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MYXOBOLUS MISSISSIPPIENSIS N. SP. (MYXOSPOREA) FROM GILLS OF LEPOMIS MACROCHIRUS IN MISSISSIPPI

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ABSTRACT: *Myxobolus mississippiensis* n. sp. is described from gill lamellae of the bluegill (*Lepomis macrochirus*) inhabiting the Pascagoula River System, Mississippi. Fresh spores measure 16.4–18.7 µm long, 3.9–6.2 µm wide, and 4.7–6.2 µm thick. Spore width to length ratio is 1:3.2. Polar capsules are 5.5–7.8 µm long and 1.5–2.3 µm wide, with 9–10 filament coils that when extruded measure 42.1 ± 4.2 µm. This parasite is unique among known species of *Myxobolus* in having spores that are lenticular in frontal view.

During examination of centrarchid fishes of Mississippi for myxosporean parasites, we found a previously undescribed species of *Myxobolus* Bütschli, 1882 (Myxosporaea) parasitizing gills of the bluegill. This report describes that material and discusses its possible relation to species in *Henneguya* Thélohan, 1892.

MATERIALS AND METHODS

Five adult specimens of the bluegill (*Lepomis macrochirus*) were collected in September 1994 by seining in the Pascagoula River and joining bayous, near Vancleave, Mississippi. Fish were fixed whole in 10% buffered formalin and rinsed overnight in tap water prior to necropsy, which included microscopical examination of all organs. Sample tissues were dehydrated in a graded ethanol series, cleared in xylene, and embedded in Paraplast. Histological sections (7 µm thick) were stained with hematoxylin and eosin. Fresh spores were obtained from an additional 4 of 10 bluegills collected 19 February 1996 from the Pascagoula River. Those spores from 3 pseudocysts were mixed together in a wet mount and then measured and photographed. Air-dried smears of fresh spores were stained with Giemsa. Other fresh spores were mounted in India ink or stained with Lugol's iodine solution. Spore measurements are presented in micrometers as a mean ± SD followed in parentheses by the range.

DESCRIPTION

Myxobolus mississippiensis n. sp. (Figs. 1–12)

Plasmodia occurring as subspherical pseudocysts, up to 300 µm long; ectoplasm thin; endoplasm poorly defined, containing randomly arranged fully developed spores. Spores lenticular in frontal view; anterior end usually more blunt than posterior end (see figures); posterior extremity tapered, rounded, or pointed; posterior tip frequently bending slightly away from sutural plane; aberrant spore specimens (0.5% of spores in a pseudocyst) often with pair of thin posterior extensions of spore valves; extensions 1–16 long (Fig. 12). Fresh spores (n = 15) 17.7 ± 0.6 (16.4–18.7) long, 5.2 ± 0.7 (3.9–6.2) wide, 5.4 ± 0.8 (4.7–6.2) thick, without mucous envelope; fixed spores (n = 15) from different specimen 16.8 ± 0.8 (16–18) long, 5.2 ± 0.3 (5.0–5.3) wide, 5 thick. Spore width to length ratio in fresh spores 1:3.3 ± 0.5 (1:2.8–4.4), in fixed spores 1:3.2 ± 0.2 (1:2.9–3.5). Spore valves smooth, de-

void of sutural ridge folds. Polar capsules narrowly pyriform, converging anteriorly but not crossing, 7.2 ± 0.59 (5.5–7.8) long (6.3 ± 0.6 [5.5–7.0] long in fixed specimens), with ratio of length to spore length 1:2.4 ± 0.2 (1:2.2–2.8), 1.6 ± 0.2 (1.5–2.3) wide (1.5 ± 0.2 [1.0–2.0] wide in fixed specimens), typically equal in length but frequently with 1 capsule 1–2 shorter than other, with intercapsular appendix absent. Polar filament exhibiting 9–10 coils arranged perpendicular to long axis of capsule, 42.1 ± 4.2 (35–46) long when extruded. Sporoplasm single, occupying almost ¾ of spore length, sometimes containing prominent (2 µm wide) roundish-shaped vacuole. Iodinophilous vacuole absent.

