

Tropical freshwater Copepoda from Papua, New Guinea, Burma, and Costa Rica, including a new species of *Mesocyclops* from Burma

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A new subspecies, *Eucyclops birmanus aequatorialis* ssp. nov., is described from Papua, New Guinea; *Mesocyclops pehpeiensis*, known from China, is recorded from Burma, Sri Lanka, and Malaysia; and a new species, *Mesocyclops restrictus* sp. nov., is described from Burma. Based on abundant material from Costa Rica, the status of *Diptomus dorsalis* Marsh is reexamined.

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On trouvera ici la description d'une nouvelle sous-espèce, *Eucyclops birmanus aequatorialis* de Papouasie en Nouvelle-Guinée, l'addition d'une espèce chinoise *Mesocyclops pehpeiensis* à la faune de Birmanie, de Sri Lanka et de Malaisie, ainsi que la description d'une nouvelle espèce *Mesocyclops restrictus*, trouvée en Birmanie. L'examen d'un grand nombre de spécimens provenant de Costa Rica nous oblige à remettre en question le statut de *Diptomus dorsalis* Marsh.

Introduction

When studying tropical freshwater zooplankton we encountered some interesting cyclopoid and calanoid Copepoda which included a new species of *Mesocyclops* from Burma and a subspecies of *Eucyclops birmanus* from Papua, New Guinea. We have also been able to compare previous descriptions of a widely distributed American calanoid, "*Arctodiptomus*" *dorsalis*, described under various names and comment on these based on our study of Costa Rican material.

Materials and methods

This material was collected as part of a worldwide survey of tropical and equatorial freshwater zooplankton. The samples were obtained with nets of 20 and 25 cm diameter and 157- and 64- μ m mesh and fixed in 5% formaldehyde. Before study, the specimens were placed in a solution of 10 parts glycerine and 90 parts of 70% ethyl alcohol tinted with rose bengal overnight. Dissections were done in glycerine.

Eucyclops birmanus aequatorialis ssp. nov.

(Figs. 1–7)

In his first publication on cyclopoids collected in Burma, Lindberg (1949) described a new species *Eucyclops birmanus*. It is very similar to *Eucyclops vandouwei* (Brehm, 1909) according to the key to *Eucyclops* species of Lindberg (1955).

In a collection of plankton made by Dr. Marcus Chambers, University of Papua, New Guinea, in Lake Pogera (Papua, New Guinea) on July 3, 1983, we found a species similar but not quite identical to *E. birmanus*. We have named it as a subspecies of *E. birmanus*, *Eucyclops birmanus aequatorialis* ssp. nov.

Description

Female

Body ovoid; thoracic segments overlap each other from Th2 to Th5. This last segment has long terminal lateral hairs (Fig. 1). Genital segment as in *E. serrulatus* (Fischer 1851) which has been recently figured by Dussart (1982). Other abdominal segments with posterior margins crenulated. Abd5

with spines laterally, ventrally, and partly dorsally (Fig. 5). The posterior portion of the furca is somewhat swollen. Furca 4 times as long as wide with internal margin lacking hairs and almost parallel. Serra oblique with setae commencing in the subventral region and running in a slightly curved line to the margin where they are lateral. The most distal spines are dorsal (Fig. 5). Outer furcal seta strong, slightly curved, and armed with spines on one side and hairs on the other. It is situated at some distance from the end of the furca and has some spinules at its base. Inner terminal seta slender, slightly less than twice the length of the outer seta. Dorsal seta slightly longer than the outer seta. Medial setae with heteronomous ornamentation; where they are narrow, the hairs are dense.

