ISC/22/BILLWG-02/05

Update Japanese catch and size statistics for the North Pacific swordfish stock assessment.

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This working paper was submitted to the ISC Billfish Working Group Workshop, 28-30 November 2022 held at Fisheries Resources Institute, Japan Fisheries Research and Education Agency.

Abstract

This document compiles Japanese catch and size composition data for the North Pacific swordfish (*Xiphias gladius*) stock assessment. Fleet definitions for data compilation are based on new stock boundaries and previous stock assessments. The longline catch data source after 2008 has been updated using new 5° X 5° grid data. The Japanese yearbook after 2003 was also updated for available data on the Japanese government webpage. Changes in catch data due to these updates were minor. The longline size composition data were recompiled, removing the 5°X10° grid resolution data for 1998 and earlier. As a result, the sample size was reduced, and the distribution's shape was changed. The 5° X 10° resolution data must be excluded because it straddles different fleet areas. The shape of the swordfish size distribution caught by the Japanese longline fishery in Area 1 did not change when adding the size composition data after 2016.

Introduction

The North Pacific swordfish distribution straddles the WCPFC and the IATTC convention areas. Ichinokawa and Brodziak 2010 estimated the stock boundary by analyzing the Japanese longline CPUE. Based on this result, the ISC Billfish Working Group (BILLWG) conducted stock assessments of the two stocks. Subsequently, the tagging survey results reported the movement of swordfish between the east-west boundary assumed by the BILLWG (Griffiths et al., 2020). In light of these results, the BILLWG discussed the east-west stock boundary again, and a new stock boundary was determined (ISC 2021).

On the other hand, the BILLWG adopted the area as a fleet approach to the Japanese longline fishery. Specifically, a finite mixture model analysis was conducted for the Japanese longline fishery, defining a fishery divided into two areas (Ijima and Kanaiwa 2018). Using a two-area-based Japanese longline fleet, the BILLWG conducted a Western and Central North Pacific swordfish stock assessment in 2018 (ISC 2018). This paper updates Japanese catch statics and size composition data based on this new stock boundary and the fleet definitions used in the previous stock assessment. In addition, some data sources have been improved, and these have also been reflected.

Material and methods

Stock boundary and fleet definition of Japanese swordfish fishery

We have redefined the Japanese fleet for stock assessment based on the new stock boundaries (Figure 1). There are no changes for fleets other than longlines. The longline fishery in Area 2 has been reduced by one 5° X 5° grid block due to the boundary change with the EPO area. The EPO and sensitivity analysis area for the longline fleet was also defined, and data sets were added. The data sources were also organized because the data available for each fishery definition is different (Table 2, 3).

Catch statics

We used public domain data on longline fishery aggregated to a 5° X 5° grid and the yearbook. The Japanese government compiled the yearbook that has been available since the 1950s. However, the yearbook data have been paper-based, and digital on-website data is available after 2003. The National Research Institute of Fisheries Resources Institute has compiled paper-based data and reports to each RFMO. The catches of driftnet and other fisheries were extracted from the yearbook. The longliners' 5° X 5° grid data are based on logbooks.

The logbook data has been in a different format since 1994, and the longline gear material was changed from natural to nylon in the mid-1990s. Therefore, the longline fleets were divided into two time periods. The reporting rate of the longline logbook is not 100% because small-scale coastal vessels and some coastal vessels were not required to submit the logbook. The yearbook estimated these unreported longline catches and have been reflected in the ISC catch table. The unreported longline catch has been decreasing year by year, but the calculation methods vary by species. For 2008 and later, the values estimated from the video management software (VMS) information can be used to standardize unreported longlines. This paper compiled the catch statistics to be input into Stock Synthesis 3 using the same data sources as in the previous stock assessment. However, the yearbook has tabulated after 2003, which can be downloaded from the website. A new data set considering unreported catch was also used for the 5° X 5° grid longline catch.

Size composition data

Japanese size data was researched on the landing port or on board. Swordfish size data include length and weight composition data from 1946 to the present and biological survey data from 1999. The biological survey data logs individual-based

length and weight, the measurement day, and the catch location. The biological survey data generated the size composition data after 1999. These data sets are disaggregated by fishing method, and for North Pacific swordfish, those for drift nets and longlines are available. The resolution of catch location has been reported at the 1° X 1°, 5° X 5°, 5° X 10°, and 10° X 20° levels. Before 1998, the 5° X 10° and higher resolution levels were used to ensure sample size, but the 5° X 10° resolution data were not used in this study because 5° X 10° grid data could not separate Area 1 and Area 2. After 1999, 1° X 1° and 5° X 5° resolution data were used, as in the previous stock assessment. Data on the length composition of swordfish did not exist before 1998. Thus, semi-dress weight composition data were converted to length using the conversion factor (Ijima 2018). The conversion equation is

 $EFL = \exp\left(\frac{\log(W) + 12.13}{3.214}\right)$, where *EFL* is the eye-fork length, and *W* is the semi-dress weight, respectively.

Size composition data for the Area 2 longline exists. However, most of the data have been from training vessel surveys. The BILLWG did not use it in the 2018 stock assessment due to the different locations of operations from commercial vessels and the difference from spatial trends in body mass calculated by the logbook data.

