Myriapodologica

A SERIES OF OCCASIONAL PAPERS PUBLISHED AT RADFORD UNIVERSITY
ISSN 0163-5395

Vol. 2, No. 8 August 29, 1988

Systematic position of the milliped species Alloiopus solitarius Attems and the genus Ghilarovia Gulicka (Chordeumatida, Anthroleucosomatidae)

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ABSTRACT

The poorly known milliped species *Alloiopus solitarius* Attems (Iran) is redescribed and assigned to the Family Anthroleucosomatidae. New illustrations are provided for *Ghilarovia kygae* Gulicka (Altai Mtns., USSR), and the new species *G. novosibirica* is described (Novosibirsk, USSR); *Ghilarovia* is also assigned to Anthroleucosomatidae. Relationships within the family are discussed.

INTRODUCTION

Graf von Attems' 1951 description of *Alloiopus solitarius,* the first chordeumatid milliped recorded from Iran, lacked details needed for the placement of the species in the modern system. His illustrations of the gonopods were crude and difficult to interpret. A study of the type material (Zoologisches Museum, Museum für Naturkunde, Humboldt-Universität, Berlin) confirmed suspicions that the species belongs in the large (and perhaps heterogenous) family Anthroleucosomatidae, prevalent in the Balkans, the eastern Mediterranean region, and the southern USSR. However, the structure of the posterior gonopods of *A. solitarius* (fig. 6) is more primitive than in most previously known forms, assuming the apomorphic form to be much reduced.

The same posterior gonopod structure (figs 13, 15) is found in the two species of the genus *Ghilarovia* Gulicka (one of them new) from the Novosibirsk region of the USSR and the Altai Mountain range (Gulicka, 1972). Though the anterior gonopods are somewhat different in the two genera, homologies can be traced.

The anterior gonopods of *Ghilarovia* species (figs. 12, 14) reinforce the placement of the genus in Anthroleucosomatidae, extending the range of the family far to the east. The relationships of these two genera to several others *(Adshardicus, Ratcheuma, Caucaseuma, Persedicus, Bulgarosoma,* and *Dacasoma)* are explored in the following paragraphs.

Adshardicus strasseri Golovatch, described from Adjaria, in the Caucasus Mountains, USSR (Golovatch, 1981), has almost entirely lost the telopodites of the posterior gonopods[1]. The posterior gonopods of *A. strasseri* are very similar to those of *Caucaseuma lohmanderi* Strasser (1970) and *Ratcheuma excorne* Golovatch (1987), from the western Caucasus. This similarity was discussed by Golovatch (1981, 1987), and I agree with his conclusion that these three genera are very close. The discovery of more species related to them may result in synonomy of the genera under *Caucaseuma*, the oldest name.

Even in their extreme reduction, the posterior gonopods of *A. strasseri, C. lohmanderi,* and *R. excorne* retain most of the elements present in the less specialized ones of *A. solitarius* and *Ghilarovia* species. The telopodites, as already mentioned, are substantially reduced in the former three species, and two-segmented in the latter. All have three coxal processes, one of which is obviously a coxal gland remnant in *Adshardicus* and *Caucaseuma.*

Mauriès (1982) described a second Iranian chordeumatid, *Persedicus martensi,* from the Elburz Mountains of Mazandaran Province, 200 km east of the type locality of *A. solitarius*[2]. This species is also an anthroleucosomatid, as its author discerned, and the anterior gonopods are not dissimilar to those of *Ghilarovia, Alloiopus, Adshardicus, Ratcheuma,* and *Caucaseuma.* However, the posterior gonopods differ. The coxae bear single, rather blade-like processes instead of the three processes typical of the genera already mentioned, but the telopodite, though a single segment, is relatively large. This is more like the situation in *Bulgarosoma* and *Dacasoma* species (Strasser, 1960, 1970; Tabacaru, 1967); these two genera are found in Bulgaria and Yugoslavia as part of a complex of related anthroleucosomatids extending westward to an isolated occurence in southern France (Tabacaru, 1967).

