Preliminary stock assessment of Indian Ocean albacore based on ASPIC and consideration on the specification of joint longline CPUE

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Summary

Preliminary analysis of Indian Ocean albacore was conducted based on ASPIC. The objective is to see the results based on each CPUE including CPUE fit. Also, available CPUE indices were reviewed and examined. The trend of CPUE differed among fleets. Results of ASPIC seem much more reasonable with the CPUE of Taiwanese longline. Recent increase in Japanese longline CPUE seems to be affected by the change in fishing strategy, and so may not be a good indicator. Therefore, it may be better to eliminate catch and effort data for Japanese longline in recent period.

1. Introduction

At the last (2016) Indian Ocean albacore stock assessment, of several assessment models presented, the results of Stock Synthesis III (SS3) were used for management advice. This is reasonable considering that the model incorporates various information. At that time, as for abundance index for SS3 base model, longline joint CPUE based on Japanese, Taiwanese and Korean longline operational data, which incorporated vessel effect by vessel ID and targeting by cluster analysis (Hoyle et al., 2016), was used.

Sharp increase in CPUE by Japanese longline in the south area is observed for recent period especially in the southeast area (Matsumoto and Kitakado, 2016). Although in recent years albacore seems to be not targeted in the Indian Ocean by Japanese longline, there may be some changes in fishing strategy. Therefore, it is considered that recent increase in Japanese longline CPUE does not fully reflect the abundance of the stock. At the last assessment, as for SS3 model, this increase was adjusted by using time variant q after 2006 (IOTC, 2016), and reasonable results were obtained. However, as for some other models, such as production models (ASPIC, BBDM, etc), this type of adjustment can't be done, and the results were unreasonably optimistic. This is probably because Japanese longline data in recent years were included in the joint CPUE. In the past, usually Taiwanese longline CPUE was used in the base models of stock assessment. Taiwanese longline fishery seems to target albacore in the Indian Ocean comparatively consistently, and so seems to be better indicator of the stock. At the last assessment, it was problematic that each fleet CPUE based on the same method as that for joint CPUE was not created. That prevented from comparing CPUEs by fleet, or from using individual fleet CPUE for stock assessment. Another problem is that in the past, there was no data preparatory meeting for albacore, and so there was almost no opportunity to discuss and revise CPUE well before stock assessment.

In 2018 the joint CPUE analysis workshop was held and albacore CPUE indices for each fleet as well as joint CPUE were created (IOTC 2018). Also, in 2019, data preparatory meeting will be held for albacore for the first time in IOTC. Therefore, it is possible to compare CPUE indices among fleet, and to discuss and consider the specification of joint longline CPUE to use in the stock assessment.

ASPIC (A Stock-Production Model Incorporating Covariates, Prager, 2004) has less flexibility and can not incorporate various information, but is very simple and so it is possible to conduct many runs in a short period. Therefore, it can be used for checking CPUE fit. In this document, available CPUE indices are reviewed and the results including CPUE fit is checked using ASPIC model. The objective is to make a suggestion for appropriate specification of joint CPUE for stock assessment models.

2. Data

2.1 Catch

We used the nominal catch data up to 2017 by gear (fleet) from the IOTC database (as of November 2018). Fig. 1 shows the trends of catch by fleet type. Most of the catch is by longline fishery, but a certain proportion of catch was made by gillnet fishery between mid-1980s and early 1990s. Catch was increasing trend until around mid 1990s, and fluctuated after that.

2.2 CPUE

Standardized (STD) albacore CPUE for Japanese tuna LL (Matsumoto and Hoyle, 2019), Taiwanese tuna LL and joint CPUE by Japanese, Korean and Taiwanese longline fishery combined (Hoyle et al., 2019) are available, all of which were created at 2018 IOTC joint CPUE workshop. For each CPUE, which was originally area specific (**Fig. 2**), area aggregated indices (all and south area) were created based on scaling factors (Hoyle 2019) and were used. CPUEs only from 1979 which incorporated vessel ID were used because sharp decline was observed during the early period, which may be caused by the change of targeting, and so may not fully reflect the abundance of the stock. Another reason is that vessel ID for Japanese longline fishery is currently available only from 1979.

