Preliminary analysis of CPUE of swordfish caught by Japanese coastal longliners in the northwest Pacific[1]

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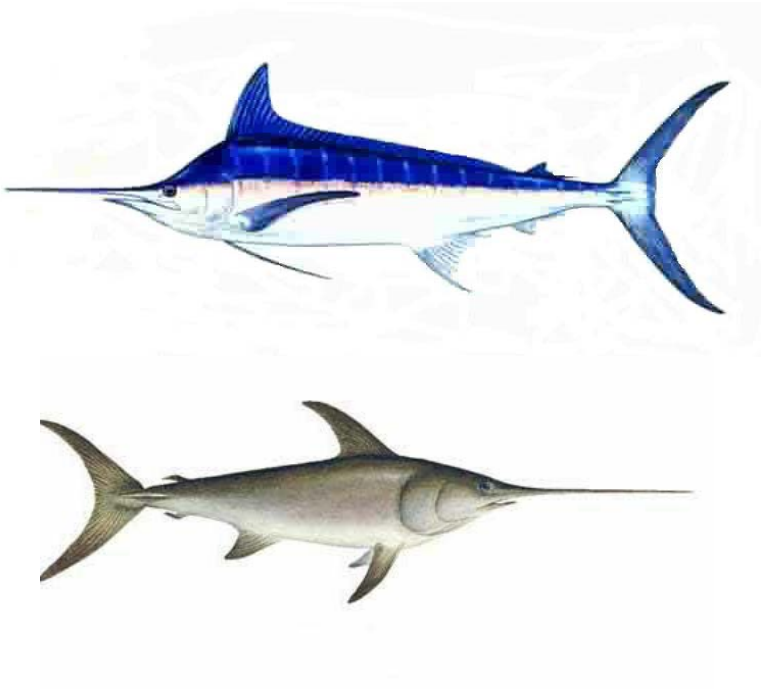

[1]Working document submitted to the ISC Billfish Working Group Workshop, 19-26 March 2007, Chinese Taipei. Document not to be cited without author's written permission.

Introduction

Japan Fishery Agency started to collect the log book of Japanese coastal longliners (defined as the longliners less than 20 tons) in 1994. Yokawa and Yamada (2002) standardized CPUE of Pacific bluefin tuna caught by Japanese coastal longliners using this log book data, and suggested that this fishery should be treated as separate from Japanese offshore and distant-water longliners, because they used different fishing strategy, different gear configuration, and many log book not reported the number of hooks per basket. Yokawa (2006) reported standardized CPUE of striped marlin caught by Japanese longliners to the ISC Marlin and Swordfish Working Group meeting in 2006, and the group decided to use the estimated abundance index by this study for the stock analysis of the north Pacific striped marlin as the estimated index was contains good information of population dynamics of striped marlin in the northwest Pacific (ISC, 2007). This study is the first trial of the standardization of CPUE of swordfish caught by Japanese coastal longliners operated in the northwest Pacific, and the purpose of this study is to investigate the usefulness of the standardized CPUE of this fishery for the stock evaluation, as well as to seek an appropriate method of CPUE standardization.

Materials and Methods

Data set used in this study is same as the previous study on striped marlin (Yokawa, 2006). Japan Fishery Agency started to collect the log book of Japanese coastal longliners (defined as the longliners less than 20 tons) in 1994. Though the coverage of log book is not precisely known, it is roughly estimated to be between 80 – 95 %. Set by set data is used in this study for the analysis of CPUE because no aggregation of data is conducted.

As in the previous study, data with unrealistic number of hooks per basket (HPB) were deleted (<3 and 25<). The gear configuration (as a proxy of target species) of each operation expressed by the HPB which was classified into 10 categories (3, 4-5, 6, 7, 8-9, 10-11, 12-15, 16-20, 21-22, 23-25) based on the simple GLM analysis using HPB values, area, quarter, and year as main factors. Area stratification (Fig. 1) was decided based on the nominal CPUE distribution pattern (Figs. 2 and 3). The analysis of CPUE was conducted by the simple generalized linear model assuming log normal error distribution. Year, area, the gear configuration, and quarter were included in to the model as fixed factors and the interaction terms between year and area, year and quarter as well as area and quarter were also included;

$$\ln(CPUE_{ijkl}+const)=year+quarter+area+gear+(interacteion\ term)+error$$

The variable of "const" is a constant value for treating zero catch data. The parameter is set as 1/10 of the overall nominal CPUE of SWO. Analysis was made by GLM procedure of computer software, "SAS Ver. 9.1".

