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Summary of size data update for North Pacific albacore (*Thunnus alalunga*) in Japanese fisheries

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Summary

1. We prepared and summarized the length composition data of North Pacific albacore caught by Japanese fisheries between 1967 and 2022 based on the area definition of the last stock assessment.
2. In this update, we added several old data sources that were newly digitized/organized into the database.
3. Updated and newly added data consists of three databases (Size csv, Size org, SKJ NAS), and the newly prepared data has more data than the 2019 data in most years, but the number of data are less in the period from 1998 to 2000.
4. The less data in the period 1998-2000 was derived from the use of size csv in the period, instead of using size org due to missing data of measurements at Yaizu port in 1998-2001 in size csv.
5. Seasonal and historical trends for length frequency in 2022 data is almost similar to those in 2019 data for three fisheries (longline, pole-and-line, drift net) and stock assessment areas except for the pole-and-line fishery operated in the southern region, which is brought by the additional historical data in this update.
6. Newly updated size data showed that albacore caught by longline and pole-and-line tends to be smaller in higher latitude areas, and this common trend between fisheries roughly agrees with the insight of change in spatial distribution along with their life stages.

Introduction

Understanding trends in size data of albacore (*Thunnus alalunga*) is an important component of its stock assessments as it represents selectivity of the fisheries. In fact, Japanese fisheries catch albacore by different types of gears such as longline, pole-and-line, drift net (until 1993 due to moratorium), and etc. and their gear usage, in other words the size of albacore they catch, is related to the areas and seasons of the operations as albacore seasonally migrates toward off Japan areas and changes their swimming depth (Kiyofuji et al., 2013).

Albacore size data by Japanese fisheries has been updated in every stock assessment not only to include the most recent data, but also to review and include newly found data sources. In this update, we are ready to add several data sources that have not been utilized for the stock assessment because they were not digitalized (Fig. 1) or organized into a database. The new data are now formatted with several error checks and ready to be used for the stock assessment.

This paper first describes the newly added data and data processing steps which were used throughout all data sets. Then we further check the data consistency by comparing it with ones that were used in the last assessment and summarize the characteristics of the Japanese size data in longline, pole-and-line, and driftnet fisheries.

Data and Methods

Data sets

The size data available for Japanese fisheries consist of two different databases, Tuna stat and SKJ NAS, that are independent from each other (Fig. 2). Tuna stat is mainly composed of longline data obtained by training/research vessels, observers, and port sampling, whereas SKJ NAS is composed of pole-and-line data obtained by training/research vessels and port sampling operated by Fisheries Research Agency (FRA) staff and several prefectures.

Tuna stat database had experienced changes in data categories of operation (length code, length unit, vessel name, vessel size, etc.) through time and the data are recognized as size org (size data by original text file, available since 1948 to present) for the old format and size csv (1998 to present) for the new format. It has been recommended to use size csv rather than size org by our data manager as size csv data contains more detailed information of sampling. In this update, we followed the recommendation and data for periods of 1998-2022 were prepared by size csv and 1948-1997 by size org.

The updates of SKJ NAS since the last assessment includes addition of its data

sources (Figs. 1 and 2). Some hand-written data books were newly digitized and organized data were added after proper error checks. Size data prepared for stock assessment usually consist of the dataset used in the previous assessment and newly added data. We found the lack of data source information in the datasets used in the last 2019 assessment especially in their old periods, thus we fully re-generated the size data for the 2022 assessment from the original database to facilitate data reproducibility in a transparent manner. As the data sources of the last assessment were unknown, it should be noted that complete comparison between the 2019 and 2022 size data is impossible. Newly generated size database includes the following data sources.

• Pole-and-line fishery

• Training/Research vessels: 1964-2021

• Port sampling by FRA staffs

Tohoku National Fisheries Research Institute: 1953-1978,
National Research Institute of Far Seas Fisheries measured in
Chiba-Katsuura:2006-2013, Kesennuma: 2002-2021, Yaizu:2011-2021
Marine Fisheries Research and Development Center: 2002-2005

• Port sampling by prefectures

Miyagi:2001-2015, Ibaraki:1973-2001, Mie:2005, Wakayama: 2002-2015,
Chiba: 2003-2005

• Longline fishery

• Port sampling by prefectures

Miyazaki: 2001-2022, Miyagi: 2001-2021, Kochi: 2002, Chiba: 2001-2012,
Wakayama: 2001-2021

• Port sampling by FRA staffs

Tohoku National Fisheries Research Institute: 1974

•Drift net fishery within EEZ

• Port sampling by prefectures

Chiba: 2012

•Other fisheries (Purse seine, trawl fishery, Bottom dragging net)

• Port sampling by prefectures

Fukushima: 2013, 2016, Mie: 2022, Miyagi: 2001-2020, Wakayama: 2002-2021

• Observer: 2017-2019

• Port sampling by FRA staffs:

Kesennuma: 2008
Tohoku National Fisheries Research Institute: 1970-1977

Data preparing process

Data processing flows to prepare the 2023 stock assessment size data were shown in Fig. 3. Three data files (Sizeorg, Sizecsv, SKJ NAS) were merged and then re-formatted. Information necessary for the input data of the stock assessment such as a fleet definition and stock assessment areas information (Fig. 4) were added. Then, the filtering processes below were applied to extract suitable data for north Pacific albacore stock assessment:

•Species: albacore
•Gear: longline, pole-and-line, drift net
•Area: north Pacific Ocean (i.e., latitude >=0) and inside the stock assessment areas
•Area level: 1x1, 5x5
•Year: 1998-2022 for size csv, 1948-1997 for sizeorg
•Vessel: commercial vessel
•Error: remove length >=160, Year>=2023

Results and Discussion

The number of size data available from each database for this stock assessment was shown in Fig. 5. The Data periods mainly covered by Tuna stat are as follows; Size org covers from 1988 to 1997 and size csv covers from 1998 to 2021. Most of the recent data comes from SKJ NAS with additional historical data from 1974 to 1978 obtained by newly digitized book records.

Locations of port measurement recorded in each database were shown in Fig. 6. Tuna stat (i.e., size csv and size org) data for longline, pole-and-line, drift net fishery were basically measured at three ports (Kesennuma, Nachi-Katsuura, and Yaizu). Other data in Tuna stat were those measured onboard. On the other hand, SKJ NAS data came from wide areas of Japan (15 ports) as the data includes measurements by prefectural institutes.

Comparison between 2019 and 2022 size data

Comparing the number of size data prepared for 2022 with that of 2019 revealed that more data exist in the 2022 data than in the 2019 data in most years (Fig. 7) as the several data sources are newly prepared and added in the 2022 data. However, the trend from 1998 to 2000 shows the opposite. The difference in these years between the 2019 and 2022 data is which database of Tuna stat was used, which were size org for the 2019 data and size csv for the 2022 data (Fig. 8), which has been noted as data inconsistency in Ohashi et al., 2019. Comparison of the number of size data by area (Fig. 9) revealed the data from Area 6 (data by pole-and-line) clearly contributes to this difference, and it was the data of Yaizu port in 1998-2001 that were missing (Fig. 10). Since the size csv still

needs some updates and reviews which require several works, it may need to be discussed which of the data from size org or size csv in early periods should be used in this stock assessment.

Characteristics of Japanese size data

Sampling locations, median lengths in each location (1x1 grid), histogram of size data for each area and quarter, and historical changes in the histogram for longline, pole-and-line and drift net were shown in Figs. 11-19. The same figures made in the 2019 assessment can be found in Ohashi et al., 2019, and it should be noted that there are certain differences in data preparation process between the 2019 and 2022 data.

Longline

Sampling locations of the longline fishery mainly comes from areas 1-3 (Fig. 11). In areas 1 and 3, relatively small individuals around 75 cm FL were caught in quarters 1 and 2 (Fig. 11 bottom, Fig. 12). On the other hand, in southern areas (areas 2 and 4), large individuals around 100 cm FL were caught. In area 5, intermediate size individuals around 90 cm were caught (Fig 12) by scarce data, though. These trends continue through the years from 2000 to present (Fig. 13). Overall trend in the 2022 size data of the longline fishery is quite similar to that of the 2019.

