



INDICATOR: AQUATIC STRESS INDEX

STRATEGIC DIRECTION: Reduce Threats

TARGET: N/A

THEME: Pressures on Ontario's Biodiversity – Habitat Loss

Background Information:

Habitat loss is a major threat to freshwater ecosystems globally (MEA 2005; Helfman 2007). The loss, degradation and fragmentation of aquatic habitats is the main factor negatively impacting fish species at risk in North America, Canada and Ontario (Dextrase and Mandrak 2006; Jelks et al. 2008). Aquatic habitats can be affected directly by in-water activities (e.g., dredging, filling, dams), shoreline alterations (e.g., rock and concrete reinforcements, removal of riparian vegetation), as well as by large-scale alterations of the watershed (e.g., urban subdivisions). Streams and lakes tend to reflect the conditions of their surrounding watersheds.

Despite the well-known impacts of habitat loss and alterations on aquatic biodiversity, the actual amount of aquatic habitat that has been impacted has not been assessed at a broad level in Ontario. Therefore, this indicator uses the Aquatic Stress Index from Chu et al. (2003, 2015) to represent the relative intensity and distribution of threats affecting aquatic habitats in Ontario. The Stress Index was developed to identify the intensity of human stressors for each tertiary watershed across Canada and incorporates information on population density, roads, industrial activity, agriculture and forestry. The Stress Index does not include dams, but does consider some factors that relate directly to pollution as opposed to direct habitat loss (e.g., waste facilities). Although the waters of the Great Lakes are not included in the Stress Index, coastal habitats and nearshore areas would be impacted by stresses in adjacent watersheds that have been assessed (Chu et al. 2014). Similar information on impacts to habitats within the Great Lakes is available through the Great Lakes Environmental Assessment and Mapping Project web site ([GLEAM](#)) and the Great Lakes Aquatic Habitat Framework web site ([GLAHF](#)).

Data Analysis:

Aquatic Stress Index values for this indicator are from the work of Chu et al. (2003, 2015). They estimated the stress placed on each watershed based on the distribution of stressors using census and business pattern data from Statistics Canada. Crop agriculture density, waste facilities, petroleum manufacturing, forestry, dwellings, discharge sites, and roads were selected for further analysis from a list of potential stressors. Values for the density of these stressors in each watershed were standardized by dividing each value by the maximum value across all watersheds. An overall watershed Stress Index was calculated (on a scale of 0-1) as the average of all the agricultural, industrial, and population stress values in each watershed.

Data for the 2003 Stress Index were from the 1996 Census and data for the 2013 Stress Index were from the 2006 Census. The change in the Stress Index between the two time periods was calculated as the simple difference between the 2013 and 2003 values for each watershed (Figure 1).

- [download Aquatic Stress Index data](#)



Results:

Trend: Mixed

Data Confidence: Medium

Geographic Extent: Provincial

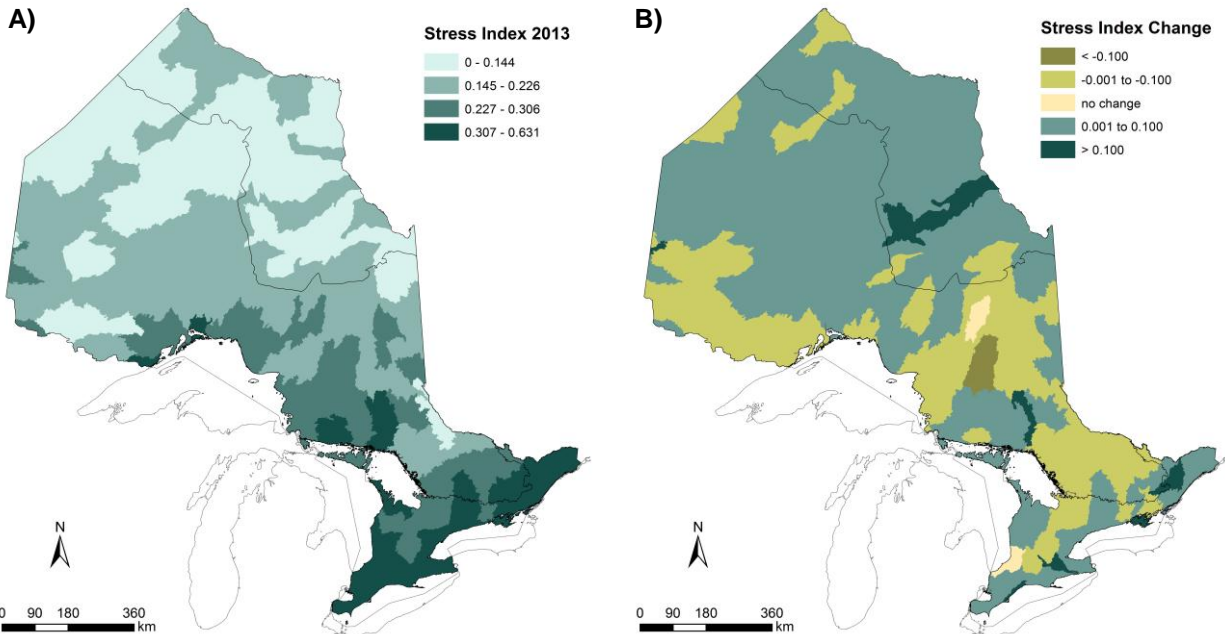


Figure 1. A) 2013 Stress Index for tertiary watersheds in Ontario based on Chu et al. (2015). Higher Stress Index scores represent a higher level of stress to aquatic ecosystems; B) Changes in Stress Index scores between 2003 and 2013 (negative values indicate reduced stress; positive values indicate increased stress).

Status:

- The average Stress Index for Ontario tertiary watersheds increased by 0.018 between 2003 and 2013, representing a 7.5% increase. The Stress Index increased for 90 watersheds (62%) and decreased for 53 watersheds (37%).
- Watersheds in the Mixedwood Plains Ecozone have the highest Stress Index values, suggesting that aquatic habitat loss and degradation is highest in this part of the province. The Stress Index has increased in 73% of watersheds in this ecozone since 2003.
- Watersheds in the southern part of the Ontario Shield Ecozone have high Stress Index values as do watersheds near population centres elsewhere within the ecozone. The northwestern portion of the ecozone has low Stress Index values. The Stress Index has increased in just over half (54%) of these watersheds since 2013.
- Watersheds in the Hudson Bay Lowlands Ecozone have comparatively low Stress Index values, however the Stress Index in most of these watersheds (76%) has increased since 2003.



Links:

Related Targets: N/A

Related Themes: N/A

Web Links:

SOLEC 2011 [Watershed Stressor Index – p. 514] <http://binational.net/wp-content/uploads/2014/11/sogl-2011-technical-report-en.pdf>

Great Lakes Environmental Assessment and Mapping Project <http://greatlakesmapping.org/>

Great Lakes Aquatic Habitat Framework <http://ifr.snre.umich.edu/projects/glahf/>

References:

Chu, C., M.A. Koops, R.G. Randall, D. Kraus, and S.E. Doka. 2014. Linking the land and the lake: a fish habitat classification for the nearshore zone of Lake Ontario. *Freshwater Science* 33:1159–1173.

Chu, C., C.K. Minns, N.P. Lester, and N.E. Mandrak. 2015. An updated assessment of human activities, the environment, and freshwater fish biodiversity in Canada. *Canadian Journal of Fisheries and Aquatic Sciences* 72: 135-148.

Chu, C., C.K. Minns, and N.E. Mandrak. 2003. Comparative regional assessment of factors impacting freshwater fish biodiversity in Canada. *Canadian Journal of Fisheries and Aquatic Sciences* 60:624–634.

Dextrase, A.J., and N.E. Mandrak. 2006. Impacts of alien invasive species on freshwater fauna at risk in Canada. *Biological Invasions* 8:13-24.

Helfman, G. 2007. *Fish conservation: a guide to understanding and restoring global aquatic biodiversity and fishery resources*. Island Press, Washington, DC.

Jelks, H.L., and fifteen co-authors. 2008. Conservation status of imperilled North American freshwater and diadromous Fishes. *Fisheries* 33:372-407.

Millennium Ecosystem Assessment (MEA). 2005. *Ecosystems and human well-being: biodiversity synthesis*. World Resources Institute, Washington, DC.

Citation

Ontario Biodiversity Council. 2015. *State of Ontario's Biodiversity* [web application]. Ontario Biodiversity Council, Peterborough, Ontario. [Available at: <http://ontariobiodiversitycouncil.ca/sobr> (Date Accessed: May 19, 2015)].