

THE PARASITIC CRUSTACEANS
OF FISHES FROM THE BRAZILIAN AMAZON.
5. **BRASERGASILUS** GEN. NOV. (COPEPODA: CYCLOPIDEA),
A "THREE-LEGGED" ERGASILID, WITH TWO NEW SPECIES
AND THE PROPOSAL OF ABERGASILINAE SUBFAM. NOV.

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Resumo

Brasergasilus jaraquensis gen. et sp. nov. e **B. anodus** sp. nov. (Copepoda: Cyclopidea: Ergasilidae) são descritas como parasitas das brânquias de **Semaprochilodus insignis** (Schomburgk) e **Anodus elongatus** Spix, da Amazônia brasileira. O novo gênero tem somente 3 pares de pernas natatórias e, portanto, mostra semelhança unicamente com uma espécie da Nova Zelândia, **Abergasilus amplexus** Hewitt, 1978. Os dois gêneros também têm a segunda (preênsil) antena de três segmentos e não quatro, como é o caso dos demais gêneros de Ergasilidae. **Abergasilus** tem ainda um crescimento grande, em forma de espinho, na base do segundo segmento da antena preênsil com o qual o ápice do terceiro segmento pode se juntar. O novo gênero carece totalmente dessa estrutura fundamental. Aliás, **Abergasilus** tem seis segmentos torácicos livres, enquanto o novo gênero somente tem cinco. A nova subfamília Abergasilinae é proposta para estes dois gêneros e suas três espécies. Ergasilinae nom. nov. é provisoriamente definida e proposta para conter os outros onze gêneros da família. A espécie tipo de **Brasergasilus** gen. nov. é **B. jaraquensis** sp. nov. e ela distingue-se de **B. anodus** da maneira seguinte: 1) a espécie tipo é maior e mais verde enquanto **B. anodus** tem menos grânulos de pigmentação e estes são de uma cor mais azul. 2) **B. jaraquensis** tem a segunda antena mais fina e a dobra mais pronunciada da unha

ocorre distalmente; a segunda antena de **B. anodus** é menos fina e a dobra da unha encontra-se proximalmente. 3) o urópodo da espécie tipo tem duas setas e dois pequenos espinhos, enquanto o da outra espécie tem três setas e carece de espinhos. 4) a primeira perna de **B. jaraquensis** é serrilhada lateralmente enquanto a de **B. anodus** é pectinada. As duas espécies parasitam dois gêneros diferentes de hospedeiros e, provavelmente, são específicas para eles.

INTRODUCTION

The ergasilid fauna of South America is still but little known and, prior to the present series, only 10 species had been reported from this continent. Amazonian ergasilids are reported in the studies of Cressey (1970, in Cressey & Collette, 1970), Thatcher (1981a & 1981b), Thatcher & Robertson (1982), and Thatcher & Boeger (in press). At present, 14 species of ergasilids are known to occur on the South American continent, with 6 of these being native to the Amazon River Basin.

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Ergasilids are parasitic copepods in which only the female is found attached to the gills of a fish host. Males, and all immature stages, occur as free-living elements in the zooplankton (Kabata, 1970 & 1981). Since the parasitic females are highly pathogenic, they represent a serious economic problem in relation to pisciculture. The present report is part of a continuing study which plans to elucidate the morphology, systematics, pathogenicity, ecology, host specificity and control of these parasites.

Recently, two undescribed species of an unusual new genus of ergasilid have been found parasitizing Amazonian fishes. This new form has a female with only three pairs of swimming legs, instead of the usual five pairs. World-wide, only one "three-legged" ergasilid has been previously reported, and that species occurs in New Zealand (Hewitt, 1978). This difference in the number of appendages is so basic as to require the erection of a new Subfamily, which is herein proposed.

MATERIALS AND METHODS

The methods used in this study were explained in Thatcher (1981a) and in Thatcher & Robertson (1982). Type specimens are preserved in whole-mounts made in Canada balsam. Color determina-

tions were made with reference to Smith (1975). Drawings were made with the aid of a camera lucida and measurements with a measuring ocular. All measurements are given in micrometers.

SYSTEMATIC SECTION ERGASILIDAE NORDMANN, 1832 ERGASILINAE NOM. NOV.

Subfamily Diagnosis: Cyclopoidea: Ergasilidae: with the following characters: Female with 4 pairs of swimming legs; 5th pair of legs present, but vestigial. Second (prehensile) antenna 4 or 5-segmented.

Type genus: *Ergasilus* Nordmann, 1832.

Other related genera: *Acusicola* Cressey, 1970 (in Cressey & Collette, 1970); *Macrobrachinus* Hesse, 1871; *Markewitschia* Yamaguti, 1963; *Megabrachinus* Hesse, 1871; *Neoergasilus* Yin, 1956; *Nipergasilus* Yin, 1956; *Parergasilus* Markewitsch, 1937; *Pseudergasilus* Yamaguti, 1936; *Sinergasilus* Yin, 1949 & Thersitina Norman, 1905.

ABERGASILINAE SUBFAM. NOV.

Subfamily Diagnosis: Cyclopoidea: Ergasilidae: with the following characters: Female with 3 pairs of swimming legs; vestigial legs lacking. Second (prehensile) antenna 3-segmented.

Thatcher & Boeger

Type genus and species: **Abergasilus amplexus** Hewitt, 1977.

Other related genus: **Brasergasilus** gen. nov.

Brasergasilus gen. nov.

Generic Diagnosis: Ergasilidae: Abergasilinae: with the following characters: Female with simple, 3-segmented second antenna; thorax with 5 free thoracic segments; first maxilla lacking.

Type Species: **Brasergasilus jaraquensis** sp. nov.

Brasergasilus jaraquensis sp. nov.
(Figs. 1-9)

Host: **Semaprochilodus insignis** (Schomburgk), "jaraqui".

Site: Gill filaments.

Prevalence: Unknown.

Intensity: 1 — 144/host.

Locality: Manaus, Amazonas, Brasil.

Male: Unknown.

Holotype (female): Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus.

Paratypes: INPA and Museu de Zoologia da Universidade de São Paulo, Brazil.

Etymology: The new generic name honors the country of origin and was selected because the coloration of the type species is si-

milar to that of the Brazilian national flag. The specific name is adapted from the common indigenous name of the fish host.