Fig. 3 shows trend of these indices. CPUEs for Japanese longline fishery show increasing trend from early 1990s, but decreasing trend in recent years. The trend of joint CPUEs are similar to Japanese longline CPUE. On the other hand, Taiwanese longline CPUEs show mostly decreasing trend or were constant over the period. There was not large difference of CPUE trend between all and south areas.

3. ASPIC analyses

We used the Fox production model option available in the ASPIC software (ver. 5.16) developed by Prager (2004).

As for catch data, we thought that it is better to use the period as long as possible. Catch for IOTC database are available from 1950, so data for 1950-2017 were examined. Catch for fisheries other than longline was combined with that of longline fishery (i.e. one fleet in the model) because CPUE for those fisheries are not available and the proportion was usually not large. B1/K (ratio of initial biomass to carrying capacity) was fixed at 0.9 as with previous analyses, considering that stock status in 1950 is close to virgin biomass. A total of four runs were conducted based on different CPUE.

Table 1 shows summary results of ASPIC runs. Fig. 4 shows historical trend for B ratio and F ratio based on the results of four scenarios. As for the scenarios with joint or Japanese CPUE, B ratio and F ratio show almost constant trend, and the results seem a bit too optimistic (unrealistic). As for the scenarios with Taiwanese CPUE, B ratio and F ratio show decreasing and increasing trend, respectively, and the results seem more realistic.

Fig. 5 shows CPUE fit for the four ASPIC runs. Fit for Taiwanese longline CPUE looks comparatively well. However, joint and Japanese indices do not fit well.

4. Discussion

So far, when creating longline albacore joint CPUE, basically all available catch and effort data (fleets) were combined. During the early period (until 1970s), almost only Japanese longline data are available. Therefore, truncating CPUE for that period almost equals to truncate Japanese longline data. However, there is large conflict of CPUE trend between Japanese and Taiwanese longline during the recent period. Most likely there is some changes in fishing strategy for Japanese longline in recent years, and so is not a good indicator of the stock. It may be better to eliminate catch and effort data for Japanese longline in recent period (e.g. from mid 2000s) to create joint CPUE. It may worth considering using only Taiwanese longline CPUE in the assessment model. Korean longline indices were not available when the analyses were conducted. Therefore, the WPTmT need to review and consider how to use Korean longline data for Joint CPUE.

References

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Table 1 Summary and results of ASPIC runs, along with SS3 base model at 2016 stock assessment.

Scenario No	CPUE	MSY 1000t tons	TB current million tons	TB msy million tons	TB ratio	F current	F msy	F ratio	Comments
2016 SS3 base	Joint area specific (south, 1979-2014)	38.8	0.03	0.03	1.80			0.85	SB level instead of total biomass (TB)
1	Joint all area 1979-2017	260.7	1.02	0.40	2.58	0.04	0.66	0.06	Too optimistic
2	TWLL all area 1979-2017	44.7	0.29	0.17	1.70	0.13	0.27	0.50	
3	TWLL south area 1979-2017	40.0	0.15	0.10	1.49	0.26	0.40	0.64	
4	JP all area 1979-2017	79.1	2.73	1.24	2.20	0.14	0.64	0.22	Too optimistic

