Brief information for Japanese fishery statistics of North Pacific swordfish (*Xiphias gladius*) . [1]

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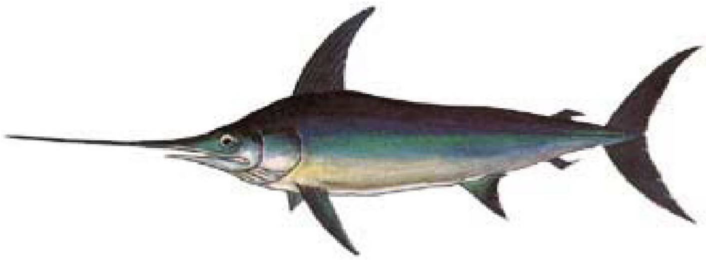

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Abstract

To apply the North Pacific swordfish datasets caught by Japanese vessels for Stock Synthesis 3, I summarized Japanese catch statistics and size composition data. The logbook data and the yearbook data are available statistics for the fishery catch. The logbook data has been reported catch of the longline fishery that includes 5 ° × 5 ° area grid information. On the other hand, the yearbook did not report the fishing ground, but almost fisheries that were reported by the yearbook have operated Japanese coastal area. The dataset format of size composition was changed at 1999. The commercial vessels and the training vessels have observed the swordfish size composition of the longline fishery. However, their fishery ground and that size frequency are different. Size composition data of training vessel might not represent Japanese longline selectivity.

Introduction

The ISC Billfish working group are planning to use the Stock Synthesis 3 (SS3) for the next North Pacific swordfish (*Xiphias gladius*) stock assessment. The SS3 needs two type data sets that are fishery data and biological data. However, Japanese fishery statistics are very complicated because that format changed historically. Here, I introduce the historical change of Japanese fishery statistics and suggest the candidate fishery definition of SS3 considering the statistics feature.

Japanese fishery statistics

Catch statistics

There are two types of catch statistics of North Pacific swordfish that are the logbook data and the yearbook data (Figure.2). The latest year of these datasets is 2014(yearbook) and 2016(logbook) respectively (Figure.2). The National Research Institute of Far Seas Fisheries (NRIFS) have been made the logbook data by quarterly and 5 ° × 5 ° area grid using the operational fishery data. The yearbook data are annual national statistics, but there are no quarterly-spatial information (Figure.2). The NRIFS had submitted catch weight data of North Pacific swordfish to the ISC however, catch weight data between 1951 and 1993 have been submitted estimated value. Furthermore, this dataset needs to divide into the Western and Central North Pacific ocean (WCNPO) and the Eastern Pacific Ocean (EPO) in the next stock assessment (Figure.1, Figure.2). The detail of each fisheries catch statistics are as follows:

Longline fishery

The NRIFS defines three type longline fishery as offshore and distant water longline, the coastal longline and the small-scale coastal longline. The offshore and distant water longline operates in the whole area of North Pacific Ocean. The almost coastal longline operates in the east of the 160 °. The small-scale coastal longline operates near the Japanese coastal area. The number based logbook data is continually available to the offshore and distant water longline (Figure.2). The catch of coastal longline started in 1969, and after 1994, the Japanese government ordered to submit operational data for coastal longliners. The small-scale coastal longline does not have the duty to provide operational data. Thus, the yearbook is available for the small-scale coastal longline.

Driftnet fishery

The drift net fishery needs to divide into before 1992 (offshore driftnet) and after 1993 (coastal driftnet) because the moratorium of driftnet fishery started on the high seas in 1993. Japanese driftnet fishery has operated inside Japanese EEZ since 1993. The data source of driftnet fishery is the weight-based yearbook data which can't divide 5 ° × 5 ° area grid. However, it is considered that offshore driftnet fishery has operated in the WCNPO until the moratorium.