Pole-and-line

Sampling locations of the pole-and-line fishery are concentrated on the northern area of 6 in quarters 2 and 3 (Fig. 14). This sampling pattern is related to the fishing strategies of the Japanese pole-and-line fishery. They mainly target skipjack in most seasons but some of the vessels seasonally change their targets to albacore in these quarters. The median size of albacore in area 6 (80 cm FL) tends to be slightly smaller than that in area 7 (85 cm FL). The latitudinal trend of size (the higher the latitude it gets, the smaller the size becomes) found in the longline fishery is also found in the pole-and-line fishery. It should be noted that the several modes are found in the pole-and-line fishery (Fig. 15 Top), and historical changes also show similar modes (Fig. 16). Overall trend in the 2022 size data is similar to the 2019 data (Ohashi et al., 2019), but the size in area 7 shows slight differences. In the 2019 data, the size data of area 7 mainly consist of individuals more than 80 cm FL (Ohashi et al., 2019), whereas there is an increase in data of individuals less than 80 cm in the 2022 size data (Fig. 15 Top). This is a progress in the size data collection, though sampling in the area is still too scarce to capture the trend.

Drift net

Sampling locations of the high seas driftnet and Japanese drift net fisheries are shown in Fig. 17. The high seas driftnet is widely distributed in the central Pacific Ocean (Fig. 17), and most individuals were sampled in the northern area of 8. The sizes recorded in area 8 have two modes (55 cm and 70 cm in FL), while that in area 9 has one mode (55 cm FL, Fig. 18). Regarding historical trends (Fig. 19), only fragmental information is available for the high seas driftnet fishery which ceased their operations in 1993 (Uosaki et al., 2011). Japanese drift net data after 2000 in area 8 shows high variability in their recorded sizes.

Reference

Kiyofuji, H., Okamoto, S., and Ijima, H. 2013. Vertical and horizontal changes of North Pacific albacore derived from archival tag data. Working paper submitted to the ISC Albacore Working Group Intercessional Workshop, 5-12, November 2013, National Research Institute of Far Seas Fisheries, Shimizu, Shizuoka, Japan.

Ohashi, S., Ijima, H., and Kiyofuji, H. 2019. Summary of historical size data of North Pacific albacore (Thunnus alalunga) caught by Japanese fisheries. ISC/19/ALBWG-02/06. Working Paper submitted to the ISC Albacore Working Group Intercessional Workshop, 12-18 November 2019, National Research Institute of Far Seas Fisheries, Shizuoka, Japan.

Uosaki, K., Kiyofuji, H., and Matsumoto, T. 2011. Review of Japanese albacore fisheries as of 2011. ISC/11/ALBWG/13. Working Paper submitted to the ISC Albacore Working Group Stock Assessment Workshop, 4-11 June 2011, National Research Institute of Far Sea Seas Fisheries, Shimizu, Japan.

Figure

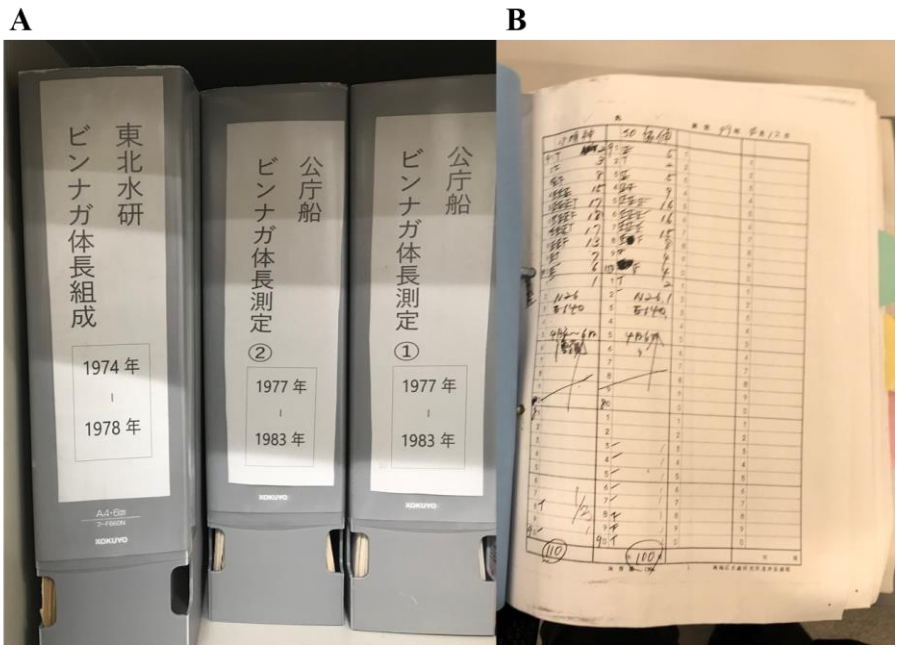

Fig. 1. An example of unorganized albacore size data in the FRA library. (A) Original written record files of albacore size data measured along port sampling by FRA staff (left) from 1974 to 1978 and by training/research vessels (middle and right) from 1977 to 1983. (B) Columns of size, date and locations by FRA staff recorded in 1974.

	Training/Research vessel	Observer	Port sampling by FRA staff	Port sampling by Prefecture
Longline (LL)	Tuna stat	Tuna stat	Tuna stat	SKJ NAS*
Pole and line (PL)	SKJ NAS*	No data	SKJ NAS*	SKJ NAS*
Drift net (DN)	No data	No data	Tuna stat	SKJ NAS
Trawl, Purse seine etc	No data	No data	SKJ NAS*	No data

Fig. 2. Available Japanese size database (DB). Sizeorg and Sizecsv in Tuna stat share basically the same data, but the Sizecsv contains new columns such as length type, length unit, weight type, weight unit, vessel name, vessel size, call sign, etc. which had started since 1998. * represents newly digitized or organized of the historical record. Note that all updated data is added into the SKJNAS.

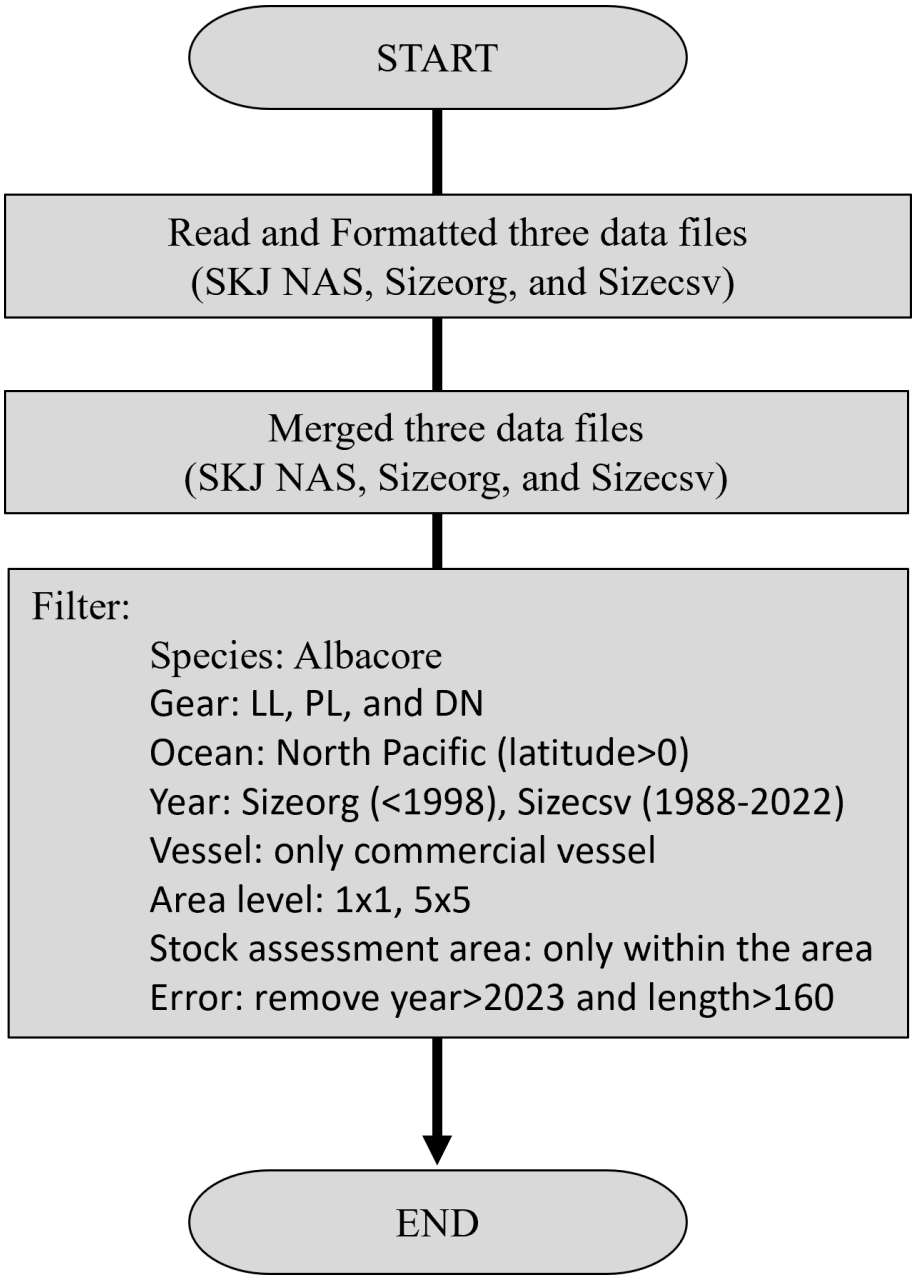

Fig. 3. Data preparation flow of Japanese size data for north Pacific ISC albacore stock assessment.

