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A SURVEY OF PLANORBID MOLLUSCS IN THE AMAZONIAN REGION OF BRAZIL

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A survey of the planorbid fauna in the Brazilian states of the Amazonian river basin revealed the occurrence of 14 species, 8 of the genus Biomphalaria, *4 of* Drepanotrema, *1 of* Antillorbis *and 1 of* Plesiophysa, *besides a naturalized population of* Helisoma duryi *at Santa Rosa, municipality of Formosa, state of Goiás. The following is the distribution of the species by genera, in decreasing order of frequency (number of localities in parentheses):*

1. Biomphalaria straminea *(50): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Pará and Roraima; 2.* B. occidentalis *(30): Acre, Amazonas, Mato Grosso and Mato Grosso do Sul; 3.* B. schrammi *(22): Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul and Pará; 4.* B. amazonica *(14): Acre, Amazonas and Rondônia; 5.* B. glabrata *(13): Distrito Federal, Goiás, Maranhão and Pará; 6.* B. peregrina *(4): Distrito Federal, Goiás and Mato Grosso do Sul; 7.* B. tenagophila *(2): Distrito Federal and Goiás; 8.* B. oligoza *(2): Mato Grosso do Sul; 9.* Drepanotrema lucidum *(72): Acre, Amapá, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Pará, Rondônia and Roraima; 10.* D. anatinum *(41): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso do Sul, Pará, Rondônia and Roraima; 11.* D. depressissimum *(19): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul and Pará; 12.* D. cimex *(15): Acre, Amazonas, Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul and Pará; 13.* Antillorbis nordestensis *(3): Distrito Federal, Maranhão and Pará; 14.* Plesiophysa ornata *(1): Goiás.*

B. glabrata *is responsible for transmission of schistosomiasis mansoni in northeastern Pará, northern Maranhão and central Goiás including the Distrito Federal.* B. tenagophila, *although susceptible to experimental infection with* Schistosoma mansoni, *has not been found naturally infected so far in the area.* B. straminea *has been incriminated as the vector at Fordlândia and Belém, state of Pará; it is the vector at Goiânia, state of Goiás.*

Besides those actual vectors of S. mansoni *there occur in the area two potential vectors,* Biomphalaria amazonica *and* B. peregrina.

Some years ago (Paraense, 1967) I published a preliminary review of the planorbid fauna of the Amazonian region, based on the available literature and on material

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studied by myself. Until then three species of *Biomphalaria* (*B. straminea, B. schrammi* and *B. amazonica*) and four of *Drepanotrema* (*D. anatinum, D. cimex, D. depressissimum* and *D. kermatoides*) had been recorded in 30 localities of the Brazilian states of Acre, Amazonas, Goiás, Mato Grosso, Pará and Rondônia.

Additional collecting was done in subsequent years during a series of trips, between May 1976 and July 1981, to the above-mentioned states, to the Maranhão state, the territories of Amapá and Roraima, and the Distrito Federal. Some samples received from local institutions for identification are also included.

The survey was planned to cover the area corresponding to the drainage basin of the Amazon river, but it was extended to the south of Mato Grosso and Goiás states to gain some knowledge of that little-studied area, notwithstanding its situation in the Paraguay and Paraná basins.* For the same reason the samples from eastern localities of Pará and Maranhão states are also included in this paper.

In all, 14 planorbid species were found in 130 localities (Table I and Figs. 1-3): 8 of the genus *Biomphalaria*, 4 of *Drepanotrema*, 1 of *Antillorbis* and 1 of *Plesiophysa*. A naturalized population of *Helisoma duryi* was found at Santa Rosa, a district of the Formosa municipality, Goiás state (Paraense, 1976), where it was introduced probably with aquatic plants conveyed by aquarists, since the genus *Helisoma* does not occur naturally in Brazil.

THE PLANORBID SPECIES

The following list comprises the localities where planorbid species have been found in the surveyed area. A number of localities are not recorded because when visited they could not be properly searched for reasons of drought, flood or heavy rains. In some of them planorbids were not actually found, which may have resulted from their having been visited on inappropriate season. In every instance identification was based on anatomic besides shell characters. In case of previous record, reference is made to the first author for the respective locality. Localities without reference to authors are those where planorbids had not been recorded before the present survey.

1. *Biomphalaria amazonica* Paraense, 1966.

State of Acre: Feijó, Tarauacá.

State of Amazonas: Careiro, Manaus (Paraense, 1966a); Anori, Benjamin Constant, Camará, Codajás, Humaitá, Manacapuru, Tabatinga, Tefé.

State of Rondônia: Guajará-Mirim, Porto Velho.

2. *Biomphalaria glabrata* (Say, 1818)

Distrito Federal (Crespo et al, 1965).

State of Goiás: Formosa at Lagoa Feia (Paraense & Deslandes, 1959).

State of Maranhão: Cururupu, São Luís (Lucena, 1956); Alegre, Areia Branca, Paço do Lumiar, Reginaldo, São Bento, São Lourenço (Martins & Almeida, 1966); Alcântara, Anajatuba, Araioses, Bacuri, Barreirinhas, Bequimão, Mirinzal, Palmeirândia,

*In October 1977 the southern part of Mato Grosso state was separated as the new state of Mato Grosso do Sul.

TABLE I

Origin of examined samples of planorbids

Locality	*B. am*	*B. gl*	*B. oc*	*B. ol*	*B. pe*	*B. sc*	*B. st*	*B. te*	*D. an*	*D. ci*	*D. de*	*D. lu*	*A. no*	*P. or*
ACRE														
1. Cruzeiro do Sul							+				+	+		
2. Tarauacá	+		+						+		+	+		
3. Feijó	+								+		+	+		
4. Sena Madureira			+								+	+		
5. Rio Branco							+		+		+	+		
6. Xapuri							+		+		+			
7. Brasiléia			+							+		+		
AMAZONAS														
8. Atalaia do Norte									+					
9. Benjamin Constant	+								+					
10. Tabatinga	+													
11. São Paulo de Olivença									+					
12. Santo Antônio do Içá									+					
13. Japurá									+					
14. Fonte Boa									+					
15. Tefé	+		+[1]											
16. Coari									+			+		
17. Camará	+								+			+		
18. Codajás	+								+			+		
19. Anori	+								+					
20. Manacapuru	+								+					
21. Manaus	+								+			+		
22. Careiro	+								+	+	+	+		
23. Humaitá	+													

TABLE I (cont.)

