Eco-HCRs: Bringing the Environmental Dimension into Harvest Control Rules for Marine Fisheries Management?

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Summary

The backdrop of ecosystem-based management makes a stronger case for integrating biotic and abiotic information, guided by ecological theory and empirical evidence. In the Norwegian-financed strategic program ADMAR, we build on Brunel et al.(2010) and Skagen et al. (2013)and the concept of "link functions" as a tactic to bring the abiotic and biotic connections into a management framework at the population level: by doing this, we add a dimension to the harvest control rule setup that include environmental cues along with the traditional biological input on stock biomass

Introduction

A major challenge for fisheries science is to make intelligent use of the plethora of data and knowledge contained in fisheries and marine science. Our main research question is what do we gain/lose from adding a ecological/environmental dimension to the HCR?

Methods in progress

We formulate a suite of abiotic-biotic links from previous studies and current work in ADMAR work packages that affect the population dynamics. Table 1 outlines a suite of abiotic-biotic links from the ADMAR project (WP3 and WP4) and the literature. The abiotic-biotic link function affects the biological basis (x-axis) or explicitly in the z-axis of the Eco-HCR.

Table 1: Abiotic-biotic links and their quantitative function. The function links these elements to the biological basis of the Eco-HCR (actual functional link left blank intentionally, in preparation).

Abiotic element	Link to Biotic element	Function
Ambient sea surface temperature	positive relationship to egg survival	xxx
Open water area	Positive relationship to plankton	xxx
Decadal predictions of the Barents Sea	Indicator of recruitment	xxx

Traditionally, harvest control rules are described in two dimensions: a catch quota, F (y-axis) as a function of a reference biomass (usually spawning stock biomass, SSB, x-axis). Our approach to including environmental data in to the HCR framework is through a third dimension (z-axis) of the traditional harvest control rule seen below in Figure 1.

Before our experimental set-up, we conduct a brain-storming and scoping expercise,that also includes philosophical reflections: Why an Eco-HCR? What's wrong with the status quo? What are we trying to achieve with an Eco-HCR? How do we know if the link functions are "useful" enough? How to we qualify useful information? When we include climate variability etc, will that also be an "eco-HCR"? What about evolution? Is it then eco-evo-HCR? Or when we include economics or more sociological

considerations do we need a new word or scientific term? And for what it does not cover, and what does that mean?

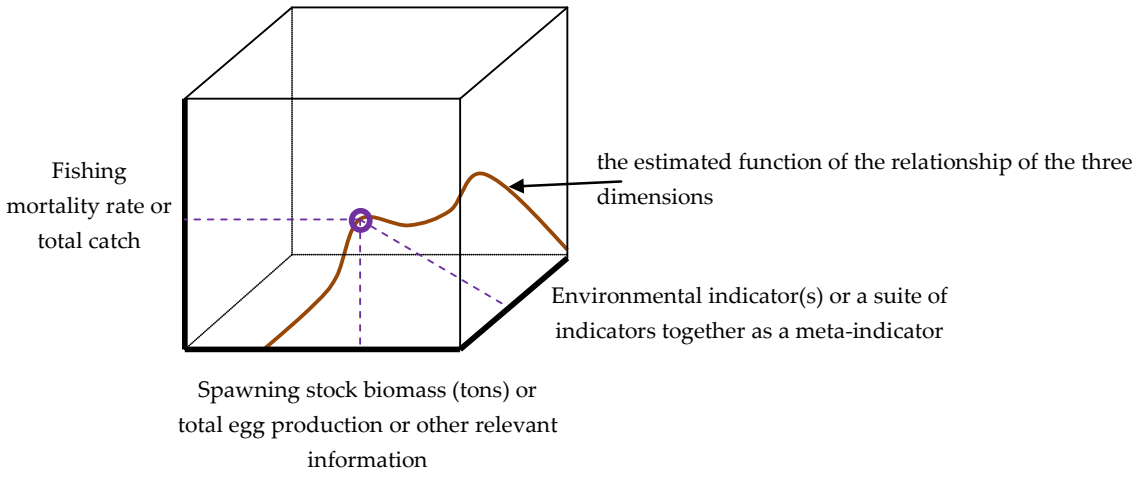

Figure 1: The three plausible dimensions of the Eco-HCR.

Our discussions will also include managers to more fully define the scientific mandate. To go forward, we will describe how the shape of the HCR conforms to the state-of-the-art knowledge base for simulations of how the F/SSB/Environmental data relationship could be, using a specific stock like Northeast Arctic cod and the data from the last 20 years as a calibration

Discussion

We will take the project further by comparing the Northeast Arctic cod Eco-HCR case with other cases in order to unmask and quantify environmental cues that can affect the predicted optimal harvest control rule. The ADMAR project is additionally concerned with management advice for data-poor stocks. We will continue the Eco-HCR work with three contrasting life histories:

- Data rich/long-lived: Northeast Arctic cod
- Data rich/short-lived: Barents Sea capelin
- Data poor: Wolffish

By developing the model for a data-rich stock (Northeast Arctic cod), we plan to determine the methods strengths and weaknesses, and then study whether harvest control rules can be derived for data-poor stock without having much more biological information other than SSB. What is the eco-HCR's potential, how can we use knowledge from deriving methods on data-rich stocks to giving advice on data-poor? We will present our first results at the ICES Annual Science Conference in September 2014.

References

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Skagen, D. W., Skern-Mauritzen, M., Dankel, D., Enberg, K., Kjesbu, O. S., and Nash, R. D. M. 2013. A simulation framework for evaluating fisheries management decisions using environmental information. ICES Journal of Marine Science: Journal du Conseil.