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**Intestinal helminths as population markers of the Amazonian fish
Mylesinus paraschomburgkii, with descriptions of five new genera
and seven new species of trematodes**

by

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Abstract

Helminths from the intestinal tracts of fish called "pacus" were studied. The fish were found only in rapids areas of Northeastern tributaries of the Amazon River. Since this species, *Mylesinus paraschomburgkii* JÉGU, SANTOS & FERREIRA, 1989, does not migrate, each river has a separate population in its upper reaches. These populations are believed to have been isolated from each other, by high water, since the last glaciation some 12,000 years ago. It was thought that differences in the helminth faunas might reflect such isolation. Collection sites were: the Uatumã, Pitinga and Capucapu Rivers, Amazonas State (considered one population), the Trombetas and Jari Rivers, Pará State and the Araguari River, Amapá State. Seven species of trematodes were found, namely: *Alphamphistoma canoeforma* gen. et sp. nov. which has a body that is extremely concave ventrally and short ceca; *Betamphistoma jariense* gen. et sp. nov. which has parallel testes and a cirrus sac with heavy muscular walls; *Gammamphistoma collaris* gen. et sp. nov. a small species with large suckers and an anterior collar; *Deltamphistoma pitingaense* gen. et sp. nov. a form with short to moderately long ceca and testes that extend laterally beyond them; *Zetamphistoma compacta* gen. et sp. nov. with a wide body that is convex on both surfaces and thin marginally; *Pseudocladorchis cylindricus* (DIESING, 1836) with a large, cylindrical body, parallel testes and vitelline follicles that extend anteriorly to beyond them and the Haploporidae, *Saccocoelioides rotundus* sp. nov. which has a compact body, rounded posteriorly and vitellaria that nearly surround the testis. *P. cylindricus* was found at all sites except the Jari River. The latter has also been reported from other hosts. From three to four species of trematodes were found in each host population and some of these appear to be useful as markers. *D. pitingaense* was found only in the Amazonas State population and *B. jariense* appeared only in fish from the Jari River. The haploporid, *S. rotundus* was found in the Trombetas River population exclusively. The most typical trematode from Araguari River hosts was *Z. compacta* but this species was also found in fish from the Trombetas River. Two nematode species representing the family Atractidae, namely; *Protractis* sp. and *Rondonia rondoni* TRAVASSOS, 1919, were found in all the fish examined. The former inhabits the pyloric ceca and the first three or four centimeters of upper intestinal tract whereas *R. rondoni* completely packs the rest of the gut. Another nematode, *Cucullanus* sp. (Cucullanidae), was found in numbers from 1-24 in the upper intestinal tracts of hosts from the Trombetas River only.

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The neotropical fish, *Mylesinus paraschomburgkii* JÉGU, SANTOS & FERREIRA, 1989 (Fig. 1) is a member of the large family Serrasalminidae. This species is one of several known as "pacus" and when adult it feeds almost exclusively on Podostemaceae, a family of aquatic plants. *M. paraschomburgkii* lives only in rapids areas of Northeastern tributaries of the Amazon River (see map, Fig. 2). Since this species is not known to migrate, there are believed to be several isolated populations. These groups may have been separated from each other by rising water levels since the last glacial period, about 12,000 years ago (JÉGU & SANTOS 1993).

Members of the trematode family Cladorchiidae have a life cycle in which the cercariae that are liberated from infected snails encyst on aquatic vegetation and form the metacercarial or infective stage. Members of the families Angiodictyidae and Haploporidae have similar life-cycles. The presence of any of these trematodes in a vertebrate host indicates that the latter consumes vegetation. We have found a surprising quantity and variety of such trematodes in Amazonian fish (THATCHER & VARELLA 1981; THATCHER 1978, 1979, 1991, 1992a, 1992b, 1993). Greater host specificity than expected has also been observed. In some cases, it has been possible to characterize populations or species of serrasalminid fish on the basis of their unique intestinal helminths.

Material and methods

Fish hosts were netted in rapids areas of the Uatumã, Pitinga and Capucapu Rivers of Amazonas State, the Trombetas and Jari Rivers of Pará State and the Araguari River of Amapá State (the latter being a new distributional record for this host). All of these are Northeastern tributaries of the Amazon River in Brazil. Fish were fixed in 10 % formalin solution and later transferred to 70 % alcohol. The fixed intestinal tracts were removed, opened and washed in tap water. Trematodes were recovered in finger bowls by hand sedimentation. Permanent slide preparations were made by the phenol-balsam method which is explained in THATCHER (1992a). Drawings were made with the aid of a camera lucida and measurements are in μm except where indicated as mm. The amphistome classification followed was that proposed by SEY (1991). Holotype and paratype specimens were deposited in the Invertebrate Collection, Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil. Additional paratypes were placed in the Helminth Collection, University of Nebraska State Museum (UNSM), Harold W. Manter Laboratory, Lincoln, Nebraska.

