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# *Myxobolus macroplasmodialis* sp. n. (Myxozoa: Myxosporea), a Parasite of the Abdominal Cavity of the Characid Teleost, *Salminus maxillosus*, in Brazil

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**Summary.** A new myxosporean species, *Myxobolus macroplasmodialis* sp. n., infecting the Brazilian freshwater fish *Salminus maxillosus*, is described. The species forms large plasmodia in the abdominal cavity, which are filled with spores differing from all known *Myxobolus* species by their anteriorly diverging and anteriolaterally opening polar capsules. In this respect the species resembles members of the genus *Triangula* but in all other features it shows the characteristics of the genus *Myxobolus*.

**Key words:** Brazil, *Myxobolus*, Myxosporea, new species, pisces, *Salminus*.

## INTRODUCTION

Few myxosporean parasites have been reported from South America. Of these, members of the genus *Henneguya* Thélohan are most studied (Pinto 1928; Guimaraes and Bergamin 1933, 1934; Cordeiro *et al.* 1984; Azevedo and Matos 1989, 1995; Azevedo *et al.* 1990; Rocha *et al.* 1992). Compared to the number of *Myxobolus* species known from other parts of the world (Donets and Shulman 1984, Landsberg and Lom 1991) the number of *Myxobolus* species recorded from South American fishes is relatively low. The results of myxosporean research in South America were summarised by Walliker (1969), who reported eleven known species and described a new species, *M. serrassalmi*. The occurrence of some other *Myxobolus* spp. has been mentioned by Thatcher (1981) and Molnár and Békési (1993).

The present paper reports on the occurrence of a *Myxobolus* species which forms unusually large plasmodia in the abdominal cavity of dourado (*Salminus maxillosus*), a common economically important fish in Southern Brazil. The species is described as *M. macroplasmodialis*.

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## MATERIALS AND METHODS

*Salminus maxillosus* (Pisces, Characidae) was collected from the River Mogi-Guacu, near Cachoeira de Emas (Pirassununga). A total of

247 fish (36–87 cm long) were examined for the presence of myxosporean plasmodia between August 1996 and June 1997. Some plasmodia located free in the abdominal cavity were fixed in 70% ethyl alcohol, while others were preserved in 10% formalin. Dimensions of the plasmodia (cysts) were measured during necropsy of freshly killed fish. Spores obtained from the plasmodia (cysts) were measured after fixation. Measurements were taken from 25 alcohol fixed and 25 formalin fixed spores. Drawings were made of both formalin- and alcohol-fixed material. For photomicrography, spores were freed from alcohol-fixed cysts, laid on top of a thin agar layer, and covered with a coverslip according to the method of Lom (1969). Permanent preparations were made by placing a portion of spores into glycerol-gelatine and mounting them under a coverslip. The spores were checked for the presence of an iodinophilous vacuole after adding a drop of Lugol's solution. The measurements of spores were determined by comparing images of spores projected from an Olympus microscope to the screen of a video recorder with a computer-calibrated scale of measurements.

For histology, cysts, a part of the intestine and the inner organs, were fixed in 10% buffered formalin, embedded in paraffin wax and cut into 4 μm thick sections, which were stained with histological Giemsa stain and with haematoxylin and eosin (H & E). Plasmodial structure was studied on a well-developed plasmodium filled with fully developed spores. Photographs of alcohol-fixed spores and of the histological sections were taken with a camera attached to a Jenaval microscope.

## RESULTS

Twenty-four of 247 fish had plasmodia (cysts) located free in the abdominal cavity. The majority of the fish had one plasmodium. One fish, however, harboured 28 specimens. Plasmodia were elliptical in shape, 7–24 mm long and 3–13 mm in wide. All plasmodia found contained thousands of spores. The plasmodial wall was composed of a thin (30–42 μm) layer of host origin, which contained cytoplasm-deficient cells with large nuclei. The layer of host origin was connected to the ectoplasm of the plasmodium with a structureless layer staining blue in Giemsa-stained histological sections (Fig. 1). This structureless part of the cyst wall continued in the thin layer of the ectoplasm containing vegetative stages and developing sporoblasts of the parasite. The endoplasm contained mature spores (Fig. 2).

### Description of the species:

Type host: dourado *Salminus maxillosus* Valenciennes, 1840.

Locality: river Mogi-Guacu, near Cachoeira de Emas (Pirassununga, Sao Paulo State).

Site of infection: abdominal cavity.

Type material: spores have been deposited in the protozoological collection of the Hungarian Natural History Museum.