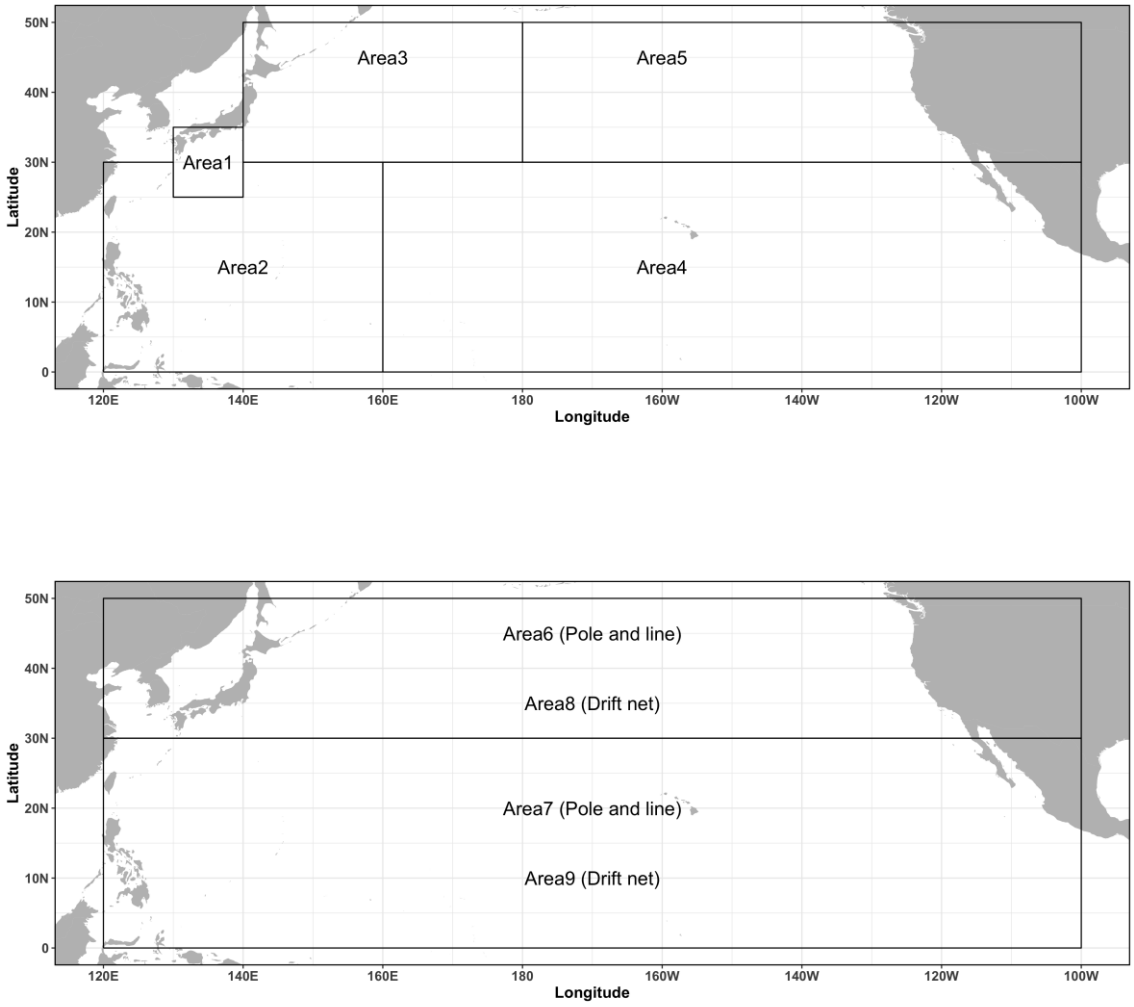

Fig. 4. An area definition for the longline (Top) and drift net and pole-and-line fisheries (Bottom).

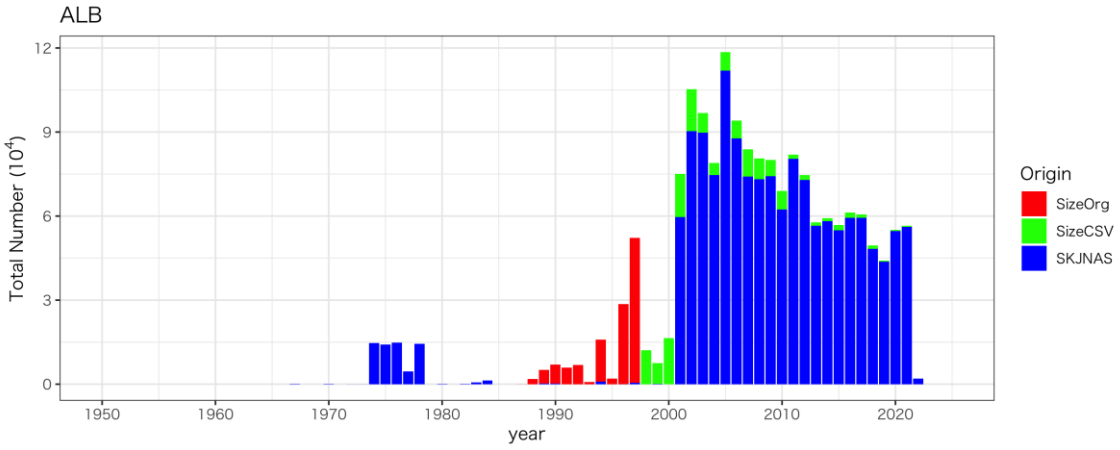

Fig. 5. The number of size data in each database (Sizeorg, Sizecsv, SKJNAS).

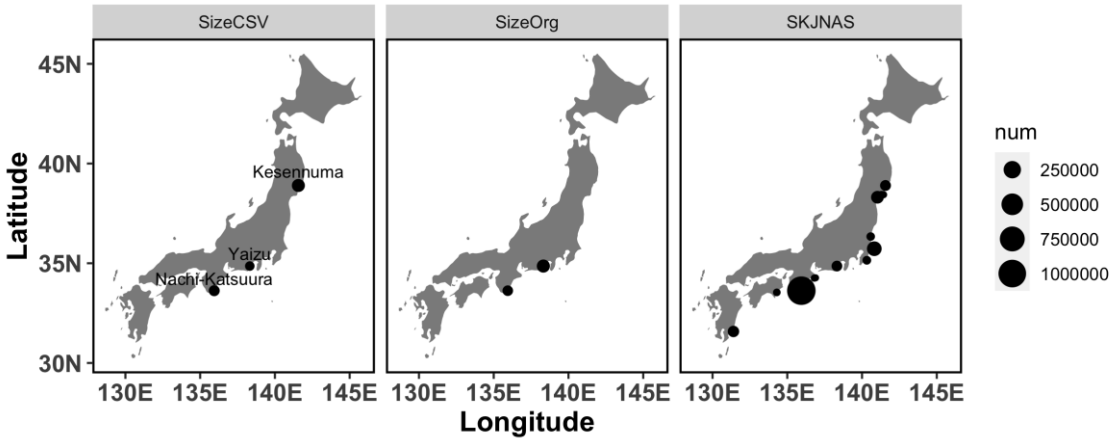

Fig. 6. Sampling locations of size data in each database (Sizeorg, Sizecsv, SKJNAS).

