# Freshwater Snails and Schistosomiasis Mansoni in the State of Rio de Janeiro, Brazil: IV - Sul Fluminense Mesoregion

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*In this paper, the forth of a series dealing with the survey of freshwater gastropods of the state of Rio de Janeiro, the results of collections carried out in the Sul Fluminense Mesoregion from 2000 to 2002 are presented and revealed the occurrence of 18 species:* Antillorbis nordestensis*;* Biomphalaria glabrata; Biomphalaria peregrina*;* Biomphalaria straminea*;* Biomphalaria tenagophila*;* Drepanotrema anatinum*;* Drepanotrema cimex*;* Drepanotrema lucidum*;* Ferrissia *sp.;* Gundlachia ticaga*;* Gundlachia *sp.;* Heleobia *sp.;* Lymnaea columella*;* Melanoides tuberculatus*;* Physa acuta*;* Physa marmorata*;* Pomacea sordida *and* Pomacea *sp. As to the snail hosts of* Schistosoma mansoni *the most frequent species was* B. tenagophila*, found in all municipalities surveyed, except Parati. Besides new records the present study extends the distribution of* B. peregrina *and* B. straminea *in the state. No specimens were found harbouring larval forms of* S. mansoni *although different kinds of cercariae had been observed. An account about the current schistosomiasis transmission sites in this Mesoregion is presented as well.*

Key words: freshwater snails - schistosomiasis mansoni - cercariae - Rio de Janeiro - Brazil

Aiming to elaborate a Chart of planorbids of the state of Rio de Janeiro collections have been done by the authors since 1997. During the last two years, from March, 2000 to May, 2002, collecting was done in the following municipalities of the Sul Fluminense Mesoregion: Barra Mansa, Itatiaia, Pinheiral, Piraí, Porto Real, Quatis, Resende, Rio Claro, and Volta Redonda (Vale do Paraíba Fluminense Microregion); Barra do Piraí, Rio das Flores, and Valença (Barra do Piraí Microregion); Angra dos Reis and Parati (Baía da Ilha Grande Microregion).

The freshwater snail species listed include specimens collected by the authors as well as those in the Collection of the Department of Malacology of Instituto Oswaldo Cruz. The distribution of the snail species of medical and veterinary importance, various kinds of cercariae and the number of schistosomiasis cases reported to this region during the last 18 years are also presented.

## MATERIALS AND METHODS

We have adopted the Brazilian Institute of Geography and Statistic (IBGE 1995) procedures in dividing the state of Rio de Janeiro into six Mesoregions (Baixadas, Metropolitana, Centro Fluminense, Sul Fluminense, Norte Fluminense, and Noroeste Fluminense) and the Center of Information and Data of Rio de Janeiro (CIDE 2001) for the new municipalities. The Sul Fluminense Mesoregion is 7931 $km^2$, constituting 18.1% of the state.

The molluscs were collected from different suitable snail habitats from all 48 districts of the 14 municipalities surveyed. Since at least three different habitats were investigated in each of the districts, an average of 167 samples was obtained. Live snails were kept at the laboratory for a month in aquaria containing dechlorinated tap water and, at the bottom, a thin layer of a 2:1 mixture of screened soil and ground oyster shells as a source of mineral nutrients. Snails were fed on fresh lettuce leaves. In the meantime all specimens were exposed to artificial light at five-day intervals to determine possible infection with trematode larvae. Cercariae were fixed in 70% ethanol, stained with chloridric carmine, mounted in Canada balsam and subsequently identified according to Schell (1970).

The ten larger specimens of each sample were preserved in Railliet-Henry's fluid after relaxation in a 0.05% nembutal solution and two of them were dissected under stereomicroscope for identification.

Samples of taxonomic importance were deposited at the Malacological and Helminthological Collections of Instituto Oswaldo Cruz.

The cases of schistosomiasis reported from 1985 to 2003 were obtained from the National Health Foundation (Funasa).

