Delay-difference, age-structured, and state-space models: Are hyphenated models useful for assessing stocks of orange roughy?

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Age-structured models are commonly used to assess orange roughy stocks, but many of the life history parameters are assumed known and a deterministic biomass trajectory (no recruitment variability) is often estimated. A simpler model is the delay-difference model, which can capture much of the same dynamics as an age-structured model without keeping track of individual ages. However, the assumptions made in these deterministic models may result in biased estimates and underestimate the true uncertainty. Through simulation, this study compares the ability and the usefulness of three models to estimate a biomass trajectory and catchability parameters that mimic a stochastic orange roughy population depleted to three different levels. The three models are a delay-difference model with observation error, an age-structured model with observation error, and a state-space delay-difference model with both process and observation error. Results showed that estimates of depletion were biased with the state-space model showing the least bias. Estimates of virgin biomass from the state-space model, however, were highly variable and showed a large positive bias. This was related to the amount of process error and the bias was reduced with some prior information on virgin biomass or catchability from one or more surveys. The deterministic delay-difference and age-structured models performed similarly under these assumptions and the inclusion of process error in the state-space model resulted in less biased estimates of depletion but much more variable estimates of virgin biomass.

Recent findings and accomplishments of NOAA's Fisheries and the Environment (FATE) program

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The goal of the Fisheries and the Environment (FATE) program is to provide the information necessary to effectively forecast these changes to evaluate management strategies needed to sustain fisheries while preserving ecosystem structure and function. In support of this goal, the FATE program was developed to accelerate the development of next generation forecasting tools. The FATE program provides leading indicators of ecological and oceanographic change at the population and ecosystem level and local to ocean basin scales. FATE supports research on the functional relationships between environmental forcing, competition for prey, or predation on the growth, distribution or reproductive success of managed species. This presentation provides highlights and results from projects funded in 2007 and 2008. These examples demonstrate that FATE research projects are now being incorporated into population dynamics models used to inform managers of the implications of their actions on the current and future status of marine resources. In some regions, FATE indices provide early warnings of major shifts in the productivity or distribution of key stocks. While the program is based on an ecosystem approach, it targets a suite of commercially important species including groundfish, coastal pelagics, Pacific salmon and highly migratory fishes as well as protected species.

Proceedings

11th National Stock Assessment Workshop

Characterization of Scientific Uncertainty in Assessments to Improve Determination of Acceptable Biological Catches (ABCs)

Joint Session of the National Stock and Habitat Assessment Workshops

Incorporating Habitat Information in Stock Assessments

1st National Habitat Assessment Workshop

Moving Towards a National Habitat Science Program

Hosted by the Southeast Fisheries Science Center, Southeast Regional Office, and Office of Science and Technology
St. Petersburg, FL
May 17–20, 2010

Edited by Kristan Blackhart

November 2010
NOAA Technical Memorandum NMFS-F/SPO-112

U.S. Department of Commerce
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This publication may be cited as:

Blackhart, K. (ed.) 2010. Proceedings. 11th National Stock Assessment Workshop: Characterization of scientific uncertainty in assessments to improve determination of acceptable biological catches (ABCs); Joint Session of the National Stock and Habitat Assessment Workshops: Incorporating habitat information in stock assessments; and 1st National Habitat Assessment Workshop: Moving towards a national habitat science program. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-112, 153 p.