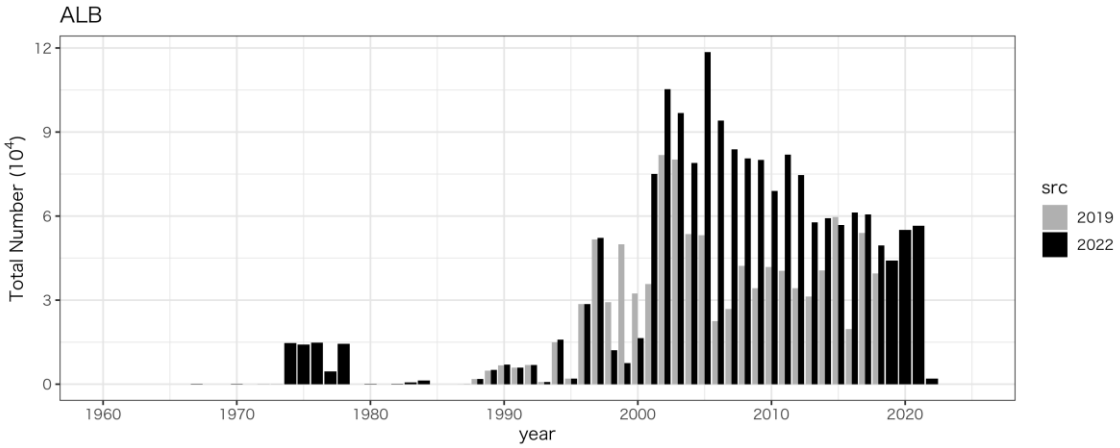

Fig. 7. Comparison of the number of size data between the size data used in the 2019 assessment(gray) and prepared 2022 data (black).

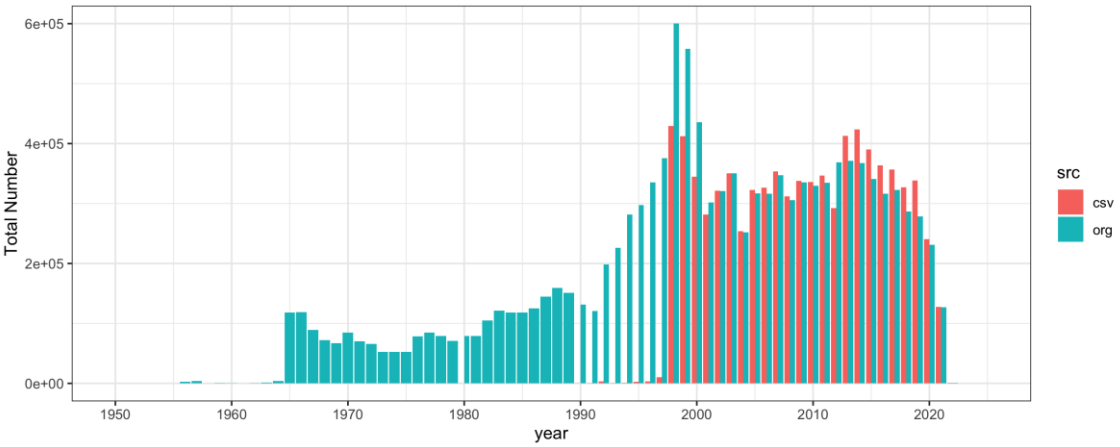

Fig. 8. Comparison of the numbers of size data for albacore derived from Sizeorg and Sizecsv in the 2022 prepared data before filtering.

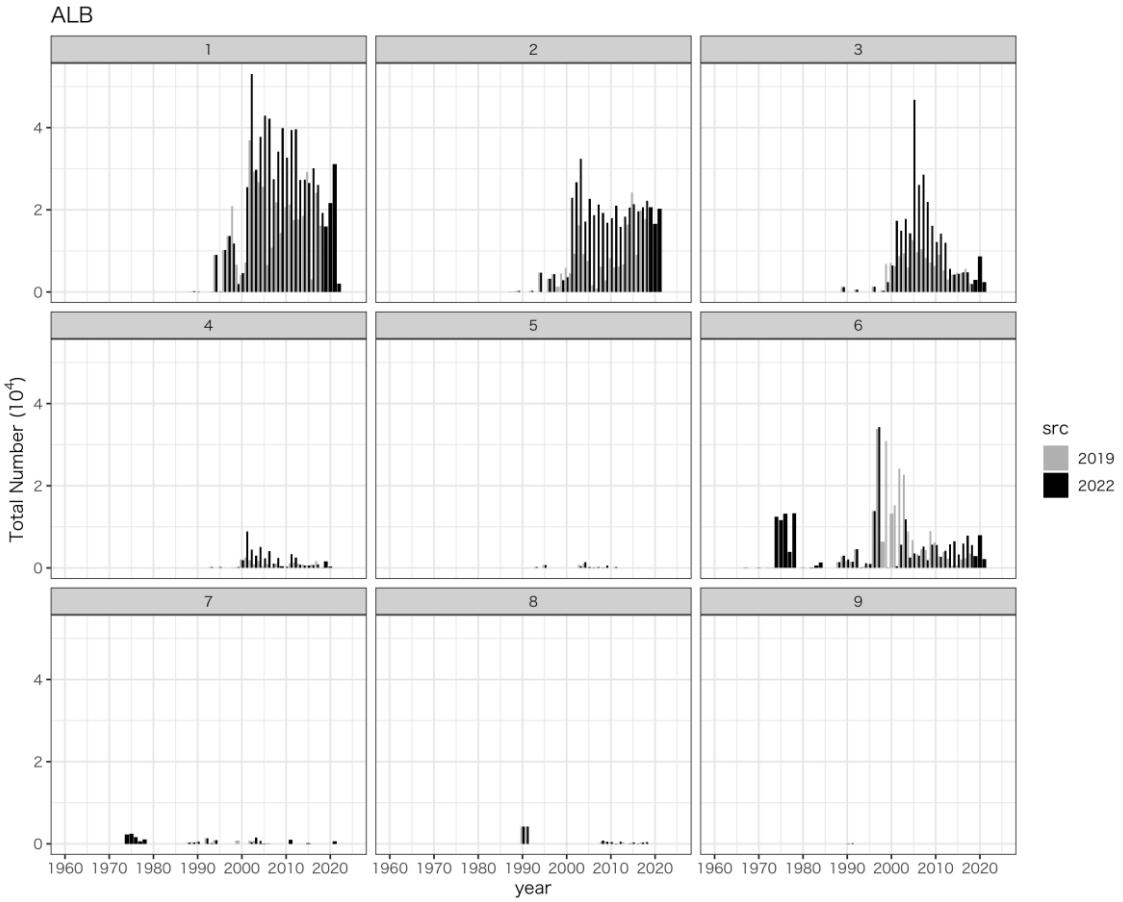

Fig. 9. Comparison of the number of size data between the 2019 and 2022 data by area.

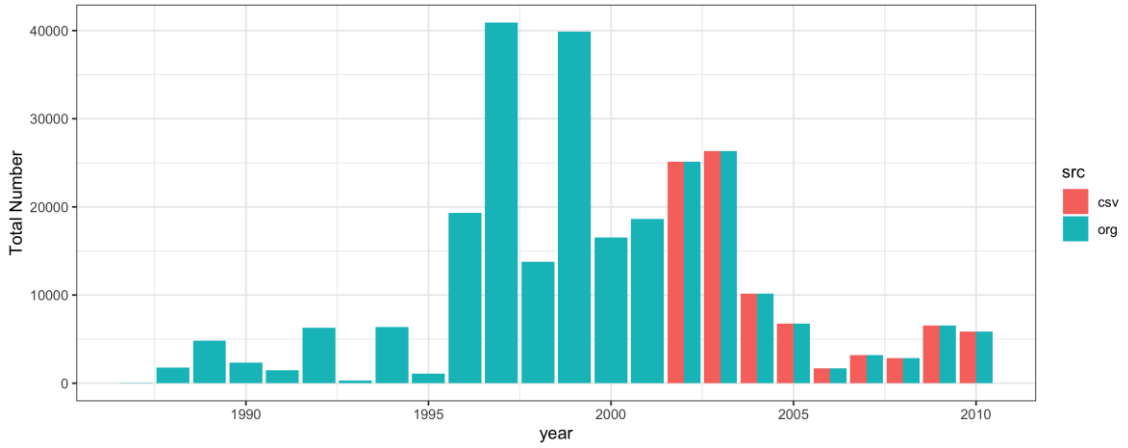

Fig. 10. Comparison of the numbers of size data from Yaizu port derived from Sizeorg and Sizecsv in the 2022 prepared data.

