ELSEVIER

Journal of Marine Systems 15 (1998) 425–431

JOURNAL OF MARINE SYSTEMS

New morphological characters useful for the taxonomy of the genus *Microcyclops* (Copepoda, Cyclopoida)

Carlos Eduardo Falavigna da Rocha *

Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11461, 05422-970 São Paulo, Brazil

Accepted 26 September 1997

Abstract

Traditionally, *Microcyclops* species have been defined according to differences in a few morphological characters of antennule segmentation, swimming legs 1 and 4, caudal rami, and mainly leg 5. Moreover, these characters have been very often referred to as variable. In five species of *Microcyclops* from Brazil, namely *M. alius*, *M. anceps anceps*, *M. ceibaensis*, *M. finitimus*, and *M. mediasetosus*, new or rarely mentioned structures were found to be useful in separating the species, such as the border ornamentation of the prosomal somites, the shape and ornamentation of the terminal spine on the endopod of leg 1, the presence and number of integumental pores on the terminal endopodal segment of leg 1, and details in the ornamentation of the middle caudal setae. Since no intraspecific variation has been observed in these features, it is proposed to consider them in future descriptions of *Microcyclops* species in order to have better characterized taxa.

Keywords: systematics; Copepoda; Cyclopoida; *Microcyclops*; new characters

1. Introduction

The scarcity of characteristics useful for the definition of taxa has stimulated taxonomists to search for new features important for the systematics of the family Cyclopidae (Fiers and Van de Velde, 1984; Van de Velde, 1984a,b; Dussart and Fernando, 1986, 1988; Reid, 1990, 1993; Holynski and Fiers, 1994; Rocha, 1984, 1995a,b). Herein, new microcharacters important for a more complete definition of some known Brazilian species of *Microcyclops* are illustrated and discussed. These characters may be helpful in separating other species within the genus as well.

