present, tubercles Bp, Da and Dp absent; prodorsal and notogastral setae very thin, extremely minutely barbed, with slight dark pigmentation (except setae ps series); spinae adnatae relatively large; only tubercle Va well-developed, other tubercles (Vp, E2a, E2p) absent; epimeral regions III and IV with three and four setae, respectively; tarsus II with 16, III with 17 setae; only leg IV (1.3 time) longer than body length.

#### DESCRIPTION

##### *Measurements*

Body length 570-600 (584.7  $\mu\text{m}$ ); length of proterosoma 218-226 (223.7)  $\mu\text{m}$ ; width of proterosoma 219-227 (223.8)  $\mu\text{m}$ ; length of hysterosoma 358-373 (366.1)  $\mu\text{m}$ ; length of notogaster 379-390 (386.5)  $\mu\text{m}$ ; width of notogaster 354-362 (358.1)  $\mu\text{m}$ .

##### *Integument*

Reddish-brown in colour. Surface of body and basal part of leg segments with thin cerotegument. Conspicuously microtuberculate on all enantiophyses and tubercles, lateral part of podosoma and around leg acetabula. Very fine punctations present on the lateral part of podosoma. Notogaster with a few adherent debris; exuvial scalps absent.

##### *Prodorsum*

Rostrum broadly rounded in dorsal view, but in lateral view slightly projected anteroventrad. Rostral seta of medium length (91-101 [96.3]  $\mu\text{m}$ ), very thin, with extremely minute barbs. Lamellar seta thin, longer (112-117 [114]  $\mu\text{m}$ ) than ro, finely barbed. Interlamellar seta short (52-59