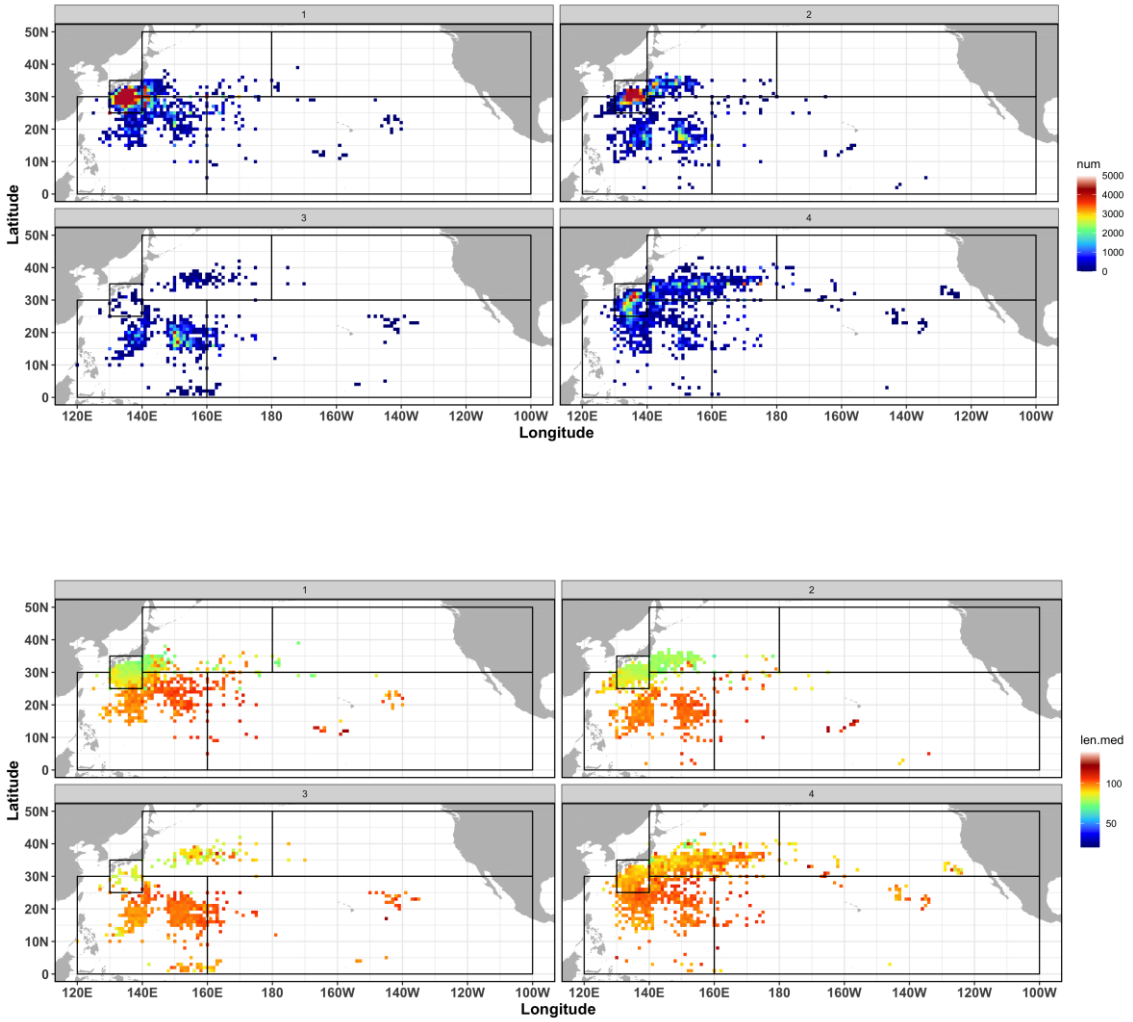

Fig. 11. The number of data (Top) and median lengths in each quarter of the longline fishery.

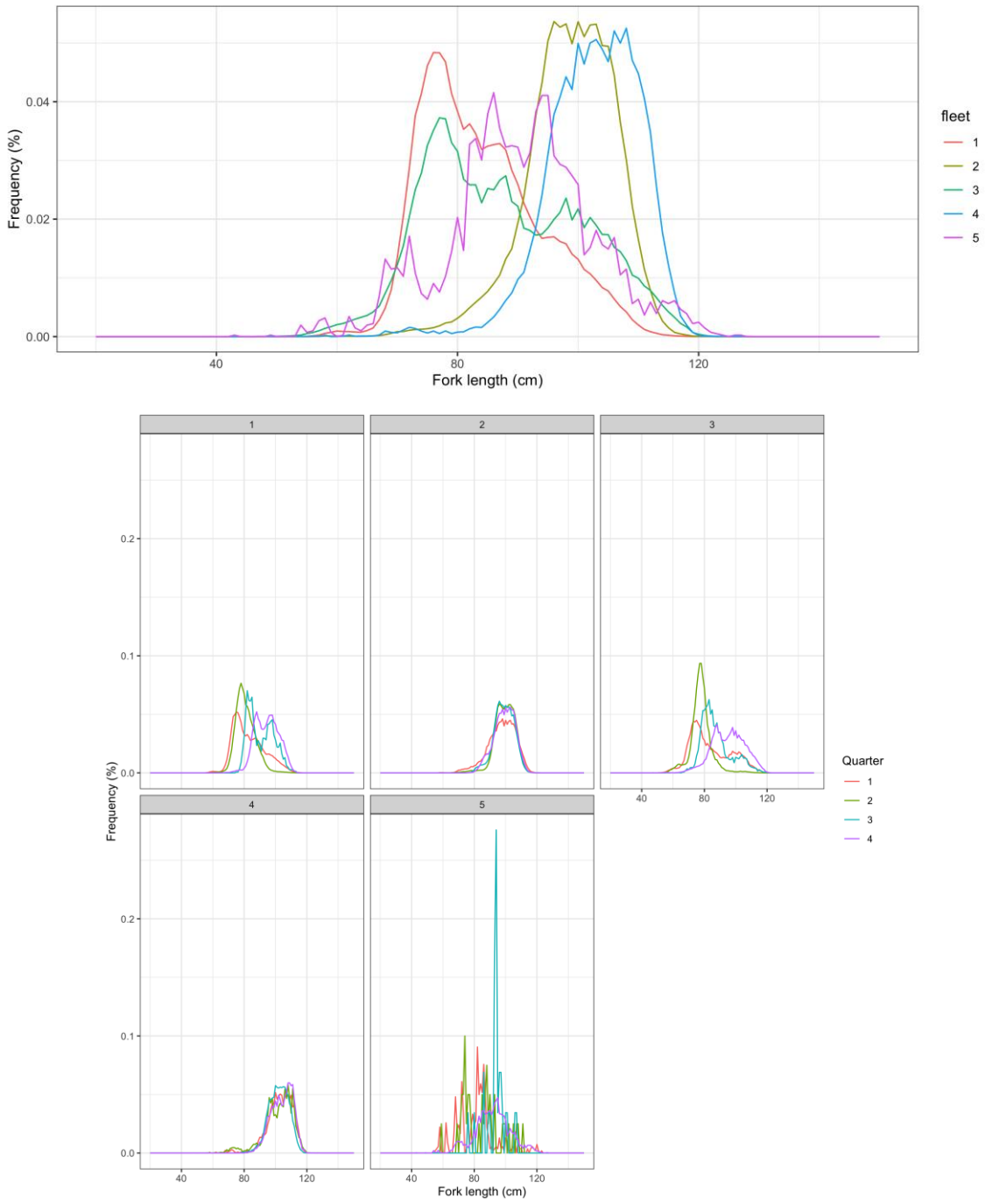

Fig. 12. Length frequency of albacore caught by the longline fishery in each area (Top) and their seasonal differences (Bottom).

