

Title: **Assessment of lake trout refuge effects on trends in relative abundance of select fish species in western Lake Superior, USA**

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Abstract:

Aquatic Protected Areas (APAs) have been established for various ecological and socio-cultural purposes in the Laurentian Great Lakes, including facilitation of lake trout (*Salvelinus namaycush*) rehabilitation through creation of refuges protected from fishing mortality. Controversy from various user groups regarding refuge effectiveness complicates policy decisions for their role in the management of lake trout in the Great Lakes, which historically has been a high-priority species for rehabilitation because of its native status, ecological significance, and economic importance. In order to further assess the potential ecological effects of these refuges, we analyzed long-term fishery-independent survey data collected by the Wisconsin Department of Natural Resources since 1980 in order to compare trends in relative abundance of select fish populations sampled inside versus outside these refuges. In addition to lake trout, we focused on changes in catch-per-unit-effort over time for lake whitefish (*Coregonus clupeaformis*) and lake herring (*Coregonus artedii*). Based on a general linear model approach, our results indicate that lake trout abundance increased at a greater rate when calculated from gill net stations sampled within the refuges versus

outside over the time series. Additionally, we found that the annual means in lake whitefish catch were surprisingly higher for areas outside of the refuge. However, the greater rate of increase in catch inside refuge boundaries may be a reflection of effects from the refuge status in this region. Since lake herring are a native prey item for lake trout, we expected to observe evidence of an indirect refuge effect demonstrated through reduced numbers of this species at stations sampled inside the refuge. However, we were not able to find a statistically significant interaction between lake herring catch and refuge status over time. These results pose interesting questions about the potential refuge effects on species other than lake trout and the potential for interactions operating at different scales. Improved understanding of the effects of these protected areas on non-target populations is important to inform fisheries management and guide future research related to the use and location of APAs in the Great Lakes.

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