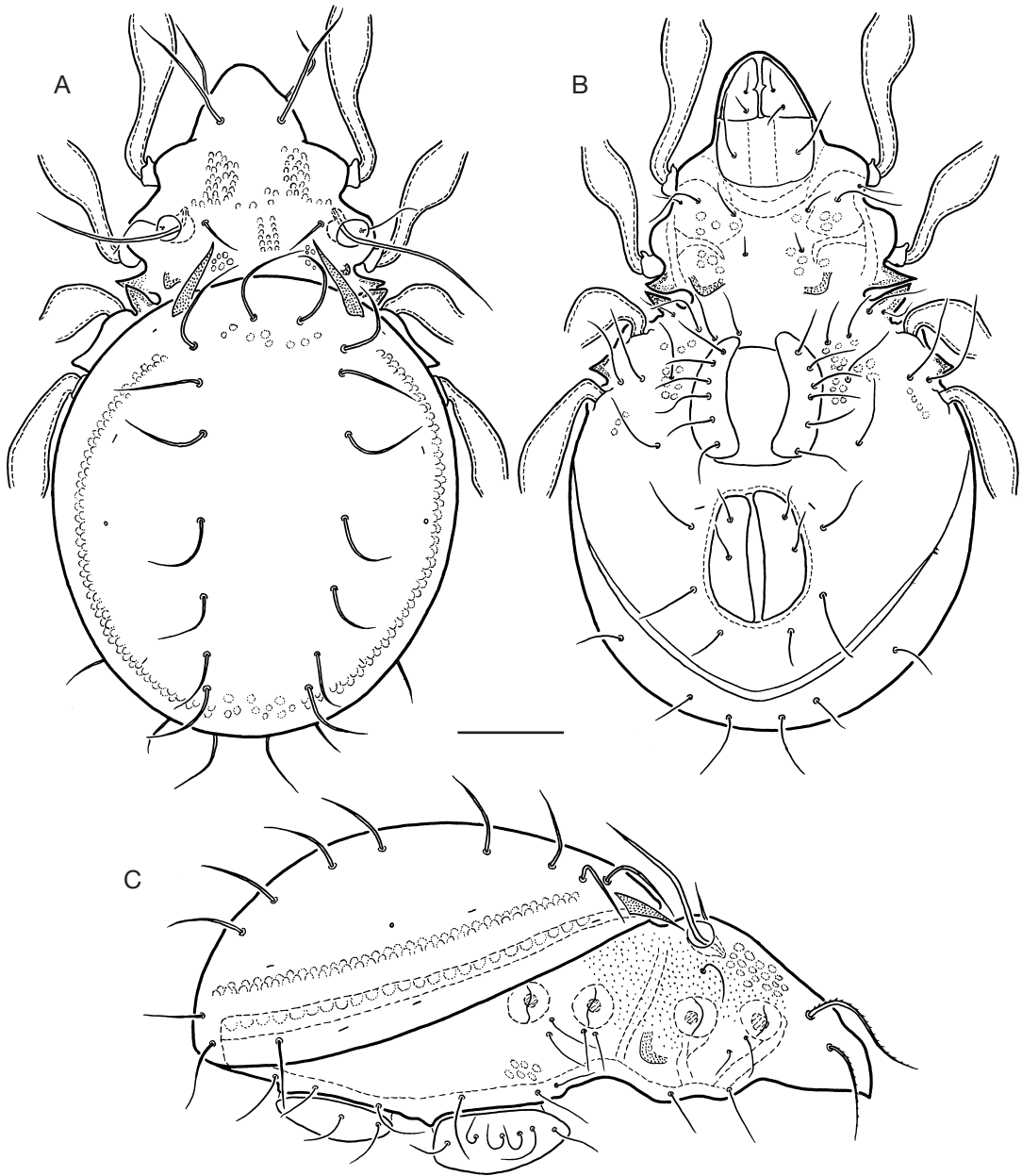


FIG. 7. — Holotype *Epidamaeus tenuisetosus* n. sp.; **A**, dorsal aspect; **B**, ventral aspect; **C**, lateral aspect. Scale bar: 100  $\mu$ m.

[55.8]  $\mu$ m), much shorter and thinner than ro or le, minutely barbed. Exobothridial seta very thin, smooth, but slightly longer (54-63 [57.4]  $\mu$ m) than in. Sensillus thin and long (147-156 [152.4]  $\mu$ m), with very minute barbs (visible only under

high magnification). Tubercles Bp, Da and Dp absent, tubercles Ba relatively small, nearly triangular in shape, widely spaced from each other, situated posterior to each bothridium. Propodolateral apophysis P absent (Fig. 7A).

