

FISHERY RESEARCH PRIORITIES: LAKE HURON Great Lakes Fishery Commission

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This listing was compiled based on input from the Lake Huron lake committee and its technical committee and from discussions within the Council of Lake Committees (for more information go to <http://www.glfcc.org/lakecom.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 Huron (link http://www.glfcc.org/pubs/SpecialPubs/Sp95_1.pdf) and the Lake Huron State of the Lake Report (http://www.glfcc.org/pubs/SpecialPubs/Sp95_2.pdf) provides a useful context for the questions listed below.

The Lake Huron Technical Committee (LHTC) has identified 5 “Issues”, or major subject areas, which we feel need to be addressed in Lake Huron. Under each of these Issue Categories is a list of Research Priority questions along with some examples. **HIGH** priority items are **bolded** and *MEDIUM* items *italicized*. Finally, the LHTC summarizes by identifying three broad research areas that capture the LHTC’s leading priorities for research in 2010-2011. These three chosen **HIGH PRIORITY** research areas are purposefully rather broad so as not to constrain unnecessarily the scope of potential research proposals. Researchers submitting proposals for funding are urged to look at the Research Issues list for insights into some specific research questions the LHTC considered in the process of developing the **HIGH PRIORITY** Research List for 2010-2011.

Text in blue font color shows some of the current or recent GLFC and other projects related to specific research priorities.

Research Issues:

ISSUE: Impediments to Lake Trout Rehabilitation

The LHTC is concerned that impediments exist which are limiting, delaying, or preventing lake trout rehabilitation efforts in Lake Huron waters. The nature of the impediments, the level of their impacts, and how to deal with them are all questions the LHTC would like to see addressed.

1) What are the major existing impediments to lake trout rehabilitation in Lake Huron? [**HIGH**]

Examples:

- What factors may be affecting declining size of lake trout at older ages? Is this related to diet? And/or to shift in distribution to colder temperature regimes? **[current diet study using angler-caught fish, USGS 2009-10; He et al. project funded in 2010 by GLFC titled: Quantifying new top-down influences on the rapidly changing food web in the main basin of Lake Huron]**
- What is the relative contribution of declining growth to changes in lake trout spawning stock biomass. What other factors are contributing to changes in spawning biomass?
- What level of recruitment is required in order to promote and sustain lake trout populations? What factors limit recruitment of hatchery and wild fish?
- What effect is EMS having on the ability of lake trout to naturally reproduce in Lake Huron?
- What explains recent trend in wild lake trout? Lake wide increase in wild fish has been observed (**Riley et al. 2007**). Genetic strain assessments indicates large

contribution of Seneca strain to wild age-0 fish and that age-0 fish are consuming benthic invertebrates ([Roseman et al. 2009](#)).

- What is the genetic heritage strain of recent wild recruits in Lake Huron?
- Is lake trout success dependant on early life history stage success of lake whitefish and cisco? Are these linkages between species life history stages important to provide lake trout with a large bodied prey? [[current diet study using angler-caught fish, USGS 2009-10](#)]

2) Is there one life stage which is more critical to lake trout rehabilitation than any other life stage? [*Medium*]

Examples:

- What is the variation in rates of egg deposition, fry emergence, and fry survival on historically productive lake trout spawning reefs and what factors contribute to this variation.
- What is the variability in post-stocking survival of hatchery lake trout and what factors (stocking density, prey availability for adults, predation, exotic species) influence survival rates?

3) Are there specific life history information gaps which are limiting our ability to rehabilitate lake trout? [*Medium*]

Examples:

- What is the level of lake trout hooking mortality by size category? (**This is directly related to existing lake trout population models in Lakes Huron, Michigan, and Superior.**)
- What is the natural mortality of lake trout, by age group, in Lake Huron?
- What is the spatial definition, physical description, and present utilization of current and historic lake trout spawning reefs in Lake Huron today and how are they being utilized for spawning?
- Is declining prey availability and size having an adverse effect on lake trout age at maturation, spawning capacity? [[He et al. project funded in 2010 by GLFC titled: Quantifying new top-down influences on the rapidly changing food web in the main basin of Lake Huron](#)] [[also see related pro funded by GLFC to Y. Zhao in 2010 addressing mortality-induced changes in lake trout and lake whitefish with respect to fisheries management](#)]