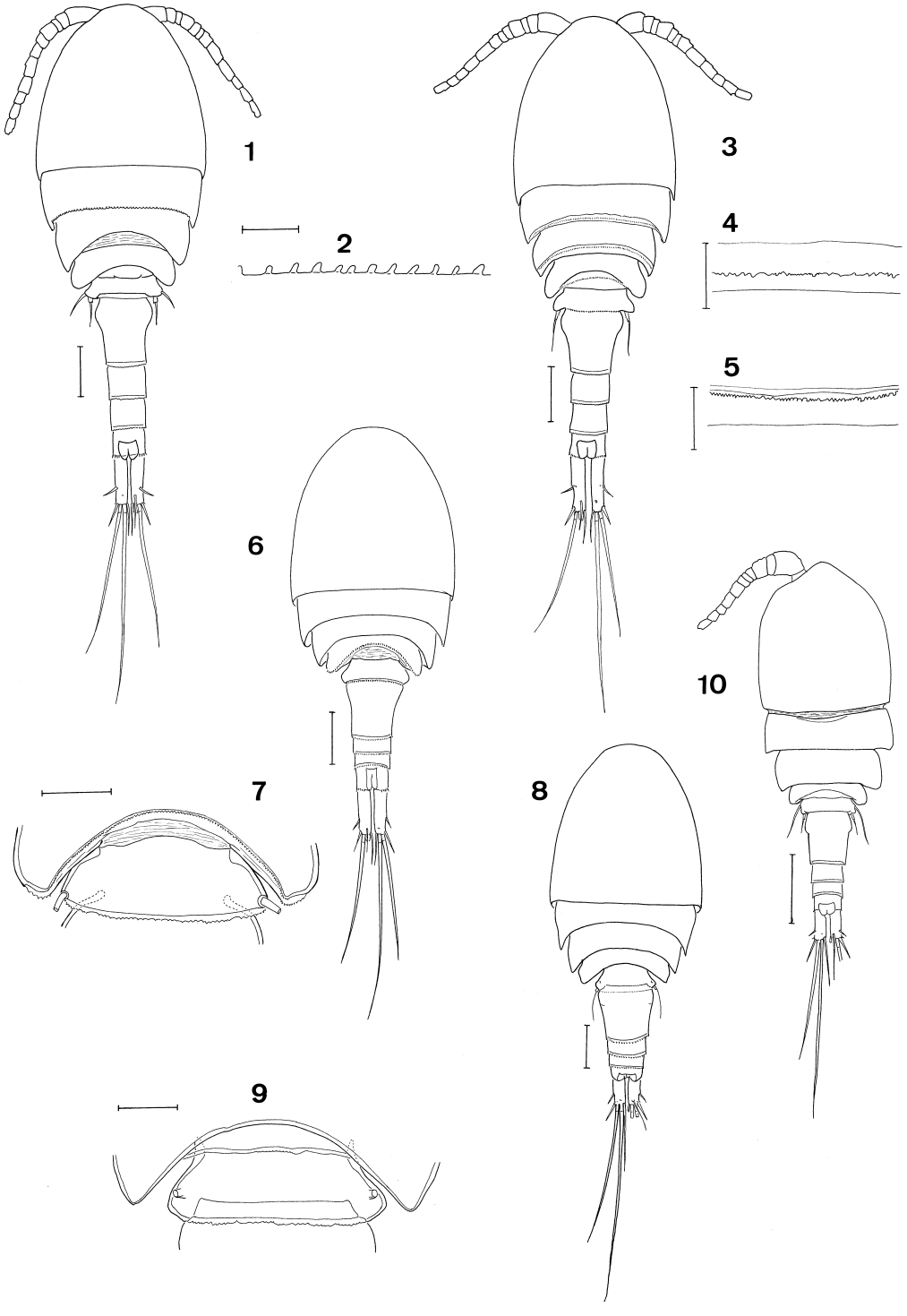
2. Material and methods

The material examined was sorted from samples collected in the Brazilian localities listed below:

(1) Southern Pantanal Matogrossense near Corumbá, State of Mato Grosso do Sul, among the roots of floating macrophytes in rivers and pools;

* E-mail: cefrocha@usp.br

0924-7963/98/$19.00
PII S0924-7963(97)00091-2


1
2
3
4
5
6
7
8
9
10

C.E.F. Rocha col.; August, 1994. *Microcyclops* species: *M. ceibaensis* (Marsh, 1919) (62 ♀♀, 28 ♂♂); *M. anceps anceps* (Richard, 1897) (447 ♀♀, 89 ♂♂); *M. finitimus* Dussart, 1984 (26 ♀♀, 13 ♂♂); *M. alius* (Kiefer, 1935) (15 ♀♀, 10 ♂♂), and *M. mediasetosus* Dussart and Frutos, 1985 (20 ♀♀, 14 ♂♂).

(2) Juréia Ecological Reserve, State of São Paulo, among roots of *Paspalum* sp. in Rio Una do Prelado; C.E.F. Rocha col.; June 7, 1984. *Microcyclops* species: *M. anceps anceps* (18 ♀♀, 7 ♂♂); *M. ceibaensis* (15 ♀♀, 7 ♂♂); *M. finitimus* (6 ♀♀, 9 ♂♂).

Whole males and females were examined in temporary lactic acid mounts in different positions (see Rocha, 1991).

3. Results

The examination of the morphology of the specimens revealed the following useful new or rarely mentioned characters:

3.1. Ornamentation of the posterior margins of prosomal and urosomal somites

All the specimens of *M. anceps anceps* examined had a row of large indentations under the cuticle along the posterior margin of the second prosomal somite (Plate 1, 1, 2); the remaining prosomal somites have no kind of indentation along their posterior edges. It is here pointed out that the prosomal somites of *M. anceps anceps* do not have hyaline membrane along their posterior margins, as commonly found within the harpacticoids (see Moore, 1976, for details about the variety of hyaline frill design in the latter animals). Specimens of *M. ceibaensis* possess a row of irregular minute denticles along the posterior border of the second to fourth prosomal somites (Plate 1, 3–5). In *M. finitimus* (Plate 1, 6, 7), only the fourth prosomal somite has serrate hyaline membrane on the posterior border and corners. No special structures could be observed in the prosomal somites in *M. mediasetosus* (Plate 1, 8, 9) and *M. alius* (Plate 1, 10).

