

DAMSELFLIES (ODONATA: ZYGOPTERA) AS PARATENIC HOSTS OF *SERPINEMA CF. TRISPINOSUM* (LEIDY, 1852) (NEMATODA: CAMALLANIDAE)



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Abstract

Third-stage juveniles of the nematode *Serpinema cf. trispinosum* (Leidy, 1852) were collected from the mid-gut of four species of adult damselflies from Teal Ridge, a non-irrigated restored semi-permanent wetland located in Stillwater, Oklahoma. This is the first record of *Serpinema* juveniles from damselflies. *Serpinema trispinosum*, adults have been reported from 15 species of North and Central American freshwater turtles, whereas microcrustaceans such as copepods serve as intermediate hosts in this nematode's life cycle. Our review of the literature indicates that this nematode has also been reported from a single species of aquatic snail in Canada, a single species of cichlid fish from Mexico and five species of amphibians from North and South America suggesting that a wide range of invertebrates and vertebrates may serve as paratenic hosts in the life cycle of this nematode. Dietary studies of the 15 species of freshwater turtles reported as definitive hosts for *S. trispinosum* indicate that aquatic insects including damselflies are more commonly reported in turtle diet studies than are fish or amphibians. Since larval damselflies predominantly feed on microcrustaceans our discovery of *S. cf. trispinosum* in damselflies may reflect the importance of damselflies as paratenic hosts of turtle parasites in this genus.

Introduction

Serpinema trispinosum (Leidy, 1852) is an intestinal nematode that uses fresh water turtles as a definitive host. While *S. trispinosum* juveniles stage has been found in various groups of animals; microcrustaceans, fish, anurans, and snails, *S. trispinosum* has never been reported from damselflies.

The point of this study was to report damselflies as new paratenic hosts for *S. trispinosum*

Methods

Four species of adult damselflies were collected from a temporal wetland preserve, known as Teal Ridge, in Stillwater, OK (see figure 1) from the Fall of 2010 through the Summer of 2012. Damselflies were identified to species using a taxonomic key (Merritt et al., 2008; Abbott, 2011). Hosts were necropsied via a gut drag on a glass slide. Nematodes found were stored in 70% ethanol and placed onto temporary slides in glycerin. Measurements were taken using a calibrated micrometer on an Olympus BX-51 upright research microscope configured for brightfield and differential interference contrast microscopy.



