

Pathological Implications of *Spinitectus carolini* (Spirurida: Nematoda) Infections to Survival of Mayflies and Dragonflies

Members of the order Ephemeroptera often serve as intermediate hosts in parasitic infections (G. Salt, *Parasitology* 53, 527-642, 1963; E. E. Knowles and J. E. Hall, *J. Invertebr. Pathol.* 27, 351-354, 1976). In most instances there is significant pathology associated with such infections (J. E. Hall, *J. Parasitol.* 45, 327-336, 1959; J. E. Hall and J. P. Babu, *J. Invertebr. Pathol.* 23, 123-124, 1974; G. Meissner, *Z. Wiss. Zool.* 7, 1-140, 1855).

We have observed that eggs containing 1st stage larvae of *Spinitectus carolini* (Spirurida: Nematoda) are ingested by mayfly naiads, *Hexagenia limbata*, after which, the first-stage larvae are released, penetrate the midgut wall, and enter the hemocoel. The larvae were then observed in the hemocoel for 6 days, in which time they grow and molt to second-stage larvae. The second-stage larvae penetrate the abdominal muscles of the naiads and soon thereafter molt to third-stage larvae. At this time the host naiads mount a defensive reaction culminating in the encapsulation of the larvae (Figs. 1, 2, 3). However, the larvae in the capsules and the capsules continue to grow at the expense of the deteriorating muscle tissue (Figs. 2, 3).

The capsule, which is of the sheathed type, is found to contain a brownish yellow pigment. Histochemical characterization of the pigment utilizing three different stains (toluidine blue, Giemsa, and Lillie's ferrous iron) prescribed by J. E. Hall and J. P. Babu (*J. Invertebr. Pathol.* 23, 123-124, 1974), indicated the presence of melanin in the capsule wall.

Experimental infections have shown the naiads capable of harboring in excess of 100 larval *S. carolini*. Larval *S. carolini* remain viable, regardless of their duration within the naiads. However, the maximum number of third-stage larvae recovered from adult *H. limbata*, which had been infected with *S. carolini* experimentally as naiads, was 8. The larger number of *S. carolini* in naiads as opposed to in adult *H. limbata* may suggest the inability of naiads to metamorphose or survive metamorphosis when heavily infected with *S. carolini* larvae. This is to be expected on the basis of the substantial pathological deterioration created by each larva (Figs. 2, 3), to the abdominal muscle bundles, especially when compared to the normal muscle tissue (Fig. 4).

