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Length frequency of shortfin mako (*Isurus oxyrinchus*) reported in the Japanese observer program between 2011 and 2019[1]

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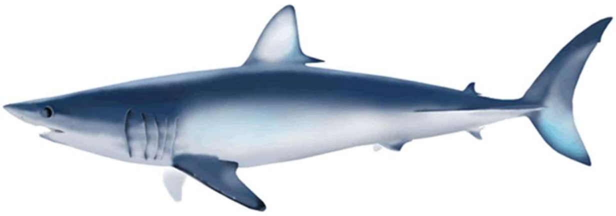

[1] Working document submitted to the ISC Shark Working Group Workshop, 22-26 February 2021, Web-meeting. **Document not to be cited without author's permission.**

Summary

This document paper summarizes the length frequency data of shortfin mako collected by the Japanese observer program between 2011 and 2019. Majority of size data was collected in the area north of 30°N and west of 175° E, which is part of main ground of shallow-set longline fishery targeting swordfish and blue shark. The annual median and quartile percentiles of catch at size of shortfin mako in PCL indicated that remarkable temporal change of body size was not clearly observed and relatively stable in the main fishing ground of offshore shallow-set longline fishery where juvenile dominates. Although coverage of observer data is not high, combined with the abundance index estimated based on shallow-set logbook data and current result, it is suggested that population decrease is unlikely to occur after the last year (i.e., 2016) of stock assessment conducted in 2018.

Introduction

Shortfin mako (*Isurus oxyrinchus*) is a wide-ranging shark, distributed from tropical to temperate oceans throughout the world. It is a common, extremely active, and highly migratory species, with occasional inshore movements (Compagno 2001).

In Japan, shortfin mako is caught mainly as bycatch in the longline fishery targeting for tunas and billfish and coastal driftnet fisheries (Semba and Kai 2021). Domestic landing of this species (mostly, North Pacific population) in Japanese main fishing ports between 1992 and 2019 ranges from 554 to 1,479 ton and 81% of the catch is from longline fishery, followed by driftnet fishery (Semba and Kai 2021). This species was listed as Appendix II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in the CoP18 (2019), which affected its utilization and fisherman's behavior, leading to release the shark in some case. In Japan, domestic utilization is still ongoing and logbook data of some longline fishery which lands the shark domestically (e.g., offshore Kinkai-shallow fleet) is useful candidate to monitor the stock abundance and stock assessment for this species (ISC 2015).

Indicator analysis of north Pacific shortfin mako was first attempted in 2015, using fishery-specific catch, fishing effort data, relative indices of abundance, and size and sex measurement (ISC 2015). Four types of indicators were developed: proportion of positive sets, abundance (CPUE) indices, sex-ratio and size compositions, although the SHARKWG considered sex-ratios to be of little value as indicators in the analysis due to lack of good understanding of the dynamics of the population by size and sex through time.

Observer data provides detailed information on the species utilized in the fishery, such as species, body length, weight, sex, reproductive status of each catch. As described above, this species is utilized domestically, not only catch number but also size data has been accumulated in Japanese observer program. This document provides annual trend of size data of this species collected by Japanese observer program operated in the North Pacific Ocean.

Materials and methods

Description of data and filtering

Japanese longline observer data was collected by Japanese observer program (JOP) and compiled by National Research Institute of Far Seas Fisheries (NRIFSF). In the Pacific, data collection under JOP started in 2008. Trained observers collect biological information including species name, body length and weight, sex, reproductive status as well as details of operation. In case of sharks, precaudal length (PCL) is measured and sex is identified by with or without claspers for each individual. Data without size measurement was removed.

Number of size data was tabulated by year and quarter (1: Jan. to Mar., 2: Apr. to Jun., 3:Jul. to Sep., 4:Oct. to Dec.). And then spatial distribution of size data and mean PCL were plotted by 1° x 1° degree grid by year to summarize the data.

Size

Considering the size segregation of this species estimated in the past study (Semba 2018), the annual median and quartile percentiles of catch at size of shortfin mako in PCL was plotted by 10° x 10° degrees grid. In addition, the available size data was collected from both shallow-set (hooks per basket (HPB): 3 and 4) and deep-set (HPB: 16 to 23), and the size frequency was compared by set-type.