Other fisheries

The yearbook is available for the other fisheries that includes the bait fishing, the net fishing, Trap net, and the others. This dataset can't summarize quarterly, and 5 ° × 5 ° area grid but this fishery have operated Japanese coastal area.

Size and weight composition data

Longline fishery

The size and weight composition data have reported since 1970. The almost data sets have been sampled by commercial longline fishery in the WCNPO (Figure.3 a, b, c). The main data source changed from weight data to length and weight data in 1999, because of data format changing (Figure.3 d). After 1999, the dataset has included operational ID. Thus effective sample size can be calculated using Pennington method (Pennington, Burmeister, and Hjellvik 2002). Japanese size and weight composition data are port sampling data that main port is Kesennuma (Figure.3 e). The area resolution has also been changed by historically, and almost data are low resolution (Figure.3 f).

The weight composition data needs to convert size data because there are only a little size data between 1970 and 1998. Using the maximum likelihood method, I estimated the convert function that is $W = 5.395 \times 10^{-6} L^{3.124} \exp(\varepsilon)$ and $\varepsilon \sim N(0, 0.12)$ (Figure.4). The quarterly estimated length frequency is approximately same as raw size composition data (Figure.5). By the annual comparison, estimated length is entirely different to raw size composition data. However, time coverage of raw size composition data is very low (Figure.6). This result suggests that estimated size data can use the SS3.

Using later period data (1999-2016), I compared the length frequency by area resolution (Figure.7). There are no differences in the area resolution however almost data sets have been reported by 5 ° × 10 ° area grid in the early period (1970-1998). Thus, I recommend using over 5 ° × 10 ° area grid resolution.

The number of training vessel data is strongly fewer than commercial vessel (Figure.3 c). However, almost data that were sampled in Central Pacific ocean is training vessel data, and that frequency is significantly different to commercial fishery (Figure.5, Figure.8). Therefore it is difficult to define size differences between operating area. The size or weight composition data of training vessel might not represent commercial vessel. Thus, I recommend not to use training vessel data for next stock assessment.

Considering these results, I recommend to use the length frequency data that was calculated by size and weight composition data (1970-1998) and remove training vessel and 10 ° × 20 ° area grid data. Using suggested size composition data, I summarized year-quarterly change of Japanese longline size composition data (Figure.9). Some bands caused by the strong year class it might need to use time-barring size or age selectivity.

Driftnet fishery

There is two size mode for the offshore driftnet that was sampled in 1991 (Figure.10). The reason of differences of length frequency is thought the operational area. In detail, the offshore driftnet has operated in the West to Central Pacific Ocean, but the coastal driftnet has operated inside of Japanese EEZ.

Summary and recommendations

- It is better using number-based logbook data for longline fishery catch because catch weight data was estimated before 1993.
- It is needs to divide driftnet fishery for two periods that are before 1992 and after 1993 because the moratorium of driftnet fishery started in 1993.
- The effective sample size can estimate after 1999. Before 1998, the effective sample size needs to be rescaled based on the estimated effective sample size.
- It is needs to use the size composition data that was converted by weight data because there are few size data before 1998.
- It is better not to use the size composition data sampled by the training vessel because training vessel might not represent commercial vessel selectivity.
- It needs to use the size composition data at least higher than the resolution of the $5^\circ \times 10^\circ$ grid because almost data was reported by $5^\circ \times 10^\circ$ grid before 1998.

References

Pennington, M., L.-M. Burmeister, and V. Hjellvik (2002). Assessing the precision of frequency distributions estimated from trawl-survey samples. *Fishery Bulletin 100*(1), 74–80.