Enallagma civile
Common Bluet



Lestes disjunctus
Southern Spreadwing



Figure 1. Collecting from Teal Ridge Pond, Stillwater OK



Ischnura hastata
Citrine Fork-Tail



Ischnura verticalis
Eastern Fork-Tail

Results

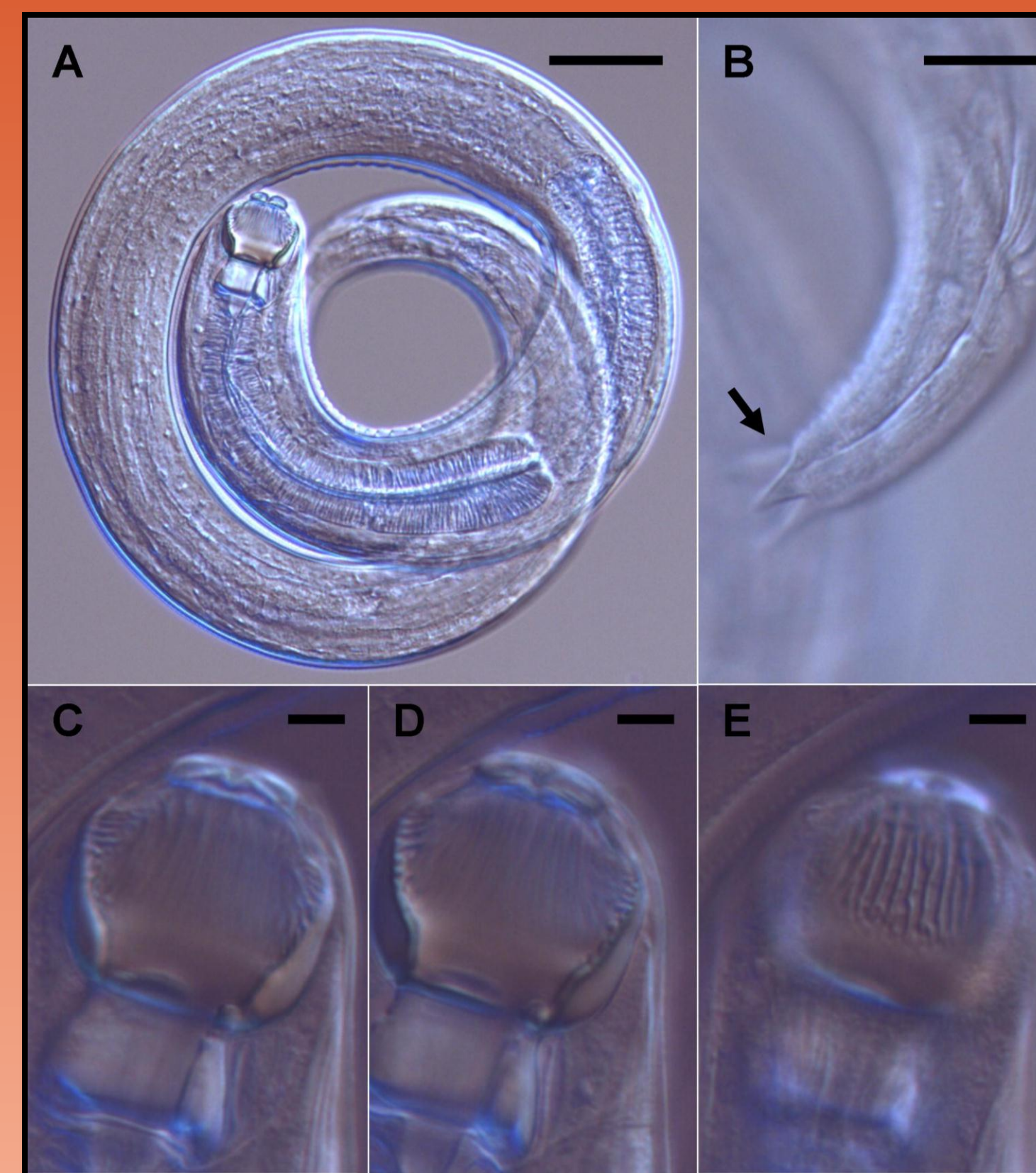


Figure 2. *Serpinema cf. trispinosum* collected from the mid-gut of the eastern forktail, *Ischnura verticalis* from Teal Ridge, Stillwater, Oklahoma. (A) Third Stage juvenile, general view; scale-bar = 50 μ m. (B) Tail note the three terminal cuticular spikes; scale-bar = 10 μ m. (C-E) Buccal capsule, lateral view. Note the ridges in buccal valve scale-bar = 15 μ m.

Results

Table I. Morphological characteristics of 3rd stage juvenile *Serpinema cf. trispinosum* from various paratenic hosts.

	This Study <i>S. cf. trispinosum</i>	Moravec et al., 1998 <i>S. trispinosum</i>	Bartlett and Anderson, 1985 <i>S. trispinosum</i>	Gonzales and Hamann, 2007 <i>S. cf. trispinosum</i>
Host Group	Damselflies	Fish	Aquatic Snails	Frogs
# hosts collected	525	18	25	43
% (No. infected/no. examined)	4%	17%	8%	16%
# hosts infected	6	5	2	11
Total Length (μ m)	881.1-1008.8	980-1295	1200-1300	1170-1930
Greatest Width	50.9-63	50-75	68-76	46-80
Buccal Cavity Anterior Length	25.2-32.76	33-38	30-36	37-42.5
Buccal Cavity Anterior Width	25.2-32.76	33-40	NA	25.3-43
Buccal Cavity Posterior Length	20.16-27.72	18-20	16-20	16-22
Buccal Cavity Posterior Width	12.6-15.12	25-28	NA	13.8-29
Muscular Esophagus Length	146.16-201.6	175-225	216-220	197.8-305
Glandular Esophagus Length	108.4-133.56	130-175	174-190	184-275
Nerve Ring*	73.08-90.72	95-118	84-88	85.1-135
Excretory Pore*	92.1-98.28	120-145	140-144	126.5-158.7
Genital Primordium*	624.96-1045.8	638-863	NA	NA
Tail End Length	42.84-63	60-70	64	52.9-115

Table 1. Morphological characteristics of 3rd stage juvenile *Serpinema cf. trispinosum* from various paratenic hosts. Compares the different ranges of morphological characteristics of the 3rd stage nematodes found in damselflies, fish, snails, and anurans.

