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Precautionary Approach Framework for Yellowtail Flounder in 3LNO in the Context of Risk Analysis

by

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Abstract

The results of a surplus production model were used to describe the stock trajectory in relation to reference points believed to be consistent with a precautionary approach. The proposed framework captures many of the strategies that have governed the management of yellowtail flounder in recent years, strategies which appear to have been instrumental in rebuilding this stock. While more work is needed to test harvest control rules in the context of annual assessments using risk analyses, adopting such a framework as a working model would provide a starting point for exploring management strategies in the context of a precautionary approach.

Introduction

The purpose of this paper is to explore reference points in the context of a precautionary approach for yellowtail flounder (*Limanda ferruginea*) in NAFO Divisions 3LNO and to discuss the process of implementation when assessments provide the information necessary to carry out risk analyses on an annual basis.

Data

The results of a surplus production model, as described in Walsh *et al.* (2000), were used to define reference points believed to be consistent with a precautionary approach. The production model also provided an estimation of the stock trajectory in terms of biomass and fishing mortality.

The Precautionary Approach Framework

For the purpose of this investigation, the elements of the precautionary approach framework described in Serchuk et al. (1997) were defined as follows:

- The limit fishing mortality, F_{lim}, was taken as F_{MSY}.
- The limit biomass reference point was taken as the estimated biomass available to the managers when the decision to close the directed fisheries was taken (in 1994 from the 1993 survey and catch data). It is noted that, at that level of biomass, the stock responded rapidly to the reduction of fishing pressure resulting from the closure of directed fisheries.

- The fishing mortality target was taken as 2/3 F_{MSY}, which represents the reference point typically requested by managers when production models serve as the basis for the assessment.
- No biomass target has been determined in the management of this stock and B_{MSY} has been used, as an interim value, as the biomass target.

In other words, following the terminology used in Serchuk et al. (1997):

F_{target} = 2/3 F_{MSY}
B_{tr} = B_{MSY}
F_{lim} = F_{MSY}
B_{lim} = B_{1993}

Serchuk et al. (1997) also define buffer reference points for biomass and fishing mortality. Buffers for limit reference points are not provided explicitly here as we suggest that annual risk analyses be used to evaluate where the stock trajectory lies in relation to the limits. In this case, harvest strategies could be expressed so as to give a low probability of the stock trajectory entering the danger zones delimited by the limit reference points. For instance, for biomass, one would be looking for a harvest strategy giving a low probability of the stock falling below the limit. In essence, when limit reference points are approached, annual risk analyses could serve to provide dynamic buffers around the limit reference points. The actual size of the buffer would depend upon the precision achieved in a given year and on the risk level selected. The advantage of such an approach is that the size of the buffer is determined from the most recent data and analyses. In the case of rebuilding strategies, risk analyses can be used to provide information on the probability that the stock will increase towards a given threshold or rebuilding target, as illustrated in Rivard et al. (1999a and 1999b).

The reference points have been normalized to the conditions at MSY to facilitate comparisons between stocks and interpretation of the results between years as estimates of reference points are expected to vary with the formulation of the production model. Under that relative framework, biomass reference points are expressed as the ratio of the selected biomass reference to the biomass at MSY, B_{MSY}. Similarly, the fishing mortality reference points are expressed of the target F to the fishing mortality at MSY. The relative reference points thus become:

${}_rF_{target}$ = (2/3 F_{MSY}) / F_{MSY} = 2/3
${}_rB_{tr}$ = B_{tr}/B_{MSY} = 1
${}_rF_{lim}$ = F_{lim}/F_{MSY} = 1
${}_rB_{lim}$ = B_{1993} / B_{MSY} = 23%

The transient trajectory (past and future in the case of projections) of biomass and fishing mortality can also be expressed as B/B_{MSY} and F/F_{MSY} for comparison against the relative reference points.

A harvest strategy recognizing a linear decrease of F_{lim} when the relative biomass lies between ${}_rB_{tr}$ and ${}_rB_{lim}$ could be used to provide the "feedback control" necessary to keep the stock at, of above, the target biomass ${}_rB_{tr}$,. While we expect that such a strategy would provide a relatively "strong" feedback and promote stock rebuilding at low biomass levels, other strategies should also be investigated.

Results

The elements of the precautionary approach framework proposed here are illustrated in Figure 1, together with the transient trajectory of biomass and fishing mortality. Also illustrated in Figure 1 is the trajectory of a projection based on a scenario of *status quo* fishing mortality, together with the 80% confidence intervals of the relative fishing mortality and relative biomass at the end of 2001 (Walsh *et al*., 2000).