Result and discussion

When longline catch data were aggregated according to fleet definition, Area 1, Area 2, EPO, and sensitivity EPO had the most significant catch in that order (Figures 2 and 3). Longline catch in Area 1 tends to be higher in the first and fourth quarters, while Area 2 tends to have a relatively higher catch in the first quarter (Figure 3). Longline catch in EPO has been almost nonexistent since the 1990s (Figure 3). In the equatorial region of EPO, swordfish catch is stable year-round (Figure 3). Compared to the data used in the 2018 stock assessment data, there has been a slight increase in catch trace numbers in Area 1 after the year when the new data source was used (Figure 4). It was considered due to a change in estimating unreported small-scale-longline vessel catch. The number of longlines in Area 2 has decreased slightly, but this is due to the transfer of one 5° X 5° grid to the EPO (Figure 4). The driftnet and other fisheries data from the yearbook slightly differed after 2003, when the yearbook was updated (Figure 5).

Length composition data changed significantly in Area 1 early because the 5° X 10° grid resolution data were excluded (Figure 6). For Area 1 and driftnets after

1994, the distribution of length composition did not change significantly, even if the data were updated (Figures 7 and 8). After 1999, the quality of Area 1 longline size composition data has been improved, but the mode varies from year to year and quarter to quarter (Figures 9, 10). Some size composition data are also available for EPO and EPO sensitivity (Figures 6, 7).

References

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| Data source | Name (Time period) | Details |
|---------------|--|--|
| Catch statics | Longline L5 (1975-1993) | Made by the longline logbook. Number-based 5° X 5° grid public domain data. Did not include coastal longline and small-scale longline catch. |
| | Longline L5 (1994-2007) | Made by the longline logbook. Number-based 5° X 5° grid public domain longline data. Did not include small scale longline catch. |
| | Longline L5X (2008-2021) | Made by the longline logbook. Number-based 5° X 5° grid public domain longline data. Includes all longline catches. |
| | Drift net logbook (1978-1993) | Number-based 1x1 grid catch data. Reporting rate is not 100%. Have not been used for the stock assessment. |
| | Yearbook (1975-2002) | Mass-based national statics.Records all fisheries catch. |
| | Yearbook (2003-2021) | Mass-based national statics. Records all fisheries catch. Accessible via the website. |
| Size statics | Length and weight composition data (1975-1998) | • Port sampling and research on board data. |
| | Individual fish survey (1999-2021) | Port sampling and research on board data. Records individual length and body mass. |

Table 1. Data source Japanese catch and size statics.

| Fleet name | Time period | Catch statics | Size statics |
|--------------------------------|----------------|------------------------------------|---|
| Longline Area1 early | 1975- 1993 | L5 | USED for the 2018 assessment. Semi-dress weight data converted to the eye-fork length. |
| Longline Area1 late | 1994- 2021 | 1994-2007: L5 2008-2021: L5X | USED for the 2018 assessment. 1994-1998: Semi-dress weight data convert to the eye-fork length. 1999-2021: Used length composition data. |
| Longline Area2 early | 1975- 1993 | L5 | NOT USED for the 2018 assessment. Almost data were measured by training vessels and their operation area differs from commercial vessels. |
| Longline Area2 late | 1994- 2021 | 1994-2007: L5 2008-2021: L5X | NOT USED for 2018 assessment. Almost data were measured by training vessels and their operation area differs from commercial vessels. |
| Longline EPO | 1975- 2021 | 1975-2007: L5 2008-2021: L5X | POSSIBLE to use for the 2023 assessment. 1994-1998: Semi-dress weight data convert to the eye-fork length. |
| Longline EPO sensitivity | 1975- 2021 | 1975-2007: L5 2008-2021: L5X | POSSIBLE to use for the 2023 assessment. 1994-1998: Semi-dress weight data convert to the eye-fork length. 1999-2021: Used length composition data. |
| Offshore driftnet | 1975- 1992 | Yearbook | NOT USED for 2018 assessment. There is a little semi-dress weight data. |
| Coastal driftnet | 1993- 2021 | Yearbook (2003-2021 Updated) | USED for 2018 assessment. 1999-2021: Used length composition data. |
| Other early | 1994- 2021 | Yearbook | NONE |
| Other late | 1994- 2021 | Yearbook (2003-2021 Updated) | NONE |

Table 2. Fleet definition and available data from Japanese swordfish fisheries.



Figure 1. The stock boundary of the North Pacific swordfish and Japanese longline fleet definition.



Figure 2. Total swordfish catch number from Japanese longline fishery summarized by 5° X 5° grid data (1975-2021).

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Figure 3. Annual swordfish catch by Japanese longline fishery. Each panel was summarized by areas that ISC BILLWG defined.

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Data — 2018 Assessment — 2023 Assessment

Figure 4. This study compares Japanese longline catches compiled with input data used in the 2018 stock assessment. Japanese 5° X 5° public domain data after 2008 was updated. The definition of EPO and Area 2 was slightly changed (one 5 x 5 grid block).



Figure 5. Comparison of updated yearbook data. This study updated yearbook data from 2003.



Figure 6. Length composition of Japanese longline fleets in the early period (1975-1993).



Figure 7. Length composition of Japanese longline fleets in the late period (1994-2021).







Figure 9. Temporal changes in longline length composition data converted by semi-dress weight.



Figure 10. Temporal changes in longline length composition data.