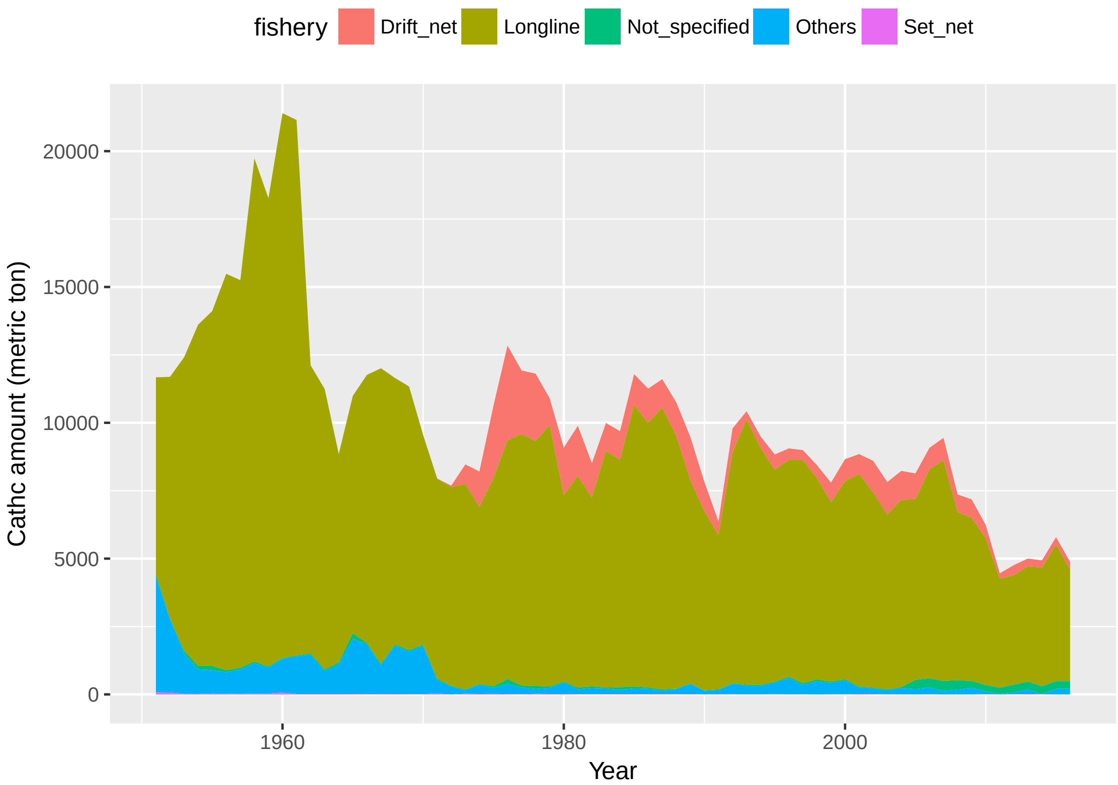

Figure 1: Historical Japanese catch weight data of North Pacific swordfish submitted to the ISC.

Fishery definition	Data source	Resolution	Unit	Period	
1. Offshore and	Logbook	Year, Quarter, 5x5	Weight	1994	2016
distant water longline	Logbook	Year, Quarter, 5x5	Number	1952	2016
2. Coastal longline	Logbook	Year, Quarter, 5x5	Weight	1994	2016
	Logbook	Year, Quarter, 5x5	Number	1994	2016
3. Other longline	Yearbook	Year	Weight	1952	2014
4. Offshore drift net	Yearbook	Year	Weight	1960	1992
5. Coastal drift net	Yearbook	Year	Weight	1993	2014
6. Other fisheries	Yearbook	Year	Weight	1952	2014

Figure 2: Summary of the Japanese catch statistics.

