Comparison of three abundance indices estimated by catch and effort data of Japanese offshore and distant water longliners[1]

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Introduction

Saito and Yokawa (2004) standardized CPUE of swordfish caught by Japanese longliners in the north Pacific swordfish (north of 10N and west of 130E) by traditional GLM methods. In that study, we used different area stratification from the one used in the last swordfish assessment in the ISC held in Nagasaki in 2002 is used (Fig. 1). As a result of this change, trend of estimated abundance index become pessimistic (Fig. 2). This document tries to figure out reasons of observed differences of the trends between the two CPUE standardizations.

An abundance index of the north Pacific swordfish estimated by Yokawa (2004) using habitat model is also compared with the other two indices.

Materials and Methods

Data and detailed methods of CPUE standardizations are described in Minami and Yokawa (2002), Saito and Yokawa (2004) and Yokawa (2004). Data used in these three studies was same, which is aggregated by 5x5 degrees block and month for the period of 1952-1975 and aggregated by 5x5 degrees block, month and number of hooks between floats (NHF) for the periods of 1975-2002. Because quality of data used changed in 1975, abundance index estimated separately by these two periods and connected at the point of 1975 to get a historical trend.

Area stratifications used in these studies are shown in Figure 1. Minami and Yokawa (2002) used different area stratifications for periods of 1952-1975 and 1975-2002, and Saito and Yokawa (2004) and Yokawa (2004) used same single area stratification for these two periods. Coverage of area of Minami and Yokawa (2002) is wider than that of Saito and Yokawa (2004).

Models used in the CPUE standardization by GLM are same between Minami and Yokawa (2002) and Saito and Yokawa (2004).

Effective fishing effort estimated by the habitat model (Yokawa, 2004) is also adjusted seasonal and areal pattern of CPUE by GLM using same area stratification as Saito and Yokawa (2004) shown in Fig. 1.

Results and discussions

(1) Comparison between Minami and Yokawa (2002) and Saito and Yokawa (2004)

Difference of the method of CPUE standardization between Minami and Yokawa (2002), and Saito and Yokawa (2004) is coverage and stratification of area (Fig. 1 and Fig. 2). Former one covered wider area and used small area stratification, and later one only used data in the main swordfish fishing ground and analyzed them with larger area stratification.

To make comparison, the north west and central Pacific region were divided into four block (north east, north west, south east and south west) and re-calculated abundance indices by two methods. Each sub-area are classified into four regions as follows;

Minami and Yokawa (2002), 1952-1975

North-west region; area 1 – area 11

North-east region; area 16

South-west region; area 12 – area 15

South-east region; area 17 and area 18

Minami and yokawa (2002), 1975-2002

North-west region; area 1 – area5, area 8, area 9

North-east region; area 6 and area 7

South-west region; area 10 and area 11

South-east region; area 12

Saito and Yokawa (2004), 1952-2002

North-west region; area 1 – area 3

North-east region; area 4

Figure 3 shows results of comparison for the north west (NW) and north east (NE) regions. All area in Saito and Yokawa (2004) are classified into these two regions. In both regions, two abundance indices shows similar trends.

Figure 4 shows contrast of abundance indices between latitudinal regions estimated by Minami and Yokawa (2002). In both western and eastern regions. trends of abundance indices are deferent between northern and southern region.

These facts indicates that observed differences of trends of abundance indices between Minami and Yokawa (2002) and Saito and Yokawa (2004) can be attributed not into the differences of way of area stratifications but to coverage of area. And also, apparently different trends of indices between four regions suggest existence of multiple stocks.

Figure 3 also shows there are some still minor difference in the historical trends of indices between the one by Minami and Yokawa (2002) and Saito and Yokawa (2004) even picking up corresponding regions. These differences could be attributed to the small difference of area coverage (ex.; In the north west region, Minami and Yokawa (2002) covers data down to 15N while Saito and Yokawa (2004) covers down to 10N) and number of area in the regions (ex.; In the north west region, number of area in Saito and Yokawa (2004) is smaller than those in Minami and Yokawa (2003). This should be examined in near future to get more reliable index.

