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Systematic position of the milliped family Niponiosomatidae (Diplopoda, Chordeumatida, Brannerioidea).

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ABSTRACT

The Japanese milliped family Niponiosomatidae belongs in the superfamily Brannerioidea, and is distinct from the family Brachychaeteumatidae, with which it formerly had been synonymized. Niponiosomatidae are the closest relatives of the North American family Tingupidae. *Calochaeteuma* Miyosi 1958 is considered a subjective synonym of *Niponiosoma* Verhoeff 1941. Two (possibly three) species are known.

INTRODUCTION

Karl W. Verhoeff's 1941 description of the Japanese cave milliped *Niponiosoma troglodytes* was accompanied by unclear illustrations of the gonopods. As a result, the species and its accompanying family name Niponiosomatidae (*recte*: Niponiosomatidae) have remained in limbo for 47 years, placed at the ends of lists of chordeumatid milliped taxa "of uncertain position" (i.e., Hoffman, 1980). Miyosi (1958, 1959) provided new illustrations of the species so different in appearance from Verhoeff's that in comparing the two, one might imagine two species to be involved. Miyosi did not use the family name Niponiosomatidae, and instead included *Niponiosoma* with two other monotypic Japanese genera, *Macrochaeteuma* Verhoeff and *Calochaeteuma* Miyosi, in the Brachychaeteumatidae. Each genus was placed in its own subfamily (probably because these changes were in Japanese in the body of the paper, rather than in the German summary, they were missed in the nomenclator of Jeekel [1971] and Hoffman's 1980 classification). *Niponiosoma* and *Calochaeteuma* are in fact closest to some North American millipeds belonging to a family undiagnosed and unnamed at the time Miyosi wrote his monograph on Japanese millipeds: Tingupidae, described in 1966 by

Loomis, and revised by me in 1981. Based on my study of interspecific gonopod differences in the genus *Tingupa*, I have concluded that both described species of Niponiosomatidae can be accommodated in the type genus.

I do not think Hoffman (1980) was correct in including Macrochaeteumatinae and Brachychaeteumatinae as separate subfamilies of Anthroleucosomatidae, but a great deal more information is needed before the complicated relationships of the nine subfamilies and 29 genera he lists as anthroleucosomatids can be understood.

Superfamilial arrangements are again in flux as more papers on Asian and Pacific Basin chordeumatids continue to be published (indeed, a paper by Mauriès, in press at this writing, will describe a new family from New Zealand which may be related to Niponiosomatidae), but Niponiosomatidae definitely belong in the superfamily Brannerioidea, as I characterized it in 1972. Hoffman (1980) has expanded this concept, and in addition to Tingupidae and Branneriidae, includes Trachygonidae (= Acrochordidae), Apterouridae, Rhiscosomididae (I still consider these latter two as striarioids), Heterolatzeliidae, and Anthroleucosomatidae. As mentioned above, Brachychaeteumatinae and Macrochaeteumatinae are listed by Hoffman as subfamilies of Anthroleucosomatidae.

Mauriès (1982) has put forward a much expanded concept of the superfamily Cleidogonoidea, which differs substantially from either my ideas (1972, 1979) or those of Hoffman (1980). The families Mauriès includes are: Anthogonidae, Cleidogonidae, Trichopetalidae, Tingupidae, Rhiscosomididae, Kashmireumatidae, Chaemaesomatidae, Branneriidae, Niponiosomatidae, Brachychaeteumatidae, and Macrochaeteumatidae. The great similarity in both anterior and posterior gonopods between *Brachychaeteuma* and *Macrochaeteuma* leads me to reject Mauriès' recognition of Macrochaeteumatidae as a separate family; the details of secondary sexual modifications, ocelli, and segment number given by Verhoeff (1914) are sufficient, in my opinion, only to distinguish subfamilies or perhaps even genera.

To summarize the nomenclatorial tangle: *Brachychaeteuma* and *Macrochaeteuma* remain in Brachychaeteumatidae, and *Niponiosoma* and its synonym *Calochaeteuma* in Niponiosomatidae. These two families are related to one another and to the North American Branneriidae and Tingupidae by a common pattern of posterior gonopod (ninth leg) reduction. The presence of an anterior gonopod flagellum may be a synapomorphy for Branneriidae and Brachychaeteumatidae; the three-branched rodlike telopodites of the anterior gonopods present a synapomorphy for Niponiosomatidae and Tingupidae.