Results

Family Cladorchiidae SOUTHWELL & KIRSHNER, 1937

Alphamphistoma gen. nov.

Generic diagnosis: With the characters of the family. Body elongate, narrow, deeply concave ventrally, with lateral margins folded in. Pharynx small, with external diverticula; esophagus without muscular bulb; ceca slender, shorter than body. Acetabulum

subterminal, without posterior indentation on rim. Testes lobate, tandem, in anterior half of body; cirrus sac in anterior one-third of body; genital pore immediately post-bifurcal. Ovary spherical, on mid-line, in posterior one-third of body; vitellaria follicular, anterolateral to ovary, not reaching level of posterior testis; uterus intercecal, eggs numerous. Intestinal parasites of freshwater fish.

Type species: *Alphamphistoma canoeforma* sp. nov.

***Alphamphistoma canoeforma* sp. nov. (Figs. 3-4)**

Host: *Mylesinus paraschomburgkii*. (Fig. 1).

Localities: All four populations. (Fig. 2).

Holotype and 6 paratypes: INPA. Three additional paratypes: UNSM.

Etymology: The generic name was formed by combining the first letter of the Greek alphabet with the classic designation for this type of worm. The specific name refers to the canoe-shaped body.

Species diagnosis (10 specimens measured): Body 5.0 (3.4-5.9) mm long and 2.0 (1.5-2.9) mm wide. Acetabulum 943 (666-1,248) long and 954 (707-1,290) wide. Pharynx 344 (258-516) long and 291 (232-400) wide; esophagus 241 (172-301) long; ceca 58-155 in diameter. Anterior testis 445 (310-707) long and 641 (430-978) wide; posterior testis 387 (310-624) long and 668 (473-874) wide; cirrus sac 323 (258-507) long and 175 (103-327) wide. Ovary (103-258) long and 160 (103-300) wide; vitelline follicles about 50 in diameter; eggs 113 x 63 (103-129 x 51-69).

Remarks: *Alphamphistoma canoeforma* sp. nov. has a body shaped like a canoe. Apparently, the entire ventral surface is used for attaching to the wall of the host's intestine. The new species also has small suckers, intercecal testes and uterus and the ceca are shorter than the body.

***Betamphistoma* gen. nov.**

Generic diagnosis: With the characters of the family. Body small, flattened, tapered anteriorly. Acetabulum terminal, with posterior indentation on inner rim. Pharynx with external diverticula; esophagus without bulb; ceca slender, shorter than body. Testes lobate, parallel, equatorial; cirrus sac with heavy muscular walls; genital pore post-bifurcal; small, spherical genital atrium present. Ovary small, subspherical, on mid-line between cecal ends; vitellaria of few small follicles, lateral to ovary; uterus intercecal, eggs numerous. Intestinal parasites of freshwater fish.

Type species: *Betamphistoma jariense* sp. nov.

***Betamphistoma jariense* sp. nov. (Fig. 8)**

Host: *Mylesinus paraschomburgkii*.

Locality: Rio Jari, Pará State, Brazil.

Holotype and 6 paratypes: INPA. Three additional paratypes: UNSM.

Etymology: The second letter of the Greek alphabet was joined to the classic

designation for the worms to form the generic name. The specific name is in reference to the Jari River.

Species diagnosis (10 specimens measured): Body 3.2 (2.8-4.1) mm long and 1.3 (1.1-1.6) mm wide. Acetabulum 433 (344-568) long and 662 (602-757) wide. Pharynx 307 (258-344) long and 191 (155-240) wide; esophagus 193 (129-300) long; ceca 65-147 in diameter. Left testis 356 (215-645) long and 357 (172-447) wide; right testis 335 (129-542) long and 359 (267-559) wide; cirrus sac 318 (215-370) long and 250 (146-378) wide. Ovary 205 (80-146) long and 101 (50-129) wide; vitellaria 34-52 in diameter; eggs 94 x 35 (85-103 x 30-40).

Remarks: *Betamphistoma jariense* sp. nov. has a small, flattened body with a terminal acetabulum. The ceca are short, the testes are parallel, the cirrus sac has heavy muscular walls and the vitellaria are of limited extent.

Gammamphistoma gen. nov.