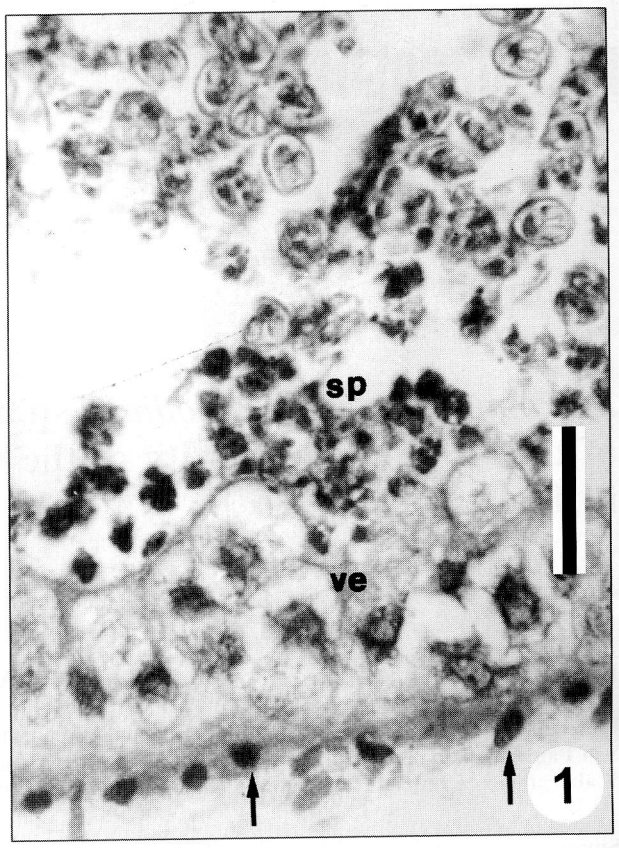


Fig. 1. Histological section of a plasmodium of *Myxobolus macroplasmodialis*, located close to the periphery of the „cyst". Layer of host origin with cytoplasm-deficient cells (arrows). Vegetative stages in the ectoplasm (ve). Young sporogonic stages (sp) consisting of sporoblasts and immature spores. Giemsa stain. Scale bar - 30 μm

Description of spores: spores (Figs. 3, 4) variable in shape, being ovoid or trapezoid in character, narrower at the posterior end in frontal view, and lemon-shaped in lateral view. Anterior end impressed in most spores, particularly in those fixed in formalin. Other spores (most notifiably specimens preserved in glycerol-gelatine) the end is rounded. Some spores with impressed end show a triangular shape (Figs. 4a-d). Spore valves relatively thin, symmetrical and smooth. Sutural line indistinct, sutural edge less protruding. Spores 11 (10.5–12) μm in length, 8.5 (8–9) μm in width, and 5.2 (5–5.5) μm in thickness. Two polar capsules pyriform in shape, equal in size, 4.5 (4–5) μm long and 2.8 (2-3) μm wide. Polar capsules diverge toward the anterior end and open anteriolaterally in a small thickening in the sutural line. The divergence of polar openings is more distinct in spores with an impressed anterior end (Figs. 4c, d). Polar filaments closely coiled, with 6 turns in the polar capsule, aligned perpendicularly

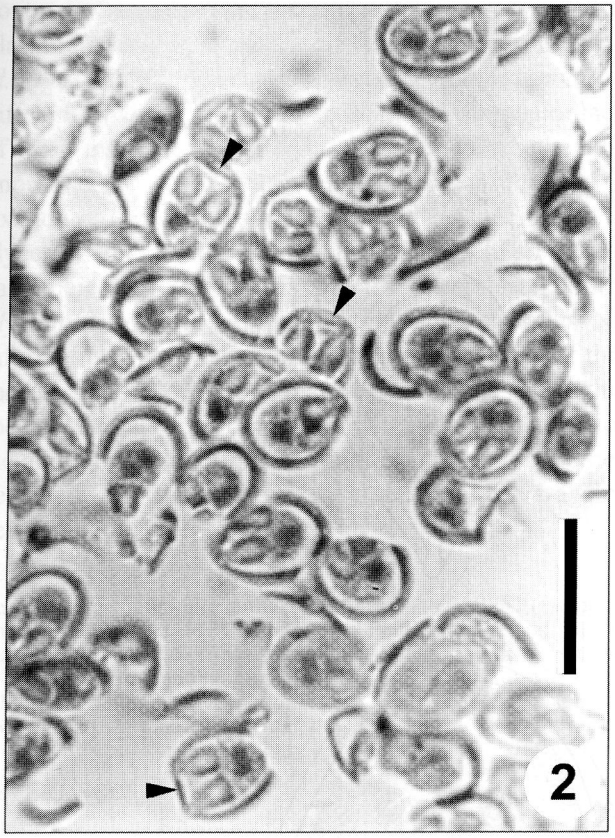


Fig. 2. Cross-sectioned spores in the endoplasm of *Myxobolus macroplasmodialis*. See the impressed anterior part and the diverging polar capsules of the spores (arrowhead). H & E. Scale bar - 15 μm

