Zebra Mussel Veliger Transport and Survival via Residual Water and Recreational Watercraft

MAISRC | Adam Doll | doll0043@umn.edu
Presentation Overview

- Project Need
- Project Overview
- Discussion of Results
- Next Steps
- Q&A
Current Needs for Study

- Zebra mussels continue to be discovered in new Minnesota lakes and rivers
- MN laws have been created to minimize the movement of aquatic invasive species (AIS) and water
- Clean – Drain - Dispose
But what happens next?

- Water may remain in a variety of places after all plugs have been pulled (MN law)
  - Watercraft are not designed to drain 100% of the water they may contain

- This *residual water* may be transported to new water bodies via recreational equipment, and is the focus of this study

- Residual water can be found in all types of recreational watercraft

- Zebra mussel larvae (veligers) are small organisms easily transported in water, but numbers surviving transport in residual water are poorly known
Project Overview

- Collect residual water samples from boats leaving two infested MN lakes that are highly connected to other water bodies by boater traffic
  - Minnetonka (Hennepin County)
  - Gull (Crow Wing County)
Project Overview

- Determine residual water volumes and numbers of veliger larvae collected from several compartment types found in recreational boats.

- Perform experimental mortality trials on larvae in two common boat compartments: live wells and ballast tanks.
  - Live wells exposed to temperatures from 20°C to 37°C.
  - Ballast tanks exposed to temperatures from 20°C to 32°C.
Project Overview

- Residual water, provided voluntarily to MN DNR WIP staff, was collected from > 350 departing boats.
Internal Compartments

Splash Well

Live well/bait well/wet storage

Bilge Area (underneath)
Internal Compartments
Watercraft Engines Sampled
Project Overview

- Water collected from I/O and inboard cooling systems with the help of Tonka Bay Marina
Project Overview

- Water collected from ballast systems by A. Doll and R. Daniels
Veliger Live/Dead Analysis
**Results – Fixed Samples**

- **Fixed samples**
  - Collected at public water accesses, Tonka Bay Marina, and in-lake
  - Many samples contained no veligers

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Samples</th>
<th>Percent of samples with zero veligers found</th>
<th>Veligers</th>
<th>Residual Water Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>Ballast</td>
<td>34</td>
<td>3%</td>
<td>347</td>
<td>247</td>
</tr>
<tr>
<td>Stern Drive</td>
<td>38</td>
<td>11%</td>
<td>232</td>
<td>13</td>
</tr>
<tr>
<td>Lower unit</td>
<td>67</td>
<td>45%</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Live well</td>
<td>127</td>
<td>54%</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Foot wells</td>
<td>20</td>
<td>60%</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Splashwell</td>
<td>28</td>
<td>68%</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Bilge</td>
<td>57</td>
<td>77%</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Jet</td>
<td>8</td>
<td>88%</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Results – Fixed Samples

[Graphs showing volume distributions for Large and Small Vol Compartments, with data points for Ballast, I/O, Lower unit, Bilge, Footwells, Jet, Live well, Splashwell types.]
Results – Fixed Samples

- Large Vol Compartments
  - Type: Ballast, I/O, Lower unit
  - Veligers: 0 to 4000

- Small Vol Compartments
  - Type: Bilge, Foot wells, Jet, Live well, Splashwell
  - Veligers: 0 to 60
Results – Live Well Mortality

- 6 identical live wells used for experiments
- Constructed by Lund Boats at New York Mills Operation Center
- Each live well filled with 1 liter of water “spiked” with veligers
- Air inside live wells heated with ceramic heaters
- Each live well sampled hourly
  - Entire live well drained to count live/dead veligers
Results – Live Well Mortality

- **Live Well Heated Trials**
  - 100% mortality observed in 3 hours at 38°C
  - 85% or greater mortality observed in 3 hours at 32°C
  - 70% or greater mortality observed in 3 hours at 27°C

- **Live Well Control Trials (20°C)**
  - 67% or greater mortality observed in 3 hours
  - 95% or greater mortality observed in 5 hours
Results – Live Well Mortality

![Survival Over Time Graph](image)

- **Proportion Alive**
- **Time Point (Hours)**
- **Treatment C):**
  - 20
  - 27
  - 32
  - 38
Ballast Mortality

- Two identical 370lb ballast tanks used for experiment
- Each ballast tank filled with 4 liters of lake water concentrated with veligers
- 100 mL of water sub-sampled at regular intervals
  - 0, 2, 4, 6, 8, 10, 12, 24, 48 hours
  - Sub samples not replaced
- Ballast tank for heated trial placed in environmental chamber set to 32°C
- Veligers counted and classified by size class
  - (D-stage and umbonal)
Results – Ballast Mortality

- Ballast Heated Trials (32C)
  - 95% or greater mortality observed at 24 hours
  - 100% mortality observed at 48 hours

- Ballast Control Trials (20C)
  - 85% or greater mortality observed at 24 hours
  - 90% or greater mortality observed at 48 hours
  - Live veligers (2%) observed during one trial at 120 hours
    - 2 out of 105 veligers were found to be alive
Results – Ballast Mortality
Results – Ballast Mortality

Survival Over Time

Survival

Time (Hours)

Treatment (C)
- 20
- 32

Lifestage
- d
- u
Next Steps

- Watercraft re-design
Next Steps

- Targeted decontamination techniques
Acknowledgments

Thank you to the many partners that have helped fund and support this project.
Questions?