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Metacercariae of *Diplostomum spathaceum* in the Eyes of Fishes from Yellowstone Lake, Wyoming

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ABSTRACT: Fish were collected from Yellowstone Lake, Wyoming (USA). Metacercariae of *Diplostomum spathaceum* was found in the lens of 11 of 12 longnose suckers (*Catostomus catostomus*). The mean number of metacercariae per sucker was 59 and the average age of the fish was 11.6 yr. There was no correlation between age and intensity of parasites ($r = 0.24$). Of 10 cutthroat trout (*Salmo clarki*) examined, there were metacercariae present in six. The metacercariae were found outside of the lens tissue in the trout; they occurred in the vitreous humor and the retina. These may be a different species from those found in the suckers.

Key words: *Diplostomum spathaceum*, cutthroat trout, longnose sucker, Yellowstone Lake, metacercariae, prevalence.

The "eye fluke," the metacercariae of *Diplostomum spathaceum*, has been reported from fishes in many areas throughout North America and Europe (Palmer, 1939; Hoffmann, 1967; Evans et al., 1976). In some areas it has caused severe problems; for example, thousands of rainbow trout (*Salmo gairdneri*) blinded by the digenean were destroyed at a state fish hatchery in New Jersey (Ferguson and Hayford, 1941). The digenean causes similar problems in Europe (Bauer et al., 1969).

The life cycle of *Diplostomum spathaceum* is typical of the strigeid trematodes (La Rue et al., 1926; Palmer, 1939; Palmieri et al., 1976). The definitive host may be one of >37 species of piscivorous birds (Palmieri et al., 1976, 1977), but it is usually a gull (*Larus* sp.). Eggs passed in the feces of the definitive host develop into free-swimming miracidia within 2 to 3 wk. The miracidia penetrate snails and develop into sporocysts within the hepatopancreas. Daughter sporocysts eventually produce free-swimming cercariae that emerge from the snail, and penetrate the second intermediate host, which is normally a fish. However, infections in reptiles, amphibians and mammals, including man, have been reported (Ferguson, 1943; Ashton et al., 1969; Palmieri et al., 1977).

Cercariae lose their tails and migrate through tissue and sometimes blood vessels to the lens tissue of the eye where they develop into metacercariae in 45 to 120 days (Larson, 1965). If the infected fish is eaten by a gull or other piscivorous bird the digenean becomes an adult in the bird's small intestine with 3 to 5 days.

Cutthroat trout (*Salmo clarki*) in Yellowstone Lake (Wyoming, USA; 44°34′ to 44°16′N, 110°35′ to 110°12′W) are sampled each fall to determine their growth rate and population trends. Non-native longnose suckers (*Catostomus catostomus*) are captured also. The purpose of this paper is to (1) report the finding of metacercariae of *D. spathaceum* in the lenses of the longnose sucker, (2) estimate the population affected, and (3) histologically evaluate the severity of the infection in these fish. Records indicated that this digenean has not been reported previously from Yellowstone Lake (Heckmann, 1971). However, Heckmann and Ching (1987) reported that the metacercariae of *D. spathaceum* were found in the suckers and *Diplostomum baeri* in the cutthroat trout of Yellowstone Lake.

The fish were collected near the outlet of Clear Creek on the east side of Yellowstone Lake (44°31′N, 110°16′W). Whole eyes were removed and fixed in Bouin's solution or frozen; opercular bones were also removed from each fish for use in estimating age.

Lenses were dissected from each eye, then teased apart on the stage of a 7 to 30 power dissecting microscope, and the metacercariae were counted. A linear regression was used to determine the cor-

FIGURE 1. *Diplostomum spathaceum* metacercariae in the lens of a longnose sucker. Note liquefaction in the lens fibers adjacent to parasite. H&E. Bar = 100 μm.

relation between the parasite intensity and the age of the fish.

The eyes that were fixed in Bouin's solution were for histological examination. Paraffin sections were cut at 5 μm and stained with hematoxylin and eosin.

Cutthroat trout were also examined for metacercariae. However, no data on intensity or age were collected.

Voucher specimens are deposited in the U.S. National Parasite Collection (Animal Parasitology Institute, USDA, Building 1180 BARC-East, Beltsville, Maryland 20705, USA; Accession Numbers 80335 and 80336 were assigned to the specimens from the longnose suckers and cutthroat trout, respectively).