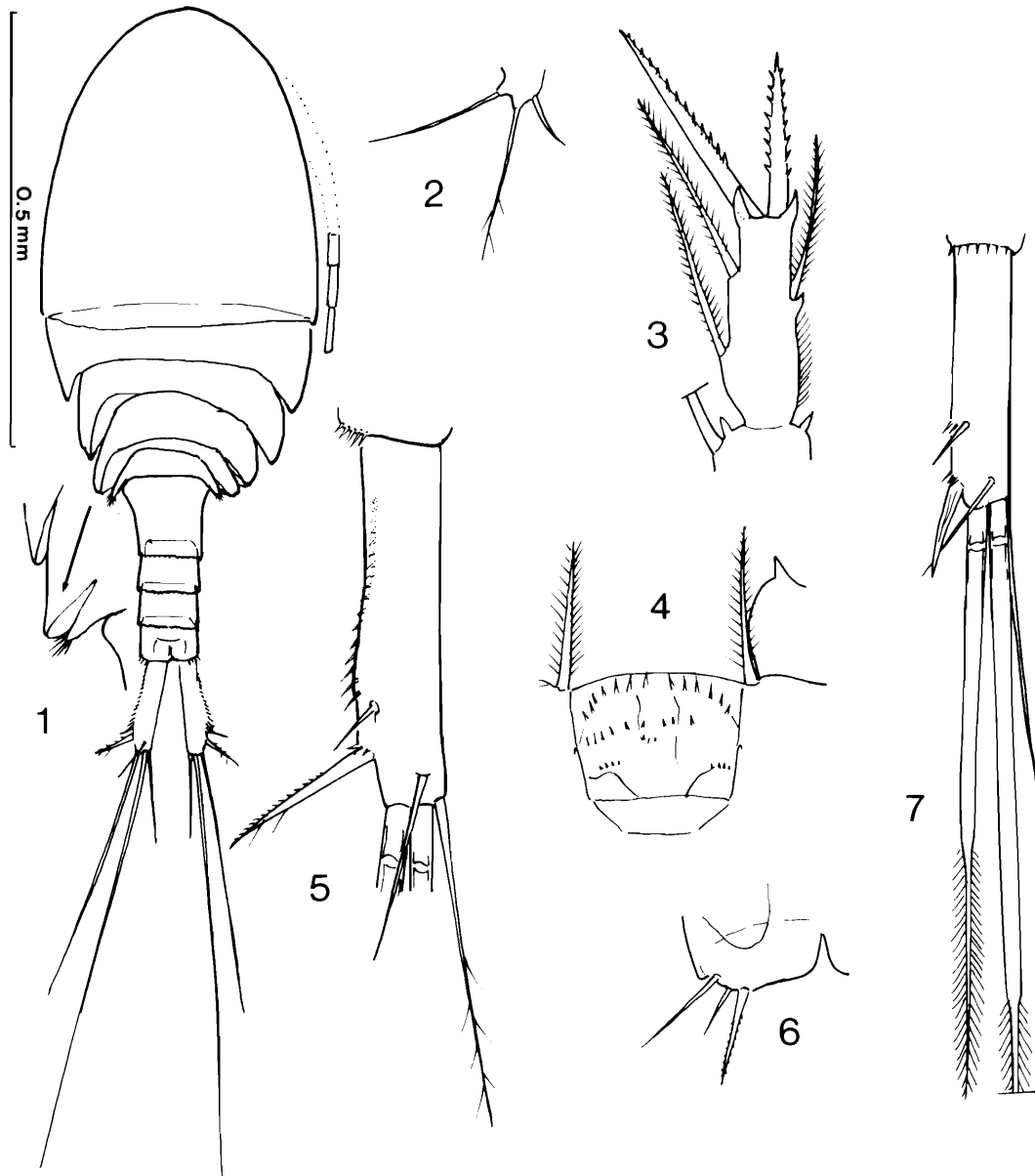
A1 relatively short, barely reaching the first thoracic segment; the last segments apparently without hyaline lamellae. P₁ with very long spine and arising at the inner corner of basipodite extending to endopodite 3. Spine formula of exopodite P₁–P₄; 3.4.4.3. P₄ precoxal lamella with several rows of spinules; the last subterminal one, a series of five or six spinules on each side (Fig. 4). Endopodite 3 P₄ with stout terminal inner spine, slightly longer than the segment, and 1.4 times longer than the outer spine; setae short, particularly the outer one (Fig. 3). P₅ with short, slender inner spine (Fig. 2). Ovisacs small and ovoid.

Length: 0.85 mm.

Male

Slightly smaller but more slender than the female. Furca slender, 4.6 times longer than wide, without serra, which is replaced by some lateral spines near the marginal seta. Inner terminal seta very long, about 3 times length of outer seta which is strong and unarmed. Terminal medial setae like those of the female but even more constricted at the beginning of the dense setation (Fig. 7). P₅ as in female. P₆ with a relatively thick inner spine which reaches the posterior margin of the next abdominal segment; medial seta relatively short, shorter than the outer seta.