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SYSTEMATICS

Family Niponiosomatidae Verhoeff

Niponiosomatidae Verhoeff 1941:34 (corrected to Niponiosomatidae by Jeekel, 1971). Hoffman, 1980: 138.

Niponiosominae, Miyosi, 1958: 14 (subfamily under Brachychaeteumatidae).

Brachychaeteumatidae, Miyosi, 1958: 14; 1959: 129 (*Calochaeteuma* and *Niponiosoma* only).

Calochaeteumatinae Miyosi 1958: 14. (subfamily under Brachychaeteumatidae).

Macrochaeteumatinae, Hoffman, 1980: 137 (*Calochaeteuma* only).

Diagnosis: Closely related to Tingupidae, from which it may be distinguished by the smooth, subcylindrical segments and the fusion of the coxites of the anterior gonopods.

Description: 28 or 30 segments. Mentum of gnathochilarium unsclerotized. Segments cylindrical, smooth, without sculpture. Legs anterior to gonopods unmodified. Legpairs 10 and 11 of males with coxal glands, pair 11 with coxal modifications. Anterior gonopods with two pairs of setose coxites, median ones basally or entirely fused. Telopodites with posterior lobelike portion and anterior, three-branched part. Posterior gonopods with small coxite and two or three-segmented telopodite; telopodite not swollen, not strongly reflexed dorsally.

Notes: Because of the similarities of the gonopods of tingupids and niponiosomatids, I first thought of synonymizing the two families. However, the differences in the form of the trunk are substantial, since in tingupids there are prominent paranota and the metazonital surface is covered with small, sharp, longitudinal ridges that give a distinctive appearance (Shear, 1981). In addition, no male tingupids presently known have the coxae of legpair 11 modified. Thus it seems reasonable to keep the two families separate while recognizing that they are sister groups. The modifications of the eleventh coxae are a synapomorphy for species of Niponiosomatidae, and the segment form and sculpture synapomorphies for species of Tingupidae.

Niponiosoma Verhoeff

Niponiosoma Verhoeff 1941:35. Miyosi, 1958: 177; 1959: 130. Hoffman, 1980: 138. Type species *N. troglodytes* Verhoeff.

Calochaeteuma Miyosi 1958: 177; 1959: 131. Hoffman, 1980: 137. Type species *C. morikawai* Miyosi. New subjective synonymy.

Notes: The brief description given for the family can also serve for the single included genus. *Niponiosoma morikawai* (Miyosi) differs from *N. troglodytes* Verhoeff in being pigmented and having eyes and possessing 28 segments in males rather than 30. However, the structure of the gonopods is similar and the differences are, in my opinion, no more than those between species. For an

analogous case, compare the drawings and descriptions of *Tingupa* species in my 1981 revision with Miyosi's 1958 illustrations of *C. morikawai* and *N. troglodytes*.

The drawings presented by Verhoeff in his original description of *N. troglodytes* are so sketchy that they are probably the source of the confusion surrounding the species. Miyosi (1958, 1959) provided much better illustrations, but these were not generally taken notice of by European or American researchers. The drawings presented here were made from the type slides and were done with a drawing tube, using Normarski interference contrast illumination. There are differences between them and Miyosi's, and I also interpret the gonopods in a very different way. Both the types and Miyosi's specimens came from Kurasawa Cave, near Tokyo. The types of *Niponiosoma morikawai* came from Yamagami-daitido Cave in Ehime Prefecture (Miyosi, 1958). I have not been able to obtain any of Miyosi's specimens on loan, and so have not seen the types of the latter species.

Niponiosoma troglodytes Verhoeff

Figs. 1-6

Niponiosoma troglodytes Verhoeff 1941: 36. Miyosi, 1958: 177, figs. 1a, b; 1959: 130, figs. 179-179''''.

