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Stock assessment on yellowfin tuna *(Thunnus albacares)* in the Indian Ocean by ASPIC and comparison to MULTIFAN-CL and ASPM

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Abstract

In this study, ASPIC (A Stock-Production Model Incorporating Covariates) was applied to assess the stock status of yellowfin tuna in the Indian Ocean (1972-2012). Using ASPIC results, we compared those of MFCL and ASPM which were conducted in 2012. Results (Kobe plot I; stock tracjectory) suggested that ASPIC and ASPM showed the similar pattern.

(NB) ASPIC results for this time should not be used for any management advices as it is conducted just to compare results among MFCL, ASPM and ASPIC.

Contents

1. Introduction

The surplus-production model has been proven useful in fisheries resources management due to their conceptual and computational simplicity (Prager, 2004). Although it has some problems with its simplicity and equilibrium assumption, it has been used as a helpful tool for stock assessment when the age-structure of the catch cannot be estimated or obtained accurately. In this study, stock assessment on yellowfin tuna in the Indian Ocean was conducted using A Stock-Production Model Incorporating Covariates (ASPIC) (Prager, 2004).

Objectives of this study is to compare ASPIC results with those of MFCL (Langley et al., 2012) and ASPM (Nishida et al., 2012) which were conducted in 2012. **Please well note that ASPIC results for this time should not be used for any management advices as it is conducted just to compare results among MFCL, ASPM and ASPIC.**

2. Data and Methods

ASPIC needs information on catch and fishing effort (or CPUE), or estimates of biomass (or index of biomass). In this study, we used the annual nominal catch and STD (standardized) CPUE of yellowfin tuna in the Indian Ocean from 1972-2012 to run ASPIC.

2.1. Catch

The IOTC database (as of September, 2013) was used as the nominal catch of yellowfin tuna by gear type (fleet) in the Indian Ocean (Fig. 1). The fleets (gears) fishing for yellowfin tuna in the Indian Ocean were divided into 2 types to run ASPIC, which were (1) LL (including hand line) and (2) others (BB, PS, GILL, TROLL and others).

2.2. CPUE

Standardized CPUEs of yellowfin tuna for Japanese tuna longline fisheries from 1972 to 2012 (Matsumoto et al., 2012) and Taiwanese tuna lonline fisheries from 1980 to 2012 (Yeh et al., 2013) were used in this study. As shown in Fig. 2, the catch trend by fleet was different between them, and especially yellowfin tuna catch by Taiwanese longline fisheries was much larger than that of Japanese longline fisheries from the mid-1980s to the mid-2000s. Therefore, to present more reasonable CPUE trend, we used the arithmetic mean of Japanese and Taiwanese CPUEs and the weighted mean using their catch. Fig. 3 shows the arithmetic mean and the weighted mean CPUEs of Japanese and Taiwanese tuna longline fisheries.

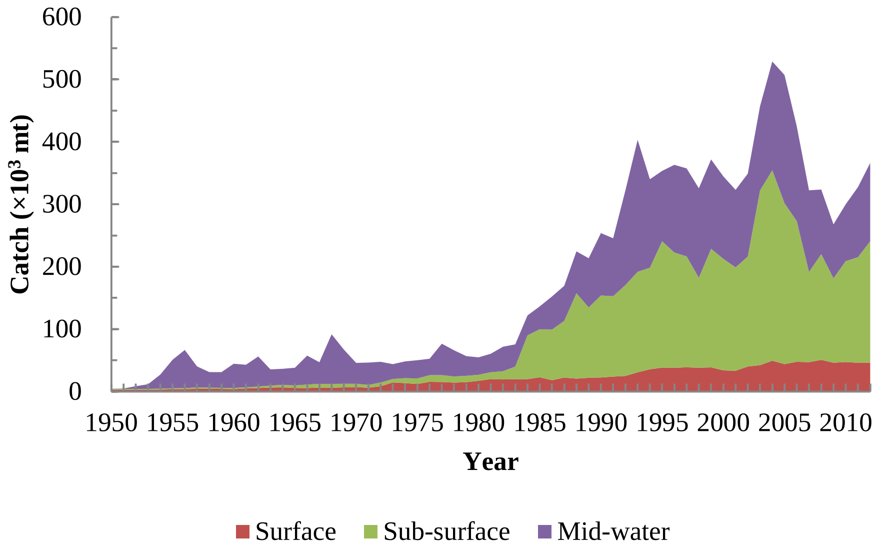


Fig. 1. Annual catch of yellowfin tuna by fleet (gear type) in the Indian Ocean, 1950-2012 (data source: IOTC database). Surface fishery includes BB, TROLL and others, sub-surface fishery includes PS and GILL, and mid-water fishery includes LL and hand line.