## RESULTS

Table I shows the localities where the 18 molluscan species were found: *Antillorbis nordestensis* (Lucena, 1954); *Biomphalaria glabrata* (Say, 1818); *Biomphalaria peregrina* (Orbigny, 1835)*; Biomphalaria straminea* (Dunker, 1848)*; Biomphalaria tenagophila* (Orbigny, 1835); *Drepanotrema anatinum* (Orbigny, 1835); *Drepanotrema cimex* (Moricand, 1839); *Drepanotrema lucidum* (Pfeiffer, 1839); *Ferrissia* sp.; *Gundlachia ticaga* (Marcus & Marcus, 1962); *Gundlachia* sp.; *Heleobia* sp.; *Lymnaea columella* Say, 1817; *Melanoides tuberculatus* (Müller, 1774); *Physa acuta* Draparnaud, 1805; *Physa marmorata* Guilding, 1828; *Pomacea* sp., and *Pomacea sordida* (Swainson, 1823).

The distribution of the intermediate hosts of *Schistosoma mansoni* Sambon, 1907 as well as that of *L. columella* the main intermediate host of *Fasciola hepatica* (Linné)

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TABLE I

List of species and localities where they were found in the Sul Fluminense Mesoregion of the state of Rio de Janeiro

| Municipalities | Districts | Ampullariidae | | Hydrobiidae | Thiaridae | Planorbidae | | | | | | | | Physidae | | Lymnaeidae | Ancylidae | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Pomacea sordida* | *Pomacea* sp. | *Heleobia* sp. | *Melanoides tuberculatus* | *Antillorbis nordestensis* | *Biomphalaria glabrata* | *Biomphalaria peregrina* | *Biomphalaria straminea* | *Biomphalaria tenagophila* | *Drepanotrema anatinum* | *Drepanotrema cimex* | *Drepanotrema lucidum* | *Physa acuta* | *Physa marmorata* | *Lymnaea columella* | *Ferrissia* sp. | *Gundlachia* sp. | *Gundlachia ticaga* |
| Barra do Piraí Microregion | Barra do Piraí | | | | | | | | | | | | | | | | | | |
| | Barra do Piraí | | + | | | | • | | + | • + | | | | + | + | + | | | |
| | Dorândia | | | | | | | | | + | | | | | + | + | | | + |
| | Ipiabas | | | | | | | + | | + | | | | + | | | + | | + |
| | São José do Turvo | | | | | | | | | + | | | | + | | + | | | + |
| | Vargem Alegre | | | | | | | | | + | | | + | | + | + | | | + |
| | Rio das Flores | | | | | | | | | | | | | | | | | | |
| | Abarracamento | | | | | | | | | + | | | | | + | | + | | + |
| | Manuel Duarte | | | | | | | | + | | | | + | + | | | + | | + |
| | Rio das Flores | • | | | | | | | + | • | | | | + | + | + | | | + |
| | Taboas | | | | | | | | | + | | | | | + | | + | | + |
| | Valença | | | | | | | | | | | | | | | | | | |
| | Barão de Juparanã | | + | | | | | | | + | | | | + | | + | + | | + |
| | Conservatória | | | | | | | | | + | | | | | + | | | | + |
| | Parapeúna | | + | | | | | | | | | | | | | | + | | + |
| | Pentágna | | | | | | | | | + | + | | + | | + | + | | | + |
| | Santa Izabel do Rio Preto | | | | | | | | | | | | + | | + | + | | | + |
| | Valença | • | | | | + | | | | • + | | + | | | + | + | | | + |
| Vale do Paraíba Fluminense Microregion | Barra Mansa | | | | | | | | | | | | | | | | | | |
| | Antônio Rocha | | | | | | | | | + | | + | | | + | + | | | + |
| | Barra Mansa | | | | | | | | + | • + | + | | + | + | + | + | | | + |
| | Floriano | | | | | | | | | | | + | + | | + | | | | |
| | Nossa S. do Amparo | | | | | | | | | + | | | | | | | | | + |
| | Rialto | | | | | | | | | + | + | | | + | + | | | | + |
| | Itatiaia | | | | | | | | | | | | | | | | | | |
| | Itatiaia | | | | | | | + | | + | | | + | | + | + | | | + |
| | Pinheiral | | | | | | | | | | | | | | | | | | |
| | Pinheiral | | + | | | | | | + | + | | + | | + | + | + | + | | + |
| | Piraí | | | | | | | | | | | | | | | | | | |
| | Arrozal | | + | | | | | | | • + | + | | + | | + | + | | | |
| | Piraí | | + | | + | | | | | • + | + | | | + | + | + | | | + |
| | Santanésia | | + | | + | | | | + | + | | + | + | + | + | + | | | |
| | Vila Monumento | + | | | + | | | | | + | | | | | + | + | | | + |

