

Great Lakes Aquatic Habitat Framework – Vision for the Future

Award No. 2016.1678

July 2019 Final Report

The overall goal of this grant is to work with other university centers and agencies to develop a long-term business plan for GLAHF that cultivates partnerships with state, federal and provincial agencies and universities and creates a long-term funding and maintenance strategy with the following goals:

- Building greater capacity within resource management agencies and the university
- Developing, maintaining, and serving spatial data needed for management and research in the Great Lakes Region
- Assisting agencies in the use of spatial approaches in research and decision making
- Developing a better understanding of the spatial ecology of the Great Lakes Basin.

A) Initiate a Future Direction Committee composed of key agency and university representatives that can guide development of a business plan and identify potential funding sources

In early 2017 we invited key representatives and decision makers from Great Lakes agencies and universities to form a future directions committee was formed (hereafter called Advisory Committee or AC). The primary goal of the AC is to identify mechanisms to ensure that GLAHF is connected with numerous research and management initiatives across the Great Lakes Basin that will ensure its’ sustainability into the future. Membership is outlined below:

Person	Agency	Position
GLAHF Future Directions Committee		
Mark Coscarelli	GLFT	
Gary Whelan	MDNR	Program Manager
Philip Chu	NOAA-GLERL	Branch Chief-Physical&Ecol Modeling
John Dettmers	GLFC	Director of Fisheries Management
Jeff Tyson	GLFC	
Beth Hinchy-Malloy	USEPA-GLNPO	Great Lakes Ecosystem Specialist
Pete Esselman	USGS-GLSC	Research Fisheries Biologist
Mark Holey	USFWS	Project Leader and GLFHP Co-Chair
Janette Anderson	Environment Canada	Great Lakes Program Officer
Dan Brown	UM-SNRE(SEAS)	Acting Dean and Professor
Tammy Newcomb	MDNR-GLFT	

We have held two meetings (3/9 and 5/31) to date that were a combination of webinar/conference call and in person meetings (5/31/2017 at the GLFC). Our next conference call meeting is scheduled for July 21, 2017. The March meeting introduced GLAHF and GLAHF –related projects to the AC and invited comments on the vision for a GLAHF-based lab



within IFR. Many attendees liked the vision of incorporating research, service, and mentoring, but in general encouraged the group to consider broadening the SNRE-IFR relationship and look for a more innovative model and staffing plan moving forward to create a more collaborative environment and successful funding framework.

The second meeting in May introduced the concept of a Common Agenda and Collective Impact as a model for organizing the AC as a body that would be involved in determining the common agenda and setting short- and long-term objectives for GLAHF. The GLAHF AC agreed that the common agenda is a good approach and should be drafted. The AC also agreed that future meetings should focus on the Collective Impact approach for long term planning while in the short term will continue to address data development and needs of existing stakeholders.

In addition to the AC, we have formed a core team that is organizing and developing materials for the AC meetings. This team has meets at least monthly since January and has organizing calls prior to AC meetings. The core team members include:

GLAHF Core Team		
Mark Coscarelli	GLFT	
Catherine Riseng	University of Michigan-IFR	Research Scientist
Li Wang	IJC	Science Advisor
Kevin Wehrly	MDNR-IFR	Research Biologist
Paul Seelbach	University of Michigan	Professor and past Coastal System Br

We hosted an in-person meeting July 24-25, 2018, to establish the business and governance plans for GLAHF. We invited key agency personnel and worked with a facilitator for the UM Water Center and USGS. For the meeting developed a draft GLAHF Business Plan that included Vision and Mission Statements, a proposed Organizational Structure and Staffing and support options.

The meeting agenda and slides that include input from the meeting are attached. Attendees included:

Meeting Attendee	Agency	Position	Attending	
			24th	25th
Debbie Lee	NOAA-Great Lakes Research Laboratory	Director	evening	yes
Ed Rutherford	NOAA-Great Lakes Research Laboratory	Research Biologist	yes	yes
Gary Whelan	MI Department of Natural Resources	Program Manager	yes	yes
John Dettmers	Great Lakes Fishery Commission	Director of Fisheries Management	yes	yes
John Hortness	US Geological Service - Chicago	Assoc Project Chief/GLRI USGS lead	no	yes
Kelli Paige	Great Lakes Observing System	Director	yes	yes
Maria Lemos	University of Michigan - School for Environment and Sustainability	Assoc. Dean and Professor	yes	yes
Li Wang	International Joint Commission	Science Advisor	yes	yes
Mark Coscarelli	Great Lakes Fishery Trust	Vice President	yes	no
Pete Esselman	US Geological Service - Great Lakes Science Center	Research Fisheries Biologist	yes	yes
Tammy Newcomb	MI Department of Natural Resources & Great Lakes Fishery Trust Science Board	Sr. Water Policy Advisor	yes	yes
Tomas Hook	IL/IN Seagrant and Purdue Professor	Director, Illinois-Indiana Sea Grant	yes	yes
GLAHF Core Team				
Catherine Riseng	University of Michigan - School for Environment and Sustainability & MI Sea Grant	Research Scientist	Yes	Yes
Kevin Wehrly	MI Department of Natural Resources - Institute for Fisheries Research	Research Biologist	Yes	Yes
Paul Seelbach	University of Michigan - School for Environment and Sustainability	Professor and past USGS Coastal System Branch Chief	Yes	Yes
Josh Miller	US Geological Service - Great Lakes Science Center & UM Water Center	Liason, facilitator	Yes	Yes
Lacey Mason	University of Michigan - School for Environment and Sustainability	GIS Tech lead	Yes	Yes

A key outcome of the meeting was that John Dettmers of the Great Lakes fishery Commission and Gary Whelan of the Michigan DNR, Fisheries Department agreed to take leadership for the development of a GLAHF business plan. A leadership team composed of John Dettmers and Jeff Tyson (GLFC), Gary Whelan and Tammy Newcomb (MIDNR), and Mark Coscarelli (GLFT) formed supported by Catherine Riseng (UM SEAS) and Kevin Wehrly (MDNR-IFR). This team met two times since the July 2018 meeting (March 13 and May 17 2019) and co-produced a GLAHF Next Steps visioning document. John Dettmers presented ideas for utility of GLAHF for the Great Lakes fish management and policy community at the GLFC Annual Meeting May 29 and 30 2019 in preparation for discussion with the GLFC Board in the Fall of 2019 about the future direction and specific projects and products needed by the GLFC including future GLFC support for GLAHF infrastructure.

- B) Develop new data that have been requested by partners, updating and improving functionality of the web-based suite of tools, and continuing to support agency and research efforts such as the WRF-Hydro project.**

Note: for published papers identified below, authors directly supported by the GLFT are shown in bold.

In January Lacey Mason and Catherine Riseng met with Joe Smith of the GLANSIS team from NOAA GLERL to discuss how to integrate GLANSIS data into GLAHF and possibly use the GLAHF website to view and share GLANSIS data. As a follow-up to this meeting, Lacey Mason worked with Joe Smith to develop the GLANSIS Map Explorer (<https://www.glerl.noaa.gov/glansis/mapExplorer.php>). GLAHF hosts the web mapping services providing the data layers for the Map Explorer. These data layers include Shoreline classification, shoreline sinuosity, depth, substrate, temperature, cumulative-degree-days, ice duration, and geomorphology.

This work was published: Smith, J. E. Lower, F. Martinez, **C. Riseng**, **L. Mason**, E. Rutherford, M. Neilson, P. Fuller, K. Wehrly, and R. Sturtevant. 2019. Interactive mapping of nonindigenous species in the Laurentian Great Lakes. *Management of Biological Invasions* 10(1): 192-199

Future work could include further developing this partnership by building web pages by leveraging previous work forecasting potential invasive species establishment in the Great Lakes basin (Kraemer et al 2017; Wittman et al. 2017).

Kramer, AM, G Annis, ME Wittmann, WL Chadderton, ES Rutherford, DM Lodge, L Mason, D Beletsky, C Riseng, JM Drake (2017) Suitability of Laurentian Great Lakes for invasive species based on global species distribution models and local habitat. Ecosphere, 8(7): e01883, <https://doi.org/10.1002/ecs2.1883>.

Wittman, ME, G Annis, AM Kramer, L Mason, C Riseng, ES Rutherford, WL Chadderton, D Beletsky, JM Drake, DM Lodge (2017) Refining species distribution model outputs using landscape-scale habitat data: Forecasting Grass Carp and Hydrilla establishment in the Great Lakes region. J. Great Lakes Res., 43: 298-307, <https://doi.org/10.1016/j.jglr.2016.09.008>.