The first urosomal somite is smooth in *M. alius* (Plate 1, 10), very slightly crenulate or smooth in *M. anceps anceps*, and has a serrate hyaline membrane (Plate 1, 7, 9) in *M. ceibaensis*, *M. finitimus*, and *M. mediasetosus*. The remaining urosomal somites of all species examined bear irregularly serrate hyaline membranes.

3.2. Ornamentation of the middle caudal setae

M. alius (Plate 2, 11) was the only species studied having both middle caudal setae heterogeneously ornamented, spinulose proximally and plumose dis-

Plate 1. Females. Scale bars: 1, 6, 8 and 10, 100 μm; 2, 10 μm; 3, 200 μm; 4, 5, 7 and 9, 20 μm.
1, 2. *Microcyclops anceps anceps*.
1. Habitus, dorsal.
2. Detail of posterior border of second prosomal somite showing indentations.
3–5. *Microcyclops ceibaensis*.
3. Habitus, dorsal.
4. Detail of posterior border of second prosomal somite.
5. The same for the third prosomal somite.
6, 7. *Microcyclops finitimus*.
6. Habitus, dorsal.
7. Detail of fourth prosomal and first urosomal somites showing hyaline serrate membrane along their posterior borders.
8, 9. *Microcyclops mediasetosus.*
8. Habitus, dorsal.
9. Detail of fourth prosomal somite, showing smooth posterior border and first urosomal somite with serrate hyaline membrane along the posterior border.
10. *Microcyclops alius*. Habitus, dorsal.

tally. This characteristic, previously referred to in the original description (Kiefer, 1935), is shared with *M. dubitabilis* Kiefer, 1934, a very close and possibly synonymous species of *M. alius* occurring in Colombia, Venezuela, the Antilles, and continental Central America (Reid, 1985). These setae are entirely plumose in the other species, but some interspecific variations could be observed in them. *Microcyclops finitimus* has very homogeneous plumose setae (Plate 2, 12), with the setules starting to appear on both sides of each seta from the point along their lengths reached by the tip of the outer and inner caudal setae, respectively. The setules start to appear a little farther from that point on both sides of the inner middle caudal seta in *M. anceps anceps* (Plate 2, 13). In *M. ceibaensis* (Plate 2, 14), an intermediary situation between the latter two patterns described was observed on the inner middle seta. The ornamentation of the middle caudal setae of *M. mediasetosus* (Plate 2, 15) is similar to that described