| Municipalities | Districts | Ampullariidae | Hydrobiidae | Thiaridae | Planorbidae | | | | | | | Physidae | | Lymnaeidae | Ancylidae | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Pomacea sordida* | *Pomacea* sp. | *Heleobia* sp. | *Melanoides tuberculatus* | *Antillorbis nordestensis* | *Biomphalaria glabrata* | *Biomphalaria peregrina* | *Biomphalaria straminea* | *Biomphalaria tenagophila* | *Drepanotrema anatinum* | *Drepanotrema cimex* | *Drepanotrema lucidum* | *Physa acuta* | *Physa marmorata* | *Lymnaea columella* | *Ferrissia* sp. | *Gundlachia* sp. | *Gundlachia ticaga* |
| Vale do Paraíba Fluminense Microregion | Porto Real | | | | | | | | | | | | | | | | | | |
| | Porto Real | | + | | | | | | | + | + | | + | | + | | | | |
| | Quatis | | | | | | | | | | | | | | | | | | |
| | Falcão | | | | | | | + | | + | | | | | + | + | | | + |
| | Quatis | | | | | | | + | | + | + | | | | + | | | | + |
| | Rib. São Joaquim | | | | | | | + | | • | | | + | | | | | | + |
| | Resende | | | | | | | | | | | | | | | | | | |
| | Agulhas Negras | | | | + | | | | + | + | + | | + | | + | + | | | + |
| | Engenheiro Passos | | | | | | | + | | + | | | | | + | + | | | + |
| | Fumaça | | | | | | | + | | | | | | + | + | | | | |
| | Pedra Selada | | | | | + | | + | | + | + | | + | + | + | + | | | + |
| | Resende | • | | | | | | | + | + | | | + | + | + | + | | | |
| | Visconde de Mauá | | | | | | | + | + | | | | + | + | + | + | | | + |
| Vale do Paraíba Fluminense Microregion | Rio Claro | | | | | | | | | | | | | | | | | | |
| | Getulândia | | | | | | | | | + | | | | | + | + | | | + |
| | Lídice | | | | | | | | | | | | | | + | + | | | + |
| | Passa Três | | | | | | | | | • | + | | | + | + | + | | | + |
| | Rio Claro | | + | | | | | | | + | + | | | | + | + | | | + |
| | Volta Redonda | | | | | | | | | | | | | | | | | | |
| | Volta Redonda | | | | + | | | | + | • | + | | | | + | + | | | + |
| Baía da Ilha Grande Microregion | Angra dos Reis | | | | | | | | | | | | | | | | | | |
| | Abraão (Ilha Grande) | | | | | + | | | | | | | | | | | + | + | |
| | Angra dos Reis | | | | + | + | | | + | • | + | | | + | + | + | | | |
| | Frade | | | | | | | | | + | | | | + | + | + | | | |
| | Mambucaba | | | + | | | | | + | | | | | | + | | | | |
| | Parati | | | | | | | | | | | | | | | | | | |
| | Parati | | | + | | | | | | | + | | + | | + | + | | | |
| | Parati-Mirim | | | | | + | | | | | | | | | | | | + | + |
| | Tarituba | | | + | | | | | | | + | | | | | | | + | + |

•: samples of the Collection of the Department of Malacology of Instituto Oswaldo Cruz

in Brazil is shown in the Figure.