Generic diagnosis: With the characters of the family. Body small, little flattened, with collar-like expansion anteriorly. Pharynx with external diverticula; esophagus short, muscular bulb present; ceca long. Acetabulum large, with posterior notch on inner rim. Testes large, lobate, tandem, pre-equatorial; cirrus sac ovoid, thin-walled; genital pore bifurcal, small genital atrium present. Ovary spherical, on mid-line near acetabulum; vitellaria follicular, lateral to ovary, of limited extent; uterus intercecal, eggs numerous. Intestinal parasites of freshwater fish.

Type species: *Gammamphistoma collaris* sp. nov.

Gammamphistoma collaris sp. nov. (Fig. 10)

Host: *Mylesinus paraschomburgkii*.

Localities: Uatumã, Pitinga and Capucapu Rivers, Amazonas State, and Jari River, Pará State.

Holotype and 5 paratypes: INPA. Three additional paratypes UNSM.

Etymology: The third letter of the Greek alphabet was joined to the classic designation of the worms for the generic name. The species name refers to the collar-like anterior expansion.

Species diagnosis (9 specimens measured): Body 1.7 (1.2-2.2) mm long and 0.7 (0.6-0.9) mm wide. Acetabulum 495 (378-585) long and 544 (482-602) wide. Pharynx 235 (189-258) long and 180 (138-241) wide; esophagus 71 (17-103) long; ceca 23-129 in diameter. Anterior testis 91 (43-172) long and 221 (172-258) wide; posterior testis 97 (52-155) long and 235 (206-275) wide; cirrus sac 176 (129-215) long and 120 (76-172) wide. Ovary 80 (58-95) long and 91 (58-129) wide; vitelline follicles 17-35 in diameter; eggs 110 x 61 (97-127 x 46-92).

Remarks: *Gammamphistoma collaris* sp. nov. has a small, nearly cylindrical body with large suckers and an anterior collar-like expansion. It also has long ceca, large testes and vitellaria of limited extent.

Deltamphistoma gen. nov.

Generic diagnosis: With the characters of the family. Body cylindrical, slightly flattened. Acetabulum small, subterminal. Pharynx with external diverticula; esophagus with muscular bulb; ceca shorter than body, usually not reaching ovary. Testes large, overlapping ceca, bluntly lobate, tandem, pre-equatorial; cirrus sac thin-walled; genital pore post-bifurcal, small atrium present. Ovary subspherical, lateral to mid-line, in posterior one-fourth of body; vitelline follicles on either side of body, near ceca, extend from ovary to posterior testis; uterus intercecal, eggs numerous. Intestinal parasites of freshwater fish.

Type species: *Deltamphistoma pitingaense* sp. nov.

Deltamphistoma pitingaense sp. nov. (Fig. 9)

Host: *Mylesinus paraschomburgkii*.

Localities: Uatumã, Pitinga and Capucapu Rivers, Amazonas State.

Holotype and 6 paratypes: INPA. Three additional paratypes: UNSM.

Etymology: The fourth letter of the Greek alphabet was combined with the classic designation for the family of worms to form the generic name. The specific name is in reference to the Pitinga River.

Species diagnosis (10 specimens measured): Body 3.4 (3.1-4.1) mm long and 1.5 (1.0-1.6) mm wide. Acetabulum 525 (430-568) long and 551 (516-602) wide. Pharynx 283 (258-344) long and 238 (206-258) wide; esophagus 135 (60-258) long; ceca 60-275 in diameter. Anterior testis 403 (215-516) long and 881 (559-1,118) wide; posterior testis 370 (241-499) long and 869 (344-1,204) wide; cirrus sac 325 (215-387) long and 247 (129-344) wide. Ovary 172 (155-206) long and 178 (155-224) wide; vitelline follicles 60-129 in diameter; eggs 105 x 44 (95-120 x 34-52).

Remarks: *Deltamphistoma pitingaense* sp. nov. has a nearly cylindrical body, small suckers, short ceca, large testes, a cirrus sac without heavy walls, an ovary displaced laterally and vitellaria extending to the posterior testis.

Zetamphistoma gen. nov.

Generic diagnosis: With the characters of the family. Body small, wide, flattened, convex on both surfaces, thinner peripherally. Pharynx with external diverticula; esophagus slender, with small bulb; ceca shorter than body. Acetabulum terminal, with indentation on posterior inner rim. Testes lobate, tandem, pre-equatorial, intercecal; cirrus sac ovoid, with thin walls; genital pore post-bifurcal. Ovary subspherical, on mid-line, near acetabulum; vitellaria of few follicles on either side of ovary; uterus intercecal, eggs numerous, small proximally, larger distally. Intestinal parasites of freshwater fish.

Type species: *Zetamphistoma compacta* sp. nov.

Zetamphistoma compacta sp. nov. (Fig. 5)

Host: *Mylesinus paraschomburgkii*.