Similar results were found in dragonfly

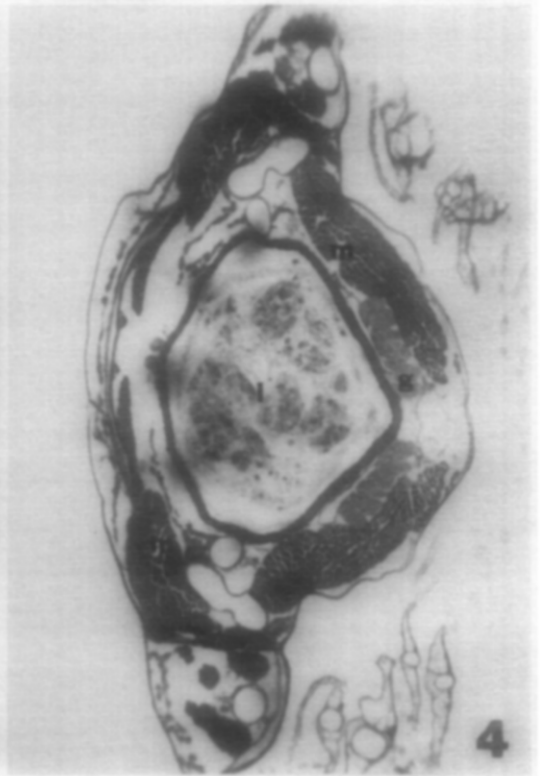
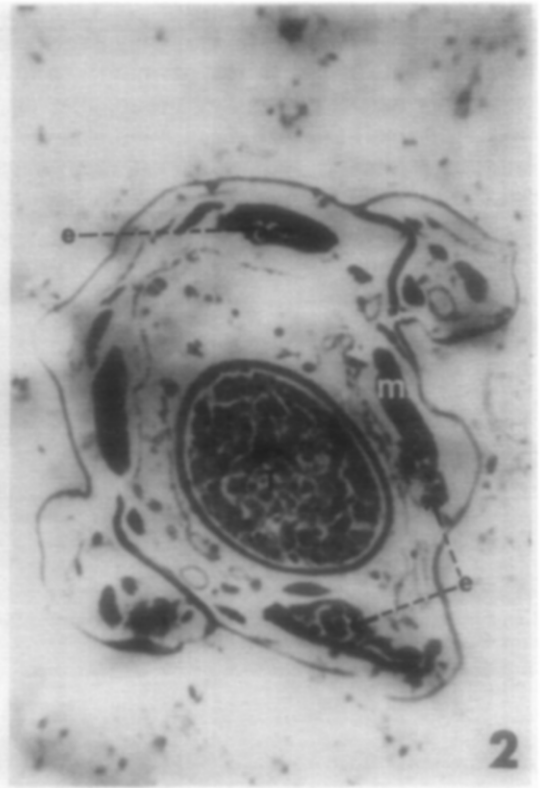
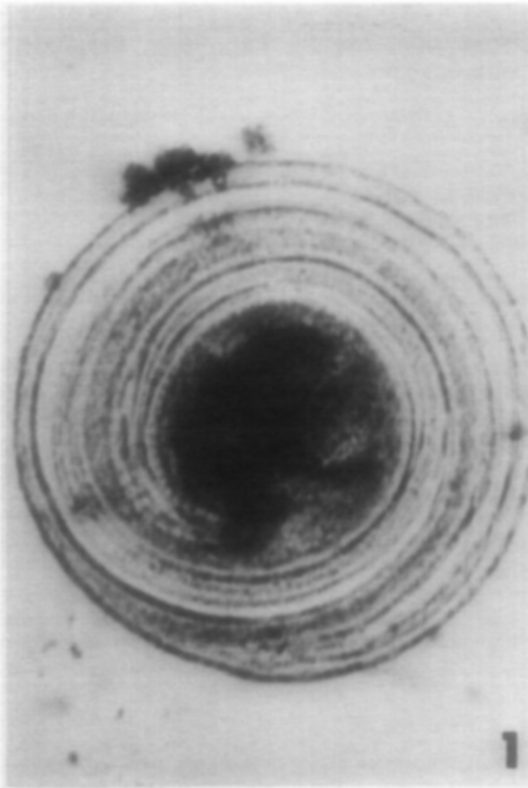
FIGS. 1-4. c, Capsule; e, encapsulated third-stage larva of *S. carolini*; g, gonadal tissue of *H. limbata*; i, intestine of *H. limbata*; m, abdominal muscle tissue of *H. limbata* naiad; p, parasite, *Spinitectus carolini* larva.

FIG. 1. Encapsulated third-stage larva of *Spinitectus carolini* excised from the abdominal muscle tissue of a mayfly naiad, *Hexagenia limbata*. $\times 200$.

FIG. 2. Cross section of *H. limbata* naiad infected with *S. carolini*. Arrows indicate encapsulated third-stage larvae of *S. carolini* in the abdominal muscle. $\times 40$.

FIG. 3. Encapsulated third-stage larva of *S. carolini* in the abdominal muscle of *H. limbata* naiad. $\times 400$.

FIG. 4. Cross section of *H. limbata* naiad showing normal histology of the uninfected control naiad. $\times 40$.



larvae infected with *S. carolini* larvae. *S. carolini* larvae, therefore, may play a role in the population dynamics of mayfly and dragonfly naiads by limiting the number of individuals that will metamorphose to adults. Incapacitation of larval mayflies and dragonflies would also serve to facilitate the perpetuation of the life cycle of *S. carolini*, by increasing their availability to fish definitive hosts.

KEY WORDS: *Spinitectus*, Spirurida, Nematoda, Mayfly Pathology, dragonfly pathology.

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