Because of these characters, this form should be called *E.*



FIGS. 1–7. *Eucyclops birmanus aequatorialis* ssp. nov. Figs. 1–5. Female. Fig. 1. Female, dorsal view and detail of Th5 laterally. Fig. 2. P₅. Fig. 3. P₄ endopodite 3 (inner terminal spine longer than outer). Fig. 4. P₄ coxal lamella. Fig. 5. Furca. Figs. 6–7. Male. Fig. 6. P₆. Fig. 7. Furca.

birmanus. However, the male is slightly different. The medial spine of P₆ is shorter than the inner spine whereas in *E. birmanus* the inner spine is shorter than the medial. Also the constriction of the terminal setae of the furca is more pronounced than in *E. birmanus* both in the male and female. The furca of the female is more swollen than in *E. birmanus* and the terminal spines of endopod P₄ are not expanded unlike in *E. birmanus*. Also, the P₅ precoxal lamella is more spinous than in *E. birmanus*.

This is the second recorded locality for the species and considerably distant from the first.

We consider it a new subspecies, *Eucyclops birmanus aequatorialis*.

HOLOTYPE: Female, dissected; NMC-C-1984-40.

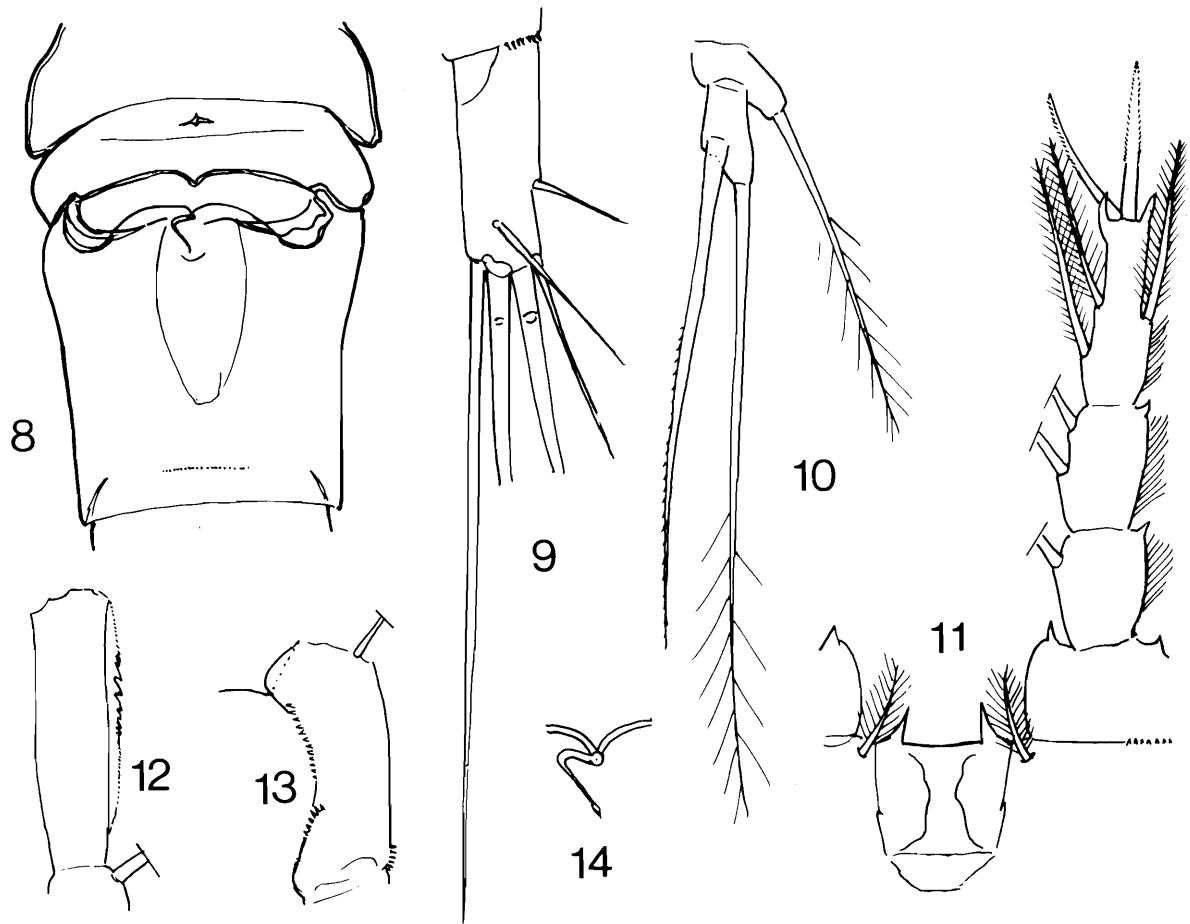
PARATYPE: Male, dissected; NMC-C-1984-41, Lake Pogera, Papua, New Guinea, 5°30' S, 143°10' E, collected by Dr. Marcus Chambers, July 3, 1983. Deposited in the National Museum of Natural Sciences, Ottawa, Canada.