Locality	*B. am*	*B. gl*	*B. oc*	*B. ol*	*B. pe*	*B. sc*	*B. st*	*B. te*	*D. an*	*D. ci*	*D. de*	*D. lu*	*A. no*	*P. or*
RORAIMA														
24. Boa Vista							+		+			+		
AMAPÁ														
25. Macapá												+		
PARÁ														
26. Monte Alegre							+							
27. Santarém							+		+			+		
28. Belterra							+							
29. Fordlândia							+		+	+		+		
30. Itaituba							+		+		+	+		
31. Altamira							+		+			+		
32. Breves							+					+		
33. Marabá									+			+		
34. Paragominas									+			+		
35. Belém						+	+		+			+		
36. Ananindeua							+					+		
37. Santa Isabel do Pará							+							
38. Igarapé-Açu							+		+			+		
39. Livramento							+							
40. Santa Maria do Pará							+							+
41. São Miguel do Guamá									+			+		
42. Nova Timboteua							+							
43. Capanema		+					+		+	+		+		
44. Primavera		+					+		+	+		+		
45. Quatipuru		+					+		+	+		+		
MARANHÃO														
46. Cururupu		+				+								+
47. São Lourenço		+												
48. Reginaldo		+												
49. Guimarães							+							
50. São Bento		+				+					+	+		

TABLE I (cont.)

Locality	*B. am*	*B. gl*	*B. oc*	*B. ol*	*B. pe*	*B. sc*	*B. st*	*B. te*	*D. an*	*D. ci*	*D. de*	*D. lu*	*A. no*	*P. or*
51. Alegre		+				+	+							
52. São Luís		+				+	+					+		
53. Paço do Lumiar		+					+					+		
54. São José de Ribamar		+										+		
55. Humberto de Campos							+							
56. Arari							+					+		
57. Pindaré Mirim							+							
58. Itinga									+			+		
59. Açailândia							+							
60. Imperatriz									+		+	+		
61. Estreito												+		
62. Carolina												+		
63. Timon							+							
64. São João dos Patos							+							
65. Paraibano							+							
66. Pastos Bons							+							
67. Nova Iorque							+							
68. São Domingos do Maranhão							+							
69. Benedito Leite							+							
RONDÔNIA														
70. Porto Velho	+								+					
71. Guajará-Mirim	+											+		
72. Ariquemes									+			+		
MATO GROSSO														
73. Pontes e Lacerda			+									+		
74. Jauru			+									+		
75. Cachoeirinha			+											
76. Quatro Marcos			+											
77. Cabaçal			+											
78. Cáceres			+							+		+		

TABLE I (cont.)

Locality	*B. am*	*B. gl*	*B. oc*	*B. ol*	*B. pe*	*B. sc*	*B. st*	*B. te*	*D. an*	*D. ci*	*D. de*	*D. lu*	*A. no*	*P. or*
79. Arenápolis			+			+						+		
80. Nortelândia			+											
81. Diamantino			+				+					+		
82. Alto Paraguai			+									+		
83. Rosário Oeste			+											
84. Nossa Senhora do Livramento			+											
85. Várzea Grande			+											
86. Cuiabá			+							+		+		
87. Jaciara			+											
88. São Pedro da Cipa											+	+		
89. Juscimeira						+								
90. Santa Elvira			+											
91. Rondonópolis			+			+					+	+		
92. Guiratinga						+						+		
93. Alto Araguaia						+					+	+		
MATO GROSSO DO SUL														
94. Bela Vista	+											+		
95. Dourados				+										
96. Rio Brilhante	+													
97. Miranda	+													
98. Aquidauana	+	+				+					+	+		
99. Piraputanga	+	+	+								+	+		
100. Palmeiras												+		
101. Campo Grande	+									+		+		
102. Ribas do Rio Pardo	+								+	+		+		
103. Três Lagoas	+						+				+			
104. Camapuã	+													
105. Coxim											+			
GOIÁS														
106. Jataí						+						+		

TABLE I (cont.)

Locality	*B. am*	*B. gl*	*B. oc*	*B. ol*	*B. pe*	*B. sc*	*B. st*	*B. te*	*D. an*	*D. ci*	*D. de*	*D. lu*	*A. no*	*P. or*
107. Rio Verde							+							
108. Itumbiara											+			
109. Piranhas												+		
110. Rancho Alegre						+								
111. Acreúna						+	+					+		
112. Piracanjuba						+	+					+		
113. Paraúna						+	+					+		
114. Hidrolândia												+		
115. Guapó						+								
116. Trindade							+							
117. Goiânia					+	+	+			+		+		
118. Anápolis						+	+			+				
119. Luziânia									+					
120. Cabeceiras							+			+		+		
121. Formosa	+							+						
122. Santa Rosa						+	+		+	+		+		+
123. Jaraguá						+			+			+		
124. Campinorte												+		
125. Porangatu							+		+			+		
126. Arraias							+							
127. Gurupi												+		
128. Colinas de Goiás									+			+		
129. Araguaína												+		
DISTRITO FEDERAL														
130. Brasília and environs	+				+	+	+	+	+	+	+	+	+	

[1]Only shells available.

Abbreviations of species names: B. am: *Biomphalaria amazonica*, B. gl: *B. glabrata*, B. oc: *B. occidentalis*, B. ol: *B. oligoza*, B. pe: *B. peregrina*, B. sc: *B. schrammi*, B. st: *B. straminea*, B. te: *B. tenagophila*, D. an: *Drepanotrema anatinum*, D. ci: *D. cimex*, D. de: *D. depressissimum*, D. lu: *D. lucidum*, A. no: *Antillorbis nordestensis*, P. or: *Plesiophysa ornata*.

