Tetracapsuloides bryosalmonae and Proliferative Kidney Disease in Montana

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Overview

1. Thank you for keeping eyes on our cages!
2. The past two years...
   • No PKD disease
   • Cooler temps, more water
   • Data → minimal threat of infection
   • Expanding research to other rivers
T. bryosalmonae (“PKX”)

Overt Infection

Covert Infection

Fish Myxospore

Clinical

Asymptomatic

Bryozoan Myxospore

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Brief History of PKD

- 1920: PKD-like symptoms described in Europe
- 1960: PKD cases in N. America
- 1974: PKD described
- 1981: T. bryosalmonae identified as "PKX"
- 1990: PKD-related mortality in Montana
- 1999: First PKD reported in U.S. (Idaho)
- 2012*: Preliminary Information - Subject to Revision. Not for Citation or Distribution
- 2016*: Subtle Yellowstone River fish kill
- 2017: Subtle Yellowstone River fish kill

* PKD Mortalities in the SF Snake River, ID
What happened in the Yellowstone?

• Hypotheses
  • Unprecedented environmental conditions
  • Nutrient loading
  • New introduction
  • New strain?
  • Changes in bryozoan populations?

• Key information
  • Where is *T. bryosalmonae* now?
  • Are there important seasonal, annual, or spatial patterns?
  • When and where do bryozoans occur?
What have we been doing?

- Where is T. bryo now?
  - Screen over 1200 fish kidneys from MT, ID, & WY
  - Water sampling at 6 different rivers
- Are there important seasonal, annual, or spatial patterns in T. bryo detection?
  - Intensive water sampling in Yellowstone R.
  - Fish cage exposures for 2 summers
  - Controlled study with collaborators in aquaculture
- When and where do bryozoans occur?
  - Visual surveys
  - Bryozoan traps
Cage Results

- 2018
  - 4 sites in the Yellowstone River from July-Sep
  - No infections detected

- 2019
  - 4 sites in the Yellowstone and 3 in the Madison from July-Sep
  - No infections detected
What does an eDNA positive mean?

Collect Water → Filter Water → Extract all DNA from Filter → Amplify Target DNA → Visualize Results

Parasite DNA
eDNA Surveillance

Shore-Based
Correlate environment with detection
Link parasite in water with parasite in fish

Thalweg
Integration of river section as a whole
Compare Rivers
- Seasonal pattern
- No spatial pattern
- Spatial pattern
- Seasonal pattern
- Annual pattern
- Spatial and Seasonal breakdown

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Current Hypotheses

- Multi-year flow drives bryozoan densities
- Bryozoan densities drive fish infection
- Temperature drives development of disease symptoms in fish
- Bryozoans are likely the lynchpin of understanding PKD
  - Also extremely challenging to collect data

- 2015 conditions increased bryozoan densities
- 2016 presented a “perfect storm” primed by 2015
  - High temps in early summer
  - Low peak flow
  - Low base flow
Yellowstone research has lead to...

- Two international PKD-focused meetings
- Joint European-USA research proposal
- New collaborations
  - Community
  - Inter-Agency
  - National
  - International
  - Private Industry
Ongoing Efforts

- Yellowstone River
  - Sentinel fish cage exposures
  - eDNA surveillance
  - Bryozoan distribution and diversity
  - Bryozoan host species
- Other Rivers
  - eDNA surveillance
  - Diagnostics and surveillance at aquaculture facility
  - Genomics approaches for T. bryo strain differences
  - Model presence and infection as a function of environment
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Water Quality at Corwin Springs

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<thead>
<tr>
<th>Ammonia</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
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<td>17 mg/L</td>
<td>0.66 mg/L</td>
<td>0.06 mg/L</td>
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*National EPA* *Lower Yellowstone*

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