Implicit spatial model to krill Dynamic Population in Antarctic Peninsula, 48-1 SubArea. SS3 aplications

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ABSTRACT

The stock assessment model for *Euphausia superba* (hereafter krill) in the Antarctic Peninsula, operating within a spatial-temporal and ecosystemic framework, highlights the importance of incorporating spatial heterogeneity. The spatial heterogeneity, such as variations in oceanographic conditions and habitat suitability across different regions, is likely to outperform a population dynamics of krill. By accounting for spatial heterogeneity, a integrated stock assessment model can better capture localized dynamics and interactions, leading to more accurate predictions of krill population dynamics. This nuanced approach allows for a more refined understanding of diferente zones shape krill abundance, fishing mortalyty and recruitment patterns across the Antarctic Peninsula. Consequently, by acknowledging and integrating spatial heterogeneity, the stock assessment model can provide more robust insights into the ecological dynamics of krill populations and improve CCAMLR fishery management and conservation strategies in this region.

Keywords: Krill populations, dynamic population, stock assessment, SS3, spatial implicit, management, CCAMLR.

INTRODUCTION

METHODOLOGY

Conceptual Model

Phases in model construction

The process of modeling and statistical analysis of a database can be structured according to the following guidelines:

- Contextualization of the problem. Definition of objectives and variables.
- Experiment design and data collection.
- Recording and preliminary processing of available information.
- Graphical inspection and trend identification.
- Consideration of distributional and relational hypotheses. Proposal of modeling.
- Model adjustment. Comparison and selection of the best model.
- Diagnosis and validation of the adjusted model.
- Assessment of the predictive capacity of the model and prediction.
- Interpretation and conclusions.

Scenarios

In Table 1 we have ten scenarios to test different option in modeling about main consideration in assessment of krill population.

Scenario	Description
s01	Fishery, Predator, Survey, Environmental data agreggate (Whole 48.1)
s1	Fishery data (Length, Index, Catch) by strata and Predator and Env data
s2	Fishery and Survey (AMLR) data Length, Index, Catch by strata and Predator and Env data
s3	Same "s2" Without S-R relation
s4	Same "s2" Ricker S-R relation estimated
s5	Same "s2" BH S-R relation weak (0.9 steepness)
s6	Same "s2" BH S-R relation strong (0.6 steepness)
s7	Same "s2" BH S-R relation mid-strong (0.65 steepness) estimated

Statistical model (SS3)

The stock assesment model was configured using Stock Synthesis (SS3 hereafter)SS3 (Methot & Wetzel, 2013) with the most updated version (V.3.30.21). SS3 is a structured age and size stock evaluation model, in the class of models called *"Integrated stock evaluation analysis model"*. SS3 has a stock population sub-model that simulates growth, maturity, fecundity, recruitment, movement, and mortality processes, and observation sub-models and expected values for different types of data. The model is coded in `C++` with estimation parameters enabled by automatic differentiation (ADMB) (Methot & Wetzel, 2013; **Fournier2012?**). The analysis of results and outputs uses R tools and the graphical interface of the *r4ss* library (**Taylor2019?**; **Winker2023?**).

Model setup

Saco los outputs en html

Data disponible para este escenario. Espinel es la serie mas consistente del conjunto de datos.

Respecto a los valores y parametros biologicos modelados, los siguientes graficos identifican los estimadores puntuales del recurso

aporte de las cohortes por año para las capturas.

AJuste de tallas por flota

Otros plots

Salida de las biomasas con las dos flotas

Diagnosis Base Model (Jabba)

step to do a good practice in diagnosis is; - 1. Convergence. Final convergence criteria is 1.0e-04 - 2. Residual - 3. Restrospective analysis - 4. Likelihood profile

Residual

Predator fleet with RW

Random Walk (RW) refers to a mathematical model that describes a stochastic process in which a variable changes randomly over time, without a clear trend or pattern.

Specifically, a random walk can be used as a Bayesian estimation technique to infer the posterior distribution of an unknown parameter. In this approach, it is assumed that the prior distribution of the parameter is a normal distribution with mean zero and a known variance, and that the parameter value at each time step follows a random walk process. Based on the observed data and the prior distribution, the posterior distribution of the parameter can be calculated using Bayesian inference.

Random walk is a useful tool for parameter estimation in dynamic models, as it allows for modeling uncertainty and variability in the parameter's evolution over time. However, it is important to note that the random walk assumes that the changes in the parameter are random and without a clear trend, which may not be appropriate in all cases.

Retrospectivo

Los análisis retrospectivo, dan cuenta de diferencias de estimación (sub - sobreestimación) en los patrones entre modelos evaluados.

Hindcast Cross-Validation and prediction skill

Implementing the Hindcast Cross-Validation (HCxval) diagnostic in Stock Synthesis requires the same model outputs generated by `r4ss:SS_doRetro()`. As a robust measure of prediction skill, we implemented the mean absolute scaled error (MASE). In brief, the MASE score scales the mean absolute. Regarding (A MASE score > 1 indicates that the average model forecasts are worse than a random walk. Conversely, a MASE score of 0.5 indicates that the model forecasts twice as accurately as a naïve baseline prediction; thus, the model has prediction skill.

Kobe

Verosimilitud

COMPARACION DE MODELOS con distinto desembarque

Methot, R. D., & Wetzel, C. R. (2013). Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. *Fisheries Research*, *142*, 86–99. https://doi.org/10.1016/j.fishres.2012.10.012