Nematode parasites of marsupials and small rodents from the Brazilian Atlantic Forest in the State of Rio de Janeiro, Brazil

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ABSTRACT. Nematodes from opossums and rodents captured in the Brazilian Atlantic Forest in the State of Rio de Janeiro, Brazil were studied. From the opossums *Didelphis aurita* Weid-Neuweid, 1826 and *Philander opossum* (Linnaeus, 1758) the following nematode species were recovered: *Viannaia hamata* Travassos, 1914, *Aspidodera raillieti* Travassos, 1913, *Cruzia tentaculata* (Rudolphi, 1819), Travassos, 1917, *Turgida turgida* (Rudolphi, 1819) Travassos, 1919, *Gongylonemoides marsupialis* (Vaz & Pereira, 1934) Freitas & Lent, 1937, *Viannaia viannai* Travassos, 1914, *Spirura guianensis* (Ortlepp, 1924) Chitwood, 1938 and from the rodents *Akodon cursor* (Winger, 1887), *Nectomys squamipes* (Brants, 1827), *Oligoryzomys eliurus* (Wagner, 1845) and *Oryzomys intermedius* (Leche, 1886): *Hassalstrongylus epsilon* (Travassos, 1937) Durette-Desset, 1971, *Syphacia obvelata* (Rudolphi, 1802) Seurat, 1916, *S. venteli* Travassos, 1937, *Physaloptera bispiculata* Vaz & Pereira, 1935, *Litomosoides carinii* (Travassos, 1919) Vaz, 1934, *Viannaia viannai, Hassalstrongylus epsilon, H. zeta* (Travassos, 1937) Durette-Desset, 1971, *Stilestrongylus aculeata* (Travassos, 1918) Durette-Desset, 1971 *S. eta* (Travassos, 1937) Durette-Desset, 1971. Highest worm burdens and prevalences were those related to *Cruzia tentaculata* in marsupials. *Stilestrongylus aculeata* was referred for the first time in *Akodon cursor*.

KEY WORDS. Helminths, mammals, prevalence.

The Brazilian Atlantic Forest is a formation distributed along the Brazilian coast, originally as a continuous belt from the State of Rio Grande do Norte to the State of Rio Grande do Sul, reaching about 1,100,000 km²; nowadays, this forest is restricted to only 5% of its original area (AZEVEDO 1997).

Due to the great deforestation process that has been occurring, the fauna is continuosly being isolated in scattered remaining patches of the original forest and thus, many species are endangered. Nowadays, the urban expansion is the major menace to the forest (AZEVEDO 1997). The destruction rates are so alarming that in 1992 this ecosystem was considered a Biosphere reserve and its biodiversity regarded as a global product and thus, a stimulating development factor (CHAVES 1997).

The protection of the Brazilian Atlantic Forest has to be conducted aiming at all environmental profiles (COPOBIANCO 1997). The autochthonous fauna consists mostly of mammals, birds and amphibians. There are 129 species of terrestrial mammals, of which 40% are endemic in cohabitation with about 160 bird species and 183 species of amphibians. Among the terrestrial mammals, there are 58 species of rodents and 23 of marsupials (FONSECA & KIERULFF 1989, AZEVEDO 1997).

Recently, studies have been undertaken with these animals from the Brazilian Atlantic Forest in order to collect data, considering their ecological importance, as well as the role these animals play as reservoirs for sylvatic zoonoses that can affect man (ALMEIDA *et al.* 1986, BERGALO 1994, CERQUEIRA *et al.* 1993, REY 1993).

Besides the systematic and taxonomic approaches, studies of the helminth fauna parasitizing these potential reservoirs of severe zoonoses, as schistosomiasis, are important to the screening of parasites infecting these hosts (GOMES 1979, GOMES *et al.* 1992, VICENTE *et al.* 1982).

Many marsupials and small wild rodents are part of this group, with peculiar habits and behavior, in a constant interrelation with the environment. This fact has been observed in some of their areas of occurrence, where schistosomiasis is more prevalent in rodents than in humans (RODRIGUES-SILVA *et al.* 1992).

In the present paper, a helminth survey of two marsupial species *Didelphis aurita* Wied-Neuweid, 1826 and *Philander*

opossum (Linnaeus, 1758) and four rodent species, *Akodon cursor* (Winge, 1887), *Nectomys squamipes* (Brants, 1827), *Oligoryzomys eliurus* (Wagner, 1845) and *Oryzomys intermedius* (Leche, 1886) from some localities of the Mata Atlântica is presented.

MATERIALS AND METHODS

The studied material was recovered during necropsies of small mammals, captured in dense tropical rain forest areas in the State of Rio de Janeiro (Figs 1-2) and was included in three groups: (a) samples received for identification, (b) collected samples (present authors) and (c) samples deposited in the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC).