Two Mesocyclops species from Burma: Mesocyclops pehpeiensis Hu, 1943 and *Mesocyclops restrictus* sp. nov.

Kiefer (1981) listed 13 *Mesocyclops* species from the Old World, i.e., Europe, Asia, and Africa. Two of these species *M. aspericornis* (Daday 1900) and *M. thermocyclopoides* (Harada 1931), are known in regions close to Rangoon where we found both these species. However, in a sample from Cantounment Gardens, Rangoon, we found *M. pehpeiensis* Hu. This species was described as *M. ruttneri* by Kiefer (1981) from specimens found in the old greenhouse of Lunz (Austria) laboratory of the late Professor F. Ruttner. Kiefer (1981) mentioned that this species probably came from Java, Indonesia. We consider *M. ruttneri* synonymous with *M. pehpeiensis*.

Mesocyclops pehpeiensis Hu, 1943

Some characteristic features of this species are the following. Th5 without lateral hairs. Furca without hairs at the inner margin. Receptaculum seminis with a comma like pore



FIGS. 8–14. *Mesocyclops restrictus* sp. nov., female. Fig. 8. Genital segment. Fig. 9. Furca. Fig. 10. P₅. Fig. 11. P₄. Fig. 12. Last segment of first antenna. Fig. 13. Basipodite of second antenna. Fig. 14. Detail of posterior margin, copulatory pore, and pore canal of receptaculum seminis.

canal and the posterior margin with a deeply indented double bracket shape (see Van de Velde (1984) for nomenclature of RS). P₄ with a long stout spine at inner corner of coxopodite and two terminal subequal spines on the third segment. This species is quite large and stout and measures about 1.5 mm (female). We have found this species widely distributed in Malaysia, Sri Lanka, and probably as far south as northern Australia (Dussart and Fernando 1985). It was described by Hu (1943) from southern China (Szechewan).

Mesocyclops restrictus sp. nov.
(Figs. 8–14)

In the same sample in which we found *M. pehpeiensis* we found one female of *Mesocyclops* which we describe as a new species.

Description

Female

Cephalothorax stout and abdomen slender. Th₅ without lateral hairs, as in *M. pehpeiensis*. Receptaculum seminis (Fig. 8) like that of *M. aspericornis*. Pore area (Fig. 14) like that of *M. pehpeiensis*. Furcal rami 2.8 times as long as wide, without hairs on inner margins (Fig. 9). The medial outer seta is placed in the second half of the segment. The other furcal setae are proportional to 1, *x* (lost), 6.6, 3.0, and 0.9 (the dorsal) in relation to the outer terminal seta (0.11 mm). First antenna with hyaline lamella on the last segment with several

teeth not well defined (Fig. 12). Second antenna with three rows of spinules at the outer margin of the basipodite (Fig. 13). Formula of exopodites P₁–P₄: 2.3.3.3. P₁ without spine on inner margin of basipodite. P₄ with coxopodite setae extremely short; they do not reach more than two-thirds the height of the basipodite. This feature is unique to this species (Fig. 11). Precoxal lamella with two long spines. P₄ endopodite terminal spines long and subequal. Lateral setae of endopodite P₄ relatively short (Fig. 11). P₅ with inner spine slender and long, shorter than the terminal seta, but longer than the outer seta (Fig. 10).