[Riley, S.C., He, J.X., Johnson, J.E., O'Brien, T.P. and Schaeffer, J.S. 2007. Evidence of widespread natural reproduction by lake trout *Salvelinus namaycush* in the Michigan waters of Lake Huron. J. Great Lakes Res. 33:917-921.](#)

[Roseman, E.F., W. Stott, T.P. O'Brien, S.C. Riley, and J.S. Schaeffer. 2009. Heritage strain and diet of wild young of year and yearling lake trout in the main basin of Lake Huron. Journal of Great Lakes Research 35\(4\):620-626.](#)

ISSUE: Effects of Invasive Species on Indigenous Species

While indigenous species still exist in Lake Huron, they continue to be threatened by an ever expanding number of invasive nuisance species. The LHTC needs to know what impacts invasive species are having or may have on Lake Huron indigenous species.

1) How might round gobies affect the sustainability or recovery of native species in Lake Huron? [**HIGH**]

Examples:

- How do they affect lake whitefish production in Lake Huron? (i.e. predation on embryos, competition between all life stages) [[Riley et al. GLFC funded in 2007 – food web dynamics and thiamine deficiency complex: identifying trophic pathways](#)]

- Are round gobies having a negative effect on reproductive success of native species in Lake Huron?
 - How does the consumption of round gobies contribute to thiamine levels in lake trout?
 - What are the densities of round gobies in Lake Huron?
 - Is bioaccumulation of contaminants affected by predator switching to newly invasive species?
- 2) Do alewives and smelt have negative impacts on the recovery/existence of indigenous species in Lake Huron. **[HIGH]**
Examples:
- If so, what types of interactions exist between these species?
 - Are alewives and smelt having any impact on the ability of lake herring to recover in Lake Huron? **[Riley et al. GLFC funded in 2007 – food web dynamics and thiamine deficiency complex: identifying trophic pathways]**
 - What are alewife biomass estimates in proximity to successful spawning sites for lake herring? Other spring-hatching species? **[Jared Meyers, Bence and Jones project working with CORA and MDNRE and others on cisco recruitment, 2009-2011]**
- 3) What life stage of indigenous species is most likely to be impacted by invasive species in Lake Huron *[Medium]*
Examples:
- Are Dreissenid mussels and declining Diporeia affecting lake whitefish diet, growth, maturation, and body condition? **[Ebener pilot project to assess thiamine levels in lake whitefish eggs with respect to dreissenid consumption, 2009] [Mike Rennie (DFO) and Erin Dunlop, GLFC funded project examining stable isotopic signatures from archived lake whitefish scale samples, benthic invertebrate, and sediment cores, in order to assess the impact of dreissenid establishment on lake whitefish growth and feeding habits. Part of the work also involves doing back-calculations of length at ages in order to assess early growth rates. We will be comparing the isotopic signatures and growth rates from whitefish scales collected prior to and after dreissenid establishment. We are targeting populations from around Lake Huron, as well as other parts of the Great Lakes]**
 - Is there an EMS phenomenon in walleye progeny from brood that consume a thiaminase-rich diet such as alewives?
 - What impact are exotics (principally Dreissenid mussels) having on spawning habitat of native fish species in Lake Huron?
 - What is the lethality of attack from sea lampreys, by species and size group on Chinook salmon, lake whitefish, walleye, bloater chub?

ISSUE: The carrying capacity of Lake Huron

In order to manage Lake Huron fish communities more effectively, it is necessary that we know what the carrying capacity of the lake is and how carrying capacity changes with changes to individual fish communities and populations.

- 1) What is the abundance of Chinook salmon in Lake Huron and what determines it? *[Medium]*
Examples:
- What is the extent of natural reproduction of Chinook salmon in Lake Huron and where is it occurring? What is the variability from year to year, from location to location? **[Currently being assessed by ON scientists, Steve Marklevitz/Y. Morbey using otolith micro-chemical signatures, 2009-10; funded by GLFC in 2007]**

