WPB-03-02

Update of standardization of swordfish CPUE of Japanese longliners in the Indian Ocean

Hirokazu Saito and Kotaro Yokawa
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-orido, Shizuoka, 424-8633, Japan

1. Summary

Abundance index for swordfish calculated with catch and effort data of Japanese longliners operated in the Indian Ocean was updated to 2002. Estimated value of abundance index in 2002 was decreased down to 76% of the one in 2000. The reason for this decreasing mainly caused by the decreased of abundance in the eastern Indian where the abundance showed 61% decrease from 2000 to 2002, and the level of abundance in the western Indian was relatively constant since 2000 (88% of the 2000).

2. Materials and methods

For CPUE standardization, the same condition as last swordfish stock assessment (WPB 2001) is used in this study.

Catch and effort statistics of Japanese longline fishery from 1975 to 2002 were used in this study. Datasets were aggregated by month, 5-degree square and the number of hooks between floats (NHF). All the analyses in this study were conducted by using catch in number, because of the number of size data of swordfish were not enough to estimate catch in weight. All observations with less than 5,000 hooks per 5X5 block by month of effort were eliminated.

Statistical model used to standardize CPUE data is generalized linear model with lognormal error. Fixed factors used in the model were year, area, quarter and gear configuration represented by NHF for the data set of 1975-2002.

As for the stratification of areas, Indian Ocean was divided into 19 areas used in the study by Yokawa and Shono (2002). In the last meeting in 2001, the working party on billfish (WPB, 2001) established a standard area stratification for the standardization of CPUE of swordfish caught by longliners in the Indian Ocean. WPB also concluded that an observed sharp decline in area 7 (West Australia) in early 1990s is not caused by the change of swordfish abundance but by a spatial change of Japanese longliners operated with the similar gear configuration due to the change of target species from southern bluefin tuna to other tunas, and decided to delete data in that area from the CPUE standardization. In this paper, we followed this conclusion and used only six areas for the estimation of

abundance index (Figure 1). NHF was categorized into two levels based on the recommendation by the IOTC method working group (WPM, 2001). Gear 1 was a shallow fishing set which included the data with 5-9 hooks between floats for years prior to 1994, and 5-12 hooks after 1994. Gear 2 was a deeper fishing set than gear 1 which has more than 10 hooks between floats prior to 1994, and more than 12 hooks after 1994.

The interaction terms of area*quarter, area*gear and year*area were also included into the model. An abundance index in Indian Ocean was calculated as area-specific standardized CPUEs weighted by the area. The calculation was done using GLM procedure of SAS (Ver. 8. 02).

3. Results and discussions

Standardized CPUE of swordfish in Indian Ocean caught by Japanese longliners for 1975-2002 (present study) and the previous one by WPB in 2001 (WPB, 2001) were shown in Figure 2. Estimated value of index in 2002 was decreased to 76% of the one in 2000. The reason for this decreasing mainly caused by the decreased of abundance in the eastern Indian where the abundance showed 61% decrease from 2000 to 2002, and the level of abundance in the western Indian was relatively constant since 2000 (88% of the 2000).

In the eastern Indian, historical trend of abundance index estimated in this study showed slightly different pattern from that estimated in the last stock assessment (Figure 2). The index in the western Indian was almost similar to the WPB (2001) except for only in 1970's. This result suggests that results of standardization in the eastern Indian Ocean is somewhat unstable than in the western part. Further study will be necessary.

Standardized CPUEs by area were shown in Figure 3. In the areas of the western Indian Ocean, CPUE values historical low level in recent years, but trends of indices did not change significantly for periods of 2000 – 2002. In the areas of eastern Indian Ocean, CPUEs showed larger decreases than in western Indian Ocean in a period of 2000 - 2002, and they dropped down to the historical lowest in 2002. In the area 1, CPUE was lower than that of WPB (2001) after 1978. The CPUE in 2002 in the area 1 was relatively constant (87% of the 2000). CPUE in 2002 increased slightly in the area 2 (111% of the 2000). General decreasing trends were observed in the areas 3, 4, 5 and 6. Especially in all the eastern Indian areas (area 4, 5 and 6), CPUEs in 2002 were 50% or less of those in 2000.