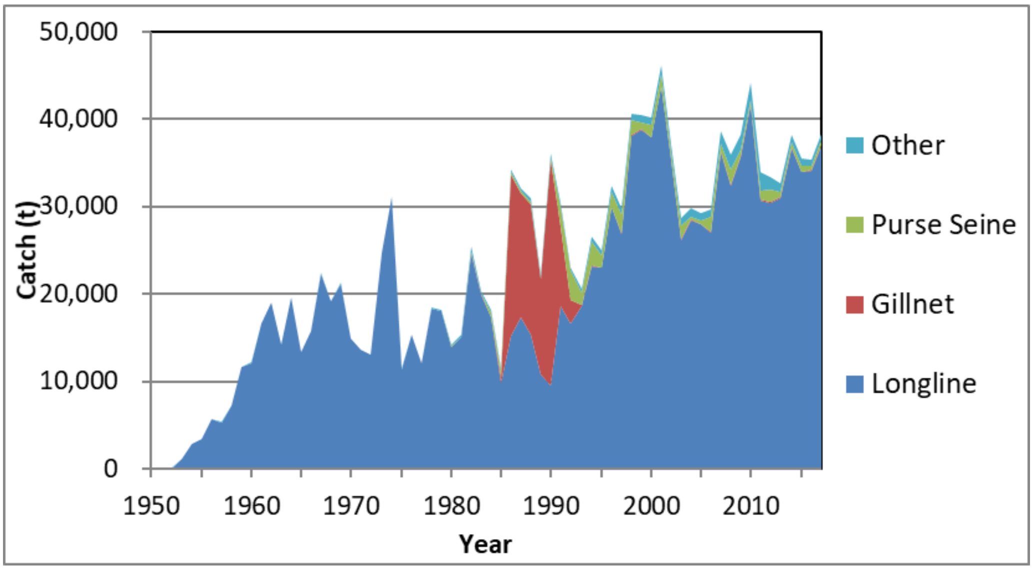

Fig. 1 Trend of albacore tuna catch in the Indian Ocean by gear (Fleet) type.

(Source: IOTC database as of November, 2018).

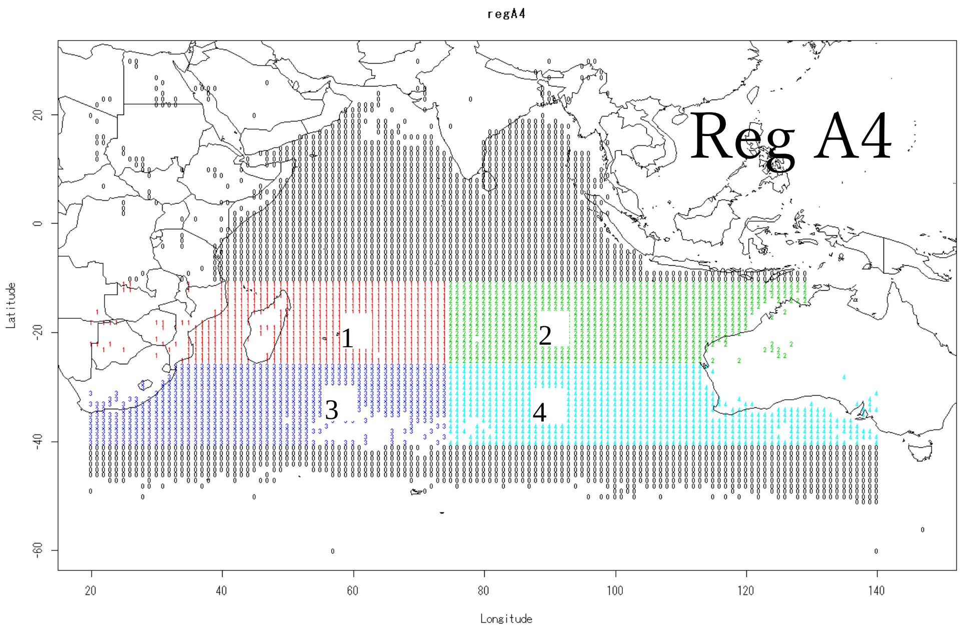

Fig. 2 Area definition for CPUE used in this study. All area: area 1-4, south area: area 3-4.