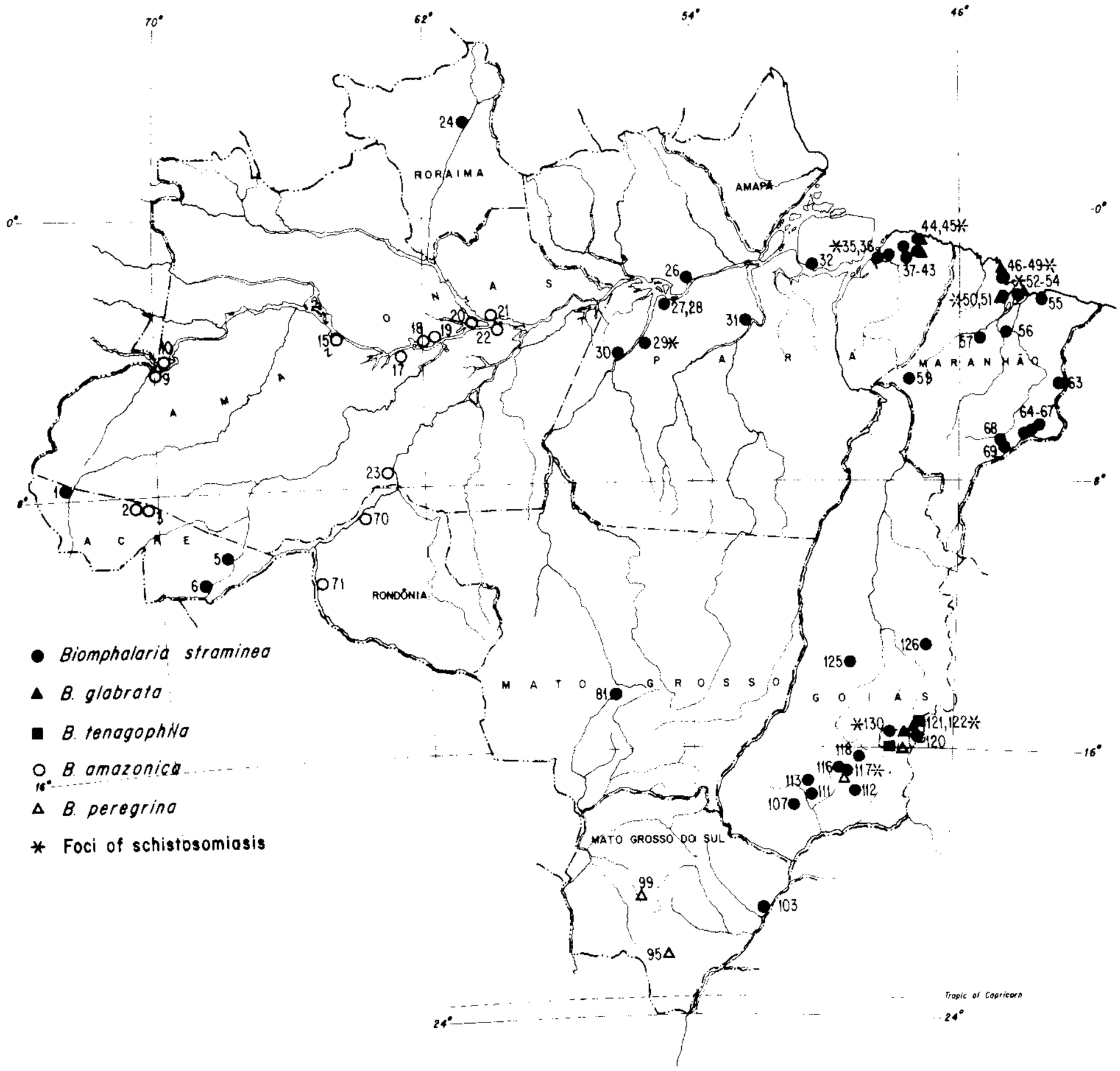

Fig. 1 – Distribution of actual and potential vectors of *Schistosoma mansoni* in the Brazilian states and territories of the Amazon river basin, examined in the present survey. Numbering of localities as in Table I.

Peri Mirim, Pinheiro, Ribamar, São João Batista, São Vicente Ferrer, Turiaçu, Tutóia, Viana (SUCAM, 1979).

State of Pará: Quatipuru (Paraense & Deslandes, 1959); Capanema (Paraense, 1959); Primavera.

3. *Biomphalaria occidentalis* Paraense, 1981

State of Acre: Brasiléia, Sena Madureira, Tarauacá (Paraense, 1981).

State of Amazonas: Tefé, based on shell characters (Paraense, 1981).

State of Mato Grosso: Alto Paraguai, Arenápolis, Cabaçal, Cáceres, Cuiabá, Diamantino, Nortelândia, Nossa Senhora do Livramento, Pontes e Lacerda, Rondonópolis,

