

SHORT COMMUNICATION

Proteocephalidean Larvae (Cestoda) in Naturally Infected Cyclopoid Copepods of the Upper Paraná River Floodplain, Brazil

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The occurrence, prevalence and infection intensity of proteocephalidean larvae in naturally infected intermediate hosts of the Upper Paraná River floodplain are reported. A total of 5,206 zooplanktonic and benthic organisms were analyzed, namely cyclopoid (2,621) and calanoid (1,479) copepods, cladocerans (704), rotifers (307), chironomid larvae (41) and ostracods (54). Eight cyclopoid copepods – two copepodids, one male and five females – comprising 0.3% of the cyclopoid copepods examined, were naturally infected. The male infected belonged to a species of Paracyclops, and the females to Paracyclops sp., Thermocyclops minutus and Mesocyclops longisetus.

Key words: larvae - Proteocephalidea - cyclopoid copepods - Upper Paraná River - Brazil

The life cycles of certain proteocephalidean cestodes have been studied in the Northern Hemisphere for the last 50 years, mainly by Wagner (1954), Fischer (1968), Priemer (1987) and Scholz (1999). The ontogenetic development of proteocephalids could start with the dissemination of the eggs in water. When ingested by an aquatic organism, generally a copepod, the oncosphere released from egg rupture actively penetrates the gut wall. Within the body cavity, the oncosphere develops into a plerocercoid or a merocercoid (Chervy 2002). As a component of the fish diet, the copepod transmits the merocercoid to suitable fish host, where the larva may migrate parenterally, becoming or not encapsulated, or it may develop into an adult if it stops in the intestinal lumen (Smyth 1994).

Pavanelli and Machado dos Santos (1991) and Rego et al. (1999) have already reported adults of proteocephalideans in fish species of the Upper Paraná River floodplain. Encapsulated merocercoids have recently been isolated from the intestinal wall, mesentery and peritoneum of *Gymnotus* spp. ("morenita", Gymnotidae) (Falavigna et al. 2000), from the intestinal wall and mesentery of *Loricariichthys platymetopon* ("cascudo-chinelo", Loricariidae) (Schäffer et al. 1992), *Pseudoplatystoma corruscans* ("pintado", Pimelodidae) (Rego & Gibson 1989), and *Hoplosternum littorale* ("caboja or tamboatá", Callichthyidae) (Falavigna et al. 2000). In order to contribute to the knowledge of the life cycle of proteocephalids in the Upper Paraná River floodplain, potential intermediate hosts of proteocephalidean cestodes were examined.

A total of 5,206 specimens of zooplanktonic and benthic organisms were collected between March 1999 and June 2000. They comprised cyclopoid copepods (2,621), calanoid copepods (1,479), cladocerans (704), rotifers (307), larvae of chironomids (41) and ostracods (54). Zooplankton 68 µm-mesh nets were used; collection occurred from 6 to 8 a.m. and from 5 to 7 p.m. (Lansac-Tôha et al. 1992).

The samples were collected in semi-lotic (Baía River) and lentic (Garças Lake; Leopoldo Backwater and Pau Véio Backwater) environments (Fig. 1). Specimens were examined on a lamina with a thin layer of water under light microscope after narcotization by 0.7% carbonated water.

Ecological terms were those suggested by Bush et al. (1997). The identification of merocercoids was based on Rybicka (1966), Jarecka (1975), Scholz (1999) and Chervy (2002) and the identification of cyclopoid copepods on Reid (1985).

Eight cyclopoid copepods, i.e. 0.3% of the copepods examined, harbored merocercoids; two were copepodids, one was male and five females (Table). The infected male was identified as *Paracyclops* sp., and the females belonged to the following taxa: *Paracyclops* sp., *Thermocyclops minutus* Lowndes, 1934 and *Mesocyclops longisetus* Thiébaud, 1914.

Only one merocercoid was observed in each naturally infected copepod (Fig. 2a). Developmental degree of larval phases ranged from a hexacant embryo, measuring 27.6 µm, to fully formed merocercoids, measuring 276-389 µm (Fig. 2a, b). They were found freely moving within the first cephalothoracic segment of the body cavity of copepods.

Species identification of larvae was impossible. However, it may be observed that the monocephalic and acetabulate larvae presented invaginated scolex provided by four suckers (86 ± 3 µm) and an apical end organ (67 ± 2 µm), lacking a primary lacuna and a cercomer (Fig. 2b). These larval cestodes were also similar to proteo-

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cephalidean larvae obtained from experimental infection of copepods (Falavigna 2002).