The received samples (a) resulted from field work related to the "Project of small mammals from the Mata Atlântica" and expeditions that were part of the survey "Ecology and systematics of mammals from eastern Brazil", between 1990-1991 under the leadership of Dr. Rui Cerqueira, from the Laboratory of Vertebrates Ecology, Department of Animal Ecology, Universidade Federal do Rio de Janeiro (UFRJ), Brazil. These samples were collected in different localities of the State of Rio de Janeiro: São Pedro da Aldeia – Fazenda Cordeiro (22° 51′ S, 42° 31′W); Casimiro de Abreu – Morro de São João (22°32′S, 42°02′W) and Fazenda União (22° 26′ S, 42° 02′ W); Macaé – Glicério (22° 14′ S, 42° 04′ W); Angra dos Reis – Mambucaba (next to Mambucaba River) (23°01′S, 44°31′W); Maricá – Reef of Barra de Maricá (22°57′S, 42°50′W); Magé – Serra dos Órgãos (22°57′S, 43°01′W) – Pamparrão and Porteira Verde Valleys.

The animals were killed and the carcasses deposited in the Museu Nacional of Rio de Janeiro/UFRJ. Helminths were preserved in 10% formaldehyde, in labeled vials with data on locality of capture, date, and site of infection. Part of the material was represented by uncut viscera, also preserved in 10% formaldehyde; organs were removed from 24 specimens of *Philander opossum*, 14 from *Didelphis aurita*, 21 from *Nectomys squamipes*, five of *Akodon cursor* and five from *Oryzomys intermedius*; stomachs and intestines were investigated for helminths.

Helminth samples collected in the present study (b) were recovered from animals captured in the State of Rio de Janeiro: four specimens of *Didelphis aurita* in the municipality of Macaé, Glicério, Nossa Senhora da Glória farm (22°14′S, 42°04′W); one *Philander opossum*, 4 *Nectomys squamipes*, seven *Didelphis aurita* and six *Oryzomys intermedius* in the Centro de Primatologia of the State of Rio de Janeiro, in the municipality of Guapimirim (22°32′S, 42°59′W); 9 *Akodon cursor* in the district of Magé, Suruí, Santa Margarida farm (22°40′S, 43°04′W).

Animals were captured with Sherman, Tomahaw and Movarte traps (live-trap-type), with 23 x 13 x 09 cm, 40 x 15 x 15 cm and 32 x 18 x 20 cm, respectively, baited with manioca portions, mixed with peanut cream, banana, bacon and oat flour, identified by a color ribbon, numbered and distributed along pre-established tracks, 10 m from each other. Traps were checked and baits changed every morning. In the field, after capture, marsupials had their weight and sex verified and were individually kept in 40 x 30 cm plastic cages with stainless steel fenced covers and wood shavings padding. Animals fed on Pedigree Champ® chow, banana, orange and filtered water from nursing bottles adapted to the covers. Cages were labeled with the number of the animal, track of capture, date, locality, sex and species.

The procedures referring to the rodents were similar, except for the food; they fed on Nuvilab® chow and were individually kept in 30 x 18.5 cm cages.

Marsupials and rodents were killed in an ether chamber according to ethical procedures (Apa 1989), either in the Laboratory of Helminth Parasites of Vertebrates or in the Laboratory of Biology and Schistosomiasis Control, Helminthology and Biology Departments, respectively, Instituto Oswaldo Cruz/Fiocruz. Nematodes were fixed in hot AFA (acetic acid 2%, formaldehyde 3%, 70° ethanol 95%).

Five males and five females/sample/host were selected for identification. Processing of nematodes for study, procedures for the attainment of "en face" glycerine-jelly mounts and "synlophe" mountings were described elsewhere (Pinto 1978, Pinto *et al.* 1994, 2002). Samples were deposited in the Helminthological Collection of the Oswaldo Cruz Institute (CHIOC).

Hosts were identified by Dr. Lena Geise from the Universidade do Estado do Rio de Janeiro (UERJ) that supplied the cariotypes of *Akodon cursor* and *Oryzomys intermedius*. Rodents captured by one of the authors (RPC) were identified by Dr. Cibele Rodrigues Bonvicino from the Instituto Nacional do Cancer (INCA)/Rio de Janeiro. **NHR** refers to New Host Record.

The prevalences and mean intensities are indicated in accordance to Bush *et al.* (1997).

RESULTS

The present results are based on the characters that better identify the studied specimens, since most of them have recently been reported.

Trichostrongyloidea, Viannaiidae, Viannaiinae

Viannaia hamata Travassos, 1914

Host: *Didelphis aurita* Wied-Neuwied, 1826.
Site of infection: small intestine.
Locality: Glicério-Macaé, Rio de Janeiro.
Specimens deposited. CHIOC n° 33472, 33474, 33477 and 33586.