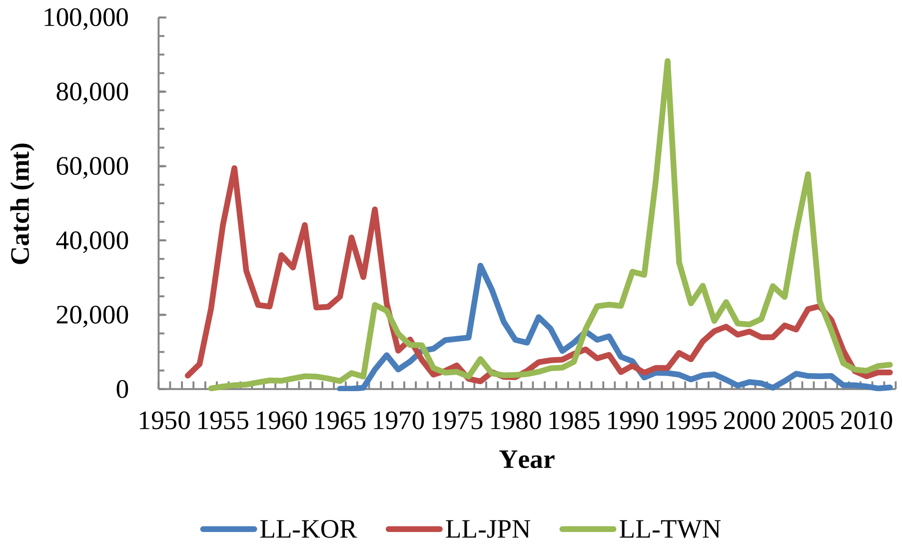


Fig. 2. Annual catch of yellowfin tuna by lingline fleet of Korea, Japan and Taiwan in the Indian Ocean, 1950-2012 (data source: IOTC database).

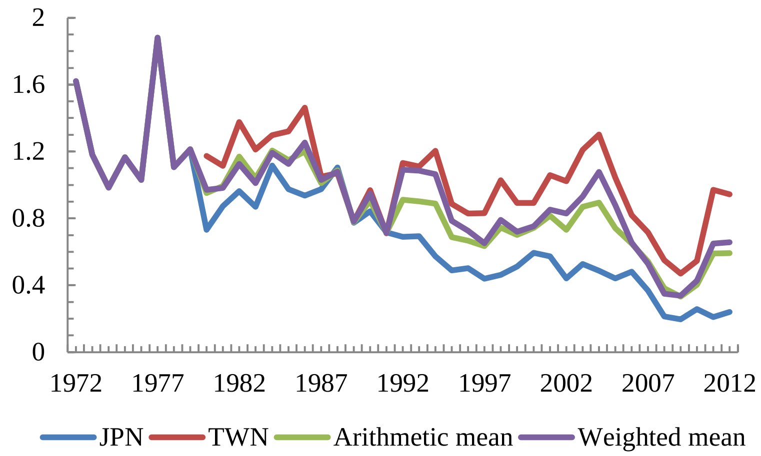


Fig. 3. The arithmetic mean and the weighted mean of Japanese and Taiwanese CPUEs, 1972-2012.

3. Results and Discussion

3.1. Catch and CPUE trends

Before running ASPIC we evaluated the relationship between catch and CPUE (arithmetic mean and weighted mean) of yellowfin tuna of longline fisheries used as input parameters in this study. Fig. 4 shows both these relationships by scatter plots representing the negative correlation, which indicates that it is reasonable and realistic. Fig. 5 shows the trends of catch and CPUE (arithmetic mean and weighted mean) of yellowfin tuna of longline fisheries in the Indian Ocean.

