Report of the
Lake Erie Habitat Task Group
2020

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    b. Strategic research direction for the LEEO's
    c. Documentation of key habitat and research projects as related to priority management areas.
    d. Use GIS techniques to refine PMA mapping, coordination and scale

2. Assist member agencies with the use of technology (*i.e.*, side-scan, GIS, remote sensing, *etc*.) to facilitate better understanding of habitat in Lake Erie, particularly in the Huron-Erie corridor, the nearshore, and other critical areas.

3. Support other task groups by compiling metrics of habitat use by fish.

Charge 1: Maintain a list of functional habitats and impediments for species specified by the LEC Fish Community Goals and Objectives (FCGO's)

Charge 1a: Priority management areas (PMA) that support LaMP, LEC Environmental Objectives (LEEO's and FCGO's)

In 2019 the HTG completed the first iteration of the PMA exercise as reported in the previous HTG report (2018/2019). During the remainder of 2019 there was no additional work toward this charge to report. Over the next year the HTG will continue to evaluate the PMA dataset to update as projects are completed and identify areas where there are deficiencies.

Charge 1b: Strategic research direction for the LEEO's

In 2017, the LEC linked the HTG strategic research direction for the LEEOs to the development of PMAs. In 2019, the HTG began investigating use of the PMA dataset to identify knowledge gaps that could then be used to develop a list of strategic research questions. Over the next year the HTG will continue to identify and prioritize those knowledge gaps to develop a list of strategic research questions.

Charge 1c: Documentation of key habitat and research projects as related to priority management areas.

Synopsis of the ODNR Wetland Restoration within the H2Ohio Program

J. Kerns

One of the most significant environmental issues facing Lake Erie is the need to reduce nutrients that contribute to harmful algal blooms. Addressing this issue was identified as the top priority action for the Western and Central basins through the PMA process. In 2015, Ohio Lt. Governor Mary Taylor signed the Western Basin of Lake Erie Collaborative Agreement, which established a goal of reducing phosphorus loading to Lake Erie by 40% by 2025. Then in 2019, Ohio General Assembly invested $172 million dollars into H2Ohio initiative proposed by Ohio Governor Mike DeWine to ensure safe and clean water through reducing phosphorus, creating wetlands, addressing septic systems, and preventing lead contamination. The Ohio Department of Natural Resources efforts within the H2Ohio program will focus on wetland creation and restoration using established and emerging technologies.

With declines of 90 percent during the last 200 years, wetlands now cover just 2% of Ohio and include swamps, wet prairies, coastal and embayment marshes, peatlands, wetlands along stream margins and backwaters. Wetlands effectively filter sediment and pollutants from water, thereby improving water quality, reducing flooding, improving critical river and stream habitat, and improving the quality and extending the lifespan of lakes and reservoirs. Drainage of wetlands for agriculture has been the primary cause of wetland loss, particularly in Northwest Ohio. However, urban development, altered drainage patterns and channelization of our streams and rivers, mining, logging, and fire also have contributed. Many of the issues H2Ohio will address are, in part, due to the lack of filtering capacity resulting from the loss of historic wetlands across the Ohio landscape.

Therefore, a comprehensive approach to wetland maintenance, restoration and creation is important. The Ohio Department of Natural Resources (ODNR) mission within the H2Ohio program will be to create, restore, and enhance wetlands in strategic, targeted areas. ODNR efforts will be statewide with an initial emphasis on the Western Lake Erie Basin, specifically within the Maumee River Watershed. These wetland practices will reduce phosphorus and nitrogen runoff, store carbon, manage flooding, and offer recreational opportunities. Created and restored wetlands will be monitored and managed but will be primarily self-sustaining once established. For more information about the wetland restoration work within the H2Ohio program and descriptions of specific projects, see: http://h2.ohio.gov/natural-resources/.

