

Sensitivity Analysis of Stock Assessment Models for Lake Whitefish in the 1836 Treaty Waters of Lake Huron

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Abstract.—Recommendations for total allowable catch and harvest regulating guidelines for lake whitefish *Coregonus clupeaformis* stocks in the 1836 treaty waters of Lake Huron are determined using stock-specific statistical catch-at-age models, which were first developed during the negotiations of the 2000 Consent Decree. Due to the rapid development and implementation of the models, not all of the approaches used in them have been fully evaluated. Therefore, we performed a general analysis of the models' sensitivity to changes in "known" inputs and model structures. Our analysis revealed that one of the four stock assessment models evaluated was unstable since it converged to an alternate solution in nearly one-third of the changes tested. This alternate solution differed from the solution of the baseline (i.e., original) model, and provided a poorer fit to the observed data than did the baseline model. In addition, all of the stock assessment models were sensitive to changes in the methods used to estimate recruitment and gear selectivity, as well as to changes in their objective functions. Our results suggest that sensitivity analysis is useful for identifying both unstable models and sensitive model processes. Consequently, a sensitivity analysis should be conducted whenever the stock assessment models are updated.

Introduction

In 1836, Native American Bands in the region that was to become the state of Michigan signed a treaty with the U.S. government which reserved their right to fish in the Michigan waters of lakes Huron, Michigan, and Superior. These fishing rights were reaffirmed by the U.S. federal courts in 1979. The federal district court later approved fishery regulations created by the Chippewa/Ottawa Treaty Fishery Management Authority (COTFMA) in 1982, while mandating that total allowable catches (TACs) be established for important fish species to prevent over-fishing. Federal, state, and tribal biologists worked together to estimate TACs for lake whitefish *Coregonus clupeaformis* during 1979-1982. During this period, the stock assessment methods used in the treaty waters were evolving and constrained by limited data. Where possible, stock sizes were estimated by application of a simple age-structured model. Although there was no formal harvest policy, TACs were generally set near the estimated maximum sustainable yield with ad hoc adjustments to the TACs being made to account for perceptions of current stock size and past harvest levels (e.g., AHWG 1979).

The 1985 Consent Decree laid out a 15 year agreement between federal, state and tribal agencies for the allocation of fishery harvest between the parties. The Technical Fisheries Review Committee (TFRC) was created by the decree to assess stocks of important fish species. As part of this mandate,

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