Remarks. Travassos (1914) proposed the genus *Viannaia* with the type *V. viannai* and also described *V. conspicua, V. pussilla, V. hydrocheri* and *V. hamata*. Freitas & Lent (1935) analyzing specimens of *V. hamata* recovered from *D. aurita*, observed that males of this species can present, in the middle portion of the dorsal trunk of the copulatory bursa, numerous globular projections, randomly disposed and also the presence of pre-bursal papillae, overlooked in the original description. Pinto & Gomes (1980) referred to *V. hamata* in *D. marsupialis* from the Amazon region. Guerrero (1985), studying Venezuelan marsupials, revised the genus *Viannaia* and redescribed *V. hamata*, adding new data on the morphology of female specimens. The prevalence of *V. hamata* was of 16% with a mean intensity of 16.2. The species was in coinfection with *A. raillieti + C. tentaculata + Turgida turgida* in 8% of the cases and to *A. raillieti + C. tentaculata* in 4% of the occurrences.

Viannaia viannai Travassos, 1914

Hosts. *Philander opossum* (Linnaeus, 1758), *Akodon cursor* (Winge, 1887).
Site of infection: small intestine.
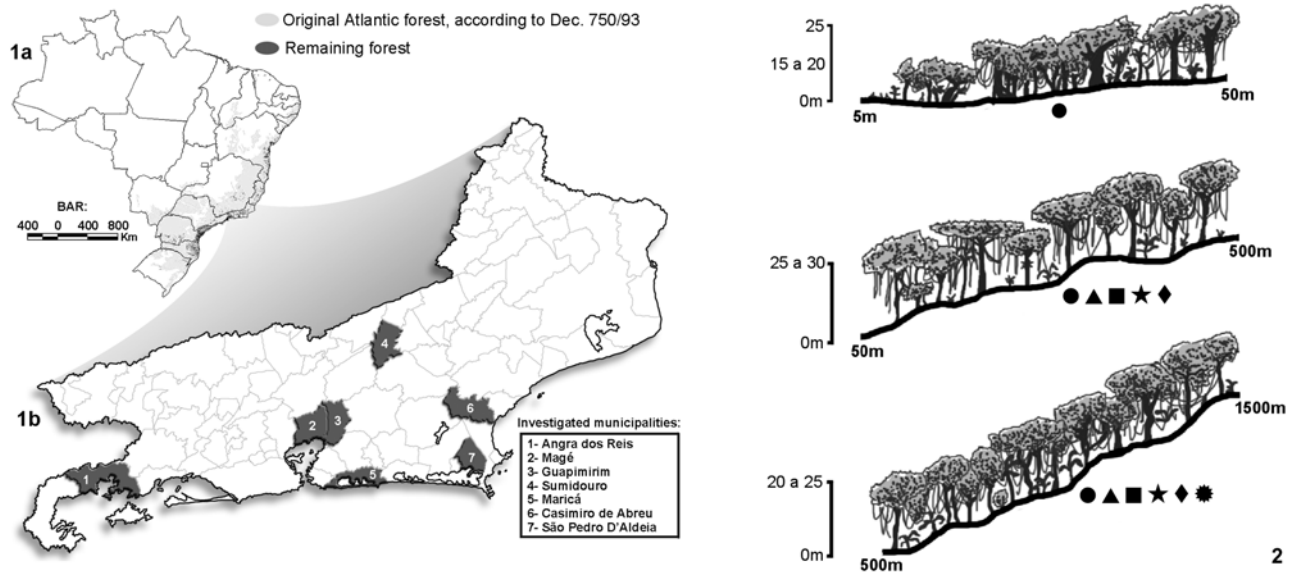
Figures 1-2. (1a) Distribuition of the Brazilian Atlantic Forest; (1b) capture in the State of Rio de Janeiro; (2) distribution of the investigated hosts in the different altitudinal levels of the Brazilian Atlantic Forest in the State of Rio de Janeiro, Brazil. (■) *Akodon cursor*, (●) *Didelphis aurita*, (★) *Nectomys squamipes*, (♦) *Oligoryzomys eliurus*, (✺) *Oryzomys intermedius*, (▲) *Philander opossum*.

Localities. Morro São João-Casimiro de Abreu, Suruí – Magé, Rio de Janeiro.

Specimens deposited. CHIOC nº 35267 and 35268.

Remarks. Proposed by Travassos (1914) as the type species of the genus, was restudied by Durette-Desset (1968) that described the "synlophe" of this species as presenting 3 cuticular longitudinal ventral ridges, directed towards the right side; besides, the author refers that trichostrongylid nematodes parasitizing American marsupials are grouped in two genera: *Travassostrongylus* Orloff, 1933 and *Viannaia* Travassos, 1914, considering *Camerostrongylus* Wolfgang, 1951 synonym of the former and *Phylostrongylus* Wolfgang, 1951, a synonym of the latter as well. The closest species to *V. viannai* is *V. hamata* that can be distinguished from *V. viannai* by the presence of an inconspicuous gubernaculum that, if overlooked can make the differentiation difficult. The prevalence of *V. viannai* alone in *P. opossum* was of 4% with a mean intensity of 11 and in coinfection with *A. raillieti + C. tentaculata*, the prevalence was also of 4%, with a mean intensity of 21.