Species Diagnosis: (based on 50 specimens studied and 10 measured): General measurements are given in Table 1. Cephalothorax bluntly rounded anteriorly; head fused with first two thoracic segments (Fig. 1). Eyespot small; anterior; bipartite; rose (Color 9 of Smithe, 1975) surrounded by spectrum blue (Color 69) granules. Body coloration spectrum blue ventrally, shading towards apple green (Color 61) more dorsally. Ovaries straw yellow (Color 56).

Antennae (Figs. 2 & 3): first antenna of six segments, bearing simple setae; setal formula = 0-2-3-2-1-4. Prehensile (second) antenna three-segmented; second segment with simple sensillum on medial margin, distally; terminal segment more curved near distal portion; ratio of segmental lengths = 1:1.8:3.

Thorax (including genital segment) of five free segments (Fig. 1); thoracic segments V and VI reduced, and without appendages. Genital segment sub-spherical (Fig. 4). Abdomen of three segments; nearly equal in size. Each uropod with one long and one short seta and two spines, laterally (Fig. 4).

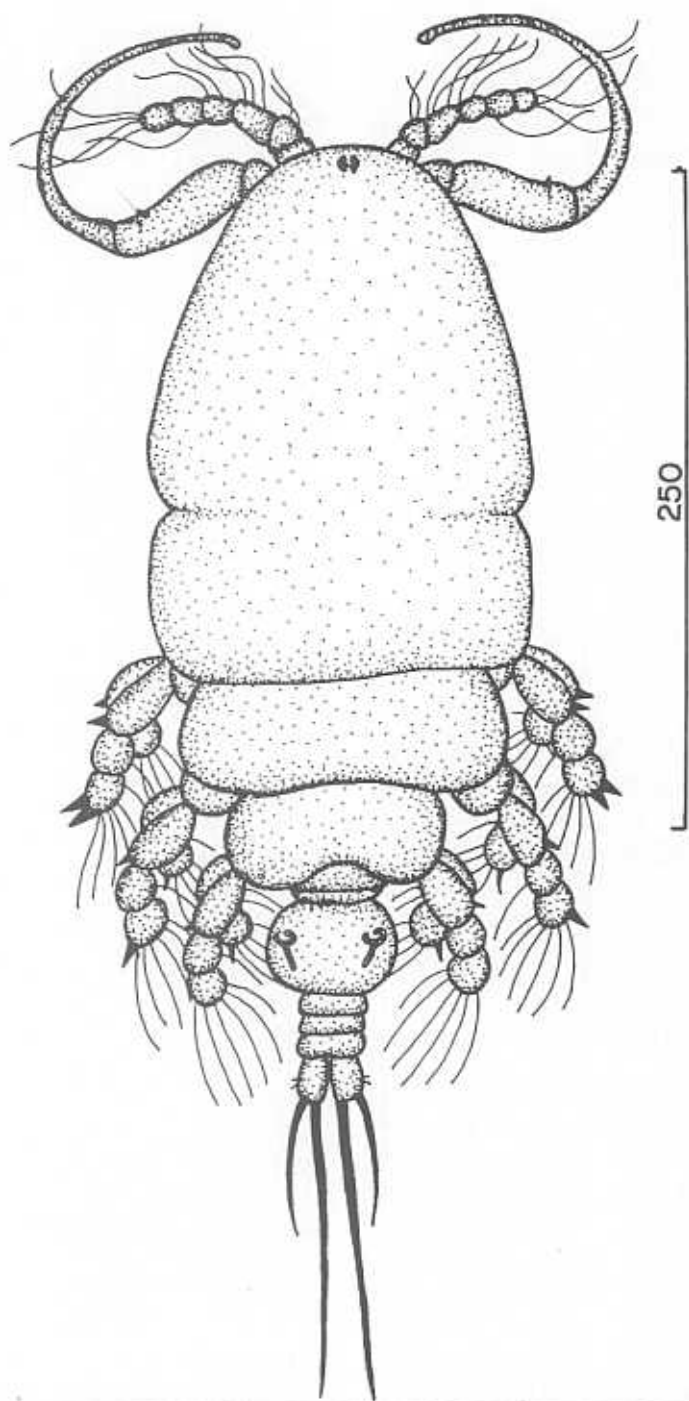


Fig. 1. *Brasergasilus jaraquensis* gen. et sp. nov. (female), Dorsal view.

TABLE 1. Measurements, in micrometers, of adult females of *B. jaraquensis* gen. et sp. n.

	Length	Width
Body (less caudal setae)	340-410 (370)	120-170 (139)
Cephalothorax	180-210 (196)	120-170 (139)
Free Thoracic Segments		
III	30-43 (37)	90-113 (104)
IV	35-45 (39)	65-73 (68)
VII (genital)	28-35 (31)	40-68 (49)
Abdominal Segments		
I	8-13 (11)	23-33 (29)
II	8-10 (9)	28-35 (30)
III	8-12 (10)	25-35 (30)
Uropods	23-28 (24)	10-18 (14)
Caudal Setae	83-143 (127)	—
Egg Sacs	170-340 (246)	30-60 (46)

Mouth parts (Fig. 9): mandible two-segmented, with bristled tip; palp simple, with bristles postero-medially; first maxilla lacking; second maxilla of two segments, terminal segment elongate and bristled on tip.

Legs (Figs. 6-8): Leg 1 (Fig. 6): endopod two-segmented; both segments serrate laterally; first segment with a single, plumose seta medially; second segment with one, plumose seta medially and four terminally; two large, rasp-like spines terminally; exopod three-segmented; first two segments serrate laterally; segment one with a single, large spine; second segment with a single, plumose seta medially; terminal segment bearing five, plumose setae and two, rasp-like, large

spines. Leg 2 (Fig. 7): both rami three-segmented; all segments of endopod serrate laterally; first segment with a single, plumose seta medially; second segment with two, plumose setae medially; terminal segment with four, plumose setae and a single, rasp-like spine; first exopodal segment with a single, rasp-like spine and a few serrations laterally; second segment with a single, plumose seta medially; terminal segment with six, plumose setae and a single, rasp-like spine. Leg 3 (Fig. 8): both rami three-segmented; first endopodal segment with a single, plumose seta medially and few thin spinules laterally; second segment with two, plumose setae medially and few long, slender spinules laterally; terminal segment with four,

plumose setae, one elongate spine and few thin spinules; first exopodal segment with a single, lateral spine; second segment with a single, plumose seta medially; terminal segment with six, plumose setae and a single, small spine.

Egg sac (Fig. 5): elongate, with 15-25 spherical eggs.

***Brasergasilus anodus* sp. nov.**
(Figs. 10-18)

Host: *Anodus elongatus* Spix.