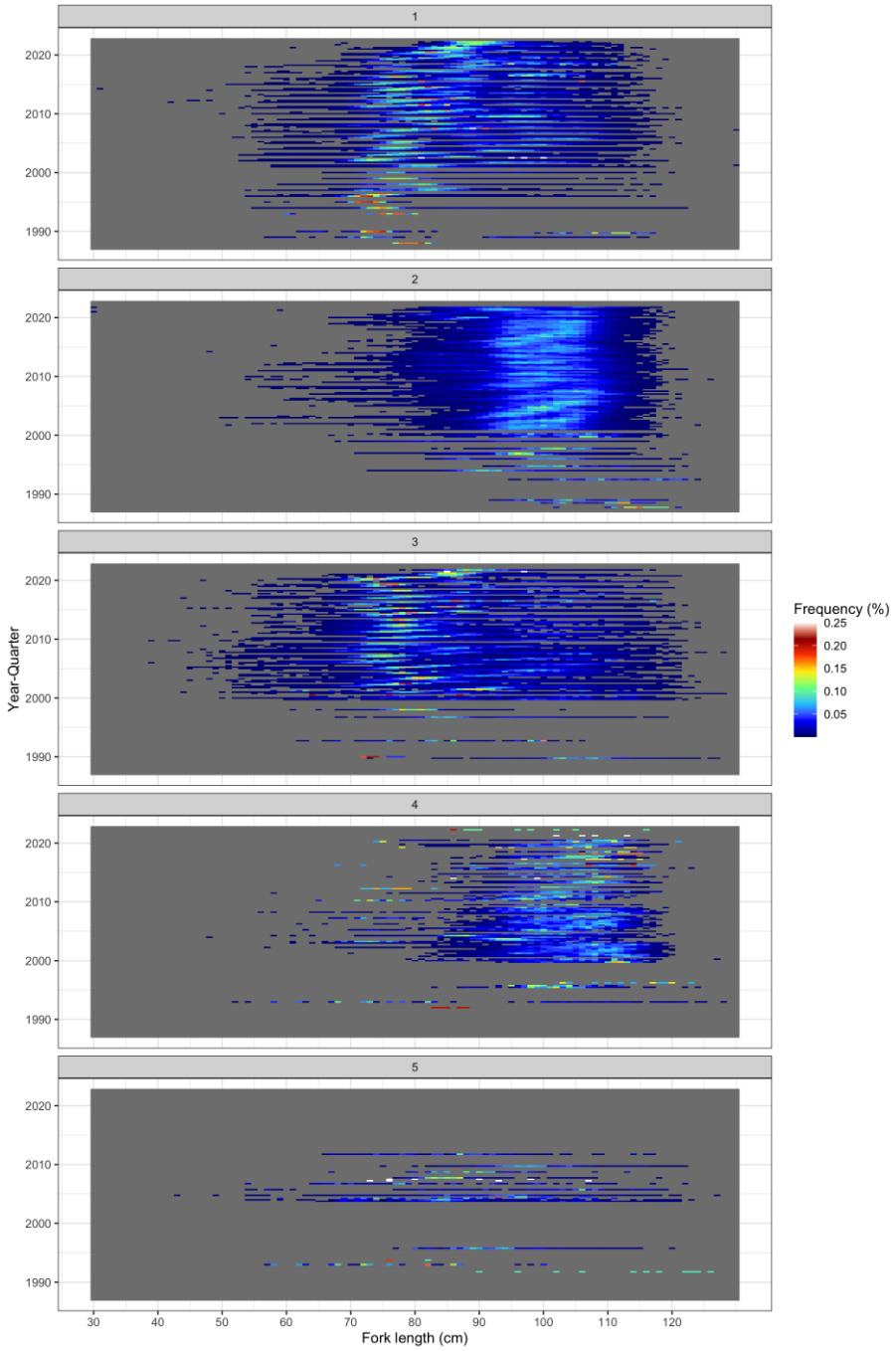

Fig. 13. Historical changes in length frequency of albacore caught by the longline fishery.

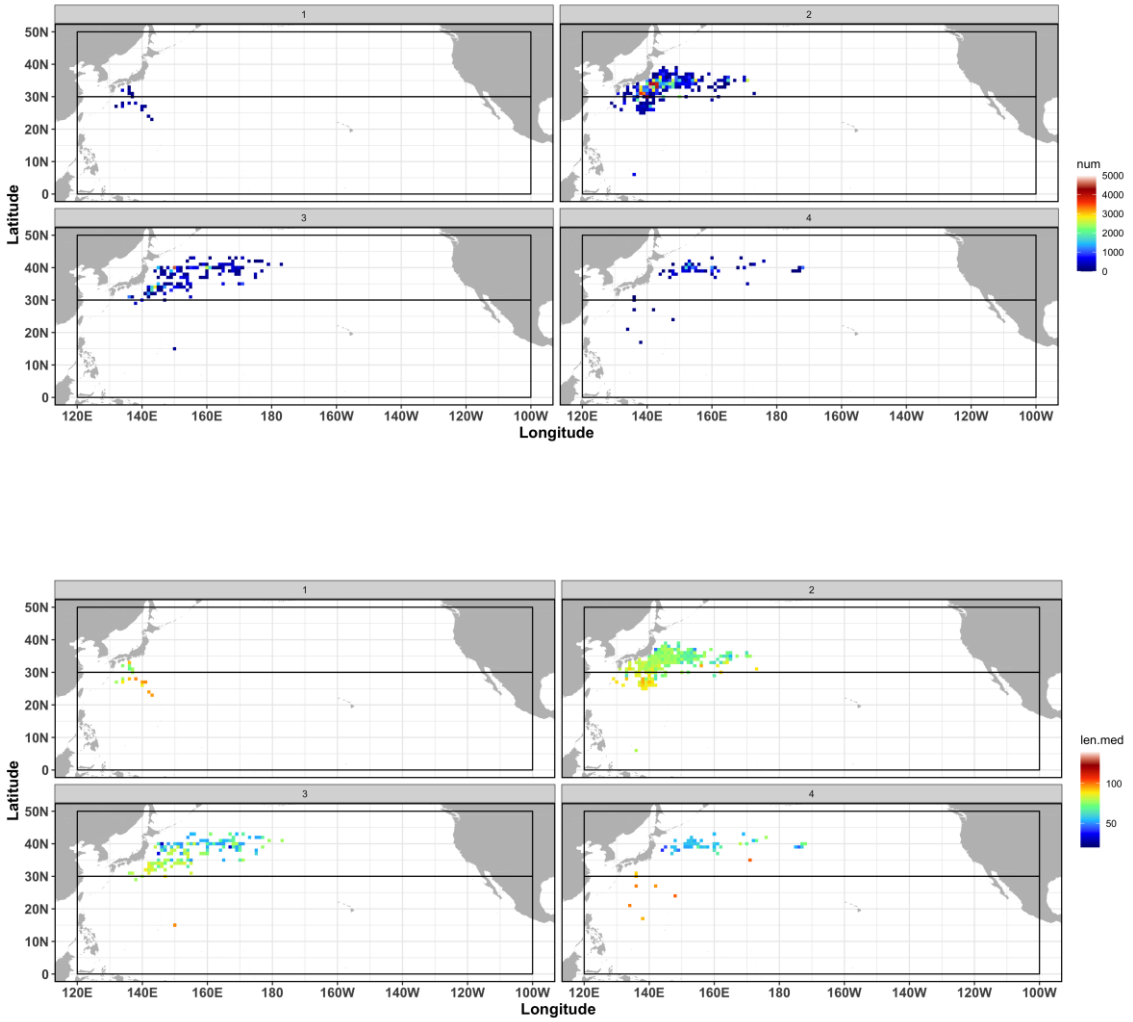

Fig. 14. The number of data (Top) and median lengths in each quarter of the pole-and-line fishery.