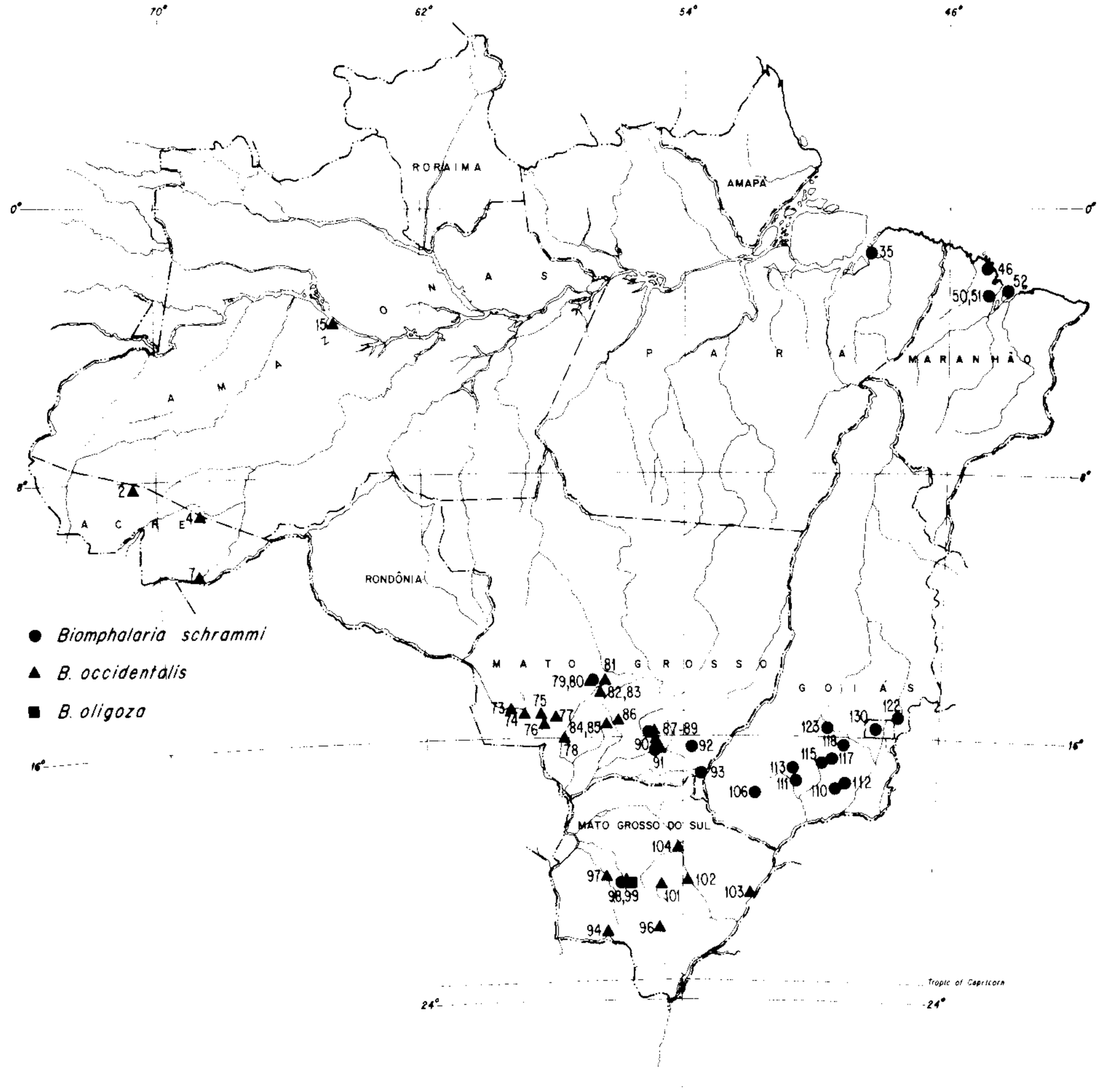

Fig. 2 – Distribution of biomphalarid snails nonvectors of *Schistosoma mansoni* in the Brazilian states and territories of the Amazon river basin, examined in the present survey. Numbering of localities as in Table I.

Rosário Oeste, Santa Elvira, Várzea Grande (Paraense, 1981); Cachoeirinha, Jaciara, Jauru, Quatro Marcos.

State of Mato Grosso do Sul: Aquidauana, Bela Vista, Camapuã, Campo Grande, Miranda, Rio Brilhante (Paraense, 1981); Piraputanga, Ribas do Rio Pardo, Três Lagoas. The snail from Porto Esperança, referred to by Lucena (1951) as *Australorbis bahiensis*, is in all probability *B. occidentalis*.

4. *Biomphalaria oligoza* Paraense, 1974

State of Mato Grosso do Sul: Aquidauana (Paraense, 1974); Piraputanga.

5. *Biomphalaria peregrina* (Orbigny, 1835)

Distrito Federal (Paraense, 1966b).

