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Progress towards the development of joint CPUE indices based on data from multiple fleets'

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Abstract

This paper reports on progress towards toward developing CPUE indices for SBT based on data from multiple fleets. The analyses will apply generalized additive models (GAMs) with spatiotemporal smoothers, and a delta lognormal approach, with operational data. Progress to date includes acquiring operational data for the Australian, Korean and New Zealand fleets, importing all datasets into R, and data cleaning, preparation, and preliminary characterisation of the New Zealand and Korean datasets. The current workplan is to completed analyses by December 2024.

Introduction

The CPUE standardization methods used for SBT have been updated to address problems with recent CPUE estimates. Analytical problems were caused by increasing aggregation of fishing effort, together with a method that relied on data availability in all strata. Sparse data caused parameter estimation problems (ESC 25, para 37). A new approach has been developed and adopted (Hoyle, 2021; Hoyle, 2022; Hoyle, 2020; Itoh and Takahashi, 2022) that uses generalized additive models (GAMs) implemented with the R package *mgcv* (Wood, 2011). The principal GAM models produced unbiased estimates with simulated data, while GLM models and less flexible GAM smoothers provided biased indices, particularly at the end of the time series as effort became more concentrated, and data became sparse (Hoyle, 2022).

However, simulations indicated that biased indices would result from increasing effort concentration through time to focus effort on areas with higher CPUE, particularly at the end of the time series when concentration was greatest. This bias may be due to loss of information from the dataset rather than model failure. ESC 27 concluded that it may be helpful to increase the available information via models that include data from other fleets as well as from Japan.

Work for 2023 involved exploring the spatio temporal effort distributions of fleets other than Japan, to help understand whether they might usefully contribute to maintaining through time the coverage of the SBT population distribution, thereby reducing the risk of parameter estimation difficulties. Results showed that data from other fleets can significantly improve coverage throughout the time series, and particularly in recent years. Catch rates of most other fleets showed similar trends to indices from the Japanese fleet.

Joint analysis using data from multiple fleets fishing on the same stock is increasingly applied as a way to increase the coverage and representativeness of CPUE indices (Hoyle et al., 2024; Hoyle et al., 2018; Hoyle et al., 2015; Kitakado et al., 2021). Such analyses require significant work to prepare data, to ensure they are compatible for a joint analysis. Different fishing methods are used by different fleets, and by different groups and even different vessels within fleets, resulting in variation in catchability. There is likely considerable catchability variation within fleets other than Japan, given the diversity of vessel size, experience, equipment, bait use, and targeting practices within domestic fleets compared to distant water fishing fleets. These sources of variability can be addressed using a combination of techniques, such as the inclusion of vessel ids, identification of targeting practices, and auxiliary analyses using additional covariates. These analyses require operational data.

Before jointly analysing national datasets, each dataset needs to be thoroughly explored and characterised to identify factors that may need to be accounted for during the standardization, and to eliminate sources of data conflict. It is also necessary to remove effort where there may be issues with reporting quality or the representativeness of the sampling frame.

Work for 2024 involved obtaining, preparing, and analysing operational data for the Australian, Korean, and New Zealand fleets. This work is as yet incomplete, and this report documents progress.

Methods

Input data

Operational data were kindly provided by the data management agencies for the Australian, New Zealand, and Korean fleets.

The Australian data covered the period 2000 to 2022, New Zealand 1990-2023, and Korean 1996-2023.

Data for New Zealand were provided in a single comma separate variable file. It reported the following fields: operation number, fishing year, vessel id, vessel flag, set start date and time, set end date and time, haul start date and time, haul end date and time, target species, start latitude, start longitude, number of hooks, weight on snoods, number of lining light sticks, lining line shooter flag, and conversion factors, scaling factors, greenweight, and number for ALB,BET, BUK, BFT, PBF, SKJ, SLT, YFT, BLM, BUM, MLS, BXQ, SFA, SSP, SWO, BSH, SMA, LAG, POR, SBT.

Data for Korea were also provided in a single comma separate variable file. It reported the following fields: vessel id, vessel name, set date, latitude, longitude, number of hooks, number of floats, retained catch of ALB, BET, BFT, BLM, BUM, MLS, OTH, SBT, SFA, SHA, SKJ, SWO, YFT, and discarded catch of SBT.

Australian data were in three excel files, with information on catch, effort, and bait type. The effort file reported the following fields: operation number, year, operation date, vessel id, latitude, longitude, depth, number of hooks, mainline length, number of hooks between bubbles, number of light sticks used, set start date and time, set end date and time, haul start date and time, haul end date and time. Catches were reported, with a key to the operation number, for 112 species or species groups in weight, number, and discards, and whether the species was a target. Bait use was also reported with a key to the operation number, reporting species, weight used, and life status.

Work completed to date includes importing all datasets into R, and data cleaning, preparation, and preliminary characterisation of the New Zealand and Korean datasets. Preparation of the Australian dataset is partially complete. Once all datasets have been loaded, cleaned, and characterised, they will be transformed to a common format. Cluster analysis will be applied to, as much as possible, identify and separate groups with different targeting practices. Then the datasets will be combined and standardized jointly.

Results and Discussion

Data preparation and analysis work was delayed and was not completed by the ESC deadline.

I am currently seeking extensions to the data access agreements with Australia and Korea, which have defined end dates.

The current workplan is to completed analyses by December 2024.

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