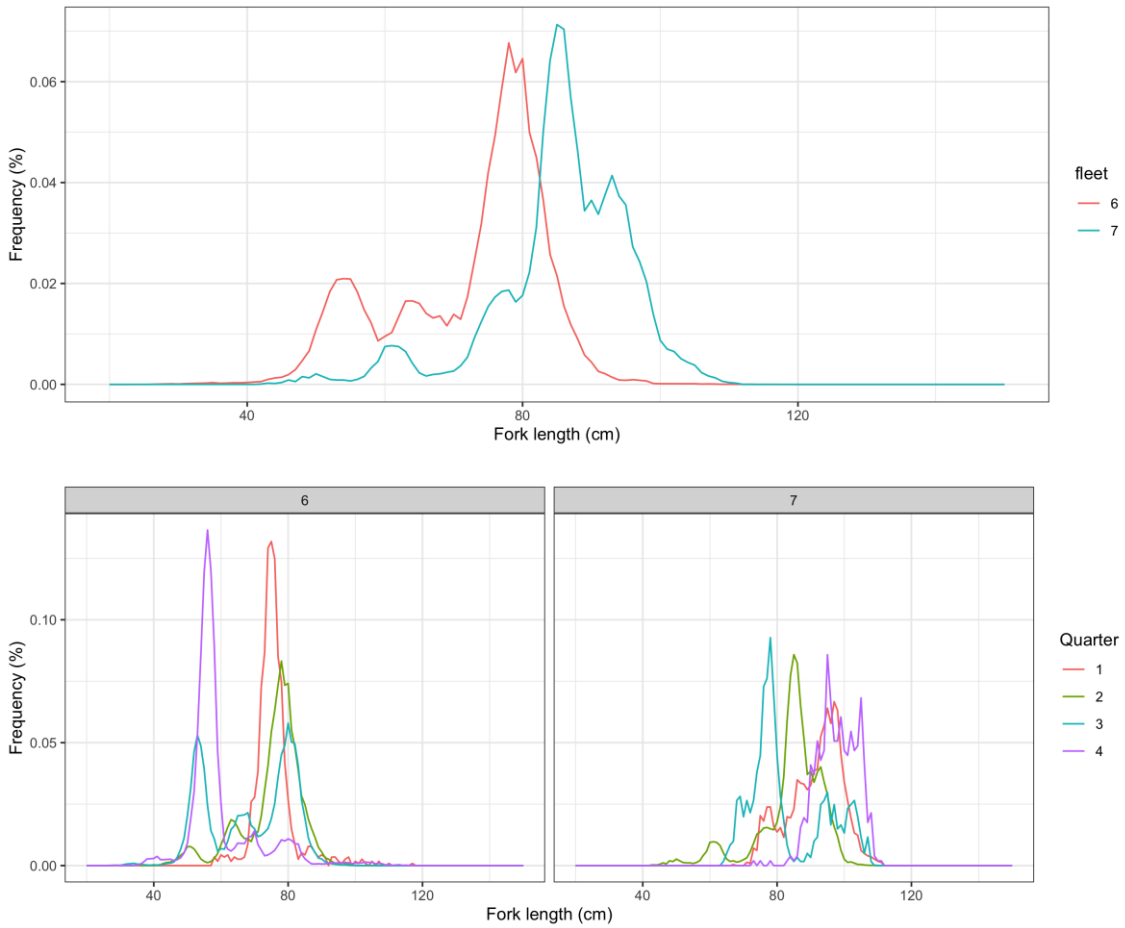

Fig. 15. Length frequency of albacore caught by the pole-and-line fishery in each area (Top) and their seasonal differences (Bottom).

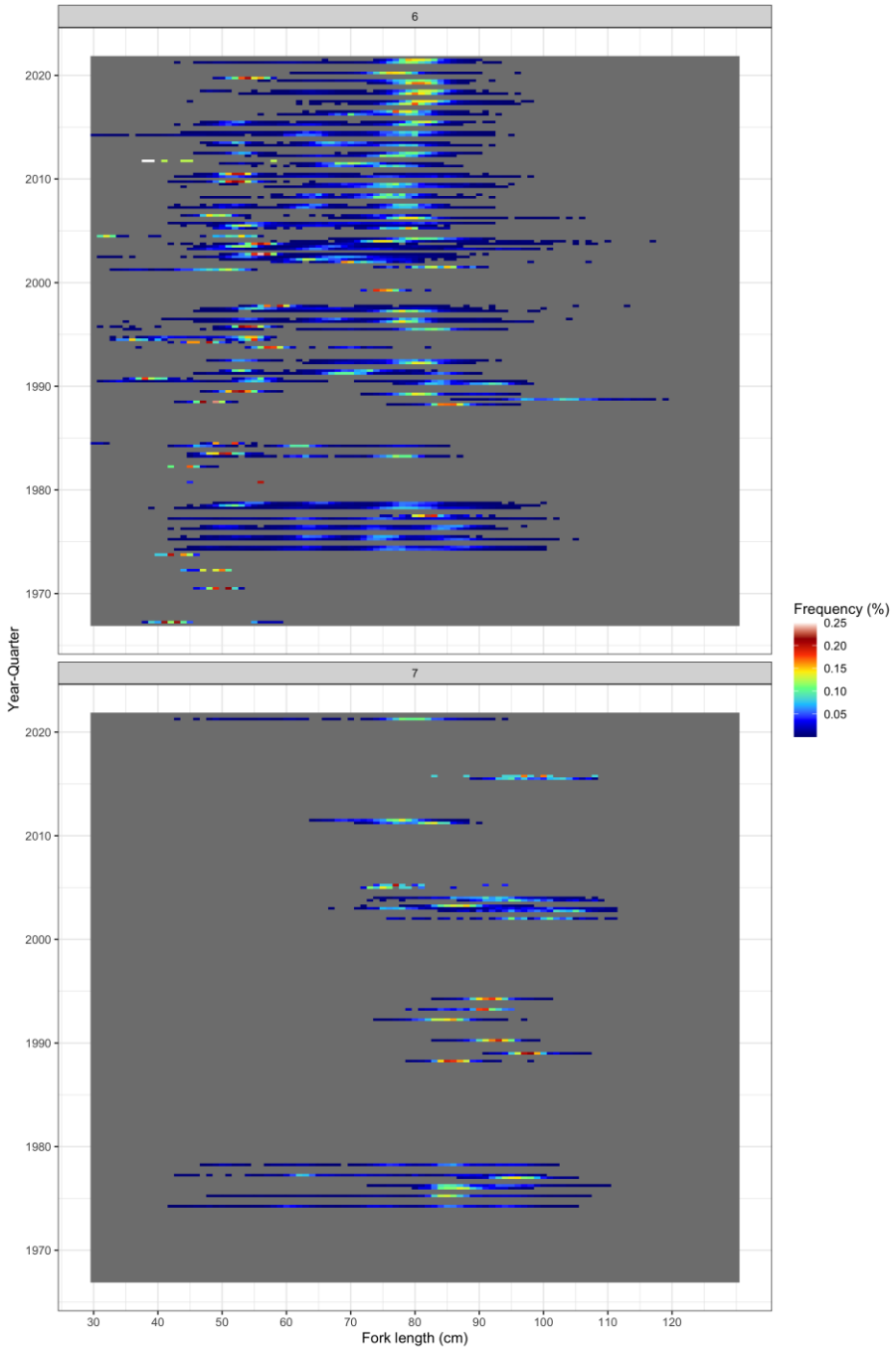

Fig. 16. Historical changes in length frequency of albacore caught by the pole-and-line fishery.

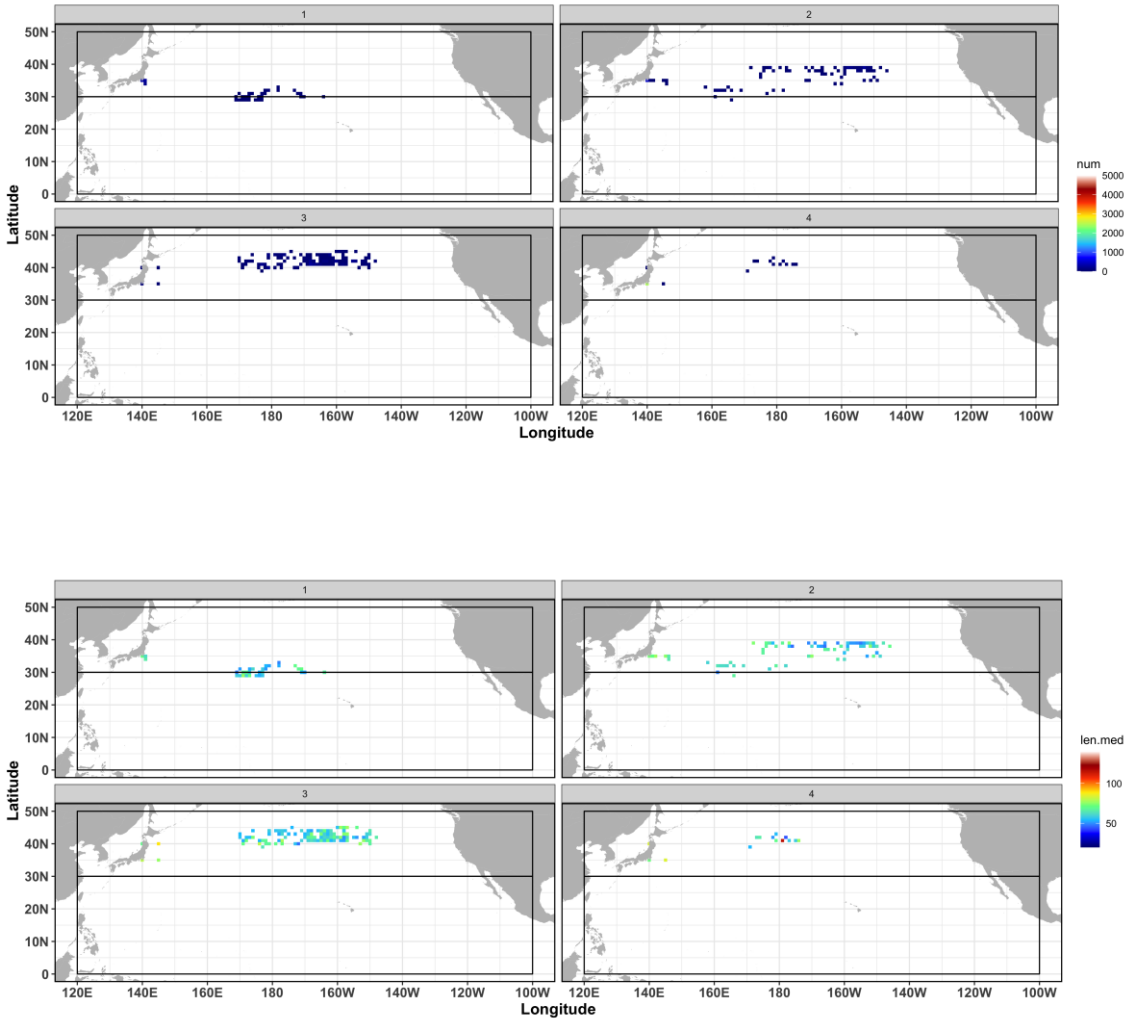

Fig. 17. The number of data (Top) and median lengths in each quarter of the drift net fishery.

