Everyone wants a window seat

Through chance and unfathomable lengths of time, evolution has shown remarkable creativity, yet some creatures still defy imagination. The digenetic (requires more than one host) trematodes definitely fall into that category. Childhood imagination could not provide a more bizarre life cycle than that evolved by some of these helminths that bedevil so called higher creatures. Diplostomum spathaceum illustrates that phylum with an ophthalmic twist.

The life cycle of D spathaceum begins as an egg in the faeces of a piscivorous bird, such as a gull or a pelican, as a definitive and unaffected host. It is in this host that the sexual phase occurs and the adult parasite lays its eggs in the bird’s gastrointestinal tract. The excrement containing the eggs is deposited in a fresh water lake or stream. As the faeces drop to the floor of the lake or stream, perhaps on the northern Canadian shield where they are prevalent, the eggs embryonate for approximately 3 weeks and then hatch when exposed to light. The photonegative and short lived miracidia exit the eggs, find their way to a snail, often of the Lymnaea genus, and penetrate the flesh. In the snail, the miracidia penetrate the hepatopancreas and undergo metamorphosis into sporocysts which develop into larvae, called cercaria. Within approximately 40 days, the cercariae exit the molluscan host. The cercariae usually depart the snail when the water temperature is approximately 10°C, assuring a departure of at least 40 days, the cercariae exit the snail when the water temperature is approximately 10°C, assuring a more bizarre life cycle than that evolved by some of these helminths that bedevil so called higher creatures. Diplostomum spathaceum illustrates that phylum with an ophthalmic twist.

The cercariae use to locate the eye is/are not known or understood. Since our current understanding of ocular immunology includes the eye as privileged and the lens as encapsulated within that privilege, re-evaluation of that model might be necessary in the case of the association between fish and D spathaceum. Normally, at least in humans, there appears to be no lens antigen release until the lens capsule is interrupted, and yet somehow this platyhelminth unerringly finds its way to these lens proteins to secure its meal of passage. Phototaxis may be a more likely mechanism although this would still present a puzzle as the parasite enters the flesh of the fish and must find its way to the lens.

D spathaceum and related species parasite a large variety of freshwater fish in North America and Europe—at least 105 species including important aquaculture species such as perch, roach, rainbow trout, bream, dace, gudgeon, and eel. Some authors report a female preponderance of infected individuals, although this may be an artefact of collection. Nevertheless, the benthic nature of the first intermediate host, the snail, and the proximity of the nesting female fish may put her at greater risk of infection.

This trematode (fluke) can and does infect humans although such infection is surprisingly rare. D spathaceum apparently is capable of penetrating the cornea and infecting the lens of frogs, turtles, birds, and even mammals although some experimental controversy exists. Interestingly, the cercariae can penetrate into, but not through, adult human corneas, and probably do not enter the anterior chamber in most instances. In some rabbits, corneal neubulae were produced by cercariae that did not penetrate. Perhaps these creatures are responsible for certain forms of nummular keratitis.

There are other piscine ocular parasites including the copepod parasites, Lernaeenicus sprattae and Phrioxcephalus cincinnatus. Both of these can penetrate the eyes of various species and may destroy the eye or blind the fish although these have not so common or so bizarre a life cycle as D spathaceum.

All of these parasites seem to jockey for a window seat.

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Rainbow trout photograph (top left) by the author taken at the American River Trout Hatchery with thanks to Dennis A Redfern. Thanks to Jerold Thrice, PhD, for his review of the essay. Sucker photograph (bottom left) by JD McLaughlin with thanks to Ron Hedrick and Thomas Waltzek for the pathological specimen.
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