(2) Comparison between indices by habitat model with others

Figure 5 shows comparison of index estimated by the habitat model (Yokawa, 2004) with indices estimated by the traditional GLM methods (Minami and Yokawa, 2002; Saito and Yokawa, 2004).

In the NW region, the index by the habitat model is relatively lower before the mid 1960's, relatively higher in the period of mid 1970's to mid 1980's than those by the GLM. Since late 1980's,

the index by the habitat model showed similar decreasing trends as those by GLM.

In the NE region, the index by the habitat model is relatively higher than those by GLM in the period before 1980's and relatively lower there after. This might be attribute to the introduction of deep longline operation in the NE region in the periods between late 1970's and early 1980's, and should be interesting to examine it.

In the NW + NE region (corresponding to main swordfish fishing ground), the index by the habitat model is somewhat optimistic before 1980's and showed similar trends with those by GLM there after.

Conclusion

As described in the previous documents about CPUE standardization of swordfish in the north west and central Pacific (Yokawa, 1999; Minami and Yokawa, 2002; Saito and Yokawa, 2004), many operations of Japanese offshore and distant-water longliners in this region conducted for targeting fishes other than swordfish, and Japanese log book data for longliners does not contain complete information to identify target species. This draws a complicated situation when one try to standardize CPUE of swordfish.

In the present study, three indices estimated by different methods were compared to explore actual stock status of swordfish in the north west and central Pacific. In the main fishing ground of swordfish (NW + NE region), three indices suggested different stock levels before 1970's, while they show similar downward trends since mid 1980's. Relative values of the three indices in 2000 – 2002 are about 40 – 50% of those in the second half of 1980's in NW + NE region. Though some recovery trends are observed in the NW region, stock status of swordfish in the NE region (Fig. 5), status of swordfish stock in the north Pacific should be closely monitored until reliable stock assessment conducted. Further information and study to improve reliability of the abundance index also be necessary.

In this study, apparent different historical trends of indices are observed between NW, NE, SW, and SE regions. Study about stock structure will also necessary to set adequate management units.

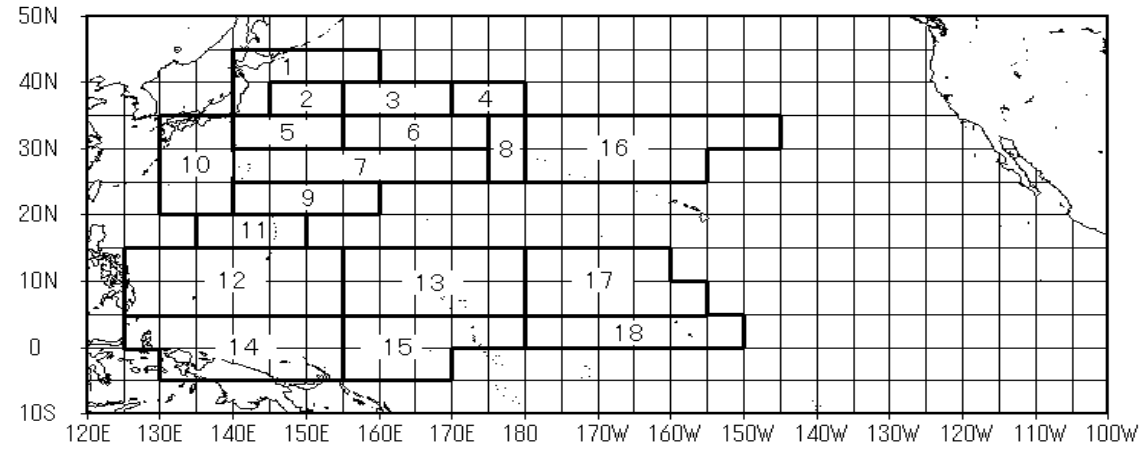
References

Minami and Yokawa. 2002; Standardized catch rate and abundance index for swordfish caught by Japanese longliner in the north Pacific in 1975 – 2000. ISC SWO/02/07, 9pp.