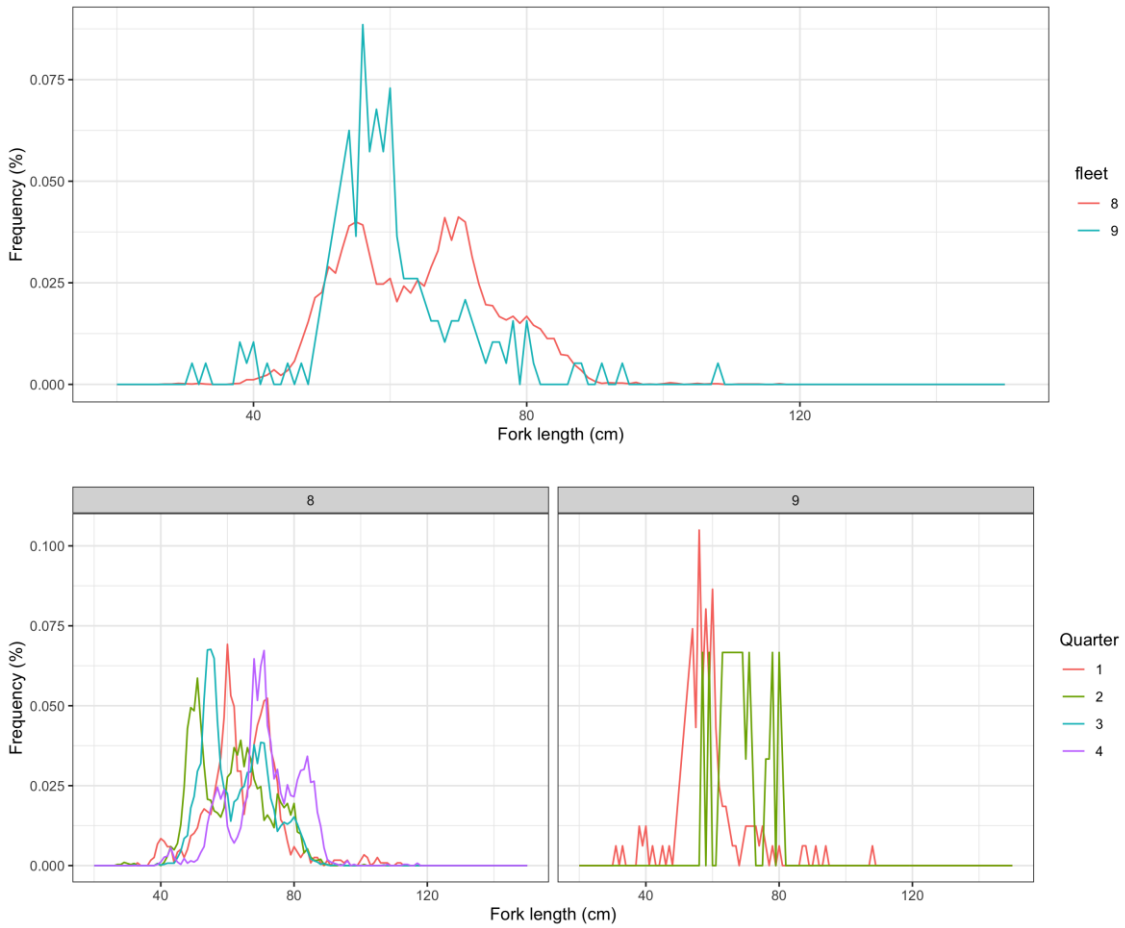

Fig. 18. Length frequency of albacore caught by the driftnet fishery in each area (Top) and their seasonal differences (Bottom).

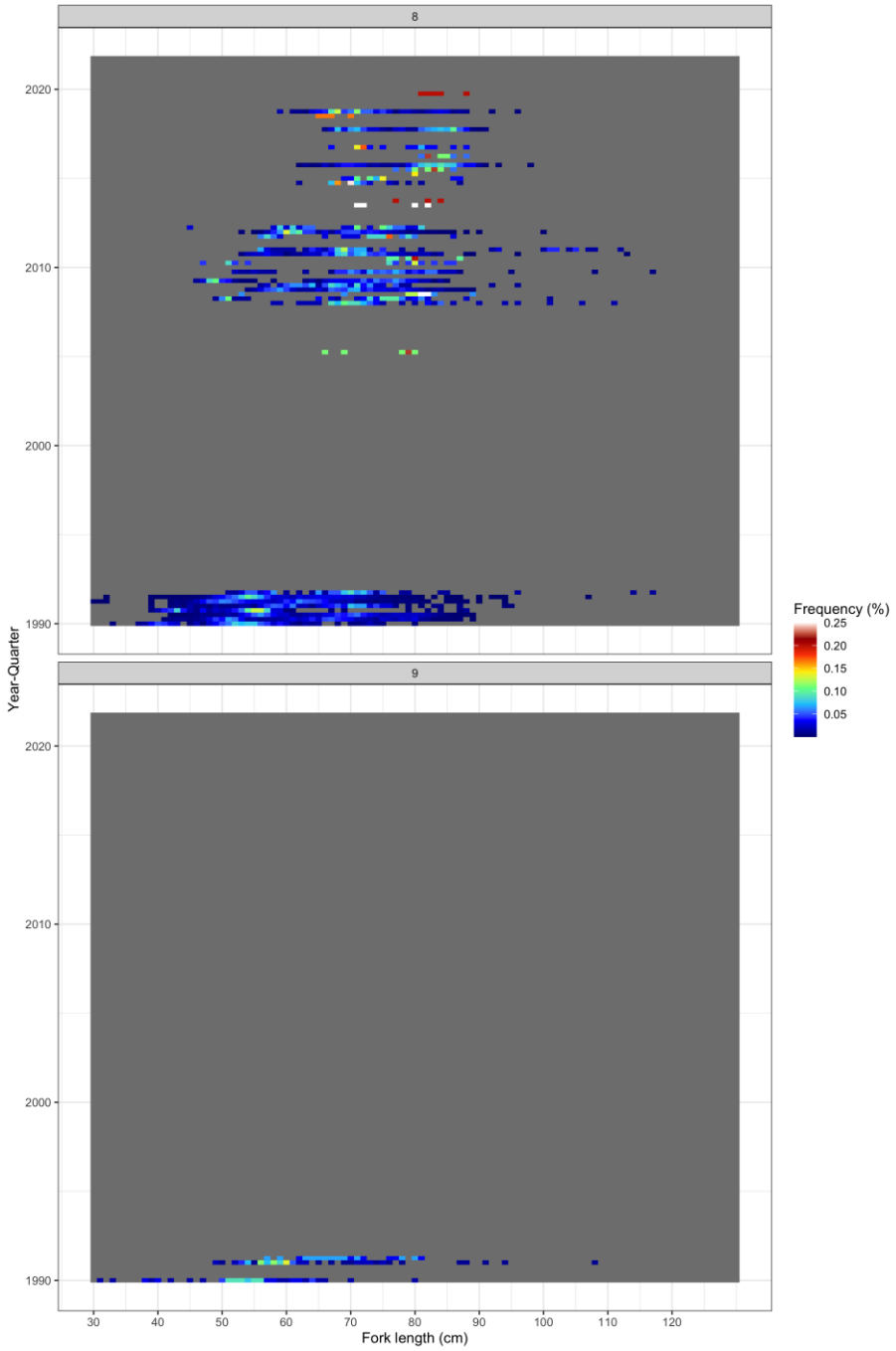

Fig. 19. Historical changes in length frequency of albacore caught by the drift net fishery.