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FISHERY RESEARCH PRIORITIES FOR THE GREAT LAKES
Great Lakes Fishery Commission

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Current as of October 2017

This listing was compiled based on input from the lake committees and their technical committees and from discussions within the Council of Lake Committees (for more information go to **http://www.glfc.org/joint-strategic-plan-committees.php**) and the Great Lakes Fish Health Committee (**http://www.glfc.org/fish-health-committee.php**). Order of listing does **not** imply relative ranking of priorities for the Fishery Research Program funding.

BASIN-WIDE FISHERY RESEARCH PRIORITIES
FOR THE GREAT LAKES
Great Lakes Fishery Commission

Updated October 2013

This listing was compiled based on discussions within the Council of Lake Committees (for more information go to **http://www.glfc.org/joint-strategic-plan-committees.php**). Order of listing does **not** imply relative ranking of priorities for the Fishery Research Program funding.

Research Priorities

The following four high priority research questions should help the Great Lakes Fishery Commission in selecting proposals that are submitted to the Fishery Research Program. These priority questions (in no specific order) are:

- What ecological and sociocultural obstacles threaten existing or prevent re-establishment of viable [or self-sustaining] populations of native species, such as lake trout, lake sturgeon, ciscoes, deepwater sculpin, American eel, and others? What management actions can be considered to overcome them?

- What mechanisms are responsible for reported changes in primary producers, secondary invertebrate, forage fish, and top predator production? What are the uncertainties and risks in potential fishery management actions to respond to these changes?

- How will invasive species affect sustainable fishery benefits in the Great Lakes, and what options should be considered by fishery managers in response to these changes?

- What attributes of aquatic habitats are essential to achieve environmental and fish community goals and objectives? What methods should fishery managers use to categorize, prioritize, and inventory specific aquatic habitats? What are appropriate methods and metrics for determining progress in implementing environmental objectives?

- What ecological conditions (biological, physical, and chemical) exacerbate the effects of pathogens on the viability of fish populations and associated fishery benefits? What are the short- and long-term effects of pathogens on the dynamics and viability of fish populations?

FISHERY RESEARCH PRIORITIES:

LAKE ONTARIO
Great Lakes Fishery Commission

November 18, 2015

The Lake Ontario ecosystem is extremely dynamic, and has experienced rapid and significant change in the last decade. The following research priorities were developed by the Lake Ontario Technical Committee, and are based on information required to assist in achieving and or evaluating the "Fish Community Objectives for Lake Ontario, 2013" (Stewart et al. 2014, http://www.glfc.org/lakecom/loc/LO-FCO-2013-Final.pdf).

The order of listing of the research priorities does not imply relative ranking of priorities for the Fishery Research Program funding.

GLFC Research theme area:

Re-establishment of Native Deepwater Fishes

- Are there differences in thiamine levels between Lake Trout strains? Does one strain incorporate gobies in their diet more than others (e.g. could be determined by investigating variation in isotopic signature among strains)?
- Identify and assess Lake Trout spawning habitat and early life history processes
- Develop effective marking techniques for stocked coregonids for assessing stocking success (life stage, location, timing etc.).
- What is the status of historical lake trout spawning grounds, and what are the limiting factors impacting wild reproduction (cladophora, goby, dreissenids)?

Physical Processes and Fish Recruitment in Large Lakes

- Characterize Lake Herring spawning habitat, investigate early life history processes and identify bottlenecks to restoration of this species in the Bay of Quinte, Hamilton Harbour, Chaumont Bay and/or Irondequoit Bay.

Energy Dynamics of Great Lakes Food Webs

- Conduct lower trophic level modeling to synthesize data and identify key variables (e.g., primary production, Mysis, Dreissenids).
- What are the important linkages/drivers between lower trophic levels and the fish community and how do they operate? Can improved understanding of these linkages

facilitate risk-management and allow managers to predict changes in the fish community (e.g. alewife biomass)?