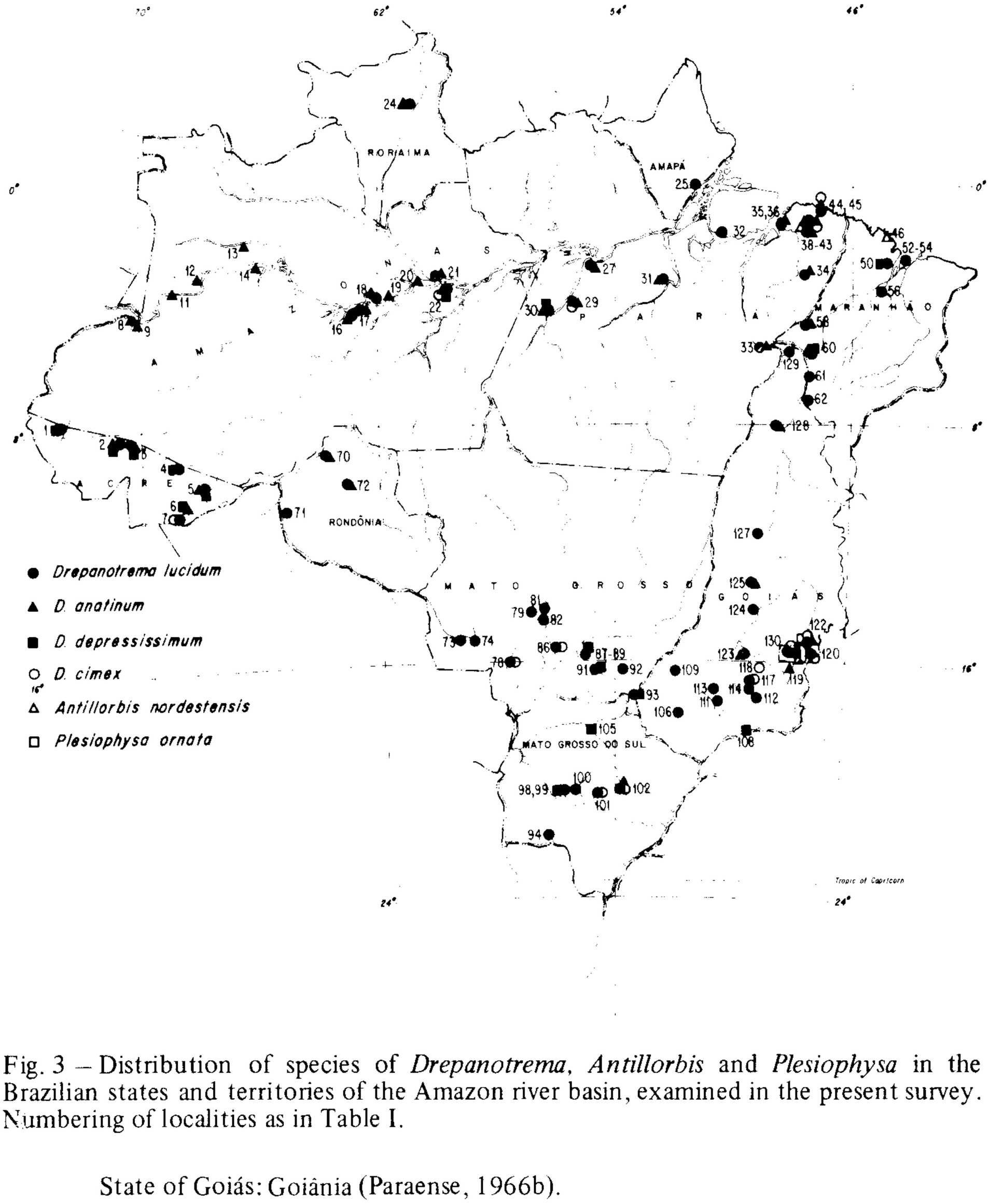

Fig. 3 – Distribution of species of *Drepanotrema*, *Antillorbis* and *Plesiophysa* in the Brazilian states and territories of the Amazon river basin, examined in the present survey. Numbering of localities as in Table I.

State of Goiás: Goiânia (Paraense, 1966b).

State of Mato Grosso do Sul: Dourados (Paraense, 1966b); Piraputanga.

6. *Biomphalaria schrammi* (Crosse, 1864)

Distrito Federal (Magalhães, 1966).

State of Goiás: Anápolis, as *Tropicorbis paparyensis* (Baker, 1945, Pl. 134, Figs. 1-3, 20, 26); Santa Rosa (Paraense, 1976); Acreúna, Goiânia, Guapó, Jaraguá, Jataí, Paraúna, Piracanjuba, Rancho Alegre.

State of Maranhão: São Luís, as *Taphius* (Lutz, apud Paraense & Deslandes, 1956); Alegre, Cururupu, São Bento (Paraense, apud Paraense et al, 1964).

State of Mato Grosso: Alto Araguaia, Arenápolis, Guiratinga, Juscimeira, Rondonópolis.

State of Mato Grosso do Sul: Aquidauana.

State of Pará: Belém (Paraense, apud Paraense et al, 1964).

7. *Biomphalaria straminea* (Dunker, 1848)

State of Acre: Cruzeiro do Sul, Rio Branco (Paraense, 1967); Xapuri.

State of Amazonas: Haas (1949a) identified as *Tropicorbis* (*Obstructio*) *paparyensis* three samples of planorbids collected by Dr. Harald Sioli from the following localities: Lago Calado, near Manacapuru, on the lower Solimões river; Lago Comprido and Lago Matafome, near Três Casas, middle portion of the Madeira river. The subgenus *Obstructio* had been proposed by Haas (1939: 99) to bring together *Planorbis janeirensis* Clessin and *Segmentina paparyensis* Baker, with the following "characteristic features": "Thickening of the lip constantly wanting; disposition of the six internal septa as follows: two parietal septa subequal, at least never so different in size as in true *Planorbula*; four palatal septa, the two upper nearly horizontal". Referring to Sioli's specimens, Haas (1949a: 305) says that "None of the specimens at hand show any of the obstructions [septa] found in those on which F. Baker based his description" [of *Segmentina paparyensis*]. And, in spite of the absence of these "characteristic features", Sioli's specimens were assigned to the subgenus *Obstructio*. Specimens from breeding-places at Fordlândia, Pará state, where Sioli had taken samples identified by Haas (1949a) as *Tropicorbis* (*Obstructio*) *paparyensis*, were studied by Pinto & Deslandes (1953), showing the anatomic characteristics of *Australorbis centimetralis*, a junior synonym of *Biomphalaria straminea*. Subsequently, Paraense & Deslandes (1956) examined topotypic specimens of *Segmentina paparyensis* Baker, showing that it was quite different from *centimetralis* and, consequently, from Sioli's specimens. Finally, Paraense et al (1964) demonstrated that *Planorbis janeirensis* and *Segmentina paparyensis* are junior synonyms of *Biomphalaria schrammi*. I have examined samples of *Biomphalaria* from Lago Calado and from the region of the Madeira river between Porto Velho and Humaitá, the latter about 70 km south of Três Casas; all of them belong to *Biomphalaria amazonica*, a species hardly distinguishable from *B. straminea* by shell characters alone.

Barbosa (1968) refers to samples of *B. straminea* received from the Instituto Nacional de Pesquisas da Amazônia (INPA) in September 1965 and collected from Igarapé da Cachoeirinha (outskirts of Manaus) and Lago do Rei (Careiro island). His identification was based on anatomical characters (genitalia, kidney and radula) and positive crossing experiments between specimens from Manaus and Quixeramobim (Ceará state). I have failed to find *B. straminea* in several samples of *Biomphalaria*, received from INPA for identification, from Careiro (Igarapé Grande, Lago do Rei and Lago do Capitarizinho, July 1964; Lago do Açaí, Lago do Capitari, Lago do Palheta and Canal do Capitari, August 1964) and from Manaus (Igarapé da Cachoeirinha, September 1964). In November 1966 I collected 142 specimens from Igarapé da Cachoeirinha and 86 from Lago do Rei, and in November 1982 I collected 123 more specimens from Igarapé da Cachoeirinha. All the mentioned material belongs to *B. amazonica*.

Distrito Federal (Paraense, 1972).

State of Goiás: Goiânia (Cunha Neto, 1967); Arraias (Cunha Neto, apud Paraense, 1967); Santa Rosa (Paraense, 1972); Anápolis, Trindade (Cunha Neto, apud Paraense, 1972); Acreúna, Cabeceiras, Paraúna, Piracanjuba, Porangatu, Rio Verde.