Figure 4 shows standardized CPUEs which were calculated by gear configurations and by subarea. Although some unrealistic change of CPUE was observed, CPUEs in each area were significantly different between gear1 and 2.

Figure 5 shows the distribution of standardized residuals which has two apparent modes; one is in the large mode around zero which close to the normal distribution, and another small mode was at around -2. This result shows that an appropriate CPUE index might not be obtained even if gear effect is added to the standardization of CPUE.

One of the possible reasons is that the change of target species within same area and gear

configuration may affect CPUE of swordfish. For instance, Japanese longliners use shallow set even if the target species are different, such as yellowfin tuna in the tropical water or southern bluefin tuna in the temperature water in the area 2. It seems that CPUE for swordfish calculated as gear 1 (shallow set) may have difference between these two fisheries. A good result might be obtained when the effect of the target species is added to develop the adequate model of CPUE standardization.

4. References

Yokawa, K. and H. Shono, 2000. Preliminary stock assessment of swordfish (*Xiphias gladius*) in the Indian Ocean. IOTC/WPTT/00/3, 154-163.

IOTC, 2001. The report of the Second Meeting of the Working Party on Billfish. IOTC/SC/01/07, 1-37.

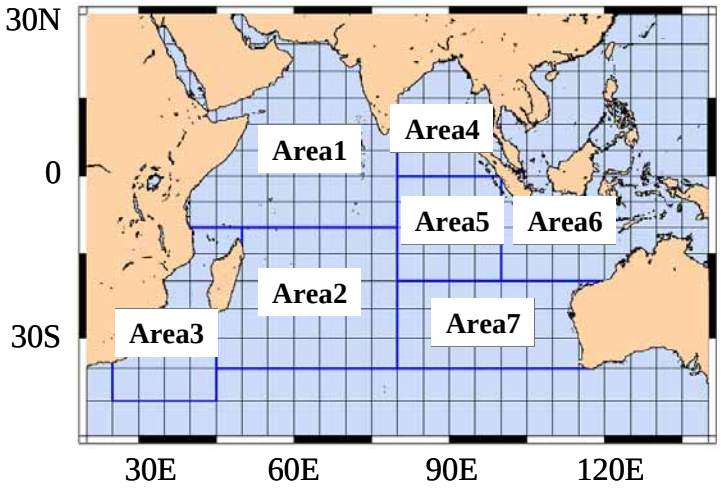

Figure 1. Definition of the areas used in the standardization of the Japanese longline CPUE. Area 7 was eliminated in the present study.