Results and Discussion

A total of 4,052 size data was available between 2009 and 2020 from Japanese longline observer program (**Table 1**). As the amount of data collected in 2009, 2010, 2012, 2013 and 2020 was small or preliminary, these data were removed from the calculation (N=4,032). The number of filtered size data by year and quarter was shown in **Table 2**. Distribution of size data was not seasonally homogeneous, but size data in quarter 3 is relatively large enough compared to the other quarters after 2014.

Figure 1 shows spatial distribution of size data (number of size data) and mean PCL by 1° x 1° degree grid by year. Majority of size data was collected in the area north of 30°N and west of 175° E, which is part of main ground of shallow-set longline fishery targeting swordfish and blue shark (**Upper panel**). Generally, juvenile shark smaller than 100 cm PCL is frequently observed in the offshore area close to the north-eastern “Tohoku” area of Japan. Latitudinal trend of mean PCL was not clear due to the lack of data south of 30°N (**Lower panel**).

The annual median and quartile percentiles of catch at size of shortfin mako in PCL by 10° x 10° degrees grid are presented in **Figure 2**. Sample size was the largest in grid 12 (40-50°N, 150-160°E), followed by grid 17 (30-40°N, 140-150°E), grid 2 (30-40°N, 160-170°E), and grid 18 (30-40°N, 150-160°E). In these grids, remarkable temporal change of body size was not clearly observed. In grid 3 (30-40°N, 170-180°E), both median and mean PCL decreased between 2014 and 2017, but then increased to the same level of 2014 in 2019. In southern area (20-30°N), sample size is small compared to area north of 30°N and mean and median PCL tends to be larger than those in the northern area with same longitude. In the area west of 140°E in the area south of 30°N, decrease of body size was observed, but sample size in these grids is smaller than 30, thus it is difficult to mention that this decreasing trend is related to the population decline.

HPB distribution of the collected size data showed that 91% of the size data was collected from shallow-set longline and remaining size data was collected in the deep-set longline operation. **Figure 3** shows size frequency of each operation type. In shallow-set dataset, clear mode was observed around 80 cm and 100-120 cm PCL. In deep-set longline operation, mode was observed around 150-160 cm PCL but less clear compared to shallow-set data. Median and mean of shallow-set dataset were 121 cm and 125 cm PCL and those of deep-set dataset were 134 cm and 131 cm PCL.

Annual median and quartile percentiles of catch at size of shortfin mako by set type indicated a stable trend for shallow-set dataset, and the median and mean PCL in 2014 and 2016 were larger than those in 2015 and 2017-2019 in deep-set (**Figure 4**). As described above, sample size in deep-set dataset is small and further data collection is necessary to utilize as stock status indicator. Although the observer coverage is not high (Kanaiwa *et al*. 2021), combined with the abundance index estimated based on shallow-set logbook data (Kai 2021) and current result, it is suggested that population decrease is unlikely to occur after the last year (i.e., 2016) of stock assessment conducted in 2018. It is necessary to continue to collect the observer data to obtain reliable indicator.

References

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Table1. Number of size data of shortfin mako collected in Japanese observer program in the North Pacific.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
No of data	1	3	196	1	4	605	1,424	318	451	597	441	11

Table 2. Number of filtered size data of shortfin mako by year and quarter. Quarter 1, 2, 3, 4 denote Jan. to Mar., Apr. to Jun., Jul. to Sep., and Oct. to Dec., respectively.

	quarter			
	1	2	3	4
2011	196	0	0	0
2014	258	4	263	80
2015	305	311	633	175
2016	14	132	121	51
2017	3	83	342	23
2018	12	191	104	290
2019	7	1	406	27
sum	795	722	1,869	646