Infected copepods were found in March and December 1999 and February 2000 (summer and spring) in the Baía River and in the Pau Vêio Backwater, at a water temperature ranging from 24 to 30°C. Flooding period and fish reproduction in the region occurred between October and February.

This is the first report of merocercoids of proteocephalidean tapeworms in naturally infected copepods in Brazil natural environments, but Békési et al. (1992) have already found proteocephalidean larvae in *Diaptomus* sp. from artificial environments (aquaculture tanks) placed in Northeast Brazil.

Low prevalence (0.3%) found here was similar to those reported by Doby and Jareka (1966) and Marcogliese (1995),

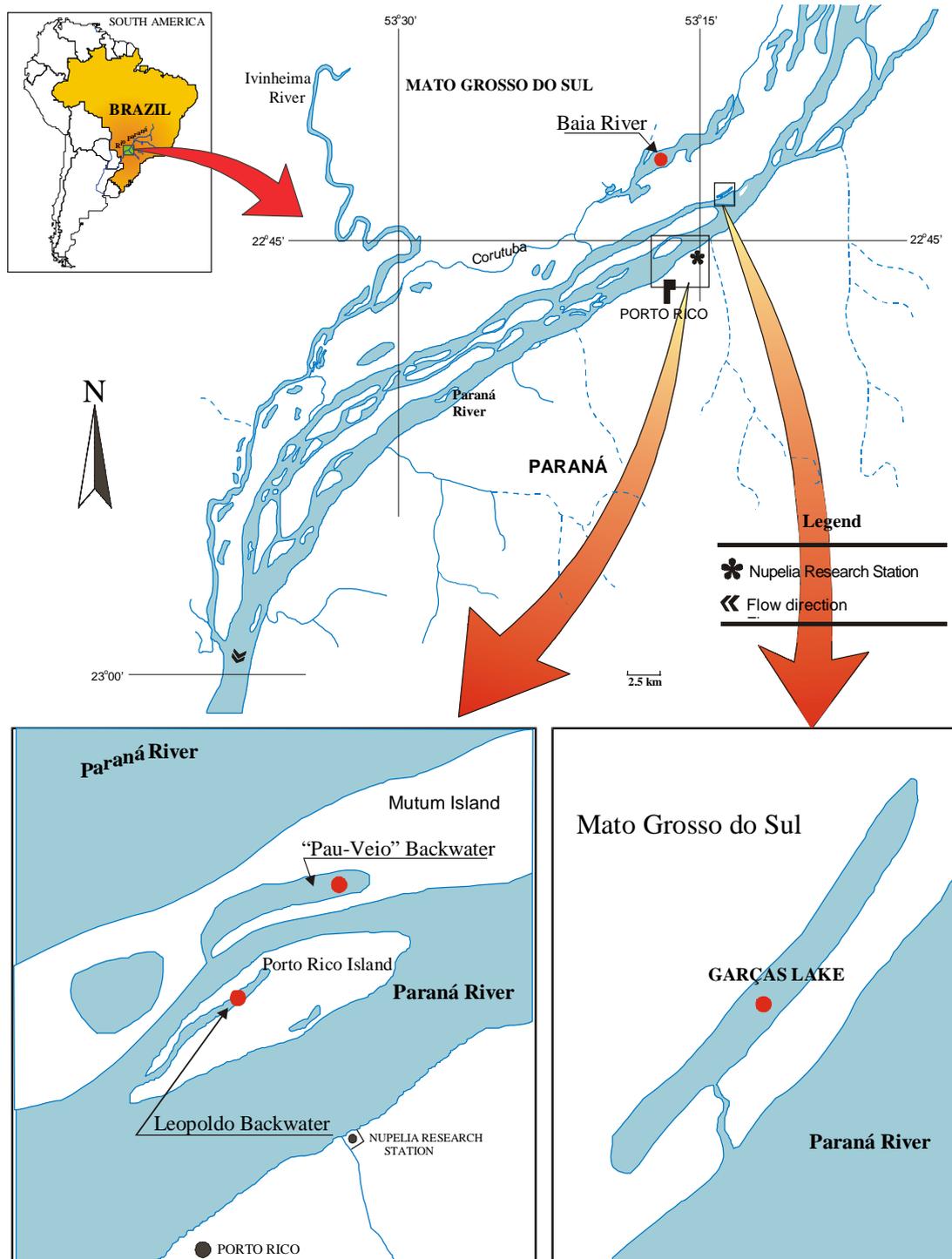


Fig. 1: collection sites in the Upper Paraná River floodplain, Brazil

who reported rates from 0.001 to 1%. There is a considerable difference between intensity of infection between natural intermediary hosts and those experimentally infected (Scholz 1999). Higher rates, found in the latter, may be explained by the absence of interferential environmental factors such as the low probability of spatial and temporal contact between copepods and protocephalidean eggs, rapid temperature changes, the decrease in copepod mobility and the difficulty in food gathering.

