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Psammic *Procylopina* (Copepoda, Cyclopoida) from the coast of Brazil

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Procylopina polyarthra Herbst is redescribed and three new species, *P. maricopeba*, *P. feiticiera* and *P. uguaipuku*, are described from intertidal interstitial waters. *Procylopina* is distinguished within the family by the enditic setation of the maxilliped 0,1,3,4, the 19-segmented antennule, and three elements in the leg 5 exopod of the female. *Procylopina* has its distribution restricted to the coast of São Paulo, Brazil. *Procylopina maricopeba* sp. n. is distinguished from *P. polyarthra* by the three-segmented leg 5 in the male and by the length:width ratio of the genital double somite in the female. *Procylopina feiticiera* sp. n. is unique in the genus by lacking the inner seta on legs 1–4 exp-1, and by the incomplete fusion of genital (seventh thoracic) and first abdominal somites in the female. *Procylopina uguaipuku* sp. n. is characterized by the antennular armature, by the caudal ramus (much longer than wide), and by the position of the proximal seta of the leg 4 exp-2 which is set on a protuberance on the posterior face. Morphological characters of *Procylopina* are compared with those of other cyclopinids.

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Introduction

The only records of Cyclopinidae from South America are from the Brazilian coast (Herbst 1955; Lotufo & Rocha 1991; Lotufo 1994). Herbst (1955) established the new genus *Procylopina* for the type-species *P. polyarthra* collected from sandy beaches in Ilhabela, State of São Paulo. He also described *Cyclopinopsis brasiliensis* and identified some specimens of *Cyclopina* cf. *steueri* from the same samples. Lotufo & Rocha (1991) described two new species, *Cuipora janaina* and *Cyclopina caiala*, from a sandy beach in Salvador, State of Bahia, and Lotufo (1994) described five new species of *Cyclopina* and redescribed *C. mediterranea* Steuer from sandy beaches in the State of São Paulo. Extensive sampling along the coast of the State of São Paulo provided the second record of *P. polyarthra* and three new species of *Procylopina* to be described in this paper. Thus, the number of cyclopinid species recorded from Brazil has risen to 14.

Material and methods

To collect psammic copepods, 100 sandy beaches along the coast of the State of São Paulo were sampled between June 1990 and July 1991. Cyclopoid copepods were found in 30 beaches. *Procylopina* occurred in 16 beaches. The interstitial fauna was collected in the intertidal zone. Interstitial water that accumulated in holes dug in the beach during low tide was filtered through a 125 µm meshed sieve. Specimens were fixed in 4% formalin. Granulometric and salinity analyses were carried out for most of the beaches sampled. Copepods found to be associated with *Procylopina* included harpacticoids and specimens of *Halicyclops* Nor-

man, *Neocylops* Gurney and *Cyclopina* Claus (Lotufo & Rocha 1993 a,b; Lotufo, 1994).

Intact specimens were examined in 85% lactic acid, and the dissected parts were mounted in glycerine on slides sealed with Glyceel. Figures were prepared using a camera lucida on a Leitz Laborlux microscope. All figures prepared from paratypes were checked against the holotype.

Type material and supplementary specimens of the species examined were deposited in Museu de Zoologia da Universidade de São Paulo (MZUSP). The remaining material was deposited in the Departamento de Zoologia da Universidade de São Paulo.

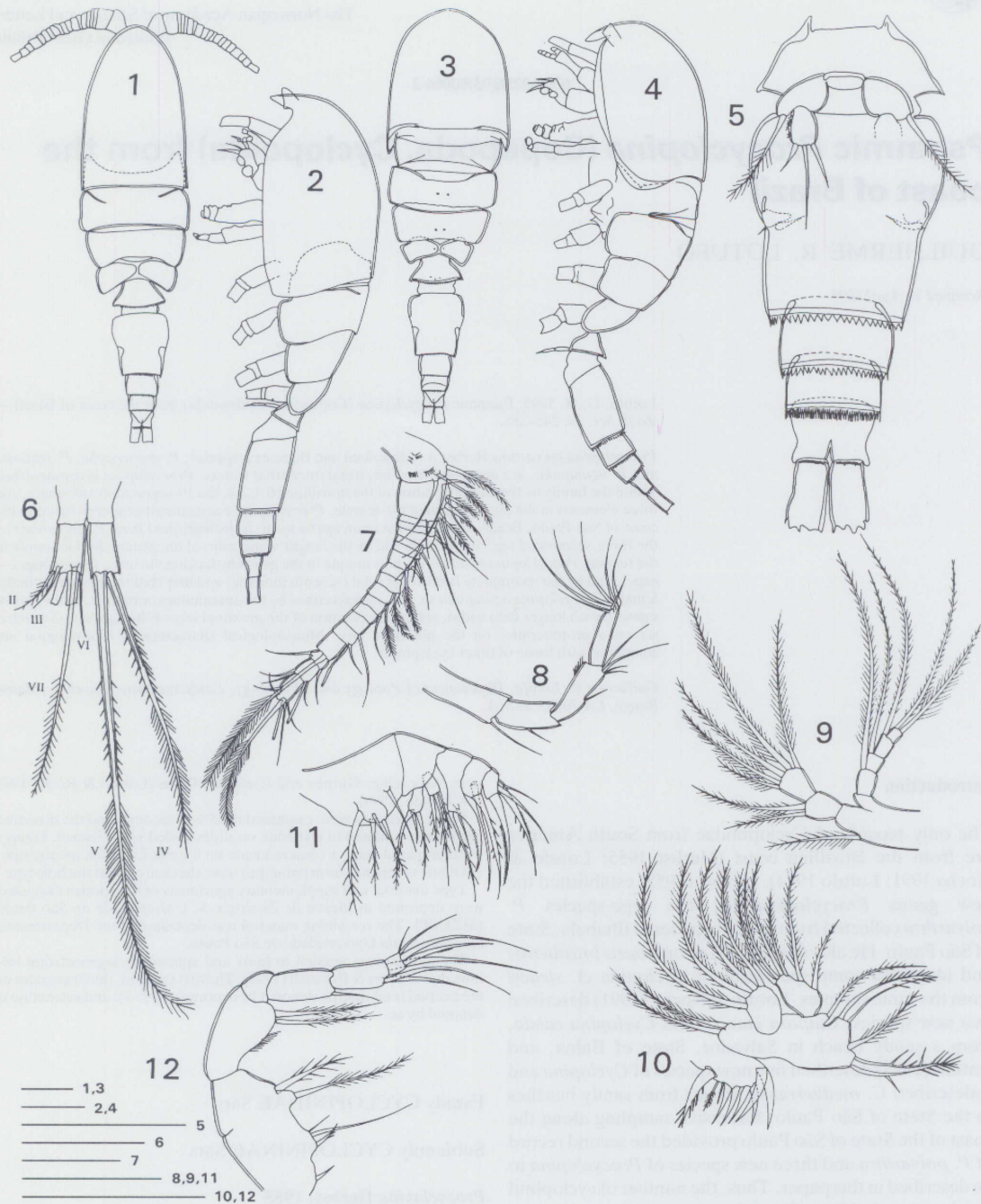
The terminology applied to body and appendage segmentation follows that of Huys & Boxshall (1991). The first (second, third) segment of the exopod (endopod) is denoted by exp(enp)-1(-2,-3), and aesthetasc is denoted by ae.