- Is Chinook reproduction auto-regulated and, if so, how is it related to the prey abundance in the lake?
 - To what extent has “benthic shift” caused by Dreissenid colonization reduced production of Chinook and other pelagic fish in Lake Huron? [**He et al. project funded in 2010 by GLFC titled: Quantifying new top-down influences on the rapidly changing food web in the main basin of Lake Huron**]
 - What is the spatial extent of Chinook shoal spawning in Lake Huron and what amount of production, if any, comes from these sites?
 - What is the genetic make up of naturally reproducing Chinook salmon in Lake Huron? How much and how fast is genetic drift occurring?
 - What is the best way to evaluate natural reproduction of Chinook salmon in Lake Huron? What is the error rate of oxytetracycline mark detection? What is the error rate in assigning age classes, using vertebrae, scales, and other structures, to Lake Huron’s slow-growing Chinook salmon?
 - What is the extent and variation of inter-lake migration of Chinook salmon originating in Lake Huron? Originating in Lake Michigan? [**Currently being assessed by ON scientists, Steve Marklevitz/Y. Morbey using otolith micro-chemical signatures, 2009-10; funded by GLFC in 2007**]
- 2) Has production potential changed in Lake Huron and has there been a shift in production/pathways? How is energy being moved to fish? [**HIGH**]
- Examples:
- Has primary productivity changed in Lake Huron and, if so, why, where, and to what degree?
 - How do changes in lower food web pathways (particularly with respect to Dreissenid colonization) affect fish populations? [**He et al. project funded in 2010 by GLFC titled: Quantifying new top-down influences on the rapidly changing food web in the main basin of Lake Huron**]
 - Are there essential nutrients that are missing/sequestered (not channeled to fish, i.e. mussel colonies)?
 - What is amphipod production in Lake Huron and has it changed in recent years? [**EPA work with Dave Jude et al., Tom Nalepa’s work; J. Stockwell funded by GLFC in 2007 to assess Mysis relicta as a keystone species in native fish communities of the Great Lakes**]
 - To what degree are episodes of hyper-productivity in the near-shore zone (especially Saginaw Bay) functions of foodweb change or nutrient inputs (rising nutrient loading from the watershed)? Can we design an index of biological integrity (for example, burrowing mayfly abundance) as a tool in monitoring nearshore trophic state? [**Pothoven, Hook, et al. current assessment of foodwebs and environments in Saginaw Bay, 2009 – 2011**]
- 3) Has the carrying capacity of Lake Huron tributaries and spawning shoals changed in such a way as to affect overall fish production in the lake? [*Medium*]
- Examples:
- Which rivers/streams still maintain lake sturgeon natural reproduction and what is the magnitude of the production? How variable is it from year to year?
 - Does shoal spawning of lake sturgeon still occur in Lake Huron and if so, to what extent?
 - What are the sources of wild walleyes in Saginaw Bay? Do the outer shoals have the potential to contribute to the population?
 - Can micro-chemical analysis be used to identify natal sources of fish?
 - What are the sources of wild walleyes in the St. Mary’s River? What is the magnitude of natural reproduction?

- What is the sediment contribution of tributaries to Saginaw Bay and what are the consequences for habitat quality and walleye reproduction?
- 4) What are abundance, distribution, and composition of Lake Huron's prey base. **[HIGH]**. (Recent increases in effort by USGS appear to be adequately addressing elements of this issue.)
- Examples:
- What are the abundance, distribution, and composition of Lake Huron's prey base as determined by hydro acoustic assessment? Does this agree with estimates using other techniques?
 - Remnant populations of lake herring exist in Lake Huron. Where do they exist and what factors allow them to persist in some areas and not in others?
 - Can the cisco (lake herring) be expanded beyond its current range in order to become a major prey item in Lake Huron? **[MDNRE culture experiments in 2008-present]**
 - What is the cause of the recent dramatic decline in deepwater bloater populations? Are sex ratios in bloater populations a useful indicator of stress?
 - Is prey fish availability in Lake Huron adequately represented with bottom trawling and hydroacoustics? What is the biomass of prey fish on hard substrates (that are not currently sampled)? What is the location and extent of these hard-substrates in Lake Huron?

ISSUE: Habitat

Habitat degradation and manipulation is an on-going issue in the Great Lakes. Knowing what types and amounts of habitat are available at different points in time is critical to understanding the ecosystem as a whole.

