Environmental Principles for Sustainable Fisheries in the Great Lakes Basin

Council of Lake Committees

March 2016

Sustainable fisheries are outcomes of a healthy Great Lakes ecosystem that supports an array of human benefits, including commerce, food, potable water, recreation, and overall quality of life. By definition, fisheries integrate fish production from suitable habitats with human use. Sustainable fish production requires dynamic habitats with biological, chemical, and physical features that continually meet reproductive, growth, and survival needs. Repeated expressions of habitat features that sustain fish production represent an ecosystem with integrity that should not require extensive management for maintenance. Accordingly, fish are indicators of healthy ecosystems and environmental conditions that sustain desired fish communities and associated fisheries in the Great Lakes provide inherent societal values.

Fisheries management agencies in the Great Lakes jointly address environmental conditions in support of sustainable fisheries through *A Joint Strategic Plan for Management of Great Lakes Fisheries.* The common goal of the agencies is "*to secure fish communities, based on foundations of stable self-sustaining stocks, supplemented by judicious plantings of hatchery-reared fish and provide from these communities an optimum contribution of fish, fishing opportunities and associated benefits to meet needs identified by society for wholesome food, recreation, cultural heritage, employment and income, and a healthy aquatic ecosystem"*. Emphasis is placed on implementing an ecosystem approach for protecting and improving aquatic habitats that ensure adequate spawning success and production of desired fish communities. The approach is to establish fish community objectives (FCOs) for each lake, identify environmental impediments to achieving FCOs, and then exercise authority and influence where possible to address the impediments. Further, the plan calls for fisheries managers to work through their lake committees with environmental agencies on unresolved or emerging issues to achieve FCOs and to coordinate with the Great Lakes Water Quality Agreement (GLWQA) Lakewide Action and Management Plan (LAMP) process.

All lake committees have developed FCOs and several have drafted formal environmental objectives that identify desired conditions and impediments for their achievement. However, progress on addressing impediments has been slow. A continuing need is to identify priorities at effective scales for implementation by a suite of potential applicators, which include both regulators and non-regulators from federal, provincial, state, tribal groups, and local government agencies, non-governmental environmental groups, universities, industries, and individual property owners. Applicators address environmental impediments through regulations, policies, practices, and projects. A foundation of guiding principles and priorities could help inform efforts at all scales for environmental improvement in the basin.

Following are seven environmental principles and priorities for sustainable fisheries that are linked through their connections to functional habitats and management decisions in the Great Lakes basin. Functional habitats are dynamic systems of hydraulically-connected areas that support requirements of desired fish species for sustained production. Sustainable fisheries can occur across the basin if functional habitats are protected or improved in each lake through a systematic, adaptive, cumulative, and collaborative approach that accommodates fishery value in decisions to act on manageable anthropogenic stresses.

Principle 1: Sustainable fish production to achieve FCOs requires a diversity of functional habitats in the Great Lakes.

- FCOs vary among the lakes and include multiple fish species and life stages with unique habitat requirements.
- Functional habitats include connected spawning and nursery areas that attract viable adults, and support early life history requirements for a suite of desired species and stocks.
- Functional habitats also include connected areas that support fish growth and survival from juveniles to viable adults.
- Functional habitats are created by hydro-geomorphic and thermodynamic processes that structure and maintain physical, biological, and chemical features required for sustainable fish production.
  - ✓ *Example: many Great Lakes tributaries have gravel substrates and flow features with connected wetland and bay nursery habitats that together support annual reproduction by discrete fish stocks.*
- Functional habitats are inherently dynamic, because of weather/climatic influences on processes with many moving components (e.g., water, inorganic and organic particles, substrates, organisms); a defined functional habitat encompasses the area affected by weather dynamics.
  - ✓ *Examples: water level changes can affect exact locations of spawning and nursery habitats in a defined functional habitat; climate changes can affect spatial and temporal use of habitats.*
- Functional habitats that fulfill requirements for fish production may be attainable under less than pristine environmental conditions.

Priorities:

1. ***Functional habitats to achieve FCOs could be designated for each lake by the lake committees for universal recognition to all potential applicators.***

   Examples: The LEC might designate the Sandusky River system in western Lake Erie as a functional habitat, which includes the Sandusky River and its watershed, Sandusky Bay, and areas influenced by the Sandusky River plume in the open lake. The LMC might designate the Green Bay system of tributaries and wetlands as a functional habitat. LHC might designate southern Georgian Bay as a functional habitat system.
2. ***Potential applicators could be made aware of designated functional habitats as being important areas for sustainable fisheries, worthy of their priority attention.***

Principle 2: Protection and improvement of functional habitats should occur systematically.

- Functional habitats can be protected or improved by addressing potential stresses on specific components of fish production, such as
  - access for viable adults to spawning areas,
  - spawning area suitability (e.g., substrates, vegetation, water flow/quality),
  - survival of fertilized eggs and hatching of larvae,
  - larval movement to nursery areas,
  - nursery suitability for growth and survival to juvenile stages of first recruitment,
  - foraging areas for sub-adults, and
  - foraging areas for gamete development in adults.