Fish Habitat Suitability Modelling in Southern Grand River, Ontario Canada

O. Hussien, T. MacDougall, S. Marklevitz

Migratory river-spawning fish are integral to the Great Lakes. In Lake Erie, there are ~48 different migratory species. Nearly half of these species are highly valued socially and economically as these species are sought by anglers and commercial fishers alike. Access to high quality connected habitat in Lake Erie tributaries like the Grand and Thames River is important for sustained fish production. This project will help MNRF identify and map suitable habitat for the purpose of protection and/or restoration of Lake Sturgeon in Southern Grand River between Caledonia and Port Maitland. A substrate survey was conducted using a consumer-grade Hummingbird Helix 9 sonar side scan (SSS) at a frequency of 455 KHz (July-October 2019). A total of 201 swaths of SSS were acquired, and 154 grab samples were collected to inform substrate delineation. For wadeable sections where acquisition of SSS was not possible, polygons of discrete substrate were created through visual identification. SonarWiz 7 (Chesapeake Technologies 2014) was used to perform post-processing operations on the SSS imagery to enhance images for substrate delineation; some swaths were excluded due to poor quality. Combined enhanced SSS, grab samples, substrate polygons and transect information available from historical study were used to manually delineate substrate. HEC-RAS was used to estimate water velocity and depth for cross-sections based on model provided by Grand River Conservation Authority (GRCA) and using long-term (1974 - 2019) average discharge[1] of York Station (I.D: 8731042, latitude: 43.0217 and long: -79.8913). A continuous raster surface for the project area was computed in HEC-RAS Mapper using the depth and velocity at cross-sections, as well as high-resolution bathymetry layer. The bathymetry layer was created by combining LiDAR[2] data (Caledonia-Cayuga; GRCA) and bathymetry layer (Cayuga to Port Maitland; MNRF). Finally, the substrate type, depth (m) and velocity (m/s) layers were converted to habitat suitability indices of “good” (0.8 - 1), “moderate” (0.31 – 0.79) and “poor” (0 - 0.3) in alignment with indices for spawning and age-0 life stages of Lake Sturgeon described previously for the Maumee River (Collier 2018). Overall suitability maps for spawning and age-0 life stages were estimated using geometric mean of habitat suitability indices based on substrate, depth and velocity of each life stages.

This work showed that ~13.5% (152.2 ha) of the Southern Grand River downstream of the town of Caledonia can be classified as “good” habitat for spawning Lake Sturgeon. However, the vast majority of this spawning habitat is inaccessible to Lake Sturgeon migrating upstream from the Lake Erie, as it exists upstream of a low head dam at river-kilometer 7. This dam, at the town of Dunnville, imposes a complete barrier to non-jumping fish (Figure 1). Approximately 25% of the area (~277 ha) was classified as “moderate” spawning habitat for Lake Sturgeon while a larger proportion (61% or 691.5 ha) was deemed poor. Alternatively, abundant “good” (30% or 338.3 ha) and “moderate” (68.4% or 767.3 ha) habitat exists to support age-0 life stages (Figure 2). Less than 2% of the study area is classified as “poor” habitat for age-0 Sturgeon. This project provides a solid foundation for fish habitat protection, restoration and enhancement in the Southern Grand River. Furthermore, the methodology and data developed for this project will be used to run similar analyses for other species of interest (e.g. Walleye) and can be applied to other key tributaries such as the Thames and Sydenham Rivers.

[1] Contains Information made available under Grand River Conservation Authority’s Open Data Licence v2.0

[2] Copyright © Grand River Conservation Authority, 2020

Reference

Collier, J. J. (2018). *Creating a Spatially-Explicit Habitat Suitability Index Model for Lake Sturgeon (Acipenser fulvescens) in the Maumee River, Ohio* (Doctoral dissertation, The University of Toledo, Toledo, Ohio USA).