Results and Discussions

Distribution pattern of residuals by year are shown in Fig. 4. The apparently bimodal patterns are observed. This would be comes from relatively higher values of over all mean of CPUE due to the swordfish directed operations. In some cases, CPUE of swordfish directed operations (especially operations with HPB=3) was more than ten times higher than non swordfish directed operations.

The yearly trends of standardized CPUEs (n / 1000 hooks) by area are shown in Fig. 5. CPUEs showed steady declining trends from 1994 to 2002 or 2003, and turn to increasing trend there after. Trend of recoveries are more evident in areas 2, 4, and 5. Because these three areas is the main fishing ground of bigeye and yellowfin tuna,

the results shown in Fig. 5 indicates that CPUEs of swordfish caught at by-catch are increased in recent years. The result shown in Figure 6 supports this fact.

Trend of CPUE in total area was calculated with two methods. One is trend of CPUE in each area was weighted by the approximate size of each area and summed up to the total, the other is not weighted one. Yearly trends of CPUEs by these two methods were quite similar (Fig. 7), and they showed continuous decreasing trend in the period between 1994 and 2003, and increased there after. The level of CPUE in 2005 is roughly 30% lower than that in 1994.

In the present study, a traditional GLM method is applied on the catch and effort data of swordfish caught by Japanese coastal longliners in the northwest Pacific. The pattern of residuals obtained by this analysis indicates that the data was not fitted on the model in a good way, but the trend of abundance indices estimated by the different two ways are quite similar. This means that thought the method of CPUE standardization should be improved and be reexamined, the results of this study roughly suggests that the stock status of swordfish in the northwest Pacific shows the sign of recovery from the lower level observed in the beginning of the 2000s. Based on the information from the Japanese offshore surface longline fleet targeting swordfish in the north Pacific recorded quite good catches in the 2006 – 2007 fishing season.

Reference

ISC 2007: Reprot of the Marlin and Swordfish Working Group Joint Workshop, November 8-15, 2006. 30p.

Yokawa, K. 2006: Update of CPUE Standardizations of striped marlin caught by Japanese coastal longliners in the northwest Pacific. ISC/06/MARWG&SWOWG-2/04, 9p.

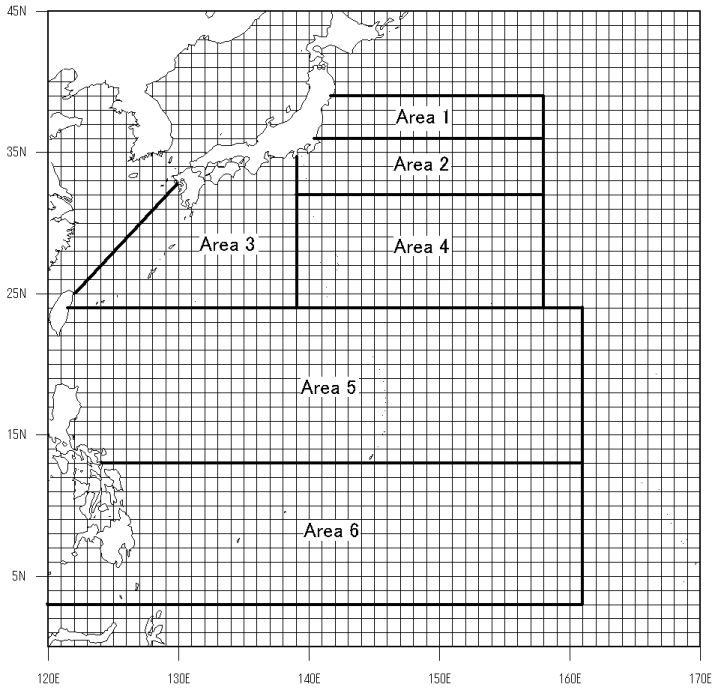

Fig. 1. Area stratification used in this study.

