Dreissenid Mussel Population Dynamics & Processes
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Ecosystem Dynamics
Selective filter-feeding can favor harmful algal species

Vanderploeg et al. (2013) Quagga and Zebra Mussels: Biology, Impacts, and Control

Increased nuisance benthic algae

Pothoven and Fahnenstiel (2013). JGLR.

Reduced primary production
Motivating Questions

• What is the status of mussels in the Great Lakes, and how is that changing?

• How are dreissenid mussels impacting the lower food web?

• How can we produce more accurate models to predict mussel populations?
GLERL Strategic Plan Research Path

EcoDyn Path #3:

Continue to *monitor the status* of benthic macroinvertebrate and dreissenid mussel populations in Lake Michigan and *conduct experiments* to evaluate factors that affect mussel abundance, feeding, growth and condition in the Great Lakes as well as mussel impacts on Great Lakes food webs.

EcoDyn Mantra:

Observations → Experiments → Concepts → Models/Applications
Southern Lake Michigan Invasive Mussel Population Trends

Mean Biomass (g/m²) +/- S.E.

- ▲ 16-30 m (Zebra)
- ▲ 31-50 m (Zebras)
- ▲ 16-30 m (Quaggas)
- ▲ 30-50 m (Quaggas)
- ▲ 50-90 m (Quaggas)
- ▲ >90 m (Quaggas)
- ▲ Weighted Mean

% Area by Depth Zone

Data Sources: Nalepa et al. (2013); Baldridge (unpub.)
Cross-Lake Comparison: Invasive Mussel Biomass

Mean Biomass (g/m²) + S.E.

- Michigan, 2010
- Ontario, 2013
- Huron, 2012

Data Source: Nalepa et al. (2014); Nalepa et al. (unpub)
Invasive Mussel Field Growth Experiment

**GOALS**

- Improve year-round growth estimates at relevant depths

**DESIGN**

- One tripod at 45 meters
- Measure mussel growth at 5 and 12 months

**INITIAL FINDINGS/ CONCLUSIONS**

- Small mussels grew 10% in length during the season
- Field growth experiment takes advantage of NOAA's unique vessel capabilities to produce more realistic year-round growth estimates.

Baldridge (in prep)
Examining relative impacts of climate change and invasive mussels on Lake Michigan zooplankton

**Method: Path Analysis**

- **Chlorophyll**
  - Total effect of dreissenid mussels is stronger than climate change

- **Zooplankton**
  - Most influenced by seasonal fluctuations in water temperature
  - Dreissenid mussels have negative effect as mediated through effects on Chlorophyll
  - Climate change not significant
  - Future work to explore differences among zooplankton taxa

Baldridge et al. *(in prep)*
Successes / Data Highlights

Promoting NOAAs involvement in projects beyond Lake Michigan

- **Lake Erie** - collaboration with USGS and University of Michigan to assemble a long-term mussel biomass record for Western Lake Erie. These data will be used in a HABs forecasting model.

- **Lakes Huron and Ontario** - We are proposing to lead the benthic surveys in 2017 and 2018 for the Cooperative Science and Monitoring Initiatives

Providing Data for Multiple Products

- **GLANSIS**
- **Great Lakes Aquatic Habitat Framework (GLAHF)**
- State of the Great Lakes 2017 Report
- Biophysical and ecosystem models (e.g., FVCOM, Ecopath w/ Ecosim)
- Post-doc and Graduate Student research projects (Mich. State, Univ. Mich., Grand Valley State Univ.)
Collaborations

Federal Partners
- EPA
- USGS
- NOAA NOS (Mussel Watch Program)
- Environment Canada

Academic Partners
- Univ. of Michigan (CILER, Water Center)
- Buffalo State College
- Grand Valley State Univ.
- Michigan State Univ.
- Eastern Michigan Univ.
Represent NOAA in the Invasive Mussel Collaborative: Co-lead of Science Team

IMC Mission

Advance scientifically sound technology for invasive mussel control to produce measurable ecological and economic benefits.

Provide a framework for communication and coordination, identify the needs and objectives of resource managers, prioritize the supporting science, recommend communication strategies and align science and management goals into a common agenda for invasive mussel control.
Future Directions

• Invasive mussel growth experiments:
  • Expand to deep and mid-depth stations of Lake Michigan in 2016
  • Incorporate into future research plans for Lake Huron (2017) and Lake Ontario (2018)

• Lake Winnipeg project to examine impact of new zebra mussel invasion on cyanobacteria community (links to HABs)

• Produce relevant estimates for parameters needed by the Dynamic Energy Budget model. Ultimately, this will improve predictions of quagga mussel biomass.
Questions?