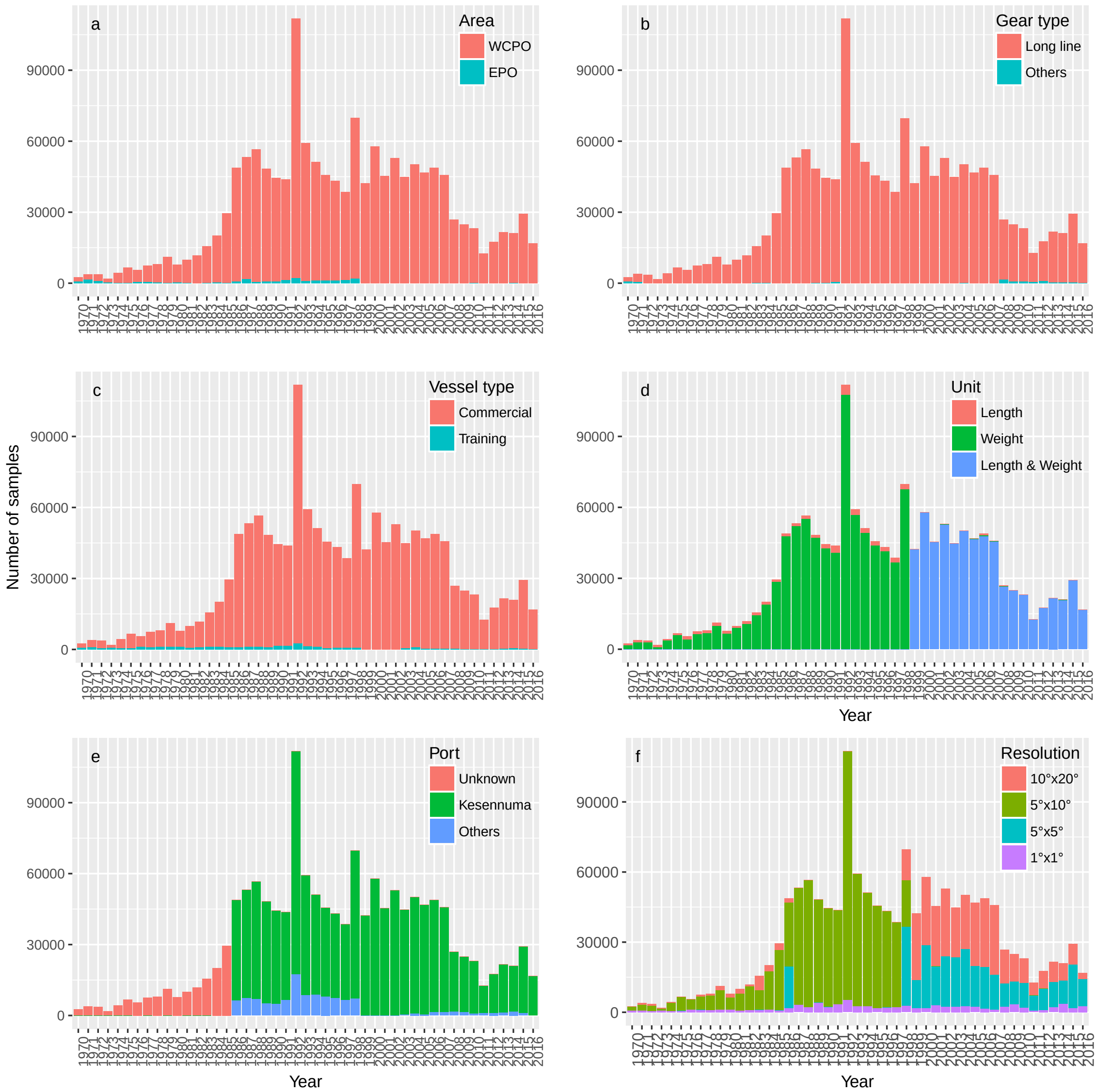

Figure 3: Annual number of samples of the Japanese size or weight composition data.