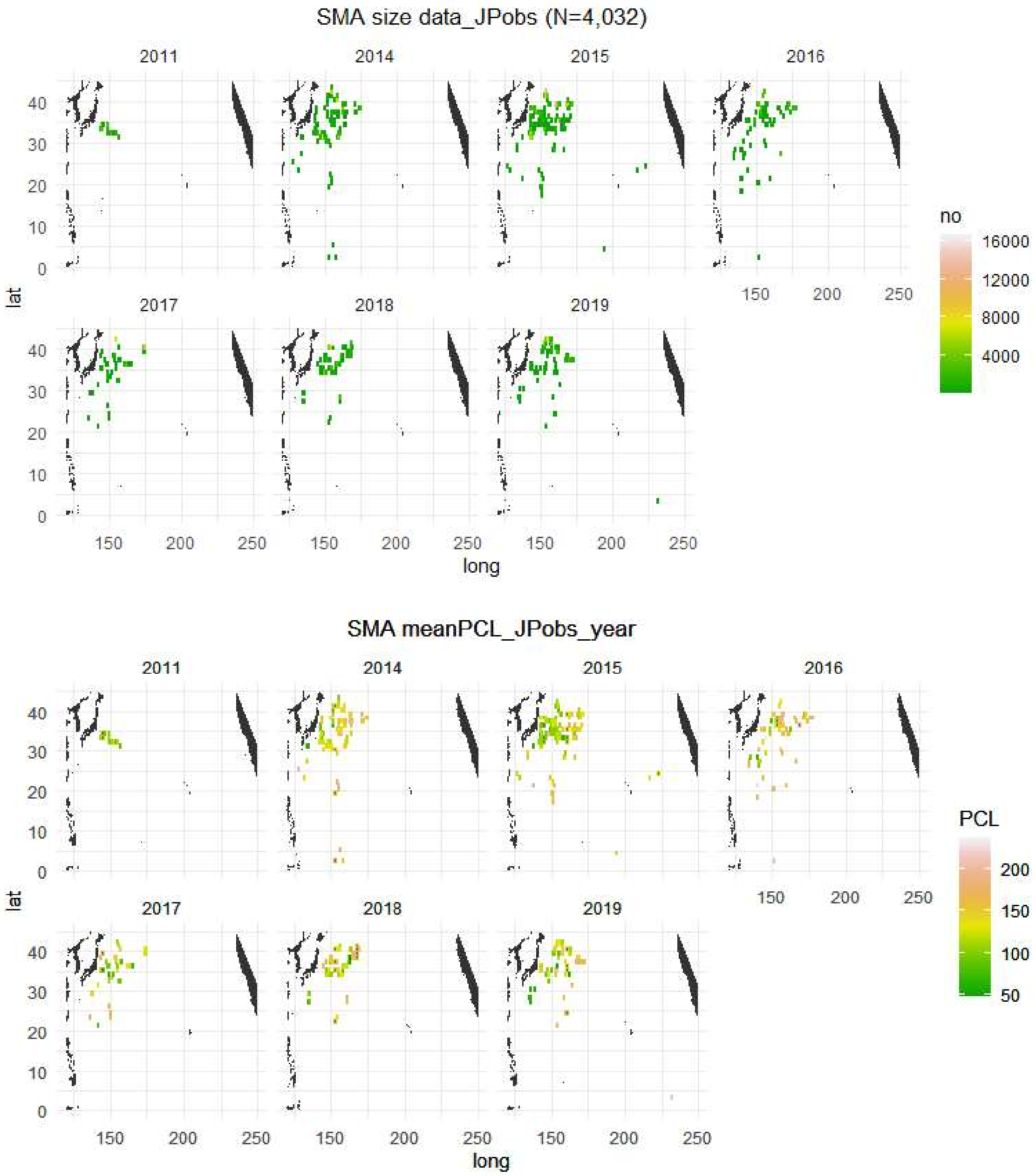

Figure1. Spatial distribution of size data (number of size data: upper) and mean PCL of shortfin mako in the North Pacific by 1° by 1° degree grid (lower) by year.