Heligmonellidae, Nippostrongylinae

Hassalstrongylus epsilon (Travassos, 1937) Durette-Desset, 1971

Hosts. *Akodon cursor* (Winger, 1887), *Nectomys squamipes* (Brants, 1827).

Site of infection: small intestine.

Localities. Mambucaba – Angra dos Reis, Rio de Janeiro Primatology Center, Guapimirim and Suruí – Magé, Rio de Janeiro.

Specimens deposited. CHIOC nº 31608 and 31882.

Remarks. Travassos (1937a) proposed the species as *Longistriata epsilon*; the "synlophe" was further described by Durette-

Desset (1969) and later (1971) included by the same author in the genus *Hassalstrongylus* Durette-Desset, 1971.

In *A. cursor*, *H. epsilon* appeared alone with a prevalence of 8% and mean intensity of 16 whereas in *N. squamipes* the prevalence was of 28%, mean intensity of 15 and appeared in 36% of the coinfection with *P. bispiculata* and in 4% of the other coinfection: *P. bispiculata + Syphacia venteli*; *L. carinii + P. bispiculata*.

Hassalstrongylus zeta (Travassos, 1937) Durette-Desset, 1971

Hosts. *Akodon cursor* (Winger, 1887), *Oligoryzomys eliurus* (Wagner, 1845), *Oryzomys intermedius* (Leche, 1886).

Site of infection: small intestine.

Localities. Rio de Janeiro Primatology Center, Guapimirim, Suruí-Magé, Rio de Janeiro.

Specimens deposited. CHIOC nº 14314, 14319, 14326, 14327, 14345, 14352 and 15748.

Remarks. The species was described by Travassos (1937a) as *Longistriata zeta*, recovered from Muridae hosts captured in Angra dos Reis, Rio de Janeiro and was also included in *Hassalstrongylus* Durette-Desset, 1971. In *A. cursor*, the prevalence of *H. zeta* was of 28% with a mean intensity of 17.6, alone in 24% of the cases. In *O. eliurus*, the prevalence was of 57.1%, mean intensity of 10.7, alone in 28.6% of the cases and in coinfection with *Stilestrongylus eta* in 14.3% and to *S. eta* in 7.1% of the occurrences. In *O. intermedius* the prevalence of *H. zeta* was of 54.5% and mean intensity of 45.7. The species appeared alone in 9.1% of the cases.

Stilestrongylus aculeata (Travassos, 1918) Durette-Desset, 1971

Host: *Akodon cursor* (Winger, 1887) – **NHR**.

Site of infection: small intestine.

Locality: Suruí-Magé, Rio de Janeiro.

Specimens deposited. CHIOC nº 35266.

Remarks. The species was described as *Heligmosomum aculeatum* by Travassos (1918), and was further transferred to the genus *Stilestrongylus* Durette-Desset, 1971. The "synlophe" is formed by 25 ridges directed from the left to the right in the dorsal side of the body and partially from the right to the left in the ventral region. The prevalence of *S. aculeata* was of 4% and mean intensity of 24 and occurred alone in 4% of the cases.

Stilestrongylus eta (Travassos, 1937) Durette-Desset, 1971

Host: *Oligoryzomys eliurus* (Wagner, 1845).
Site of infection: small intestine.
Locality: Suruí – Magé, Rio de Janeiro.
Specimens deposited. CHIOC nº 14313, 14314 and 14326.
Remarks. This species was described by TRAVASSOS (1937a) as *Longistriata eta* and was re-allocated in the present genus by DURETTE-DESSET (1971). The prevalence of the species in *O. eliurus* was of 50%, mean intensity of 11.1, appearing alone in 7.1 of the cases and in coinfection with *H. zeta*.

Oxyuroidea, Oxyuridae, Syphaciinae

Syphacia obvelata (Rudolphi, 1802) Seurat, 1916

Host: *Akodon cursor* (Winger, 1887).
Site of infection: large intestine.
Localities. Morro de São João – Casimiro de Abreu, Serra dos Órgãos, Magé and Barra de Marica – Marica, Rio de Janeiro.
Specimens deposited. CHIOC nº 14311, 15736 and 15741.
Remarks. This species was described by RUDOLPHI (1802) as *Ascaris obvelata*, that was further allocated as *Syphacia obvelata* by SEURAT (1916). NEVEU-LEMAIRE (1936) redescribed *S. obvelata*, presenting data on its geographical distribution. PINTO *et al.* (1994) in a major study of the helminth fauna of laboratory animals gave the prevalence of this species in inbred and outbred mice and fully figured *S. obvelata*, so that this pinworm could be identified also by those not acquainted to the finding of helminths during the development of experimental protocols using laboratory animals naturally infected with this common nematode, that can interfere in the final results, if undetected. *Syphacia obvelata* was only found in *A. cursor*, with a prevalence of 4% and mean intensity of 2, and was not in coinfection with other species.