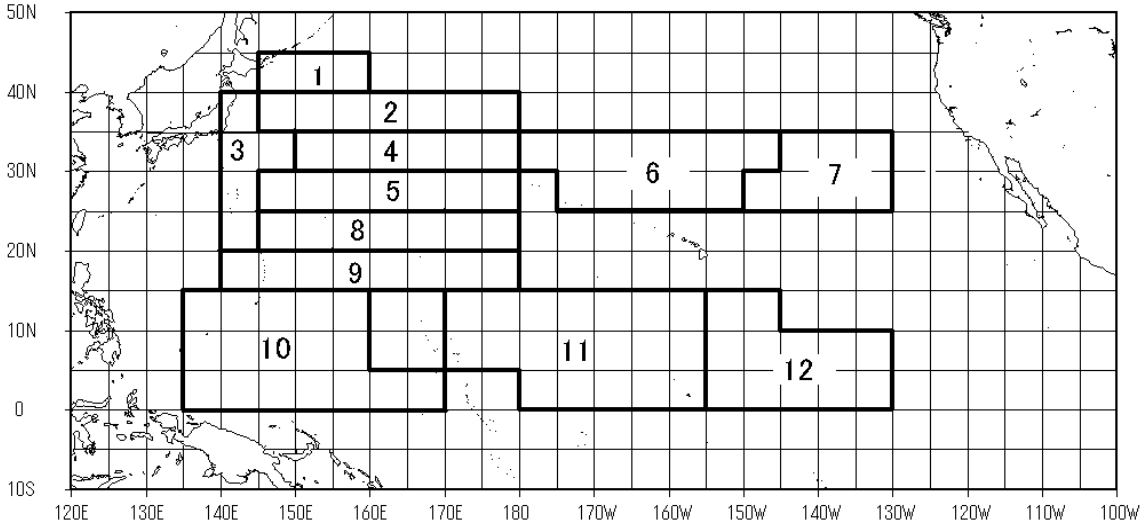
Saito and Yokawa. 2004; Estimation of abundance index for swordfish caught by Japanese longliner in the North Pacific in 1956 – 2002. ISC/04/SWO-WG/___, 8pp.

Yokawa. 1999; Standardized catch rate for swordfish caught by Japanese longliner in the north Pacific and the tentative trial of production model. ISC SWO/99/5, 27pp.

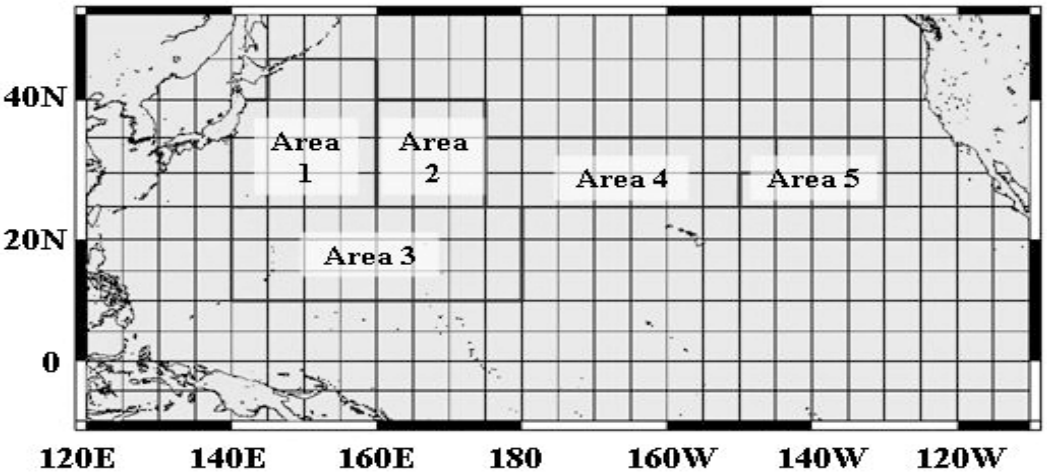
Yokawa. 2004; Estimation of abundance index of swordfish caught by Japanese longliners by the habitat model. ISC/04/SWO-WG/___, 17pp.