The management measures in place in recent years, which included moratorium on directed fisheries (1995, 1996 and 1997) and TACs based on a fishing mortality much below the 2/3 F_{MSY} target, have led to a rapid increase of the stock so that the biomass is now above B_{MSY}.

The precautionary approach framework described here captures many of the strategies that have governed the management of yellowtail flounder in recent years. In hindsight, such strategies appear to have been instrumental in rebuilding this stock. Adopting such a framework as a working model would provide a starting point for exploring management strategies in the context of a precautionary approach. To that effect, we suggest that harvest control rules using the reference points identified here as trigger points be tested through simulations so as to determine their performance under various conditions.

In addition, more work is needed to explore how the implementation of such a framework would operate when projections are based on risk analyses done annually. It is noted that annual risk analyses, if combined with simulations mimicking the estimation process, could also be used to obtain both a measure of uncertainty for recent estimates of stock abundance and fishing mortality, and a measure of uncertainty for estimates of the limits (see Mohn and Black, 1998). How such measures of uncertainty should enter a precautionary framework also deserves attention and should be addressed in future work on the precautionary approach for this stock.

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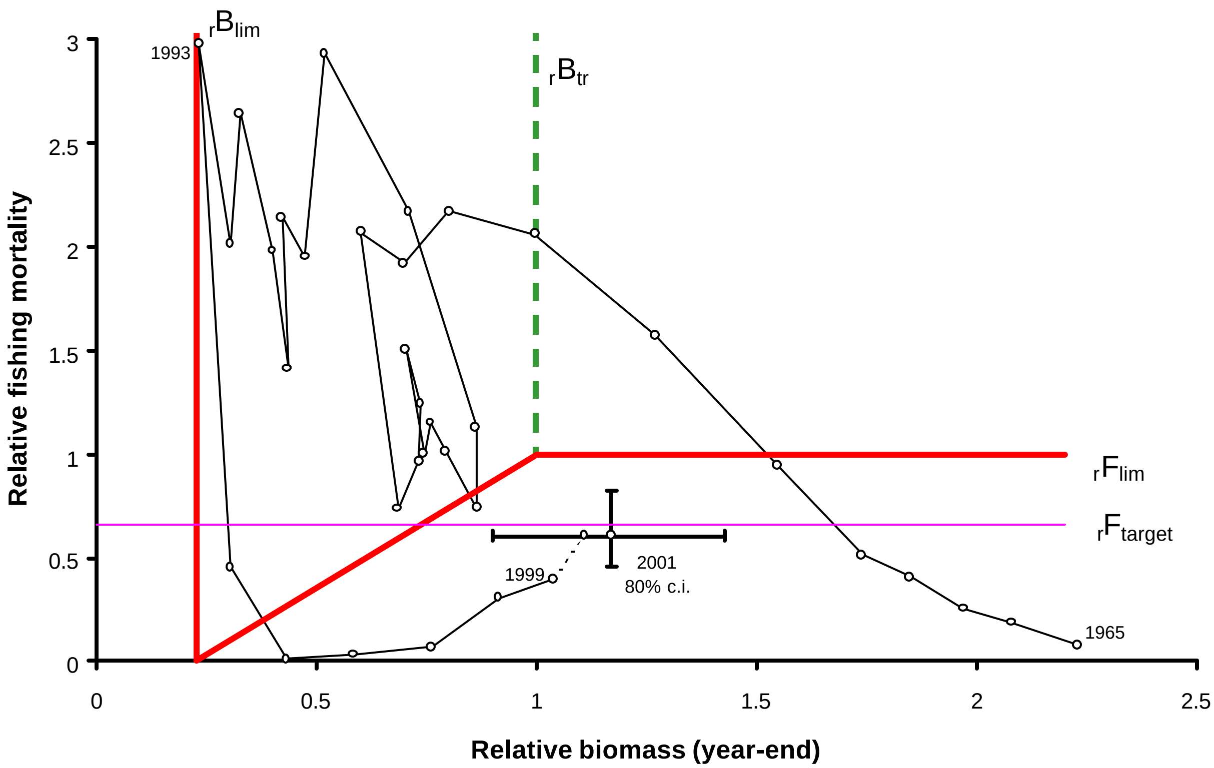

Figure 1. Schematic of a precautionary approach framework for yellowtail flounder in 3LNO.