*Distance from anterior end.

Table II. Diets of *Serpinema trispinosum* Definitive Turtle Hosts

Chelydridae (Snapping turtles)				
<i>Chelydra serpentina</i>	yes	yes	yes	yes
Emydidae (Pond Turtles)				
<i>Clemmys guttata</i>	yes	yes	yes	yes
<i>Clemmys insculpta</i>	yes	yes	yes	yes
<i>Chrysemys picta</i>	yes*	yes	no	no
<i>Deirochelys reticularia</i>	yes*	no	no	yes
<i>Pseudemys concinna</i>	yes*	yes	carrion	yes
<i>Pseudemys floridana</i>	yes*	no	no	no
<i>Pseudemys decussata</i>	yes	yes	carrion	no
<i>Trachemys scripta</i>	yes	yes	yes	yes
<i>Emydoidea blandingii</i>	yes*	yes	carrion	yes
<i>Graptemys geographica</i>	yes	yes	yes	no
<i>Graptemys pseudogeographica</i>	yes	yes	yes	no
<i>Graptemys kohnii</i>	yes	no	yes	yes
<i>Terrapene carolina</i>				
<i>Malaclemys terrapin</i>	no	yes	carrion	no
Kinosternidae (Musk and Mud Turtles)				
<i>Kinosternon subrubrum</i>	yes	no	carrion	yes
<i>Sternotherus subrubrum</i>	yes	yes	no	yes
Trionychidae (Soft Shell Turtles)				
<i>Apalone spinifera</i>	yes	no	yes	no
Total Species	14	12	13	10

Table 2. Diets of *Serpinema trispinosum* Definitive Turtle Hosts. Lists the known definitive turtle hosts and shows if they eat any of the 4 groups of paratenic hosts; aquatic insects, snails, fish, and frogs. *eats primarily

Table III. Reported Paratenic Hosts for *Serpinema trispinosum*

Host	Prevalence
Fish	
Family Cichlidae	
<i>Cichlasoma urophthalmus</i> (Mayan cichlid)	17%
Frogs	
Family Hylidae	
<i>Lysapsus limellum</i> (Uruguay Harlequin Frog)	16%
Family Ranidae	
<i>Rana catesbeiana</i> (Bullfrog)	0%
<i>Rana clamitans</i> (Green Frog)	0.003%
<i>Rana forreri</i> (Forre's Leopard Frog)	2.5%
<i>Rana pipiens</i> (Leopard Frog)	???
Snails	
Family Lymnaeidae	
<i>Lymnaea stagnalis</i> (Great Pond Snail)	8%
Odonates*	
Family Coenagrionidae	
<i>Enallagma civile</i> (Common Bluet)	3%
<i>Ischnura hastata</i> (Citrine Forktail)	3%
<i>Ischnura verticalis</i> (Eastern Forktail)	8%
Family Lestidae	
<i>Lestes disjunctus australis</i> (Northern Spreadwing)	10%

Table 3. Reported Paratenic Hosts for *Serpinema trispinosum*. Lists the various reported paratenic hosts used by the juvenile nematode and the prevalence found. *Unreported hosts.

Discussion

Aquatic insects are shown to be one of the most commonly reported food items of the nematodes definitive host turtles (see table 2). Additionally since larval damselflies predominantly feed on microcrustaceans, which serve as intermediate hosts for *S. trispinosum*, suggests that aquatic insects, like damselflies, play an important role in the transmission of this nematode to turtle hosts. So while the hypothesized life cycle involves the use of a fish, as the paratenic host, this review suggests that damselflies are the better paratenic host for this nematodes life cycle (see figure 3).

Finally a review of the literature indicates that *S. trispinosum* uses a wide range of paratenic hosts. (see table 3) This suggests that it increases its probability of infecting a wide range of turtle definitive hosts, across various landscapes, by using multiple kinds of paratenic hosts.

