Aquatic Habitat Connectivity

Overall Assessment
Status: Fair
Trend: Improving
Rationale: Dams and barriers have been significantly impacting the health of aquatic ecosystems in the Great Lakes for over a century and are a key factor in the decline of several species of fishes. In addition to limiting access of fishes to spawning and nursery habitats, loss of aquatic connectivity impacts nutrient flows and riparian and coastal processes. There are thousands of dams on Great Lakes tributaries and many are near the end of their functional life and will need to be replaced or decommissioned in the next decade. Several dam mitigation projects are occurring throughout the basin which are restoring aquatic connectivity. An increase interest in micro-hydro projects could result in additional dams, but in most cases these new projects include measures to provide for the passage of fish.

Lake-by-Lake Assessment

Lake Superior

Status: Fair
Trend: Improving
Rationale: A comprehensive assessment of barriers to aquatic connectivity has not been completed for Lake Superior. The Lakewide Management Plan reports that a binational dataset has been created that includes dams and barriers to fish passage (EC, 2011).

Lake Michigan

Status: Fair
Trend: Improving
Rationale: Aquatic habitat connectivity is being examined in the Biodiversity Conservation Strategy that was initiated in 2010. Several dam removal and mitigation projects have been initiated in the last few years through the Great Lakes Restoration Initiative (e.g. Boardman River dam removal will connect over 250 km of stream habitat back to Lake Michigan - the dam closest to the river mouth will be modified to allow for fish passage while blocking access for sea lamprey.)

Lake Huron

Status: Fair
Trend: Improving
Rationale: Status is based on the Lake Huron Biodiversity Conservation Strategy (Franks-Taylor, 2010). Expert review and opinion was used to determine that access to spawning areas is limiting the population size of migratory fishes. This report notes that one sub-basin (Eastern Georgian Bay) has a status of “good” (sufficient spawning habitat to maintain population) while another (Saginaw Bay) has a status of “poor” (spawning habitat is severely limiting population size).

Lake Erie

Status: Fair
Trend: Improving
Rationale: Aquatic habitat connectivity is being examined in the Biodiversity Conservation Strategy that was

initiated in 2010. Several dam removal and mitigation projects have been initiated in the last few years through the Great Lakes Restoration Initiative (e.g. Ballville Dam on the Sandusky River will open up 35 km of river habitat for walleye).

Lake Ontario

Status: Fair

Trend: Improving

Rationale: Status is based on the Lake Ontario Biodiversity Conservation Strategy (Lake Ontario Biodiversity Conservation Strategy Working Group, 2009). Expert review of maps developed for the migratory fishes target used to provide an assessment. Several dam mitigation projects have been initiated (e.g. dam removal in the Duffins Creek watershed by the Toronto Region Conservation Authority to improve access for Atlantic salmon).

Purpose

- To determine the amount of accessible tributary habitat for Great Lakes fishes.
- To summarize initiatives to improve connectivity of aquatic habitat.
- To highlight some of the issues related to barrier removal.

Ecosystem Objective

To reduce the impacts of barriers to aquatic connectivity on fish populations and nearshore/coastal health.

Dams and barriers have been identified as a significant threat in the Lake Ontario and Huron biodiversity conservation strategies (Franks-Taylor, 2010) and have been identified as recovery actions for at risk Great Lakes fishes such as for Lake Sturgeon (Golder Associates Ltd., 2011) and American Eel (MacGregor, 2010). Mitigation of this pressure will need to be assessed on case-by-case basis to ensure that barrier mitigation does not impact efforts to reduce the spread on aquatic invasive species and sea lamprey.

Ecological Condition

Background

Streams and rivers provide critical spawning and nursery habitat for over one-third of Great Lakes fishes. This includes walleye, lake sturgeon, (coaster) brook trout, suckers and native lamprey. Dams and barriers have been having a significant impact on the aquatic ecosystems of the Great Lakes for over a century and are a key factor in the decline of several species of fishes. As early as 1861, southern Ontario alone had over 2000 mills reported in the annual census (Fischer & Harris, 2007). Accessibility to streams has been reduced by a variety of anthropogenic barriers such as dams, culverts at road-stream crossings and dikes. In addition to improvements in habitat connectivity for migratory fishes, improving aquatic connectivity can also have a number of benefits for restoring aquatic systems. These include: reducing water temperatures, increasing levels of oxygen, transport of nutrients and woody debris, restoring natural flood cycles and increasing the amount of riparian and coastal wetland cover.