Site: Gill filaments and gill rakers.

Prevalence: Unknown.

Intensity: 1 — 60/host.

Locality: Tocantins River, Pará, Brazil.

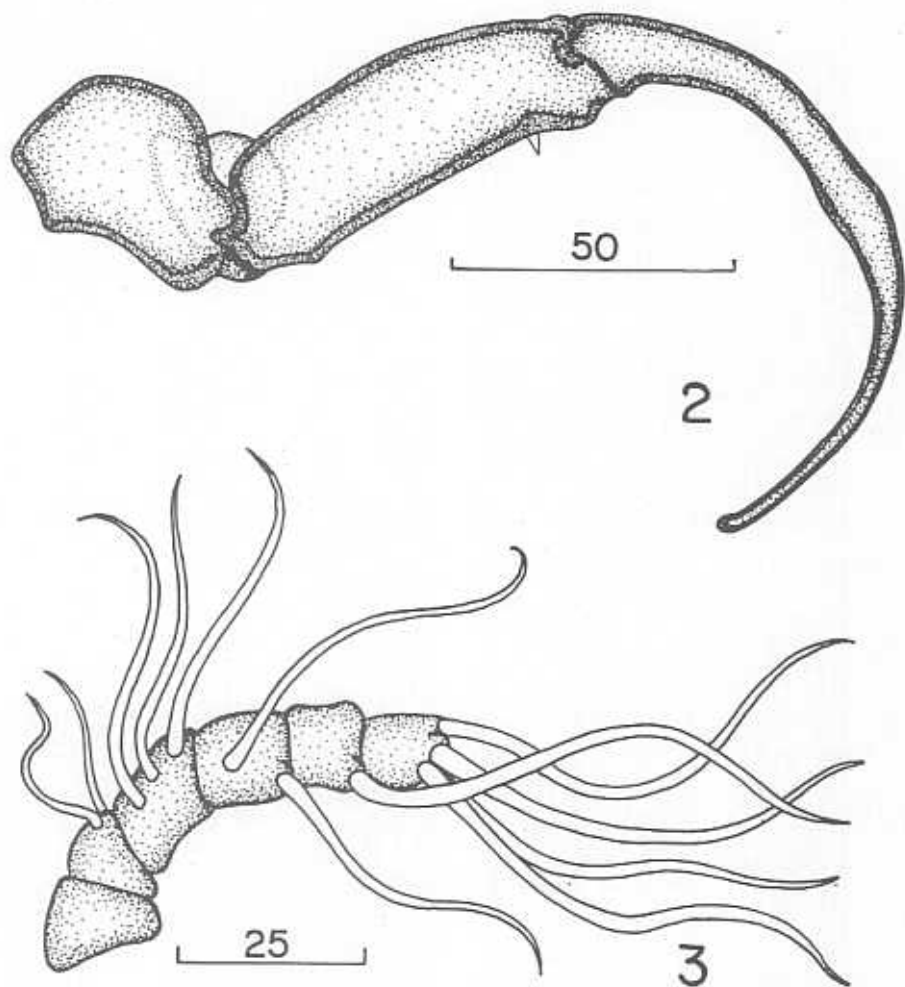
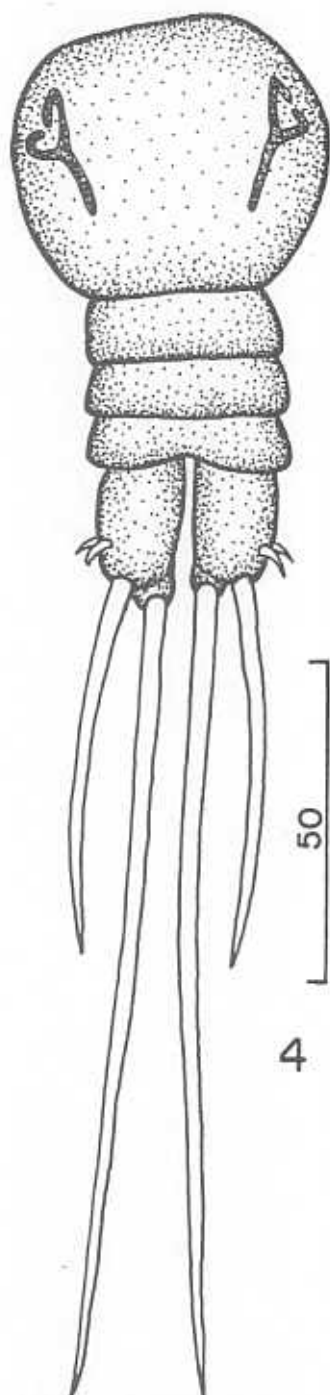
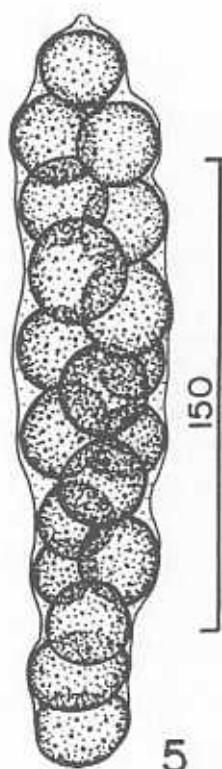


Fig. 2. *B. jaraquensis*, Second (prehensile) antenna. Fig. 3. *B. jaraquensis*, First antenna (antennule).



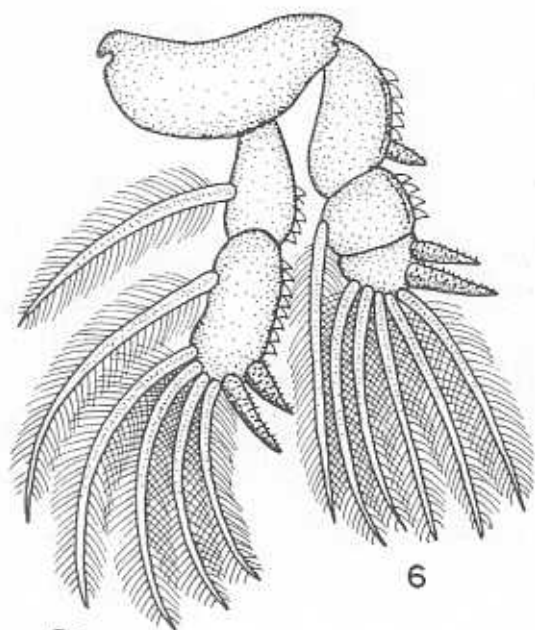
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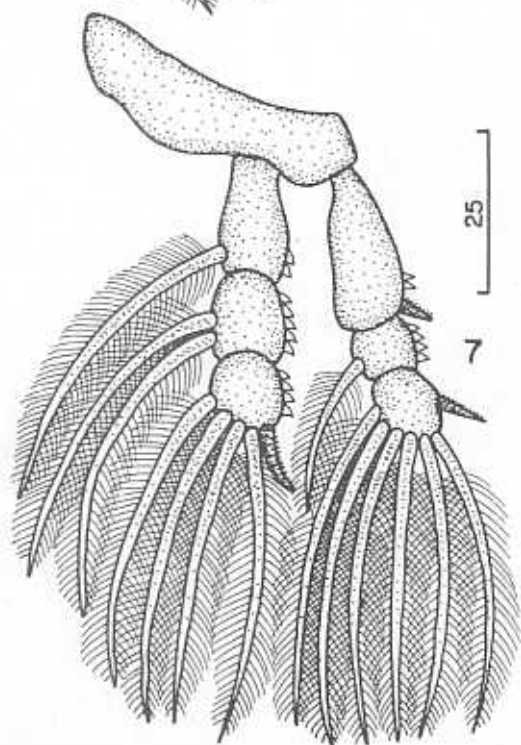
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Fig. 4. *B. jaraquensis*, Genital segment, abdomen and uropods.

Fig. 5. *B. jaraquensis*, Egg sac.



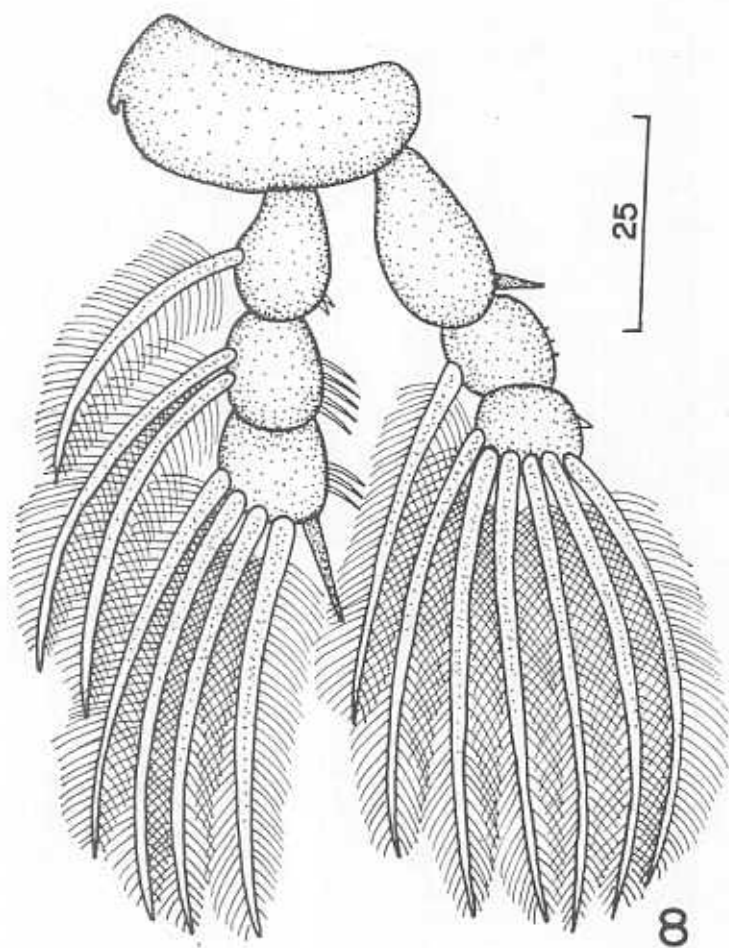
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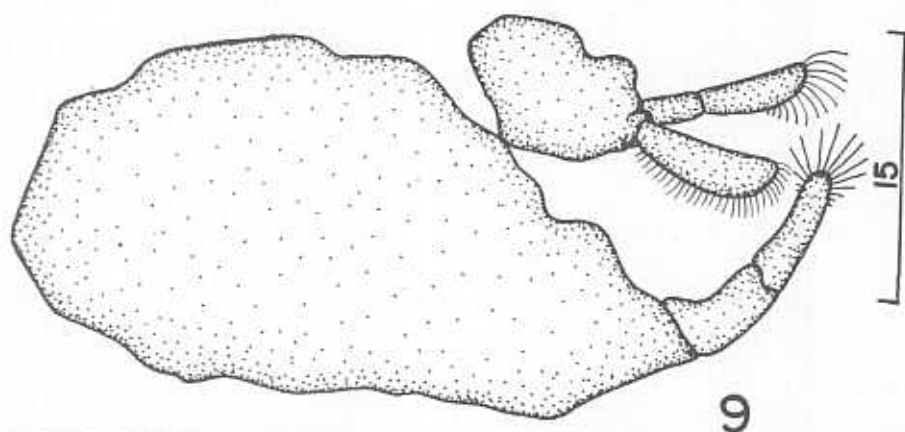
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Fig. 6. *B. jaraquensis*, Leg 1. Fig. 7. *B. jaraquensis*, Leg 2.



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Fig. 8. *B. jaraquensis*, Leg 3. Fig. 9. *B. jaraquensis*, Mouthparts.

TABLE 2. Antennal measurements, in micrometers, of adult females of *B. jaraquensis* gen. et sp. n.

	Length	Width
Antenna I (antennule)	43-69 (58)	10-14 (11)
Antenna II (prehensile)		
Segment 1	30-45 (40)	30-38 (35)
2	53-73 (62)	25-33 (29)
3	80-95 (90)	13-18 (14)

TABLE 3. Relationships of Spines to Setae on the Legs of *B. jaraquensis* gen. et sp. n.

	Exopod	Endopod
Leg 1	I-0, 0-1, II-5	0-1, II-5
2	I-0, 0-1, I-6	0-1, 0-2, I-4
3	I-0, 0-1, 0-6	0-1, 0-2, I-4

Male: Unknown.

Holotype (female): Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus.

Paratypes: INPA and Museu de Zoologia da Universidade de São Paulo, Brazil.

Etymology: The generic name of the host is used for the specific name.

Species Diagnosis (based on 30 specimens studied and 10 measured): General measurements are given in Table 4. Cephalothorax bluntly rounded anteriorly; head fused with first two thoracic segments (Fig. 10). Eyespot large, hour-glass shaped; small blue (Color 70). Body with sparse campanula pigmentation (Color 71) ven-

trally. Ovary and eggs buff-yellow (Color 53).

Antennae (Figs. 11 & 12): First antenna of six segments, bearing simple setae; setal formula = 0-2-3-2-1-4. Prehensile (second) antenna three-segmented; second segment simple, without sensilla; terminal segment bent abruptly near proximal extremity; ratio of segmental lengths = 1:1.2:2.2.

Thorax (including genital segment) of five free segments (Fig. 10); thoracic segments V and VI reduced, and without appendages. Genital segment sub-spherical (Fig. 13). Abdomen of three segments; with thin spinules ventrally at inter-segmental margins. Each uropod with long, medium and short setae (Fig. 13).

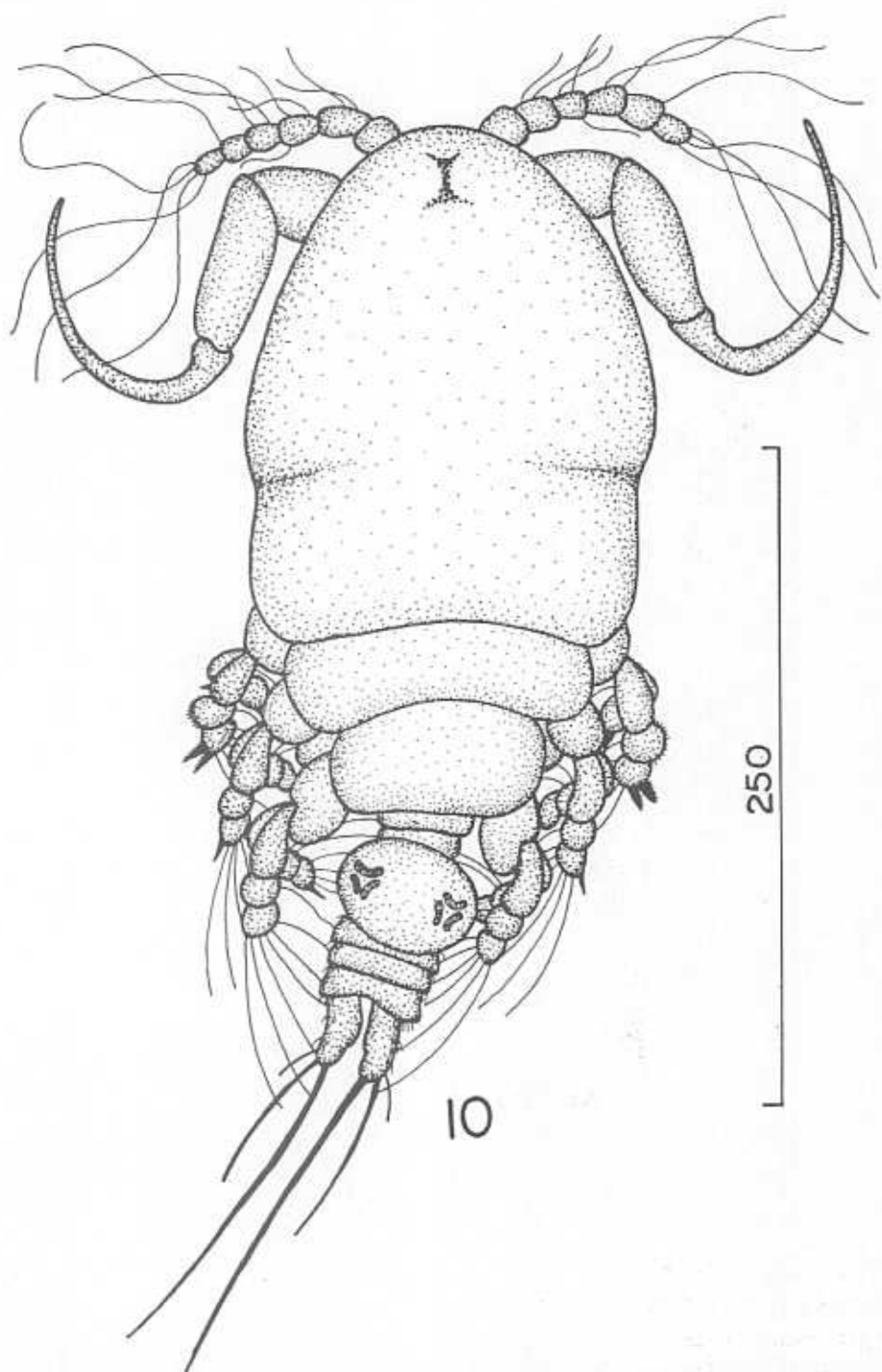


Fig. 10. *Brasergasilus anodus* sp. nov. (female) Dorsal view

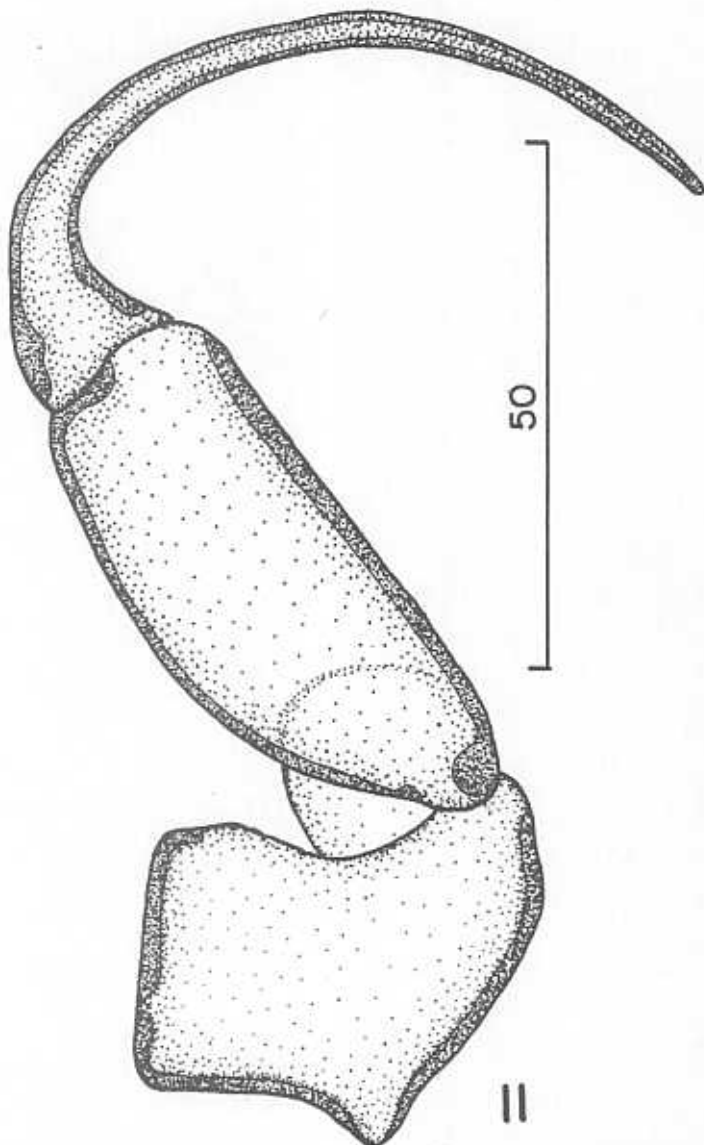


Fig. 11. *B. anodus*, Second (prehensile) antenna.

Mouth parts (Fig. 15): mandible two-segmented, with terminal segment bristled; palp with bristled tip; first maxilla lacking; second maxilla of two segments; terminal