Family CYCLOPINIDAE Sars

Subfamily CYCLOPININAE Sars

Procylopina Herbst, 1955

Diagnosis (emended): First pedigerous somite partially incorporated into cephalothorax. Antennule 19-segmented in female, 17-segmented in male. Exopod of antenna absent. Mandible with two-segmented endopod and four-segmented exopod. Endopod of maxilla two-segmented, with two setae. Endopod of maxilliped four-segmented. Legs 1–4 with three-segmented endopod and exopod. Legs 1–4 exp-3 with 4,4,4,3 spines and 4,5,5,5 setae; exp-1 without inner seta in leg 1, with or without inner seta in legs 2–4, exp-2 with inner seta in legs 1–4;

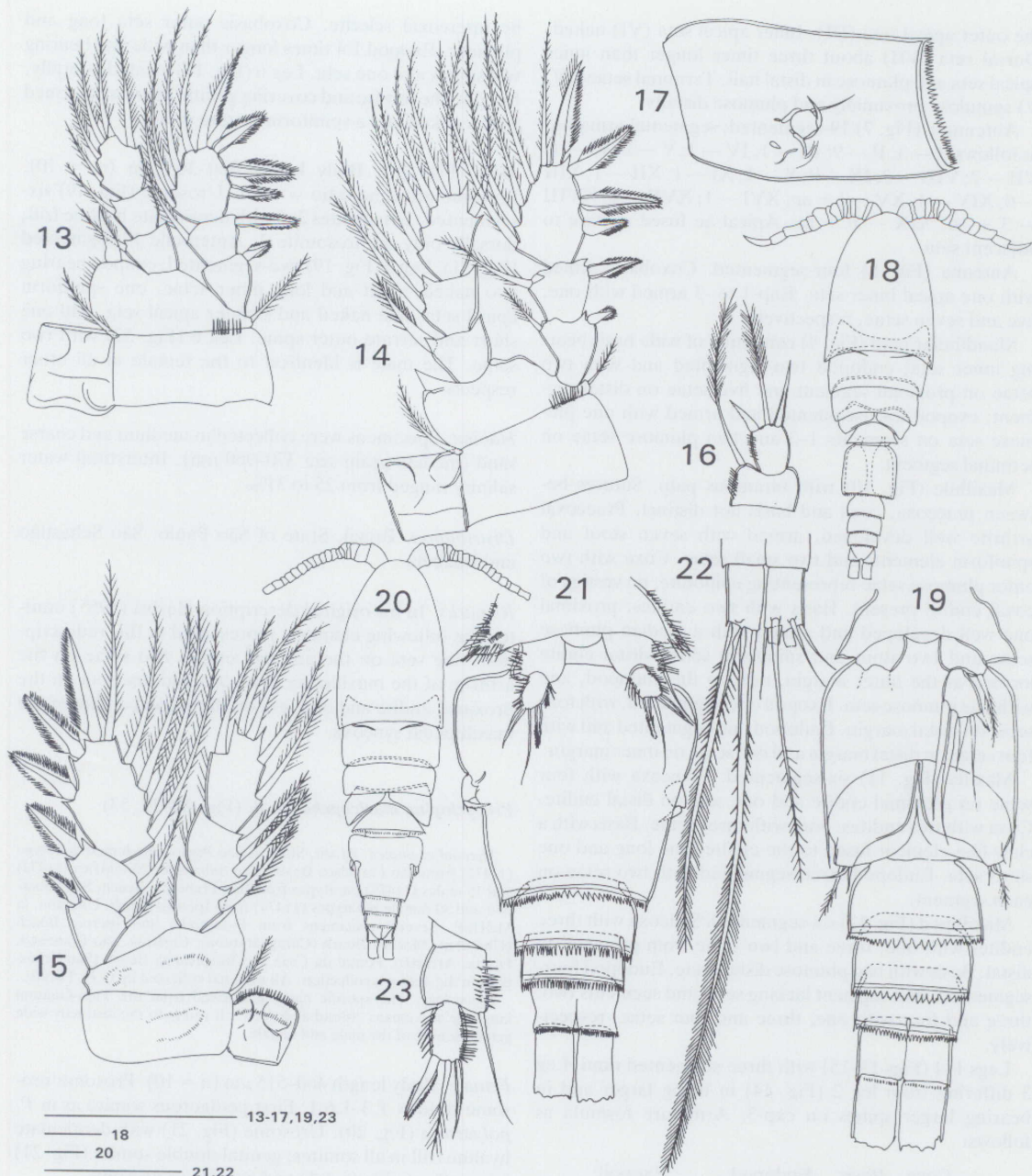


Figs 1-12. *Procytopina polyarthra* Herbst, 1955. Female:—1. Habitus, dorsal.—2. Habitus, lateral.—3. Female with distended prosome, dorsal.—4. Female with distended prosome, lateral.—5. Urosome, ventral.—6. Caudal rami, dorsal.—7. Antennule.—8. Antenna.—9. Mandibular palp.—10. Maxillule.—11. Maxilla.—12. Maxilliped. Scale bars = 50 μm.

enp-1 with inner seta in legs 1-4; enp-3 with 5,6,6,6 setae in legs 1-4. Exopod of leg 5 one-segmented and with two spines and one seta in female. Exopod of leg 5 one-segmented and with five setae or two-segmented and with four setae in male. Leg 6 with two elements in female and two or three elements in male.

***Procytopina polyarthra* Herbst, 1955 (Figs 1-19, 51-52)**

Material examined. Brazil, State of São Paulo: five females and three males from São Francisco Beach (11469) and two females and 10 males from Olaria Beach (11470), São Sebastião, in MZUSP; several specimens from Brava do Sul Beach (Ubatuba), Cigarras, São Francisco, Olaria, Deserta, Zimbros and Santiago Beach (São Sebastião) and



Figs 13-23. *Procylopina polyarthra* Herbst, 1955. Female.—13. Leg 1.—14. Leg 2.—15. Leg 4.—16. Leg 5.—17. Genital double somite, lateral, showing leg 6. Male;—18. Habitus, dorsal.—19. Urosome, ventral; *Procylopina maricopeba* sp. n. Female:—20. Habitus, dorsal.—21. Urosome, ventral.—22. Caudal rami, dorsal.—23. Leg 5. Scale bars = 50 μ m.

Pequea Beach (Ilhabela) deposited in the author's collection. All material collected by G. R. Lotufo.

Female. Body length 385-450 μ m ($n = 10$). Prosome:urosome ratio = 1.60-1.80:1. First pedigerous somite partially fused with cephalosoma and covered by cephalic shield; contours visible underneath the shield in dorsal and lateral view (Figs 1 and 2). Observations of a specimen with distended prosome revealed first pedig-

erous somite tergite to be very delicate and lacking integumental pores and well developed pleurotergites (Figs 3, 4). Pedigers 2, 3 and 4 with conspicuously chitinized areas in the tergite (Fig. 1). Urosome (Fig. 5) with denticulate hyaline frill in all somites; genital double somite longer than wide (1.1:1) and expanded anteriorly; anal somite constricted in the distal third.

Caudal ramus (Fig. 6) about twice as long as wide. Lateral seta (II) inserted dorsally on distal border, next to

the outer apical seta (III). Inner apical seta (VI) naked. Dorsal seta (VII) about three times longer than inner apical seta and plumose in distal half. Terminal setae (IV, V) spinulose proximally and plumose distally.

Antennule (Fig. 7) 19-segmented; segmental armature as follows: I—3; II—9; III—1; IV—1; V—2; VI—1; VII—2; VIII—2; IX—0; X—1; XI—1; XII—1; XIII—0; XIV—1; XV—1 + ae; XVI—1; XVII—2; XVIII—3 + ae; XIX—6 + ae. Apical ae fused at base to adjacent seta.

Antenna (Fig. 8) four-segmented. Coxobasis armed with one apical inner seta. Enp-1 to -3 armed with one, five and seven setae, respectively.

Mandibular palp (Fig. 9) consisting of wide basis bearing inner seta; endopod two-segmented and with two setae on proximal segment and five setae on distal segment; exopod four-segmented and armed with one plumose seta on segments 1-3 and two plumose setae on terminal segment.

Maxillule (Fig. 10) with biramous palp. Sutures between praecoxa, coxa and basis not distinct. Praecoxal arthrite well developed, armed with seven stout and spiniform elements and two small setae. Coxa with two outer plumose setae representing epipodite, no vestige of coxal endite present. Basis with two endites; proximal one well developed and armed with a median plumose seta and two stout and spiniform setae; distal endite located at the outer margin, next to the endopod, and with one plumose seta. Exopod one-segmented, with four setae on distal margin. Endopod one-segmented and with four setae on distal margin and two setae on inner margin.

Maxilla (Fig. 11) six-segmented. Praecoxa with four setae on proximal endite and one seta on distal endite. Coxa with two endites, both with three setae. Basis with a claw-like element fused to the endite, one long and one short seta. Endopod three-segmented with two setae on each segment.

Maxilliped (Fig. 12) six-segmented. Syncoxa with three endites with one, three and two setae from proximal to distal. Basis with two plumose distal setae. Endopod four-segmented; first segment lacking seta, and segments two, three and four with one, three and four setae, respectively.

Legs 1-4 (Figs 13-15) with three-segmented rami. Leg 3 differing from leg 2 (Fig. 14) in being larger and in bearing larger spines on exp-3. Armature formula as follows:

	Coxa	Basis	Endopod	Exopod
Leg 1	0-1	1-1	0-1; 0-1; 1,2,2	I-0; I-1; IV,4
Leg 2	0-1	1-0	0-1; 0-2; 1,2,3	I-1, I-1; IV,5
Leg 3	0-1	1-0	0-1; 0-2; 1,2,3	I-1; I-1; IV,5
Leg 4	0-1	1-0	0-1; 0-2; 1,2,2	I-1; I-1; III,5

Leg 1 (Fig. 13) exp-3 with distalmost spine slender, plumose on inner margin and serrate on outer margin. This spine is stouter and only distally plumose on legs 2 and 3, and smooth along the inner margin on leg 4. Leg 4 (Fig. 15) coxa, basis and intercoxal sclerite with rows of spinules on posterior face; enp-2 and -3 setae stout and ornamented with short and rigid setules.

Leg 5 (Fig. 16) two-segmented comprising protopod and one-segmented exopod, ventrally located and joined

by intercoxal sclerite. Coxobasis outer seta long and plumose. Exopod 1.4 times longer than wide and bearing two spines and one seta. Leg 6 (Fig. 17) located laterally, fused to the somite and covering genital apertures; armed with a naked and a spiniform serrate seta.

Male (Fig. 18). Body length 360-365 μm ($n = 10$). Prosome:urosoma ratio = 1.3:1. Urosome (Fig. 19) six-segmented. Urosomites 2-6 with denticulate hyaline frill, dorsally only on urosomite 2. Antennule 17-segmented (Fig. 51). Leg 5 (Fig. 19) two-segmented; exopod bearing two naked, stout and long inner setae, one spiniform apical seta, one naked and slender apical seta, and one short and serrate outer spine. Leg 6 (Fig. 52) with two setae. The male is identical to the female in all other respects.

Habitat. Specimens were collected in medium and coarse sand (median grain size 370-960 μm). Interstitial water salinity ranged from 25 to 31‰.

Distribution. Brazil. State of São Paulo: São Sebastião and Ilhabela.

Remarks. In his original description Herbst (1955) omitted the following elements represented in this redescription: one seta on the antenna enp-1, two setae on the arthrite of the maxillary praecoxa and one seta on the proximal endite and one seta on the second endite of the maxillipedal syncoxa.

Procylopina maricopeba sp. n. (Figs 20-25, 53)

Material examined. Brazil, State of São Paulo: one female holotype (11471) from São Francisco Beach, São Sebastião. 20 females (11472) and 15 males (11473) paratypes from São Francisco Beach, São Sebastião and 30 female paratypes (11474) from Iperoig Beach, Ubatuba, in MZUSP. Several specimens from Picinguaba and Iperoig Beach (Ubatuba); Mocooca Beach (Caraguatatuba); Cigarras, São Francisco, Olaria, Arrastão, Pontal da Cruz and Boicunganga Beach (São Sebastião) in the author's collection. All material collected by G.R. Lotufo.

Etymology. The specific name is derived from the Tupi-Guarani language and means "broad abdomen". It refers to the distinctly wide genital somite of the male and female.