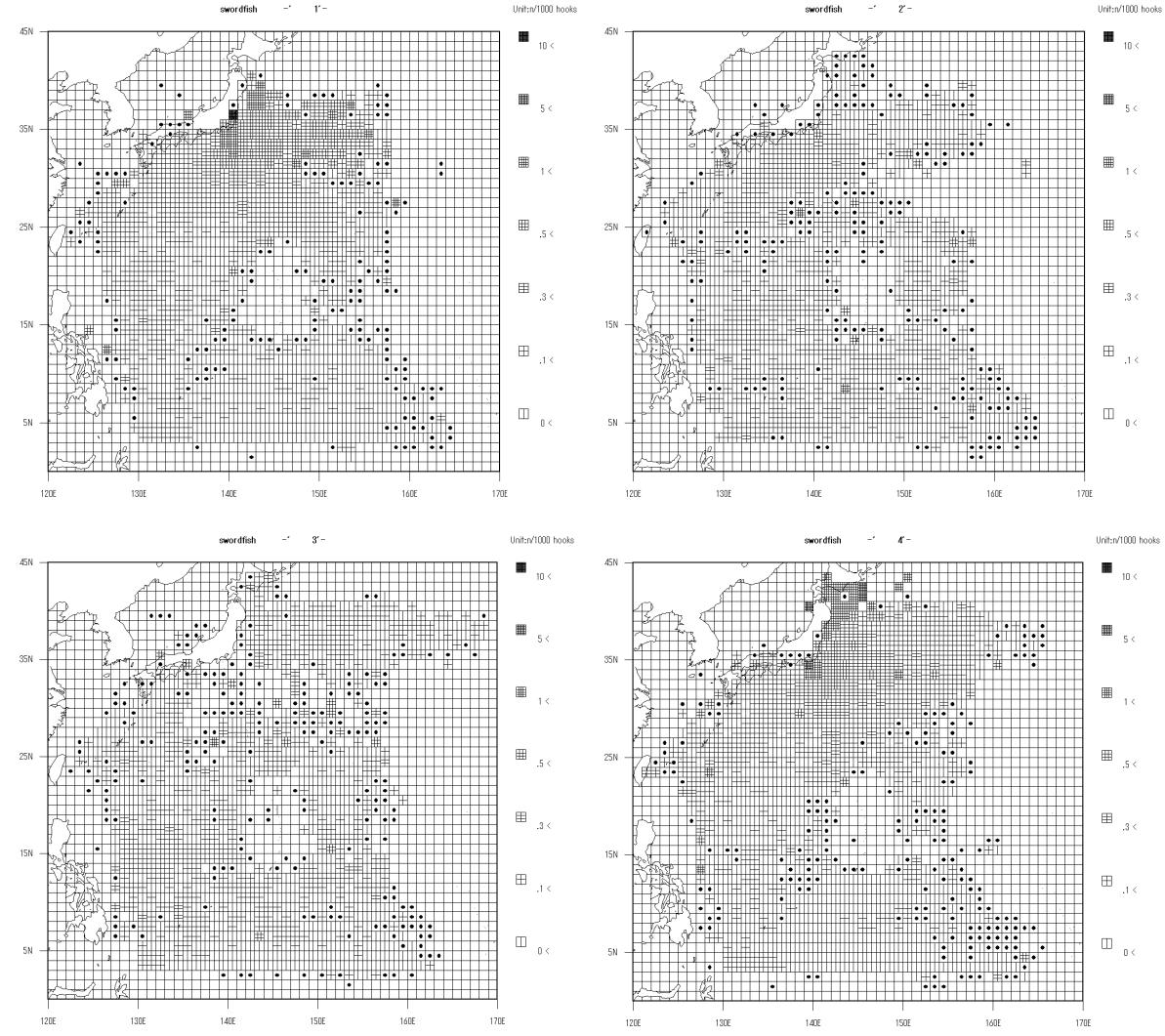

Fig. 2. Average quarterly distribution of CPUE (n / 1000 hooks) of swordfish caught by Japanese coastal longliners for the period between 1994 and 2005 in the northwest Pacific.