- 1) What is the quantity and quality of fisheries habitat in Lake Huron and its tributaries? **[Medium]**
- Examples:
- How accurate are current tributary classifications? (Ground truthing of GIS classification data.)
 - Are there specific habitat types that are in short supply and thus impeding the survival/recovery of native fish species in Lake Huron?
 - What is the status of the littoral fish community in the St Mary's River and how does it vary with shoreline type and anthropogenic development?
 - If you reclaimed an inner bay reef in Saginaw Bay, would it be used by spawning walleyes or other species (whitefish for example) and actually produce fry?
 - If fish passage were restored to rivers with barriers what levels of walleye and lake sturgeon reproduction could be expected? **[Boase/Ania USFWS work in Saginaw Bay tributaries]**
 - Where is the most critical spawning habitat for lake sturgeon in the Lake Huron watershed, what percentage is above dams or other man-made barriers, and what percentage is inundated by impoundments and therefore not available even if fish passage is provided?
 - What risk does dam removal pose in increasing the range and production of invasive species, including Dreissenids, gobies and sea lampreys, in tributaries to Lake Huron? Would the positive benefits of dam removal on desirable species be significantly eroded by competition with or predation by exotics? Can fish passage be engineered so as to more selectively pass non-jumping native species while minimizing risk of passage by invasives?
 - What levels of fish production can be expected from rehabilitated Saginaw Bay and St. Mary's River?

- Has reef spawning habitat quality been influenced by colonization of the reefs by dreissenids? What is the extent and exact location of these reef habitats?

2) What is the high resolution surficial geology of Lake Huron? [*Medium*]

Examples:

- Can maps be developed to identify geological features, in particular bedrock outcroppings, as they relate to lake whitefish and lake trout distribution and spawning habitat?

ISSUE: Sea lamprey control

Sea lamprey control has been the foundation for rehabilitation of Great Lakes fisheries. Yet, certain sea lamprey control measures have unintended consequences to native species. Building barriers to sea lamprey spawning migrations may reduce reliance on TFM (and nontarget mortality of fish) but it may also inhibit reproduction of native potamodromous fishes. There is a need to continue to develop sea lamprey control methods that minimize effects on nontarget species while maximizing effectiveness of sea lamprey control. The Lake Huron Technical Committee believes this research area should be funded by the GLFC sea lamprey control research program.

- 1) What are the risks of TFM treatment options designed to reduce incidental kills of nontarget fish, relative to potential increased survival of sea lampreys and increased sea lamprey depredation rates on adult sturgeon and other species? [*Medium*]
- 2) If barriers are removed to restore passage of desirable fish species, how much would the spawning and larval habitat for sea lampreys be increased and what level of production would be expected? Could the potentially destructive impacts of increased sea lamprey production be mitigated using other control methods, such as lampricide application? [*Medium*]
- 3) Are there barrier designs that would allow passage of non-jumping fish, such as sturgeons, suckers, and walleyes, while preventing passage of sea lampreys? [**High**]

High Priority Research List for 2010-11, Lake Huron Technical Committee

- 1) What are the chief impediments during early life stages to lake trout rehabilitation? What is the genetic heritage strain of recent wild recruits in Lake Huron? What are the effects of alewives, dreissenids, round gobies, rusty crayfish, and other egg/fry predators on early life stage (from egg stage to recruitment to the fisheries) survival? What is the relationship between abundance and growth of early life history and juvenile stages of lake whitefish and cisco with lake trout growth and recruitment? (do these species serve as large-bodied prey for lake trout and how does their abundance and growth reflect in lake trout performance?) What are the effects of thiamine deficiency on reproductive success?
- 2) How have lower foodweb linkages (nearshore/offshore, pelagic/benthic, primary to secondary, for example) been affected by dreissenid colonization and other non-native invasive species, and how have those changes influenced fish production, with particular emphasis on species with recreational, commercial, and heritage values?
- 3) How can agencies optimize their investments in fish passage improvements, particularly with respect to dams that presently prevent upstream migration of native fishes such as lake sturgeon, walleyes, and suckers identified in the Fish Community Objectives? Are there ways of improving and restoring connectivity between tributaries and Lake Huron while limiting passage of undesirable species such as sea lamprey? What percentage of spawning habitat, particularly for lake sturgeon, is inundated by the impoundments of these dams and therefore can only be made available by dam removal?