

**Freshwater copepods
of the Genus *Oithona* Baird, 1843
from the Amazonian Region (Brazil)**

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ABSTRACT

Three cyclopoid copepods of the family Oithonidae are reported from the freshwater Amazon region, *O. amazonica* Burckhardt, 1912, *O. bjornbergae* Ferrari & Bowman, 1980 and *O. bowmani* sp. n. In addition, to taxonomical data, habitat preferences are given for each species.

KEY WORDS : Taxonomy — Distribution — Copepoda — Cyclopoida — Oithonidae — Brazil — Amazonia.

RESUMEN

COPÉPODOS DE AGUA DULCE DEL GÉNERO *Oithona* BAIRD, 1843 DE LA REGIÓN AMAZÓNICA (BRASIL)

Oithona amazonica, *O. bjornbergae* y *O. bowmani* son descritas del plancton de agua dulce de la Región Amazónica. Consideraciones taxonómicas y también datos de la distribución y habitat son dados para cada especie.

PALABRAS CLAVES : Taxonomía — Distribución — Copépodos — Cyclopoida — Oithonidae — Brasil — Amazonia.

RÉSUMÉ

COPÉPODES D'EAU DOUCE DU GENRE *Oithona* BAIRD, 1843 DE LA RÉGION AMAZONIENNE (BRÉSIL)

Trois espèces de Copépodes Cyclopoides ont été récoltés dans le zooplancton de la région amazonienne du Brésil: *Oithona amazonica* Burckhardt 1912, *O. bjornbergae* Ferrari et Bowman 1980 et *O. bowmani* n. sp. Pour chaque espèce, des observations taxinomiques ainsi que des données sur la distribution et l'habitat sont présentées.

MOTS-CLÉS : Taxinomie — Distribution — Copépodes — Cyclopoides — Oithonidae — Brésil — Amazonie.

The number of species of *Oithona* found in freshwater is extremely low when compared with the number of species known from oceanic, coastal and brackish waters around the world.

Freshwater *Oithona* are endemic to northern South America. *O. amazonica continentalis* Lindberg, 1954, whose validity has been considered doubtful by FERRARI & BOWMAN (1980), and *O. bjornbergae* FERRARI & BOWMAN, 1980 have been recorded only from Amazonian Region, while *O. amazonica amazonica* Burckhardt, 1912 and *O. gessneri* have been found in the Amazon system as well as on the

Orinoco delta (KIEFER, 1956; CIPOLLI & CARVALHO, 1973; HARDY, 1980; BRANDORFF *et al.*, 1982 and DUSSART, 1984). Another species seems to occur in the Orinoco delta, since Dussart separated some specimens from Caño Guara near Tucupita as *Oithona* sp. Finally, *O. neotropica* Herbst, 1967 was described from Laguna Mucubaji, a freshwater lake situated in the Venezuelan Andes. FERRARI & BOWMAN (1980) suggested that this species may have been collected somewhere in the Venezuelan coastal region, and mislabeled (not in a freshwater Andean lake). They based their suggestion on the skeletal

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morphology of this species which resembles more the brackish and coastal species than the freshwater ones.

The material analysed here was collected in Marajó Bay and in tidal areas of some tributaries of the lower Amazon. Specimens from a lake near Manaus were also studied. Of the three species present in the samples, two could be identified with certainty and one is established as new to science to accommodate oithonids previously attributed to *O. amazonica* by FERRARI & BOWMAN (1980).

Five females and five males of each species were stained with bengal rose or chlorazol black E and then dissected for examination with a light microscope. Slides with the appendages were prepared with pure glycerine. The pore signature pattern of the males cephalosomic flap was obtained from specimens prepared according to MAUCLINE (1975).

The following abbreviations are used in the text and figures: MZUSP = Museu de Zoologia, Universidade de São Paulo; MPEG = Museu Paraense Emílio Goeldi, Belém; USNM = United States National Museum; Pr = prosome; Ur = urosome; Al = antennule; Enp = endopodite; Enp1... Enp3 = first... third segment of endopodite; Exp = exopodite; Exp1... Exp3 = first... third segment of exopodite; Md = mandible; Mxl = maxillule; P1... P6 = first... sixth pair of legs; B2 = second segment of basipodite; Th1, Th2, Th3 = first, second and third thoracic somite; s = sample.

TAXONOMY

Oithona bjornbergae Ferrari & Bowman, 1980
(Figs. 1-6)

Oithona bjornbergae Ferrari & Bowman, 1980:
9-10, Figs. 3-4.