Minami and Yokawa (2002), 1952 - 1975



Minami and Yokawa (2002), 1975 - 2002



Saito and Yokawa (2004), 1952-2002

Fig. 1. Area stratifications used in the CPUE analysis of swordfish caught by Japanese longliners in the north west and central Pacific.

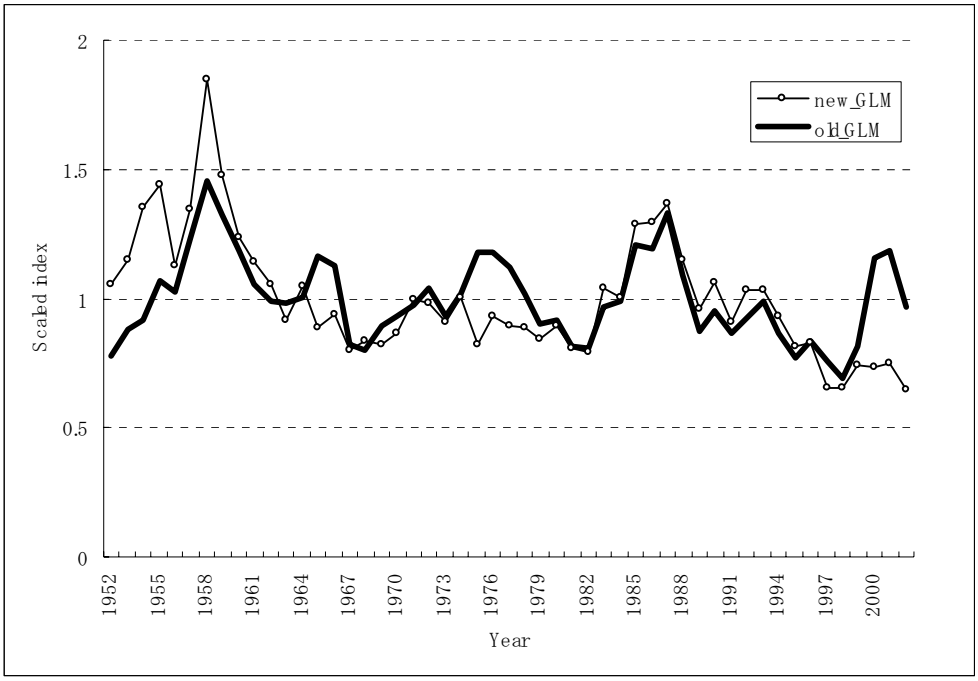


Fig. 2. Comparison of abundance indices estimated by Minami and Yokawa (2000, old_GLM) and Saito and Yokawa (2004, new_GLM). All values scaled to its average, which set at 1.0.