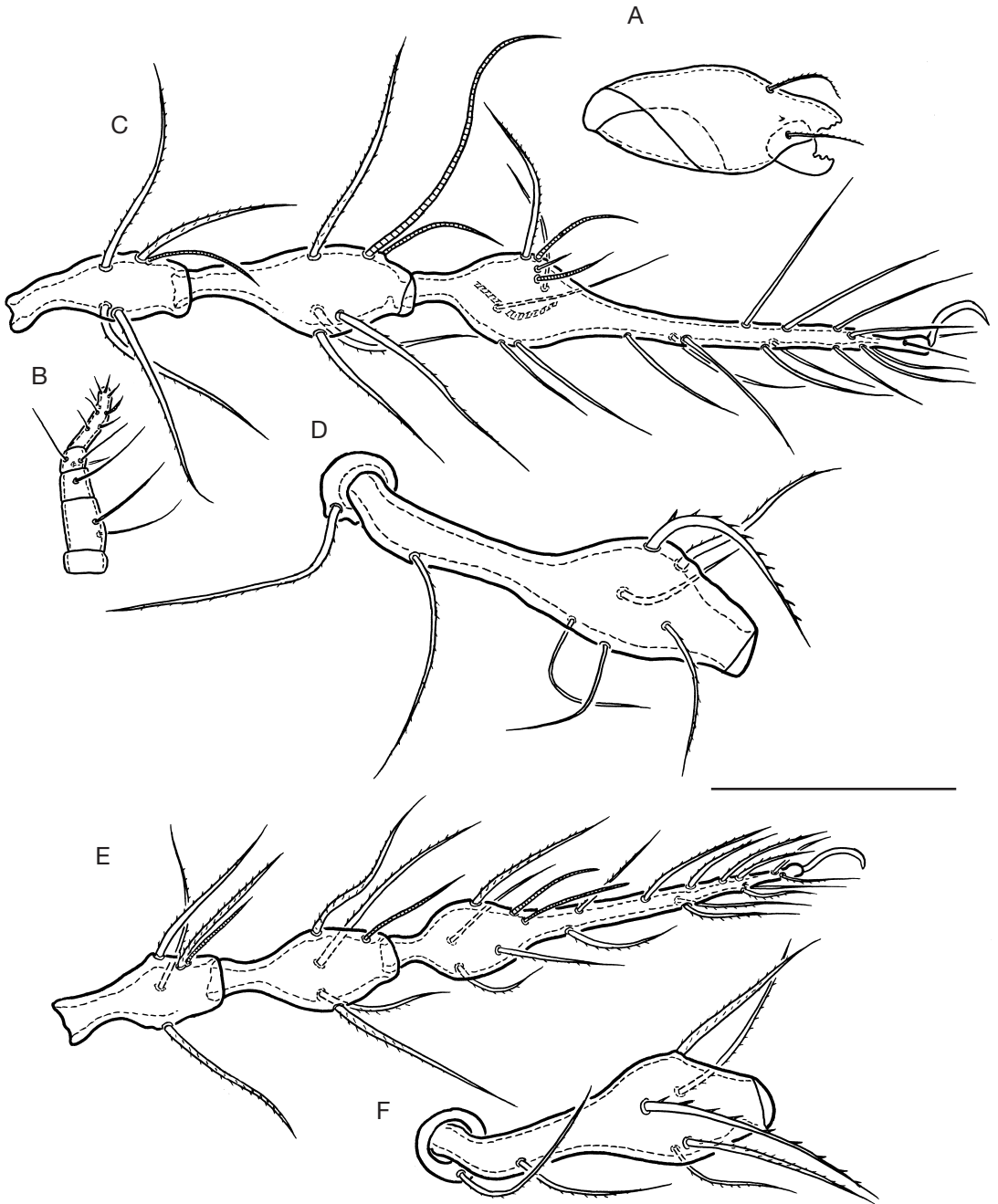


FIG. 8. — Paratype *Epidamaeus tenuisetosus* n. sp.; **A**, chelicera (right, antiaxial aspect); **B**, palp (right, antiaxial aspect); **C**, genu, tibia and tarsus of leg I (right, antiaxial aspect); **D**, trochanter and femur of leg I (right, antiaxial aspect); **E**, genu, tibia and tarsus of leg II (right, antiaxial aspect); **F**, trochanter and femur of leg II (right, antiaxial aspect). Scale bar: 100  $\mu$ m.



*Notogaster*

Slightly ovate viewed perpendicular to circum-gastric scissure; about 1.13 time as long as wide. Dorsal-ventral thickness of hysterosoma 275-283 (279.4)  $\mu\text{m}$ ; thickness of notogaster 168-173 (170.1)  $\mu\text{m}$ . Spinae adnatae relatively large (71-74 [72.4]  $\mu\text{m}$ ), curved ventral; distance between their bases almost equal to that of tubercles Ba and far longer than that between insertions of interlamellar setae. Notogastral setae of c, l and h series medium long (61-86  $\mu\text{m}$ ), very thin, minutely barbed throughout their length and slightly darkly pigmented; setae ps series (45-52  $\mu\text{m}$ ) thinner and slightly shorter than the others, lighter in colour and extremely minutely barbed. Barbs of notogastral setae visible only under high magnification. Setae  $c_1$  and  $c_2$  directed anterior, la lateral, remaining setae directed posterolateral. Lyrifissures ia, im, ih, ips and ip and latero-opisthosomal gland opening gla well-developed, but all of them small (Fig. 7A, C).

*Gnathosoma*

Infracapitular mentum almost as long as wide, without noticeable microtubercles. Hypostomal setae thin, seta h long, about three times as long as m and a (Fig. 7B). Chelicera rather strong, fixed and movable digits with three blunt teeth; setae cha and chb conspicuously barbed (Fig. 8A). Palpal setation: 0-2-1-3-8 including solenidion  $\omega$  (Fig. 8B).

*Epimeral region*

Anterior tectum of podocephalic fossa not projected, but slightly rounded under trochanter I. Only tubercles Va, Sa and Sp well-developed; other tubercles (Vp, E2a, E2p) absent. Discidium well-developed, nearly triangular. Epimeral setae thin, smooth, but long; setal formula: 3-1-3-4 (Fig. 7B, C).

*Ano-genital region*

Structure normal; setae of ano-genital region long, smooth. Adanal lyrifissures iad situated obliquely, at level slightly anteromedial of adanal setae  $ad_3$  (Fig. 7B).

TABLE 3. — Length of leg segments of *Epidamaeus tenuisetosus* n. sp. (in  $\mu\text{m}$ ).

Legs	Trochanter	Femur	Genu	Tibia	Tarsus
I	-	183	76	86	193
II	-	144	61	76	165
III	81	127	66	81	183
IV	127	152	81	132	279

*Legs*

Length measurements of leg segments are shown in Table 3. Associated setae d of genua I-III longer than their coupled solenidia  $\sigma$ . Porose areas of femora I-IV and trochanters III and IV inconspicuous. Formula of leg setation (including famulus): I (1-7-4-4-20), II (1-6-4-4-16), III (2-4-3-3-17), IV (1-4-3-3-14); 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 Figs 8C-F; 9.