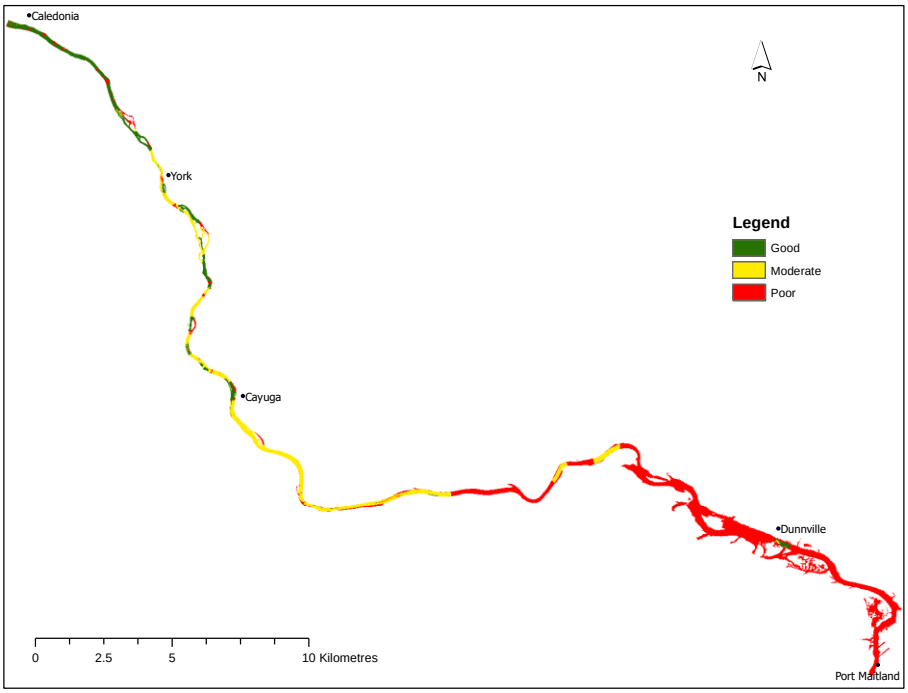

Figure 1: Combined Habitat Suitability for spawning Lake Sturgeon based on April depth, April velocity and substrate

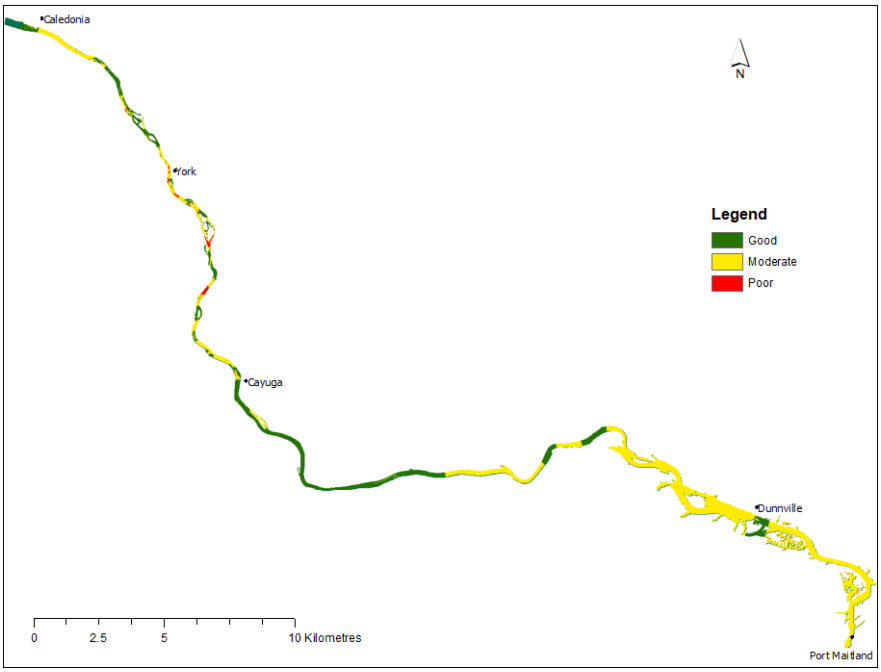

Figure 2: Combined Habitat Suitability for age-0 Lake Sturgeon based on May depth, May velocity and substrate