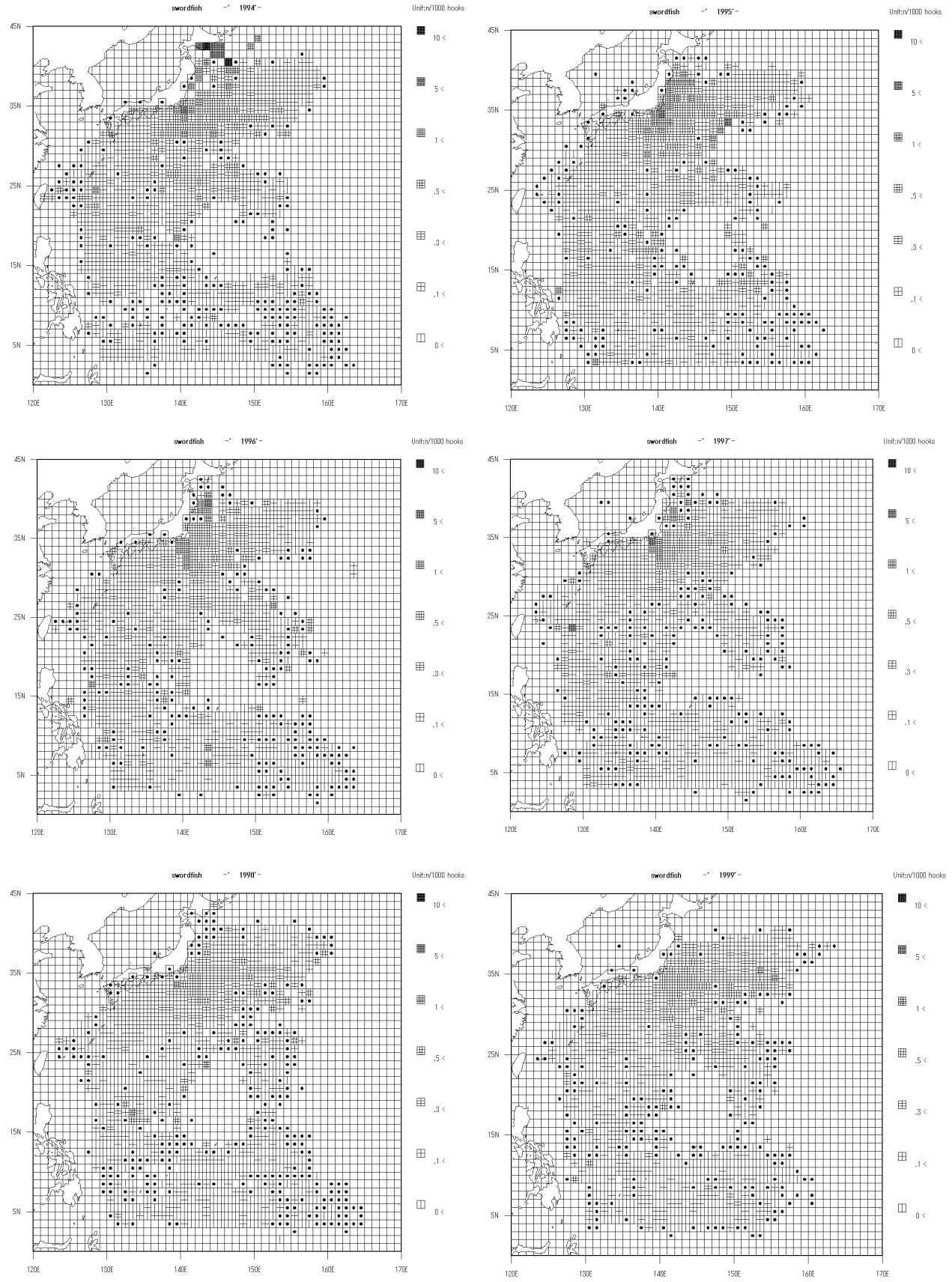

Fig. 3. Yearly distribution of CPUE (n / 1000 hooks) of swordfish caught by Japanese coastal longliners for the period between 1994 and 2005 in the northwest Pacific.

Fig. 3. Continued.