Localities: Trombetas River, Pará State, and Araguari River, Amapá State.

Holotype and 6 paratypes: INPA. Three additional paratypes: UNSM.

Etymology: The sixth letter of the Greek alphabet was combined with the classic designation for paramphistomids to form the generic name. The species name is in reference to the body shape.

Species diagnosis (10 specimens measured): Body 3.0 (2.5-3.9) mm long and 1.9 (1.5-2.5) mm wide. Acetabulum 598 (478-638) long and 803 (611-936) wide. Pharynx 344 (327-374) long and 196 (155-258) wide; esophagus 425 (344-666) wide; ceca 86-172 in diameter. Anterior testis 192 (129-430) long and 438 (344-860) wide; posterior testis 185 (129-344) long and 527 (327-946) wide; cirrus sac 224 (129-335) long and 138 (86-215) wide. Ovary 115 (69-172) long and 120 (69-172) wide; vitelline follicles 33-52 in diameter; uterus intercecal, eggs numerous, 109 x 52 (92-115 x 46-58).

Remarks: *Zetamphistoma compacta* sp. nov. has a wide, flat body that is convex on both surfaces and peripherally thin. The acetabulum is terminal, the testes and uterus are intercecal, the cirrus sac is thin-walled, the ceca are short and the vitellaria are of limited extent.

Pseudocladorchis cylindricus (DIESING, 1836) (Fig. 6-7)

Host: *Mylesinus paraschomburgkii*.

Additional hosts (according to THATCHER, 1993): *Piaractus brachypomus*, *Mylossoma aureum*, *Pterodoras granulosus*, *Pimelodus ornatus*.

Localities: This species was found in all populations except that of the Jari River, Pará State.

Voucher specimens: 5 at INPA and 5 at UNSM.

Species diagnosis (10 specimens measured): Body large, cylindrical, little flattened, measures 7.9 (5.0-10.5) mm long and 3.9 (2.9-5.0) mm wide. Acetabulum subterminal, measures 2.1 (1.5-2.8) mm long and 2.2 (1.5-2.8) mm wide. Pharynx with internal diverticula, measures 922 (624-1,248) long and 1,038 (707-1,373) wide; esophagus without bulb, 1,337 (832-1,872) long and 295 (208-416) wide; ceca shorter than body, nearly straight, slender, measure 103-416 in diameter. Testes parallel, irregularly lobed or U-shaped; left testis 1,329 (936-1,560) long and 1,375 (1,040-1,872) wide; right testis 1,285 (832-2,080) long and 1,425 (832-1,872) wide; cirrus sac subspherical, with muscular walls, measures 560 (430-707) long and 461 (344-624) wide. Ovary on mid-line near acetabulum, measures 525 (344-688) long and 572 (344-728) wide; vitellaria lateral, extend from ovary to anterior to testes, follicles measure 86-125 in diameter; uterus inter and extracecal, eggs numerous, measure 116 x 57 (95-120 x 52-69). Intestinal parasites of freshwater fish.

Remarks: *Pseudocladorchis cylindricus* (DIESING, 1836) is not as host specific as most other amphistomes. It has been found in a variety of serrasalmid and silurid fishes. This species has a robust cylindrical body, a large oral sucker with internal diverticula, short straight ceca, lobular, parallel testes, a subspherical cirrus sac, a uterus that is both inter and extracecal and extensive vitelline glands that extend anterior to the

testes and nearly reach the level of the genital pore.

Haploporidae NICOLL, 1914

Saccocoelioides SZIDAT, 1954, THATCHER, 1978

Saccocoelioides rotundus sp. nov. (Fig. 11)

Host: *Mylesinus paraschomburgkii*.

Locality: Trombetas River, Pará State.

Holotype and 6 paratypes: INPA. Three additional paratypes: UNSM.

Etymology: The species name is in reference to the rounded posterior extremity of this worm.

Species diagnosis (10 specimens measured): With the characters of the genus and family. Body small, subspherical posteriorly and tapered anteriorly, measures 657 (525-903) long and 394 (344-473) wide. Acetabulum 146 (115-189) long and 153 (127-189) wide. Oral sucker 133 (104-161) long and 155 (133-184) wide; pharynx 89 (53-115) long and 87 (80-103) wide. Testis subspherical, measures 249 (155-344) long and 234 (155-184) wide; hermaphroditic bursa 167 (138-184) long and 91 (78-104) wide. Ovary subspherical, measures 82 (55-112) long and 89 (64-172) wide; vitellaria numerous, follicular, dorsal and lateral to testis; eggs 81 x 37 (71-109 x 32-42). Excretory pore terminal. Intestinal parasites of freshwater fish.

Remarks: This new species differs from all others in the genus in having an unusually large testis that is surrounded, except on the ventral side, by vitelline follicles. *S. rotundus* lives in the pyloric ceca and upper intestinal tract.

Discussion and conclusions

Paramphistomata are primitive trematodes in which the digestive system is well developed and the intestinal walls are provided with villi. Some are known to feed on ciliates within the host's intestine. In reference to the species *Balanorchis anastrofus* in cattle, SZIDAT & NUÑEZ (1962) pointed out that since these worms feed on ciliates and do no harm to the host, they could be considered "endocommensals". In the present study, the ciliate *Nyctotherus piscicola* DADAY, 1905, was frequently seen in the intestinal ceca of the amphistomes, and no pathology related to these worms was observed. Evenso, since most of these species are highly host specific, they must have developed a biochemical dependence on their hosts.

Among the four populations of *Mylesinus paraschomburgkii*, seven species of trematodes were found. Four were from the Amazonas State population, four from the Trombetas River and three each from the Jari and Araguari Rivers (Table 1). *Alphamphistoma canoeforma* occurred in all four populations and *Pseudocladorchis cylindricus* in all but the Jari River site. This suggests a wide geographic distribution for these worms since the Amazonas and Araguari populations are separated by nearly 2,000 kilometers. The Amazonas population was "marked" by the presence of *Deltamphistoma pitingaense* and *Gammamphistoma collaris*, although the latter also occurred in the Jari River collection. The haploporid, *Saccocoelioides rotundus*, was found only in the Trombetas River population, where it was quite common. *Betamphistoma jariense* was



limited to fish from the Jari River. *Zetamphistoma compacta* was numerous and common in the Araguari River fish but it also occurred in the Trombetas River.

As for nematodes, two genera of Atractidae were found in all fish examined from all four populations. *Protractis* sp. was seen in large numbers packing the pyloric ceca and the first three or four centimeters of upper intestinal tract. *Rondonia rondoni* TRAVASSOS, 1919, occurred in even greater numbers packing the rest of the intestinal tract. Additionally, a genus of Cucullanidae namely, *Cucullanus* sp. was found in numbers from 1 to 24 in hosts from the Trombetas River only and may therefore serve to "mark" that population. The species of *Protractis* and of *Cucullanus* appear to be new and they will be described elsewhere.

Table I shows the prevalence and intensity of the different helminths in the four host populations. It can be seen that *A. canoeforma* was more prevalent (74 and 82 %) in populations I and II while *Z. compacta* occurred in 80 % of hosts from the Araguari River and only 45 % of those from the Trombetas River. The prevalence for *P. cylindricus* was 50 to 60 % in three of the populations but was not found in hosts from the Jari River.

Resumo

Helmintos intestinais como marcadores de populações de um peixe amazônico, *Mylesinus paraschomburgkii*, com descrições de cinco novos gêneros e sete novas espécies de trematódeos.

Helmintos do trato intestinal de *Mylesinus paraschomburgkii* JÉGU, SANTOS e FERREIRA, 1989, foram estudados. Os peixes foram capturados nas regiões de cachoeiras e corredeiras dos rios: Uatumã, Pitinga e Capucapu (considerados uma população), no Estado do Amazonas; Trombetas e Jari, no Estado do Pará e Araguari, no Estado do Amapá. Todos são tributários da margem esquerda do rio Amazonas. Estes peixes são conhecidos vulgarmente como "pacus", não migram e cada rio tem uma população independente. Provavelmente, estas populações estejam isoladas, uma da outra, desde a última glaciação, cerca de 12.000 anos. As faunas helmintológicas foram estudadas visando detectar modificações que poderiam resultar de tal isolamento. Sete espécies de trematódeos foram encontrados, a saber: *Alphamphistoma canoeforma* gen. et sp. nov., que tem um corpo muito côncavo ventralmente e cecos curtos; *Betamphistoma jariense* gen. et sp. nov., que tem testículos paralelos e uma bolsa do cirro com paredes grossas; *Gammamphistoma collaris* gen. et sp. nov., uma espécie pequena com ventosas grandes e um colar anterior; *Deltamphistoma pitingaense* gen. et sp. nov., uma forma com cecos curtos ou pouco compridos e testículos que projetam lateralmente aos cecos; *Zetamphistoma compacta* gen. et sp. nov., com um corpo largo que é convexo aos dois lados e fino marginalmente; *Pseudocladorchis cylindricus* (DIESING, 1836), com um corpo grande e cilíndrico, testículos paralelos e glândulas vitelínicas que estendem anteriormente aos testículos; e a Haploporidae, *Saccocoelioides rotundus* sp. nov., que tem um corpo compacto, arredondado posteriormente e glândulas vitelínicas que quase circundam o testículo. *P. cylindricus* foi encontrado em todas as populações menos a do rio Jari. De três a quatro espécies de trematódeos foram encontradas em cada população de hospedeiros e algumas destas poderiam ser utilizadas como "marcadores". *D. pitingaense* foi encontrada somente nos peixes do Estado do Amazonas e *B. jariense* apareceu somente em hospedeiros do rio Jari. O haploporídeo, *S. rotundus* foi encontrado exclusivamente nos peixes do rio Trombetas. O trematódeo mais típico dos hospedeiros do rio Araguari foi *Z. compacta*, mas esta espécie foi encontrada também nos peixes do rio Trombetas. Duas espécies de Nematoda da família Atractidae, *Protractis* sp. e *Rondonia rondoni* TRAVASSOS 1919, foram encontradas em todos os peixes examinados. A primeira destas habita os cecos pilóricos e os primeiros três ou quatro centímetros do intestino enquanto *R. rondoni* preenche totalmente o resto do trato digestivo. Um nematoídeo da família Cucullanidae, *Cucullanus* sp., foi encontrado unicamente nos hospedeiros do rio Trombetas com uma intensidade de

1-24 indivíduos por peixe.

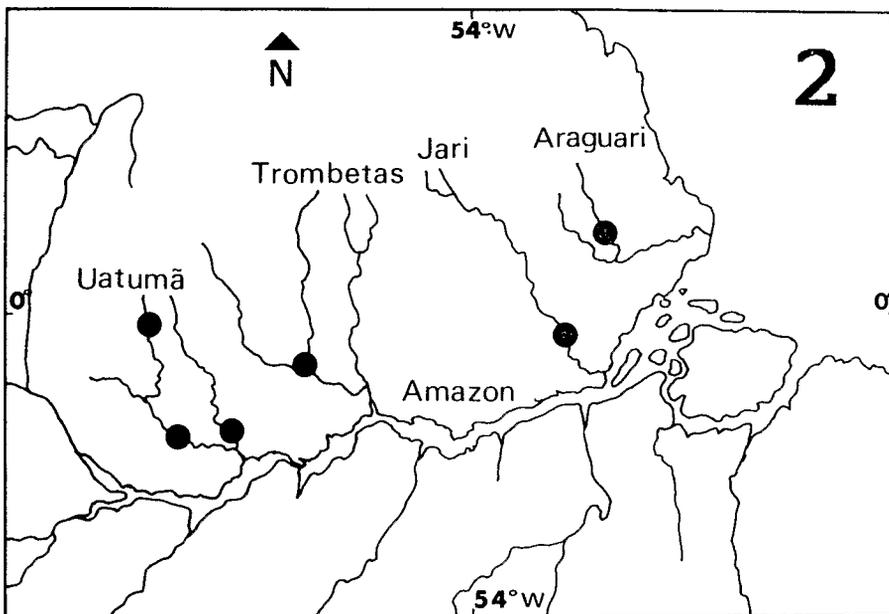
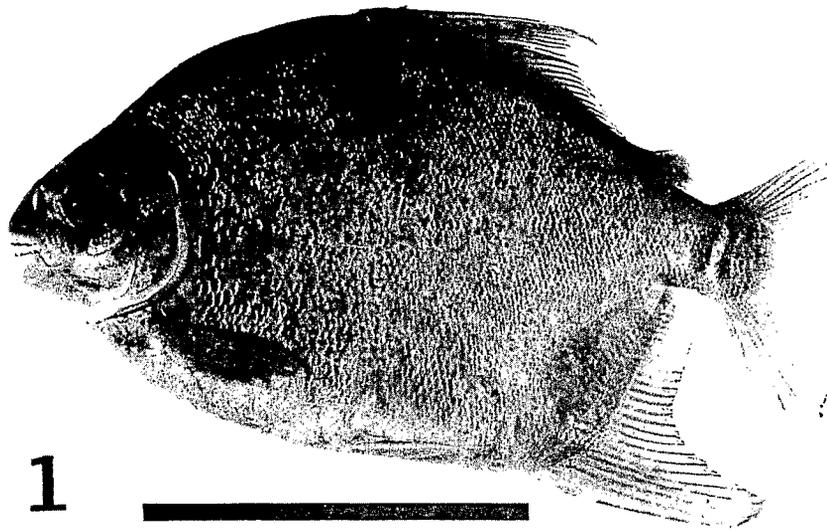
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Table 1: Populations of *Mylesinus paraschomburgkii* and their intestinal helminths*

Population	Prevalence	Intensity
I. Uatumã, Pitinga & Capucapu R.		
<i>Alphamphistoma canoeforma</i>	17/23(74 %)	3-50
<i>Gammanphistoma collaris</i>	12/23(52 %)	2-10
<i>Deltamphistoma pitingaense</i>	4/23(17 %)	1-5
<i>Pseudocladorchis cylindricus</i>	14/23(61 %)	1-6
II. Trombetas River		
<i>Alphamphistoma canoeforma</i>	9/11(82 %)	3-84
<i>Zetamphistoma compacta</i>	5/11(45 %)	1-63
<i>Pseudocladorchis cylindricus</i>	6/11(55 %)	1-3
<i>Saccocoelioides rotundus</i>	8/11(72 %)	3-78
<i>Cucullanus</i> sp.	4/11(36 %)	1-24
III. Jari River		
<i>Alphamphistoma canoeforma</i>	5/9(56 %)	10-87
<i>Betamphistoma jariense</i>	4/9(44 %)	4-32
<i>Gammanphistoma collaris</i>	2/9(22 %)	2-30
IV. Araguari River		
<i>Alphamphistoma canoeforma</i>	4/10(40 %)	3-17
<i>Zetamphistoma compacta</i>	8/10(80 %)	4-204
<i>Pseudocladorchis cylindricus</i>	5/10(50 %)	1-8

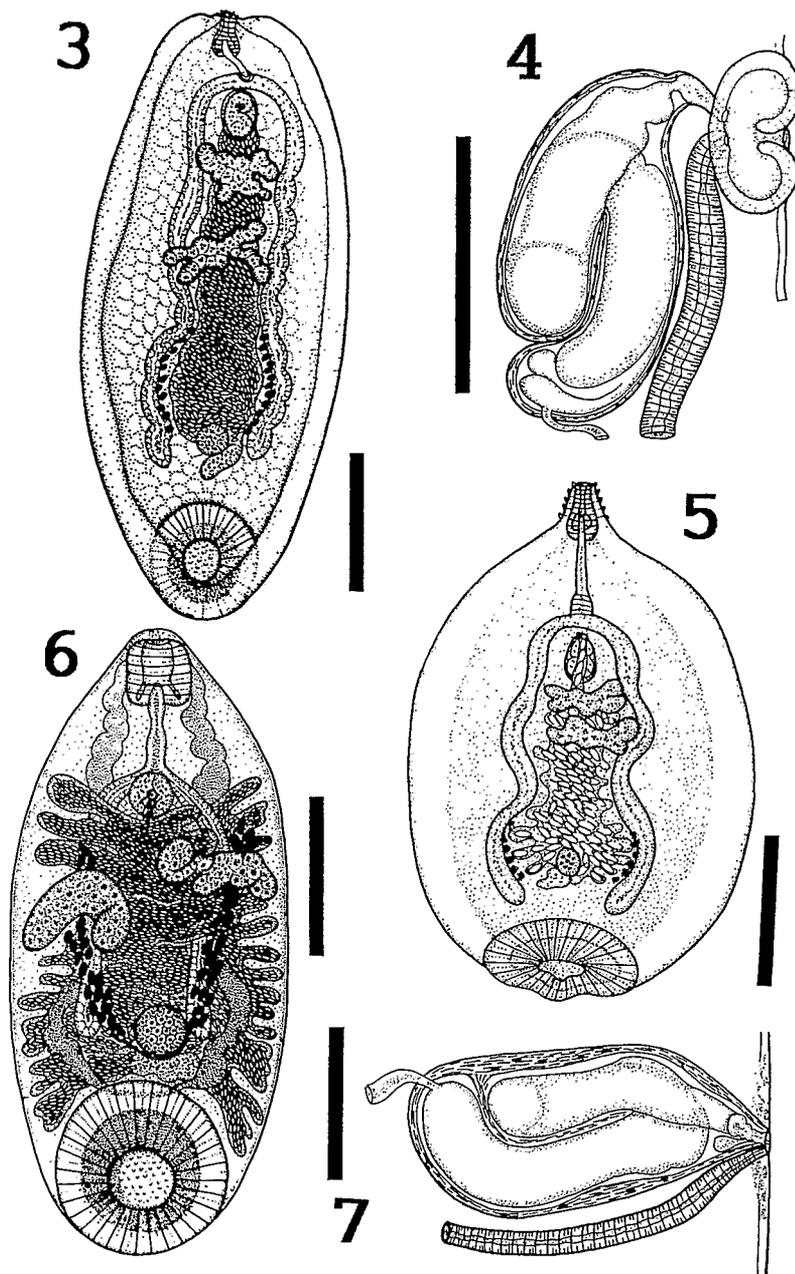
* Additionally, nearly all adult hosts contained countless numbers of nematodes *Rondonia rondoni* and *Proatractis* sp.