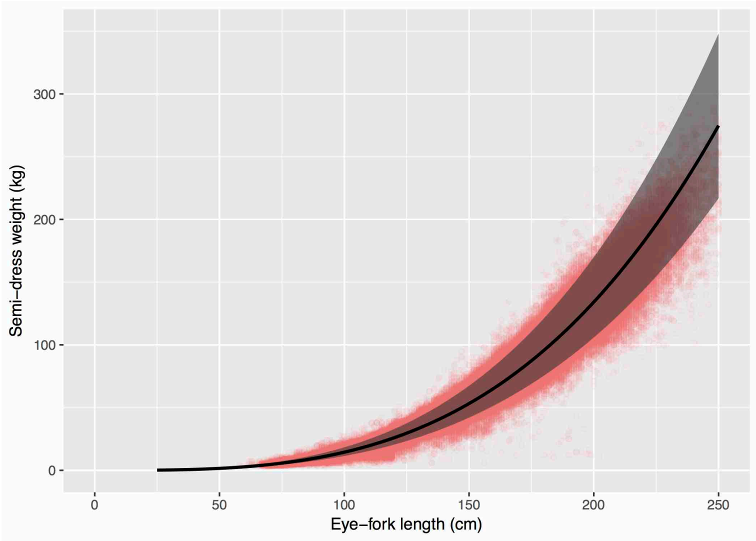

Figure 4: The length and weight relationship between 1999 and 2016. The solid line is predicted line, red dots are raw data, and the shaded ribbon is 95 % confidence interval.

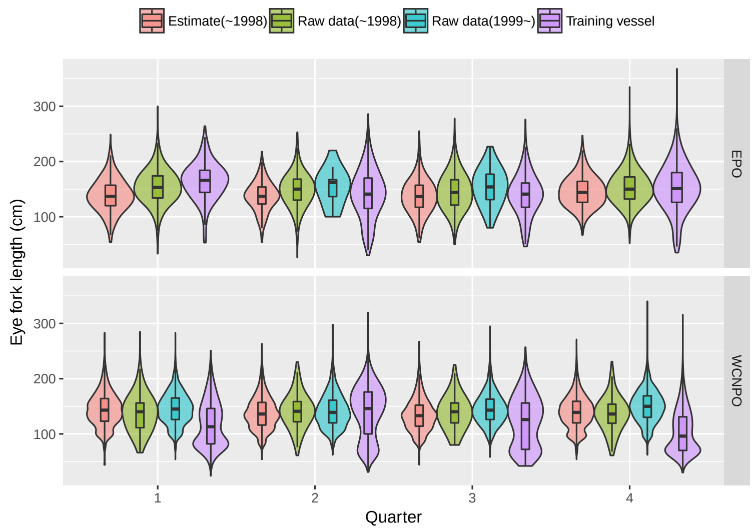

Figure 5: The comparison of the size composition data by different category.

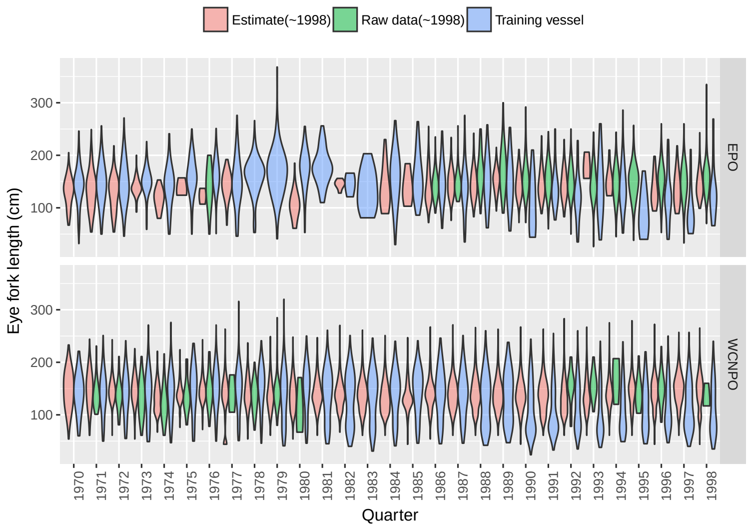

Figure 6: The historical change of the size composition data between 1970 and 1998.

