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Update Japanese data set for striped marlin stock assessment in the Western and Central North Pacific Ocean

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Abstract

This paper updated Japanese catch statistics and length composition data required for the Western and Central North Pacific striped marlin stock assessment in 2022. These data sets were prepared the same procedure as the previous stock assessment, assuming that the fishery definition would not be changed. However, a programming error was found in the longline logbook data reading. Some scripts had to fix, and longline catch statistics were changed. For driftnet catches before 1993, new estimate statistics have been submitted. However, this estimated catch is preliminary, and the data unit has changed from the catch weight to the catch number. In addition, the available period will be shorter. Thus, it would need to change the basic assumptions of the stock assessment model, such as the assessment period and the unit of catch data, when the BILLWG would use alternative driftnet catch data in the next stock assessment. The length composition data was almost the same as in the previous stock assessment data. Finally, the data for 2020 is still being compiled due to COVID-19 and should be used with caution.

Introduction

The Western and Central North Pacific (WCNPO) striped marlin stock has been overfished for many years, and a stock rebuilding plan has been implemented in the WCPFC (WCPFC 2021). On the other hand, the ISC billfish working group (BILLWG) indicated various uncertainties about the stock assessment model (ISC 2019). Because of this situation, the BILLWG proposed to conduct the stock assessment again to report a more accurate stock status for the managers (ISC 2021). This study updated Japanese catch and length composition data for the Stock Synthesis 3 model (SS3). It was assumed that the definition of fishery in the stock assessment model would be unchanged. Catch statistics and length composition data were summarized between 1975 and 2020 quarterly. In addition, it was provided a detailed description of alternative driftnet catches.

Material and Methods

• Catch statistics

Japanese catch statistics are available in the logbooks and yearbooks (Table 1). The logbook data are available for both the longline and driftnet fisheries that include information on the location of operations, dates, and catch number or catch weights by species (Table 1).

The logbook for offshore and distant water longlines has been recorded since 1952, with a close to 100% reporting rate. For the coastal longline fishery, the logbook has been published since 1994. Small-scale longlines are not required to report the logbook, and thus their reporting rate is not 100%, but all catches are reported in the yearbook.

There are two longline logbooks with area resolutions of $1^{\circ} \times 1^{\circ}$ and $5^{\circ} \times 5^{\circ}$ degrees. The

 $1 \circ \times 1 \circ$ grid data is the set by set data source and report semi-dress weight, and the $5 \circ \times 5 \circ$ grid data convert semi-dress weight to the total weight data. Japan reports each RFMO an estimated catch weight by $5 \circ \times 5 \circ$ grid. The accuracy of the longline logbook data is different by the year. For example, catch data before 1994 may have more considerable uncertainty because catch weights were not reported and used estimated value from port sampling weight frequency data. Accounting for data accuracy of catch weights, a $5 \circ \times 5 \circ$ grid of number-based catch data has been used for the stock assessment model (Yokawa et al. 2015, Ijima 2019a).

The period of the driftnet logbook is from 1978 to 1993, and that reporting rate is not 100%. Therefore, the yearbook catch has been used for stock assessment (Yokawa et al. 2015, Ijima 2019a). Driftnet fishery on the high seas was banned in 1993, but fishing within Exclusive Economic Zone (EEZ) continues and has been reported in the yearbook. For driftnets catch, there may be uncertainty. For example, the striped marlin was caught in the South Pacific before the 1992 moratorium, but the yearbook includes the South Pacific catch. Therefore, an alternative catch was estimated, but the results are still preliminary (Ijima 2021).

Other minor fisheries catch has been logged in the yearbook. The yearbook from 1951 to 2020 is an official Japanese statistic based on catch weight and summarizes the amount of fish landed at each port. However, this data set does not include detailed information such as catch dates and locations. The fisheries in the yearbook records are classified as offshore and distant water longlines, coastal longlines, other longlines, squid driftnet, driftnet, bait fishing, trap net, net fishing, and other fishing.

• Length composition data

The size statistics of the longline fishery is available from 1975. Until 1998, eye-fork length and weight data have been compiled separately. After 1999, the Japanese fisheries research agency has started measuring the eye-fork length and weight of individual fish. These size data were from port sampling and onboard (training vessels or observers). However, the primary measurement sources have changed from training vessels to port sampling. Training vessels information is not representative of the striped marlin size composition because they operate in different waters than commercial vessels, which account for most of the catch. Thus the BILLWG did not use size composition data of the early period for the stock assessment (Ijima 2019b).