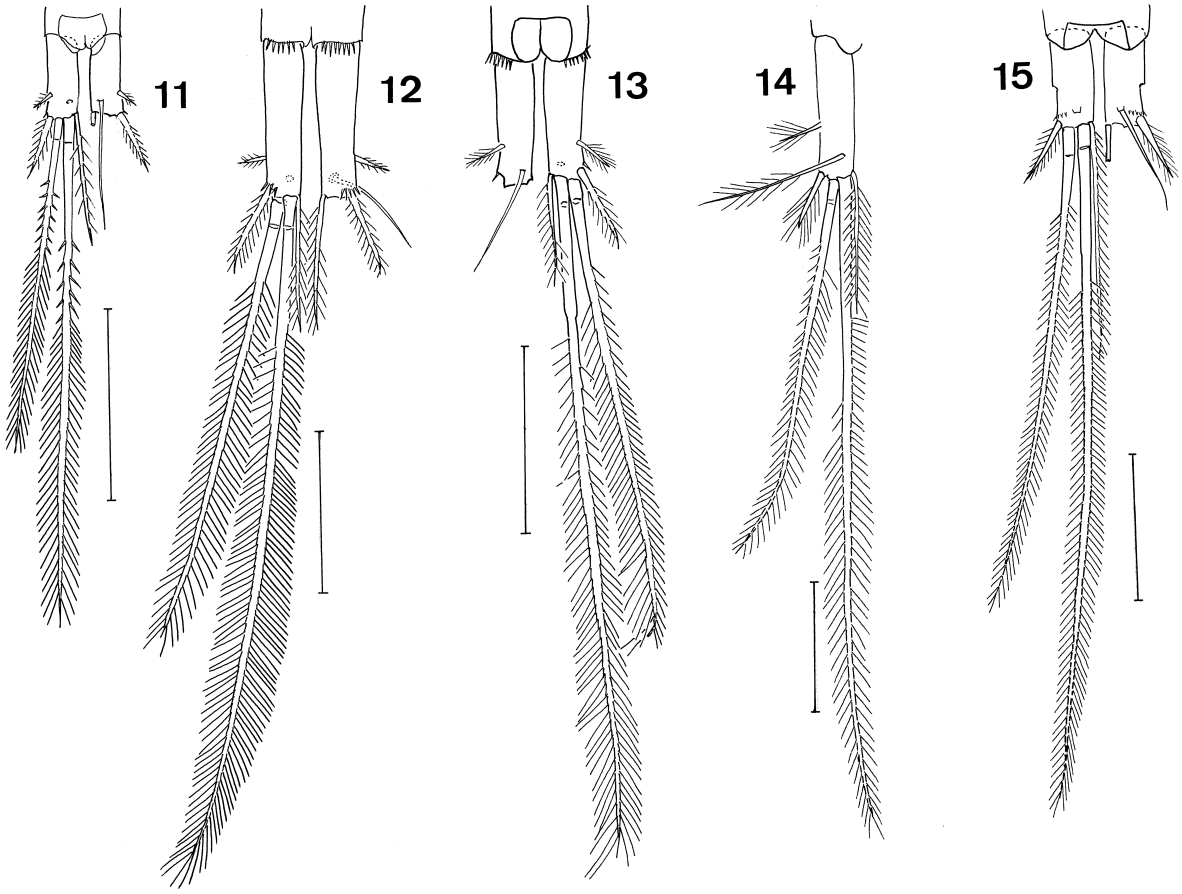


Plate 2. Caudal rami and setae. Scale bar: 100 μm.
11. *Microcyclops alius*.
12. *Microcyclops finitimus*.
13. *Microcyclops anceps anceps*.
14. *Microcyclops ceibaensis*.
15. *Microcyclops mediasetosus*.

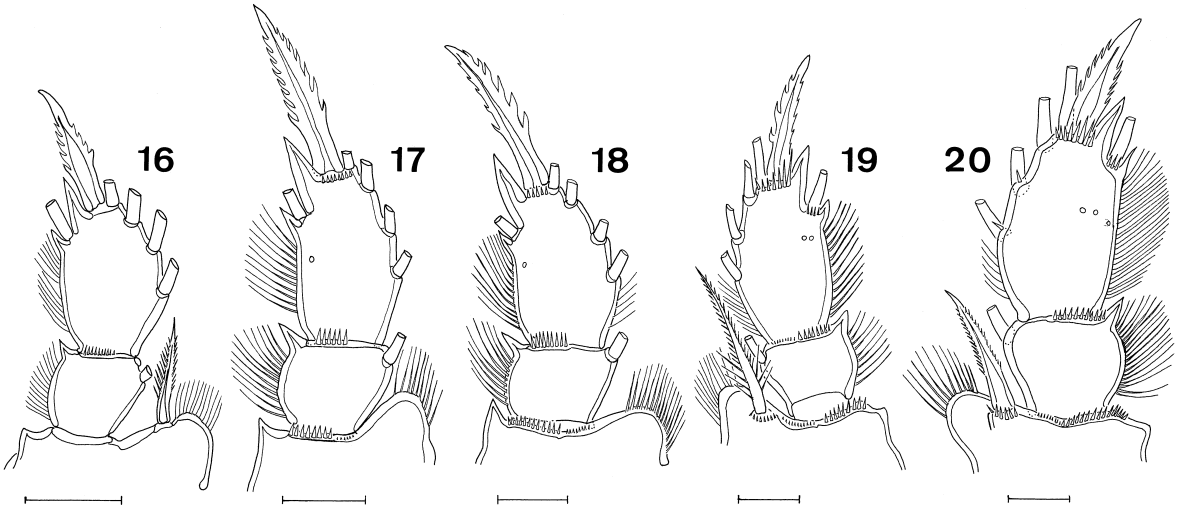


Plate 3. Anterior view of distal part of basipod and endopod of leg 1. Scale bar: 20 μm.
16. *Microcyclops alius*.
17. *Microcyclops anceps anceps*.
18. *Microcyclops finitimus*.
19. *Microcyclops ceibaensis*.
20. *Microcyclops mediasetosus*.

for *M. finitimus*, but the terminal portion of the inner caudal seta overlaps the proximal setulose area of the inner middle seta.