O. gessneri Kiefer; CIPOLLI & CARVALHO, 1973:
102, 109 (partim, misidentified).

TYPE-MATERIAL

Female holotype and 65 paratypes in USNM; not examined. Male and female are described.

TYPE-LOCALITY

Brazil, State of Pará, 01°27.8' S, 48°29.2' W, mouth of Acará Grande River.

MATERIAL EXAMINED

M. A. J. de CARVALHO's collection: numerous females and males, Guamá River, São Domingos do Capim, s 4, 11 Aug. 1970; 29 females, Capim River, mouth of igarapé (side arm) Pirajaura, s 11, 12 Aug. 1970; numerous females and males, from the following localities of the Tocantins River system: igarapé Bahia near Maiuatá, s 44, 27 Aug.

1970; igarapé São Lourenzinho, s 48, 30 Aug. 1970; igarapé Coelho, Maratapé Bay, s 52, 2 Sep. 1970; igarapé Grilo, Maratapé Bay, s 54, 4 Sep. 1970; igarapé Mapará, s 56, 5 Sep. 1970; igarapé Maloca near Cametá, s 58, 6 Sep. 1970; igarapé Aricurá near Cametá, 7 Sep. 1970. M. L. CARVALHO's collection: numerous females and males, Marajó Bay near Tatuoca Island, 6 Aug. 1983 and near Cotejuba Island, 5 Jul. 1984; numerous females and males, Guamá River, Bujarú, 18 Dec. 1983; 10 females and 5 males, Murucupi River, tributary of Barcarena River, 31 May 1984; 59 females and 15 males, Xingú River, Senador José PORFIRO, 22 Nov. 1983; 10 females, Pará River, Portel, 22 Aug. 1983; 3 females, Macapá, 21 Dec. 1983.

FEMALE

Length range (10 specimens) 465-500 μm . Pr: Ur range = 1.21-1.36:1. Caudal rami (Fig. 1) 2.2-2.4 times longer than wide and as long as anal somite; their apical median setae thickened and densely plumose, ending in flexible filament; dorsal seta little shorter than outer median apical seta and twice length of innermost apical seta; outer apical seta about a half length of inner one. Al reaching posterior border of Th2. EnpMd with 4 setae. Mxl (Fig. 2) without endopodite and with 3 setae (the median one smooth) on B2. Number of spines on external edges of ExpP1-P4: 1.1.2, 1.1.2, 0.1.1, 0.0.1. Exp1P3 (Fig. 3) and Exp1 - Exp2P4 (Fig. 4) with spinules replacing external, articulated spines. EnpP4 (Fig. 5) with 3 modified setae on internal margin.

MALE

Length range (10 specimens) 430-450 μm . Cephalosome without lateral flap. Caudal ramus (Fig. 6) twice longer than wide and with median apical setae and inner apical seta thickened. All setae of EnpP4 plumose.

GEOGRAPHICAL RANGE AND HABITAT

O. bjornbergae inhabits freshwater areas subject to tidal influence. It was found in temperatures varying from 27.0 to 30.8 °C and pH from 6.0 to 7.0. The new records presented above extend its range remarkably from its type-locality. It has been the dominant copepod species in the samples in which it has occurred.

REMARKS

The description provided by FERRARI & BOWMAN (1980) was sufficiently adequate to permit me to identify the specimens examined as *O. bjornbergae*. Nevertheless, minor differences from the original description were observed in the length ratio of the caudal setae, aspect of the terminal end of the