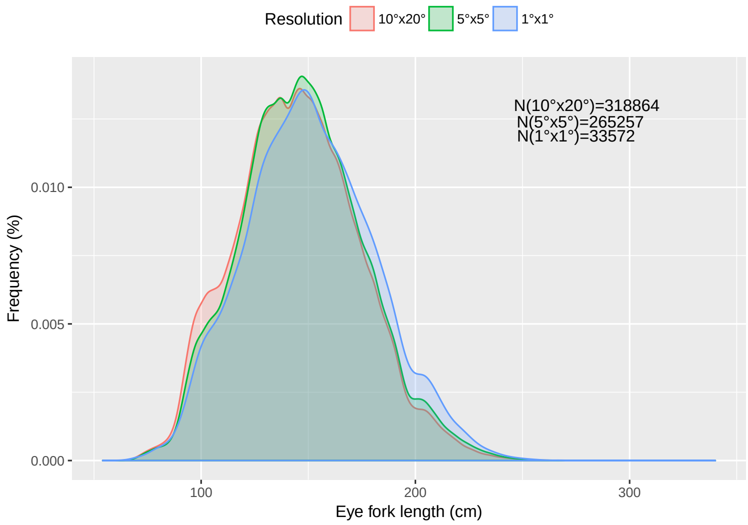

Figure 7: The comparison of different area resolution using size composition data between 1998 and 2016.