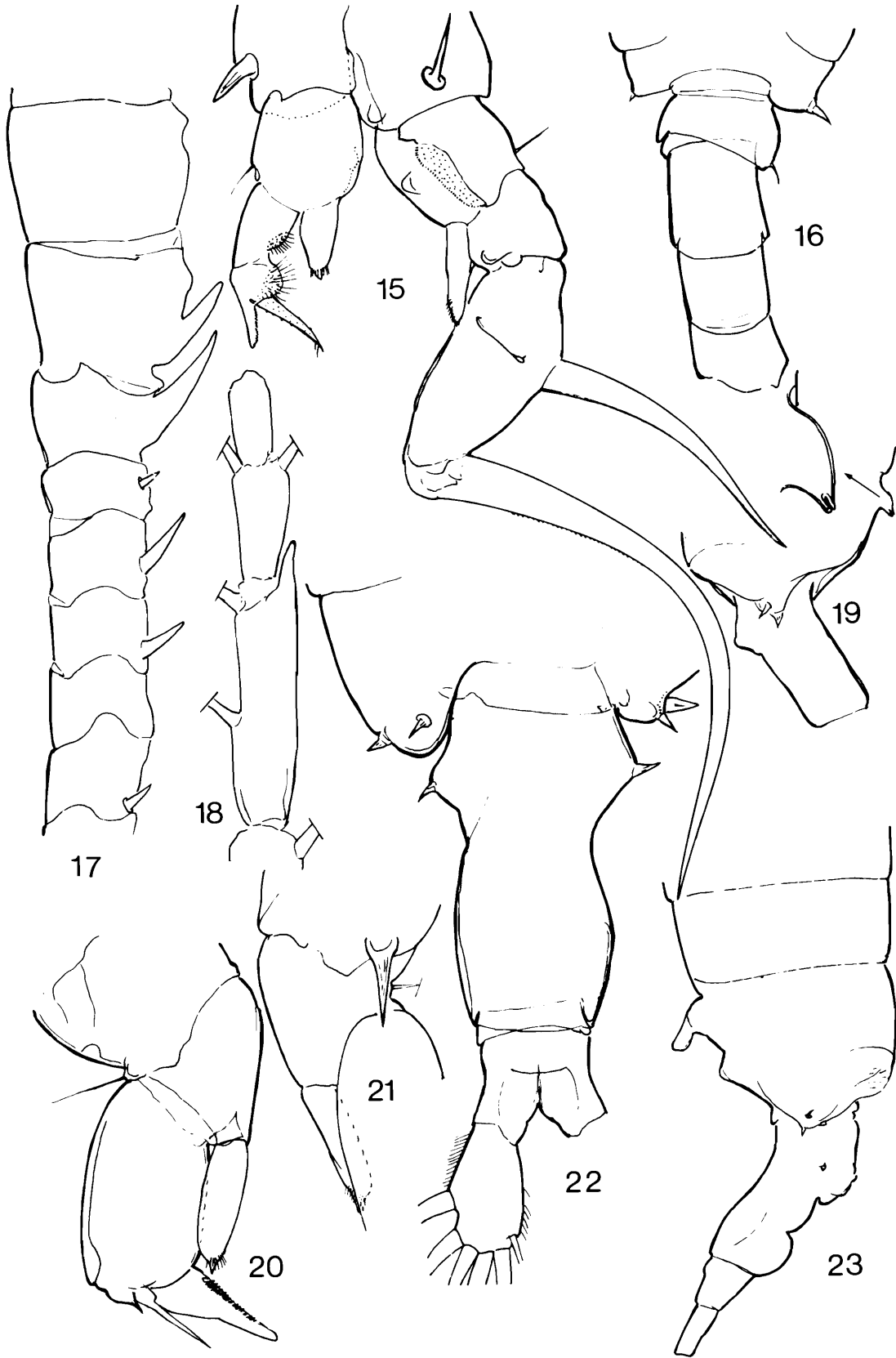
Length: 1.38 mm.

The uniqueness of this species is in the very short P₄ coxopodite setae. Also the combination of this character with the structure of the A1 hyaline lamella, relative lengths of the spine and setae of P₅, the detailed structure of the receptaculum seminis and the basipodite of A2 make it necessary to consider this a new species. We have named it *Mesocyclops restrictus* sp. nov.

HOLOTYPE: Female, dissected NMC-C-1984-42 Cantonment Gardens, Rangoon, Burma; 16°45' N, 96°15' E, collected by C. H. Fernando on September 20, 1973, and deposited in the National Museum of Natural Sciences, Ottawa, Canada.