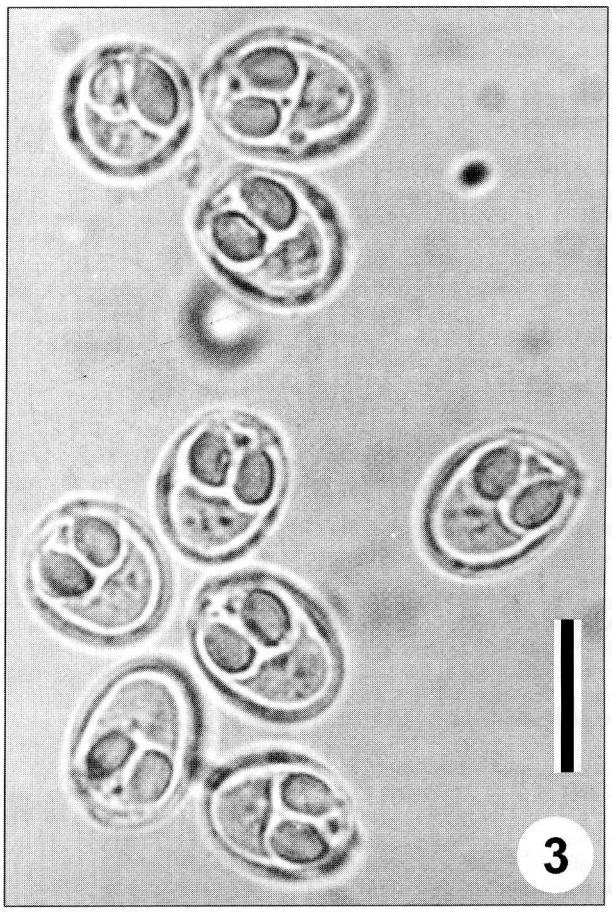


Fig. 3. *M. macroplasmodialis* spores from an alcohol-fixed plasmodium. H & E . Scale bar - 10 μm

to the longitudinal axis of the capsule. A large, triangular intercapsular appendix is located anterioraly. Due to the impression of the spore wall only a loose contact is observable between the wall and the appendix. Iodinophilous vacuole absent. Two nuclei of the sporoplasm are well discernible also in unstained preparations.

## DISCUSSION

The taxonomic position of this species is uncertain. It bears the characteristics of both the genus *Myxobolus* Buetschli and the genus *Triangula* Chen & Hsieh. In its large plasmodia, in the oval shape of polar capsules in spores preserved in glycerol-gelatine, and in the well-developed intercapsular appendix, *M. macroplasmodialis* resembles other species of the genus *Myxobolus* and differs from the two known histozoic *Triangula* spp. (*T. yangkiangensis* and *T. percae*), which develop with small plasmodia in the epithelium and in the brain, respectively (Chen and Hsieh 1984, Langdon 1989). As regards the position of the openings of polar capsules, however, this species fits well into the genus *Triangula.* The polar capsule openings of the majority of *Myxobolus* species lie very close to each other at the anterior pole of the spores; therefore, polar capsules usually converge towards the anterior pole. Nevertheless, at present this is the only major difference between our species and other *Myxobolus* species and we do not have enough arguments to relate *M. macroplasmodialis* to the already known species of the genus *Triangula*. Of species of the latter genus, *T. percae* resembles *M. macroplasmodialis* in its structure, but *T. yangkiangensis* seems to have characters rather distinct from those of the latter species.

*Myxobolus* spp. are common parasites of freshwater fishes. Most of the fish species whose parasite fauna has