## REMARKS

The new species, *E. tenuisetosus* n. sp. can be readily distinguished from most other known species by the absence of tubercles Vp, E2a and E2p from the ventral plate and the smaller body size. Among the known species of *Epidamaeus*, *E. groenlandicus* (Hammer, 1953), *E. tenuipes* (Michael, 1885) and *E. arcticolus* (Hammer, 1952) resemble *E. tenuisetosus* n. sp. The first species, described by Hammer (1953) from Greenland is distinguishable from the new species by 1) the absence of tubercle Ba; 2) the spinae adnatae strongly widened at the basal part; 3) the very short interlamellar setae; 4) the larger body size. The original description and redescription of this species by Hammer (1953) and Bulanova-Zachvatkina (1957c, 1967, 1975), respectively, were inadequate, and most characters, except only dorsal aspect, are not available for comparison.

The British species, *E. tenuipes* described by Michael (1885) and redescribed by Luxton (1989) is different from *E. tenuisetosus* n. sp. in 1) the very short sensillus with expanded portion in distal half; 2) the relatively narrow basal part and relatively thick distal half of the spinae adnatae;

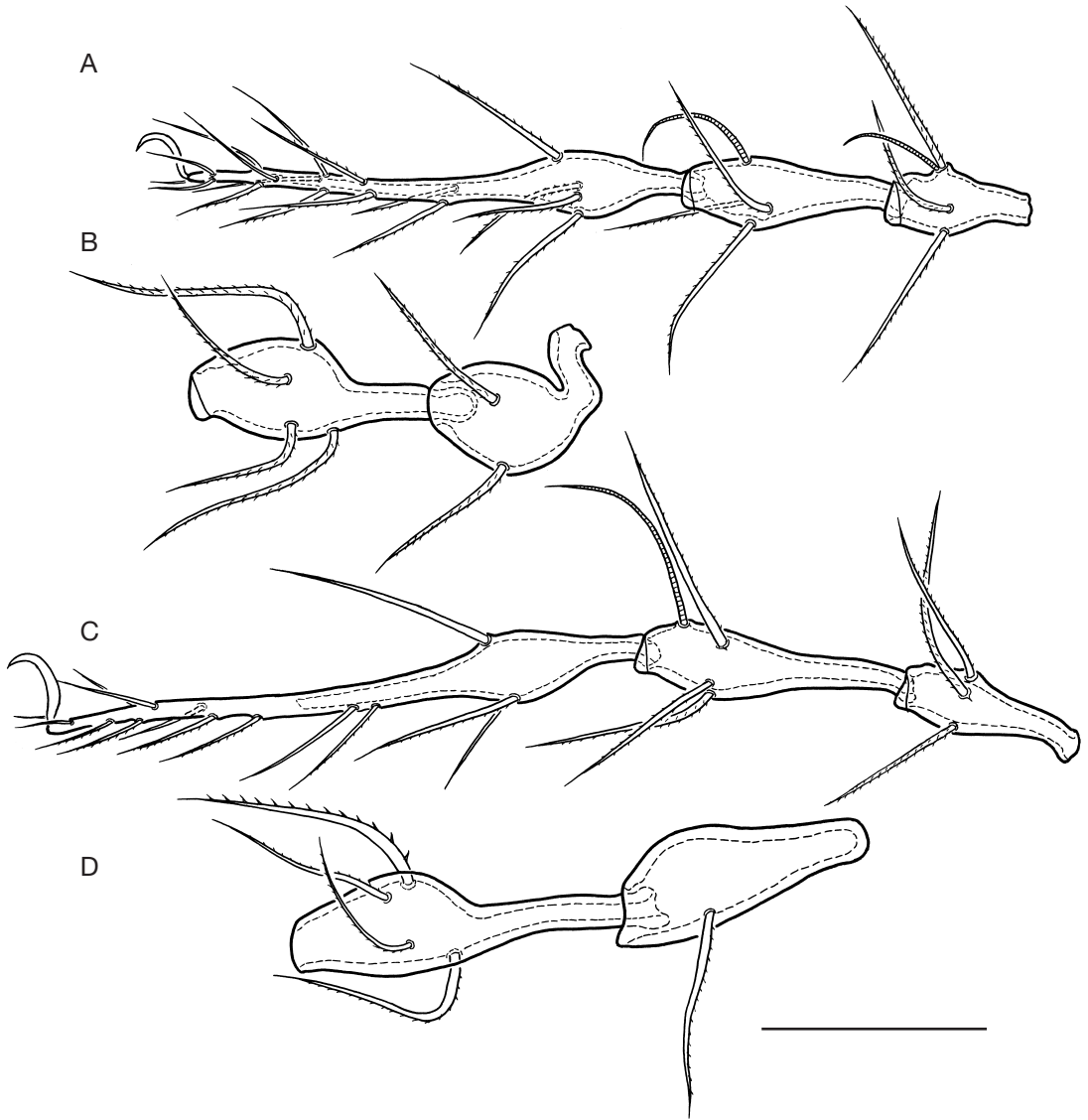


FIG. 9. — Paratype *Epidamaeus tenuisetosus* n. sp.; **A**, genu, tibia and tarsus of leg III (right, antiaxial aspect); **B**, trochanter and femur of leg III (right, antiaxial aspect); **C**, genu, tibia and tarsus of leg IV (right, antiaxial aspect); **D**, trochanter and femur of leg IV (right, antiaxial aspect). Scale bar: 100  $\mu$ m.

3) the number of setae on tarsus I (19 setae in *E. tenuipes* 20 in *E. tenuisetosus* n. sp.); 4) the larger body size.

The Canadian species, *E. arcticolus*, described by Hammer (1952) and later redescribed by Bulanova-Zachvatkina (1975) and Behan-Pelletier & Norton (1983) is readily distinguished from

*E. tenuisetosus* n. sp. by 1) the very small spinae adnatae; 2) the very long sensilli; 3) the presence of the well-developed propodoventral tubercle Vp; 4) the relatively short and rounded shape of the tubercle Sp; 5) the robust and evenly rounded notogaster in lateral view; 6) the number of setae on femur III (*E. arcticolus* with five setae,

*E. tenuisetosus* with four setae), and tarsus II (*E. arcticolus* with 17 setae, *E. tenuisetosus* with 16 setae).