Figs. 1-2:

1: *Mylesinus paraschomburgkii*. Lateral view. Scale = 100 mm.

2: Map of lower Amazon River showing collecting sites on Northern tributary streams.



Figs. 3-7:

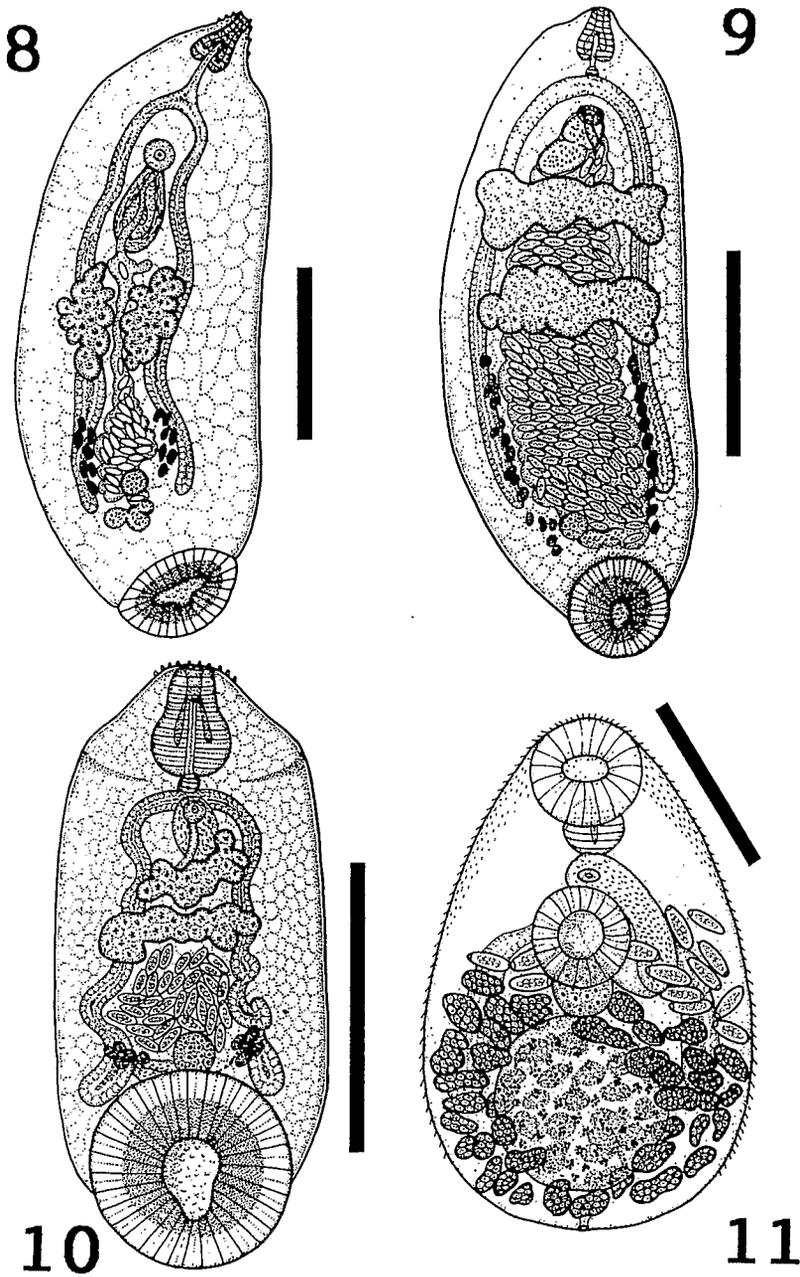
3: *Alphanphistoma canoeforma* gen. et sp. nov. Ventral view. Scale = 1 mm.

4: Terminal genitalia of *A. canoeforma*. Scale = 250 μ m.

5: *Zetamphistoma compacta* gen. et sp. nov. Ventral view. Scale = 1mm.

6: *Pseudocladorchis cylindricus*. Ventral view. Scale = 2 mm.

7: Terminal genitalia of *P. cylindricus*. Scale = 500 μ m.



Figs. 8-11:

8: *Betamphistoma jariense* gen. et sp. nov. Ventral view. Scale = 1 mm.

9: *Deltamphistoma pitingaense* gen. et sp. nov. Ventral view. Scale = 1 mm.

10: *Gammamphistoma collaris* gen. et sp. nov. Ventral view. Scale = 1 mm.

11: *Saccocoelioides rorundus* sp. nov. Ventral view. Scale = 250 μ m.