segment expanded, rounded and bristled.

Legs (Figs. 16-18): Leg 1 (Fig. 16); endopod two-segmented; first segment with a single, plumose

TABLE 4. Measurements, in micrometers, of adult females of *B. anodus* sp. n.

	Length		Width	
Body (less caudal setae)	320-370 (354)		118-163 (143)	
Cephalothorax	173-205 (185)		118-163 (143)	
Free Thoracic Segments				
III	30-39	(34)	95-133	(105)
IV	25-45	(33)	55-76	(65)
VII (genital)	23-38	(29)	40-50	(46)
Abdominal Segments				
I	8-10	(9)	28-40	(31)
II	5-8	(7)	28-38	(31)
III	8-10	(9)	28-35	(30)
Uropods	18-25	(23)	10-18	(13)
Caudal Setae	95-163	(136)	—	
Egg Sacs	100-350	(257)	50-110	(68)

TABLE 5. Antennal measurements, in micrometers, of adult females of *B. anodus* sp. n.

	Length		Width	
Antenna I (antennule)	68-83 (74)		10-20 (15)	
Antenna II (prehensile)				
Segment 1	45-58	(50)	28-40	(33)
2	55-68	(63)	20-28	(23)
3	70-88	(80)	10-15	(13)

TABLE 6. Relationships of Spines to Setae on the Legs of *B. anodus* sp. n.

	Exopod			Endopod		
Leg 1	I-0,	0-1,	II-5	0-1,	II-5	
2	0-0,	0-1,	I-6	0-1,	0-2,	I-4
3	0-0,	0-1,	0-6	0-1,	0-2,	I-4

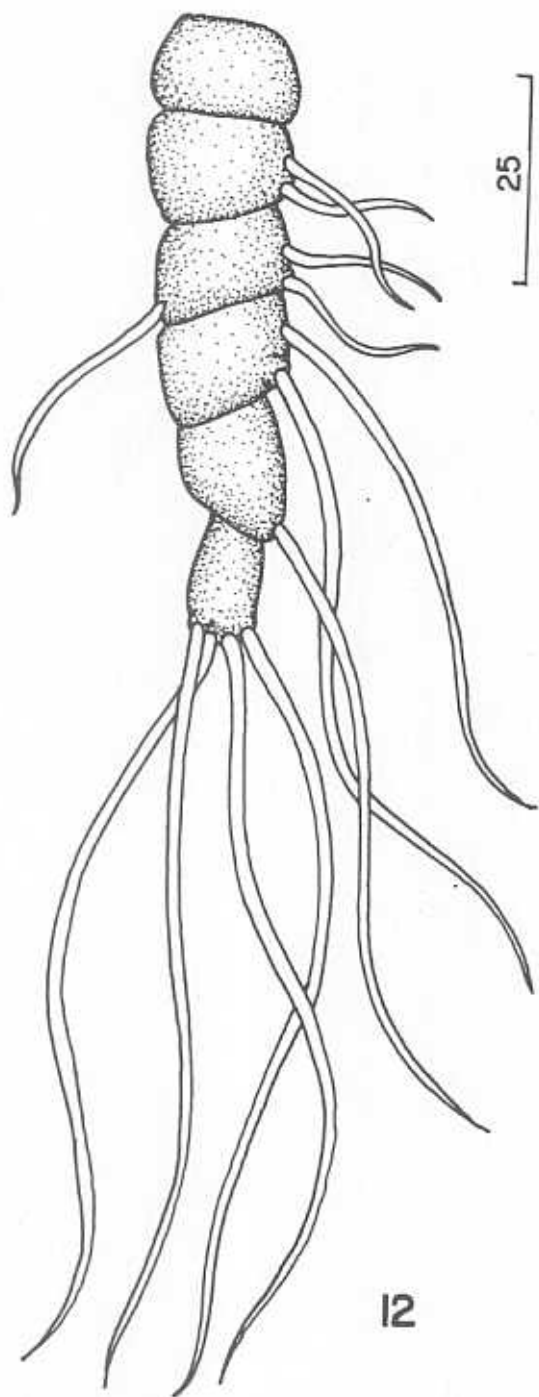


Fig. 12. *B. anodus*, First antenna (antennule).