Non-theme Research

- Identify the most important contributing factors to apparent smallmouth bass recruitment impairment in Lake Ontario and the St. Lawrence River(e.g. fecundity, spawning habitat, egg/fry predation, prey availability for YOY, angler impacts, VHSv, Cladophora, etc.)?
- What factors are contributing to declining yellow perch populations?
- What determines the survival of Atlantic Salmon in the open lake environment?
- What are novel approaches to mitigating the impacts of mortality of American Eel in hydroelectric generation turbines during their downstream migration?
- Based on new insights into Chinook salmon survival/natural reproduction and lakewide alewife abundance, develop new models to predict overall trout and salmon abundance and predator:prey balance.
- Are there differences in the thiamine levels present in stocked vs. wild salmon and trout found in Lake Ontario? For wild and stocked Chinook at the same thiamine levels, do untreated embryos experience similar survival?
- There have been dramatic declines in benthic fish abundance and distribution in the Eastern Outlet Basin over the past two decades. What factors have contributed to this?

Updated October 31, 2009

This listing was compiled based on input from the Lake Erie lake committee and its technical committee and from discussions within the Council of Lake Committees (for more information go to **http://www.glfc.org/joint-strategic-plan-committees.php**). Order of listing does **not** imply relative ranking of priorities for the Fishery Research Program funding.

Research Priorities

These Lake Erie Fisheries Research Priorities were developed to encourage progress towards meeting the published Lake Erie Fish Community Objectives (FCO's). We wish to emphasize here that specific FCO's must be interpreted in the context of the developed Goals for Lake Erie and the Guiding Principles used to frame specific objectives. Interested researchers should review the Lake Erie Fish Community Goals and Objectives (Ryan et al. 2003 link to http://www.glfc.org/pubs/SpecialPubs/Sp03_2.pdf   ) for additional background information concerning these research priorities.

Bold font indicates the **highest priorities** and *italics font* indicates *medium priorities*. Remaining priorities are lower priorities.

Ecosystem Conditions Objective
- *How can we best monitor, manage, and maintain optimum mesotrophic conditions in the west, central, and nearshore east basin?*
- *How can we best develop bathy/thermographic (and other habitat) maps that facilitate our understanding of the size, dynamics, and impact of river or tributary plumes in Lake Erie?*
- *How can we best describe important habitat characteristics, complete mapping of Lake Erie habitat, and distribute this information to managers, researchers, stakeholders, and the public?*
- How can we best map or model known disease dynamics in Lake Erie?

Productivity and Yield Objective
- **What are appropriate biological reference points and fisheries reference points for fished populations and how can they be estimated?**
- **How can we best describe, map, evaluate and maintain suitable nearshore habitats that can support high quality fisheries for smallmouth bass, northern pike, muskellunge, yellow perch, and walleye using hydroacoustics/GIS software?**
- What is the influence of size or slot limits on fish population dynamics?
- What is the impact of fishing sanctuaries on fish populations of interest and are the goals of sanctuaries being met?
- How can we optimize the potential for sustainable harvests of highly valued fish species?
- What changes in catchability have occurred in the commercial and sport fisheries operating on Lake Erie over time?

- What are the spatial and temporal dynamics of invasive species in Lake Erie and what are their impacts on desired fisheries productivity and yields?

Nearshore Habitat Objective

- **How can we best describe, map, evaluate and maintain suitable nearshore habitats that can support high quality fisheries for smallmouth bass, northern pike, muskellunge, yellow perch, and walleye using hydroacoustics/GIS software?**
- *How can we best describe important habitat characteristics, complete mapping of Lake Erie habitat, and distribute this information to managers, researchers, stakeholders, and the public?*

Western Basin Objective

- **What are the stock structures of walleye, yellow perch, smallmouth bass and other desired fish?**
- **How can we identify, rehabilitate, conserve, or protect locally adapted stocks?**
- *How can we best provide sustainable harvest of desirable fish species of fish?*
- What are the stock/spawner-recruitment relationships in desired fish populations?
- What are the natural mortality (M) rates in desired fish populations?
- What are the limiting factors and causes leading to reduced or lost recruitment of desired fish species and what are the solutions to remedy this lost recruitment?

Central Basin Objective

- **What are the stock structures of walleye, yellow perch, smallmouth bass and other desired fish?**
- **How can we identify, rehabilitate, conserve, or protect locally adapted stocks?**
- *How can we best provide sustainable harvest of desirable fish species of fish?*
- What are the stock/spawner-recruitment relationships in desired fish populations?
- What are the natural mortality (M) rates in desired fish populations?
- What are the limiting factors and causes leading to reduced or lost recruitment of desired fish species and what are the solutions to remedy this lost recruitment?

Eastern Basin Objective

- **What are the stock structures of walleye, yellow perch, smallmouth bass and other desired fish**
- **How can we identify, rehabilitate, conserve, or protect locally adapted stocks?**
- *How can we best provide sustainable harvest of desirable fish species of fish?*
- What are the stock/spawner-recruitment relationships in desired fish populations?
- What are the natural mortality (M) rates in desired fish populations?
- What are the limiting factors and causes leading to reduced or lost recruitment of desired fish species and what are the solutions to remedy this lost recruitment?
- How can we best restore self-sustaining populations of lake trout to historic levels of abundance in the east basin?

Fish Habitat Objective

- *What are the best methods for evaluation, protection, and enhancement of fish habitat throughout the Lake Erie watershed?*
- How can we update the Great Lakes Spawning Atlas to reflect recent changes in the Lake Erie basin?

Genetic Diversity Objective
- **What are the stock structures of walleye, yellow perch, smallmouth bass and other desired fish**
- **How can we identify, rehabilitate, conserve, or protect locally adapted stocks?**

Food Web Structure Objective
- How can we best manage the food web structure of Lake Erie to optimize production of highly valued fish species?

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FISHERY RESEARCH PRIORITIES:
LAKE HURON
Great Lakes Fishery Commission

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Version November 2014

The following list of questions represents the latest effort by the Lake Huron Technical Committee (LHTC) to communicate focal areas for research into the fish community of Lake Huron. The LHTC has dispensed with its previous hierarchical, theme-based research priority structure, which offered a more detailed and exhaustive list of questions, in favor of this more focused list. The LHTC has identified below those questions which we believe should receive priority focus*, though we encourage any research that will further attainment of 1) management objectives detailed in the *Fish Community Objectives for Lake Huron* http://www.glfc.org/pubs/SpecialPubs/Sp95_1.pdf; or 2) restorations goals for species with existing restoration plans in place. Further guidance on relevant focus areas can be obtained by reviewing the most recent State of the Lake Huron Report http://www.glfc.org/pubs/SpecialPubs/Sp13_01.pdf.

What long-term trade-offs for the Lake Huron fish community would result from removal of barriers that restrict movement of potadromous fishes? Which barrier designs or strategies would allow passage of non-jumping fish, such as sturgeons, suckers, and walleyes, while preventing passage of sea lampreys and other invasive species?

How has fish production potential changed in Lake Huron as a result of shifts in energy cycling/pathways? What are the implications for fisheries and species diversity?

What factors control the distribution and structure of Lake Huron's preyfish populations, including cisco?

What strategies can be employed to expand cisco beyond its current range and limited population size in order for it to become a major prey item in Lake Huron?

How do invasive species affect the productivity and stability of Lake Huron fish populations?

What factors influence early life survival of lake trout and what is the relative importance of these factors on recruitment to the adult stage?

To what extent does fish community structure in Lake Huron influence juvenile sea lamprey survival? What are the implications for sea lamprey control efforts?

What level of stock discrimination exists in Lake Huron's ecologically significant fish stocks, including lake trout, lake whitefish, walleye and cisco? How does stock intermixing affect the stability of exploited fish stocks?

Has catchability in surveys and fisheries changed over time and, if so, how does this influence our assumptions about fish stocks?

What is the probability of surviving a sea lamprey attack for host species other than lake trout, particularly lake whitefish and cisco?