On the other hand, longline logbooks after 1994 provide detailed data for each operation (e.g., date, fishing location, number of catches, and catch weights). The usual catch number of striped marlin by sets is zero or one, and the weight of one fish can be used as a proxy for size. The total number of fish caught is also known, and thus the effective sample size can be calculated (Ijima 2019b).

The size statistics are also available for driftnet fishery. However, that period is short, from 2005 to 2020 (Table 1). It is impossible to use a driftnet logbook for the length composition data because the logbook records catch numbers only.

• COVID-19

Due to the impact of COVID-19, there has been a significant delay in the compilation of statistics for 2020 and 2021. There is a possibility that some data has not been reported yet. Similarly, the number of operations may have significantly decreased. Thus, the BILLWG should take care in handling the data for 2020.

• Make data sets for Stock Synthesis 3

Catch data

The same method was used to make the catch data as in the previous stock assessment (Ijima 2019a). In the previous stock assessment, the fishery data were compiled by 15 fleets that are 12 longline fleets, two driftnet fleets, and other fisheries (Table 2). The definition of the No. 1-11 longline fishery follows the results of the mixture model analysis (Ijima and Kanaiwa 2019; Figure 1). The logbook compiled these longline fisheries catch numbers. Other fisheries include squid drift nets, bait fishing, net fishing, trap nets, and other fisheries. The driftnet fishery, other longline fishery, and other fisheries for which the yearbook is the data source need to estimate their catches quarterly. Driftnet quarterly catch rates were estimated from logbook data that recorded the number of fish caught. Seasonal other longline fishery and other fisheries catch was assumed their annual catches by a quarter.

• Length composition data

Length composition data were also updated using the previous method (Ijima 2019b). The individual fish catch weight data recorded in the logbook was converted to EFL for each fishery definition (Figure 2). The conversion equation is as follows:

$W = 2.6104 \times 10^{-6} EFL^{3.2427} exp(\varepsilon), \ \varepsilon {\sim} N(0, 0.1296),$

where *W* is the semi-dressed weight and unit of *EFL* is the Eye-fork length (cm). The estimation error was used to generate the final length composition. The length composition data for the driftnet fishery was compiled on an annual, quarterly basis according to the definition of the fishery.

Result and Discussion

Catch data

In creating the longline catch data, a bug was fixed in the reading program of the original logbook

files from 1994 onwards, and catch data was corrected (Figures 3 and 4). Although the general trend of the catches remained the same, the maximum difference between the previous and revised catch was about 4,000mt (Figure 3). For driftnet catch, previous and updated catch data were the same for all years except 2017, when preliminary values were used (Figure 5). Ijima 2021 re-estimated driftnet catches by going back to logbook and paper-based catch statistics. However, this method is insufficient because it needs to be confirmed for other species. In addition, the catch unit changes from weight to the number. There are no values for 1975 and 1976, and some seasonal catches in 1977 are assumed to be zero. Thus up-to-date caution is required when using this method in the stock assessment. There are no differences in all catches except for the catch in 2017 for the other fisheries (Figure 6).

• Length composition data

Comparing with the updated length composition data from the longline fishery and the previous one showed almost the same distribution (Figure 7). The time-series variation of length composition shows that small MLSs have been caught in area 1 in recent years (Figure 8). The length composition of the driftnet fishery was also compared with the previous and updated values, and it was confirmed that there was little difference between them (Figure 8).

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Data source	Gear	Unit	Resolution	Period
Logbook ¹ (5x5 grid and	Offshore and Distant water LL	mt, Number	Location, Year, and Season	mt (1971-1993, 1994-2020) n (1952-1993, 1994-2020)
1x1 grid)	Coastal LL ²	mt, Number	Location, Year, and Season	1994-2020
	Drift net ³	Number	Location, Year, and Season	1978-1993
Yearbook	Offshore and Distant water LL	mt	Year	1951-2020
	Coastal LL ⁴	mt	Year	1951-2020
	Other LL	mt	Year	1951-2020
	Drift net	mt	Year	1951-2020
	Other fisheries ⁵	mt	Year	1951-2020
Size composition data (CSV) ⁶	Longline	Kg, cm(EFL)	Location, Year,	1999-2020
	Drift net	Kg, cm(EFL)	Location, Year, and Season	2005-2020

Table 1. Data source of Japanese statistics.

