INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

15TH MEETING

La Jolla, California (USA)
10 - 14 June 2024

DOCUMENT SAC-15 INF-U

ANALYSIS OF JAPANESE LONGLINE FISHERY DATA FOR SKIPJACK IN THE EASTERN PACIFIC OCEAN

Takaaki Hasegawa, Keisuke Satoh, Yoshinori Aoki, Yuichi Tsuda
Fisheries Research and Education Agency, Fisheries Resources Institute, Yokohama, Japan.

SUMMARY

Japanese longline data play an important role in the stock assessment of skipjack tuna (*Katsuwonus pelamis*) in the Eastern Pacific Ocean (EPO). The interim assessment in 2022 used Japanese longline catch and effort data for the longline abundance index and length composition data to estimate the asymptotic length for growth and selectivity curve. However, concerns regarding representativeness of the data have been raised because skipjack is a by-catch species for Japanese longliners in the EPO. This report summarizes preliminary results of catch and effort data analysis, along with length composition data for skipjack collected by Japanese longliners in the EPO to examine their characteristics. We found that the skipjack catch by Japanese longliners has been fairly low, ranging from 12 to 80 tons for the assessment period (after 2006). The percentage of skipjack catch was less than 2% of the total catch, indicating that skipjack is a by-catch species for Japanese longliners. The low spatial coverage for the catch suggests that the Japanese data alone does not provide enough information for standardizing longline CPUE in the EPO. We also investigated the spatio-temporal variations in size-at-catch and discussed potential factors for the dominance of larger fish after 2000s compared to 1970s.

BACKGROUND

Japanese longline fishery rapidly expanded their fishing grounds in 1950s, first fishing in the Eastern Pacific Ocean (EPO) in 1958 and reaching the coast of Central America in 1960 (Suzuki et al., 1978). Their fishing grounds continued to expand into the temperate zones of both the northern and southern hemispheres, reaching its greatest expansion until 1970. Initially, yellowfin and albacore were caught for canning and other processed products, but by the 1970s, the main target species changed to bigeye tuna (Figure 1), due to increased demand for sashimi and improved freezing facilities, the main target species changed to bigeye tuna in the EPO. Japanese longline data have played important roles in tuna stock assessments in the EPO (Minte-Vera et al., 2019; Xu et al., 2019). Among all distant water longline vessels operating in the EPO, Japanese longline vessels have the highest spatial coverage and the longest history of high-quality logbook data, providing the information needed for the standardization of a reliable abundance index with a large contrast across time.

The IATTC (Inter-American Tropical Tuna Commission) conducted the previous stock assessment of skipjack in 2022 (Maunder et al., 2022). It was the first assessment of the species based on an integrated age-structured model undertaken by the IATTC scientific staff since 2005 (Maunder and Harley, 2005), and it was also the first conventional stock assessment considered reliable by the staff for use in management advice. The assessment was conducted for the period 2006 to 2021, avoiding the period where the floating object fishery expanded after the mid 1990s, covering a period where the purse-seine data collection methods were more consistent, avoiding the potential influence of the 1998 El Niño on catchability and selectivity, and eliminating a period of the early 2000's where the longline abundance index was highly variable.

Several indices of abundance were considered in the assessment, including catch in numbers per hook for the Japanese longline fishery for the assessment period. The sample size for calculating CPUE-based indices of abundance was low because few skipjack tuna are caught by the longline fisheries. For this reason, the ratio of the sum of the catch divided by the sum of the number of hooks fished for each year-quarter was used as the index of abundance.

Length composition data collected from the Japanese longline fishery was used in the assessment to represent the longline data for the whole EPO because of the longest time series of Japanese length composition data. The length composition data was also used to determine the asymptotic length (Linf) for the growth curve. Since reliable aging and tagging data are not available for old fish, the age of fish at a given length had to be assumed, and the asymptotic growth was derived from the length composition data. Additionally, the asymptotic length for longline selectivity was determined from the length composition data because the longline fishery captures the largest skipjack tuna and is, therefore, assumed to have asymptotic selectivity.

Although Japanese longline data played an important role in the stock assessment of skipjack tuna for the reasons listed above, there are concerns about the representativeness of those data for assessment purposes because skipjack is a by-catch species for Japanese longliners. The length composition data for the longline index is sparse, highly variable, not well fit by the stock assessment model, and is cut off at 60 cm (Maunder, 2023). To provide more information about the data, this report presents the results of our analysis on catch and effort data and length composition data for skipjack collected by Japanese longliners in the EPO. Specifically, we focused on the spatial coverages of the data to examine if they are representative enough for longline CPUE. Additionally, we analyzed the length composition data to address the question of why we have not seen fish under a specific size range (<60 cm) for the assessment period (>2006).