- Components of each functional habitat could be evaluated for impairments and for prevention or remedial options to mitigate manageable stresses on fish production.
- Remedial options for mitigation include restoration of stressed components to an unimpaired state by addressing sources of stresses; physical processes should help maintain restoration outcomes.
    - ✓ *Example: restoration is removing a dam to replenish a downstream spawning habitat through hydraulic transport of gravel*
- Remedial options also include enhancement of stressed components to a less impaired state by treating symptoms; enhancement benefits are likely to be temporary.
    - ✓ *Example: enhancement is periodically adding truckloads of gravel to a spawning habitat below a dam.*
- Unmanageable constraints on stressed components of functional habitats should be accommodated in remedial options.
    - ✓ *Examples: spawning habitats altered during the construction of a shipping channel cannot be restored there; round gobies cannot be excluded from smallmouth bass nesting areas; developed waterfronts in major cities cannot be restored to previous wetland habitats.*
- Manageable sources of anthropogenic stresses are pathways for addressing threats and impediments to functional habitats (Principle 7).

Priorities:

1. ***Functional habitats that support desired fish production should be protected as the highest priority in each lake and in connecting corridors.***
2. ***Restoration of stressed components of functional habitats should receive second highest priority in each lake and in connecting corridors.***
3. ***Enhancement of stressed components to functional habitats should occur if protection and restoration are not options in each lake and in connecting corridors.***
4. ***Each lake committee could identify and prioritize recommended protective or remedial actions for potential or extant impairments to components of functional habitats in their lake.***
5. ***Lake committees could make potential applicators aware of desired remedial actions and priorities for sustainable fisheries in each lake.***

Principle 3: Protection and improvement of functional habitats should occur adaptively in the basin.

- Working knowledge of specific factors affecting desired fish production from functional habitats varies among lakes and species.
- Information gaps exist for components of functional habitats; stresses and remedial options may not be fully understood for all species.
- Environmental changes to the Great Lakes basin add complexity and uncertainty to expected outcomes from efforts to protect or improve functional habitats.
- Adaptive approaches require science-based methods with continued commitments to fish community and/or habitat monitoring for evaluation.
- Adaptive approaches also require timely communication of working knowledge and expected outcomes from remedial actions, and recognition of uncertainties and information gaps.

Priorities:

1. ***Working hypotheses could be developed by the lake committees for functional habitats in each lake to provide expected outcomes from proposed preventive or remedial actions.***

   Examples:

   $H_{w\ BV\ dam}$ - If the Ballville dam on the Sandusky River is removed, then fish production from the Sandusky River system will increase.

   $H_{w\ GB\ wetlands}$- If coastal wetland complexes in Green Bay are not protected from development and diminish in size, then production of wetland-dependent sport fishes will decline.

2. ***Null hypotheses could be identified and tested through monitoring and research to validate and improve working hypotheses; rejection of a null hypothesis would validate the working hypothesis.***

   Examples for the working hypotheses above:

   $H_{null\ BV\ dam}$ - Viable adults will not spawn in areas above the Ballville dam after removal.

   $H_{null\ BV\ Dam}$- Substrate quality of spawning areas below the dam will not improve after removal.

   $H_{null\ BV\ Dam}$- Fish recruitment from the Sandusky River system will not increase after dam removal.

   $H_{null\ GB\ wetlands}$ – Abundance of wetland-dependent, viable adults utilizing Green Bay wetlands is unrelated to wetland size.

   $H_{null\ GB\ wetlands}$ – Abundance of young-of-year in coastal wetlands is not related to wetland size.

   $H_{null\ GB\ wetlands}$ – Growth of juvenile sport fish is no higher in coastal wetlands than in other areas of Green Bay.

3. ***Working and null hypotheses could be communicated to potential applicators in a manner to encourage and facilitate their consideration and use.***
4. ***Working and null hypotheses should be updated as knowledge accrues over time.***

Principle 4: Protection and improvement of functional habitats should occur cumulatively.

- Fundamentally, any action that prevents or mitigates stressed components of functional habitats will collectively benefit fish production in the basin.
- Short-term benefits to fish production may not always be apparent for every action, but will accumulate through application of systematic and adaptive principles.

Priorities:

1. ***Acting with uncertainty on opportunities that are expected to protect or improve functional habitats (e.g., application of Principle 3) is preferred over no action and acceptance of outcomes that may be irreversible.***
2. ***Lack of immediate results from remedial actions with expected benefits (Principle 3) should not be a deterrent for continued efforts if working hypotheses remain valid.***

Principle 5: Protection and improvement of functional habitats should occur collaboratively.