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[1]The structures labelled as "seminal canals" in Golovatch's 1981 illustrations of the anterior gonopods of *A. strasseri* cannot be such, since the *vasa deferentia* in millipeds open on or behind the second legpair, and it is well known that chordeumatid millipeds transfer spermatophores formed in the coxal glands of the tenth and/or eleventh legpairs.

[2]Mauriès also mentions females of additional *Persedicus* species, and females of an underscribed genus from Azerbaidjan Province. Golovatch (in litt.) has found *P. martensi* in the Caucasus and believes it to be endemic to the Hyrcanian region in both Iran and the USSR.

Thus *Alloiopus* and *Ghilarovia* are similar in their primitive posterior gonopod structure, *Caucaseuma, Adshardicus,* and *Ratcheuma* similar to each other and more apomorphic, and *Persedicus, Bulgarosoma,* and *Dacasoma* form a trio of genera with even more simplified posterior gonopods. Retention of larger telopodites of the posterior gonopods is a plesiomorphic character, and so gives no real clues to relationships, but it is interesting to note that the most unmodified posterior gonopods occur in the Caucasian forms and the most reduced further west, in the Balkans and western Mediterranean.

The admittedly ecletic Anthroleucosomatidae of Hoffman (1980) includes subfamilies in which the posterior gonopods are virtually lost, and others in which they remain quite leglike. Probably this family , as Hoffman conceived of it, will have to be broken up, but there are among the "traditional" anthroleucosomatid genera common features in anterior gonopod plan.

It must be noted that the structure of the anterior gonopods of all the genera so far mentioned does not necessarily correspond to the similarities noted in the posterior gonopods. While a common basic plan is present, *Persedicus* and *Ghilarovia* have anterior gonopods most like one another, and *Bulgarosoma* most resembles *Alloiopus.* Golovatch (1981, 1987) discerned that *Caucaseuma, Ratcheuma,* and *Adshardicus* form another group which does correspond to the grouping on the basis of the posterior gonopods, adding further weight to the idea that only a single genus is involved.

Finally, the resemblance in anterior gonopods between *Altajella pallida* Gulicka, from the Altai Mountains (Gulicka, 1967), *Caucaseuma,* and *Prodicus (Balkandicus) albus* Strasser (1960) should be noted. The illustrations of *A. pallida* do not provide the required information for family placement, but it is likely that this species is also an anthroleucosomatid.

Since new genera and species of Asian anthroleucosomatids are being discovered and described (Golovatch, in litt.), and since the anterior gonopods of *Ghilarovia* species and *Alloiopus solitarius* are rather different, no connections between them can be firmly drawn. The purpose of this paper is to place the two genera in the correct family, redescribe *A. solitarius,* and describe a second species of *Ghilarovia.*

ACKNOWLEDGEMENTS

I thank Dr. M. Moritz, Zoologisches Museum, Humboldt-Universität, Berlin, for the loan of the only known material of *Alloiopus solitarius.* Dr. S. Golovatch, Institute of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences, Mowcow, loaned the collection which contained both new material of *Ghilarovia kygae* and the new species *G. novosibirica;* he also provided most welcome comments on the manuscript.

SYSTEMATICS

Family Anthroleucosomatidae Verhoeff

Alloiopus solitarius Attems
Figures 1-11

Alloiopus solitarius Attems 1951: 412, figs. 25-33

Type: Part of male holotype (complete except for gonopods, segment 5, legs 4-7[?], 10 and 11) in alcohol; three microscope slides as follows: 1) anterior gonopods, 2) posterior gonopods, legs 4-7[?], 10 and 11, and 3) pleurotergite of diplosegment 5. Conserved in Zoologisches Museum, Humboldt-Universitat, Berlin. Specimen collected in tea plantation near Lahidjan, Iran.