Syphacia venteli Travassos, 1937

Host: *Nectomys squamipes* (Brants, 1827).
Site of infection: large intestine.
Localities. Barra de Maricá – Maricá and Morro de São João – Casimiro de Abreu, Rio de Janeiro.
Specimens deposited. CHIOC nº 9739, 9740, 9883 and 31606.
Remarks. This species was described by TRAVASSOS (1937b) from the same host presently studied and was also referred by QUENTIN (1969) from Colombian cricetid rodents. GOMES & VICENTE (1984) reported to the occurrence of *S. venteli* in *N. squamipes*, with a prevalence of 9.5% of the 42 examined host specimens. In the present study, the prevalence of the species was 4% (25 examined), with a mean intensity of 3, appearing in coinfection with *P. bispiculata + H. epsilon* in 4% of the cases.

Heterakoidea, Aspidoderidae, Aspidoderinae

Aspidodera raillieti Travassos, 1913

Hosts. *Didelphis aurita* Wied-Neuwied, 1826, *Philander opossum* (Linnaeus, 1758).
Site of infection: large intestine.
Localities. Mambucaba – Angra dos Reis, Barra de Maricá – Maricá, Serra dos Órgãos – Magé, Vales do Pamparrão and Porteira Verde – Sumidouro, Rio de Janeiro Primatology Center – Guapimirim, Glicério – Macaé, Morro de São João – Casimiro de Abreu, Rio de Janeiro.
Specimens deposited. CHIOC nº 33545 and 33558.
Remarks. RAILLIET & HENRY (1912), proposed the genus *Aspidodera*; TRAVASSOS (1913), while studying samples of *Heterakis* **sp.**, found, in coinfection, an unknown aspidoderid worm that was proposed as *Aspidodera raillieti*. PROENÇA (1937), SKRJABIN & SCHIKHOBALOVA (1947) revised the genus confirming its validity. The first occurrence of *A. raillieti* overseas was that reported by WOLFGANG (1951) in marsupials of the Trinidad Islands. Further, VICENTE (1966) presented a detailed study of the species of Aspidoderinae, including *A. raillieti*; PINTO & GOMES (1980) reported the species parasitizing *Philander opossum*. SANTOS *et al* (1990) in a new revision of the genus, proposed a key for the identification of the species and considered the cephalic cordons as one of the most reliable systematic character. In *Didelphis aurita*, the species appeared with a prevalence of 32% and mean intensity of 51.2; coinfection of *A. raillieti* was with *C. tentaculata + T. turgida* and *C. tentaculata + T. turgida + V. hamata* or only with *C. tentaculata*. Coinfection of *A. raillieti* was also with *C. tentaculata + V. hamata*; *C. tentaculata + T. turgida + Gongylonemoides marsupialis*. The prevalence of coinfection was 4%. In *P. opossum*, *A. raillieti* had a prevalence of 48%, mean intensity of 10.4, appearing alone in 4% of the cases and in 36% of the coinfection with *C. tentaculata + V. viannai*.

Cosmocercoidea, Kathlaniidae, Cruziinae

Cruzia tentaculata (Rudolphi, 1819) Travassos, 1917

Hosts. *Didelphis aurita* Wied-Neuwied, 1826, *Philander opossum* (Linnaeus, 1758).
Site of infection: large intestine.
Localities. Glicério – Macaé, Barra de Marica – Marica, Morro de São João – Casimiro de Abreu, Fazenda Cordeiro – São Pedro da Aldeia, Serra dos Órgãos – Magé, Vales do Pamparrão and Porteira Verde – Sumidouro, Rio de Janeiro.
Specimens deposited. CHIOC nº 33542, 33543, 33544, 33571, 33572, 33574, 33575, 33576, 33577 and 33578
Remarks. The species was described by RUDOLPHI (1819) as *Ascaris tentaculata* and further included in *Oxysoma* by SCHNEIDER (1886). TRAVASSOS (1917) proposed the family Cruzidae with the type genus *Cruzia* in which included *C. tentaculata* that was briefly described with the presence of an intestinal cecum, what excluded *C. tentaculata* from specimens of the former Heterocheilidae. TRAVASSOS (1922) fully illustrated the species; CABALLERO (1937) refers to the occurrence of *C. tentaculata* in *Didelphis marsupialis mesamericana* Allen, 1902 (= *D. marsupialis* Linnaeus, 1758) in the Mezquital Valley in Mexico and later CABALLERO *et al.* (1944) reports the species in *Didelphis marsupialis tabascencis* Allen, 1901 (= *D. marsupialis*