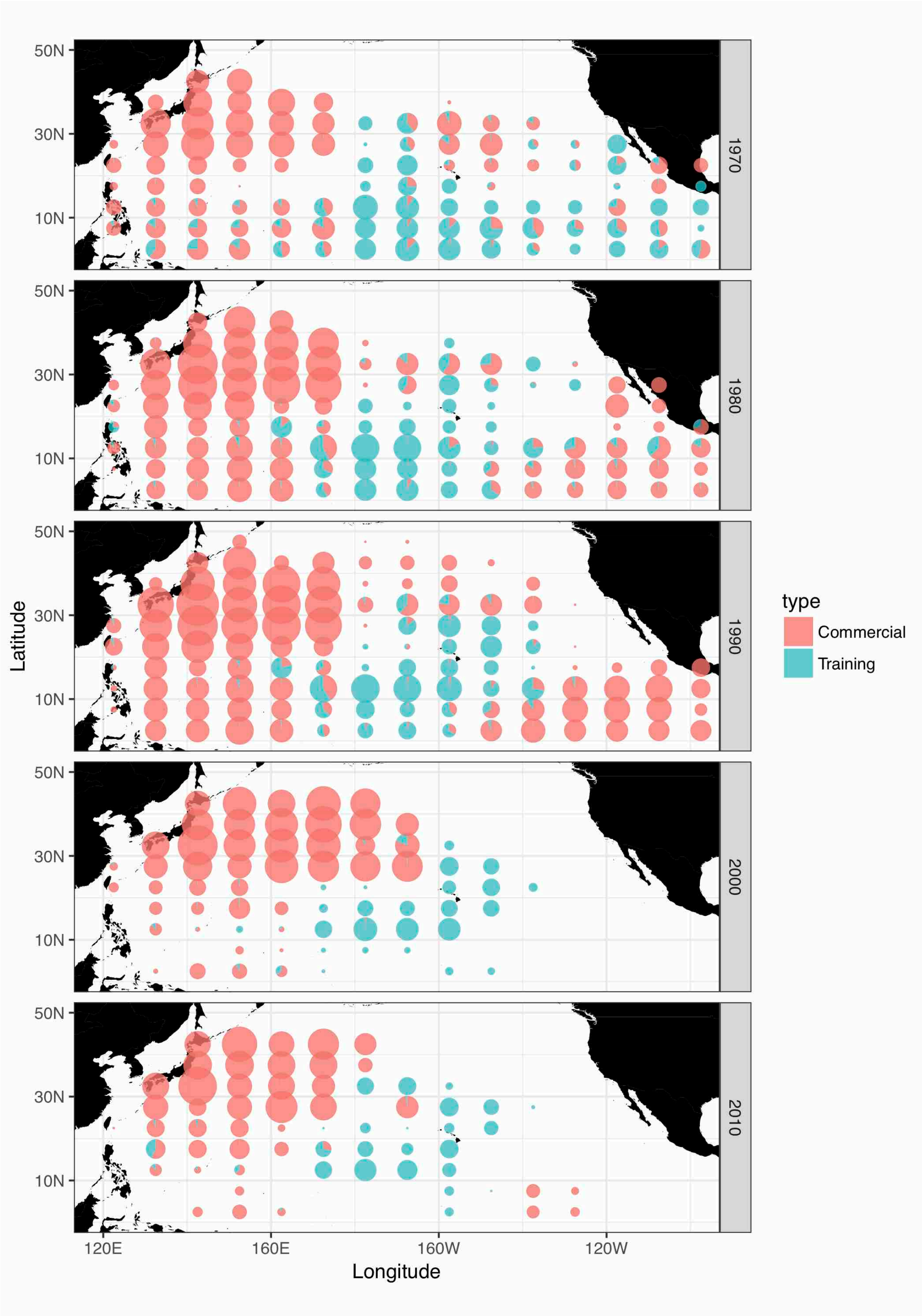

Figure 8: The time-spatial changes of the number of samples (log scale). The number of samples was aggregated by 5 ° × 10 ° area grid and removed 10 ° × 20 ° area grid data.