Description: Length, about 10 mm. Greatest width, 1.05 mm, third antennal article 0.44 mm long. Thirteen unpigmented, well-separated ocelli in subtriangular patch in transverse rows of 5, 4, 3, and 1 (dorsal to ventral). Frons strongly flattened, mandibular cheeks protruding. Metazonites with pronounced lateral swellings (fig. 1).

First three legpairs normal. Legs 4-6 shortened, swollen, crassate (fig. 2); Legs 7 similar, but larger, with prominent, curved coxal process bearing numerous macrosetae (figs. 3, 4). Pregonopodal legs described differently by Attems (1951); see below.

Anterior gonopods in anterior view (fig. 5, 6) with anterior sternal sac (as in *Adshardicus strasseri* and others). Central element with median rod bifid at tip, complex lateral structures on each side comprising at least three branches each: posterior, lamellate branch (A), more anterior fimbriate one (B), and anteriomedian, lobulate, finely setose branch (B). Central element cupped laterally on each side by broad angiocoxites (CX) with densely fimbriate inner surfaces.

Posterior gonopods (figs. 7, 8) well separated from one another, with broad, prominent sternum. Coxae with three processes, a lateral, curved, lamellate one (E), anteromesal triangular process (F), and posterior, acute, apically fimbriate (G). Telopodite two-segmented, reduced; apical segment acuminate, reflexed dorsad, with faint indications of subdivision (small claw present on left telopodite).

Coxa of leg 10 (fig. 9) with gland and mesoapical hooked process; leg 11 similar, but gland evidently much reduced (fig. 10). Legs 12-19 with normal coxae. Coxae of legs 20-28 with mesal knobs that progressively come to appose one another (fig. 11).

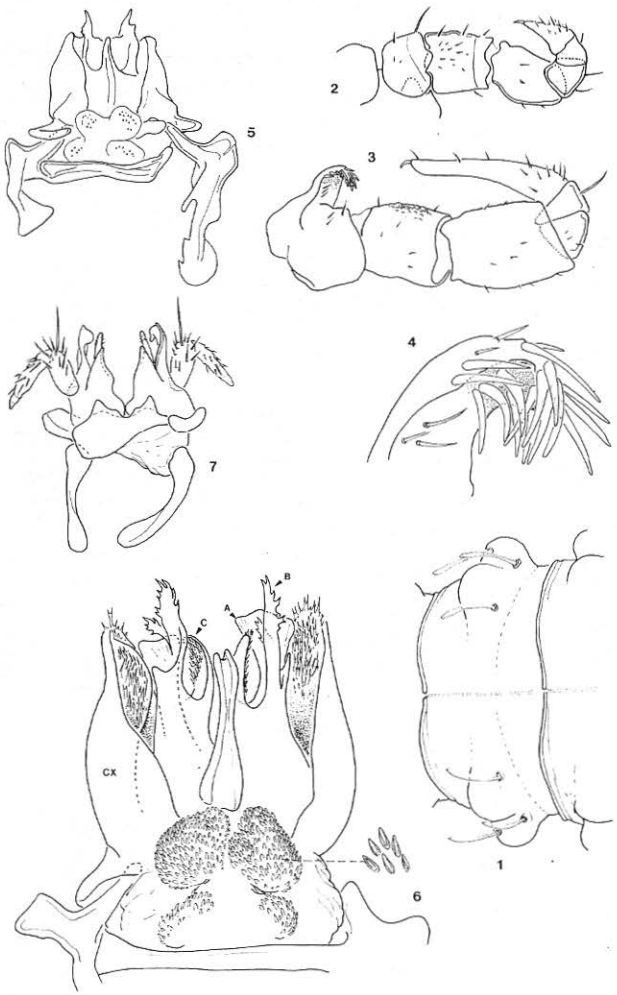
Coloration, after years of preservation, uniform creamy tan.

Female unknown.