State of Maranhão: São Luís (Lucena, 1956); São Bento, as *Australorbis centimetralis* (Martins & Almeida, 1966); Paço do Lumiar (Paraense, 1972); Alcântara, Araioses, Bacuri, Barreirinhas, Bequimão, Cajapió, Cururupu, Matinha, Mirinzal, Palmei-

rândia, Pastos Bons, Peri Mirim, Pinheiro, Primeira Cruz, Ribamar, Rosário, Santa Helena, São João Batista, São Vicente Ferrer, Turiaçu, Tutóia, Viana (SUCAM, 1979); Açailândia, Alegre, Arari, Benedito Leite, Guimarães, Humberto de Campos, Nova Iorque, Paraibano, Pindaré Mirim, São Domingos do Maranhão, São João dos Patos, Timon.

State of Mato Grosso: Diamantino.

State of Mato Grosso do Sul: Ponta Porã (Lucena, 1951); Três Lagoas.

State of Pará: Fordlândia, Cupari river (Aveiro municipality) near its mouth, Aniperi river (right tributary of the São Manuel river, Itaituba municipality) near its mouth, Lago do Tostão (Óbidos municipality), Santarém, Lago Grande do Caruaí (Santarém municipality), as *Tropicorbis* (*Obstructio*) *paparyensis* (Haas, 1949a); Flechal, Lago do Caxias and Lago Curuçá, all on the Cupari river (Aveiro municipality), Lago do Timbó near Curi (Itaituba municipality), Lago Salgado, Lago do Tracoá and Cuminá river (Oriximiná municipality), Belterra, as *Tropicorbis* (*Obstructio*) *paparyensis* (Haas, 1949b); Belém, as *Armigerus* (*Tropicorbis*) *centimetralis* (Costa, 1952); Igarapé-Açu, João Coelho (now Santa Maria do Pará), Nova Timboteua, as *Australorbis centimetralis* (Costa et al, apud Maroja, 1953); Livramento, Monte Alegre, Quatipuru (Paraense, 1972); Altamira (Ruiz, 1975); Ananindeua, Breves, Capanema, Itaituba, Primavera, Santa Isabel do Pará.

As seen above, with reference to Amazonas state, it is not easy to distinguish *B. amazonica* by shell characters alone. Although records by Haas (1949a, b) from localities along the Tapajós river in the municipalities of Aveiro, Itaituba and Santarém really correspond to *B. straminea*, the occurrence of this species at localities related to the Amazon river (Óbidos and Oriximiná) must be confirmed through anatomical examination.

Territory of Roraima: Boa Vista.

8. *Biomphalaria tenagophila* (Orbigny, 1835)

Distrito Federal (Crespo et al, 1965).

State of Goiás: Formosa.

9. *Drepanotrema anatinum* (Orbigny, 1835)

State of Acre: Feijó, Rio Branco, Tarauacá, Xapuri.

State of Amazonas: Lago Calado, near Manacapuru, Lago Comprido, Lago Matafome and Lago Paxiúba near Três Casas (Haas, 1949a); Careiro, Manaus (Paraense, 1967); Anori, Atalaia do Norte, Benjamin Constant, Camará, Coari, Codajás, Fonte Boa, Japurá, Santo Antônio do Içá, São Paulo de Olivença.

Distrito Federal (Magalhães, 1966).

State of Goiás: Santa Rosa (Paraense, 1976); Colinas de Goiás, Jaraguá, Luziânia, Porangatu. Of 235 specimens collected at Luziânia from a pool on the highway to Belo Horizonte (km 54), 50 that were dissected were aphallic.

State of Maranhão: Imperatriz, Itinga.

State of Mato Grosso: Lago Peri on the Juruena river (Haas, 1949a).

State of Mato Grosso do Sul: Ribas do Rio Pardo.

State of Pará: Belém (Baker, 1914); Cupari river near its mouth, Santarém, Lago Grande do Caruaí (Haas, 1949a); Flechal, Lago do Caxias and Lago Curuçá, all on the Cupari river, Lago Curi, Rio Branco de Óbidos, Lago Salgado (Haas, 1949b); Fordlândia (Haas, 1952); Altamira, Capanema, Igarapé-Açu, Itaituba, Marabá, Paragominas, Primavera, Quatipuru, São Miguel do Guamá.

State of Rondônia: Ariquemes, Porto Velho.

Territory of Roraima: Boa Vista.

10. *Drepanotrema cimex* (Moricand, 1839)

State of Acre: Brasiléia.

State of Amazonas: Careiro (Paraense, 1980).

Distrito Federal (Magalhães, 1966).

State of Goiás: Anápolis (Baker, 1945, Pl. 128, Figs. 20-22); Cabeceiras, Goiânia (Paraense, 1980); Santa Rosa.

State of Mato Grosso: Cáceres (Paraense, 1980); Cuiabá.

State of Mato Grosso do Sul: Campo Grande, Ribas do Rio Pardo, Três Lagoas.

State of Pará: Capanema, Quatipuru (Paraense, 1980); Fordlândia, Primavera.

11. *Drepanotrema depressissimum* (Moricand, 1839)

State of Acre: Cruzeiro do Sul, Feijó, Rio Branco, Sena Madureira, Tarauacá, Xapuri.

State of Amazonas: Careiro (Paraense, 1967).

Distrito Federal (Paraense, this survey).

State of Goiás: Itumbiara.

State of Maranhão: São Bento, as *Drepanotrema cultratus* (Lucena, 1956); Imperatriz.

State of Mato Grosso: Alto Araguaia, Rondonópolis, São Pedro.

State of Mato Grosso do Sul: Aquidauana, Coxim, Piraputanga.

State of Pará: Cupari river near its mouth (Haas, 1949a); Itaituba. The species *Drepanotrema kermatoides* (Orbigny, 1835) was recorded by Haas (1949a) from Igarapé do Guaranazal, a small tributary of the Cupari river. This isolated finding in so huge an area requires confirmation, since in young specimens the shell of *D. depressissimum* closely resembles that of *D. kermatoides*.

12. *Drepanotrema lucidum* (Pfeiffer, 1839)

State of Acre: Cruzeiro do Sul, Rio Branco (Paraense, 1967); Brasiléia, Feijó, Sena Madureira, Tarauacá.

Territory of Amapá: Macapá.

State of Amazonas: Lago Matafome near Três Casas, as *Gyraulus* (*Drepanotrema*) *schubarti* (Haas, 1949a); Careiro (Paraense, 1967); Camará, Coari, Codajás, Manaus.

