

Lake Michigan Food Web Research Workshop

April 1-2, 2014

Ann Arbor, MI

Workshop Background

The Great Lakes Regional Research Information Network (GLRRIN) Lake Michigan team previously hosted two workshops designed to bring academic, federal and state agency researchers together to discuss the impacts of invasive species on Lake Michigan food webs. The workshops and subsequent discussions led to a variety of activities, including (1) coordinated sampling efforts between federal, state, and university researchers, particularly during the 2010 Coordinated Science and Monitoring Initiative (CSMI) year for Lake Michigan; (2) a 20 presentation session at the 2013 International Great Lakes Research Annual Conference in West Lafayette, IN, titled “Tracking and Understanding Changes in Lake Michigan's Emerging Food Web”; and (3) subsequent development of a special issue for a scientific journal looking at recent changes to the Lake Michigan food web (further details below). In addition, Illinois-Indiana Sea Grant and Wisconsin Sea Grant issued three joint Requests For Proposals (RFPs). As a result of these joint RFPs, 6 projects were funded (3 from Sea Grant, 3 from the U.S. EPA GLRI), totaling almost \$2.2M in direct funds.

Workshop Purpose

The Lake Michigan team hosted a two-day workshop on April 1-2, 2014 in Ann Arbor, MI. On the first day, participants discussed the current state of Lake Michigan food web research. Three overview presentations in the morning summarized the current status of research related to:

- [Nutrients and physical limnology](#) (Paris Collingsworth Illinois-Indiana Sea Grant liaison to US EPA Great Lakes National Program Office, Dale Robertson USGS Wisconsin Water Science Center, Cary Troy Purdue University)
- [Lower trophic levels](#) (Harvey Bootsma University of Wisconsin-Milwaukee, Tom Nalepa University of Michigan Graham Sustainability Institute, Hank Vanderploeg NOAA Great Lakes Environmental Research Laboratory)
- [Fisheries](#) (David “Bo” Bunnell USGS Great Lakes Science Center, Sergiusz Czesny Illinois Natural History Survey, Tomas Höök Purdue University and Illinois-Indiana Sea Grant)

In the afternoon, meeting participants were invited to present 3 minute summaries of their own research related to Lake Michigan food webs. Nineteen participants from 11 different institutions participated in these “rapid fire” presentations (Appendix A) which spanned the importance of the lower food web, the influence of wetland and riverine systems on Lake Michigan food webs, the importance of substrate to fish communities, and tools under development that may be of use to researchers.

A breakout session immediately following these presentations gave participants an opportunity to discuss general research priorities, following these guidelines:

- *Based on today’s presentations and past understanding, list 5-8 research priorities related to the Lake Michigan food web.*
- *Consider key unknowns, data gaps, and/or interesting preliminary data.*
- *Consider both scientific interest in the issue AND importance to management.*

Toward the end of the day, participants heard from Glenn Warren of the US EPA Great Lakes National Program Office about the 2015 Coordinated Science and Monitoring Initiative year on Lake Michigan.

The second day focused on future directions for Lake Michigan food web research. In the morning, breakout group discussions focused on four emerging themes from Day 1:

1. Transport of nutrients (P) and carbon offshore, including influence of dreissenid mussels
2. The microbial food web
3. The importance of coastal and/or nearshore habitat
4. Fisheries

With a goal to help define the role that Lake Michigan Sea Grant programs could play in future Lake Michigan food web research, participants in each group were asked to identify:

- *Data currently being collected in the given topic area;*
- *Research studies already being conducted in the given topic area by federal agencies, state agencies and/or academic researchers; and*
- *The kinds of studies needed to fill existing knowledge gaps.*

Following these breakout sessions, representatives from the Illinois-Indiana, Michigan, and Wisconsin Sea Grant programs summarized current research in three potential areas for future discovery:

1. Relationship of food web research to potential impacts of climate change
2. Relationship of food web research to emerging contaminants
3. Similarities between Lake Michigan and Lake Huron food webs.

General discussion in the afternoon provided further direction for future Sea Grant RFPs.