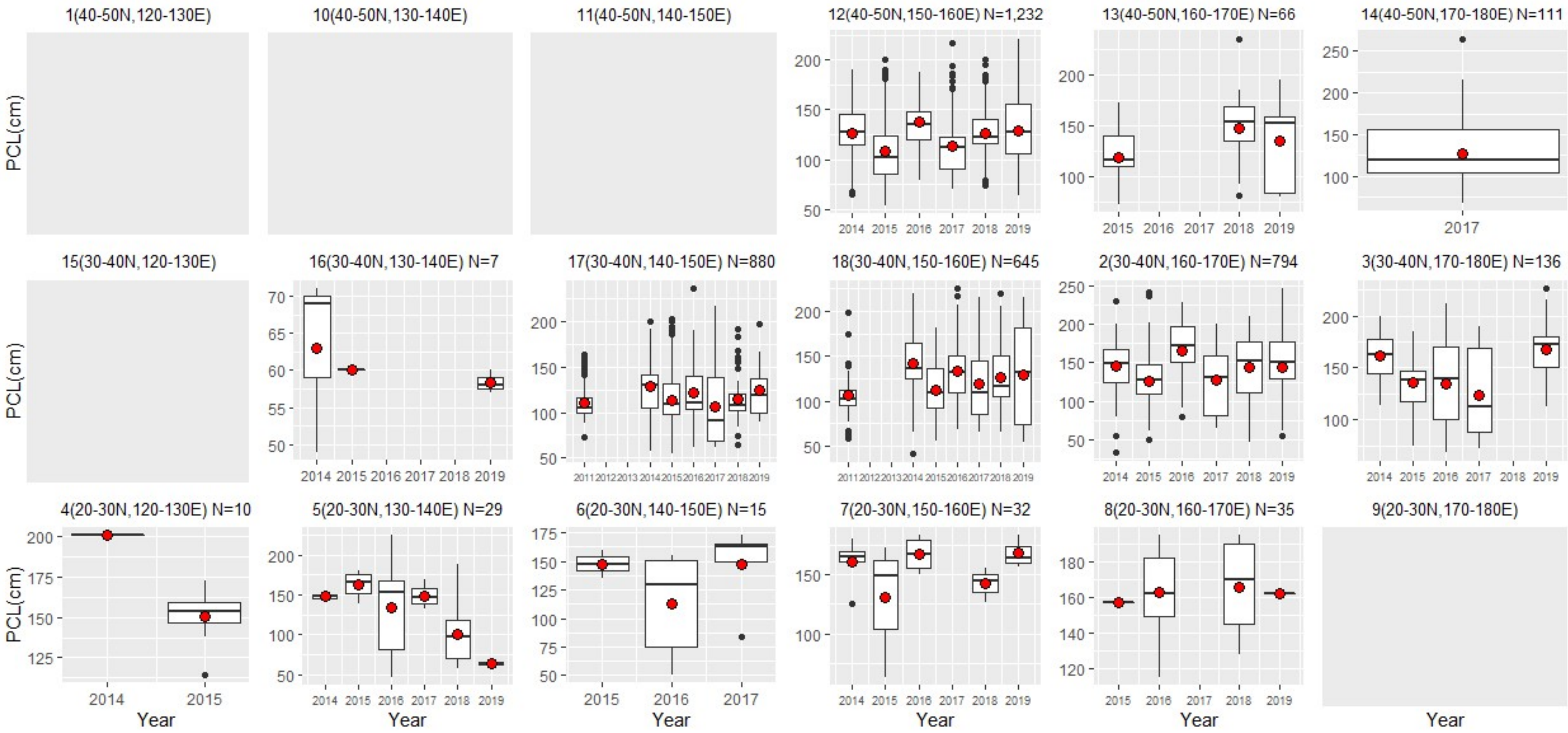

Figure 2. The annual median and quartile percentiles of catch at size of shortfin mako in PCL by 10° by 10° degrees grid. Red circle is mean PCL in each year and grid.