How do fluctuating water levels, habitat alteration/loss/fragmentation and climate change influence fish productivity and species diversity?

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FISHERY RESEARCH PRIORITIES:
LAKE MICHIGAN
Great Lakes Fishery Commission

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Updated January, 2014

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Research Priorities

These Lake Michigan Priority Research Needs were developed to encourage progress towards meeting Lake Michigan Fish Community Objectives (FCOs; http://www.glfc.org/pubs/SpecialPubs/Sp95_3.pdf). We emphasize that the specific FCOs need to be interpreted in the context of the Goals and Guiding Principles within which they were framed. Interested researchers should review the FCOs (Eshenroder et al. 1995), as well as the latest version of the State of Lake Michigan document (Holey and Trudeau 2005), for additional background information concerning these research priorities. Priorities are updated annually; copies of the most recent priority list, the Fish Community Objectives, and the State of Lake Michigan report are available on the GLFC web site (www.glfc.org), from the chairperson of the Lake Michigan Committee (Tom Gorenflo - CORA), or from the chairperson of the Lake Michigan Technical Committee (Greg Wright – CORA). **The current list of priority research questions identified by the Lake Michigan Committee and Technical Committee is indicated below**, but any innovative research project that clearly will advance the achievement of FCOs will be given serious consideration for support by the LMC, even if not included on the specific list of priority research questions.

1) What are the current species-specific abundances, production, and forage demand of the Lake Michigan salmonine community? And what levels of salmonine production and yield are sustainable without threatening the biological integrity of the Lake Michigan fish community – including consideration for other Fish Community Objectives? (Salmon and Trout Object)

2) What is the ecological role of invasive species (Dreissenids, Bythotrephes, Hemimysis and Round Goby),their impact on zooplankton and their influence on fisheries production as competitors, predators and prey? (Planktivore, Inshore Fish Objective)

3) What contributions do naturalized fish make to the lakewide salmonine abundances, production, forage demand, and annual yield? Is there an interaction between salmonine stocking rates and naturalized salmonine production? (Salmon and Trout Object)

4) To what extent does thiamine deficiency complex (TDC) impact the Lake Michigan ecosystem? (Lake Trout Objective,)

5) Is it possible to keep alewife below levels that suppress native fish populations while maintaining a viable fishery? If so, what predator salmonine community is best suited to accomplish this? (Salmon and Trout, Planktivore Objects)

6) Are the current targets (wounding target of 5 wounds per 100 lake trout and spawning-phase target of 57,000 ±13,000) for sea lamprey control appropriate measures for assessing the relationship between observed wounding indices and the actual population impacts experienced by lake trout, Chinook salmon, whitefish and other host species? (Sea Lamprey Objective)

7) Which streams and/or lentic sources contribute to the parasitic lamprey population of Lake Michigan and in what proportion (i.e., account for all sources of lamprey)? (Sea Lamprey Objective)

8) What factors contribute to the instability of Lake Michigan yellow perch stocks? (Inshore Fish Objective)

9) What are the factors preventing native planktivore rehabilitation in Green Bay? (Planktivore Object)

10) What are the population specific factors limiting survival, recruitment and population growth in each remnant and recently stocked lake sturgeon population in the Lake Michigan basin, and what are current demographics and trajectories of existing populations? (Benthivore Objective)

Updated July 31, 2016

This listing was compiled based on input from the Lake Superior lake committee and its technical committee and from discussions within the Council of Lake Committees (for more information go to http://www.glfc.org/joint-strategic-plan-committees.php). Order of listing does **not** imply relative ranking of priorities for the Fishery Research Program funding.

Research Priorities

A review of the fish community objectives for Lake Superior (http://www.glfc.org/pubs/SpecialPubs/Sp03_1.pdf) and the Lake Superior State of the Lake Report (http://www.glfc.org/pubs/SpecialPubs/Sp10_1.pdf) provides a useful context for the priorities listed below.

