

# Plan for updates to the future projection program<sup>1</sup>

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## Abstract

This paper reports on the update plan of future projection program that was used in previous ISC albacore stock assessment. Significant work is to improve the calculation method of F at age. Specifically, it needs to perform the calculation in C++ and obtain F at Age in the fleet base. Next, MCMC result will use as the initial number at age, but as in the case of Bootstrap, the posterior distribution might be asymmetrical. Thus, careful comparison with the base case is necessary.

## Introduction

ISC albacore working group (ALBWG) used future projection program written by R software "Rcpp" (Ijima et al., 2016). However, this program needs to modify some points. In this paper, I report about the update plan of the future prediction program.

## Result and Discussion

The contents to be update up to the next stock assessment are as follows.

- ✓ To improve calculation script of F at Age.
  - i) R calculation script of F at age needs change to C++ script.
  - ii) Enable to calculate Fleet-based F at Age.
  - iii) Make it possible to calculate F at Age from the result of MCMC.
- ✓ To update a more accurate calculation method of the reference point.
  - SS3 outputs weight at age up to the maximum age, however, SS3 use three generations weight at age in the calculation of the value of reference point. Thus, it needs to calculate longer weight at age outside of SS3.
- ✓ To set the Harvest Control Rule (HCR).
  - I will add two type HCRs function that is i) biomass-based HCR and ii) CPU based HCR.
- ✓ To included autocorrelated process error and environmental factors in the stock-recruitment model.

Among these improvements, calculation of F at Age and correspondence to MCMC have high priority. I recommend using MCMC that generate the initial population number in the prediction because MCMC is faster than bootstrap, However, similar to the result of bootstrap, the mean value of MCMC might be different from the value of the base case. The reason is thought that the posterior distribution of MCMC is asymmetrical. Theoretically, maximum likelihood estimates are likely to be close to the mode of the MCMC. After the improvements, Rcpp script will convert to R software package and upload to "Github". We are also planning meta-analysis for all tuna and tuna-like species using this package and case study analysis of the North Pacific swordfish.

## References

H Ijima, O Sakai, T Akita and H Kiyofuji. New future projection program for North Pacific albacore tuna (*Thunnus alalunga*) : considering two-sex age-structured population dynamics. ISC/16/ALBWG-02/06