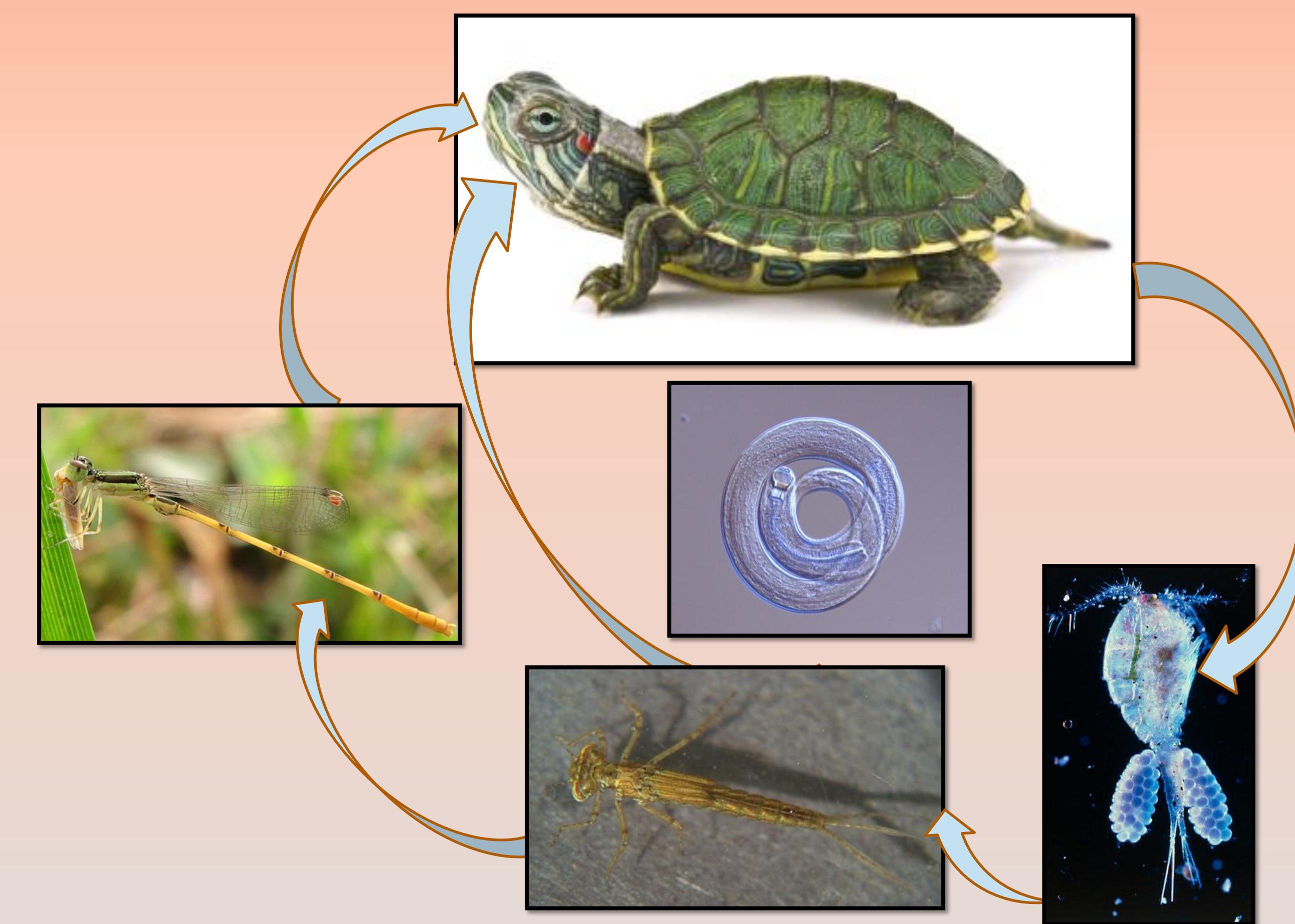


Figure 3. A suggested life cycle of *Serpinema trispinosum*.

Future Research

The identification of the juveniles and adult nematodes with the use of DNA analysis. Tell them you collected adults are measuring them and will sequence for ITS and COI.

Acknowledgements

Thanks to Cleo Issacs and my many undergraduate helpers for help with collecting, dissections, and measurements.

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