Workshop Conclusions

General research priorities

When asked to identify 5-8 general research priorities, participants suggested several avenues for investigation:

A. Overarching research questions

- Examination of effects of nearshore-to-offshore gradients for all aspects of food web, especially with respect to nutrient transfer
- Relative importance of different sources of carbon or phosphorus to food webs
- Importance of hydrodynamics on nutrient transport and biological processes, particularly with respect to episodic events and subsequent pulses of inputs to nearshore zones
- Spatial heterogeneity and relative importance of what is present in the nearshore zone (e.g., drowned river mouths, wetlands) to food web processes in different portions of the lake (north, south, east, west)

B. Data needs

- More autonomous/continuous sampling data to be made available to researchers, especially over winter
- Better monitoring of the impacts of episodic events
- Better substrate and habitat maps
- Sampling over all types of habitat including rocky areas (may require different gear)
- Metadata about data that already exist or are currently being collected

C. Specific food web components

- Dreissenid mussels
 - Impacts on all aspects of food web dynamics
 - Potential changes to mussel growth and distribution (e.g. what is causing decreased condition and veliger counts, impacts of climate change)
- Microbial food web
 - Basic understanding
 - Quantifying nutrient and energy flows from microbes to higher trophic levels
 - Responses of higher trophic levels to changes in microbial food web
- Additional carbon sources at base of food web (e.g. picoplankton and bacteria, *Cladophora*)
- Fisheries
 - Mechanisms that drive trajectories of key populations (e.g., salmonids, yellow perch, bloater)
 - Importance of patchiness and stratification on availability of food, understanding of individual variation in fish feeding strategies

During discussions on the second day, participants began to dig into the details of how to tackle certain research questions. Participants identified many data that were already being collected, and these will be compiled into lists and distributed to the GLRRIN Lake Michigan group at a later date. Research themes that cut across topic areas of discussion included:

1. Greater understanding of the movement of nutrients and resources from near-to-offshore but also from off-to-nearshore (e.g. physical events, salmonids travelling upstream), using both models and remote sensing data;
2. Relative importance of different types of nearshore habitat (e.g. wetlands, drowned river mouths) to the broader Lake Michigan food web; and
3. Importance of episodic events on food web processes. Participants noted that results from the Episodic Events Great Lakes Experiment EEGLE data may help guide future research (<http://www.glerl.noaa.gov/eegle/products/products.html>).

Participants also emphasized once again the importance of developing a basic understanding of the importance and function of the microbial food web.

Some participants noted that public perception of the Lake Michigan food web may not be in line with current expectations, e.g. the lake may not be able to support the strong fishery that it once did. Sea Grant programs could perhaps fund social science research to evaluate how to best communicate the implications of the changing food web to the public. In a previous GLRRIN workshop, there was much discussion of a need for understanding of the microbial food web but also a need to justify funding decisions to the public (i.e., the public might not care about the microbial food web). This is another area that might benefit from social science research.

Network coordination

The GLRRIN Lake Michigan partner organizations plan to continue to organizing network meetings, as they provide valuable information to the Lake Michigan Sea Grant programs and appear to serve their intended purpose.

A. General meeting format

Participants found that inclusion of both the summary presentations and the rapid fire presentations was useful. These network meetings may be particularly useful for new investigators (including graduate students). The facilitated discussion provided nice opportunities for researchers to interact and several participants noted that attending this meeting was a very good use of their time. Organizers should consider holding meetings in a non-Michigan location to encourage greater participation from researchers on the western side of lake. Meeting organizers are open to suggestions for where to hold future meetings; however availability of funding affects where each meeting is held.

B. Network website

The GLRRIN Lake Michigan website is out of date and meeting organizers do not have the means to modify it. As a result, a new website not under the GLRRIN umbrella will be developed. Organizers currently plan to include a list of resources (e.g. field stations and available research vessels around lake including contact information, what data are being collected where and by whom, links to USGS SPARROW models, common sampling protocols), and will explore whether participants could attach their LinkedIn or ResearchGate profiles (in response to discussion during the 2012 workshop). The website will also include links to reports and presentations from previous GLRRIN Lake Michigan meetings and information for new investigators. Network partners will be strongly encouraged to provide information for the website.

C. Frequency of meetings

Some participants expressed interest in meeting more often, potentially in smaller topic groups. Given restrictions on travel and the number of other meetings that participants attend e.g., annual scientific meetings, Great Lakes Fishery Commission annual meetings, State of Lake Michigan biennial meetings, organizers feel that the large GLRRIN Lake Michigan group should continue to meet every two years. Network organizers will discuss the possibility of having smaller topic area meetings and/or new investigator meetings more frequently, but would likely rely on additional partners to help plan and execute such meetings.

D. Sea Grant RFPs

Currently, Sea Grant programs issue RFPs for large, two-year projects every 2 years. This means that the start of Sea Grant-funded projects do not always coincide with CSMI years on Lake Michigan (5 year cycle). The Sea Grant programs will consider issuing RFPs for small grants to coincide with CSMI sampling. These would likely be for projects that could take advantage of the sampling cruise plans already in place (e.g., by US EPA, USGS, NOAA-GLERL).

E. Using this network as a means to answer broad research questions

The goal of the GLRRIN Lake Michigan research network is to bring researchers together to discuss food webs in Lake Michigan. During GLRRIN Lake Michigan meetings, researchers often identify large-scale questions that could be tackled via coordinated sampling efforts. The GLRRIN Lake Michigan network does not have the means to answer such large-scale questions and we acknowledge that several other coordinating bodies exist; however, we hope that discussion during the GLRRIN meetings helps guide coordinating processes by multiple agencies and organizations. In addition, the Sea Grant partners will continue to explore how to work together and with other agencies to answer large-scale research questions related to Lake Michigan food webs.

Additional topics

Special issue

Researchers are encouraged to submit manuscripts to a special issue in the Journal of Great Lakes Research (JGLR). The issue title is “Complex interactions in Lake Michigan’s rapidly changing ecosystem” and the guest editors are Henry “Hank” Vanderploeg, David “Bo” Bunnell, Hunter Carrick and Tomas Höök. The short title (i.e. what to choose when submitting to the JGLR website) is “SI: Lake Michigan interactions”.

Manuscripts should be uploaded to JGLR website by July 1, 2014 and questions should be directed to Henry Vanderploeg (Henry.Vanderploeg@noaa.gov). Note that JGLR’s impact factor is 2.3 and that articles in special issues tend to get cited more often.

Opportunity to examine the impacts of extensive ice cover on the Great Lakes

John Janssen read an email from Guy Meadows (Michigan Tech University) to the broader group. Given the extent of ice cover on the Great Lakes this year, Guy is interested in taking the opportunity to study the impacts of extensive ice cover on various aspects of Great Lakes physics, ecology, etc. Interested parties should contact Guy or John directly.

Workshop Outcomes

As a result of this meeting:

- A new GLRRIN Lake Michigan website will be developed (likely under a slightly different name)
- Illinois-Indiana Sea Grant, Michigan Sea Grant and Wisconsin Sea Grant will discuss the possibility of issuing future joint RFPs informed by major findings of the workshop, especially as related to the 2015 CSMI year on Lake Michigan
- Steering committee members will plan to convene another Lake Michigan food web research meeting in 2016, dependent on availability of funds

As before, ultimately, success of the network will lie not only with the steering committee but with the network members.

Appendix A. List of “Rapid Fire” presenters and presentation topic

| Presenter | Institution | Topic |
|----------------------|--|--|
| Ashley Baldrige | University of Michigan | Climate change and dreissenids |
| Hunter Carrick | Central Michigan University | Microbial food web |
| Matthew Cooper | University of Notre Dame | Relationship between coastal wetland and nearshore food webs |
| Joshua Dub | Illinois Natural History Survey | Yellow perch recruitment |
| William Fetzer | Michigan State University | Nearshore fish communities in Michigan waters of Great Lakes |
| Carolyn Foley | Illinois-Indiana Sea Grant | <i>Diporeia</i> and dreissenids |
| Austin Happel | University of Illinois at Urbana-Champaign | Broodstock diets and success of progeny (esp. lake trout) |
| John Janssen | University of Wisconsin-Milwaukee | Variability in substrate and importance to fishes |
| Dave Jude | University of Michigan | <i>Mysis</i> trends in Great Lakes 2006-2011 |
| Kevin Keeler | University of Michigan | Control of spiny water flea |
| Momcilo Markus | University of Illinois at Urbana-Champaign | Impacts of extreme events/climate change on export of pollutants to Great Lakes |
| Scott McNaught | Central Michigan University | <i>Hemimysis anomala</i> in nearshore food web |
| Catherine Riseng | Michigan Sea Grant | Great Lakes Aquatic Habitat Framework |
| Mark Rowe | University of Michigan | Quagga mussel modeling |
| Carl Ruetz III | Grand Valley State University | Ecological contribution of river mouths to nearshore habitat (esp. drowned river mouth lakes) |
| Ed Rutherford | NOAA-GLERL | 3 minutes with larval fish (esp. alewives) |
| Sara Creque - Thomas | Illinois Natural History Survey | Nearshore community composition (zooplankton, benthic invertebrates, fish) |
| Lynn Vaccaro* | Michigan Sea Grant | Michigan Sea Grant Integrated Assessments |
| Ed Verhamme | LimnoTech | Real-time buoy network, Green Bay hypoxia model, Great Lakes Power Plants and effects on nearshore zones |

*Presented by Catherine Riseng.