The highest species richness occurred in Piraí (12 species), Resende (12), and Valença (12). On the other hand, in Porto Real only five species were found.

Specimens of *P. marmorata* were found in all municipalities and among the planorbid species, the most frequent was *B. tenagophila*, observed in 13 municipalities.

Although many different kinds of cercariae had been observed (Table II), no specimens were found infected with *S. mansoni* or *F. hepatica*. Xiphidiocercariae (including Ubiquita cercaria and Ornatae cercaria) were the most frequent type of trematode larvae, followed by Echinostome cercariae. The major diversity of cercariae was found in Barra Mansa, in the following species: *B. tenagophila, D. cimex, L. columella*, and *P. marmorata.* As shown in the Table II, out of 122 infected snails, there were found harbouring Xiphidiocercariae (51.6%), Strigid cercaria (26.2%), Echinostome cercaria (13.1%) and Brevifurca-apharingeata-clinostomatoide cercariae (4.9%).

Even though no specific parasitological surveys have been performed by Funasa in the Sul Fluminense Mesoregion, cases of schistosomiasis were detected in Angra dos Reis, Barra do Piraí, Barra Mansa, Itatiaia, Parati, Pinheiral, Piraí, Porto Real, Quatis, Resense, Rio Claro, Valença, and Volta Redonda (Table III).


Map showing the distribution of the species of medical and veterinary importance. (▲) *Biomphalaria glabrata*; (●) *Biomphalaria straminea*; ( + ) *Biomphalaria tenagophila;* (▼) *Biomphalaria peregrina;* (■) *Lymnaea columella*

TABLE II

List of types of cercariae and the localities where they were found in the Sul Fluminense Mesoregion of the state of Rio de Janeiro

| | Trematode | | Mollusc host | | |
|---|---|---|---|---|---|
| Municipalities | Larval stages | Possible family | Species | Infected | Total |
| Angra dos Reis | Echinostome cercaria | Echinostomatidae | *B. tenagophila* | 2 | 145 |
| | Xiphidiocercariae | - | *B. tenagophila* | 1 | 145 |
| | Brev.- aphar.-clinostomatoide cercaria | Clinostomatidae | *B. tenagophila* | 2 | 145 |
| | Strigid cercaria | Strigeidae or Diplostomatidae | *P. marmorata* | 1 | 11 |
| Barra Mansa | Echinostome cercaria | Echinostomatidae | *B. tenagophila* | 1 | 54 |
| | Echinostome cercaria | Echinostomatidae | *P. marmorata* | 1 | 24 |
| | Metacercariae | Echinostomatidae | *P. marmorata* | 7 | 24 |
| | Xiphidiocercariae (Ubiquita cercaria) | Microphallidae | *B. tenagophila* | 1 | 54 |
| | Xiphidiocercariae (Ubiquita cercaria) and Strigid cercaria | Microphallidae and Strigeidae or Diplostomatidae | *B. tenagophila* | 2 | 54 |
| | Strigid cercaria | Strigeidae or Diplostomatidae | *B. tenagophila* | 26 | 54 |
| | Xiphidiocercariae (Ornatae cercaria) | Haplometridae or Macroderoididae | *D. cimex* | 2 | 14 |
| | Xiphidiocercariae | Haplometridae or Macroderoididae | *L. columella* | 20 | 31 |
| Barra do Piraí | Xiphidiocercariae (Ornatae cercaria) | Haplometridae or Macroderoididae | *L. columella* | 2 | 15 |
| | Xiphidiocercariae | - | *B. tenagophila* | 1 | 11 |
| Itatiaia | Echinostome cercaria | Psilostomatidae | Ancylidae | 2 | 17 |
| | Echinostome cercaria | Echinostomatidae | *B. tenagophila* | 2 | 33 |
| Parati | Echinostome cercaria | Echinostomatidae | *P. marmorata* | 1 | 21 |
| | Xiphidiocercariae (Ornatae cercaria) | Haplometridae or Macroderoididae | *L. columella* | 1 | 8 |
| Pinheiral | Echinostome cercaria | Echinostomatidae | *P. marmorata* | 1 | 32 |
| Piraí | Xiphidiocercariae | - | *B. tenagophila* | 28 | 124 |
| | Brev.- aphar.-clinostomatoide cercaria | Clinostomatidae | *B. tenagophila* | 4 | 124 |
| | Strigid cercaria | Strigeidae or Diplostomatidae | *B. tenagophila* | 1 | 124 |
| | Echinostome cercaria | Echinostomatidae | *D. anatinum* | 2 | 42 |
| | Strigid cercaria | Strigeidae or Diplostomatidae | *P. marmorata* | 1 | 11 |
| Quatis | Echinostome cercaria | Echinostomatidae | *B. peregrina* | 4 | 39 |
| Resende | Strigid cercaria | Strigeidae or Diplostomatidae | *P. marmorata* | 1 | 4 |
| Rio Claro | Xiphidiocercariae (Ornatae cercaria) | Haplometridae or Macroderoididae | *P. marmorata* | 3 | 47 |
| | Xiphidiocercariae (Ornatae cercaria) | Haplometridae or Macroderoididae | *B. tenagophila* | 1 | 19 |
| Valença | Xiphidiocercariae | - | *B. tenagophila* | 1 | 5 |