1) Recruitment

   Are observed recruitment declines in Lake Trout, Lake Whitefish and prey fishes due to top-down influences from predation or bottom-up influences from lower trophic levels, or are they limited by inherent stock-recruitment relationships and/or environmental conditions?

   Have we reached carrying capacity for Lake Trout and Lake Whitefish in Lake Superior? Have these species reached density dependence?

2) Mortality

   Is the balance of mortality (natural, fishery-induced, and Sea Lamprey) allocated in SCAA models appropriate?

   Are the current biological reference points for Lake Trout, Lake Whitefish and Cisco sustainable and appropriate?

3) Ecological Interactions

   Can an ecosystem model be developed to allow the assessment of various management scenarios (impact of a siscowet fishery, impact of (or introduction of) invasive species, etc.), including possible climate change scenarios?

   Do environmental factors drive ecosystem models, or do population-level and community interactions have the ability to influence model outcomes?

   Are there negative interactions (competition, predation) between Brook Trout and non-native salmonines preventing restoration objectives for Brook Trout?

4) Habitat

   What is fish production in waters < 15 m? Is this production similar across habitat types?

5) Assessment of methods

   Have indicators been developed for inshore fish communities in Lake Superior, and are inshore and embayment fishes communities diverse and healthy?

   Is gill net CPUE correlated with bottom trawl densities for Lake Whitefish, deepwater ciscoes, and Lake Trout morphotypes? What factors might drive any observed differences?

Updated August 2014

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Research Priorities

- What is the ecology of fish pathogens and diseases of concern in the Great Lakes Basin? Examples include (but are not limited to) viral hemorrhagic septicemia virus (VHSv) genotype IVb, Heterosporis sp., Epizootic Epitheliotropic Disease virus (EEDv), Flavobacterium sp., and emerging diseases.
- What non-lethal field sampling methods and tissue/fluid samples are equivalent to conventional lethal field sampling methods to determine fish pathogen and/or disease status?
- Develop and validate new methods to detect emerging fish pathogens or pathogens of concern in the Great Lakes Basin.

Additional Research Interests

1. What is the effectiveness of the GLFHC disinfection protocols in eliminating key pathogens of interest from fish eggs? There is a need for a reliable disinfection methodology to prevent pathogen transmission via eggs and sperm.
2. Disease Ecology and Epidemiology
   (a) What is the susceptibility of Great Lakes fish species to emerging fish pathogens in the Great Lakes?
   (b) Identification of reservoirs and vectors (including ballast water) for fish pathogens in the Great Lakes Basin
   (c) What mechanisms affect the virulence and persistence of fish pathogens?
   (d) What is the effect of population size on disease expression?
   (e) What are the effects of multiple pathogens or combination of pathogens and nutritional deficiency and/or contaminant exposure on disease expression?
   (f) What are the projected changes on fish pathogen prevalence and intensity as a result of climate change?
3. Nutritional Aspects of Fish Health in the Great Lakes.
   (a) What is the role of lipids or other nutrients in determining and predicting health status?
   (b) What is the role of thiaminase-producing organisms in Great Lakes ecosystems?
   (c) What affect do invasive species have on nutrient stores in the Great Lakes and what are the associated effects on fish health?
   (d) What is the effect of nutrition on reproductive success?

(e) Does protein substitution in hatchery feeding formulations or extrusion manufacturing methods have a negative impact on survivorship, migratory behavior and reproductive success of hatchery-reared salmonids?

4. Fish Pathogen and Disease Management.
   (a) What are the effects of fish stocking and other management decisions on the manifestation of fish disease in the Great Lakes Basin?
   (b) What effects does culling brood stock for pathogen control have on the genetics of production fish?
   (c) When should fish not be moved past barriers (from a disease perspective)?
   (d) Development of an emergency response plan for disease outbreaks in the Great Lakes Basin, including (but not limited to) training of field personnel and preplanning.
   (e) What is the effectiveness of immunostimulants against key pathogens of interest in hatcheries?
   (f) What is the effect of vaccination of hatchery fish on pathogen virulence?