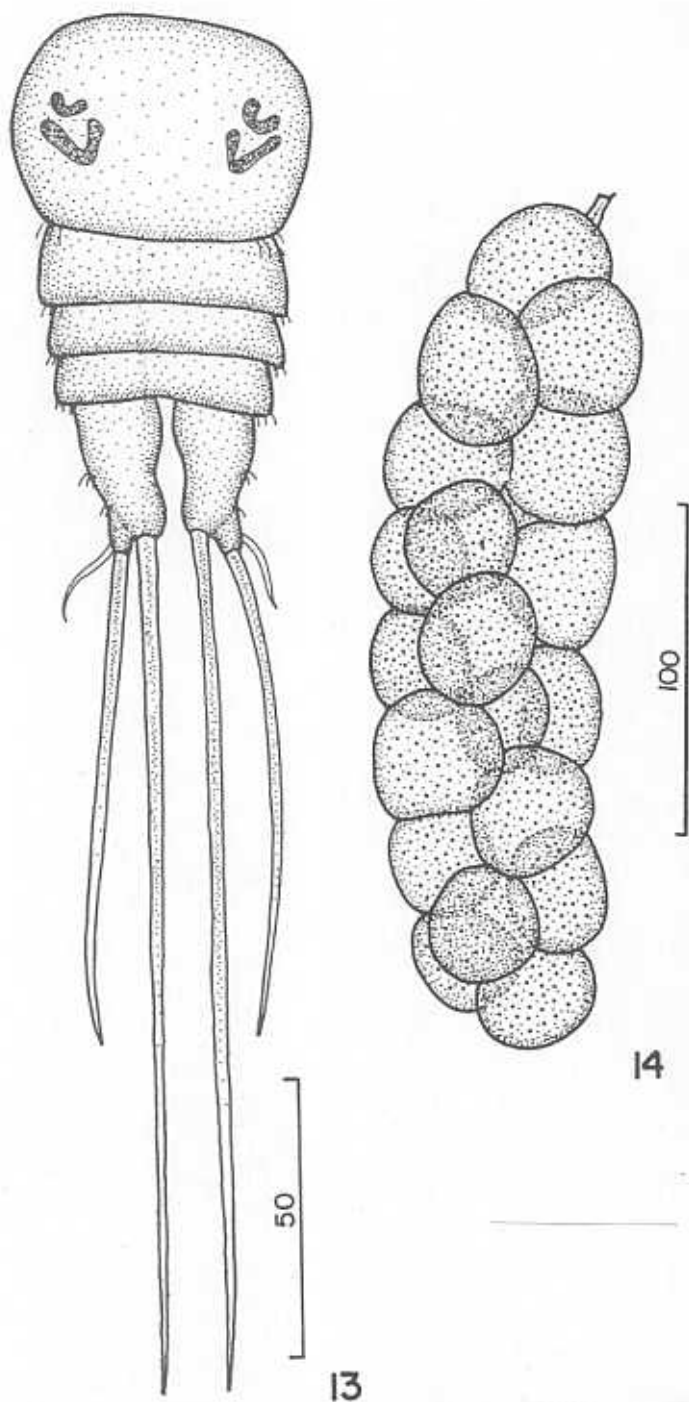


Fig. 13. *B. anodus*, Genital segment, abdomen and uropods.

Fig. 14. *B. anodus*, Egg sac.

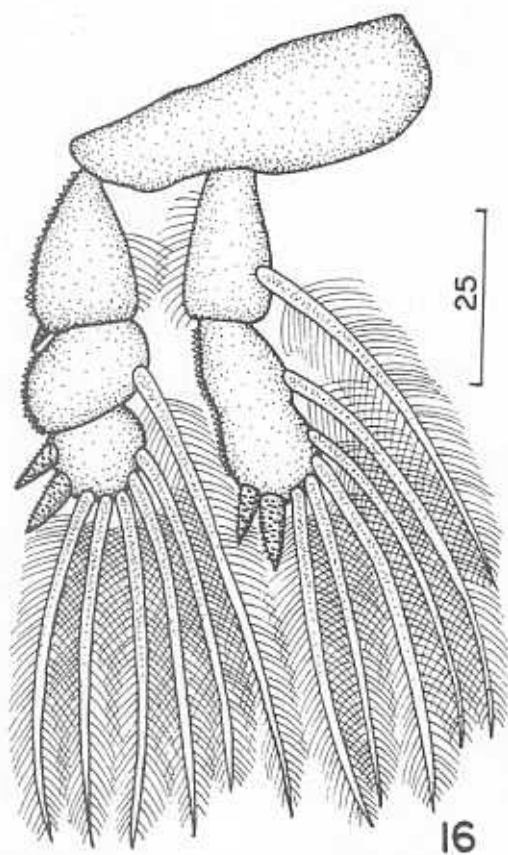
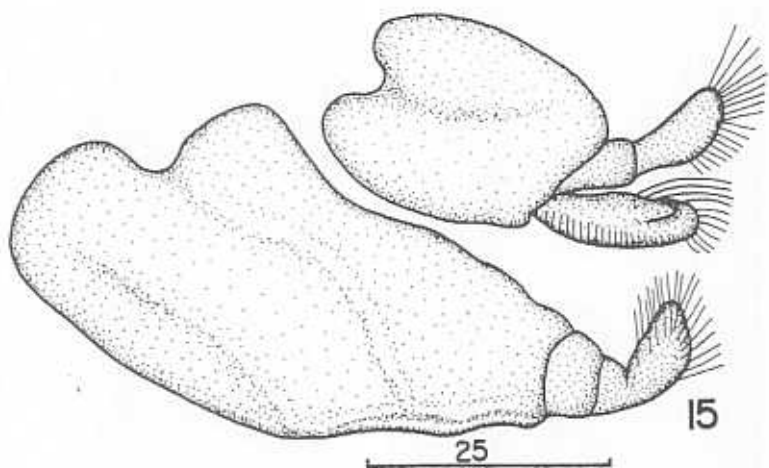
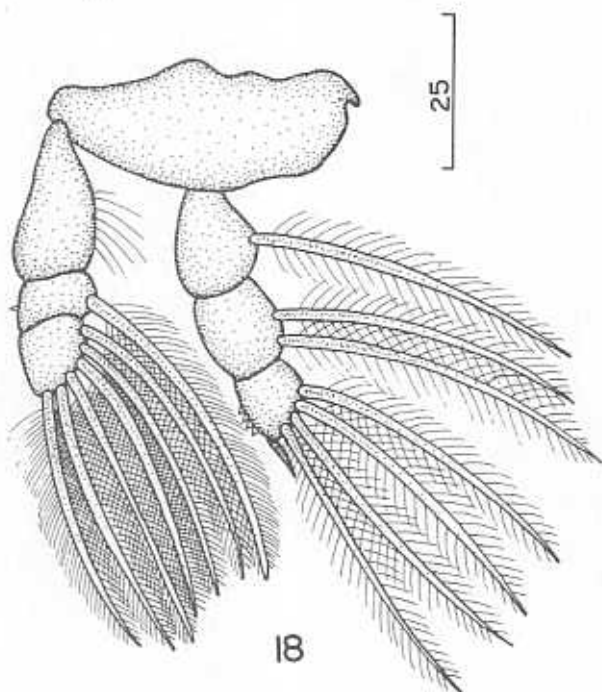
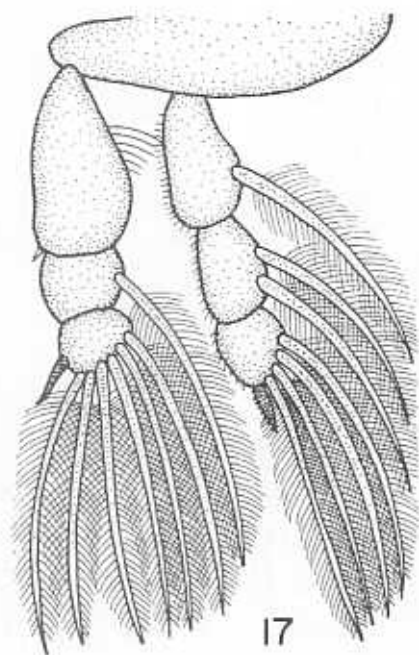


Fig. 15. *B. anodus*, Mouthparts. Fig. 16. *B. anodus*, Leg 1.