Linnaeus, 1758) again in Mexico and also in Guatemala. Wolfgang (1951), Potkai (1970) affirmed that *C. tentaculata* commonly parasitizes marsupials in South and Central America. Pinto & Gomes (1980) also refer to *C. tentaculata* in *Didelphis opossum* Larrañaga, 1923 (= *Didelphis aurita* Wied-Neuwied, 1826) from the Amazon region. The specimens presently studied were closer to those referred by Travassos (1922). In *D. aurita*, this species showed a prevalence of 68% and a mean intensity of 75.6. In 16% of the cases, coinfection of *C. tentaculata* was observed with *T. turgida*; *A. raillieti* + *T. turgida*; *A. raillieti* + *T. turgida* + *V. hamata* and alone in 8% of these cases; also representing 16% of the occurrences. *C. tentaculata* appeared in coinfection with *A. raillieti* + *T. turgida* + *G. marsupialis*; *A. raillieti* + *V. hamata* and alone in 4% of these cases. In *P. opossum*, the prevalence was of 48%, mean intensity of 68.6; coinfection with *A. raillieti* occurred in 36% of the animals; with *A. raillieti* + *V. viannai* in 4% and alone in 28% of the cases.

Physalopteroidea, Physalopteridae, Physalopterinae

Physaloptera bispiculata Vaz & Pereira, 1935

Host: *Nectomys squamipes* (Brants, 1827).

Site of infection: stomach.

Localities. Barra de Maricá – Maricá, Morro de São João – Casimiro de Abreu, Rio de Janeiro.

Specimens deposited. CHIOC nº 31978 and 31916.

Remarks. Seurat (1916) described *P. getula* recovered from African *Mus musculus* Linnaeus, 1758; Vaz & Pereira (1935) found specimens of physalopterids in *N. squamipes* from São Paulo, SP, that were nominated as *P. bispiculata*. Morgan (1943) in a key to the species of the genus parasitizing rodents, observed that the original description of *P. getula* even incomplete and misinterpreted, suggested that *P. bispiculata* could be a junior synonym of this species; nevertheless, Vicente *et al.* (1982) refer to the occurrence of *P. bispiculata* in *N. squamipes* from Ilha Grande, Rio de Janeiro. Later, Gomes & Vicente (1984) during necropsies of specimens of this same rodent captured in Sumidouro, Rio de Janeiro, found physalopterid nematodes that were compared to the original material studied by Vaz & Pereira (1935); they could observe that the vulvar aperture was located in the first third of the body as referred by Morgan (1943) and thus the synonymy of *P. bispiculata* with *P. getula* was ratified. Mafra & Lanfredi (1998), studying specimens of physalopterid nematodes recovered from *N. squamipes* from Rio Bonito, Rio de Janeiro, verified by means of SEM, that the number of caudal papillae and other characters were identical to those referred by Vaz & Pereira (1935) to *P. bispiculata*, that, in fact, proved to be a valid species. *P. bispiculata* appeared with a prevalence of 76 %, and a mean intensity of 14; it was found alone in 36% of the cases and in coinfection with *L. carinii* in 12%, to *H. epsilon* in 8%, to *H. epsilon* + *S. venteli*; *H. epsilon* + *L. carinii*, in 4% of the occurrences.

Turgida turgida (Rudolphi, 1819) Travassos, 1919

Host: *Didelphis aurita* Wied-Neuwied, 1826.

Site of infection: stomach.

Localities. Fazenda União and Morro São João – Casimiro de Abreu, Glicério – Macaé, Mambucaba – Angra dos Reis, Vales Pamparrão and Porteira Verde – Sumidouro, Rio de Janeiro.

Specimens deposited. CHIOC nº 33573 and 33574.

Remarks. Travassos (1920b) studied the species of *Turgida* Schulz, 1931 with a key to the subfamilies of Physalopterinae and described *T. torresi* (Travassos, 1920) Ortlepp, 1922. With respect to *T. turgida* it is referred parasitizing Brazilian opossums with high prevalences. Caballero (1937), Caballero *et al.* (1944) report to the occurrence of the species in marsupials from Mexico and Guatemala. Wolfgang (1951) referred to *T. turgida* in South and Central America. The morphometry of our specimens was closest to that presented by Travassos (1920b); the species appeared with a prevalence of 56%, mean intensity of 12.6, occurring alone in 16% of the cases and in coinfection with *C. tentaculata* in 12%; coinfection, either with *C. tentaculata* + *A. raillieti* or with *C. tentaculata* + *A. raillieti* + *V. hamata*, represented 8% of the occurrences whereas with *C. tentaculata* + *A. raillieti* + *G. marsupialis* and *V. hamata* + *C. tentaculata*, the species appeared in 4% of the cases.

