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Stock assessment and management implications of horse mackerel in Korean waters, based on the relationship between recruitment and the ocean environment

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Introduction

This research is to estimate population parameters of the Korean horse mackerel stock and to determine the status of the stock. Considering the linkage of recruitment with the variation of environmental conditions in the early life history, acceptable biological catch (ABC) of horse mackerel was estimated.

Data and methodology

A biomass-based cohort analysis (Zhang & Sullivan, 1988) approach was adopted for estimating biomass and recruitment of horse mackerel during 1965-1995, using fishery and biological data of the species from the National Fisheries Research & Development Institute (NFRDI). The potential environmental factors affecting recruitment of horse mackerel in Korean waters were selected as seawater temperature, salinity, volume transport of the Kuroshio Current, and zooplankton biomass in the southern Korean waters. Based on statistical tests and correlation and regression analyses using various environmental factors in the South Sea and southern East Sea, proper factors were selected as important environmental factors. These factors were added to classical spawning biomass-recruitment models, such as Caputi (1988), Modified Ricker, Modified Beverton & Holt, and Generalized additive models. ABCs of horse mackerel were determined using a procedure that took into account the quantity and quality of available data and the exploitation

history of the fishery. A five-tier-classification system was constructed to reflect their information available for the total allowable catch (TAC) management system.

Result and summary

Considering the current stock status of horse mackerel, ABCs were estimated, based on the stock assessment combined with environmental factors in their spawning and feeding grounds. The following conclusions were derived.

First, information level for the ABC determination should be increased for accurate stock assessment. The results implied that the higher information level could avoid overestimating the actual status of stock.

Second, incorporating environmental factors in stock assessment is important, especially for the pelagic stocks, which are sensitive to variations in environmental conditions. The ABCs estimated without environmental factors could be overestimated.

Third, since the current biomass of the Korean horse mackerel stock was 50% lower than $B_{30\%}$, fishing level should be set at 0.220/year as a biological reference point to estimate ABC, $F_{ABC}=F_{30\%} \times (B_{\text{current}}/B_{30\%})$, which is much lower than the $F_{30\%}$ level of 0.462/year, in order to rebuild this stock to the spawning biomass level at 30% of the virgin level. This fishing level is also lower than $F_{0.1}$ of 0.334/year.

Reference

- Caputi, N. 1988. Factors affecting the time series bias in stock-recruitment relationships and the interaction between time series and measurement error bias. *Can. J. Fish. Aquat. Sci.* 45: 178-184.
- Zhang, C. I. and P. J. Sullivan. 1988. Biomass-based cohort analysis that incorporates growth. *Trans. Amer. Fish. Soc.* 117: 180-189.