Impacts of Lake Erie Harmful Algal Blooms on the Abundance and Growth of Larval Fishes and their Prey Resources

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Harmful Algal Blooms (HABs)

- HABs are a growing concern worldwide
- Link terrestrial and aquatic ecosystems
- Cultural eutrophication affects water quality and fisheries
• 1960s-1970s: cyanobacterial blooms
• 1972: Clean Water Act, Great Lakes Water Quality Agreement
• Recent increase in frequency and intensity
  • 1995-2001: minimal HABs
  • 2002-2007: yearly moderate HABs
  • 2008-2015: yearly severe HABs
• Overlap with critical fish habitat in the western basin
Research Hypothesis

• H: Lake Erie *Microcystis* blooms will decrease fishery recruitment indirectly by limiting the availability of suitable prey.
  • Specific focus on walleye, a keystone predator that supports a valuable fishery
  • Prey: Clupeids (alewife, gizzard shad), Notropis spp. (shiners), rainbow smelt
  • Linked to zooplankton indirectly through these prey fishes
  • Trophic cascade framework
Trends in YOY CPUE

• Fishery-independent bottom trawl survey to estimate year class strength
• Total CPUE was not significantly different HAB vs. non-HAB years

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Trends in YOY CPUE

• HABs associated with lower clupeid and walleye CPUE

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Trends in YOY CPUE

- Relationship between shiners and HABs depended on species

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Trends in YOY CPUE

- Rainbow smelt CPUE was higher during HAB years

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Trends in YOY CPUE


- Alewife, spottail shiner CPUE decreased with increasing HAB severity

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Trends in YOY CPUE

• Gizzard shad, walleye CPUE is highest during minimal HAB years

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Trends in YOY CPUE


• Rainbow smelt CPUE is lowest during minimal HAB years

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Trends in YOY CPUE


- Total CPUE, emerald shiner, mimic shiner is highest during moderate HABs

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Trends in YOY CPUE

• Walleye may withstand moderate HABs, if they switch to less desirable prey (Clupeids → Notropis), and if there aren’t too many consecutive HABs years
Trends in YOY length

- Length as a proxy for growth
- Alewife and gizzard shad were significantly longer in non-HAB years
- Emerald shiner, spottail shiner, rainbow smelt were longer in HAB years
- No significant difference in walleye length in HAB vs non-HAB years
- We see a decrease in YOY abundance (year class strength) because of decreased growth and survival during the larval stage
Trends in larval CPUE and length

• 2015 field study
• Total CPUE, gizzard shad, Notropis spp., and walleye CPUE were higher at sites without HABs
• No significant difference in walleye length at HAB vs non-HAB sites
Zooplankton Trends

- Zooplankton density is higher at HAB sites
  - Copepod density was higher, no significant difference in Daphnia density
- Suggests larvae are not prey-limited during HABs
Summary

- Walleye YOY CPUE is lower during any HAB event because their preferred prey (clupeids) are less abundant.
- Other prey items (Notropis) are available until HABs are consistently severe.
- Larval CPUE (overall) is lower during HABs.
Literature Cited

Acknowledgements


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Questions?