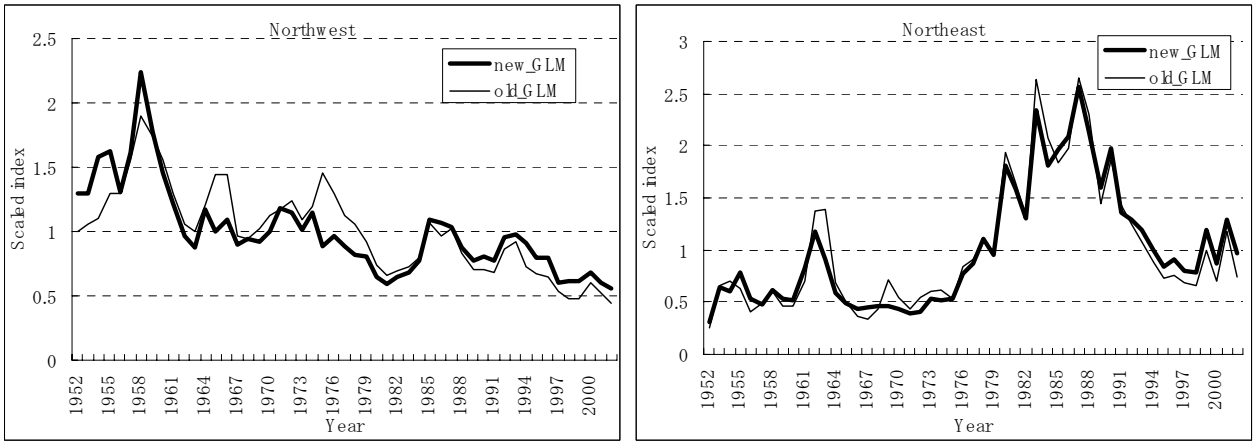


Fig. 3. Comparison of regional abundance indices estimated by Minami and Yokawa (2002, old_GLM) and Saito and Yokawa (2004, new_GLM). Left panel shows the one in the northwestern region and right panel shows the one in the northeastern region.

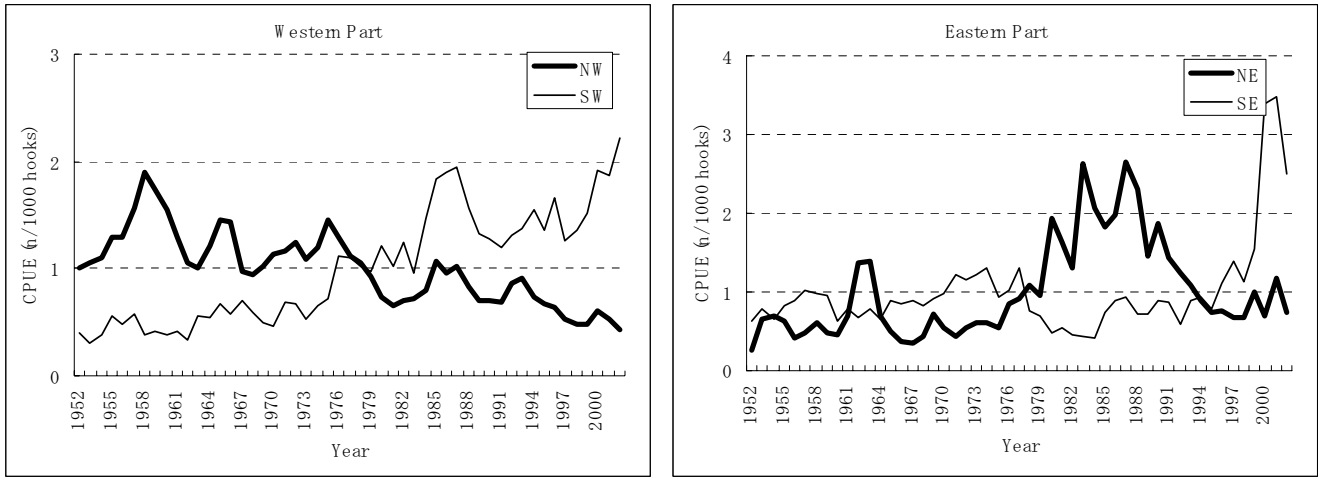


Fig. 4. Comparison of abundance indices by latitudinal region estimated by Minami and yokawa (2002). Left panel shows a contrast between north west region and south west region. Right panel shows a contrast between north east region and south east region. All values scaled to its average, which set at 1.0.

