

# GREAT LAKES FISHERY COMMISSION

## 2004 Project Completion Report<sup>1</sup>

### Decision Analysis Workshops for Percid Management on Lake Erie

by:

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March 2004

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Memorandum to: Allison Niggemyer, GLFC

From: Michael L. Jones, Michigan State University

Date: March 29, 2004

Subject: Decision analysis workshops for percid management on Lake Erie: Completion report

The Great Lakes Fishery Commission provided funds, through its Coordination Activities Program, to introduce biologists and managers working on Lake Erie percid management to the concepts and applications of Decision Analysis. This completion report documents the tasks that have been successfully completed with the support of this funding.

**Proposed tasks:**

The original request for funding stated that the following tasks would be completed:

“We propose to conduct two 1.5-day workshops whose objectives would be to allow the LEC, the WTG, and the YPTG to include Decision Analysis techniques into future TAC decision-making frameworks. We propose to model our workshops after the highly effective BOTE Stock Assessment workshop series in 2000.

The first workshop would serve as an introduction to Decision Analysis, and would expose participants to underlying principles and theories, as well as practical applications in resource management (several case histories reported in BOTE’s Stock Assessment Workshops included Decision Analysis components). Participants would also be taught the data requirements necessary for successfully incorporating Decision Analysis into the TAC-setting process.

The second workshop would be geared towards developing a improved TAC decision framework for yellow perch in 2002, and for walleye beginning in 2004 (expiration of the 3-year fixed TAC). This workshop will also allow for identification of parameters most subject to uncertainty (e.g., M, F, recruitment,...) and the risks associated with those uncertainties. This would help identify data needs for further improvement of the decision process, and would allow the LEC to prioritize tasks assigned to the WTG and the YPTG.”

**Progress towards completion of tasks:**

The first workshop, to introduce Lake Erie fishery managers to Decision Analysis, was held on September 26-27, 2002, at Weber’s Inn in Ann Arbor. I led the workshop, which was attended by approximately 25 biologists and managers from Ontario, Michigan, Ohio, Pennsylvania, and New York. The workshop included an introduction to the rationale for and methods of decision analysis and a preliminary discussion of the application of the methodology to walleye harvest management in Lake Erie. The

workshop agenda, a set of transcribed flip chart notes, and slides from Powerpoint presentations I used were included in an earlier progress report for this project.

At the first workshop LEC managers elected to concentrate subsequent steps on the development of a decision analysis model for Lake Erie walleye. Three tasks were assigned: (1) analysis of uncertainty associated with estimates of walleye natural mortality rates; (2) development and assessment of a stock-recruitment model for Lake Erie walleye; and (3) development of an initial decision modeling package for potential use by Lake Erie biologists and managers. We agreed to hold the second funded workshop once these tasks had been completed. The first two tasks were assigned to agency biologists while the third task was assigned to our group at Michigan State University.

The second workshop was held in November 2003 at Michigan State University. It was attended by a smaller group of LEC biologists and managers. At the workshop we discussed the analyses completed for tasks 1 and 2 and presented the preliminary decision model we had developed. The participants in this workshop have formed an ad-hoc decision analysis (DA) working group for LEC, and there was general agreement on the part of the managers in attendance that the effort was progressing well. The LEC continues to anticipate using the decision model as a tool to support walleye harvest decisions starting in 2005. The second workshop concluded with the assignment of new tasks to both the agency biologists and the MSU team. We agreed to meet in February, 2004 to update one another on progress, and refine the decision model.

The DA working group met again February 2-3, 2004 in Ann Arbor. We presented the results of incorporating the natural mortality and recruitment uncertainty analyses into the decision model, and discussed how the model could be used to evaluate various management options, including fixed and variable harvest policies. Again there was general agreement that the model development process was progressing well, and a number of suggestions were offered for further refinements. The Lake Erie committee and MSU jointly submitted a second proposal to CAP for continued funding to support the MSU involvement in this initiative. This proposal has been approved by the GLFC and we will be continuing to assist the LEC during 2005, including a meeting tentatively planned for June.

### **Decision model**

Originally, the CAP funds were to be used to support a process – primarily two workshops – that would serve to introduce Lake Erie fish managers and biologists to decision analysis. After the first of these workshops the LEC decided to endorse the approach and proceed with an actual implementation of decision analysis for walleye harvest management. Consequently some of the funding originally allocated for workshops was redirected to support the programming and data analysis tasks required to develop a preliminary decision model. This model has been presented to the DA working group on two occasions, and we will continue to refine the model during the second phase of this project, as described above.

The decision model was developed in a “Visual Basic in Excel” programming environment. The Visual Basic code is embedded in an Excel worksheet and other worksheets are used to summarize model inputs and outputs. The model is an age-structured population model that forecasts future abundance and harvest of walleye using standard fish population modeling techniques (e.g., Ricker recruitment function, Baranov catch equation). The model is structurally very similar to the stock-assessment models used to estimate walleye population abundance from historical catch and survey data. As a decision analysis model, it is specifically designed to account for uncertainty. It does so by operating in an iterative, stochastic manner, with multiple sequential simulations of a single management strategy (i.e., harvest policy) drawing random samples of the uncertain parameter values from an approximation of their joint posterior probability distribution. The uncertain parameters include: initial population structure, natural mortality rates, three stock-recruitment parameters, catchability and age-specific vulnerability for both recreational and commercial fisheries. The posterior distributions for all of these parameters were derived from a MCMC (Markov Chain Monte Carlo) algorithm applied to the same stock assessment models that are currently being used to derive point estimates for all of these parameters for management purposes.

Because the model is stochastic, each management strategy can result in a variety of outcomes. In consultation with the DA working group we have developed a number of display options for examining results, all of which are available within the decision model software. These include: means and medians of population and harvest trajectories over time; histograms of the proportion of simulations in which the population (or harvest) fell below a target value in each year; frequency plots of the distribution of population sizes or harvest among simulations for a single year or a set of years; and histograms of the frequency and duration of periods when populations or harvest fall below a target value. These displays provide alternative ways to visualize the risk characteristics of management options, which allows decision makers to consider the expected (i.e., average) performance of a strategy, but also the risk of undesirable outcomes of that strategy.

Attached (electronically) to this report are two powerpoint presentations, one for the February 2004 meeting of the DA working group and a second for a March 2004 presentation to the Lake Erie Committee, updating them on our progress. Also attached is a copy of the decision model. Note that this software has not been documented for general use, **and should not be distributed**. It is provided for GLFC internal use at this time only.