Shoreline improvement at Brandenburg Park in Chesterfield, MI

C. Harris

Since 1976, Brandenburg Park has been the recreational destination of Chesterfield Township, positioned along the shore of Anchor Bay and serves the recreational needs of the township and the greater Lake St. Clair area with a unique assortment of facilities. Erosion has led the original seawall to crumble and breakaway, resulting in portions of the land being unsafe for park users, increased sediment flow into the lake, and reduced access for fishing. The primary goal of this project is to improve fish habitat at the park while eliminating a shoreline safety hazard and improving coastal recreation, especially fishing. Strong local government and community support will help sustain the proposed restoration activities and support healthy populations of native fish species into the future. Fish species found in Anchor Bay and the area near Brandenburg Park include: smallmouth bass, muskellunge, northern pike, yellow perch, and walleye. Historically, spawning, migration, feeding, and nursery habitat was plentiful along the coast of Lake St. Clair. However, urban development and armoring along the shore, including Brandenburg Park, has substantially reduced available nearshore habitats for these, and other fish species.

Figure 3. Conceptual drawing of the habitat improvements planned for Brandenburg Park, Chesterfield Township.

This project will focus on shoreline softening and in-water habitat structure for the nearshore area which is a very high priority in a medium PMA. A total of 740 linear feet of shoreline will be improved by removing the seawall, sloping the shoreline back, planting native vegetation and installing a pathway to the water's edge. Rocky breakwater structures with rootwads will be installed slightly offshore to reduce wave energy and provide habitat for additional aquatic organisms like turtles and mudpuppies. Depth contouring and native aquatic plantings will occur between the breakwater structures and shore to provide improved habitat for fish species. Monitoring of the site before and following the project will be conducted to evaluate the success of this habitat improvement. Funding is provided by the Great Lakes Restoration Initiative and U.S. Environmental Protection Agency through the National Oceanic and Atmospheric Administration (NOAA)/Great Lakes Commission (GLC) Regional Partnership.

Charge 1d: Use GIS techniques to refine PMA mapping, coordination and scale

In 2019, the HTG began collaborating with the Great Lakes Aquatic Habitat Framework project team to begin interpreting the PMA dataset into GIS layers. Through these efforts the work group was able to develop conceptual layers for the functional habitats identified

in the PMA dataset. During 2020, the HTG will continue to pursue opportunities to further develop these layers and begin using them to help refine the PMA data set.

Charge 2. Assist Member Agencies with Technology Use

Real-time Aquatic Ecosystem Observation Network (RAEON)

K. Johnson

The Real-time Aquatic Ecosystem Observation Network (RAEON) is funded by the Canadian Foundation for Innovation (CFI) and Ontario Ministry of Research and Innovation. RAEON provides instruments, technical expertise, and data management for Canadian researchers and partners for research on the Great Lakes. The majority of instruments are *in situ*, placed in lakes to collect continuous and often real-time data, and measure a wide variety of parameters from water quality (dissolved oxygen, chlorophyll, temperature, etc.) to acoustically tagged fish. Instruments are loaned to researchers for a low or nominal fee, and agreements include data management that is part of the Great Lakes Observing System (GLOS). Please visit the RAEON website (raeon.org) for lists of instruments and instructions on requesting instruments. The data collected through this program will be beneficial for addressing knowledge gaps in Lake Erie, including those identified in the PMA dataset.