TABLE III
Number of positive cases of schistosomiasis in the Sul Fluminense Mesoregion of the state of Rio de Janeiro

| Year | Municipalities | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A. dos Reis | Barra do Piraí | Barra Mansa | Itatiaia | Parati | Pinheiral | Pirai | Porto Real | Quatis | Resende | Rio Claro | Valença | Volta Redonda |
| 1985 | - | - | 571 | - | - | - | 2 | - | - | - | - | - | 16 |
| 1986 | - | - | 436 | - | - | - | 8 | - | - | - | - | - | 2 |
| 1987 | - | - | 337 | - | - | - | 2 | - | - | - | - | - | - |
| 1988 | - | - | 49 | - | - | - | 37 | - | - | - | - | - | - |
| 1989 | - | - | 106 | - | - | - | 11 | - | - | - | - | - | - |
| 1990 | - | - | 46 | - | - | - | 31 | - | - | - | - | - | - |
| 1991 | - | - | 0 | - | - | - | 53 | - | - | - | - | - | - |
| 1992 | - | - | 39 | 7 | - | - | 19 | - | - | - | - | - | - |
| 1993 | - | - | 67 | - | - | - | 33 | - | - | - | - | - | - |
| 1994 | - | - | 32 | - | - | 2 | 18 | - | - | - | - | - | - |
| 1995 | 6 | 14 | 35 | - | - | - | 0 | - | - | 25 | - | 4 | - |
| 1996 | - | - | 50 | 17 | - | - | 0 | - | 0 | 17 | 0 | 1 | 1 |
| 1997 | 1 | - | 77 | 38 | - | - | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | - | - | 46 | 12 | - | - | 8 | 0 | 3 | 0 | 4 | 0 | 15 |
| 1999 | 10 | - | 58 | - | - | - | 4 | - | 0 | 2 | 0 | - | 0 |
| 2000 | 71 | - | 12 | 0 | 1 | - | 0 | - | - | 1 | - | - | 9 |
| 2001 | 23 | - | 4 | - | 2 | - | - | 1 | - | 1 | 1 | - | 9 |
| 2002 | 40 | 1 | 4 | - | 1 | - | - | - | - | 3 | - | - | - |
| 2003 | 5 | - | 1 | - | - | - | - | - | - | - | - | - | 1 |

## DISCUSSION

The present study extended the geographical distribution of *B. tenagophila* and *B. straminea*, natural vectors of schistosomiasis in Brazil. *B. straminea* was previously recorded in 22 municipalities in the state of Rio de Janeiro (Paraense 1986, Grault et al. 1995, Thiengo et al. 1998, 2001, 2002a, b) and the records for Angra dos Reis, Barra do Piraí, Pinheiral, Piraí, Resende, Rio das Flores, and Volta Redonda are new. Up to now it had only been found in Barra Mansa according to Grault et al. (1995).