The localization of a single merocercoid in the first thoracic segment of infected copepods seems to be the rule in natural infections (Scholz 1999). However, multiple infections may be obtained in an experimental way, possibly due to the greater egg availability (Falavigna 2002).

With regard to seasonality, the infected copepods were detected in the end of spring and summer. It coincided with flooding period and that of reproduction of copepods and fishes. It is acknowledged that the flooding period in the Upper Paraná River floodplain largely contributes towards the species richness and dispersion of cope-

pods (Lansac-Tôha et al. 1997), while reproduction favors infection and parasitism in aquatic organisms (Dogiel 1970). According to Pavanelli et al. (1997), environmental abiotic factors (hydrological flow oscillations, temperature, dissolved oxygen concentration and turbulence of the water) and biotic factors (composition of the zooplanktonic and benthic fauna) have decisive influence on the susceptibility of fishes to parasite infections and on the epidemiology of certain species of parasites. Besides, the mating process and the egg production consumes accumulated energy and stimulates the females to feed themselves voraciously (Poulin 1996, Wedekind & Jakobsen 1998). The dispersion of infected copepods in semi-lotic and lentic environment such as the Baía River and the Pau Véio Backwater, respectively, enhances the chance of infection of zooplanktivorous larvae and young fishes, once these places are breeding sites of *Gymnotus* spp., *L. platymetopon*, *H. littorale* – paratenic hosts – and *P. corruscans* – definitive host of protocephalideans in the region (Falavigna 2002).

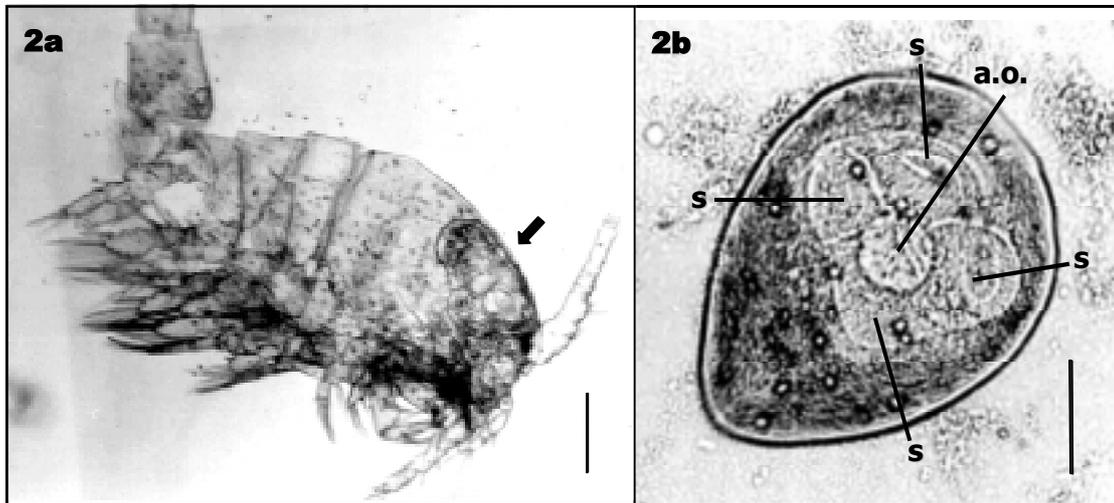


Fig. 2a: copepod with merocercoid (arrow); b: free merocercoid after release from copepod, having invaginated scolex with apical end organ (a.o.) and four suckers (s). Bar = 100 µm

TABLE

Merocercoids in zooplanktonic and benthic organisms collected between March 1999 and June 2000 in the aquatic environments of the Upper Paraná River floodplain, Brazil

| Organisms | Stage | N | Ni | Prevalence (%) |
|--------------------|-----------------------|-------|----|----------------|
| Cyclopoid copepods | Immature ^a | 1,565 | 2 | 0.1 |
| | Males | 406 | 1 | 0.3 |
| | Females | 650 | 5 | 0.8 |
| Subtotal | | 2,621 | 8 | 0.3 |
| Calanoid copepods | Immature ^a | 516 | - | - |
| | Adults | 963 | - | - |
| Subtotal | | 1,479 | - | - |
| Cladocerans | | 704 | - | - |
| Rotifers | | 307 | - | - |
| Ostracoda | | 54 | - | - |
| Chironomida larvae | | 41 | - | - |
| Total | | 5,206 | 8 | 0.2 |

N: number of examined; Ni: number of infected; a: nauplii and copepodids

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