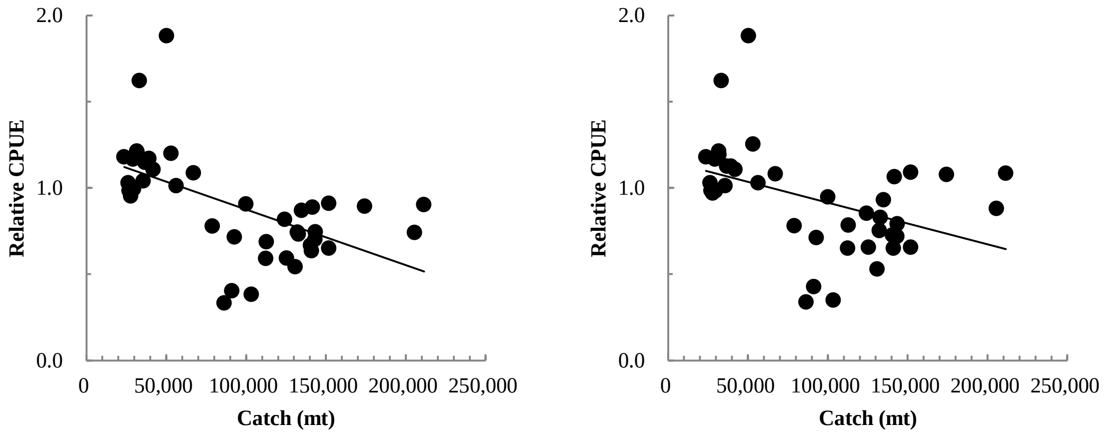


Fig. 4. Relationships between catch and CPUE of the arithmetic mean (left) and the weighted mean (right).

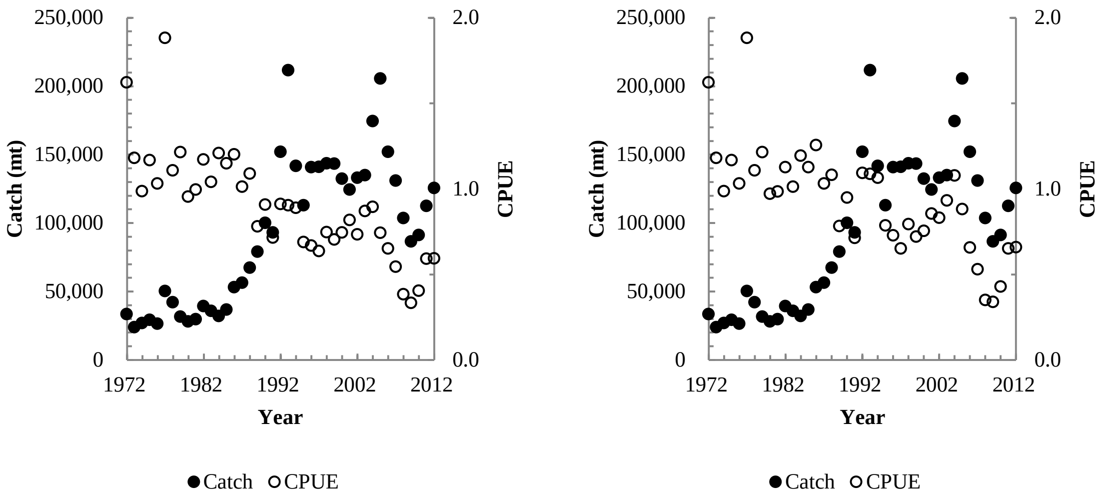


Fig. 5. Annual changes in catch and CPUE of the arithmetic mean (left) and the weighted mean (right).