Notes. The material described above is not labelled as being the holotype, but is undoubtedly the specimen from which Attems drew his description. Since numerous details in my description differ from those of Attems (1951), some explanation is required.

Attems found only 11 ocelli; I counted 13.

In his diagnosis of the new genus, Attems contrasted it with the unrelated *Tianella* of Nepal (Cleidogonidae; see Shear, 1979, 1987). Striking in his diagnosis is the statement that there are only 6 pairs of legs in front of the gonopods in *Alloiopus*. Attems goes on to say that legpairs 1, 2, and 5 are slender, and pairs 3, 4, and 6 are thickened. Later, in the species description, he admits that one of the



Figs. 1-7. *Alloiopus solitarius* male. 1. Midbody segment, dorsal view. 2. Right leg 4?, Posterior view. 3. Right leg 7? posterior view. 4. Process on coxa of right leg 7?, posterior view. 5. Anterior gonopods, anterior view, to show general structure. 6. Anterior gonopods, anterior view, partially restored (see text for explanation of lettering). 7. Posterior gonopods, posterior view.

pairs of pregonopodal legs could have been lost in the process of making the slide preparation. I am sure this is so. Legpairs 1 and 2 are still attached to the body, and the slide bears a single pair of normal-looking, but somewhat-smaller-than-usual, legs, and three pairs of greatly enlarged legs, one of these with the characteristic hook Attems attributed to the sixth pair. I think the slender pair on the slide is the third, the enlarged pair with hooks the seventh, and the two remaining enlarged pairs two from the set 4-6, but which two is impossible to say. Generally, crassate and normally slender pregonopodal legpairs are not interspersed in chordeumatid males; the crassate legs are used to grasp the female during mating, and are usually the more posterior pairs (there are exceptions, i.e., *Crassotyla, Malayothrix).*

The interpretation of milliped gonopods mounted permanently on slides, particularly in the case of complicated and highly modified anterior gonopods, is very difficult because of clearing and flattening. Thus my drawing of the anterior gonopods of *A. solitarius* has to be regarded as at least a partial reconstruction, aided in this case by study under Normarski interference contrast illumination, which allows for separation of closely appressed parts by optical sectioning. I had to rely also on the illustrations of related forms, especially the excellent drawings of *Bulgardicus* gonopods by Tabacaru (1967). A comparison by the reader of Tabacaru's fig. B., Plate 7, with my drawings will show the similarities. However, I was not able to visualize a clear posterior view of the *A. solitarius* anterior gonopod.

Attems (1951) misinterpreted the posterior gonopods. The "2 langen zweiteiligen Fortsatzen" he placed on the sternum are in fact two entirely separate processes on the coxa of each gonopod, as described and illustrated here.

Finally, the modifications of the coxae of legs 20-28, overlooked by Attems, are most interesting—as far as I know, unique among chordeumatids. It is tempting to consider them remnants of a once-continuous series of coxal glands on the postgonopodal legs, as found in the orders Callipodida and Platydesmida.

Ghilarovia Gulicka

Ghilarovia Gulicka 1972:39. Type species, *G. kygae* Gulicka.

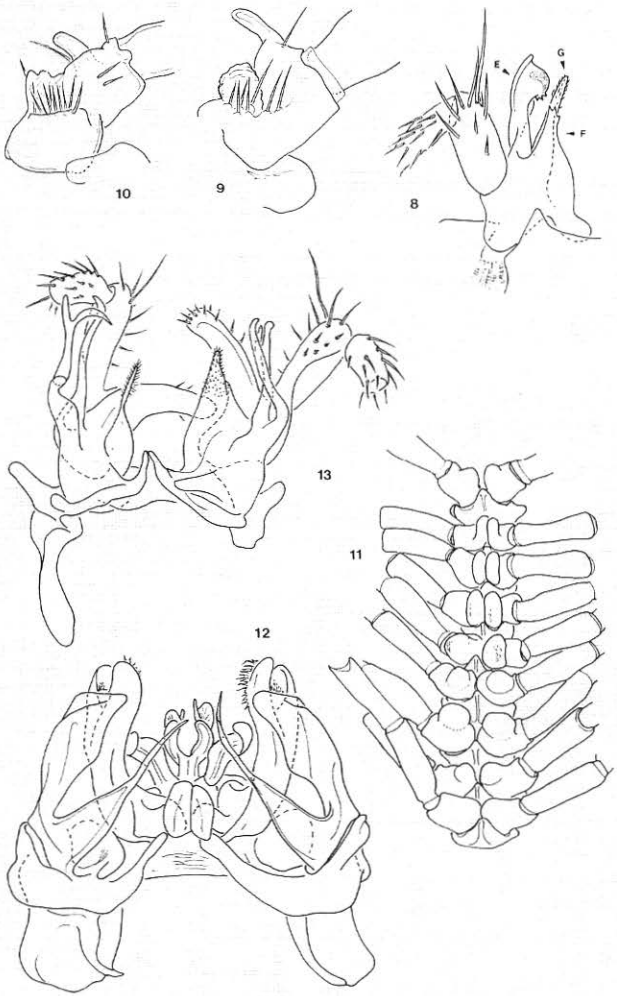
Gulicka erred in counting the segments of the type species, the only one known to him, so his description of the genus as having 30 segments is incorrect. *Ghilarovia kygae* and *G. novosibirica* have 28 segments in adults of both sexes.

There is an older genus name *Giljarovia* Kratchovil, in Arachnida (Opiliones, Nemastomatidae). The spelling is different enough to preserve the later diplopod name, but the unfortunate result is two generic names for soil-dwelling animals pronounced exactly the same.

Ghilarovia kygae Gulicka

Figures 12, 13

Ghilarovia kygae Gulicka, 1972: 39-41, Pl. 2, figs. 1-4.



Figs. 8-13. Anthroleucosomatid milliped males. 8-11. *Alloiopus solitarius*. 8. Right posterior gonopod, anterior view (see text for explanation of lettering). 9. Right coxa 10, anterior view. 10. Right coxa 11, anterior view. 11. Bases of legpairs 20-28, ventral view, anterior below. 12, 13. *Ghilarovia kygae*. 12. Anterior gonopods, posterior view. 13. Posterior gonopods, anterior view.

Type locality, Kyga River region, Teletskoye Lake, Siberia.

Figures of the anterior (fig. 12) and posterior gonopods (fig. 13) are presented here for comparison with those of the new species, *G. novosibirica*. The numerous specimens I studied are probably near-topotypes; they were collected in the Altai Mountains of Siberia, near Teletskoye Lake, by A. Tikhomirova, from litter under *Betula* and *Picea,* in September, 1969. A male and female have been deposited in the AMNH, and the others returned to Dr. S. Golovatch, Moscow, who kindly loaned them to me.

Ghilarovia novosibirica, n. sp.