 $^{1}5^{\circ}x5^{\circ}$ grid logbook data was made by $1^{\circ}x1^{\circ}$ set by set data and reported semi-dress weight converts to whole weight. Size composition data was made by $1^{\circ}x1^{\circ}$ grid logbook data to improve the spatial sampling bias and to estimate effective sample size (Ijima 2019c).

² Small-scale longline catch do not include.

³ Reporting rate is not 100%.

⁴ Small-scale longline catch include.

⁵ Other fisheries are Squid driftnet, Bait fishing, Net fishing, Trap net and Others.

⁶ There are more extended data sets that include before 1999. However, most of the data were measured by training vessels whose operational area differs from commercial vessels (Ijima 2019b).

No	Fleet name	Unit	Resolution	Period ⁵	Size composition	CPUE
1	JPNLL qt1 area1	Number	Year-Quarter	1975-2020	Yes 7	Yes ⁹
2	JPNLL qt1 area2	Number	Year-Quarter	1975-2020	Yes 7	Possible
3	JPNLL qt1 area3	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
4	JPNLL qt1 area4	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
5	JPNLL qt2 area1	Number	Year-Quarter	1975-2020	Yes 7	Possible
6	JPNLL qt2 area2	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
7	JPNLL qt3 area1	Number	Year-Quarter	1975-2020	Yes 7	Yes ⁹
8	JPNLL qt3 area2	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
9	JPNLL qt4 area1	Number	Year-Quarter	1975-2020	Yes 7	Possible
10	JPNLL qt4 area2	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
11	JPNLL qt4 area3	Number	Year-Quarter	1975-2020	Possible ⁷	Possible
12	JPNLL other 1	mt	Year ³	1975-2020	No	No
13	JPNDF qt14	mt	Year-Quarter ⁴	1975-2020 ⁶	Yes ⁸	No
14	JPNDF qt23	mt	Year-Quarter ⁴	1975-2020 ⁶	Yes ⁸	No
15	JPN others ²	mt	Year ³	1975-2020	No	No

Table 2. Summary of Japanese data set for Stock Synthesis 3

¹JPNLL other = Coastal LL(yearbook)+ Other LL(yearbook) - Coastal LL(Logbook)

² Other fisheries are Squid driftnet, Bait fishing, Net fishing, Trap net and Others.

³ The quarter catch was estimated by the annual catch divides into four.

⁴ The quarter catch was estimated by the seasonal catch ratio from logbook data.

⁵ 2019 and 2020 data are preliminary, and because of COVID-19, 2020 data is still compiling.

⁶ The alternative estimated data period is 1978-1993.

⁷ Eye-Fork length was estimated by logbook data that records one individual catch weight (1994-2020).

⁸ The available data period is after 2005.

⁹ There are two time series 1976-1993 and 1994-2020.



Figure 1. Area-seasonal fleet definition of Japanese longline fishery defined by the finite mixture model analysis. These fishery definitions applied to the logbook data.



Figure 2. Mean body weight (Kg) of striped marlin caught by Japanese longline fishery. Mean body weight was total catch semi-dress weight divided by total catch number.



Figure 3. Historical catch trend of the WCNPO striped marlin that summarizes Japanese longline logbook data.



Figure 4. Historical catch trends in the WCNPO striped marlin caught by Japanese longline fishery that have not been reported to the logbook statistics. After 2008, some vessels submitted logbook data.



Figure 5. Historical catch trends in the WCPO striped marlin caught by Japanese driftnet fishery.



Figure 6. Historical catch trends in the WCPO striped marlin caught by Japanese other fishery.



Figure 7. Size composition data of Japanese longline fishery for the Stock Synthesis 3 (1994-2020). Length of the striped marlin was estimated by logbook data.



Figure 8. Historical changes in size composition data of Japanese longline fishery (1994-2020).



Figure 9. Size composition data of Japanese driftnet fishery for the Stock Synthesis 3 (2005-2019).