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Life histories of the trematodes found in Double-crested Cormorant populations in the Mississippi Delta and the potential impact of these parasites on commercial and wild fish species found in this region

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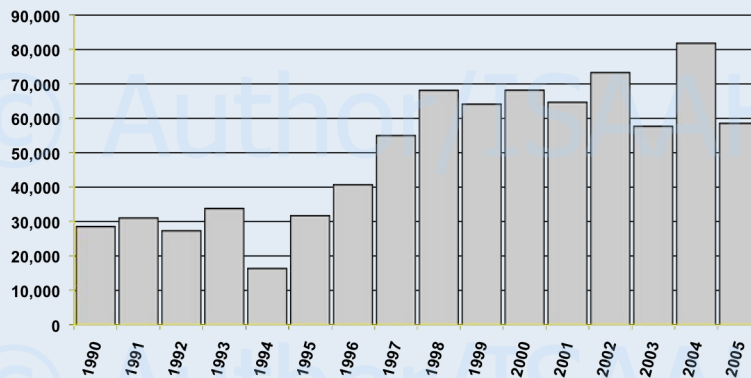
Double-crested cormorant

Phalacrocorax auritus

- Summer in Great Lakes area and central Canada
- Winter in southern US
 - September-May
- Population increase
 - Migratory Bird Treaty Act
 - DDT banned
- Prefer shallow open water
- Feed primarily on catfish and gizzard shad by diving and pursuing prey (MS Delta)
- Host to digenetic trematodes



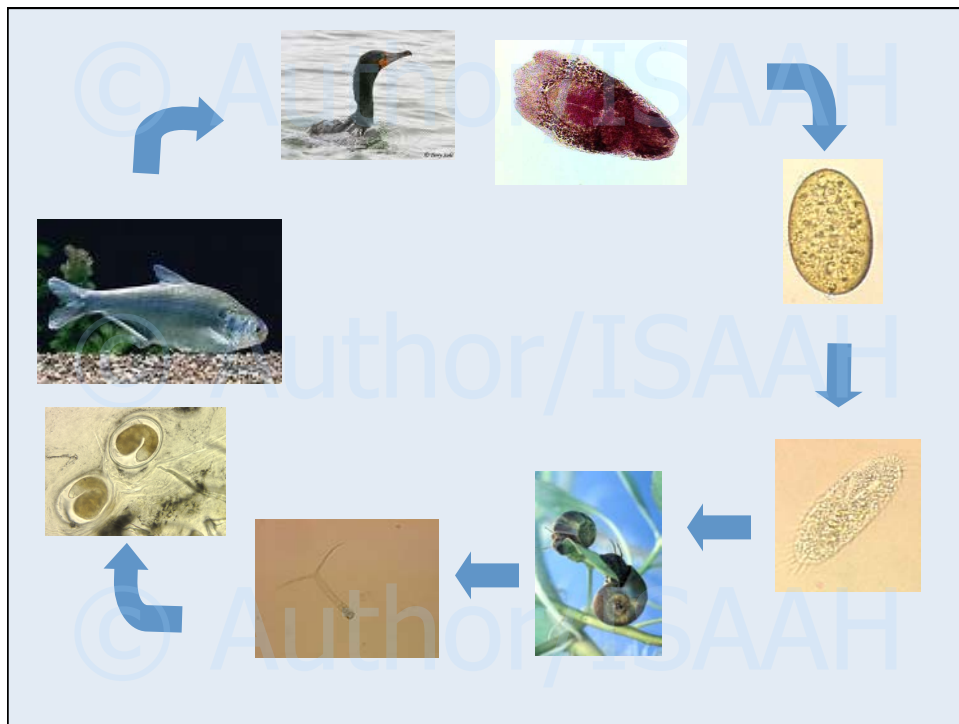
Double-crested Cormorant Mid-winter Roost Surveys



Pond Management

- 7-15 acre ponds
- Water Depth: 4-5 ft
- Stocking rates:
10,000-12,000 fish/acre
- Mixed population
- Cormorants tend to prey on fish that are the most readily available
- DCCO predations are estimated at 3-7% of catfish crop a year





Objectives

- Identification of adult trematodes collected from Double-crested cormorants and their impact on commercial and wild fish populations in the Mississippi Delta
- Identification of larval trematodes collected from wild fish collected in an ox-bow lake with a large cormorant population

Trematode Survey Bird Collection

- USDA-NWRC employees collected 35 wild Double-crested cormorants from MS Delta from Jan 2003-May 2003 and Jan 2004-March 2004
 - Bolivar
 - Humphreys
 - LeFlore
- Transported to MSU-CVM on ice
- Necropsied upon arrival



Trematode Survey Parasite Collection

- Stomach and Intestines
 - Opened and contents washed through a brass screen (aperture 75 μm)
 - 3 of 5 samples examined immediately
 - 2 of 5 samples fixed in 10 % formalin immediately
- Parasites were removed and placed in 70% mol ETOH for morphometric and molecular techniques

Survey Results

- 5 trematode species were collected from the stomach and intestines of the Double-crested cormorants collected
 - *Austrodiplostomum ostrowskiae*
 - *Drepanocephalus spathans*
 - *Hysteromorpha triloba*
 - *Ascotyle longus*
 - *Pseudopsilostoma varium*

Survey Results



- *Austrodiplostomum ostrowskiae*
 - Formerly *A. mordax*
 - Found primarily in the intestine
 - Present in 18 of the 35 cormorants (~51%)
 - Range: 0-44
 - Mean: 5
 - Eye fluke in several fish species

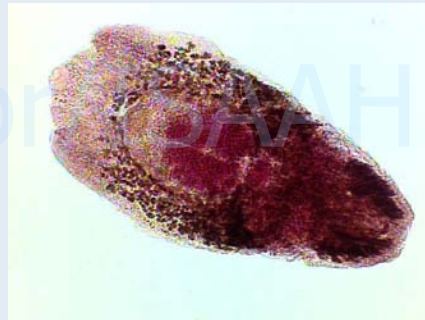
Survey Results



- *Drepanocephalus spathans*
 - Found in stomach and intestine
 - More heavily concentrated in intestine
 - In 30 of 35 cormorants (~86%)
 - Range: 0-364
 - Mean: 72
 - Life Cycle Unknown

Survey Results

- *Hysteromorpha triloba*
 - Found in stomach and intestine
 - In 26 of 35 cormorants (~74%)
 - Range: 0-184
 - Mean: 25
 - Thin walled-cysts in dorsal and abdominal muscles of several fish species (including catfish)
 - Interfere with muscle function, can lead to hemorrhage and purulence



Survey Results



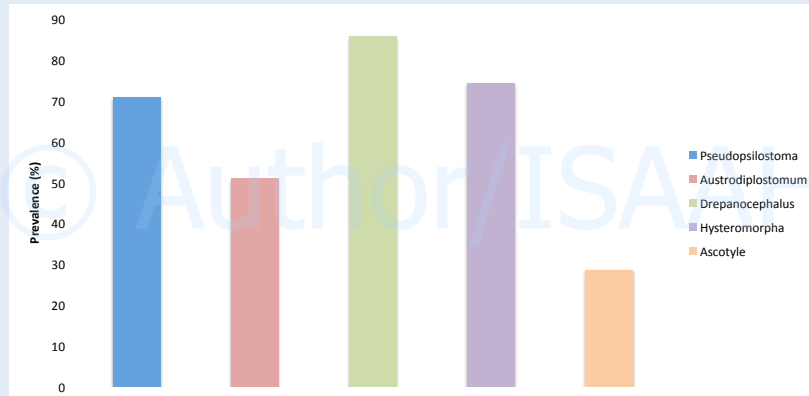
- *Ascotyle longus*
 - Present in stomach and intestine
 - In 10 of 35 cormorants (~29%)
 - Range: 0-61
 - Mean: 4
 - Encysted in heart, stomach, liver, kidney and spleen of several fish species
 - Causative agent of heterophyiasis in Brazil
 - Severe gastro-intestinal disease from consuming raw mullet

Survey Results

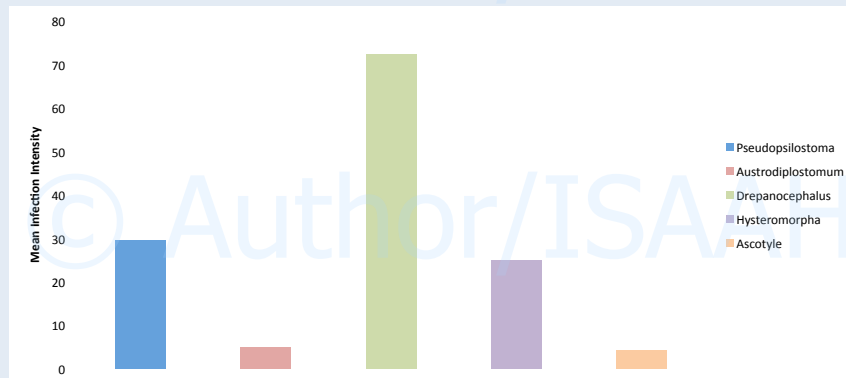
- *Pseudopsilostoma varium*
 - Found in the stomach of cormorants
 - In 25 of 35 cormorants (71%)
 - Range: 0-466
 - Mean: 30
 - Life Cycle Unknown



Prevalence of Trematode Infections in the Double-crested Cormorant



Mean Infection Intensity of Adult Trematodes in a Double-crested Cormorant



Ox-Bow Lake Fish Survey

- Ox-Bow Lake in Mississippi Delta
 - Large resident cormorant population
 - Near several commercial catfish operations
- 15 species of fish were collected at 5 different sites
 - Up to 5 species per site were collected
 - Fish were captured using electrofishing techniques and were euthanized on site
 - Transported back to MSU-CVM on ice and necropsied on arrival
 - Fish were examined externally and internally for the presence of parasites
 - Specimens preserved in 70% mol ETOH

Electrofishing Stunboat



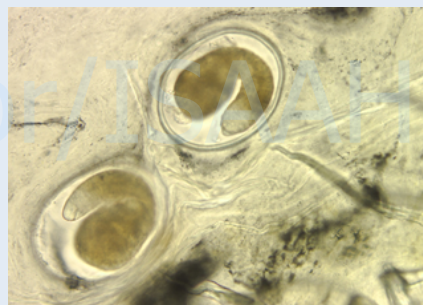
Ox-Bow Lake Survey Fish Species Collected

- Thread-fin Shad
- Spotted Gar
- Blue Gill
- Large Mouth Bass
- Carp
- Sun Fish
- Orange Spot
- Short nose Gar
- Black Spot
- Small Mouth Buffalo
- Bowfin
- Pug Minnow
- War Mouth
- Gizzard Shad
- White Crappie



OX-Bow Lake Survey Results

- 28% of fish collected were positive for trematode infections
 - Metacercariae stage
- Fish infected with trematodes were found at all 5 sites
- Identification of metacercariae done morphologically and molecularly



Posthodiplostomum minimum

- Only larval trematode stage recovered from Ox-bow lake fish
- Identified morphologically
 - Preliminary sequencing data confirm *P. minimum* infection
- Prevalence of 28% (38/136)
- High prevalence in Centrarchid Fish (67%)

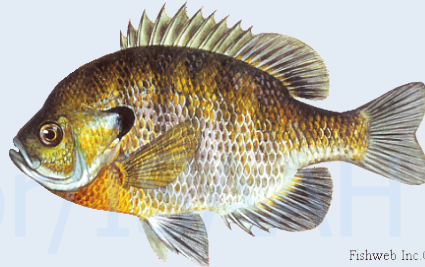


Prevalence of *P. minimum* metacercariae in Ox-bow Lake Fish



Ox-Bow Lake Survey Preliminary Results (Trematodes)

- Blue Gill
 - 21 of 25 Blue Gills (84%)
 - Liver, kidney, muscle and mesentery
 - Sites 1-5



Fishweb Inc. ©

- Large Mouth Bass
 - 8 of 15 LMBs (53%)
 - Muscle, liver, kidney
 - Sites 1, 3 and 4



Ox-bow Lake Survey Preliminary Results (Trematodes)

- Orange Spot
 - 3 of 4 (75%)
 - Muscle and Heart
 - Sites 1 and 4
- War Mouth
 - 2 of 5 (40%)
 - Heart
 - Site 4
- Long ear Sun Fish
 - 1 of 3 (33%)
 - Muscle
 - Site 2



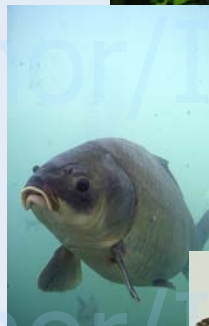
Ox-Bow Lake Survey Preliminary Results (Trematodes)

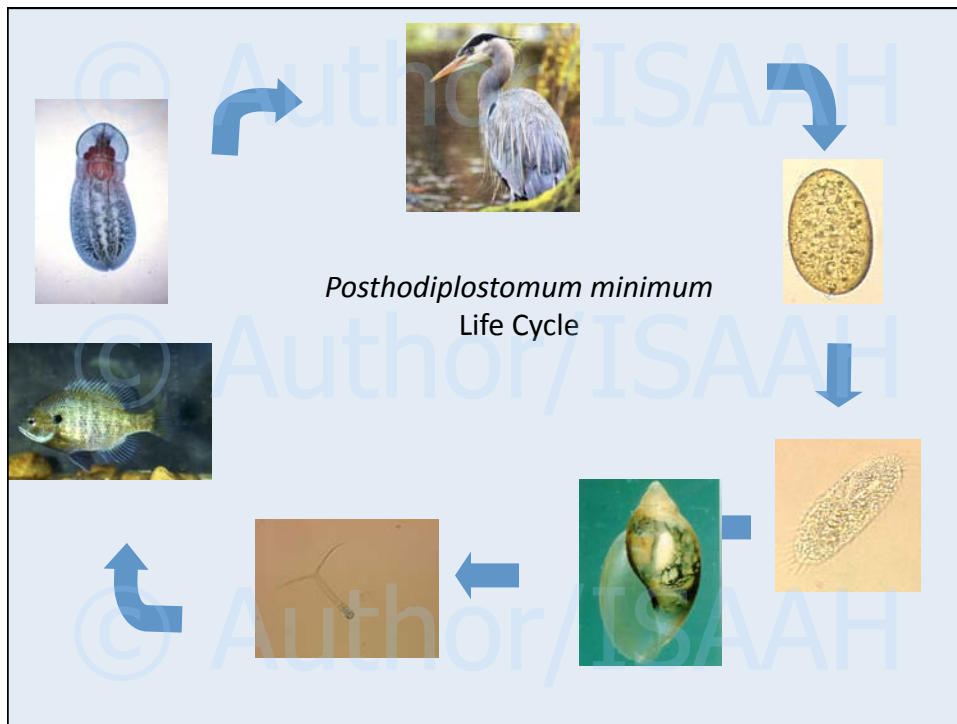
- Thread-fin Shad
 - 1 of 25 (4%)
 - Mesentery
 - Sites 1, 2, 4 and 5
- Gizzard Shad
 - 2 of 15 (13%)
 - Kidney
 - Site 5



Posthodiplostomum minimum Negative Fish

- Spotted Gar
- Carp
- Short nose Gar
- Black Spot
- Small Mouth Buffalo
- Bowfin
- Pug Minnow
- White Crappie





Posthodiplostomum minimum

- Generally considered to be non-pathogenic
- Parasites walled-off by inner cyst of parasite origin
- Elicit little or no host response
- Intense infections can cause damage
 - Rare
 - Gross displacement of tissue, inflammatory response, rupture of abdomen, death

Conclusions

- No metacercariae found in fish populations link to the adults found in the Double-crested Cormorant. Despite the high numbers of cormorants on this lake, this piscivorous bird seems to have little parasitic impact on this fish population.
- Herons, the definitive host for *P. minimum*, were observed in small numbers at the ox-bow lake, however they seem to have the greatest parasitic impact. Other definitive hosts?
- The species of snails inhabiting this lake may play a key role in determining which trematodes infect the ox-bow lake fish.

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Questions?



Catfish Aquaculture

- Began in 1960s
- Rapid growth in 1980s and 1990s
 - Concurrent rise in avian predation of catfish
 - Allows for completion of digenetic trematode life cycles
- United States
 - \$480 million in sales
- Mississippi
 - \$275 million in sales in 2004 (57%)
- Cormorant Predation
 - ≤ 25m/yr MS Farmers