Also the following two species, *E. folium*, *E. angulatus*, described from Japan by Fujikawa & Fujita (1985) resemble the new species in having 17 setae on tarsus III. However, *E. folium* is easily distinguishable from the present new species by the following features: 1) very large body size (840 × 630 μm) as opposed to small size of *E. tenuisetosus* n. sp.; 2) the thick and distinctly barbed sensilli and all prodorsal setae as opposed to thin and minutely barbed setae and sensilli in the new species; 3) the presence of the tubercle Bp; 4) the leaf-like notogastral setae as opposed to very thin setae in the new species; 5) the number of setae on tarsi I (22 setae), II (19 setae), IV (15 setae); 6) the lacking of tubercle Va from ventral plate.

The second Japanese species, *E. angulatus* can be distinguished from *E. tenuisetosus* n. sp. by 1) the very long and distinctly barbed sensillus and interlamellar setae; 2) the relatively short spinae adnatae; 3) the presence of the tubercle Bp and propodolateral apophyses P; 4) the presence of three setae on the epimeral region IV; 5) the presence of the tubercles E2a, E2p and Vp on the ventral plate (T<sub>1</sub>, T<sub>2</sub> and V<sub>2</sub> according to the terminology used by Fujikawa & Fujita); 6) the long, thick and conspicuously barbed notogastral setae; 7) the rounded tubercle Sp; 8) the different number of setae on tarsus II (17 setae), tibiae I (8 setae) and IV (3 setae).

In the original descriptions of above two species and also in those of *E. bacillum*, *E. flexus* and *E. variabilis*, Fujikawa & Fujita (1985) mentioned that these species have only 10 pairs of notogastral setae. However, it might be a mistake, and probably they overlooked one of the pseudanal setae. Not only the known species of *Epidamaeus*, but also all other representatives of Damaeidae are known to have 11 pairs of notogastral setae. Moreover, in the figures 4 (*E. flexus*) and 5 (*E. angulatus*) given by them clearly show the presence of 11 pairs of setae, and all of them were labeled in the figure of the latter species.

## Acknowledgements

I would like to express my heartfelt thanks to Prof. Jun-ichi Aoki, Yokohama National University, Yokohama, Japan, for his valuable advice and helpful comments on the manuscript. Thanks are also due to the reviewers for their critically reading the manuscript with many useful comments. This study was supported by the Japan Society for the Promotion of Science.

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*Submitted on 21 March 2000;  
accepted on 21 July 2000.*