Type. The presumed type material consists of three microscope slides in the Zoologische Staatssammlung München, Munich. These slides are not labelled as types. At least two individuals, perhaps a male and a female are represented. The slide labelled "Kopf. Gp. ♂" bears a head in pieces, a few tergite scraps, anterior gonopods, male legpairs 10 and 11 and others, and female vulvae and third legpair. The other two slides are of partial bodies. The posterior gonopods could not be found on any of the slides.

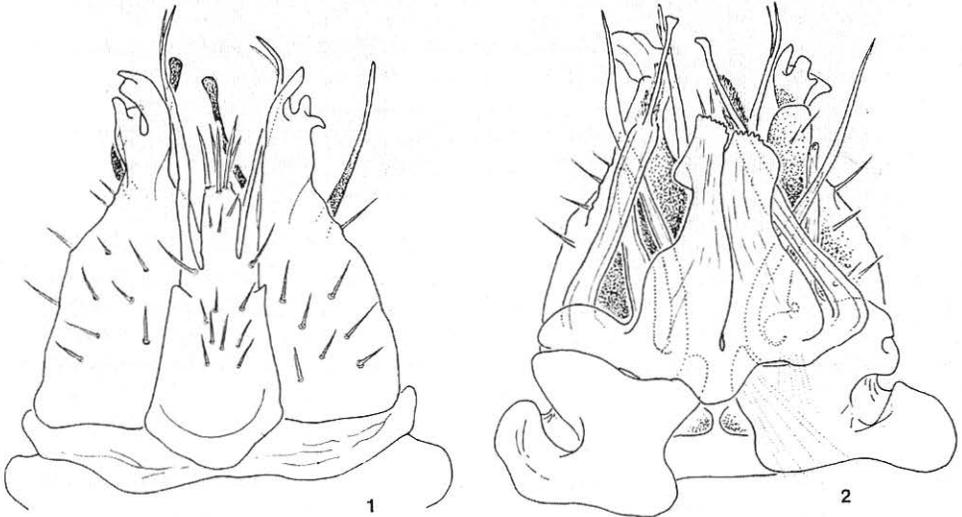
Description of male. Because all the specimens are broken up I must rely on Verhoeff's original 1941 description for details on the general structure. Length, 8.5-9.0 mm Ocelli absent. Body without pigment. Anterior gonopods (figs. 1, 2, 4, 5) with median, fused coxite bearing on each side long, apically divided, flagelliform branch; median lobe with five large apical setae and smaller, scattered setae basally. Lateral coxite (fig. 4) of each side basally setose, apically with complex, curved lamellae. Telopodites with posterior lobelike portion evidently basally fused, apical details distorted by slide-mounting process. Three sclerotized branches (fig. 5) of anterior part of telopodite with posteriormost longest, tubular, apical part with dense patch of cuticular fimbriae; median branch shortest, bearing small knobs at tip; anteriormost branch evenly tapering to acute tip. Posterior gonopods not on type slides, shown by Miyosi (1958) as much reduced, with small, lamella-like coxal plate, cylindrical prefemur, and two buttonlike terminal segments. Coxae 10 with glands, otherwise unmodified. Coxae 11 with glands and posterior, curved, dentate processes (fig. 6). Sternum 12 not modified.

Notes. Miyosi (1958) interpreted the gonopods of *N. troglodytes* differently, evidently reversing anterior and posterior. Thus the coxites were called syntelop-