Althought no specimens of *B. glabrata* have been found in the present study, Paraense (1975) reported that snail vector in Barra do Piraí. However, caution is needed in attributing the disappearance of this species, considered the most important host of *S. mansoni* in Brazil, due to its high susceptibilitity to infection.

The distributional pattern of *B. peregrina*, considered a potential vector by Paraense and Corrêa (1973), has been extended to include Barra do Piraí, Itatiaia, Quatis, and Resende.

In relation to the non-vector planorbid species, *D. lucidum* was the most common, followed by *D. anatinum*, *D. cimex*, and *A. nordestensis*. In the previously studied Mesoregions, the most frequent species were *D. anatinum* in the Metropolitana and Centro Fluminense Mesoregions (Thiengo et al. 2001, 2002a) and *D. cimex* in the Baixadas Mesoregion (Thiengo et al. 2002b). The distribution of *A. nordestensis*, previously known in 24 municipalities in the state (Thiengo et al. 1998, Santos et al. 1999, Thiengo et al. 2001, 2002a, b), is now extended to include Angra dos Reis, Parati, Resende, and Valença.

Of the remaining Pulmonata species, *P. marmorata* was found most frequently (all municipalities; 39 districts), followed by *L. columella* (all municipalities except Porto Real; 30 districts) and *P. acuta* (9 municipalities; 17 districts). According to Paraense and Pointier (2003), *P. acuta* proved indistinguishable, in shell and anatomy, from topotypic *Physa cubensis* Pfeiffer, 1839, pointing to the synonymy of the two nominal species under the older name. Thus, the distribution of *P. acuta* in the state was now extended to 41 municipalities.

The Afro-Asian thiarid *M. tuberculatus* was found in the Vale do Paraíba Fluminense (3 municipalities) and Baía da Ilha Grande Microregions (1 municipality). Recently, Fernandez et al. (2003) reported the wide distribution of this species in Brazil and argued about its employment as competitor of snail intermediate hosts of *S. mansoni* in Brazil and Caribe. Possible environmental impacts caused by *M. tuberculatus* high dense populations that have been observed at different natural breeding sites in Brazil are pointed out as well.

Concerning the Prosobranchia, hydrobiid species were found only in the Baía da Ilha Grande Microregion. Specimens of *Pomacea* sp., collected from six municipalities, resembled those reported by Thiengo et al. (2002a) in Centro Fluminense and Baixadas Mesoregions. Further morphological studies are being undertaken on samples from those regions, aiming to identify them.

Among the ancylids *G. ticaga* was the most frequently found species, occurring in all municipalities surveyed, except Porto Real. The same was observed in the previously studied Mesoregions, e.g., Metropolitana, Centro Fluminense, and Baixadas (Thiengo et al. 2001, 2002a, b).

Although the number of positive cases must be seen

as underestimated information, because of the limitation of logistic resources available to Funasa, the results of the coproscopical and malacological surveys carried out showed cases of schistosomiasis in Barra Mansa and pointed out *B. tenagophila* as the snail intermediate host. Even though the transmission has been reducing after intervention carried out since 1985 by the local health authorities, this municipality is still recognized as a low transmission site in the state.

The distribution of *L. columella* overlaps the occurrence of fascioliasis foci in this Mesoregion (Serra-Freire et al. 1995) as well as the first report of a human case in the state, e. g., in Volta Redonda (Pile et al. 2000).

With regard to other trematode, the xiphidiocercariae was the most frequently larval type found in the molluscs, corroborating Thiengo et al. (2002a,b).

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