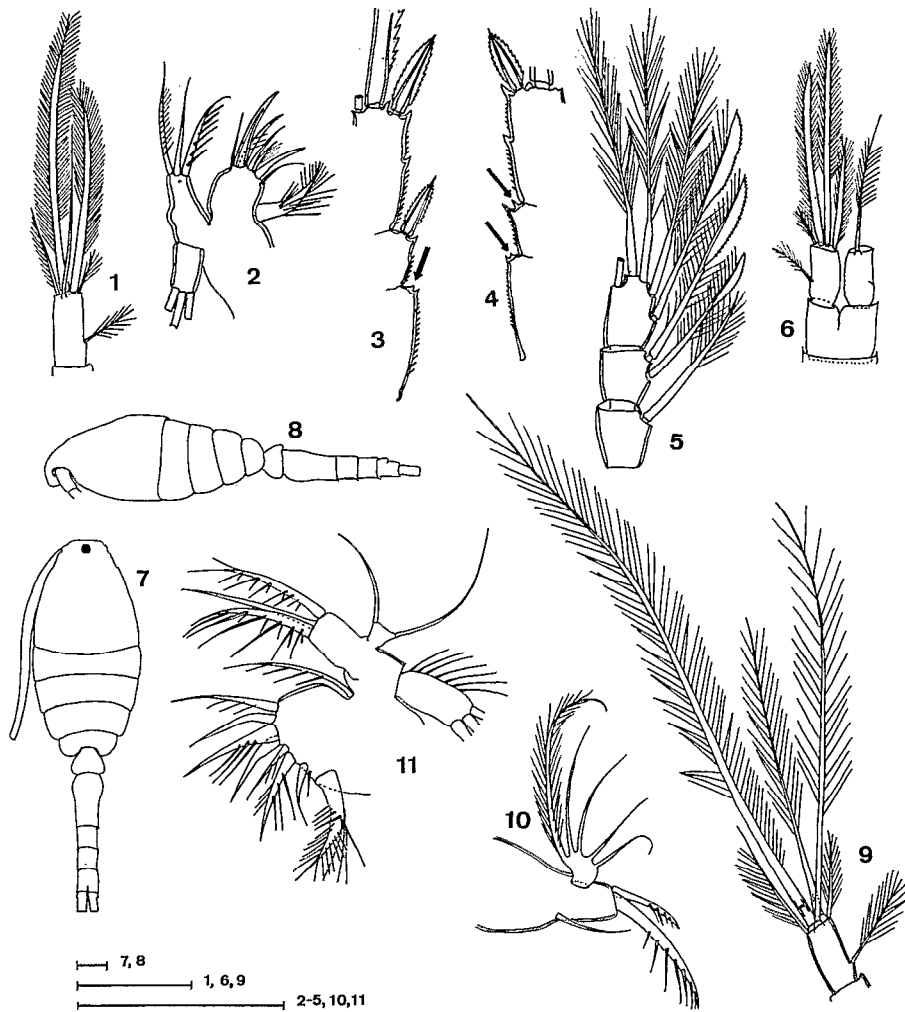


FIG. 1-11. — *Oithona bjornbergae*. Female. 1 : caudal ramus ; 2 : Mx1 ; 3 : ExpP3 ; external and apical edges ; 4 : ExpP4, external and apical edges ; 5 : EnpP4. Male. 6 : anal somite and caudal rami. *Oithona amazonica*. Female. 7 : habitus, dorsal view ; 8 : habitus, lateral view ; 9 : caudal ramus ; 10 : Md palpus ; 11 : Mx1. Arrows indicate details absent in the original description drawings. Scale bars : 50 μ m

Oithona bjornbergae. Femelle. 1 : branche caudale ; 2 : Mx1 ; 3 : ExpP3 ; bords externe et apical ; 4 : ExpP4, bords externe et apical ; 5 : EnpP4. Mâle. 6 : segment anal et branches caudales. *Oithona amazonica*. Femelle. 7 : habitus en vue dorsale ; 8 : habitus en vue latérale ; 9 : branche caudale ; 10 : Palpe mandibulaire ; 11 : Mx1. Les flèches indiquent les détails qui ne figurent pas sur les dessins originaux. Écailles : 50 μ m

caudal median apical setae and size of the flange on the distal part of the inner proximal seta of the Enp2P4.

The material collected by M. A. J. de CARVALHO had previously been identified as *O. gessneri* (CIPOLLI & CARVALHO, 1973) which is very similar to *O. bjornbergae*. Males and females of the latter can be easily identified by the two thickened median apical setae on the caudal rami. A few adults and copepodids of another oithonid (*Oithona bowmani*

sp. n.) were found together with *O. bjornbergae* in CARVALHO's samples 47, 54 and 56.

***Oithona amazonica* Burckhardt, 1912 (Figs. 7-21)**

Oithona amazonica Burckhardt, 1912: 726; 1913: 422, pl. 15P, Figs. 6-22, pl. 15Q, Figs. 2-6, 16R, Figs. 2, 3, 7-9, 11, 12, pl. 16S, Figs. 1, 3-8, 17; ROSENDORN, 1917: 46-47 (descr.); WELLERSHAUS, 1970: 481-482 (key); HARDY, 1980: 594 (distr.);

BRANDORFF *et al.*, 1982: 106 (distr.); DUSSART, 1984 (distr.).

(non) *O. amazonica* Burckhardt; FERRARI & BOWMAN, 1980: 5-6, Fig. 2.

O. amazonica continentalis Lindberg, 1954: 195-197 (SYN. N.).

TYPE-MATERIAL

Not located; male and female are described.

TYPE-LOCALITY

Brazil, State of Pará, Marajó Island, Aramá Grande River.

MATERIAL EXAMINED

Brazil, Amazonas State: 49 females and 40 males from near Manaus, E. R. HARDY col. Ten females and 10 males in MZUSP (no. 6656).

FEMALE

Length range 580-640 μm ($n = 10$). Pr: Ur = 1.3-1.5:1. Prosome frontally truncate in dorsal view (Fig. 7) and curved laterally (Fig. 8); rostrum absent. Caudal rami (Fig. 9) twice longer than wide (30:15 μm in 10 specimens) and little shorter than anal somite (35 μm); inner apical seta 1.5 times longer than outer one (55:37 μm); dorsal seta longer than outer median apical seta; inner median apical seta twice length of outer one and little longer than urosome. Al with 12 segments, reaching the posterior border of Th3 if bent backwards parallelly to prosome (Fig. 7). Md (Fig. 10) with 2 spines different in thickness and length on B2, both bearing sparse setules; Enp with 5 setae. Mxl (Fig. 11) with 3 setae on B2 and 2 slender, long setae on Enp. Number of external spines of ExpP1-P4 (Figs. 12-15): 1.1.2, 1.1.3, 1.1.1, 0.0.1; all spines with hyaline membrane on their lateral edges; spines of P1 (Fig. 12) with flexible whiplike extension each. External edges of Exp3P1-P3 serrate. Enp3P4 proximal seta (Fig. 15) slightly curved, longer and thicker than other setae and without flange on its smooth edge. Terminal segment of P5 (Fig. 16) with seta reaching beyond distal border of genital somite.

MALE

Length range 565-625 μm ($n = 10$). Pr: Ur = 1.48-1.61:1. Cephalosome (Fig. 17) protruded laterally into a flap extending beyond posterior border of Th1. Pore signature of flap in 3 specimens as in Fig. 18. Caudal rami (Fig. 19) shorter than anal somite and 1.3-1.5 times longer than wide. Md (Fig. 20) with 5 setae on Enp; spines of B2 more similar in length than those in female. ExpP1 (Fig. 21) with 3 spines not 2 as in female. All setae of P1-P4 plumose.

GEOGRAPHICAL RANGE AND HABITAT

O. amazonica has been recorded in the Amazon delta (Aramá Grande River, Marajó Island) by BURCKHARDT (1912, 1913), Negro River near Manaus (LINDBERG, 1954; HARDY, 1980), some lakes on the edges of Solimões River (HARDY, 1980), lower Nhamundá River (Brandorff *et al.*, 1982) and in Orinoco at Barrancas and Ciudad Bolívar (DUSSART, 1984). In the Amazon system, this species has predominantly been found in non-tidal freshwater bodies.

REMARKS

LINDBERG (1954) separated specimens of *O. amazonica*, from Negro, near Manaus, in the subspecies *O. amazonica continentalis*, based on two differences: (1) the replacement of the spines on the external edge of P1 of the forma *typica* by plumose setae and (2) the presence of two spines more different in length on the B2Md than those described and illustrated by BURCKHARDT (1913).

The specimens analysed here have a mandible similar to that of Lindberg's subspecies. On the other hand, on the ExpP1 they bear long, weak spines with the structure commonly found in the genus, i.e., spines with a reduced hyaline membrane on the lateral edges continuing as a flexible whiplike extension. This probably led Lindberg to interpretate erroneously these spines as setae. Thus, the main characteristic of *O. a. continentalis* is not valid and the difference in the mandible is so small that the separation of *O. amazonica* into two subspecies seems to be unnecessary, as has already been suggested by FERRARI & BOWMAN (1980).

These authors identified some oithonids from the mouth of Acará Grande River as *O. amazonica*. They found interpretation of Exp3P1 armature of Burckhardt's descriptions and illustrations was difficult because Burckhardt did not describe all spines and setae of that pair of legs. They suggested that their specimens could be separated in a new species. The presence in the material analysed here of oithonids identical to those assigned to *O. amazonica* by BURCKHARDT (1913) as well as by FERRARI & BOWMAN (1980) has permitted comparing the females of both forms and solving this taxonomical uncertainty. Exp3P1 armature of *O. amazonica* females has been confirmed as consisting of two external spines, one seta-like apical spine and four setae, while Ferrari & Bowman's females has been found to have three spines, one seta like apical spine and four setae on that segment of P1. This morphological difference, among others, justifies the proposition of a new species to accommodate the latter animals, which will be described below as *Oithona bowmani*.

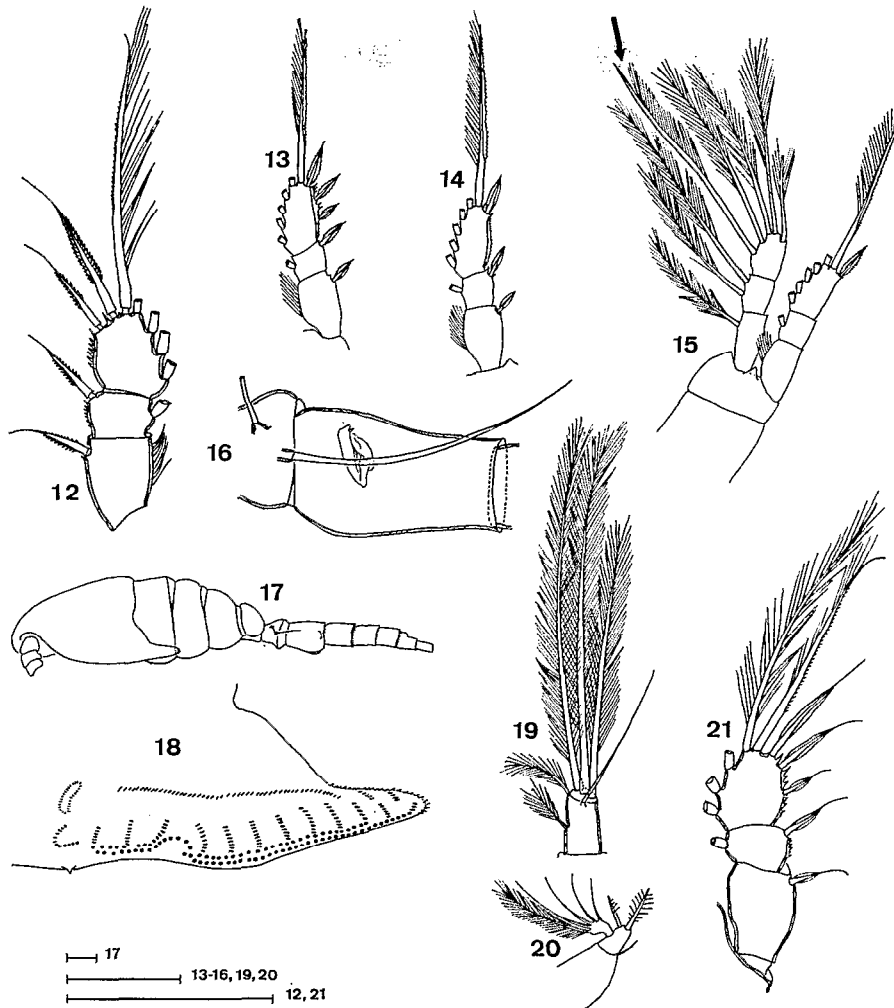


FIG. 12-21. — *Oithona amazonica*. Female. 12 : ExpP1 ; 13 : ExpP2 ; 14 : ExpP3 ; 15 : P4 (the arrow indicates the modified seta) ; 16 : P5 and genital somite, lateral view. Male. 17 : habitus, lateral view ; 18 : pore signature of the cephalosomic flap ; 19 : caudal ramus ; 20 : Md palpus ; 21 : ExpP1. Scale bars : 50 μ m

Oithona amazonica. Femelle. 12 : ExpP1 ; 13 : ExpP2 ; 14 : ExpP3 ; 15 : P4 (la flèche indique les soies modifiées) ; 16 : P5 et segment génital en vue latérale. Mâle. 17 : habitus en vue latérale ; 18 : pores du céphalosome ; 19 : branche caudale ; 20 : Palpe mandibulaire ; 21 : ExpP1. Écailles : 50 μ m

***Oithona bowmani* sp. n.** (Figs. 22-37)

Oithona amazonica Burckhardt; FERRARI & BOWMAN, 1980: 5, Fig. 2 (misidentification).

Oithona gessneri Kiefer; CIPÓLLI & CARVALHO, 1973: 102, 109 (partim; misidentified).

TYPE-MATERIAL

M. A. J. de CARVALHO's collection: female holotype (MZUSP no. 6652) and 60 paratypes (25 females and 5 males, MZUSP no. 6655; 25 females and 5 males, MPEG) from a lake connected with igarapé

Espírito Santo, Baião, Tocantins River system, s 69, 11 Sep. 1970; 10 females and 11 males, igarapé Jacarequara, Abaetetuba, s 47, 29 Aug. 1970; 17 females and 2 males, igarapé Grilo, Maratapé Bay, s 54, 4 Sep. 1970; 5 females and 6 males, igarapé Mapará, s 56, 5 Sep. 1970; 2 females and 7 males, igarapé Murú, Tucuruí, s 70, 12 Sep. 1970. M. L. CARVALHO's collection: 158 females and 44 males, São Francisco River, tributary of Barcarena River, 31 May 1984; 71 females and 16 males, Xingú River, Senador José PORFIRO, 22 Nov. 1983.

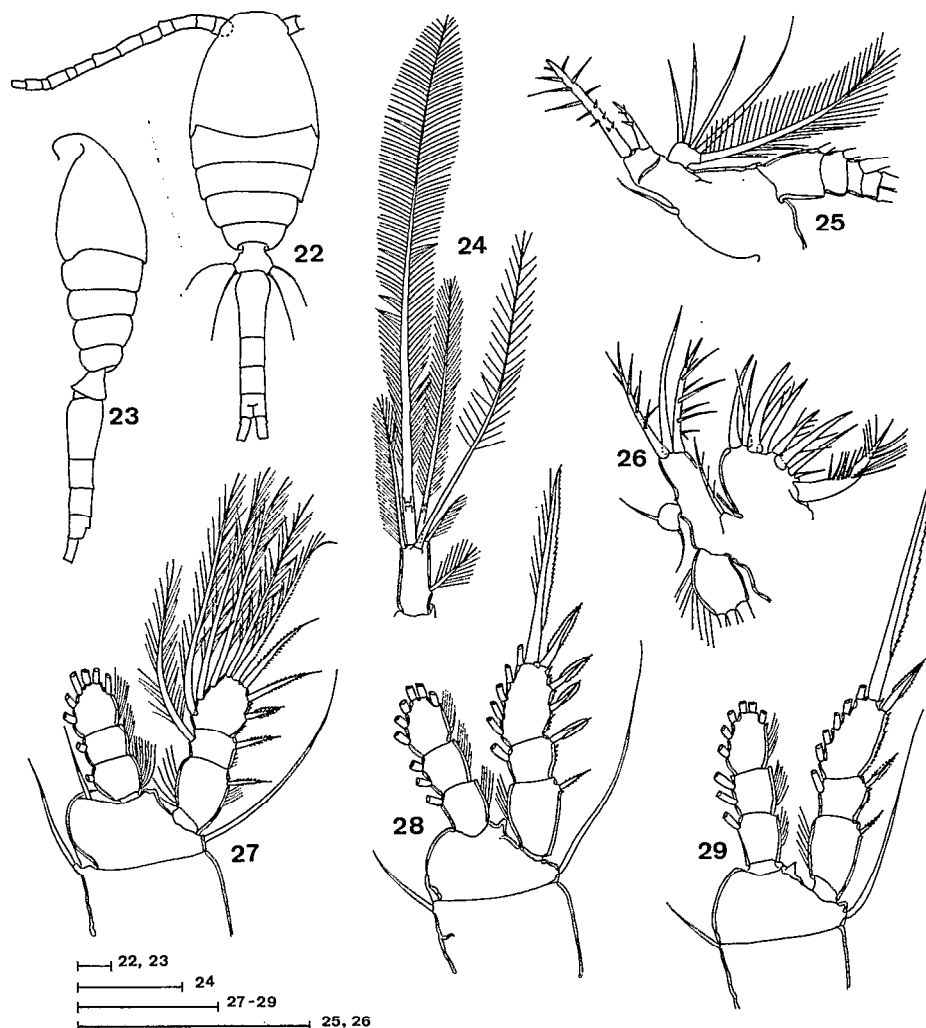


FIG. 22-29. — *Oithona bowmani* sp. n. Female. 22 : habitus, dorsal view ; 23 : habitus, lateral view ; 24 : caudal ramus ; 25 : Md palpus ; 26 : Mxl ; 27 : P1 ; 28 : P2 ; 29 : P3. Scale bars : 50 μ m

Oithona bowmani sp. n. Femelle. 22 : habitus en vue dorsale ; 23 : habitus en vue latérale ; 24 : branche caudale ; 25 : Palpe mandibulaire ; 26 : Mxl ; 27 : P1 ; 28 : P2 ; 29 : P3. Écailles : 50 μ m

FEMALE

Holotype 620 μ m. Length range 560-620 μ m, Pr: Ur range = 1.3-1.4:1 (in 20 specimens from sample 69); 650-700 μ m, Pr: Ur = 1.2-1.3:1 (in 10 specimens from sample 54). Pr truncate frontally in dorsal view (Fig. 22) and rounded laterally (Fig. 23). Rostrum absent. Caudal rami (Fig. 24) twice longer than wide and little shorter than anal somite. Inner apical seta 2.5 times longer than outer apical seta. Dorsal seta longer than outer median apical seta. Inner median apical seta twice length of outer median apical seta. A1 with 13 segments, reaching Pr-Ur articulation when bent backwards.

Md (Fig. 25) with 5 setae on Enp. B2Md with 2 spines, the outermost little more than twice longer than the innermost; both armed with spinules. Mxl (Fig. 26) with 3 setae on B2 and 2 slender, short setae on Enp. Number of external spines of ExpP1-P4 (Fig. 27-30): 1.1.3, 1.1.3, 1.1.1, 0.0.1. P1 (Fig. 27) with only proximal spine of Exp3 with hyaline marginal membrane; other outer spines very finely serrate; apical spine seta-like, being finely serrate externally and plumose internally. Enp3P4 (Fig. 30) with proximal seta the thickest and longest of Enp and with serrate flange on distal 2/3. Terminal segment of P5 (Fig. 31) with seta reaching posterior