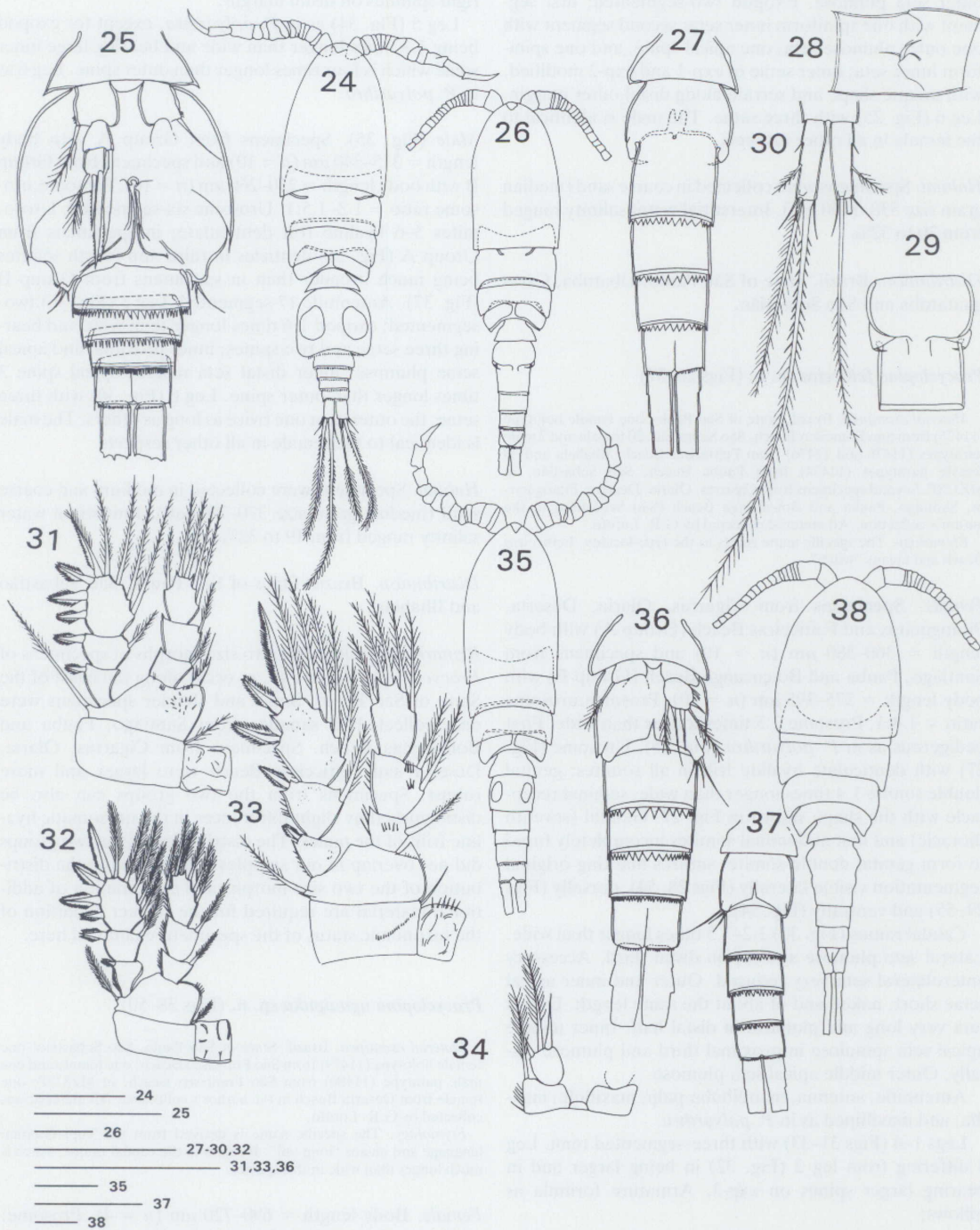
Female. Body length 460-515 μm ($n = 10$). Prosome:urosoma ratio = 1.3-1.6:1. First pedigerous somite as in *P. polyarthra* (Fig. 20). Urosome (Fig. 21) with denticulate hyaline frill in all somites; genital double somite (Fig. 21) longer than wide (1.1:1) and as wide as prosome.

Caudal ramus (Fig. 22) as in *P. polyarthra*, except for outer apical seta being shorter than lateral seta.

Antennule, antenna, mandibular palp, maxillule, maxilla, maxilliped, and legs 1-4 as in *P. polyarthra*.

Leg 5 (Fig. 23) as in *P. polyarthra*, except for basis bearing stouter spinules and exopod segment bearing rows of spinules on both margins. Leg 6 (Fig. 53) as in *P. polyarthra*.

Male (Fig. 24). Body length 360-440 μm ($n = 10$). Prosome:urosoma ratio = 1.4-1.55:1. Urosome six-segmented (Fig. 25). Urosomites 2-6 with denticulate hyaline frill; genital somite 1.2 times wider than longer,



Figs 24-25. *Procylopina maricopeba* sp. n. Male:—24. Habitus, dorsal.—25. Urosome, ventral, showing leg 5 and leg 6; *Procylopina feiteira* sp. n. Female:—26. Habitus, dorsal.—27. Urosome, ventral, showing seminal receptacle.—28. Genital double somite, lateral.—29. Genital double somite, dorsal.—30. Caudal rami, dorsal.—31. Leg 1.—32. Leg 2.—33. Leg 4.—34. Leg 5. Male:—35. Habitus, dorsal.—36. Urosome, ventral, showing leg 5 and leg 6.—37. Specimen from Group B, urosome, ventral; *Procylopina uguaipuku* sp. n. Female:—38. Habitus, dorsal. Scale bars = 50 μm.

and containing spherical spermatophores. Antennule 17-segmented. Leg 5 (Fig. 25) three-segmented. Coxobasis outer seta plumose. Exopod two-segmented; first segment with one spiniform inner seta; second segment with one outer plumose seta, one apical spine, and one spiniform inner seta; inner setae of exp-1 and exp-2 modified, with unique shape and serrate along distal outer margin. Leg 6 (Fig. 25) with three setae. The male is identical to the female in all other respects.

Habitat. Specimens were collected in coarse sand (median grain size 530–1150 μm). Interstitial water salinity ranged from 20 to 32‰.

Distribution. Brazil. State of São Paulo: Ubatuba, Caraguatuba and São Sebastião.

Procylopina feiteira sp. n. (Figs 26–37)

Material examined. Brazil, State of São Paulo: one female holotype (11475) from São Francisco Beach, São Sebastião. 20 female and 7 male paratypes (11476 and 11476) from Feiteiras Beach, Ilhabela and 30 female paratypes (11474) from Pauba Beach, São Sebastião, in MZUSP. Several specimens from Cigarras, Olaria, Deserta, Pitangueiras, Santiago, Pauba and Boiçucanga Beach (São Sebastião) in the author's collection. All material collected by G. R. Lotufo.

Etymology. The specific name refers to the type-locality, Feiteiras Beach and means "witch".

Female. Specimens from Cigarras, Olaria, Deserta, Pitangueiras and Feiteiras Beach (Group A) with body length = 360–380 μm ($n = 10$) and specimens from Santiago, Pauba and Boiçucanga Beach (Group B) with body length = 275–295 μm ($n = 10$). Prosome:urosoma ratio = 1.4:1. Prosoma 2.5 times longer than wide. First pedigerous as in *P. polyarthra* (Fig. 26). Urosome (Fig. 27) with denticulate hyaline frill in all somites; genital double somite 1.4 times longer than wide; seminal receptacle with the shape shown in Fig. 27. Genital (seventh thoracic) and first abdominal somites incompletely fused to form genital double somite; sutures marking original segmentation visible laterally (Figs 28, 54), dorsally (Figs 29, 55) and ventrally (Fig. 54).