Spiruroidea, Gongylonematidae, Gongylonematinae

Gongylonemoides marsupialis (Vaz & Pereira, 1934) Freitas & Lent, 1937

Host: *Didelphis aurita* Wied-Neuwied, 1826.

Site of infection: esophagus.

Locality: Fazenda União – Casimiro de Abreu, Rio de Janeiro.

Specimens deposited. CHIOC nº 33586 and 33663a-c.

Remarks. The species was proposed as *Gongylonema marsupialis* by Vaz & Pereira (1934), on the basis of a female specimen recovered from *D. aurita*; Freitas & Lent (1937), during necropsies in specimens of *D. aurita* and *Metachirops opossum* (Temminck, 1824) [= *Philander opossum* (Linnaeus, 1758)] found females identical to that described previously as well as males, that presented generic characteristics different from those referred for specimens of *Gongylonema* Molin, 1857; thus, they proposed the genus *Gongylonemoides* Freitas & Lent, 1937 and included the former *Gongylonema marsupialis* in the new genus. The species appeared with a prevalence of 4% and mean intensity of 15 and was in coinfection with *A. raillieti* + *C. tentaculata* + *T. turgida* in the cases of occurrence.

Spiruridae, Spirurinae

Spirura guianensis (Ortlepp, 1924) Chitwood, 1938

Host: *Philander opossum* (Linnaeus, 1758).

Site of infection: esophagus.

Locality: Serra dos Órgãos – Macaé, Rio Janeiro.

Specimens deposited. CHIOC nº 33496, 33550, 33553 and 33562.

Remarks. The species was described as *Protospirura guianensis* by Ortlepp (1924), on the basis of a male specimen from the stomach of a primate from Suriname. Chitwood (1938) included the species in *Spirura* Blanchard, 1849, considering the presence of the ventral "hump", the most outstanding character. Quentin (1973) described the life cycle of *S. guianensis* and affirmed that the species of the genus are distributed among the hosts of ancient origin, mainly insectivores, carnivores, rodents, Neotropical marsupials and primates. Amato *et al.* (1976) refer the first occurrence of the species in Brazil, parasitizing *Philander opossum quica* (Temminck, 1825), informing

that from a single host specimen, more than 200 worms were recovered. PINTO & GOMES (1980) report to the presence of *S. guianensis* in marsupials from the Amazon Region, ratifying QUENTIN (1973) on what concerns to the parasitism of the species in Brazilian marsupials. The prevalence of this species was of 12% with a mean intensity of 2.7.

Filarioidea, Onchocercidae, Onchocercinae

Litomosoides carinii (Travassos, 1920) Vaz, 1934

Host: *Nectomys squamipes* (Brants, 1827).

Site of infection: pleural cavity.

Localities. Barra de Maricá – Maricá and Morro de São João – Casimiro de Abreu, Rio de Janeiro.

Specimens deposited. CHIOC nº 32403.

Remarks. TRAVASSOS (1920a), described as *Filaria carinii* nematodes found in the pleural and peritoneal cavities of *Sciurus* sp. MAZZA (1928) examining nematodes recovered from the peritoneal cavity of *Holochilus vulpinus* Wagner, 1843 (= *Holochilus brasiliensis* Desmarest, 1819) from Argentina, described *Filaria patersoni* Mazza, 1928 [= *Litomosoides patersoni* (Mazza, 1928) Chitwood, 1932], justifying that the description of the new species was based on the fact that this would be the first of the genus to occur in South America, since the genus was proposed to contain *L. sigmodontis* from the cotton rat *Sigmodon hispidus* Say & Ord, 1825 (CHANDLER 1931). VAZ (1934) indicates *L. carinii* as the type species of the genus, on the basis the similarities between *L. carinii* and *L. sigmodontis*, considered a junior synonym of the former. PINTO *et al.* (1982) refer to the occurrence of *L. carinii* in *Oryzomys subflavus* (Wagner, 1842) and GOMES & VICENTE (1984), in *N. squamipes* from Sumidouro, Rio de Janeiro, with a prevalence of 45.2%. The prevalence of this species in the same host herein investigated, was of 16%, with a mean intensity of 24.5 and the coinfection was with *P. bispiculata* in 12% of the cases and with *H. epsilon + P. bispiculata* in 4% of the occurrences.

GENERAL REMARKS

The South American mammalian fauna has been evolving from ancient autochthonous strains of great diversity and different origins that colonized the continent in different periods, as well (REIG 1981).

The history of the marsupials in South America goes back to the Didelphidae; these are the most spread and ancient group with fossils dating from the Cretacean and can be found from the southern region of North America to almost all the South American continent (CLEMENS 1966, FOX 1971, SIGÉ 1971, TEDFORD 1974, SIMPSON 1990).

Marsupials of the genus *Alphadon* Simpson, 1929 have been conventionally considered primitive and ancestral of the existing species (MARSHAL *et al.* 1990). The first marsupialian species from South America is represented by *A. antracinus* Simpson, 1929 from a Peruvian Superior Cretacean deposit. (SIGÉ 1971, 1972).