Taxonomic summary

Type host: *Lepomis macrochirus* Rafinesque, 1819, bluegill (Centrarchidae).

Site of infection: Capillary bed of secondary gill lamellae. Other organs not infected.

Type locality: Bluff Creek; also in nearby Swift Bayou and associated Pascagoula River, Jackson County, Mississippi.

Type specimens: Syntypes on Giemsa-stained, air-dried smear in U.S. National Parasite Collection no. 86817, Beltsville, Maryland.

Prevalence of infection: Five of 11 (45%).

Etymology: The species is named for the type locality.

DISCUSSION

Four-hundred sixty-six nominal species of *Myxobolus* have been described from aquatic vertebrates, the majority of which are from fishes (Cone et al., 1990; Maeno et al., 1990; Landsberg and Lom, 1991; Segovia Salinas et al., 1991; Fomena et al., 1993; Lom and Dyková, 1994; Masoumian et al., 1994). Of these, 110 species are known from freshwater fishes of North America (Cone and Raesly, 1995; Cone et al., 1996). *Myxobolus mississippiensis* n. sp. is unique in its lenticular frontal view. Spores of all other known species of *Myxobolus* are either circular, ellipsoidal, pyriform, or narrowly pyriform in frontal view (Shulman, 1966; Lom and Dyková, 1992).

Three species of *Myxobolus* in addition to *M. mississippiensis* have been reported from *Lepomis macrochirus*: *Myxobolus osburni* Herrick, 1936, *Myxobolus cartilaginis* Hoffman, Putz, and Dunbar, 1965, and *Myxobolus corneus* Cone, Horner, and Hoffman, 1990 (see Herrick, 1936; Otto and Jahn, 1943; Hoffman et al., 1965; Cone et al., 1990). Spores of these species can be easily distinguished from those of *M. mississippiensis* by their circular or suboval frontal aspect.

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FIGURES 1–10. *Myxobolus mississippiensis* n. sp. parasitizing *Lepomis macrochirus* from the Pascagoula River system, Mississippi. 1. Small oval plasmodium from fresh tissue smear, unstained. Scale bar 30 µm. 2. Histological section (H&E stained) through a plasmodium revealing its location within secondary lamellae. Scale bar 20 µm. 3–5. Photomicrographs of series of developed spores in frontal view. 6. Side view. Scale bar 10 µm. 7–10. Series of spores with atypical development of posterior extremity.

FIGURES 11, 12. Line drawings of *Myxobolus mississippiensis* n. sp. in frontal view. 11. Typical spore. 12. Abnormal spore with posterior extension of the valve. Scale bar 5 μ m.

We have assigned *M. mississippiensis* to *Myxobolus* because it complies with the revised definition of the genus, characterized by having species with 2 polar capsules in the apex of the spore, both of which are set in the sutural plane (Lom and Noble, 1984; Lom and Dyková, 1992). The unique lenticular shape of spores of *M. mississippiensis* expresses a similarity to that for spores of species in *Henneguya*. The valves differ by normally not extending as posterior filaments. Perhaps the occasional filamentous spore of *M. mississippiensis* and the filaments on spores of species of *Henneguya* are homoplasies resulting from convergent evolution. If so, such an event among species of *Myxobolus* is rare. On the other hand, those spores of *M. mississippiensis* with short filament-like posterior extensions of the valves, similar in appearance to the spores with normal filaments on species of *Henneguya*, provide the more likely explanation that *M. mississippiensis* is related to species of *Henneguya*. That relationship suggested by morphological features similar to those of some species of *Henneguya* would support rRNA sequence studies by Smothers et al. (1994) that suggest *Henneguya* and *Myxobolus* are related. They showed that certain species of *Myxobolus* apparently had closer phylogenetic ties with species of *Henneguya* than with other species of *Myxobolus*. The finding of abnormal spore extensions is not unique for *M. mississippiensis*. Some spores of at least one other species, *Myxobolus muelleri* Mitchell, 1989 from freshwater fishes in Montana, also exhibited abnormal posterior filaments (Mitchell, 1989).

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