3.3. Second endopodal segment of leg 1

Plate 3, 16–20 illustrate the differences in shape, pattern and extension of the serration along the margins of the terminal spine in the five species. In *M. alius* (Plate 3, 16), the spine consists of a serrate, inflated proximal part, and a narrow, smooth terminal portion curved outward at the tip. The marginal serration of the spine is slightly asymmetrical in *M. anceps anceps* (Plate 3, 17); this asymmetry is more conspicuous in the spine of *M. finitimus* (Plate 3, 18) and *M. ceibaensis* (Plate 3, 19). The spine of *M. mediasetosus* is similarly serrate on both margins (Plate 3, 20).

The species also differ in the presence and number of integumental pores on the anterior surface of the terminal endopodal segment. No pores were observed in *M. alius* (Plate 3, 16). *Microcyclops a. anceps* (Plate 3, 17) and *M. finitimus* (Plate 3, 18) share the presence of one pore near the outer margin of the segment. Two pores were present in the same position in *M. ceibaensis* (Plate 3, 19). The highest pore number observed was 3 in *M. mediasetosus* (Plate 3, 20).

4. Discussion

The separation of the species of *Microcyclops* has been based on the following morphological aspects observed, mainly in females: (1) the presence, size and position of the spinule on the inner surface of the free, cylindrical segment of leg 5; (2) the proportions of the caudal rami and their setae; (3) the proportions of the second endopodal segment of leg 4 and its terminal spines; (4) the armament of the intercoxal sclerite of leg 4; (5) the segmentation of the antennule; and (6) the presence of the seta on the inner corner of the basis of leg 1. Except for the

latter character, all the others have been referred to as variable. Knowing this, authors have often complemented descriptions or registers with measurements and proportions of these characters in their animals.

Of the species studied, *M. ceibaensis* seems to be the most variable. Reid (1986), in a table, compiled the great variation of the afore-mentioned characters in females ascribed to this species from eight different localities in Central and South America.

Likewise, *M. anceps* has been reported as very variable (Kiefer, 1956). Lowndes (1934) observed such variability in the supposed diagnostic characters of the species that he initially thought he was dealing with material representing no less than four separate species instead of only one, as he finally concluded after further investigation. Lindberg (1955) stated that he found remarkable variations in the armament of the intercoxal sclerite and the inner border of the basis of leg 4, as well as in the seta implanted on the coxa of this leg. In addition, he mentioned a female having one of the antennules with 14 segments (12 is the number of segments usually found) and an atypical leg 5. Two females from the 'Pantanal' also possessed an atypical leg 5, with the spinule placed approximately halfway on the inner margin of the free segment, instead of the usual subterminal position. As the shape and position of this spinule have been referred to in the literature as the most important character defining the species, the present author thought he was examining individuals of a species different from *M. anceps*. But observation of the new characters presented herein made it possible to ascribe those females to *M. anceps*. Most probably, these same characters will be helpful in verifying the validity of the subspecies *M. anceps pauxensis* proposed by Herbst (1962), based on two females from the Amazonian region.

These examples make it clear that the features used until now to distinguish *Microcyclops* species vary so much that their value as diagnostic characters is dubious. The new characters proposed herein may be considered difficult to visualize, but most of the characters traditionally used are also. The new characters have the advantage of being constant, not dimorphic, and visible without dissection if the material is prepared and examined by the light microscope, following the method used here. Their usefulness for the taxonomy of the genus will be tested when other species are examined.