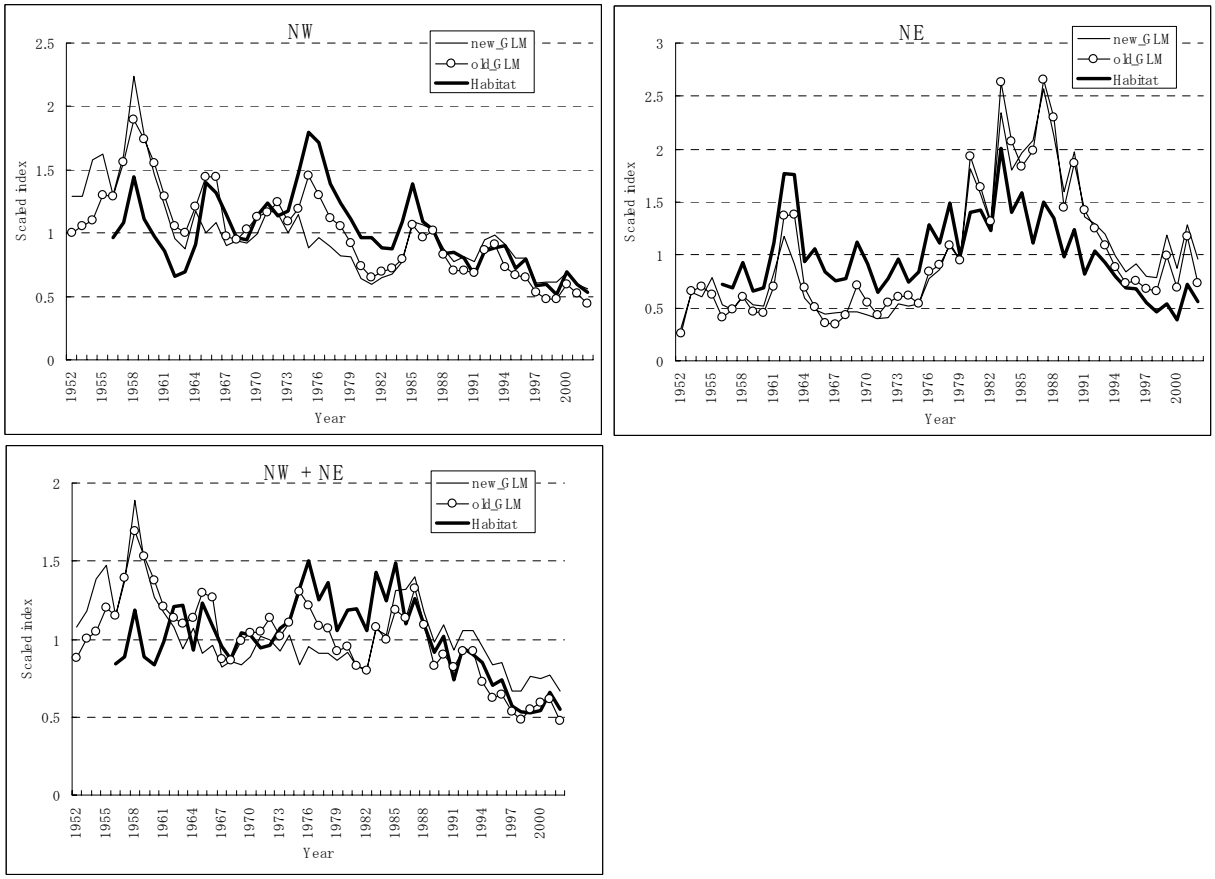


Fig. 5. Comparison of abundance indices estimated by habitat model (Yokawa 2004) and GLM methods (Minami and Yokawa, 2002; Saito and Yokawa, 2004). Upper left panel shows indices in the north west region, upper right panel shows one in the north east region, and lower left panel shows composite of the north west and east region (weighted by size of each area). All values scaled to its average for 1956-2002, which set at 1.0.