- Management of functional habitats for sustainable fish production exceeds the authorities and capacities of provincial and state fisheries agencies.
- Various governmental agencies, tribal groups, non-profit environmental organizations, local community groups, universities, and private industries/groups have responsibilities or interests in a healthy Great Lakes ecosystem that will also fulfill FCOs.
- Opportunities exist for collaboration between fisheries agencies and various applicators on common interests that affect functional habitats, including

- water quality and pollutants,
- contaminated sediments,
- water withdrawals,
- lake levels,
- watershed land management practices,
- environmental engineering capabilities,
- hydraulic barriers and connectivity,
- channel or basin morphology and modifications,
- riparian and shoreline usage,
- wetland protection and mitigation,
- aquatic vegetation management,
- artificial and natural reefs,
- water mass characteristics and dynamics, and
- aquatic invasive species prevention, management and control

Priorities:

1. ***Lake committees and/or member agencies should develop and foster effective working relationships with key applicators, especially regarding functional habitats where long-term, remedial attention is expected.***
2. ***Lake committees should consider the interests and capabilities of potential applicators in the development of recommendations for remedial actions on components of functional habitats (Principle 2).***
3. ***Lake committees could consult potential applicators for assistance in the development and use of working and null hypotheses (Principle 3).***

   Examples: researchers could be requested to help with filling information gaps and developing testable null hypotheses; funding organizations could be asked to consider working and/or null hypotheses as themes in RFPs or in criteria for project selections.

Principle 6: Fishery value should be explicitly accommodated in environmental management decisions that affect functional habitats in the Great Lakes.

- Sustainable fisheries have societal value that should be considered in analyses of tradeoffs (e.g., costs/benefits, pros/cons) by applicators when making decisions that affect functional habitats, including
    - economic outputs (e.g., commercial fishery landed values, direct fishery trip expenditures, indirect fishery expenditures and sales, tax revenues generated, jobs created, indirect tourism expenditures due to sport fishing attraction),
    - benefits to multiple jurisdictions from migratory stocks,
    - sources of food,
    - management of aquatic invasive species (prevention, detection, and removal),
    - platforms for observation, education, and monitoring
    - cultural/legal/aesthetic/social considerations and obligations
- Many of these societal values are known, have been quantified, and are available for use in decisions at a lake or regional scales, but not at functional habitat scales.
- Environmental features that support fishing activities are often ignored as important attributes of sustainable fisheries but warrant consideration in decisions that affect functional habitats, including
    - allowable access to and use of functional habitats,

- proximity to fisher access areas,
- structural features (e.g., reefs, vegetation) that attract fishes, and
- connectivity to encourage fish use, especially by migratory stocks

<u>Priorities</u>:

1. ***Lake committees and/or member agencies could compile and communicate fishery value information to applicators at lake, jurisdiction, and functional habitat scales.***

   Example: recommended remedial actions under Principle 2 might include expected costs/benefits to fisheries that use a functional habitat.

2. ***Research should be conducted to identify and fill gaps in fishery value information.***
3. ***Decisions by applicators that affect fishery use of functional habitats should include an evaluation of effects (losses/gains) on fishery values.***

   Examples: movement of impounded sediment during a dam removal should be managed to minimize adverse impacts on downstream fisheries; application of nutrient control actions in a functional habitat should not compromise FCOs.

4. ***Formal structured decision analyses should be recommended by lake committees to applicators for decisions involving uncertainty and the potential for impacts on fishery value from a proposed action in a functional habitat.***
   Example: removal of the Black Sturgeon Dam for native species restoration with implications to sea lamprey control.

Principle 7: Manageable sources of anthropogenic stresses are pathways for addressing threats and impediments to functional habitats.

- Manageable sources of anthropogenic stresses include
  - native and non-native biota (introductions, AIS, genetic diversity/stock structure)
  - point source pollution (single sources of discharged pollutants into water or air)
  - non-point source pollution (diffuse sources of pollutants through water or air)
  - hydrologic alterations (barriers, dredging, channelization, drainage, withdrawals)
  - behavioral disturbances (human activities that disrupt spawning or displace fish)
  - edge structuring (vegetation/woody debris removal, rubble dumping, rip rap/sheet-piling, dikes/piers, utility cables/pipelines)
- Management actions on these sources should occur systematically (Principle 2), adaptively (Principle 3), and collaboratively (Principle 5) for cumulative benefits (Principle 4) to provide a diversity of functional habitats in the basin (Principle 1).

<u>Priorities (basinwide)</u>:

1) ***Bi-nationally coordinated, water quality management through nutrient control, sediment management, toxic contaminants, and disruptive chemicals/materials (GLWQA LAMPS)***
2) ***Provincial and state management of water withdrawals (Great Lakes - St. Lawrence River Basin Water Resources Compact),***
3) ***Comprehensive management (all groups) of aquatic invasive species to prevent establishment of new threats and to control extant populations where possible,***

4) ***Comprehensive management to improve connectivity in rivers, shorelines, and coastal wetlands, balancing the risk of enabling unacceptably harmful impacts from invasive species against the benefits of having those functional habitats in support of FCOs, and***
5) ***Research on fish behavior to improve knowledge of adaptive habitat use by various species, effects on fish production, and viable management options.***