Examination of the lenses of longnose suckers usually revealed large numbers of *D. spathaceum* metacercariae; 11 of the 12 suckers examined in 1981 had at least one metacercariae. The mean (SD) number of parasites per sucker was 59 (42), and the average estimated age of the fish was 11.6 (3.1) yr. There was no significant correlation between age and parasite intensity ($r = 0.24$). The parasite was not seen in body sites other than the lens in the infected fish.

There was a large difference in the number of digeneans between lenses from the same fish. Rau et al. (1979) showed that there was bilateral asymmetry in lens infections in the lake whitefish (*Coregonus clupeaformis*) and postulated that the *Diplostomum* sp. metacercariae reach the eyes through the blood stream. Damage to the minute blood vessels and tissue by the initial invasion could cause an inflammatory response. Since the inflamed tissue receives an increased blood supply, it was postulated that this may channel more metacercariae into the infected eye. However, previously Larson (1965) found that more metacercariae reached the eye by migrating through tissues than by being transported in the blood stream.

Metacercariae were observed in most lenses examined histologically. They often caused cataracts; lens fibers were disturbed

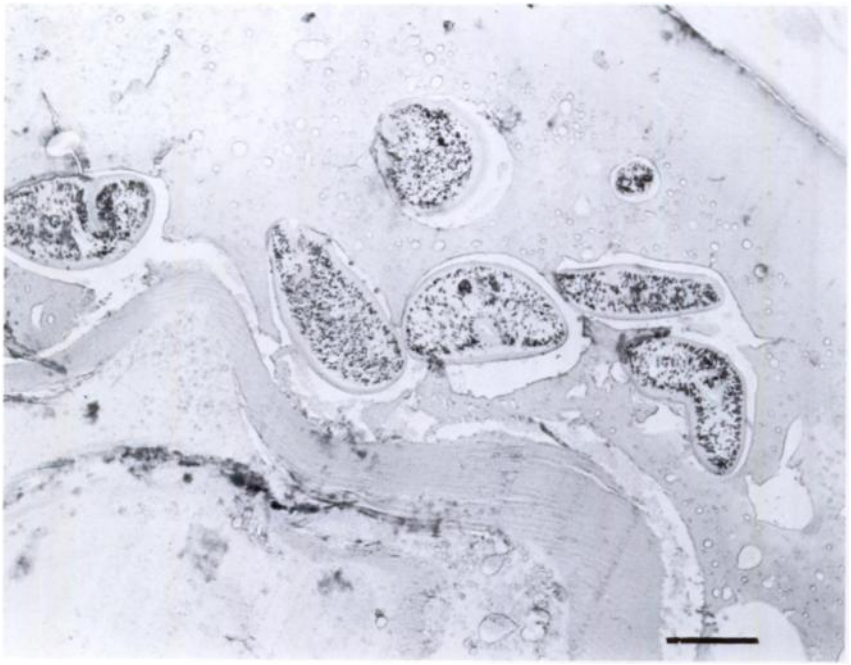

FIGURE 2. Several *Diplostomum spathaceum* metacercariae in the lens of a sucker. Note the disruption of the lens fibers and underlying lens nucleus. H&E. Bar = 200 μm.

and appeared to be liquefied (Figs. 1, 2). No effects of *Diplostomum* sp. were seen in the lens epithelium or other areas of the eye. Perhaps the inflammatory response subsided after the parasites entered the lens. Shariff et al. (1980) showed a number of changes, including retinal dislocation and rupture of the lens capsule in heavily infected rainbow trout.

The suckers with high prevalence of metacercariae infection were apparently blind. However, this evidently did not impair the ability of the fish to feed since there was no noticeable reduction in their condition. Because suckers are bottom feeders, eyesight may be of little consequence; however, other behavioral changes probably occur.

Diplostomum sp. were found also in the cutthroat trout of Yellowstone Lake. Ten trout were examined and the parasite was present in six. The metacercariae were found outside of the lens tissue in the trout; they occurred in the vitreous humor and retina. These may be *D. baeri* as reported by Heckmann and Ching (1987).

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