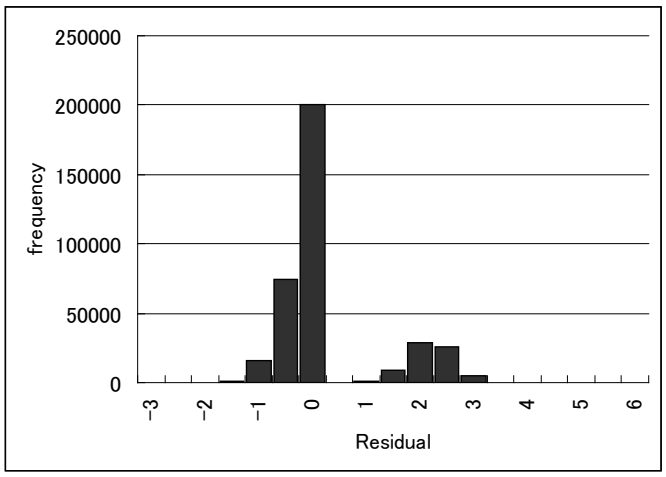

Fig. 4. Frequency of residual in the results of CPUE analysis.

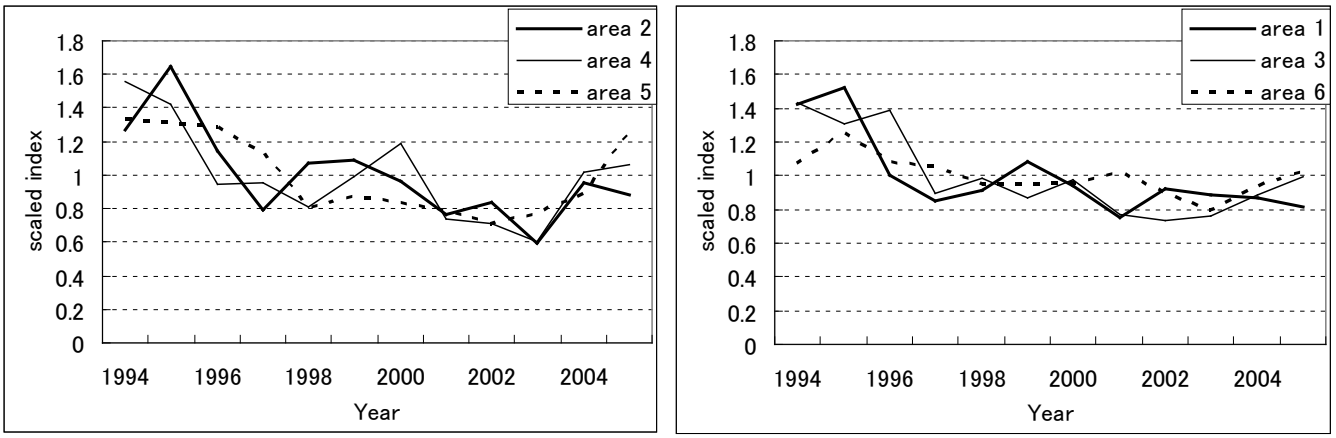

Fig. 5. Standardized CPUE (n / 1000 hooks) by area of swordfish caught by Japanese coastal longliners in the northwest Pacific for 1994 – 2005. All values scaled to their average which was set at 1.0. Left panel shows CPUEs for areas 2, 4, and 5. Right panel shows those for areas 1, 3, and 6.

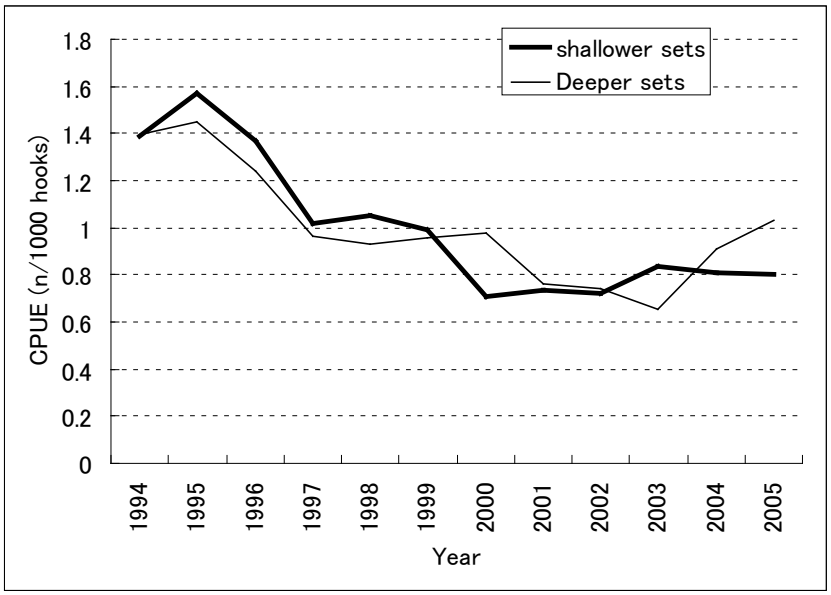

Fig. 6. Standardized CPUE (n / 1000 hooks) by shallower sets (number of hooks between floats is less than 11) and deeper sets (number of hooks between floats more than 10).