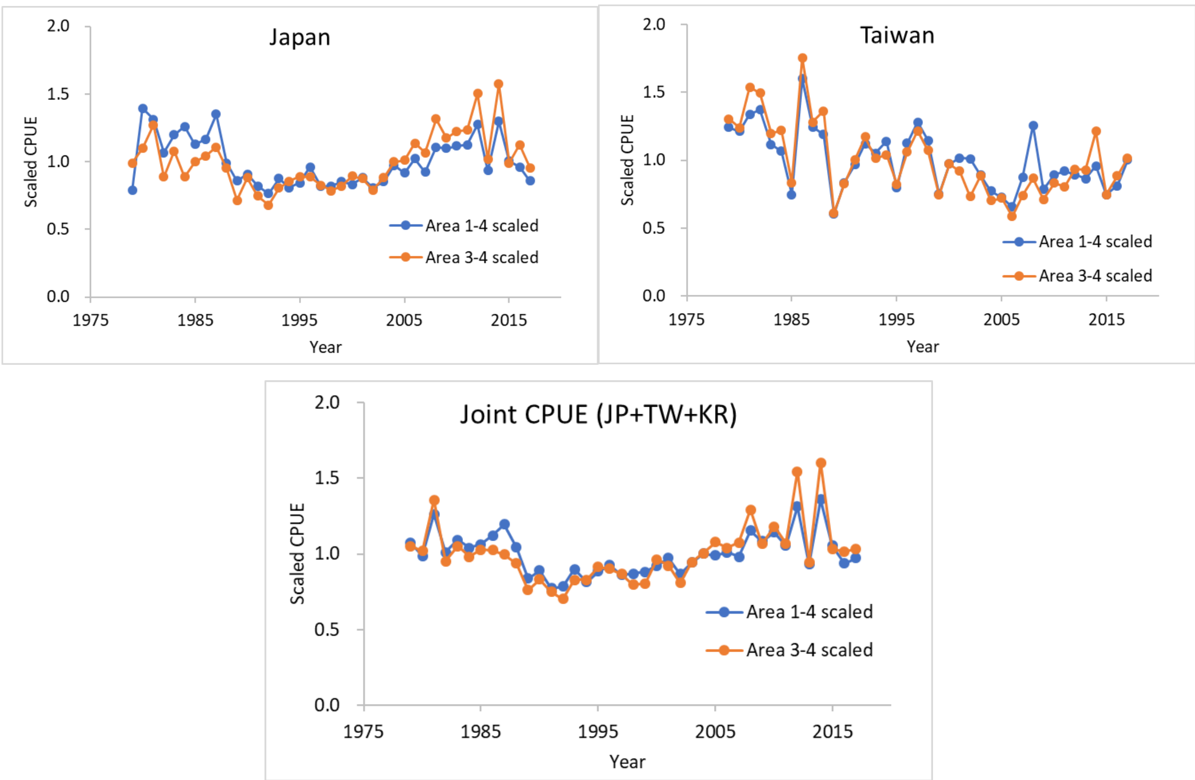

Fig. 3 CPUE used for ASPIC analysis. Area 1-4: all area, area 3-4: south area.