Figure 4. Image of a deployed RAEON real-time sensing station in Lake Erie

Tipping Point Planner

E. Rutherford

The Lake Erie Habitat Task Group used the PMA process to rank 2 watershed habitat actions as high priority. These actions were: (1) nutrient reduction programs to limit phosphorus and HAB frequency and intensity; and (2) sediment reduction programs to reduce runoff from watershed tilling and channelization, increase wetlands and buffer strips (Le HTG 2019 annual report, Appendix B). Tipping Point Planner (TPP) is an ongoing project funded by EPA GLRI that can be used to identify local and watershed-scale land use tipping points for nutrients and sediment runoff that affect ecosystem health and fisheries in Great Lakes tributary and near shore habitats, and aid planning to reduce such threats.

The TPP science and outreach team from multiple universities (Michigan State, Michigan, Purdue, Minnesota, Wisconsin) and agencies (NOAA GLERL, Sea Grant) developed an interactive decision support system (DSS) (http://tippingpointplanner.org) that models relationships between land use practices and endpoints of interest at present and future timescales (out to 2050). The DSS (Figure 5) is a facilitation tool for extension specialists, coastal managers, and consultants who work with land use commissions, watershed planning committees, and agency managers to prioritize and develop management plans that sustain coastal resources. The DSS helps watershed leaders identify land-based activities that result in point and nonpoint source nutrient and sediment pollution, and the impacts of such runoff on tributary and coastal resources. The TPP team has engaged directly with several Great Lakes communities to identify and prioritize specific areas and action strategies required to address nutrient and associated habitat and food web issues. Nutrient source maps in TPP identify nutrient delivery "hotspots" where the greatest proportion of nutrient loads originate on the landscape. These hotspots represent priority areas for management where reductions in landscape applications are most effective at reducing in-stream nutrient and sediment concentrations, and subsequent effects on PMA areas in Lake Erie's western and central basins.