Comments on Arctodiaptomus dorsalis and its synonyms (Figs. 15–23)

Kiefer (1936) described a calanoid from Haiti which is very



FIGS. 15–23. "*Arctodiaptomus*" *dorsalis* (Marsh, 1907). FIGS. 15–18. Male. FIG. 15. P₅. FIG. 16. Last thoracic segment. FIGS. 17 and 18. First antenna. FIGS. 19–23. Female. FIG. 19. Last thoracic segment, lateral view. FIG. 20. P₅, posterior view. FIG. 21. P₅, anterior view. FIG. 22. Last thoracic segment. FIG. 23. Lateral view of last thoracic segment.

similar to *D. dorsalis* described by Marsh (1907) from Louisiana. Kiefer called his species *D. proximus* to indicate its similarity to *D. dorsalis*. Kiefer also considered that the differences between his description and that of Marsh (1907) could be due to differences in the preparation of animals.

"*Arctodiaptomus*" *dorsalis* is a widely distributed species. Wilson (1959), who synonymized *A. dorsalis* and *A. proximus* without any comment, records it from the states in the Gulf of Mexico and the West Indies, Smith and Fernando (1980) recorded it in Cuba, and we have examined abundant material from many localities in Costa Rica. Bowman (1979), who followed Wilson's (1959) view of synonymy of the two species, found *A. dorsalis* in the Lesser Antilles. We have studied our Costa Rican material in detail and commented on the differences between the descriptions of Marsh (1907) and Kiefer (1936) of what we consider "*Arctodiaptomus*" *dorsalis*.

Kiefer (1936) described *D. dorsalis*, which he called *D. proximus* in detail and figured the species accurately. Marsh (1907), on the other hand, drew only the P₅ and the penultimate segment of the first antenna of the male and the dorsal view of abdomen and P₅ of the female, but no other relevant features. In particular, the male P₅ must be observed in three dimensions and not only flat as illustrated by Marsh (1907). In reality, the differences in the figures from the two author's is due to compression of the animal between slide and coverslip in the preparation. In Marsh's drawings, it is easy to see that the outer medial spine (aculeus) of exopodite 2 of the right P₅ of male is short because it is oblique and not in the plane of the leg. The hyaline membrane of the basipodite of the left P₅ was noted previously only in Kiefer's figure since it is easy to observe when the right P₅ is oblique. Kiefer showed this in the drawing of the point of fixation of the aculeus. We have illustrated P₅ of the male to show these features (Fig. 15). Marsh presents a female P₅ with a small spine on the coxopodite. Kiefer observes at this place a normal large hyaline spine. In fact, as noted in his figure (Kiefer 1936, Fig. 4 after p. 268) this spine is dorsal and very difficult to observe properly (Figs. 20 and 21). The perceived length of the endopodite and of the terminal seta of exopodite 3 of the female P₅ depends also on the obliquity of the figure. The difference of interpretation between these two authors is evident.

We found *Arctodiaptomus dorsalis* in eight localities in Costa Rica. We studied in detail material from four of them, namely La Sabana, San José Province, January 21, 1982; Nuñez, Guanacaste Province, June 23, 1981; Lago Hule, Alajuela Province, February 6, 1983; and Laguna Río Cuarto, Alajuela Province, February 6, 1982.

We illustrate the last thoracic segment and the abdomen of the male (Fig. 16), the antennule of the male (Figs. 17 and 18), and relevant features of the female (Figs. 19 and 23). This will enable comparison of this widely distributed species.

Recently, Dussart and Defaye (1982) synonymized *D. alter* Herbst, 1960 with *D. proximus*. Thus, the distribution of "A." *dorsalis* now extends from the southern U.S.A. to Costa Rica and the Caribbean. It has been recorded in Louisiana, Mexico, Nicaragua, Costa Rica, Cuba, and Haiti.

We noted in our study that "*Arctodiaptomus*" *dorsalis* is not very different in morphology from *Prionodiaptomus colombiensis* (Thiebaud, 1914), common in the northern part of South America and Central America. The use of the generic name *Arctodiaptomus* for *D. dorsalis* needs clarification as this genus, found in Europe, has not been studied in the New World in much detail as yet.

Acknowledgements

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