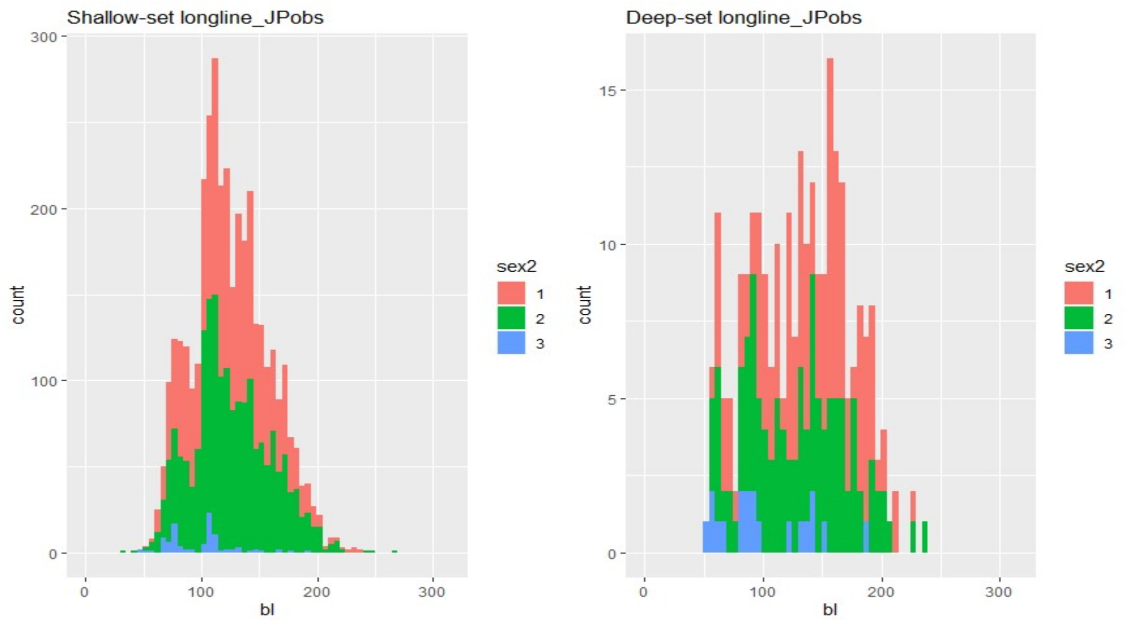

Figure 3. Size frequency of shortfin mako from shallow-set longline (left) and deep-set longline (right). X-axis is PCL (cm).

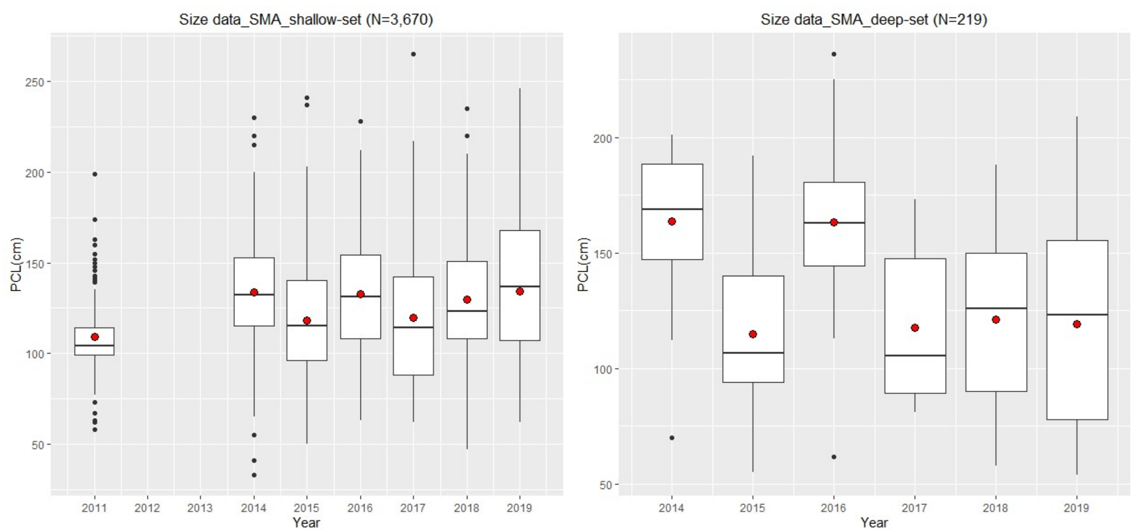

Figure4. Annual median and quartile percentiles of catch at size of shortfin mako in PCL for shallow-set longline (left) and deep-set longline (right). Red circle is mean PCL in each year and set-type.