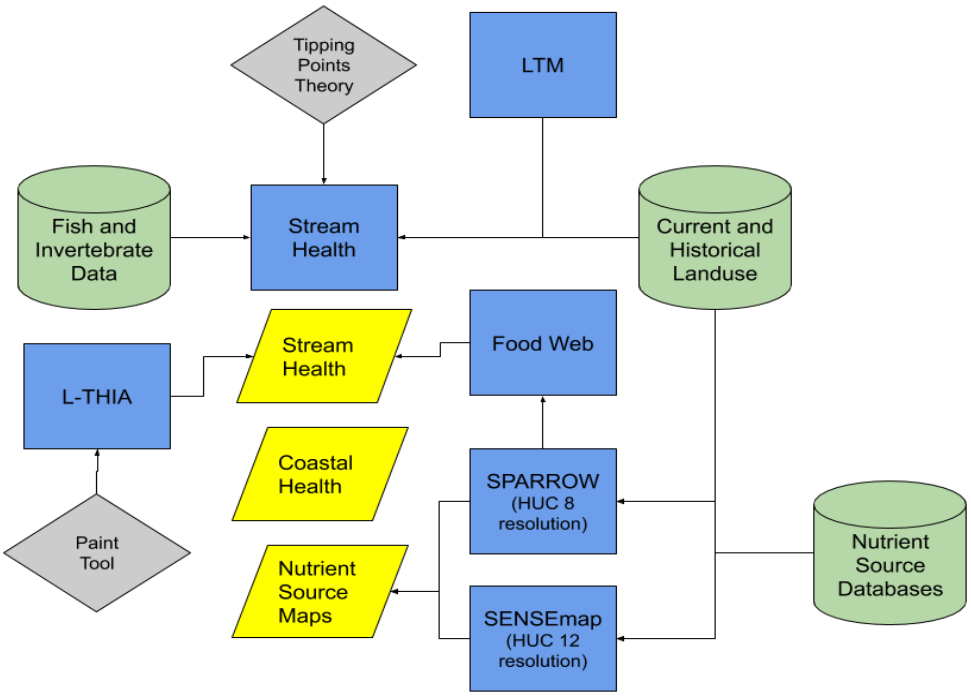

Figure 5. Linkages among Tipping Point Planner models (blue), input data (green), DSS data products (yellow), and other DSS elements (grey). The models include: Purdue University's land-use forecast tool 'Land Transformation Model (LTM)'; Purdue's water quality model 'Long-Term Hydrologic Impact Analysis (L-THIA)'; the USGS 'SPatially Referenced Regression on Watershed (SPARROW) model; MSU's 'Spatially Explicit Nutrient Source Estimate map (SENSEmap)' model; UM's land-use biotic tipping point model 'Stream Health'; and several Ecopath with Ecosim (EwE) food web models that are driven by nutrient loads from watersheds in coastal and main basin areas of Lake Erie (Zhang et al. 2016 and in review).

Charge 3: Support other task groups by compiling metrics of habitat

Development of an experimental hypoxia forecast model for Lake Erie

M. Rowe

Hypoxia, defined as dissolved oxygen (DO) < 2 mg/L, results from a combination of physical and biological processes. Hypoxia in Lake Erie reduces habitat and food supply for fish and complicates drinking water treatment. A collaboration led by scientists from the NOAA Great Lakes Environmental Research Laboratory, applied a mathematical model that was driven by weather information (wind and air temperature) and simulated water temperature, currents, and DO (Rowe et al. 2019). By evaluating whether a model that focused on physical processes could predict hypoxia, the group investigated the relative importance of physical versus biological drivers. Model temperature and DO results were compared with measurements conducted by researchers on Lake Erie. In years with dominant southwesterly winds, persistent downwelling occurred along the south shore, which resulted in a thinner thermocline and earlier initiation of hypoxia along the south shore than the north. Occasional northeast winds temporarily reversed this pattern, causing upwelling along the south shore that brought hypoxic water to nearshore locations and water intakes. The DO model reproduced observed spatial and temporal patterns of hypoxia, indicating the importance of physical drivers, and revealed locations subject to episodes of hypoxia, including nearshore Ohio, north of Pelee Island, and near the Bass Islands.

The model has already been used to provide advance notice of hypoxic upwelling events that affected Ohio drinking water plants in 2017-2019. The model also has been used to assist with decision making for Ohio DNR bottom trawl surveys in the Central Basin. The model provides a daily nowcast and five-day forecast, July through October with archived and current graphics available (Figure 5) at: https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/hypoxiaWarningSystem.html. Over the next two years, improvements to the physical model will be tested and the development of a biophysical hypoxia model will begin.

Reference

Rowe, M. D., Anderson, E. J., Beletsky, D., Stow, C. A., Moegling, S. D., Chaffin, J. D., et al. (2019). Coastal upwelling influences hypoxia spatial patterns and nearshore dynamics in Lake Erie. Journal of Geophysical Research: Oceans, 124. https://doi.org/10.1029/2019JC015192