In Brazil, the genera of marsupials proposed by PAULA COUTO (1952, 1962, 1970) for the Superior Pliocene of São José de Itaboraí, reveal a high level of morphological diversities, suggesting that the specimens represent different groups and subfamilies of Didelphidae. The primitive didelphids were

mostly omnivorous, feeding on insects, annelids, eggs, amphibians, reptiles, birds, mammals, fruits and juicy parts of vegetables (SIMPSON 1990).

However, the rodents share ancestors that are not included among the South American ancient representatives from the Paleocene and Eocene periods; primitive rodents are known from the fauna of the Tertiary in North America, Eurasia and Africa. Fossil findings show the presence of different forms of this group in the Inferior Oligocene in Patagonia and Bolivia. Some authors (HERSHKOVITZ 1966, 1972, SAVAGE 1974, REIG 1975, 1978, 1980, 1981) suggest that the South American rodents derived from an ancient strain that reached South America at the beginning of the Miocene.

Most of the genera in the sigmodontines probably were differentiated during distinct local cladogenetic episodes, from an ancestral strain that reached the north of South America, coming from North America. The settlement in South America could be accomplished by means of transoceanic dispersion, before the establishment of the Panamanian link and the Inferior Miocene was the most probable period in which the migratory process took place. This could have occurred locally in South America in different areas of the Andes, where the Oryzominii, the most primitive Sigmodontini, originally differentiated in Colombia, Ecuador and Venezuela (REIG 1981).

The hosts, as they moved, carried their parasites that, during the evolutionary process, were submitted to mutations and natural selection, since parasites and hosts may interact; the evolution of the parasite is related to the modifications of the host that, generally, evolves to a more adapted organism able to tolerate the parasite; thus, the survival of the parasite depends on that of the host. It is known that long-term parasites are less aggressive to their hosts and when both are adapted to each other, immunological responses tend to be low (FERREIRA 1973).

Helminths, specifically the nematodes, originated from free-living forms to further develop monoxenous or heteroxenous life cycles; the latter is essential for the evolution of nematodes from vertebrates (CHABAUD 1978). According to CHABAUD (1954) the intermediate host was a recent or secondary acquisition in the transmission of nematodes that previously had invaded vertebrates and developed by means of monoxenous life cycles. The dispersion of the parasites clearly seems to follow the specialization of a host species in a group; this specialization was not acquired by chance, but, in fact, is due to previous successful infections in host species that have become extinct. Thus, during the mammals age, an outbreak of the Trichostrongylidae nematodes, to which the evolution depends on the dispersion of the hosts, was observed (DURETTE-DESSET 1971, DURETTE-DESSET & CHABAUD 1977).

HUMPHERY-SMITH (1983) shows the similarities between the Herpestrongylinae nematodes parasitizing marsupials in North America and the Viannaiinae from South American marsupials; differentiation of specimens representing these subfamilies is based on the the bursal rays and synlophe. Specimens of *Didelphis aurita* Wied-Neuwied, 1826 and *Philander opossum* (Linnaeus, 1758) feed on invertebrates, mostly insects, small vertebrates, eggs and fruits. The arthropods, mainly those found in the forest ground are the principal item in the diet of these marsupial species; variations in the height, decomposition degree, humidity and temperature of the forest ground coverage are important aspects to be considered, since these ani-

mals, using this site, can promote the growth of arthropods (Willis 1976, Lieberman & Dock 1982, Pearson & Derr 1986, Lynch et al. 1987).

The nematode *Cruzia americana* Maplestone, 1930, that occurs in North American marsupials, has a monoxenous life cycle (Crites 1956 in Anderson 1992), whereas the infecting larvae of another nematode *Physaloptera* **sp**. a most common parasite of the stomach of marsupials, from the Brazilian Atlantic Forest develop in cockroaches; also, Gongylonematidae nematodes need intermediate hosts, generally beetles, to maintain the life cycles (Anderson 1992).

Previous reports confirm the presence of insects in the diet of *Akodon cursor* (Winger, 1887) (Fonseca & Kierulff 1989, Stallings 1989). Fragments of Coleoptera and Hymenoptera were found in specimens of *Oryzomys intermedius* (Leche, 1886) and *Nectomys squamipes* (Brants, 1827); the latter also presented parts of spiders. These findings show that the ground coverage of the Brazilian Atlantic Forest plays an important role in the transmission of helminths with heteroxenous life cycles.

Results of the prevalence of the nematodes reported herein are in accordance with previous reports and show the correlation between the number of investigated host specimens and the size of worm burdens yelded, what is a reliable parameter for the evaluation of parasitic loads and their maintenance in the hosts. Moreover, the present data indicate that parasites can serve as biological indicators of the dispersion of hosts in the case of environmental disarrays.

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