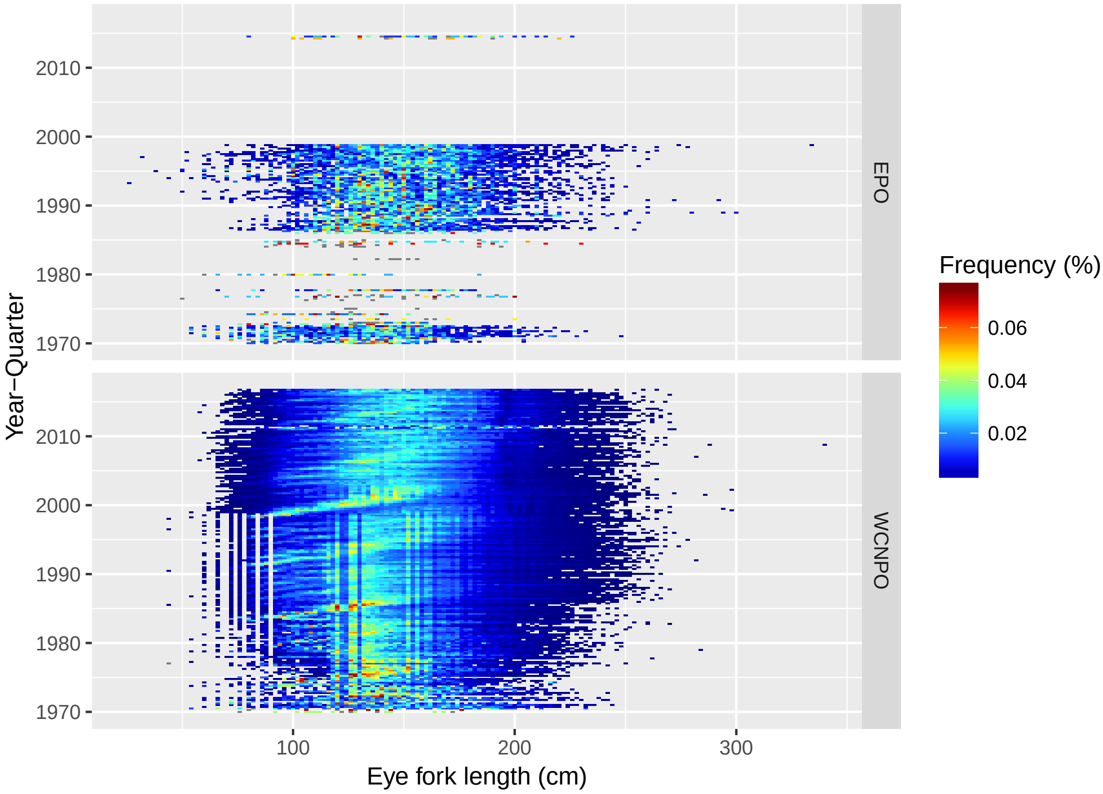

Figure 9: The year quarterly change of length frequency for Japanese longline fishery. The length frequency was calculated by size and weight composition data and removed training vessel data.

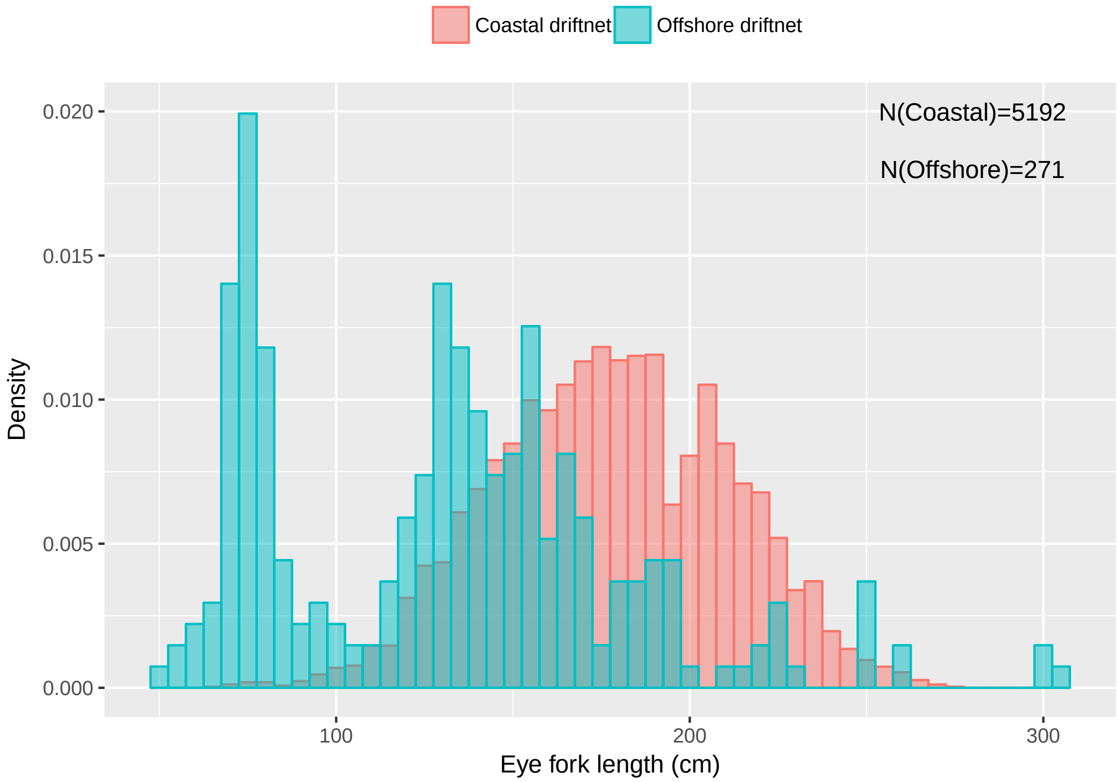

Figure 10: The size composition data of the driftnet fishery. The driftnet fishery needs to divide into two periods (before 1992 and after 1993) because the moratorium of driftnet fishery started in 1993.