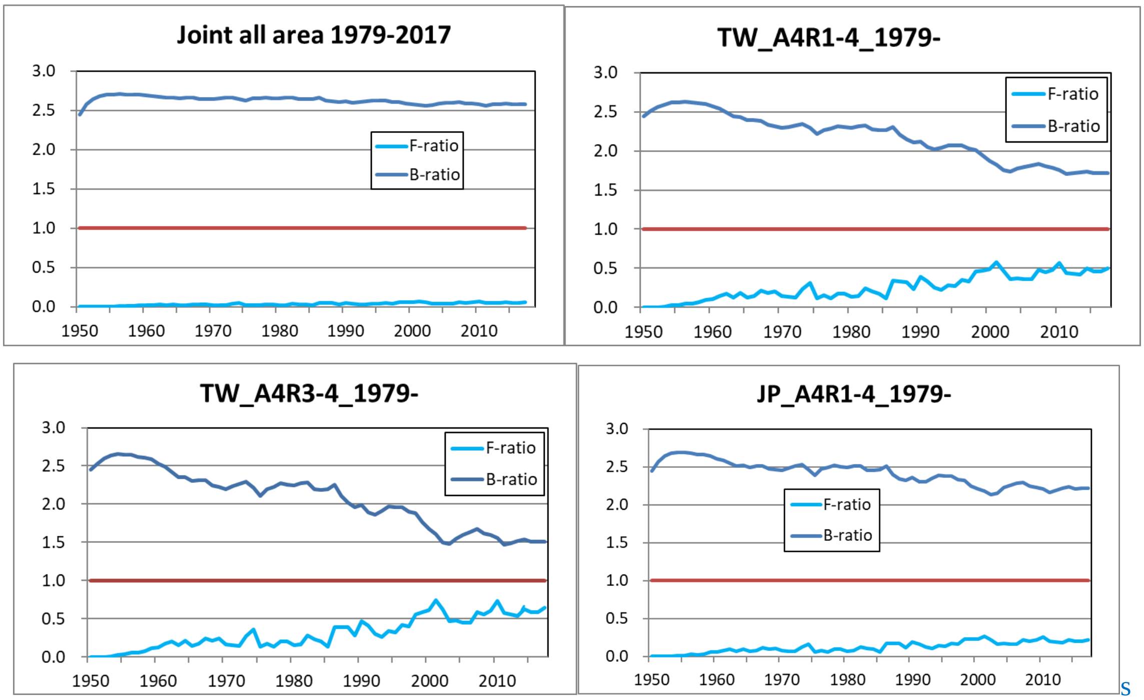

Fig. 4 Trajectories of B-ratio (B/BMSY) and F-ratio (F/FMSY) for ASPIC runs.

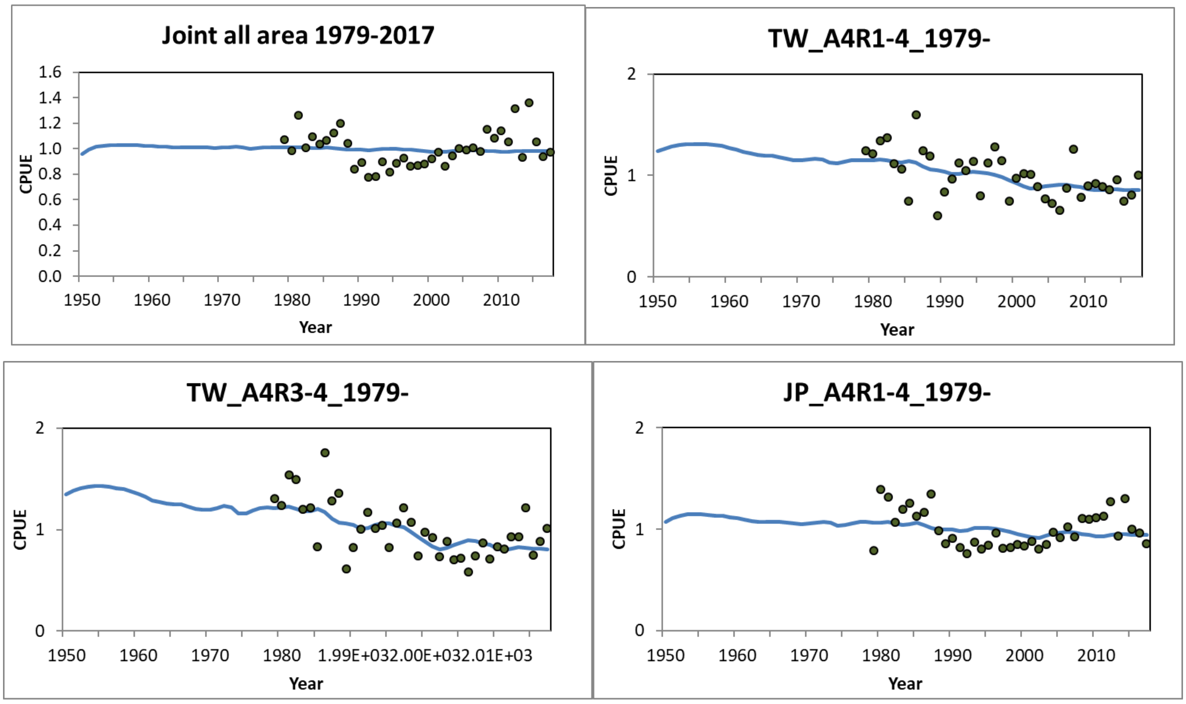

Fig. 5 CPUE fit for the four ASPIC runs. Line: estimated, circles: observed.