Distrito Federal (Magalhães, 1966).

State of Goiás: Santa Rosa (Paraense, 1976); Acreúna, Araguaína, Cabeceiras, Campinorte, Colinas de Goiás, Goiânia, Gurupi, Hidrolândia, Jaraguá, Jataí, Paraúna, Piracanjuba, Piranhas, Porangatu.

State of Maranhão: Arari, Carolina, Estreito, Imperatriz, Itinga, Paço do Lumiar, Ribamar, São Bento, São Luís.

State of Mato Grosso: Alto Araguaia, Alto Paraguai, Arenápolis, Cáceres, Cuiabá, Diamantino, Guiratinga, Jauru, Pontes e Lacerda, Rondonópolis, São Pedro.

State of Mato Grosso do Sul: Aquidauana, Bela Vista, Campo Grande, Piraputanga, Ribas do Rio Pardo, Vila Palmeiras.

State of Pará: Fordlândia, as *Gyraulus* (*Drepanotrema*) *schubarti* (Haas, 1949a); Lago Grande Caruaí, as *Gyraulus* (*Drepanostoma*) *schubarti* (Sioli, 1953); Altamira, Ananindeua, Belém, Breves, Capanema, Igarapé-Açu, Itaituba, Marabá, Paragominas, Primavera, Quatipuru, Santarém, São Miguel do Guamá.

State of Rondônia: Porto Velho (Paraense, 1967); Ariquemes, Guajará-Mirim.

13. *Antillorbis nordestensis* (Lucena, 1954)

Distrito Federal (Magalhães, 1966).

State of Maranhão: Cururupu.

State of Pará: Santa Maria do Pará.

14. *Plesiophysa ornata* (Haas, 1938)

State of Goiás: Santa Rosa (Paraense, 1976).

COMMENTS

All the three species which serve as natural vectors of schistosomiasis mansoni in the Western Hemisphere – *Biomphalaria glabrata, B. tenagophila* and *B. straminea* – are represented in the surveyed area.

B. glabrata is confined to isolated areas in northeastern Pará, northern Maranhão and central Goiás including the Distrito Federal. As usual with this species, its presence in those areas is associated with schistosomiasis. The three mentioned areas are very distant from the continuous portion of the species range, which extends from Rio Grande do Norte to Minas Gerais and which includes the areas of highest schistosomiasis endemicity.

B. tenagophila is restricted to the Distrito Federal and immediate areas of Formosa municipality in the state of Goiás. So far no specimens have been found naturally infected with *Schistosoma mansoni*, although experimental infection was easily obtained by Paraense & Corrêa (1978) exposing snails from Brasília to miracidia of a strain infective to *B. tenagophila*. As in the case of *B. glabrata*, the populations of *B. tenagophila* here concerned are isolates far apart from the continuous species range which extends from southern Bahia to the extreme south of Brazil. And, differing from *B. glabrata*, its role as

a vector has been recognized only in a small part of its range, in the states of Espírito Santo, Rio de Janeiro, São Paulo and Santa Catarina. An important peculiarity of *B. tenagophila* is that it is practically unsusceptible to infection with the schistosome transmitted by *B. glabrata*; on the other hand, *B. glabrata* is practically unsusceptible to infection with the schistosome transmitted by *B. tenagophila* (Paraense & Corrêa, 1963a). The two kinds of parasites differ in size of the adult worms and of the eggs, and in length of the prepatent period in the snail. They are interfertile, producing hybrids which are able to infect both snail species, although at a lower rate than each parental schistosome in its associate snail. Therefore, they should be considered biological races rather than separate species (Paraense & Corrêa, 1963b, 1981). The tenagophila-compatible race is in process of expansion over the range of its associate snail, through an area till recently free of schistosomiasis. Since *B. tenagophila* from the Distrito Federal and adjoining area is susceptible to infection with the mentioned race of *S. mansoni* (Paraense & Corrêa, 1978), the possibility of the latter establishing itself in this area should not be disregarded.

B. straminea is the most widely spread of the three vectors, not only on the surveyed area but also on the whole Neotropical region, since it ranges from Central America to South America east of the Andes, between latitudes 10° N at Costa Rica and 35° S at Argentina. In this survey it was found in 50 localities of Acre, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Pará and Roraima, and was missing in Amapá, Amazonas and Rondônia. It is well known that this species is a major vector of schistosomiasis in the highly endemic area of northeastern Brazil, and that only in a few places outside that area has it been incriminated as a vector. In the surveyed region its involvement in transmission has been recognized only at Fordlândia and Belém, Pará state, and Goiânia, Goiás state.

Fordlândia is a village on the lower Tapajós river where the first focus of schistosomiasis in the Amazon region was established (Machado & Martins, 1951) after the recruitment of numerous laborers from the endemic area of northeastern Brazil to work in a rubber-tree plantation of the Ford Motor company. In a preliminary survey by direct stool examination, Machado & Martins (1951) found 40 infected children, 16 of which were surely autochthonous cases. Later on, Maroja (1953) detected 45 autochthonous cases among 139 examined people. From 1953 to 1956 a comprehensive campaign was undertaken by the Departamento Nacional de Endemias Rurais (National Department for Rural Endemic Diseases), consisting in environmental sanitation, treatment of infected people, snail control and health education, resulting in the decrease of prevalence to 6 cases (Galvão, 1968). After the failure of the plantation enterprise changes in populational composition and other undetermined factors led to an apparent inactivation of the focus, as suggested by the negative results of fecal surveys in 1973, 1974 and 1975, involving 1244, 1014 and 1036 people, respectively (Pardal et al, 1976).

The role of *B. straminea* as a vector of schistosomiasis at Fordlândia was not actually demonstrated, but seems evident from the fact that no other species of *Biomphalaria* was ever found there. Several workers searched a total of about 6400 wild specimens for developing stages of *S. mansoni* with negative result (Machado & Martins, 1951; Sioli apud Maroja, 1953; Maroja, 1953; Paraense, 1967). However, experimental infection of 3 among 28 laboratory-reared specimens exposed each to 10 miracidia from a Belo Horizonte strain of the parasite was obtained by Paraense (1967).