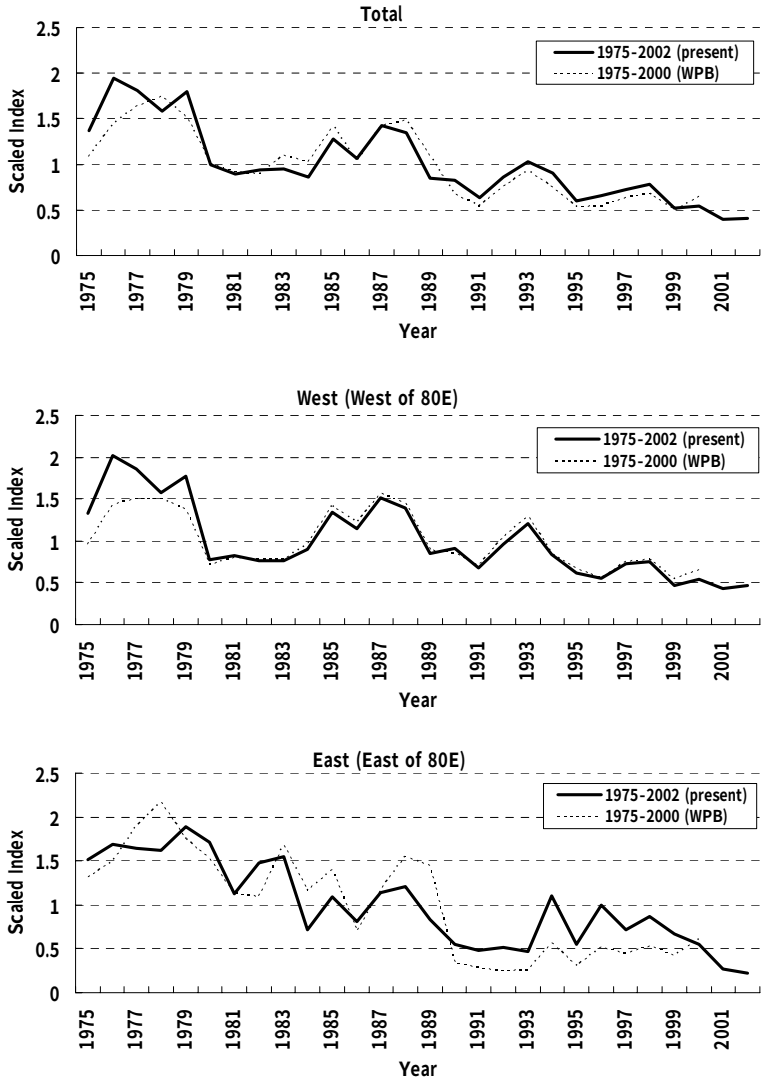

Figure 2. Scaled abundance index for total, western, and eastern Indian Ocean for 1975 - 2002. All the values were scaled to the average which is set at 1.0. Solid lines are obtained by the present study for 1975-2002. Dashed lines are calculated by the IOTC Working Party on Billfish (2001) for 1975-2000.