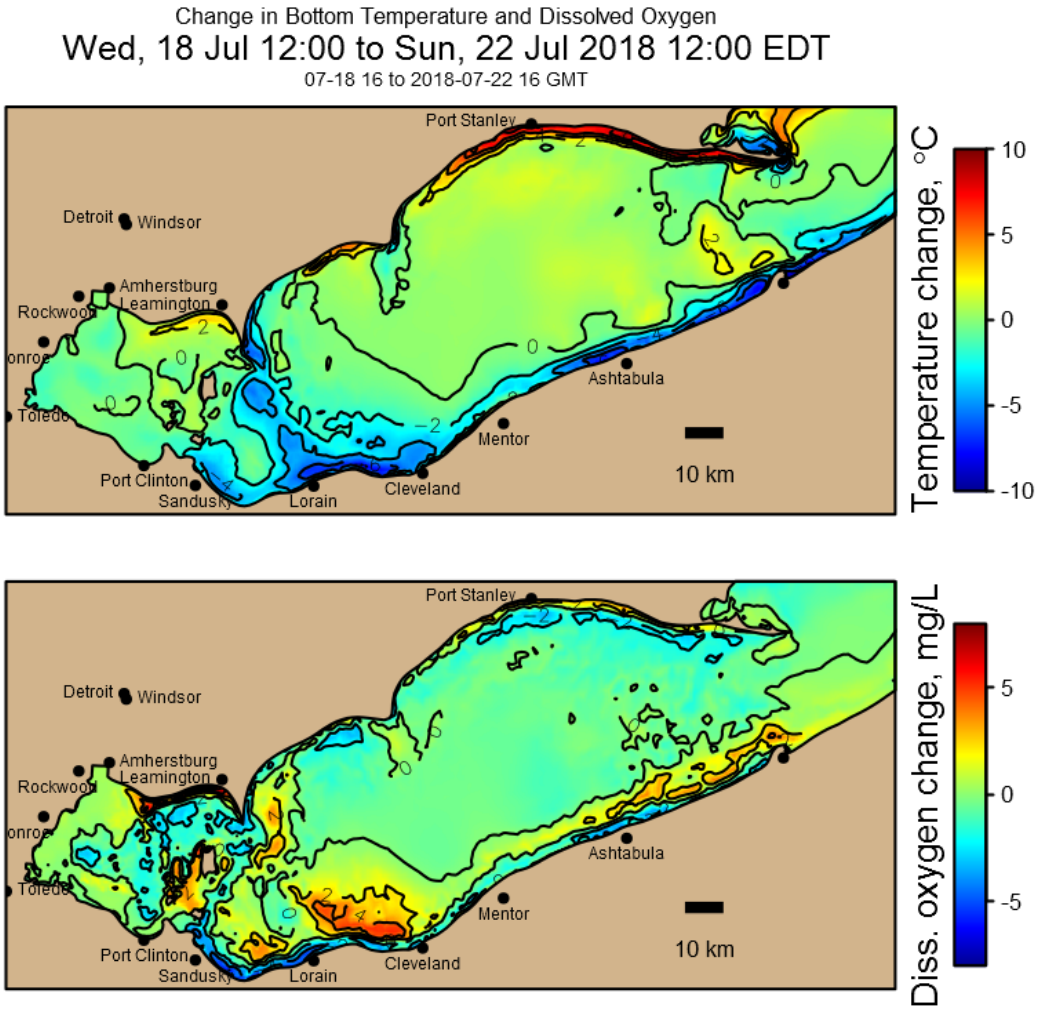

Figure 6. Image from the Lake Erie hypoxia change in bottom temperature and dissolved oxygen forecast animations as generated by the experimental hypoxia forecast model.

Protocol for Use of Habitat Task Group Data and Reports

- The HTG has used standardized methods, equipment, and protocol in generating and analyzing data; however, the data are based on surveys that have limitations due to gear, depth, time and weather constraints that vary from year to year. Any results or conclusions must be treated with respect to these limitations. Caution should be exercised by outside researchers not familiar with each agency's collection and analysis methods to avoid misinterpretation.

- All data provided from the PMA exercise is reported with the caveat that it is a working dataset based on the best available information. The intention, as designed, is for the HTG to continuously refine the data as new information becomes available and prioritizations are subject to change. Use of the PMA information should be done with this understanding and consultation with HTG co-chairs to ensure proper interpretation of the most recent dataset is highly advised.

- The HTG strongly encourages outside researchers to contact and involve the HTG in the use of any specific data contained in this report. Coordination with the HTG can only enhance the final output or publication and benefit all parties involved.

- Any data intended for publication should be reviewed by the HTG and written permission received from the agency responsible for the data collection.

Acknowledgements

The HTG would like to acknowledge and thank the many contributors to the work presented in this report. As this report is mostly an overview of projects underway in the Lake Erie basin, it is impossible to identify every project and every individual involved. If you are involved in a habitat-related project in the Lake Erie basin and would like your work to be represented in the project table, please contact a member of the Habitat Task Group.