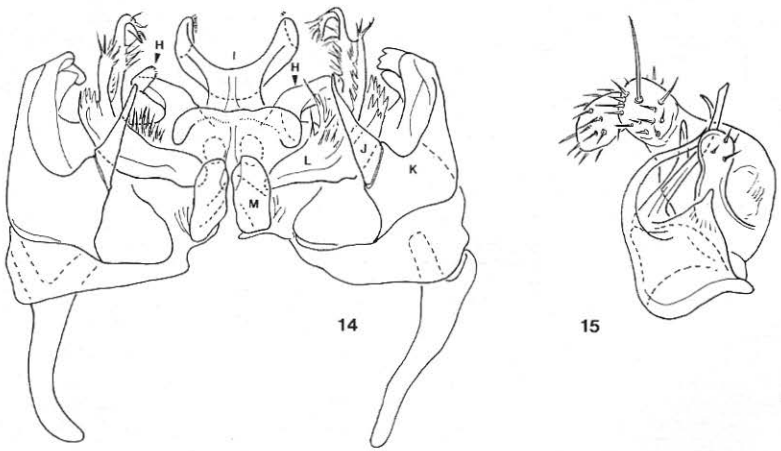
Figures 14, 15

Types: Male holotype, 2 female and 2 juvenile paratypes (Zoological Museum, State University of Moscow, USSR) from near Mirnyi, Togachinsk District, Novosibirsk area, Siberia, USSR; collected from *Abies, Betula,* and *Populus* forest (no collection date or collector's name on label).

Diagnosis: The figures presented here clearly separate the two known species of *Ghilarovia*. Attention is drawn in particular to the much larger median sternal process of the anterior gonopods of *novosibirica*.

Etymology: The species epithet is a noun in apposition and refers to the type locality.

Description. Male holotype. Twenty-eight segments. Length, 9.5 mm, width 1.04 mm, length of antennal segment three 0.52 mm. Ocelli 19 or 20, well-



Figs. 14, 15. *Ghilarovia novosibirica* male. 14. Anterior gonopods, posterior view (see text for explanation of lettering). 15. Left posterior gonopod, mesal view.

pigmented, in subtriangular patch. Frons distinctly flattened, with faintly indicated transverse carina between eyes above flattened area. Pregonopodal legs slightly encrassate, but not otherwise modified. Trunk segments nearly cylindrical.

Anterior gonopods (fig. 14) much wider than long, not strongly projecting. Sternum with two pairs (H and I) of anterior, lyre-like process. Angiocoxites entirely lateral, shallowly divided, with acute posterior lamella (J) and complex lateral part (K). Colpocoxites (L) two-branched, mesal branch fimbriate, hooked, lateral branch broken up distally into small, chitinous rods. Telopodites (M) much reduced, lobe-like. Posterior gonopod (fig. 15) with large coxa bearing two acuminate processes, one of which is bifid, and anterior triangular lamella. Prefemur with large setose knob, distal segment small, subglobular.

Sternite 10 with long knob projecting between coxae on anterior side; this not so large as in *G. kygae.* Coxae 10 and 11 with glands, somewhat enlarged, otherwise not modified.

Color uniformly light tan, ocelli black, antennae suffused with dark purplish brown.

Female paratype. Twenty-eight segments. Length, 10.2 mm, width 1.14 mm, antennal segment three 0.42 mm long. Somatic structure as in male, but frons not flattened. Cyphopods well-sclerotized, prominent.

ANTHROLEUCOSOMATID GONOPODS

I interpret the gonopods of the anthroleucosomatid genera I have studied somewhat differently from Strasser (1960) and Mauriès (1982). Because the large lateral pieces clearly articulate with the sternum (fig. 5) and are muscularized from the sternal apodemes, I consider them angiocoxites (derived from the sclerotized walls of the leg coxae), rather than telopodites, the interpretation of Strasser and Mauriès. The complex, paired, central elements are most likely colpocoxites (derived from the coxal glands, which have become sclerotic), by analogy with the gonopods of the related Brannerioidea (see Shear, 1972, for detailed interpretations of the gonopods of several families of this superfamily). Mauriès (1982) considers them syncoxal in *Persedicus:* this may be so. However, they may also be partly or entirely fused telopodites, as in *Pseudotremia* (Cleidogonidae), where a median structure likewise occurs. Although I have not been able to find any musculature associated with the small lobelike posterior structures on the anterior gonopods of *Ghilarovia* species, interpreting these as telopodites is consistant; alternatively they may be the coxal gland derivatives.

It is more important, however, to clearly establish the homologies of the parts of the anterior gonopods between species and genera than to establish their derivation from leg podomeres, which may in any case be an impossible task. Mauriès and I have used different hypotheses of derivation in several families, but both systems maintain internal consistancy.

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