At Belém, capital of Pará state, the first autochthonous cases of schistosomiasis were recorded in 1967 by Galvão (1968), and additional cases have been found thenceforth (Galvão & Galvão, 1971; Marques, 1979). The foci of Belém, as well as the others in Pará state, are considered of little epidemiological importance by the health authorities (Marques, 1979).

Moraes & Rezende (1960) reported the first two autochthonous cases in Goiás state, the patients having contracted the infection very probably in contact with waters of

the Meia Ponte river, near Goiânia. Naturally infected *B. straminea* (0.02% of about 29,000 examined specimens) were found by Cunha Neto (1967) in several breeding-places related to the Meia Ponte river. The infection seems to be expanding very slowly in the area, and no published reports have appeared after the review by Barbosa et al (1967).

In places still free of schistosomiasis where *B. straminea* is present the possibility of its becoming a vector if favorable conditions supervene should be considered. This problem has been little investigated in the surveyed area. Barbosa (1968) reported negative results after exposure of specimens from Manaus, and Ruiz (1975) infected specimens from Altamira with miracidia of a human and a rodent strain.

Of the other species of *Biomphalaria* found in the area, *B. amazonica* and *B. peregrina* may be considered potential vectors of schistosomiasis. *B. amazonica* from Careiro proved highly susceptible to infection with a strain of *S. mansoni* from Belo Horizonte, Minas Gerais, and another one from São José dos Campos, São Paulo, with infection rates of 48% and 73%, respectively (Corrêa & Paraense, 1971); and *B. peregrina* from Lapa, state of Paraná (outside the surveyed area) became infected in the proportion of 45% with the Belo Horizonte strain (Paraense & Corrêa, 1973). Recent experiments with *B. amazonica* from Porto Velho confirmed the susceptibility of this species (Paraense & Corrêa, to be published).

B. occidentalis was confused until recently with *B. tenagophila* owing to the close likeness of their shells and to the great resemblance of their anatomic characters. Ten populations of this species, from the states of Mato Grosso, Mato Grosso do Sul, Paraná and São Paulo, proved unsusceptible to a strain of *S. mansoni* from São José dos Campos (Paraense & Corrêa, 1982).

As to the other species of *Biomphalaria* – *B. oligoza* and *B. schrammi* – they seem to be refractory to infection with *S. mansoni*.

Of the species of *Drepanotrema*, *D. lucidum* is the most frequent, having been found at 72 localities throughout the area, followed by *D. anatinum* (41 localities, absent from Amapá and Mato Grosso), *D. depressissimum* (19 localities, absent from Amapá, Rondônia and Roraima) and *D. cimex* (15 localities, absent from Amapá, Maranhão, Rondônia and Roraima).

Antillorbis nordestensis and *Plesiophysa ornata* were found only occasionally, the former at the Distrito Federal, Cururupu (Maranhão) and Santa Maria do Pará, the latter at Santa Rosa (Goiás).

For identification of the above-mentioned species the reader may refer to Paraense (1975, 1981).

RESUMO

São apresentados os resultados de um levantamento da fauna de planorbídeos nos Estados brasileiros da bacia Amazônica, revelando a ocorrência de 14 espécies, 8 do gênero *Biomphalaria*, 4 de *Drepanotrema*, 1 de *Antillorbis* e 1 de *Plesiophysa*, além de uma população naturalizada de *Helisoma duryi* em Santa Rosa, município de Formosa, Goiás. É a seguinte a distribuição das espécies por gêneros, em ordem decrescente de freqüência (número de localidades entre parênteses):

1. *Biomphalaria straminea* (50): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Pará e Roraima; 2. *B. occidentalis* (30): Acre, Amazonas, Mato Grosso e Mato Grosso do Sul; 3. *B. schrammi* (22): Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul e Pará; 4. *B. amazonica* (14): Acre,

Amazonas e Rondônia; 5. *B. glabrata* (13): Distrito Federal, Goiás, Maranhão e Pará; 6. *B. peregrina* (4): Distrito Federal, Goiás e Mato Grosso do Sul; 7. *B. tenagophila* (2): Distrito Federal e Goiás; 8. *B. oligosa* (2): Mato Grosso do Sul; 9. *Drepanotrema lucidum* (72): Acre, Amapá, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Pará, Rondônia e Roraima; 10. *D. anatinum* (41): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso do Sul, Pará, Rondônia e Roraima; 11. *D. depressissimum* (19): Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul e Pará; 12. *D. cimex* (15): Acre, Amazonas, Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul e Pará; 13. *Antillorbis nordestensis* (3): Distrito Federal, Maranhão e Pará; 14. *Plesiophysa ornata* (1): Goiás.

A *B. glabrata* é responsável pela transmissão do *Schistosoma mansoni* no nordeste do Pará, norte do Maranhão e centro de Goiás incluindo o Distrito Federal. A *B. tenagophila*, embora suscetível à infecção experimental pelo *S. mansoni*, até agora não foi encontrada naturalmente infectada na área. A *B. straminea* tem sido incriminada como vetora em Fordlândia e Belém, Estado do Pará, e transmite a infecção em Goiânia, Estado de Goiás.

Além dos vetores atuais do *S. mansoni* acima referidos, ocorrem na área dois vetores potenciais, *B. amazonica* e *B. peregrina.*

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ADDITIONAL SAMPLES FROM MATO GROSSO AND RONDÔNIA

After sending this paper to the press I received samples of *Biomphalaria straminea* from Barão de Melgaço (Mato Grosso), collected by Dr. José Augusto Ferraz de Lima (SUDEPE – Superintendência de Desenvolvimento da Pesca, Cuiabá); of *Biomphalaria occidentalis, B. amazonica* and *Drepanotrema lucidum* from Barão de Melgaço, and *B. occidentalis* and *B. lucidum* from Santo Antônio do Leverger (Mato Grosso), sent by Dr. Benedicto de Figueiredo (SUCAM, Cuiabá); and of *B. occidentalis* from Ouro Preto d'Oeste (Rondônia), sent by Dr. José Evandro Machado Melo (SUCAM, Brasília).

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