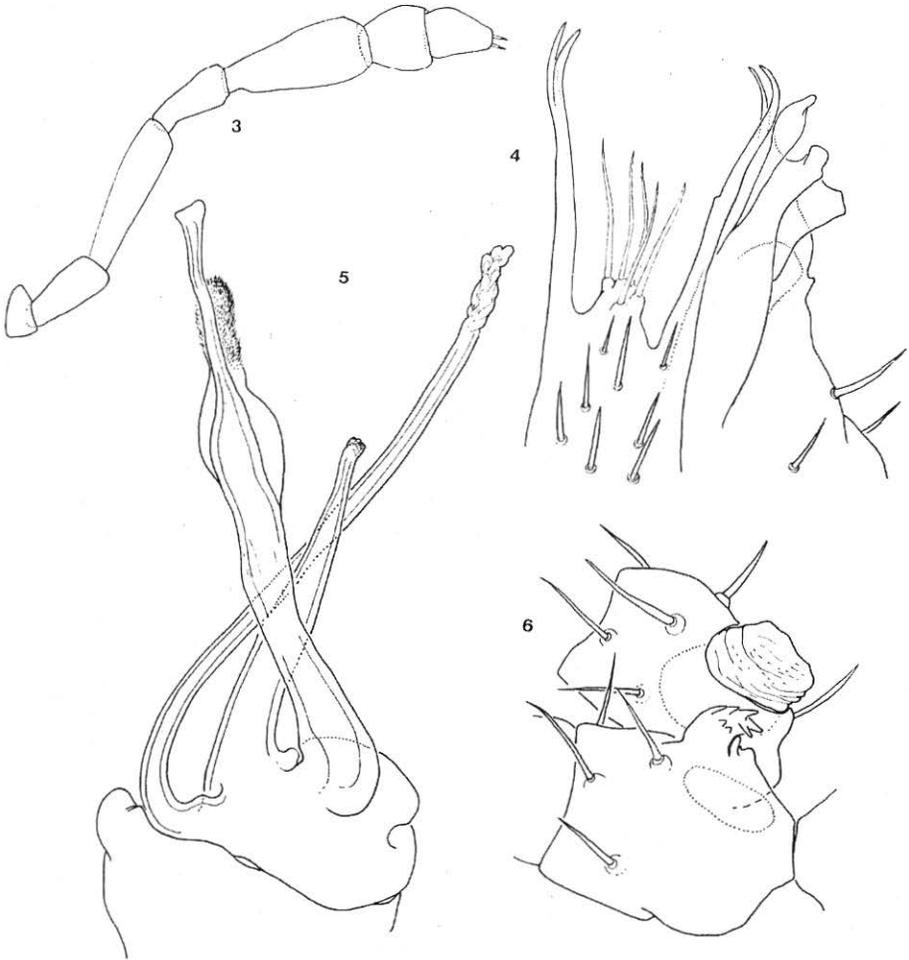
odites, and the real telopodites, coxites. The same interpretation was presented for *N. morikawai*.

It appears that Mauriès and I disagree on the interpretation of the gonopod anatomy of brannerioid and cleidogonoid families, particularly on which parts of the anterior gonopods constitute the telopodites. In particular, in his 1982 diagnoses, the telopodites of the anterior gonopods are not mentioned for genera and families (such as *Cleidogona*; Cleidogonidae) in which not only do they occur, but are freely movable (Shear, 1972). The structures in the anterior gonopods of Cleidogonidae, for example, that I have called colpocoxites, Mauriès (1982) calls angiocoxites (derivatives of the sclerotized wall of the podomere), and what I call telopodites, he calls colpocoxites (sclerotized derivatives of coxal glands). In another interpretation of the gonopods of *Pseudotremia*, closely related to *Cleidogona*, what I have considered the setose lobes of the coxae are designated telopodites by Mauriès (1986). Only further studies of the musculature, now in progress, can resolve this disagreement, but in the genus *Cleidogona*, I found the telopodites to be freely movable and muscularized (Shear, 1972), an unlikely situation if these structures were indeed derived from sclerotized, permanently everted coxal glands.

The distribution of coxal glands on the postgonopodal legs is a character I consider to be an important clue to systematic placement; by outgroup comparison (with Callipodida), an homologous series of such glands probably existed on all legs of an ancestral form. In most chordeumatids, these have been reduced to two pairs, found on the tenth and eleventh coxae, and in one evidently homogeneous group of families, the eleventh coxal glands have been lost.



Figs. 1,2. Anterior gonopods of *Niponiosoma troglodytes*. 1. Anterior view. 2. Posterior view.



Figs. 3-6. *Niponiosoma troglodytes*. 3. Left antenna, lateral view. 4. Median coxites and right lateral coxite of anterior gonopods, anterior view. 5. Left telopodite of anterior gonopods, posterior view. 6. Coxae of left eleventh and tenth legs, posterior view.

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