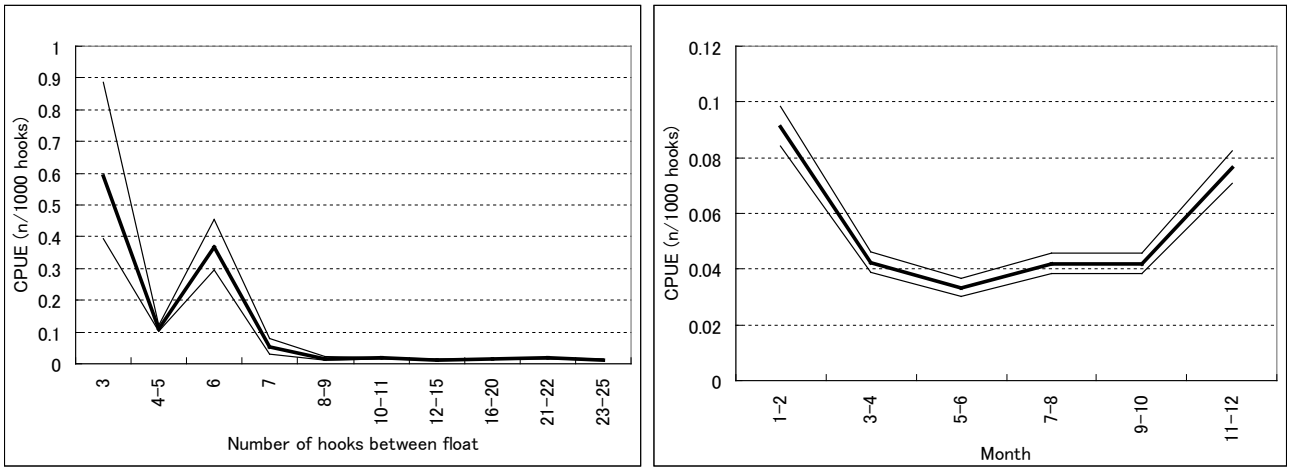

Fig. 7. Standardized CPUE (n / 1000 hooks) by the number of hooks between float (left) and by month (right).

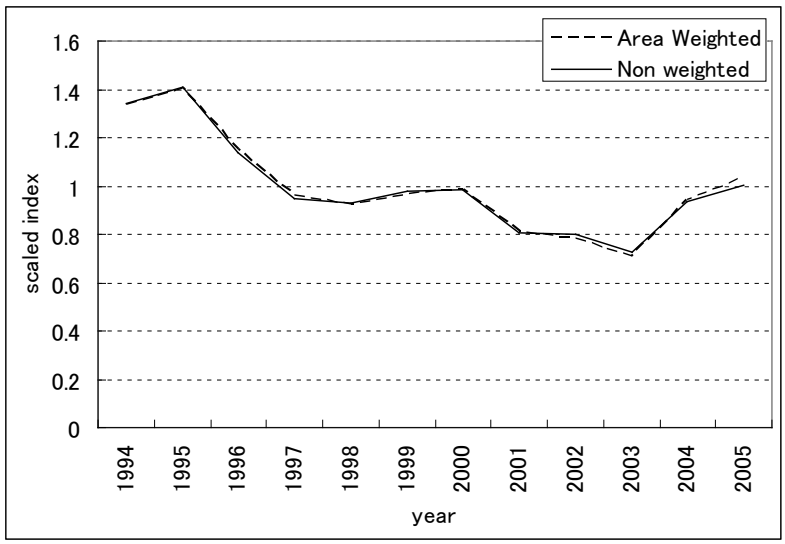

Fig. 8. Trend of abundance indices of the northwest Pacific swordfish estimated by two methods, one is the average of 6 areas (non weighted), and another is CPUE of each area weighted by the approximate size of area.