References

Dussart, B.H., Fernando, C.H., 1986. The *Mesocyclops* species problem today. Syllogeus 58, 288–293.

Dussart, B.H., Fernando, C.H., 1988. Sur quelques *Mesocyclops* (Crustaceam Copepoda). Hydrobiologia 157, 241–264.

Fiers, F., Van de Velde, I., 1984. Morphology of the antenna and its importance in the systematics of the Cyclopidae. Crustaceana (Suppl.) 7, 182–199.

Herbst, H.-V., 1962. Crustacea aus dem Amazonasgebiet, gesammelt von Professor Dr. H. Sioli und Dr. R. Braun. 1. Litorale und substratgebundene Cyclopoida Gnathostoma (Copepoda). Crustaceana 3, 259–278.

Holynski, M., Fiers, F., 1994. *Mesocyclops thermocyclopoides* species-group: redefinition and content. Hydrobiologia 292–293, 41–51.

Kiefer, F., 1935. Neue Süsswassercyclopiden (Crustacea Copepoda) aus Uruguay. Zool. Anz. 109, 181–188.

Kiefer, F., 1956. Freilebende Ruderfusskrebse (Crustacea Copepoda). I. Calanoida und Cyclopoida. Ergebn. Dtsch. Limnol. Venezuela-Exped. 1, 233–268.

Lindberg, K., 1955. Cyclopides (Crustacés Copépodes) récoltés au Pérou par le Dr. Hernando de Macedo. Folia Biol. Andina, II, Zool. 1, 1–18.

Lowndes, A.G., 1934. Reports of an Expedition to Brazil and Paraguay in 1926–7 supported by the Trustees of the Percy Sladen Memorial Fund and the Executive Committee of the Carnegie Trust for Scotland. Copepoda. J. Linn. Soc. Zool. 39, 83–131.

Moore, C.G., 1976. The form and significance of the hyaline frill in harpactioid copepod taxonomy. J. Nat. Hist. 10, 451–456.

Reid, J.W., 1985. Chave de identificação e lista de referências bibliográficas para as espécies continentais sulamericanas de vida livre da ordem Cyclopoida (Crustacea, Copepoda). Bolm Zool. Univ. São Paulo 9, 17–143.

Reid, J.W., 1986. A redescription of *Microcyclops ceibaensis* (Marsh, 1919) (Copepoda: Cyclopoida) from Marsh's specimens in the National Museum of Natural History. Proc. Biol. Soc. Wash. 99, 71–78.

Reid, J.W., 1990. Use of fine morphological structures in interpreting the taxonomy and ecology of continental cyclopoid copepods (Crustacea). An. IV Encontro Brasileiro de Plâncton, Recife, pp. 261–282.

Reid, J.W., 1993. New records and redescriptions of American species of *Mesocyclops* and of *Diacyclops bernardi* (Petkovski, 1986) (Copepoda: Cyclopoida). Bidr. Dierk. 63, 173–191.

Rocha, C.E.F., 1984. Four new species of *Halicyclops* Norman, 1903 (Copepoda, Cyclopoida) from Brazil. Hydrobiologia 119, 107–117.

Rocha, C.E.F., 1991. A new species of *Halicyclops* (Copepoda, Cyclopidae) from California, and a revision of some *Halicyclops* material in the collections of the US Museum of Natural History. Hydrobiologia 226, 29–37.

Rocha, C.E.F., 1995a. Copepods of the genus *Halicyclops* (Cyclopidae) from Belize. Hydrobiologia 308, 1–11.

Rocha, C.E.F., 1995b. *Neocyclops* (*Protoneocyclops*) *ferrarii*, a new species of cyclopid (Copepoda: Cyclopoida) from Belize, with remarks on the morphology of the genus *Neocyclops*. Contrib. Zool. 65, 41–51.

Van de Velde, I., 1984a. Introduction of new diagnostic characters in *Mesocyclops*, with African species as an example. Crustaceana (Suppl.) 7, 404–419.

Van de Velde, I., 1984b. Revision of the African species of the genus *Mesocyclops* Sars, 1914 (Copepoda: Cyclopidae). Hydrobiologia 109, 3–66.