We published a methods paper describing the development and technical validation of the effective fetch and relative exposure index (REI) data layers in the journal *Scientific Data*: **Mason L.A., C.M. Riseng, A. Layman**, and R. Jensen. 2018. Effective Fetch and Relative Exposure Index Maps for the Laurentian Great Lakes. *Scientific Data*, 5:180295 | DOI: 10.1038/sdata.2018.295. A required step prior to publishing in *Scientific Data* is archiving the dataset and minting a data object identifier (DOI). We worked through this process with the University of Michigan Library and effective fetch and REI layers can be found by keyword searching Data Cite (<https://search.datacite.org/>).

We are continually updating the GLAHF website (<https://glahf.org/>) with new material. The coastal and nearshore fish habitat assessment have been added to the GLAHF Explorer. The Coastal group published their work that used GLAHF habitat data and framework for assessing coastal fish habitat: **Kovalenko, K.**, L.B. Johnson, **C.M. Riseng**, M. Cooper, **L. Mason**, J. McKenna, **K. Wehrly**, **B. Sparks-Jackson**, and D. Uzarski. 2018. Great Lakes Coastal Fish Habitat Classification and Assessment. Journal of Great Lakes Research, 44(5) 1100-1109. <https://doi.org/10.1016/j.jglr.2018.07.007>

We most recently developed the classification webpage. **The GLAHF classification was published: Riseng, C., K. Wehrly**, L. Wang, E. Rutherford, J. McKenna, L. Johnson, **L. Mason**, C. Castiglione, T. Hollenhorst, **B. Sparks-Jackson**. 2018. Ecological classification and mapping of the Laurentian Great Lakes. Can. J. Fish. Aquat. Sci. 75:1693-1712. <https://doi.org/10.1139/cjfas-2017-0242>

Over the winter and spring of 2019, Kevin Wehrly and Catherine Riseng worked with Cleyo Harris (MDNR and member of the Lake Erie Habitat Task Force and Lake Erie Management Unit) to develop spatial units that corresponded to the fishery manager's (US and Canada) Priority Management Areas (PMAs). C. Riseng hired two UM-SEAS graduate students that worked with Cleyo to identify and map these units. Cleyo provided several databases of prioritized management and restoration actions but these had minimal spatial identification. The students worked with Cleyo to identify where the PMA units were located and then linked the location data to existing habitat data and management recommendation. This work provided a pathway for how PMA work done for all the five Great Lakes could be integrated with GLAHF and provide essential spatial information to help with prioritization and the spatial framework for restoration and management actions.

Also during the winter and spring of 2019, Michelle Seltzer (MDNR-OGL) contracted with the MDNR-IFR to provide and support the platform and spatial infrastructure for planning and implementing the St. Clair-Detroit River System (SCDRS) Initiative softening shoreline and coastal wetland habitat restoration projects. The project had two main tasks:

Task 1: Provide data, information and mapping products.

Task 2: Support stakeholder outreach and engagement.

C. Riseng hired two UM-SEAS graduate students to assist the MDNR-IFR with these tasks. These students incorporated existing data with new data that they researched to identify areas of restoration in the SCDRS including restored wetlands and softened shorelines, as well and restored floodplains and reclaimed contamination areas. These areas were then maps and used to develop metrics for areas restored in the system. These table were used by the MDNR to identify restoration needs based on priority goals and to map existing and proposed restoration projects in the context of existing habitat to better understand habitat connectivity and contiguity benefits for proposed restoration projects.

Past accomplishments:

The GLAHF Advisory Committee suggested we track website users, so we are able to survey users as needed. We currently track the name, company, and email address of all users who download the spatial framework package. In addition to the spatial framework package, we are reviewing options to track users who download files from the Data webpage and general website users. A forced website login is an option but is not recommended since it deters website users, so we are researching and evaluating other options.

The GLAHF Explorer website has been updated to a new software platform (<https://glahf.org/explorer/>). The first version of the Explorer was built on a custom JavaScript application which is difficult to update and maintain in the long-term. In the fall of 2017, all of the Explorer components were migrated to Esri's new Web Appbuilder platform and the new version of the website went live in December 2017. A few new features were added during the update including the "Add Data" tool which allows users to add their own point data or shapefiles to the Explorer on their local machine. We also custom built a "Layer Select" tool to view the hundreds of maps developed as part of the Great Lakes coastal fish habitat assessment, and we are continuing to add informational text.

Drew Gronewold and Xiaolong Ji at NOAA-GLERL have developed a model to predict if and when ice will occur along the Apostle Islands National Lakeshore. They applied this model to other regions in the Great Lakes and have collaborated with GLAHF to determine which regions they should focus on (based on Mason et al. 2016) and leveraged GLAHF sub-basins and standardized ice grids to summarize percentage of ice cover, daily, for the six focus regions. We are advising a 2018 summer fellow at NOAA-GLERL on proper geospatial techniques to fill-in the shoreline difference between the two grid resolutions of the ice coverage data.

We continue to share our data and methods with the Great Lakes community. The nearshore fish abundance models across the Straits of Mackinac were shared with the Michigan Tech Research Institute to support the risk assessment of the Line 5 pipeline. Our methods working with and propagating data were shared with a researcher at the University of Waterloo, Canada working on improving the existing moored buoy network supporting weather forecasting in the Great Lakes with NOAA National Weather Service and Environment Canada. We have also supplied habitat data and technical expertise to several graduate students at the University of Michigan SEAS working in collaboration with USGS and NOAA-GLERL.

We have also provided data to Jeff Buckley from OMNRF and his colleagues on Great Lakes habitat data that they are using to develop AIS habitat models for the Great Lakes. They were particularly interested in using the GLAHF spatial framework and the data that had been attributed to and summarized for the framework.

C) Outreach efforts to share the GLAHF tools and opportunities with partners across the basin including plans to host one or two workshops (potential locations NOAA

GLERL in Ann Arbor and IJC offices in Windsor) and meet with the following groups over the course of the next year: Lake Committee; Binational leaders of the Habitat and Species GLWQA Annex; NOAA GLERL: NOAA Office for Coastal Management: State DNR fisheries management groups; Canadian managers and researchers in Environment Canada and Department of Fisheries and Oceans.

Updates:

See sections A and B above. Most efforts over the past six months have been focused on new directions and team activities to envision a GLAHF business plan and administrative and infrastructure support (Part A). C. Riseng and K. Wehrly have also worked with the Lake Erie Habitat Task Force and the St. Clair Detroit River System to use the GLAHF spatial framework and habitat data to help prioritize management and restoration activities for these two Great Lakes Systems (Part B).

Past accomplishments:

In January 2017, C. Riseng and K. Wehrly met with Gary Whelan, MDNR-IFR Director, to review GLAHF progress and products and get his input and feedback on next steps.

C. Riseng and other members of the core team met with the binational GLWQA Habitat and Species annex Canadian and US representatives on 5/31/2017 (GLFC offices) to review their assessment findings and discuss how GLAHF data was used and how the assessment could be incorporated into GLAHF. The assessment is in the process of being finalized. C. Riseng is also a member of the GLWQA Baseline Assessment Advisory Committee and participate in bimonthly calls.

In December 2016, M. Coscarelli, K. Wehrly and C. Riseng met with Dan Brown, acting Dean of SNRE-UM. He was very supportive of GLAHF and agreed to serve on the AC. He also suggested meeting with leaders of the other key centers at UM. In December 2016 and January 2017 K. Wehrly and C. Riseng met with leaders of key Centers within UM to assess support for GLAHF and get input on future directions: Dr Lemos of the Great Lakes Integrated Assessment center (GLISA primary climate related research), Dr. Cardinale of CIGLR, and Dr. Read of the Water Center. All were supportive and were interested in future collaboration.

In a follow-up meeting on July 6, 2017, P. Seelbach and C. Riseng met with Brad Cardinale, Director of the Cooperative of Great Lakes Research (CIGLR) to discuss best approaches to integrate with NOAA GLERL and other NOAA offices. This was a wide-ranging discussion and Dr. Cardinale had some visionary ideas for integrating with NOSS offices. The next step will be to arrange a meeting with key NOAA decision makers.

In September of 2017 Paula Seelbach and Catherine Riseng met with representatives from EPA GLNPO (Liz LaPlante, Beth Hinchey Malloy, Jamie Schardt, Derek Ager, Kevin O'Donnell, Leah Medley, Mari Nord (EPA R5 National Coastal Condition Assessment) and the US Army

Corps of engineers (David Bucaro) to share GLAHF purpose and utility, discuss past project and identify discuss how GLAHF could best serve GLNPO and USACOE needs. This was a very productive meeting. Seelbach and Riseng also met with representatives from the USGS Great Lakes Science Center on November 11, 2017 (Russ Strach, Pete Esselman, Dave Warner, Jeff Schaeffer) and NOAA-GLERL on December 18, 2017 (Debbie Lee (Director); Drew, Felix Martinez (GLANSIS); George Lescovitch, Ed Rutherford). These meeting all had similar objectives and structures. The outcome of these meeting was the in-person meeting scheduled for July 2018. The agendas for these meeting are attached. Riseng also presented to a group of Coastal Zone mangers and ACOE regional representatives February 16, 201 that was organized by ACOE and designed to get feedback and the utility of GLAHF for this group.

D) In addition to the above meetings, we expect to continue working with the following groups:

- *Lake Michigan Lower Trophic Level Task Group.*

Riseng participated in the Lake MI Lower trophic food web task force meetings and review of a white paper prepared by the group for the Lake Michigan Committee. GLAHF was used to prepare key figures for the white paper which is now finalized and submitted. No url link yet.

- *National Center for Atmospheric Research (NCAR) scientists to assist with the development of the WRF-Hydro high resolution stream flow model for the Great Lakes basin – funding committed through 2017.*

Note – these activities are ongoing but led by Lacey mason who is now employed with NOAA-GLERL. July 8, 2019.

Starting in spring of 2016 GLAHF collaborated with NOAA-GLERL and the National Center for Atmospheric Research to develop a “hydrofabric” to support the state-of-the-art hydrologic model, WRF-Hydro, and the operational implementation referred to as the National Water Model (<http://water.noaa.gov/about/nwm>). As of June 2017, the geospatial hydrofabric is completed using the Great Lakes Hydrography Dataset and the NHD Plus Version 2. Currently we are in the process of preparing the required tables to support the WRF-Hydro model and writing documentation

During early 2018 in collaboration with NCAR and Chuliang Xiao (CIGLR), assessed precipitation forcings used to run the WRF-Hydro model over the Great Lakes hydrofabric. Researchers at NOAA-GLERL are writing a precipitation forcings recommendation to the National Water Center for use in the operational version of the

basin. At this time the Great Lakes basin, including the Canadian land surface, will be included in version 2.1 of the National Water Model (operational September 2019).

Building on the Great Lakes basin hydrofabric development the International Joint Commission funded NOAA-GLERL and CIGLR to develop a flood forecasting for Lake Champlain. As part of the flood forecasting model a seamless hydrofabric is needed to support the hydrologic modeling component using WRF-Hydro. GLAHF was asked to be a part of the project to leverage our extensive knowledge of harmonizing data across the U.S.-Canadian border. A 1: 24,000 scale hydrofabric is completed and undergoing testing in the basin and a 1: 100,000 scale hydrofabric will be completed in July of 2018.

- *USGS led bottom mapping workgroup – assisting with the effort to harmonize and share high resolution maps of Great Lakes bathymetry and bottom classifications.*

Riseng attended Great Lakes Coastal Mapping Summit and gave a lightening talk on April 6, 2017 to introduce GLAHF to the attendees. She has also been invited to since on the Steering Committee for the Bottom Mapping Workgroup and participated in a planning call on June 26, 2017.

Riseng continues to attend meeting of the Bottom Mapping group and is promoting GLAHF as a repository for the most updated and fine-scaled processed bathymetry and substrate data for the Great Lakes. (*ongoing 7/8/19*)

- *Lake Erie Habitat Task Group – continued development of the GLAHF Fish Habitat Criteria tool with new fish habitat models and incorporation of new substrate data collected by the group.*

In April 2017, Riseng and Mason met with Ed Rutherford of NOAA-GLERL and members of the LEHTF to discuss implementation of the walleye habitat model in the GLAHF framework. We discussed the discrepancy between the suitability predicted in the Pandit et al. 2013 model that used Canadian water data and that predicted using the GLAHF data. It was agreed that Pandit would supply GLAHF staff with their original data that would be incorporated into GLAHF and then we would implement the model within GLAHF to compare the model output. This is in process.

GLAHF continues to be a part of the LEHTF annual report, especially with respect to fish habitat.