Caudal ramus (Fig. 30) 3.2–3.5 times longer than wide. Lateral seta plumose and set on distal third. Accessory anterolateral seta very reduced. Outer and inner apical setae short, naked and of about the same length. Dorsal seta very long and plumose in distal half. Inner middle apical seta spinulose in proximal third and plumose distally. Outer middle apical seta plumose.

Antennule, antenna, mandibular palp, maxillule, maxilla, and maxilliped as in *P. polyarthra*.

Legs 1–4 (Figs 31–33) with three-segmented rami. Leg 3 differing from leg 2 (Fig. 32) in being larger and in bearing larger spines on exp-3. Armature formula as follows:

	Coxa	Basis	Endopod	Exopod
Leg 1	0–1	1–I	0–1; 0–1,1,2,2	I–0; I–1; IV,4
Leg 2	0–1	1–0	0–1; 0–1,1,2,3	I–0; I–1; IV,5
Leg 3	0–1	1–0	0–1; 0–1,1,2,3	I–0; I–1; IV,5
Leg 4	0–1	1–0	0–1; 0–2,1,2,2	I–0; I–1; III,5

Leg 4 (Fig. 33) enp-1 and enp-2 setae stouter than

others on rami; coxa, basis and rami with rows of spinules on posterior face; intercoxal sclerite ornamented with rigid spinules on distal margin.

Leg 5 (Fig. 34) as in *P. polyarthra*, except for exopod being 1.3 times longer than wide and bearing large inner spine which is four times longer than outer spine. Leg 6 as in *P. polyarthra*.

Male (Fig. 35). Specimens from Group A with body length = 315–340 μm ($n = 10$) and specimens from Group B with body length = 230–260 μm ($n = 10$). Prosome:urosoma ratio = 1.3–1.5:1. Urosome six-segmented. Urosomites 3–6 hyaline frill denticulate; in specimens from Group A (Fig. 36) denticles in third and fourth somites being much broader than in specimens from Group B (Fig. 37). Antennule 17-segmented. Leg 5 (Fig. 36) two-segmented; exopod 1.6 times longer than wide and bearing three setae and two spines; inner proximal and apical setae plumose; inner distal seta naked; apical spine 3 times longer than outer spine. Leg 6 (Fig. 36) with three setae; the outermost one twice as long as others. The male is identical to the female in all other respects.

Habitat. Specimens were collected in medium and coarse sand (median grain size 370–790 μm). Interstitial water salinity ranged from 19 to 32‰.

Distribution. Brazil. State of São Paulo: São Sebastião and Ilhabela.

Remarks. It is clear that two size-morphs of specimens of *Procylopina feiteira* sp. n. occur along the coast of the State of São Paulo. Small and slender specimens were only collected in samples from Santiago, Pauba and Boiçucanga Beach. Specimens from Cigarras, Olaria, Deserta and Feiteiras Beach were larger and more robust. Specimens from the two groups can also be distinguished by slight differences in the urosomatic hyaline frills of the males. The distribution of the two groups did not overlap in our samples. More data on the distribution of the two size-morphs and examination of additional material are required for the correct definition of the taxonomic status of the specimens examined here.

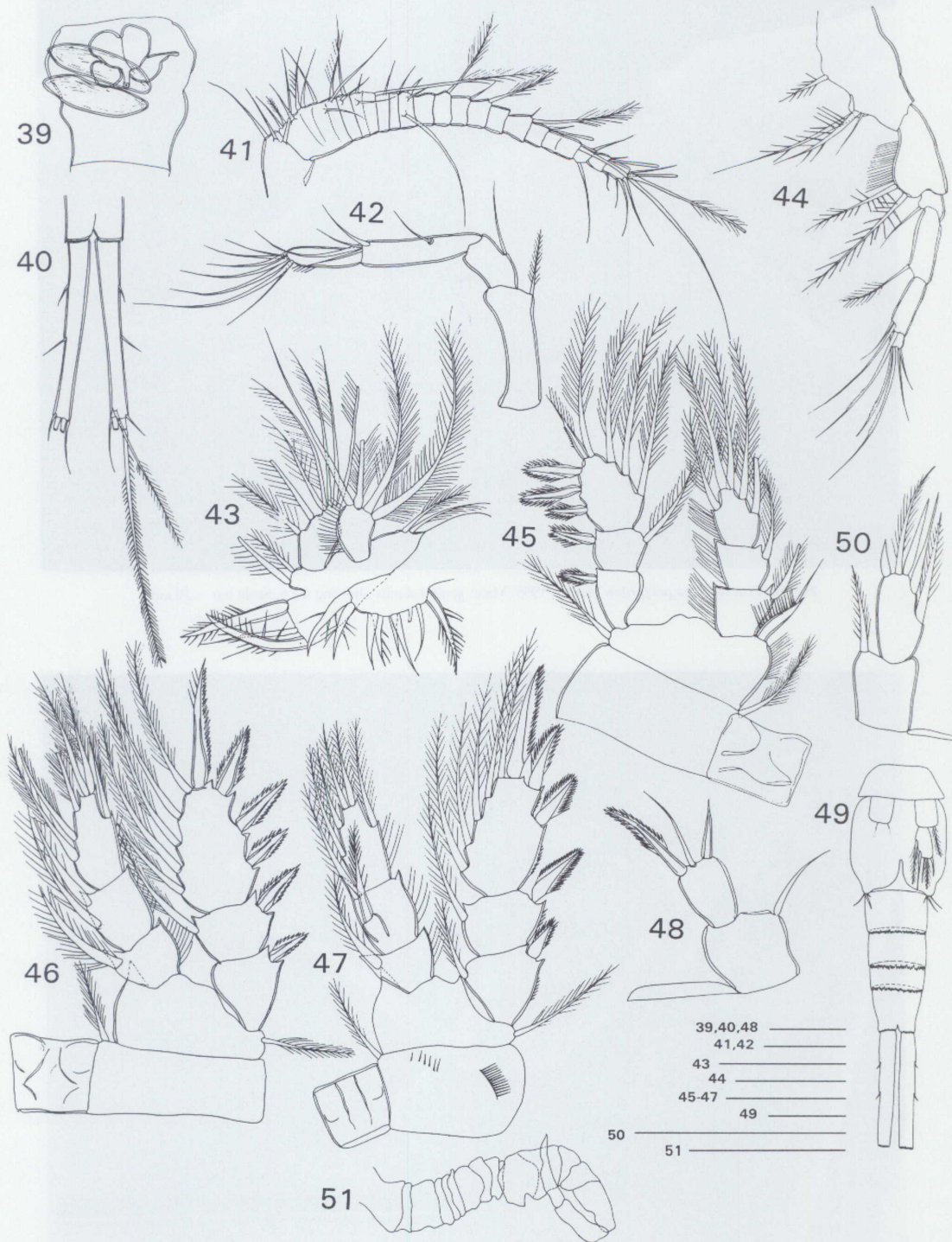
Procylopina uguaipuku sp. n. (Figs 38–50)

Material examined. Brazil, State of São Paulo, São Sebastião: one female holotype (11479) from São Francisco Beach; one female and one male paratype (11480) from São Francisco Beach, in MZUSP; one female from Deserta Beach in the author's collection. All material was collected by G. R. Lotufo.

Etymology. The specific name is derived from the Tupi-Guarani language and means "long tail". It refers to the caudal ramus, which is much longer than wide in this species.

Female. Body length = 690–720 μm ($n = 4$). Prosome:urosoma ratio = 1.2:1. First pedigerous somite as in *P. polyarthra* (Fig. 38). Urosome with denticulate hyaline frill in all somites. Genital double somite (Fig. 39) about 1.3 times longer than wide; seminal receptacle in anterior half of somite and as shown in Fig. 39.

Caudal ramus (Fig. 40) nine times longer than wide and bearing anterolateral accessory data. Lateral seta naked



Figs 39-51. *Procylopina uguaipuku* sp. n. Female:—38. Habitus, dorsal.—39. Genital double somite, ventral, showing seminal receptacle and pair of spermatophores.—40. Caudal rami, dorsal.—41. Antennule.—42. Antenna.—43. Maxillule.—44. Maxilliped.—45. Leg 1.—46. Leg 2.—47. Leg 4, posterior face.—48. Leg 5. Male:—49. Urosome, ventral.—50. Leg 5. *Procylopina polyarthra* Herbst, 1955. Male:—51. Antennule, dorsal. Scale bars = 50 μ m.

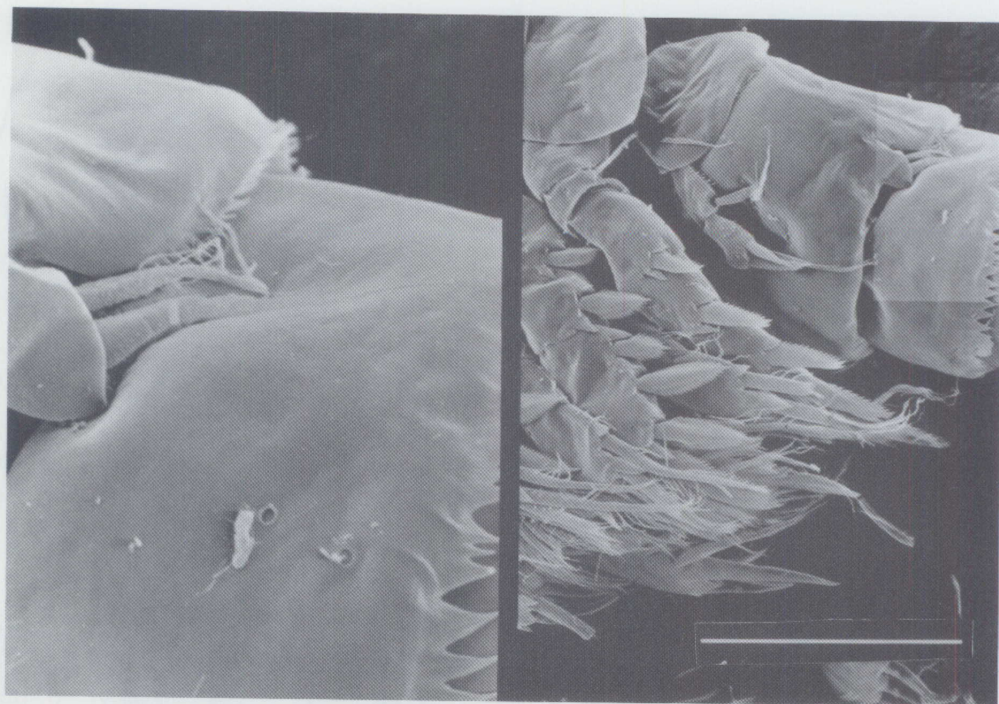


Fig. 52. *Procylopina polyarthra* Herbst, 1955. Male: genital somite showing leg 6. Scale bar = 50 μ m.

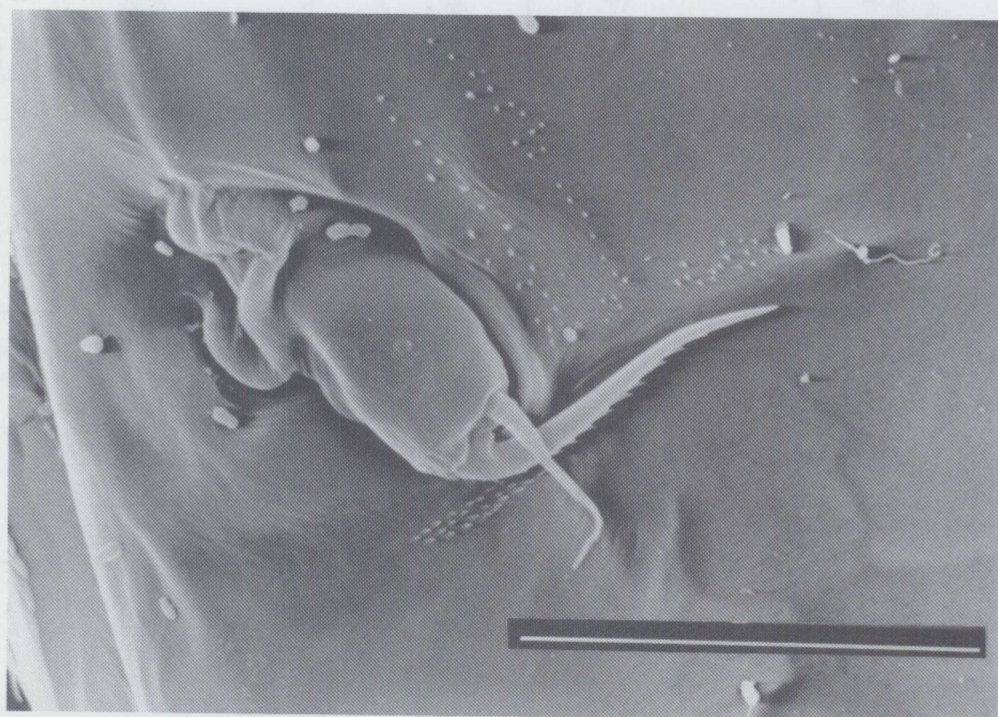


Fig. 53. *Procylopina maricopeba* sp. n. Female: leg 6. Scale bar = 20 μ m.