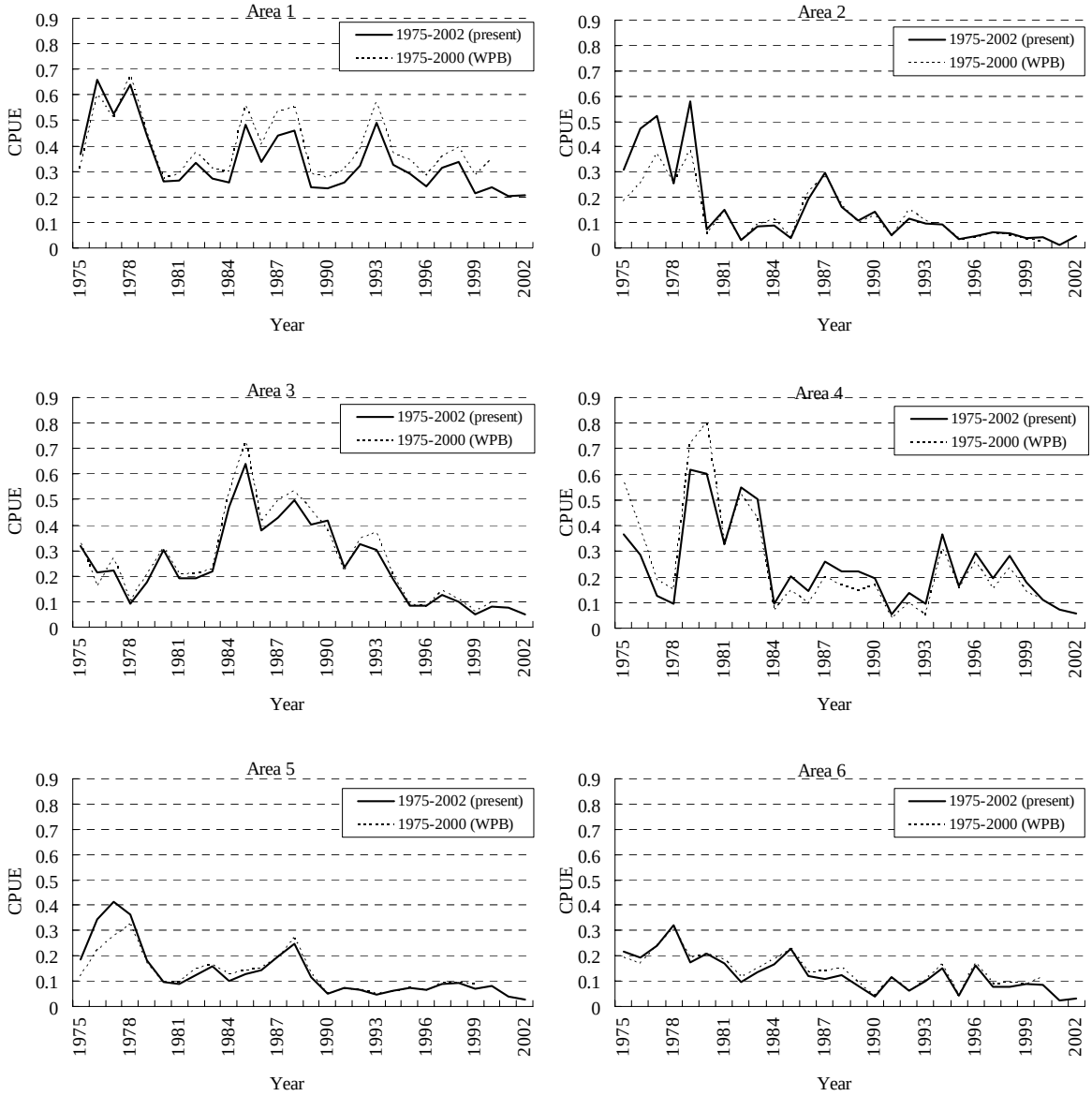

Figure 3. Comparisons of standardized CPUEs (n/1000 hooks) of swordfish caught by Japanese longliners by subareas. Solid lines are obtained by the present study for 1975-2002. Dashed lines are calculated by the IOTC Working Party on Billfish (2001) for 1975-2000.