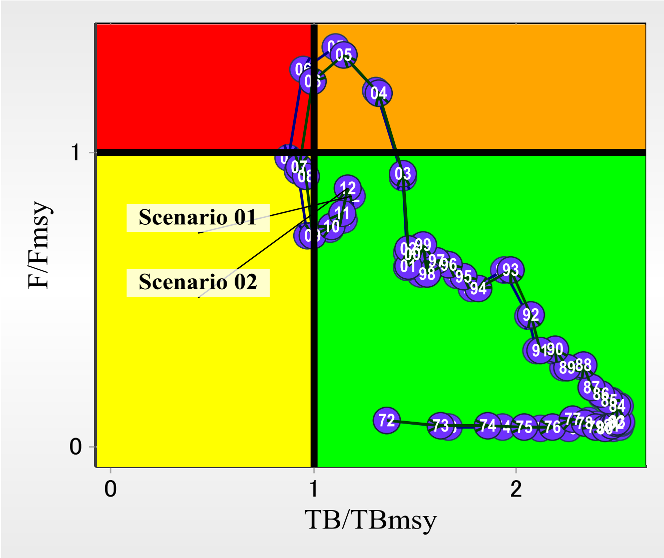
3.2. ASPIC

The Fox production model option being available in ASPIC software was chosen to assess yellowfin tuna stock in the Indian Ocean. In this model, we run ASPIC based on two scenarios which are the arithmetic mean and the weighted mean of Japanese and Taiwanese CPUEs, fixed B1/K at 0.5. The ASPIC results are summarized in Table 1.

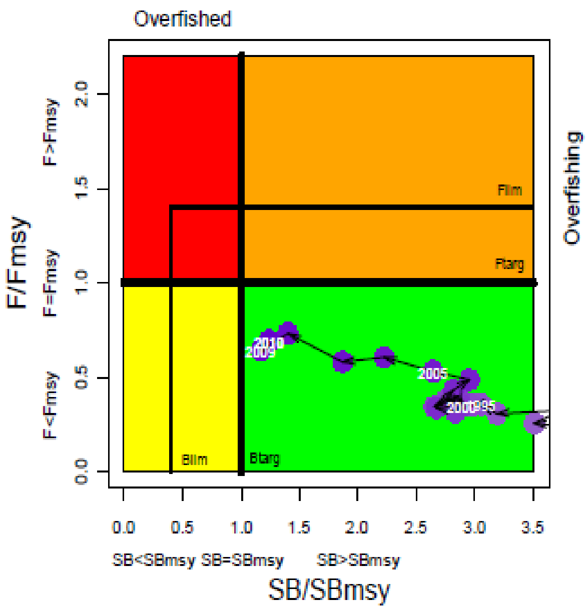
Table 1. Results of ASPIC runs

Years	LL CPUE JPN+TWN	B1/K	MSY (x 10^3)	TB_{2012} (x 10^3)	TB_{MSY} (x 10^3)	TB ratio	F_{2012}	F_{MSY}	F ratio
1972-2012	arithmetic mean	0.5	364	1,032	873	1.178	0.355	0.417	0.851
	weighted mean	0.5	358	1,173	1,009	1.157	0.312	0.355	0.880

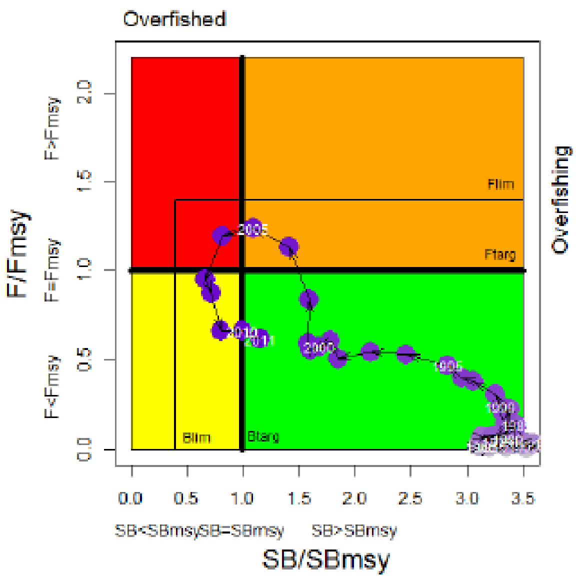
Fig. 6 (a) presents the Kobe plot I (stock trajectory) which suggests that two scenarios show almost same similar results. Fig. 6 also presents comparison of Kobe plot I among ASPIC (a), MFCL (b) and ASPM (c), which shows that results of ASPIC and ASPM are similar.



(a) ASPIC (Scenario 1: arithmetic mean, Scenario 2: weighted mean)



(b) MFCL (Langley et al., 2012)



(c) ASPM (Nishida et al., 2012)

Fig. 6. Kobe plot I (stock trajectory).

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