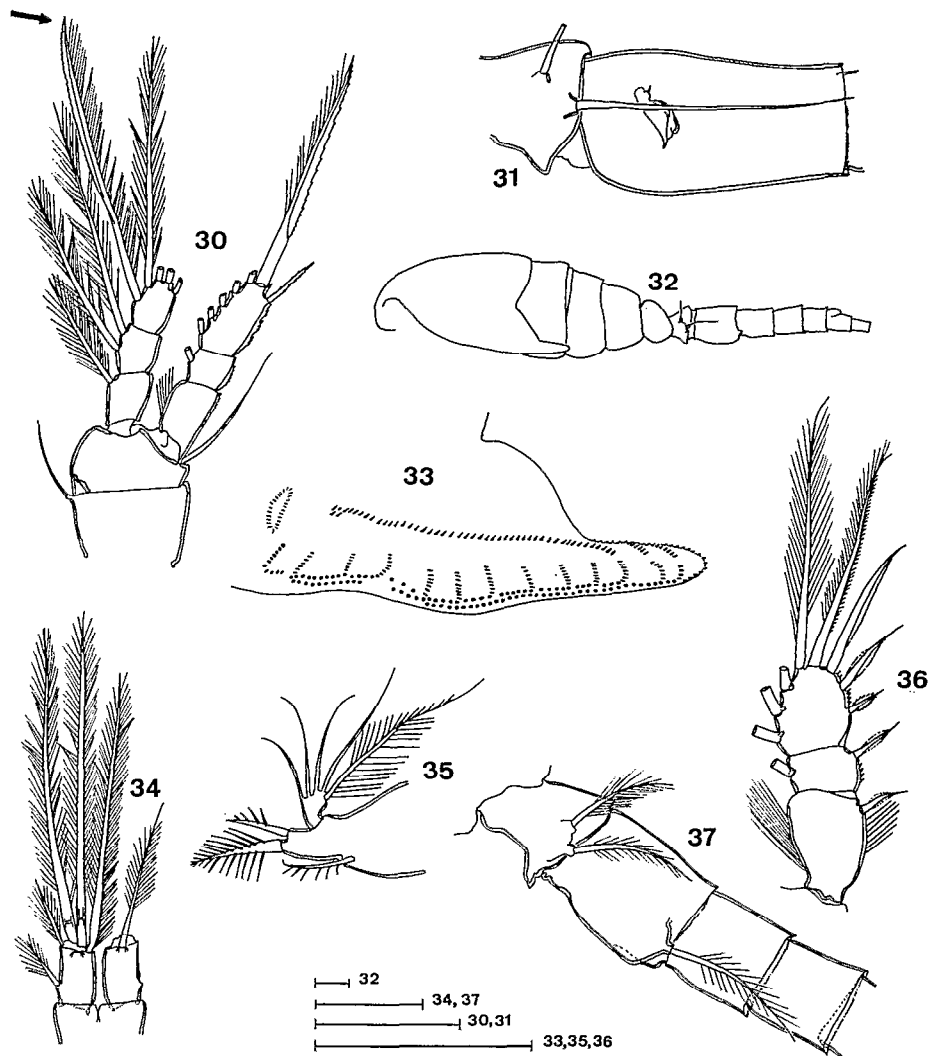


FIG. 30-37. — *Oithona bowmani* sp. n. Female. 30 : P4 (the arrow indicates the modified seta); 31 : P5 and genital somite, lateral view. Male. 32 : habitus, lateral view; 33 : pore signature of the cephalosomic flap; 34 : caudal rami; 35 : Md palpus; 36 : ExpP1; 37 : partial and lateral views of the urosome bearing P5 and P6. Scale bars : 50 μ m

Oithona bowmani sp. n. Femelle. 30 : P4 (la flèche indique les soies modifiées); 31 : P5 et segment génital en vue latérale. Mâle, 32 : habitus en vue latérale; 33 : pores du céphalosome; 34 : branches caudales; 35 : Palpe mandibulaire; 36 : ExpP1; 37 : vues partielle et latérale de l'urosome portant P5 et P6. Écailles : 50 μ m

border of genital somite. Genital somite with a knob near genital opening armed with a minute spine.

MALE

Length range 580-620 μ m in 10 specimens from sample 69 and 640-660 μ m in 10 specimens from São Francisco River. Cephalosome (Fig. 32) protruded laterally into a flap extending beyond posterior border of Th1. Pore signature of flap in 4 specimens as in Fig. 33. Caudal rami about 1.5 times longer

than wide and with armature as in Fig. 34. Md (Fig. 35) with 5 setae on Enp. ExpP1 (Fig. 36) with 3 marginal spines as in female. All setae of P1-P4 plumose. P5 and P6 as in Fig. 37.

GEOGRAPHICAL RANGE AND HABITAT

O. bowmani has been found from the mouth of Acará Grande River (FERRARI & BOWMAN, 1980) as far as Tucuruí on the Tocantins River. It occurred together with *O. bjornbergae* in some localities near the mouth of the Tocantins and in the Xingú (Sen.

José PORFIRO). It seems to inhabit preferably waterbodies without tidal influence since it was the dominant cyclopoid in a sample from a lake near Baião. Temperature range: 27.0-32.6 °C; pH range: 6.0-7.0.

ETYMOLOGY

This species was named after Dr. T. E. BOWMAN, who first examined it together with Dr. F. D. FERRARI.

REMARKS

The difference in size of the specimens from the lake near Baião in relation to those from other localities where the species has been collected is remarkable. On the other hand, the specimens are identical morphologically. The size difference may reflect different environmental conditions.

O. bowmani closely resembles *O. amazonica*. The main difference is the number of external spines of Exp3P1 of the females, which bears three spines in the former species and only two in the latter. Besides, differences between the females can be perceived in the appearance of the Enp3P4 proximal seta, the length of the setae of the EnpMxl, the number of segments of A1 and in the length ratio between the inner and outermost caudal setae. Males of both species are very similar, but can be separated by the length of the setae on the caudal rami, presence of a single, curved row of pores between fourth and fifth column in the cephalosomic flap of *O. amazonica* and a double row in the same area of the flap of *O. bowmani* and, as in female, by the length of the setae of the EnpMxl.

CONCLUSIONS

Three species of *Oithona* (*O. amazonica*, *O. bjornbergae* and *O. bowmani* sp. n.) have been recorded in the freshwater plankton of the Amazonian rivers and lakes. *O. amazonica continentalis* is a junior synonym of *O. amazonica* s. str. and the specimens previously identified as *O. gessneri* have been assigned in part to *O. bjornbergae* and in part to *O. bowmani* after re-examination of some samples of CIPOLLI & CARVALHO's (1973) material. Therefore, *O. gessneri* seems limited to the Orinoco delta.

O. bjornbergae is the most tolerant of the three species to the tidal influence, being replaced by *O. bowmani* in areas farther from the Amazon mouth in the Tocantins River system and by *O. amazonica* in waterbodies of the Central Amazonia. The latter species has been found to be the most common freshwater oithonid in the Amazon-Orinoco complex. Nevertheless, more intensive collecting is required in order to provide new data on the ranges of the oithonids in the Amazon region as well as to allow a better knowledge of their distribution and ecology in South America.

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