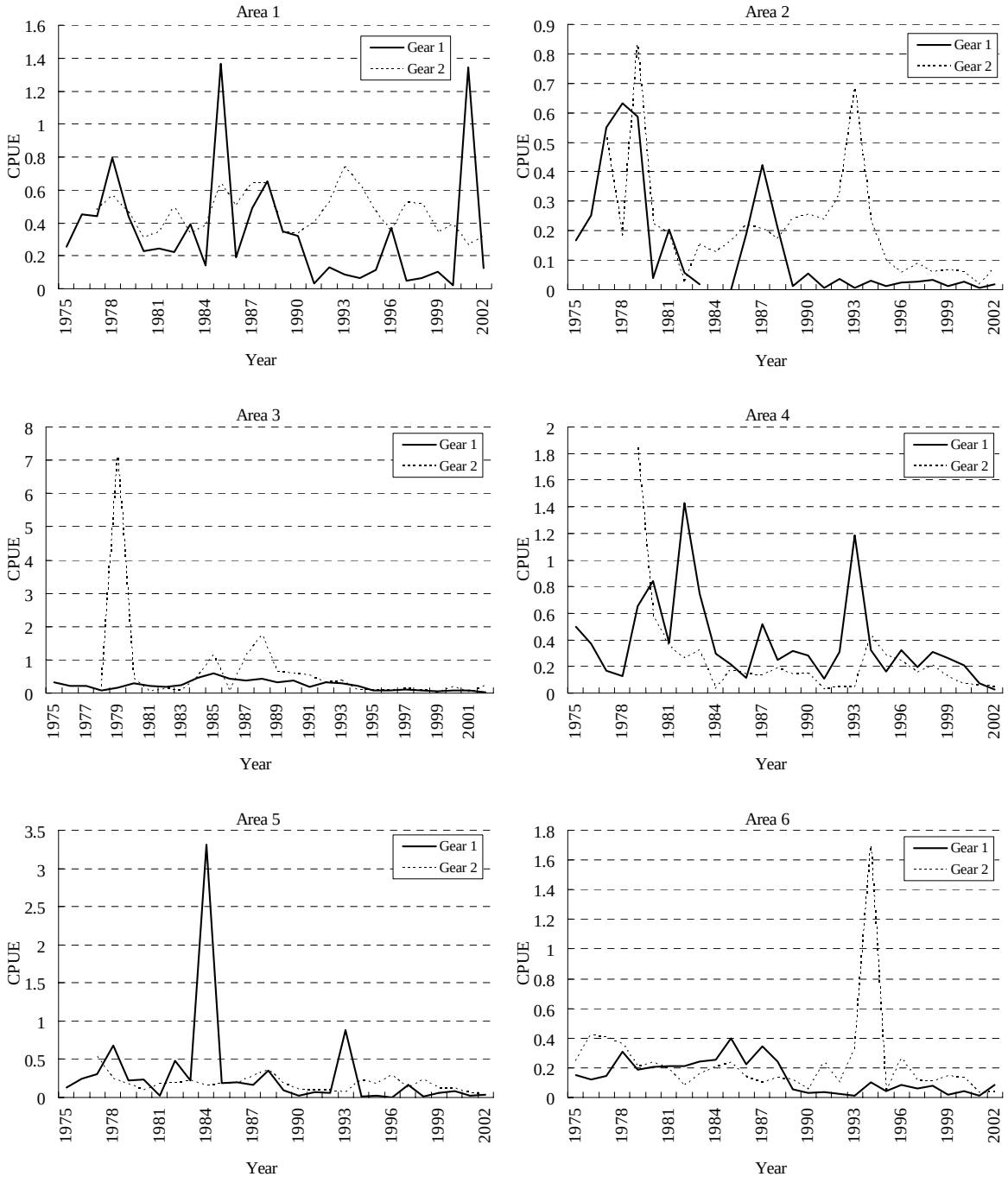

Figure 4. Standardized CPUEs (n/1000 hooks) of swordfish caught by Japanese longliners for each gear configuration by subareas. Solid lines denote shallow set (Gear 1). Dashed lines denote deep set (Gear 2).

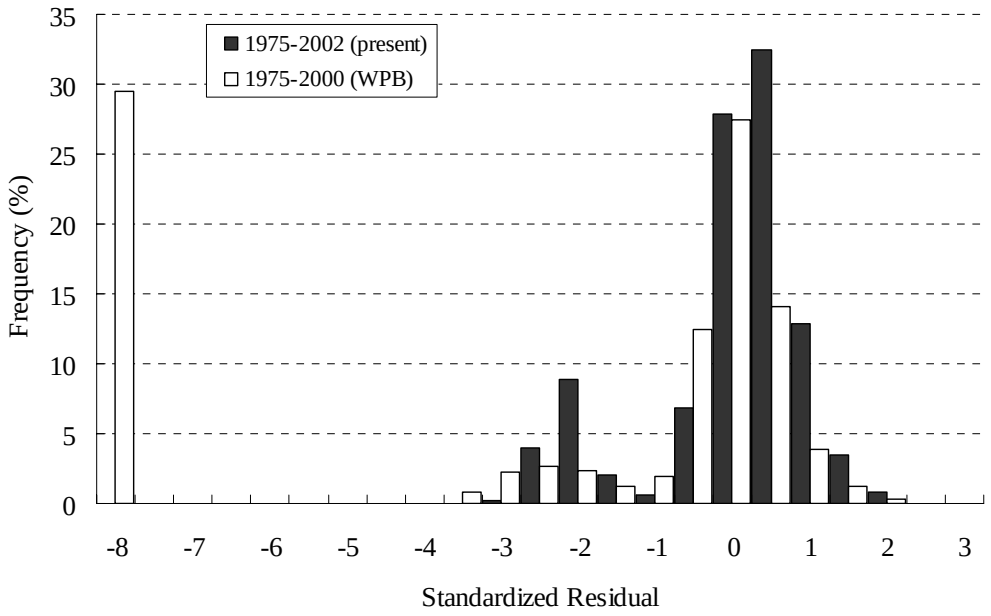

Figure 5. Distribution of residuals for the standardized CPUE of Japanese longliners. Black bar represents present study for 1975-2002. White bar represents the result calculated by IOTC Working Party on Billfish (2001) for 1975-2000.