Measure

Aquatic habitat connectivity can be measured at a landscape level though Geographical Information Systems by intersecting the hydrology network with dams. The distance between the Great Lake and the first barrier can be measured to provide an assessment of the amount of accessible riverine habitat that is available. Information on the distribution of dams can be obtained from the National Inventory of Dams (U.S. Army Corps of Engineers) and the Ontario Dam Registry (Ontario Ministry of Natural Resources). More detailed spatial information on dams occurs for some lake basins and watersheds (e.g. Great Lakes Fisheries Commission, Conservation Authorities).

Road-stream crossings can also reduce aquatic habitat connectivity. While road-stream crossing can be easily identified by intersecting the hydrology network with roads (Figure 3), field verification is required to determine if the crossing do actually cause a disruption to connectivity (such as a "perched" culvert). In general, road-stream crossings are only an issue on small tributaries where culverts are installed.

Aquatic habitat connectivity is a pressure measure (i.e. it measures a threat). Other potential measures would include a direct measure of the population of key migratory fishes that will benefit from access to tributaries (e.g. SOLEC has indicators for lake sturgeon and walleye). The number of barrier mitigation projects could also be measured as a response indicator.

Linkages

Sea Lamprey: Barrier mitigation must be coordinated with efforts to limit the access of seam lamprey to spawning areas.
Walleye and Sturgeon: Loss of aquatic connectivity has contributed to the decline of the species.
Watershed Stressor Index: The number of dams and barriers is an important factor in assessing watershed stress.

Management Challenges/Opportunities

There has been an increase in dam and barrier removal projects over the last few years. This activity has been initiated because of an increase in funding availability (e.g. Great Lakes Restoration Initiative) and because many dams are deteriorating. Most dams in the basin are 50 years+ will require repair or removal in the next decade to avoid failure. This presents a significant opportunity to restore aquatic habitat connectivity.

With the increase in interest in dam removal, there are now several BMPs and assistance programs available in the U.S. and Ontario. While a comprehensive bi-national database of the dams in the basin, describing current use and ownership, does not exist, efforts in both countries may combine to produce this important source of information. For example, in Ontario an on-going province-wide inventory of dams will include a registration program by 2012.

Improvements in aquatic connectivity must be coordinated with efforts to limit the spread of aquatic invasive species, sea lamprey and VHS. Some dams and barriers may be a key management tool for mitigating these other pressures. Decisions about fish passage or dam removal need to be assessed on the basis of local conditions.

Comments from the author(s)

Improving access to spawning habitats is one of the key strategies to restoring populations of Great Lakes fishes. While other pressures that had a major impact on fish populations in the past have had significant success, such as overfishing and water quality, basin-wide mitigation actions to restore the historic riverine spawning and nursery habitats is just beginning.

Assessing Data Quality

Insert "x" under the statement that best corresponds with each data characteristic

Data Characteristics	Strongly Agree	Agree	Neutral or Unknown	Disagree	Strongly Disagree	Not Applicable
1. Data are documented, validated, or quality-assured by a recognized agency or organization		X				
2. Data are traceable to original sources	X					

3. The source of the data is a known, reliable and respected generator of data		X				
4. Geographic coverage and scale of data are appropriate to the Great Lakes basin		X				
5. Data obtained from sources within the U.S. are comparable to those from Canada		X				
6. Uncertainty and variability in the data are documented and within acceptable limits for this indicator report		X				
Clarifying Notes: Information on barriers to aquatic connectivity is available, but not complete. Not all dams are included in the database, and current databases do not include information on fish passages.						