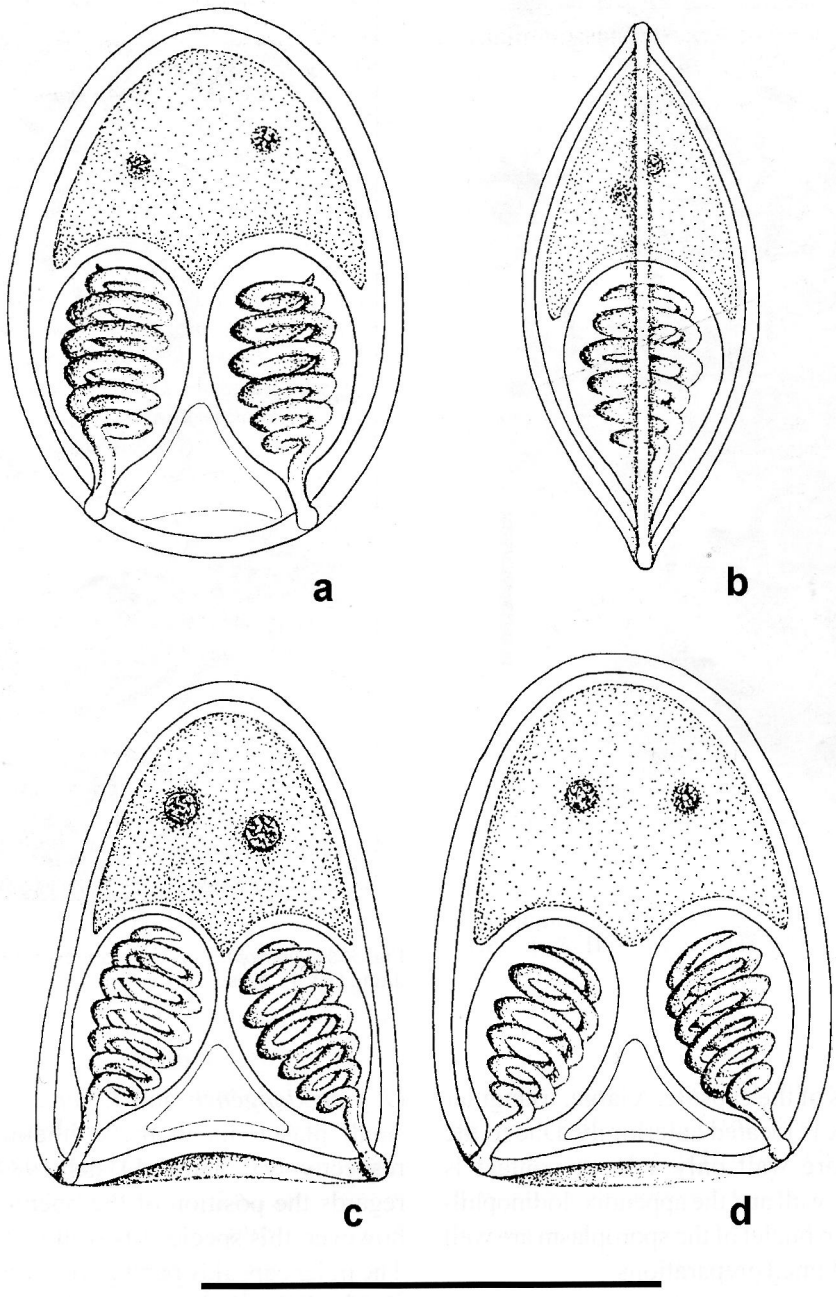


Fig. 4. Schematic illustration of *M. macroplasmodialis*. a - alcohol-fixed spores in frontal view; b - alcohol-fixed spores in lateral view; c,d - formalin-fixed spores. Scale bar - 10 μm

been studied has one or more *Myxobolus* species. Little is known about the host specificity of *Myxobolus* spp. but new data indicate that the number of species with a wide host range is low and most species appear to be strictly host specific or capable of developing only in closely related fishes. From characid fishes only a single *Myxobolus* species, *M. colossomatis* has been described (Molnár and Békési 1993) and the occurrence of two other *Myxobolus* spp. mentioned (Walliker 1969). *M. macroplasmodialis* is distinct in that it develops in unique, large cysts. The plasmodia of the majority of *Myxobolus* species measure 0.5–3 mm, whereas those in *M. macroplasmodialis* exceed 1 cm. Furthermore, the plasmodium of *M. macroplasmodialis* is composed of a single unit, in

contrast with some other species with large amalgamated plasmodia such as *M. nodulointestinalis* (Massoumian *et al.* 1996). In addition to its cyst size, *M. macroplasmodialis* differs from other species in spore morphology. For lack of fresh material it cannot be determined whether the impression on the anterior end is only a consequence of fixation or a genetic characteristic of the species. As in glycerol-gelatine preparations the majority of spores regain their oval shape, this species differs from other *Myxobolus* spp. only in its diverging polar capsules. No information is available on the tissue specificity of this species, but the location of mature cysts suggests that this species starts its development in the serous membranes of the abdominal wall or abdominal organs, and becomes detached from those sites only at an advanced stage of development.

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