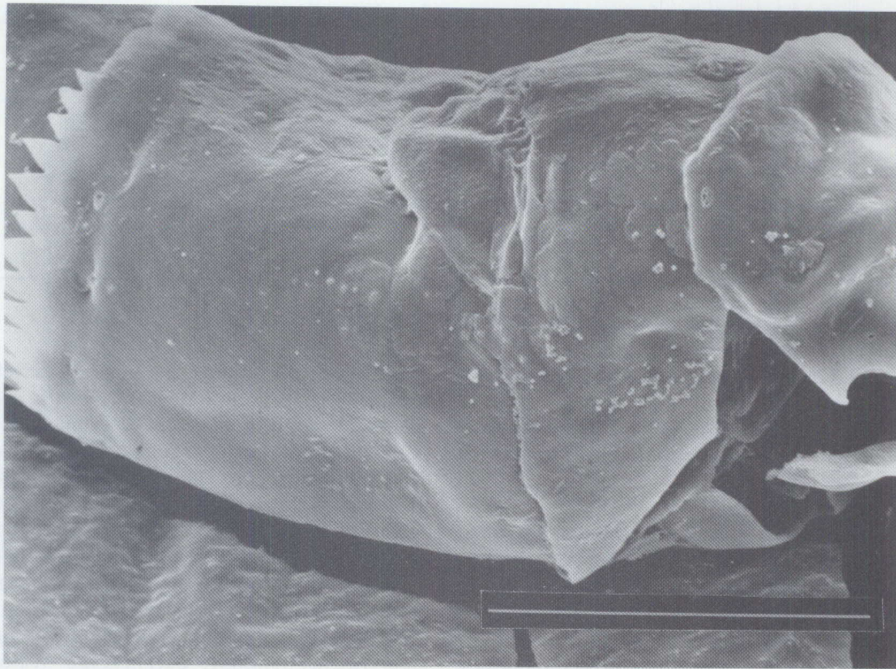


Fig. 54. *Procylopina feiteira* sp. n. Female: genital double somite, ventro-lateral. Scale bar = 20 μ m.

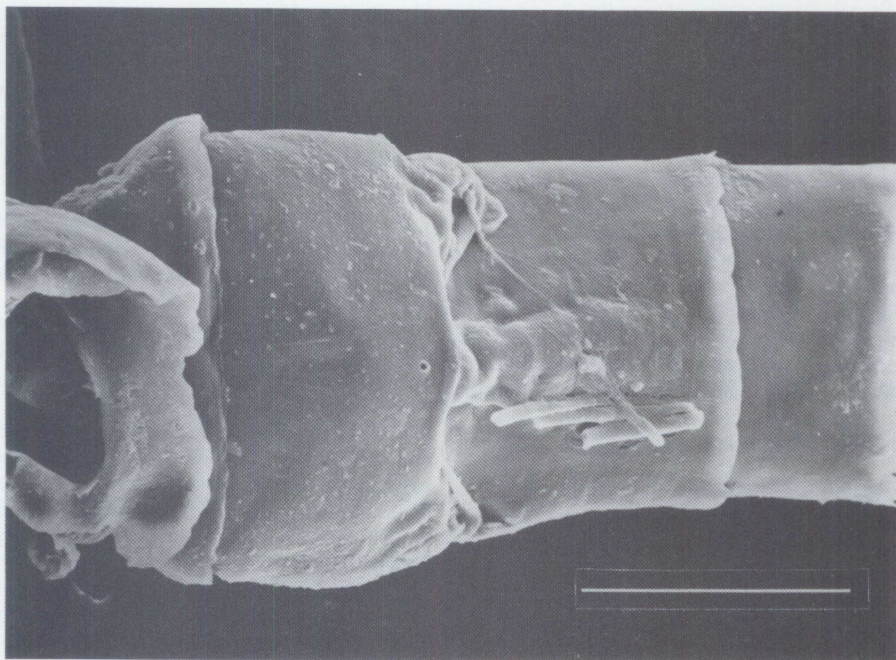


Fig. 55. *Procylopina feiteira* sp. n. Female: genital double somite, dorsal. Scale bar = 20 μ m.

and set medially on ramus. Dorsal seta shorter than ramus and plumose on distal half. Outer apical seta half the length of inner apical seta; both setae naked. Inner middle apical seta was broken in all specimens examined. Outer middle apical seta spinulose proximally and plumose distally.

Antennule (Fig. 41) 19-segmented. Segmental armature as follows: I—3; II—9; III—2; IV—1; V—2; VI—1; VII—1; VIII—3; IX—0; X—1; XI—1; XII—1; XIII—0; XIV—2; XV—1 + ae; XVI—1; XVII—2; XVIII—2 + ae; XIX—6 + ae. Apical ae fused at base to

Table 1. Morphological differences among species of *Procyelopina*. Numerals indicate number of setae

Species	Genital double somite	Caudal ramus seta I	♀ Antennule VII, VIII, XIV, XVIII	Maxillule distal basal endite/enp	Maxilliped syncoxa enp 1-4	Legs 1-4 exp-1 enp-2	♂ leg 5 exp	♂ leg 6
<i>P. polyarthra</i>	Fused	Absent	2,1,1,3	1/6	1,3,2	0 1 1 1	5	3
<i>P. maricopeba</i>	Fused	Absent	2,1,1,3	1/6	0,1,3,4 1,3,2	1 2 2 2 0 1 1 1	1,3	3
<i>P. feiteira</i>	Incompletely fused	Present	2,1,1,3	1/6	0,1,3,4 1,3,2	1 2 2 2 0 0 0 0	5	2
<i>P. uguaiipuku</i>	Fused	Present	1,2,2,2	2/7	0,1,3,4 1,3 1,1,3,4	1 1 1 2 0 0 0 1 1 2 2 2	5	3

adjacent seta. Original segmentation of segments 2 and 16 partially marked by incomplete sutures.

Antenna (Fig. 42), mandibular palp and maxilla as in *P. polyarthra*.

Maxillule (Fig. 43) as in *P. polyarthra*, except for distal basal endite bearing two setae and endopod bearing seven setae.

Maxilla as in *P. polyarthra*.

Maxilliped (Fig. 44) six-segmented. Syncoxa proximal endite with one spinulose seta and distal endite with one naked seta and two spinulose setae. Basis with two long, spinulose setae; endopod four-segmented and with one, one, three and four setae on segments 1-4, respectively.