Acknowledgments

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Information Sources

EC, E. (2011). *Lake Superior Lakewide Management Plan Annual Report.* U.S. Environmental Protection Agency and Environment Canada.

Fischer, G., & Harris, M. (2007). *Ontario's Historic Mills.* Erin, Ontario: Boston Mills Press.

Franks-Taylor, R. A. (2010). *An International* . tnc, ncc.

Golder Associates Ltd. (2011). *DRAFT Recovery Strategy for Lake Sturgeon (Acipenser fulvescens) – Northwestern Ontario, Great Lakes-Upper St. Lawrence River and Southern Hudson Bay-James Bay populations in Ontario* Peterborough, Ontario: Ontario Ministry of Natural Resources.

Lake Ontario Biodiversity Conservation Strategy Working Group . (2009). *The Beautiful Lake - A Bi-national Biodiversity Conservation Strategy for Lake Ontario.* U.S. Environmental Protection Agency and Environment Canada.

MacGregor, R. J. (2010). *DRAFT Recovery Strategy for the American Eel (Anguilla rostrata) in Ontario.* Peterborough, Ontario.: Ontario Recovery Strategy Series. Prepared for Ontario Ministry of Natural Resources, .

List of Figures

Last Updated

State of the Lakes Ecosystem Conference (SOLEC) 2011

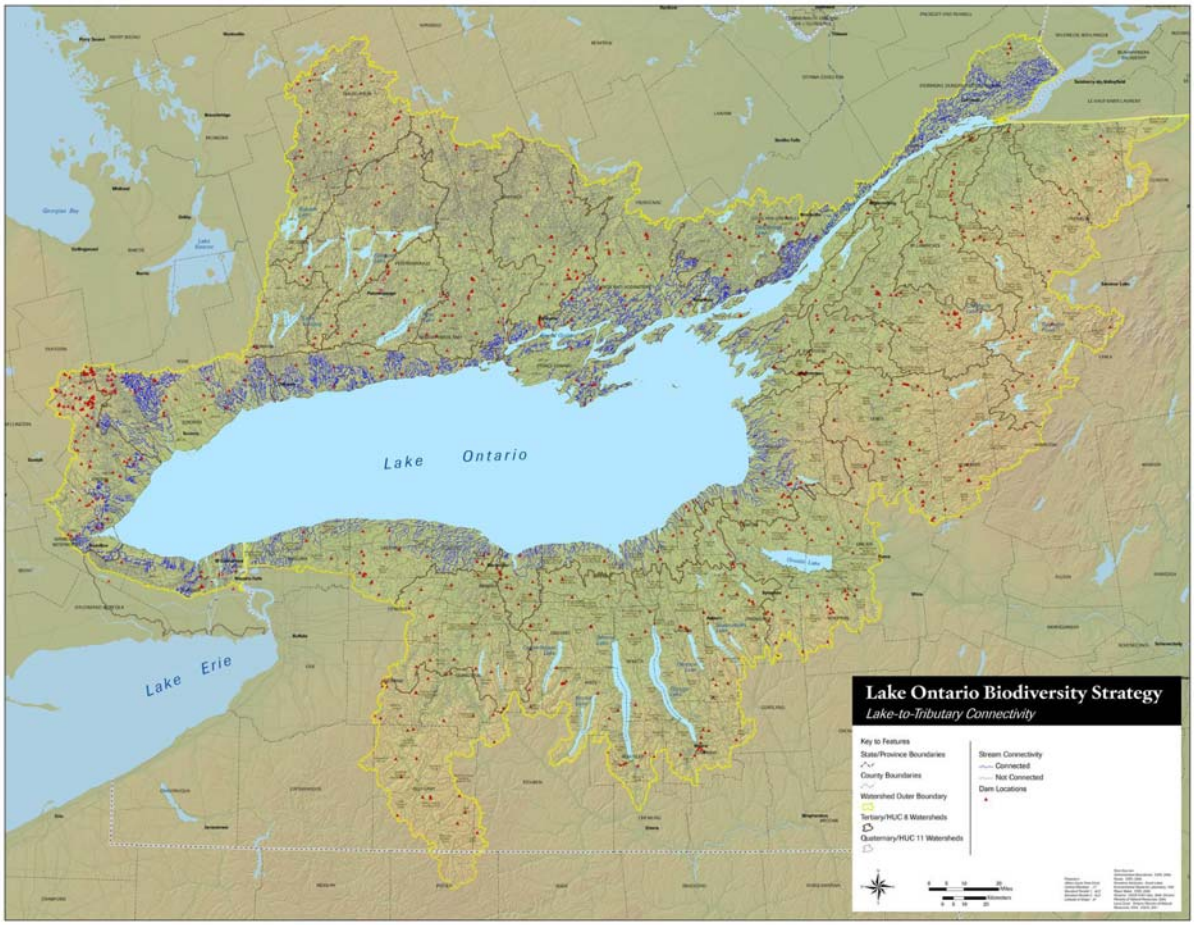

Figure 1. Aquatic Connectivity for Lake Ontario.
Source:

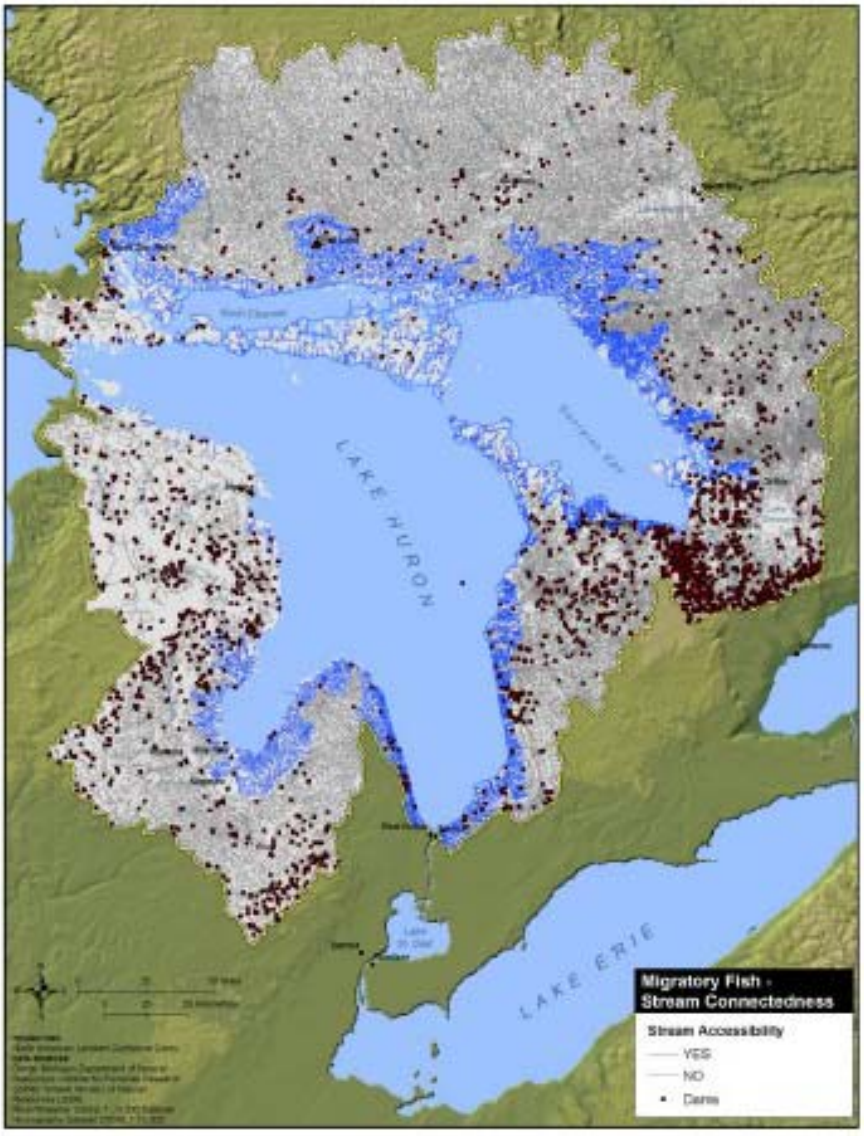

Figure 2. Stream Connectedness – Lake Huron.
Source:

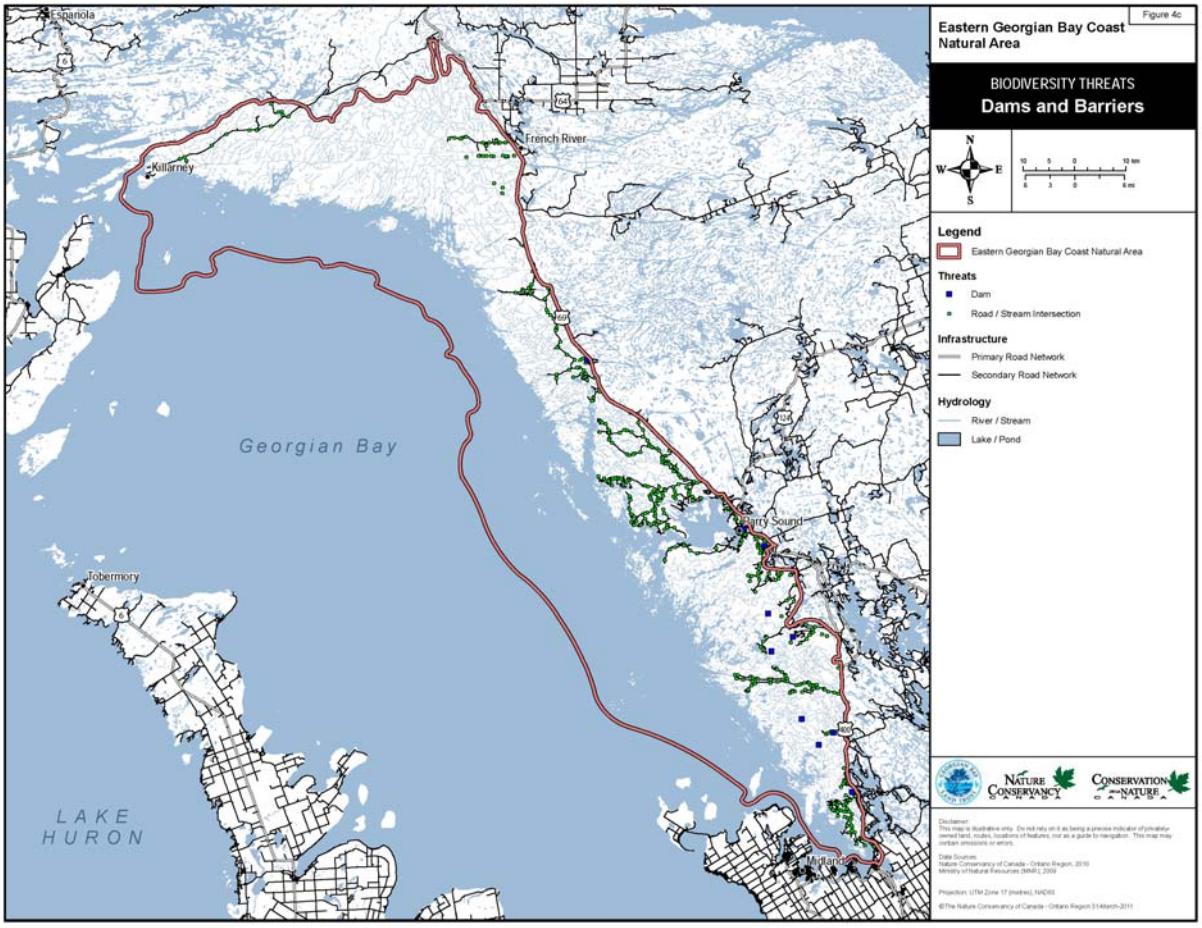

Figure 3. Example of Road-Stream Crossing Analysis for Eastern Georgian Bay.
Source: