Zebra Mussel Pilot Projects
A discussion of the recent eradication efforts in Minnesota and what next?

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MNDNR Zebra Mussel Pilot Projects

Eradication efforts in MN

- Christmas
- Independence
- Ruth
- Minnewashta
- Marion

Lessons learned & future strategies
Physical Control

- **Hand removal (via SCUBA)**
  labor intensive, hard to keep up!
  - Lake Mille Lacs, MN
  - Lake George, NY

- **Tarps & benthic barriers**
  non-selective, destruction of habitat
  - Lake Tahoe, CA/NV (Asian clams)

- **Drawdowns**
  long seasonal exposure, non-selective
  - Lake Zumbro, MN (winter)
Molluscicide Control

**Closed water systems**

restricted use, non-target and human health

- Clam-Trol® (Chloride), Bayluscide (Niclosamide)

**Open water applications**

Zequanox® (Biopesticide)

- Minnetonka, Carlos/Darling (MN), Deep Quarry (IL)

Copper (chelates & CuSO₄)

- Ossawinnamakee (MN), Offutt (NE), Rose/Irene (MN)

Potash (KCl) not registered for use

- Millbrook Quarry (VA), Sister Grove Creek (TX), Lake Winnipeg (Manitoba- CA)
ZM Pilot Projects: #goals

- **Focus on new infestations to prevent lakewide spread**
  - small, localized populations

- **Examine molluscicides in inland lakes in MN**
  - efficacy, concentration-exposure time, non target impacts

- **Develop protocols to evaluate ZM projects**
  - in-lake pre & post treatment monitoring

- **Create partnerships and engage stakeholders**
  - Stakeholder interest and support $$$
ZM Pilot Projects: considerations

- Does it meet the basic PP requirements?
- Is it likely to succeed in the eradicating the identified population?
- Does it have sufficient support to follow through on post-treatment monitoring?
- Is it likely to offer significant new knowledge?
- Does the project have funds and support to fulfill monitoring requirements and treatment costs?
- Is the project likely to have acceptable non-target impacts?
ZM Pilot Projects: implementation

1. Confirm new infestation and extent via lakewide survey
2. Apply for permit w/ initial population assessment data
3. DNR reviews application w/ ZM review panel
4. Gather materials (barrier & product)
5. Conduct pre-treatment monitoring
6. Conduct treatment
7. Conduct post-treatment monitoring (up to 3 years)
### Pilot Projects
2014-present

- [http://www.dnr.state.mn.us/invasives/aquaticanimals/zebramussel/pilot_project.html](http://www.dnr.state.mn.us/invasives/aquaticanimals/zebramussel/pilot_project.html)

### Treatments of zebra mussels in Minnesota lakes

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Treatment Type</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>Lake Marion (Dakota County)</td>
<td>EarthTec QZ® (copper product)</td>
<td>Post-treatment monitoring will occur in spring of 2018.</td>
</tr>
<tr>
<td>2016</td>
<td>Lake Minnewashta (Carver County)</td>
<td>EarthTec QZ® (copper product)</td>
<td>Post-treatment monitoring will continue in 2018.</td>
</tr>
<tr>
<td>2015</td>
<td>Ruth Lake (Crow Wing County)</td>
<td>EarthTec QZ® (copper product)</td>
<td>Adult zebra mussel found outside treatment area in fall 2016. Post-treatment monitoring will continue through 2018.</td>
</tr>
<tr>
<td>2014</td>
<td>Christmas Lake (Hennepin County)</td>
<td>Zequanox®, some physical removal, EarthTec QZ® (copper product), potassium chloride</td>
<td>Zebra mussels found lakewide post-treatment.</td>
</tr>
<tr>
<td>2014</td>
<td>Lake Independence (Hennepin County)</td>
<td>EarthTec QZ® (copper product), potassium chloride</td>
<td>Zebra mussels found near boat access post-treatment.</td>
</tr>
<tr>
<td>2011</td>
<td>Rose Lake (Otter Tail County)</td>
<td>Cutrine Ultra® (chelated copper)</td>
<td>Adult zebra mussel reported in 2016 (no zebra mussels had been found since 2012).</td>
</tr>
<tr>
<td>2000</td>
<td>Lake Zumbro (Olmsted County)</td>
<td>Mussels exposed to air by lowering water level</td>
<td>Zebra mussels found post-treatment, survived in remaining water.</td>
</tr>
</tbody>
</table>
Ruth Lake (2015)

- 25 zebra mussels
- 3 acres EarthTec QZ® @ 1ppm
- Cost: $13,000 (barrier), $4,900 (treatment)
Ruth Lake (2017-2018)

2017: veliger tows, settlement plates, snorkel/SCUBA surveys - NO ZEBRA MUSSELS -

2018: veliger tows, settlement plates, snorkel/SCUBA surveys - NO ZEBRA MUSSELS -
Lake Minnewashta (2016)

- 15 juvenile zebra mussels
- 1 acre EarthTec QZ® @ 1ppm,
- 29 acres EarthTec QZ® @ 0.5 ppm
- Cost: $9,000 (barrier), $6,100 (treatment)
Lake Minnewashta (2017)

- 4 juvenile zebra mussels
- 1 acre EarthTec QZ® @ 1ppm
- Cost: used barrier & product 2016

Lake Minnewashta 2m survey (21 September 2017)
- 4 juvenile zebra mussels found beneath dock @ public access

Search crew: MN DNR, MCEWD, Carver County staff
Search method: SCUBA & snorkelling

Acrylic tubes with fine mesh on each end.
Zebra mussel cages.
Lake Minnewashta (2018)

June 28th: veliger tows, settlement plates, snorkel/SCUBA surveys – 1 ZEBRA MUSSEL –

July 20th: veliger tows – 1 VELIGER –, settlement plates, snorkel/SCUBA surveys, eDNA – POSITIVE –
Lake Marion (2017)

- 19 total zebra mussels at public access
- 17 adult zebra mussels
- 2 juvenile zebra mussels
- Shell length 7-26 mm
- Found on September 14 & 20, 2017

- 19 zebra mussels
- 6 acres EarthTec QZ® @ 0.5ppm
- Cost: $1,500 (barrier), $14,600 (treatment)
Efficacy of Earth TecQZ for Zebra Mussel Control - Lake Marion

Mean Mortality Rate (%) vs. Days Post-Treatment

- **ZM Mortlity %**
- **EarthTec QZ (ppm)**

Mean Copper Concentration (ppm) vs. Days Post-Treatment
August 9th: veliger tows – 100-200 veligers/m³ –

dock checks, snorkel/SCUBA surveys – FRESH BYSSAL THREADS–
ZM Pilot Projects: evaluation

✔ Focus on new infestations to prevent lakewide spread
  ▶ Early detection monitoring program is essential
  ▶ Outcomes: suppress/slow in-lake and between lake spread
  ▶ Initial challenges w/ treatment size
  ▶ Go Ruth Lake!

✔ Examine molluscicides in inland lakes and MN
  ▶ CED relationship of Zequanox®, Earthtec QZ®, and potash (lab trials and in-lake)
  ▶ Non-target assumptions
  ▶ Barriers and challenges with in-lake application
  ▶ EPA exemption and special permit process
ZM Pilot Projects: evaluation

✔ Develop protocols to evaluate ZM projects
  ▶ In-lake bioassays/cage trials
  ▶ Residual pesticide monitoring
  ▶ Search methods (dive and repeat)
    ▶ Challenges w/ low densities (on-going)
  ▶ SOPs, DNR webpages, externa documents

✔ Create partnerships and engage stakeholders
  ▶ Better understanding of cost, labor, resources
  ▶ Good communication
  ▶ USGS, University of Minnesota, Minnesota Department of Agriculture, product manufacturers
  ▶ Emerging tools: eDNA, pop-up laboratories
ZM Pilot Projects: what next?

- **Search detectability… Are you sure?**
  - Did we have a limited population to begin with?
  - Did we get them all with certainty?
  - How can we incorporate other tools (e.g. eDNA)?

- **How do we deal with on-going stress of re-introductions?**
  - Prevention and management considerations

- **Other control methods/proposals to consider?**
  - e.g. Bay-wide veliger suppression (2019)
Thank You!

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Treatment Date, Area, Product

- Zebra Mussels found
  - Sept 2014 243 m² Zequanox
  - Oct 2014/Dec 2014 3,035 m² EarthTec QZ/Potash
  - June 2015 3,076 m² Potash
  - July 2015 41,278 m² Potash