Legs 1-4 (Figs 45-47) with three-segmented rami. Leg 3 differing from leg 2 (Fig. 46) in being larger and in bearing larger spines on exp-3. Armature formula as follows:

	Coxa	Basis	Endopod	Exopod
Leg 1	0-1	1-1	0-1; 0-1; 1,2,2	I-0; I-1; IV,4
Leg 2	0-1	1-0	0-1; 0-2; 1,2,3	I-0; I-1; IV,5
Leg 3	0-1	1-0	0-1; 0-2; 1,2,3	I-0; I-1; IV,5
Leg 4	0-1	1-0	0-1; 0-2; 1,2,2	I-1; I-1; III,5

Leg 1 (Fig. 45) exp-3 distalmost spine modified; proximal half stout and serrate along outer margin; distal half slender and plumose along inner margin. This spine is stouter, serrate along outer margin and plumose only distally along inner margin on legs 2 and 3; on leg 4 it is smooth along inner margin. Leg 4 (Fig. 47) with rows of spinules on posterior face of coxa and outer margin of exp-1 to -3; enp-2 proximal seta set on a protuberance on posterior face. One specimen was observed bearing seven setae on leg 1 exp-3.

Leg 5 (Fig. 48) and leg 6 as in *P. polyarthra*.

Male. Body length = 595 μ m ($n = 1$). Prosome:urosome ratio = 1.2:1. Urosome (Fig. 49) six-segmented. Urosomites 3-6 with denticulate hyaline frill. Antennule damaged in specimen examined. Leg 5 (Fig. 50) two-segmented, comprising protopod and exopod; exopod twice longer than wide and bearing three setae and two spines: inner proximal and apical setae plumose, inner distal seta naked, apical spine twice longer than outer spine. Leg 6 (Fig. 49) with three setae. The male is identical to the female in all other respects.

Habitat. Specimens were collected in coarse sand (median grain size 530 and 1150 μ m). Interstitial water salinity = 20‰.

Distribution. São Sebastião, State of São Paulo, Brazil.

Discussion

The most recent key to the genera of Cyclopininae is provided by Huys and Boxshall (1990), containing 30 genera, including three new taxa. Lotufo & Rocha (1991) described a new genus, *Cuipora*, raising this number to 31. Cyclopinidae are distinguished solely by a combination of plesiomorphic characters. They have no diagnostic apomorphy and possibly constitute a paraphyletic taxon (Ho & Thatcher 1988; Huys & Boxshall 1990).

Prior to this study, *Procyelopina* was a monospecific genus, as are most genera of Cyclopinidae (all genera, with the exception of *Cyclopina* Claus, *Cyclopinella* Sars, *Paracyelopina* Smirnov, *Cyclopinodes* Wilson, *Cyclopinopsis* Smirnov, *Pseudocyclopinodes* Lang, *Cyclopinoides* Lindberg, *Metacyelopina* Lindberg and *Allocyelopina* Kiefer. More species would probably be added to the current list if benthic marine environments, especially interstitial water, were more often explored around the world. Extensive sampling in the intertidal zone of sandy beaches in Brazil elevated the number of species of *Procyelopina* to four, all of them recorded so far only from sandy beaches in the State of São Paulo, Brazil.

Procyelopina can be distinguished by a combination of 19-segmented antennule and leg 5 exopod with two spines and one seta in the female and enditic setation of the maxilliped 0,1,3,4.

According to Huys & Boxshall (1991), in all cyclopoids the genital (seventh thoracic) and first abdominal somites are fused to form a genital double somite, the exception being the Notodelphyidae, in which the two somites are free. *Procyelopina feiteira* sp. n. constitutes the first record of a Cyclopinidae with incomplete fusion of these two somites, a situation also found in the Thespesiopsyllidae and Misophrioida. A comparison with the hypothetical ancestral cyclopoid reconstructed by Huys and Boxshall (1991) reveals that in the female 19-segmented antennule of *Procyelopina*, segment I is derived from the fusion of the original segments I-II, segment II from the fusion of III-VII (with segment IV retaining two setae), segment VII from the fusion of XIII-XIV and segment XVI from the fusion of XII-XIII. Incomplete sutures evidencing the original segmentation are visible in the antennule of *P. uguaiipuku*. A 19-segmented antennule is also found in *Cyclopidina* Steuer, *Pseudocyclopinodes* Lang and *Parapseudocyclopinodes* Lindberg. The epipodite on the maxillae is represented in *Procyelopina* by two setae on the outer surface of the coxa, a number also recorded for *Cyclopina*. A maximum number of three

setae is found only in *Cyclopicina* Lindberg. In *Procylopina* the distal endite in the maxillule is located at the outer margin of the basis, an unusual configuration also found in *Psammocyclopina* Wells and the Oithonidae (Huys & Boxshall 1991). The male antennules are structurally complex and details are difficult to discern. The maximum number of 17 segments occurs in several species of cyclopids and in *Cyclopinoides* (Huys & Boxshall 1991) and was also observed in *Procylopina*. The maxillary endite formula 4,1,3,3, the most plesiomorphic in Cyclopoida, is found, among the Cyclopininae, only in *Procylopina* and *Arctocyclopina* Mohammed & Neuhof. The unique enditic setation of the maxillipedal endopod 0,1,3,4 in *Procylopina* is indicative that the third segmented originated through fusion of the third and fourth original segments. The loss of the inner seta on enp-1 legs 1-4 occurs in *Procylopina feiiceira* sp. n. and also in *Cyclopinella*, *Paracyclopina*, *Neocyclopina* Herbst, *Psammocyclopina* and *Herbstina* Huys & Boxshall. Five elements on a one-segmented exopod in the male leg five are characteristic of *P. polyarthra*, *P. uguaipuku* sp. n. and *P. feiiceira* sp. n. and also occurs in *Cyclopinopsis curticauda* Smirnov and *Cyclopuella* Por. A two-segmented exopod in this appendage with only the inner seta on the first segment and three setae on the second segment is an exclusive feature of *P. maricopeba* sp. n. *Metacyclopina* Lindberg also retains only the inner seta on the first segment, but bears four elements on the distal exopod segment. Other genera with two-segmented exopod are *Cyclopinodes*, *Pseudocyclopina* and *Neocyclopina*.

Table 1 shows differences among the four species of *Procylopina*. The female of *P. maricopeba* is similar to *P. polyarthra* except for the densely spinulose pediger 5 and genital double somite as wide as the prosome. The loss of the inner seta in the exp-1 of all swimming legs occurs only in *P. feiiceira* sp. n., the loss of this seta in legs 1-3 occurs in *P. uguaipuku* and loss in only leg 1, in *P. polyarthra* and *P. maricopeba* sp. n. *Procylopina feiiceira* sp. n. is the only species with only one inner seta on enp-2 legs 1-4. An anterolateral seta in the caudal ramus

is lacking in *P. polyarthra* and *P. maricopeba* sp. n. *Procylopina feiiceira* differs from the other species in the genus by the incomplete fusion of the original somites comprising the genital double somite in the female. *Procylopina uguaipuku* sp. n. also differs from the other *Procylopina* species in the caudal ramus, much longer than wide, and in the proximal seta on the enp-2 leg 4, set on a protuberance on the posterior face. There is no other reference in the literature about a swimming leg seta inserted in such a way in cyclopoids.

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