F.g. 17. *B. anodus*, Leg 2. Fig. 18. *B. anodus*, Leg 3.

seta medially and pilose lateral margin; terminal segment with five plumose setae and two rasp-like, large spines; lateral margin pectinate; exopod three-segmented; first segment pilose medially and pectinate laterally and with one spine postero-laterally; second segment with a single, plumose seta medially and pectinate laterally; terminal segment with five, plumose setae and two, large, rasp-like spines. Leg 2 (Fig. 17): both rami three-segmented; first endopodal segment pilose laterally, with a single, plumose seta medially; second segment pilose laterally and with two plumose setae medially; terminal segment pilose laterally and with four plumose setae and a single, rasp-like spine; first exopodal segment with a few hairs medially and a small spinule postero-laterally; second segment with a single, plumose seta medially; terminal segment with six plumose setae and a single, large spine; Leg 3 (Fig. 18): both rami three-segmented; first endopodal segment with a single, plumose seta medially; second segment with two, plumose setae medially; terminal segment with four, plumose setae, one large spine and a few spinules; first exopodal segment with a few hairs medially; second segment with a single, plumose seta medially and a single spinule laterally; terminal segment with six, plumose setae.

Egg sac (Fig. 14) elongate, with 15-25 spherical eggs.

DISCUSSION

The Family Ergasilidae, as presently conceived, contains more than 70 species of *Ergasilus* and an additional 24 species distributed in 10 other genera. Yamaguti (1963) did not divide this group into Subfamilies as he did for the Bomolochidae. The occurrence in New Zealand of *Abergasilus* Hewitt, 1978, and the presence in Amazônia of *Brasergasilus* gen. nov., both having only three pairs of swimming legs, require a new evaluation of the Ergasilidae. Although Hewitt (1978) did not discuss the matter, it should be admitted that neither of these genera conforms to the definitions of Ergasilidae currently in use (ie. Yamaguti, 1963 & Roberts, 1970). These definitions indicate that females should have four pairs of swimming legs and a fifth pair of vestigial legs. Hewitt (1978) reported some ventral spines on the pre-genital segments of *Abergasilus* that he thought might represent vestigial legs, but this interpretation seems unlikely. Vestigial legs in ergasilids are typically represented by setae, not spines, and in any case, the spines are in the wrong position. Careful examination of *Brasergasilus* failed to reveal any vestigial legs, so we are forced to conclude that neither

genus has them. In addition to a reduction in number of legs, these genera also show greatly reduced fifth and sixth thoracic segments. These are the segments which normally bear the fourth and fifth pairs of legs in ergasilids. It is therefore necessary to propose the new Subfamily Abergasilinae for the two genera and to tentatively define Ergasilinae to include the other 11 genera of Ergasilidae. Undoubtedly, it will be found necessary to further divide this Family in the future, after other unusual Amazonian forms have been described. A redefinition of the Family and of the Order Cyclopidea will also be attempted at that time.

The fundamental difference between *Brasergasilus* gen. nov. and *Abergasilus* Hewitt, 1978, is that the latter has a large, spine-shaped projection from the base of the second segment of the prehensile antenna which abutts against the claw-like third joint. The new genus completely lacks this basic structure. Additionally, *Abergasilus* has six free thoracic segments, and the rami of all legs are three-segmented, whereas in the new genus there are only five free thoracic segments and the first endopod is two-segmented.

Brasergasilus jaraquensis sp. nov. and *B. anodus* sp. nov. can be distinguished by the following characters: 1) the type species

is slightly larger and has more pigmentation, with an overall greenish hue, while the latter has scattered, bluish pigment granules; 2) the prehensile antenna of *B. jaraquensis* is slender, and the claw has its most abrupt curvature distally, while in *B. anodus*, the antenna is stouter and the principal bend is proximal; 3) the uropod of the type species, bears two setae and two small spines, whereas that of the other species has three setae and lacks spines; 4) the first leg of *B. jaraquensis* is laterally serrate, while that of *B. anodus* is pectinate. It is also worth noting that these species were found on different genera of host fishes and they are probably host specific.

ABSTRACT

Brasergasilus jaraquensis gen. et sp. nov. and *B. anodus* sp. nov. (Copepoda: Cyclopidea: Ergasilidae), gill parasites of *Semaprochilodus insignis* (Schomburgk) and *Anodus elongatus* Spix, are described from the Amazon River. The new genus has only three pairs of swimming legs and in this respect is similar only to one species from New Zealand, *Abergasilus amplexus* Hewitt, 1978. The two genera also have in common a three-segmented prehensile antenna. *Abergasilus*, however, has the base of the second antennal segment developed into a massive spine which abutts against the claw-like third segment. The new genus completely lacks this fundamental structure. Additionally, *Abergasilus* has six free thoracic segments while the new genus only has five. Abergasilinae Subfam. nov. is proposed for these two genera and their three species. Ergasilinae nom. nov. is

provisionally defined and proposed to include the other 11 genera of the family. The type species of *Brasergasilus* gen. nov. is *B. jaraquensis* sp. nov. and it can be distinguished from *B. anodus* sp. nov. by the following characteristics: 1) The type species is larger and of a greenish coloration while *B. anodus* has fewer pigment granules that are of a bluish tint. 2) *B. jaraquensis* has a more slender second antenna and the most abrupt bend of the claw occurs distally; the second antenna of *B. anodus* is thicker and the abrupt bend is found proximally. 3) The uropod of the type species has two setae and two small spines, while that of the other species has three setae and lacks spines. 4) The first leg of *B. jaraquensis* is laterally serrate while that of *B. anodus* is pectinate. The two species parasitize two different genera of host fish and are probably host specific.

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