RESULTS AND DISCUSSION

Historical catch trends for tuna species caught by Japanese longlines in the EPO indicated that the main target of the fishery is bigeye (Figure 1, Figure 2). The skipjack catch has been significantly low, ranging from 12 to 80 tons for the assessment period (>2006, Figure 3), accounting for less than 2% of the total catch (Figure 2). To understand the spatial coverage of the skipjack catch and effort data, we compared the spatial differences in the CPUE (catch in numbers per 1000 hooks) for skipjack and bigeye (Figure 4). We found that the catch locations for skipjack overlapped with those for bigeye, but with less spatial coverage and significantly lower CPUE (mean: 0.66, sd: 0.34) compared to bigeye (mean: 4.11, sd: 2.02). The independent catch rate for skipjack, calculated by dividing the total number of operations that caught skipjack alone by the total number of operations that caught both skipjack and bigeye, was markedly low (<1%), suggesting that skipjack is an incidental catch for Japanese longliners. In addition to the limited spatial coverage, there is little information about the discard situation for this species. Thus, we suggest that Japanese longline data alone is insufficient for reliably estimating longline CPUE in the EPO. Further research is needed to investigate more about the discard and reporting rate.

The length composition data for skipjack collected by Japanese fleets are available after 1970. Japanese length composition data in the EPO has been collected by fisherman, observer and training vessels (Figure 5). Until the mid-1980s, data were mostly collected by training vessels. For bigeye and yellowfin, data began to be collected by fishermen since the mid-1980s. However, almost no data for skipjack were available from fishermen, and the number decreased until 2011. Since the observer program started in 2011, the number slightly increased but then decreased again, reaching zero due to the pandemic from 2021 to 2023. For the use of stock assessment, we rely mainly on observer data as little data is available from fishermen and training vessels during the assessment period.

We also investigated the temporal trends for the length composition of skipjack since 1970 (Figure 6). The majority of size ranged from 70 to 79 cm (1st and 3rd quantile, respectively), with a mean of 73.8 cm. There was no apparent shift in mean length over time. However, the distribution pattern has changed; small fish (under 60 cm) have not been observed since 2010, although they were present in earlier years. The same pattern is observed in the data used for stock assessment, where the length under 60 cm is absent (Figure 7). Although this absence was thought to be due to the observer program starting in 2011 and potential recording issues (e.g. the recording sheet considers only fish greater than 60 cm)., our review of the Japanese observer data form, which requires exact fish size recording, suggests that recording artifacts are unlikely. Future investigations will be necessary to understand the measurement practices by observers.

To understand the temporal change in the length distribution, we investigated the historical change in the spatial pattern for the length (Figure 8). In the 1970s, small fish (<60cm) were caught in the tropical and coastal areas, whereas the proportion of those smaller fish is thought to have decreased due to the shift of fishing grounds to the temperate zone after 1980. In the 2010s, the fishing grounds were shifted to the 0-20S range, which is the main fishing ground for large bigeye tuna, and as a result, only large fish (61 cm or larger) were caught. In general, shallow-set was the standard for Japanese longliners until around the 1970s, after which deep-set became more common. Shifting both horizontal and vertical operation patterns could explain the dominance of large fish in recent years.

The proportion of females in some tuna species decreases with size, affecting growth, maturity and natural mortality assumptions for stock assessments. We analyzed the size compositions of male and female tuna during the assessment period, indicating that there were no significant differences between male and female (Figure 9). Thus, biological assumptions differing by sex may not be necessary at this stage.

CONCLUSION

This preliminary analysis of Japanese longline fishery data for skipjack in the EPO highlights limitations in the representativeness of this data for the stock assessment purposes. Our findings indicate that skipjack is primary a by-catch species for Japanese longliners, with catches remaining consistently low. The limited spatial coverage and significantly low nominal CPUE further suggest that Japanese longline data alone are insufficient for reliably estimating the longline CPUE. The absence of smaller fish (<60cm) in length composition data for the stock assessment period (>2006) could be explained by potential changes in fishing practices that favored the capture of larger individuals or measurement practices by observers. Future efforts should focus on investigating discard practices and data collection methodologies.

REFERENCE

Suzuki, Z., Tomlinson, P.K., and Honma, M. (1978). Population structure of Pacific yellowfin tuna. Bull. IATTC, 17(5): 277- 441.es

Maunder, M.N. and Harley, S.J. (2005). Status of skipjack tuna in the eastern Pacific Ocean in 2003 and outlook for 2004. Inter-Amer. Trop. Tuna Comm., Stock Assess. Rep. 5: 109-167.

Maunder, M.N. Xu, H., Minte-Vera, C.V., Valero, J.L., Lennert-Cody, C., and Aires-da-Silva, A. (2022, May). Skipjack tuna in the eastern Pacific Ocean, 2021: Interim assessment. Inter-Amer.Trop. Tuna Comm., 13th Scient. Adv. Com. Meeting: SAC-13-07.

Maunder, M. N. (2023, May). Potential improvements to the EPO skipjack tuna stock assessment for the 2024 benchmark assessment. Inter-Amer.Trop. Tuna Comm., 14th Scient. Adv. Com. Meeting: SAC-14-08.

Minte-Vera, C., Maunder, M. N., Xu, H., Valero, J. L., Lennert-Cody, C., & Aires-da-Silva, A. (2020, May). Yellowfin tuna in the eastern Pacific Ocean, 2019: benchmark assessment. Inter-Amer.Trop. Tuna Comm., 11th Scient. Adv. Com. Meeting: SAC-11-07.

Xu, H., Maunder, M.N., Minte-Vera, C.V., Valero, J.L., Lennert-Cody, C., and Aires-da-Silva, A. 2020. Bigeye tuna in the eastern Pacific Ocean, 2019: benchmark assessment. Inter-Amer.Trop. Tuna Comm., 11th Scient. Adv. Com. Meeting: SAC-11-06.

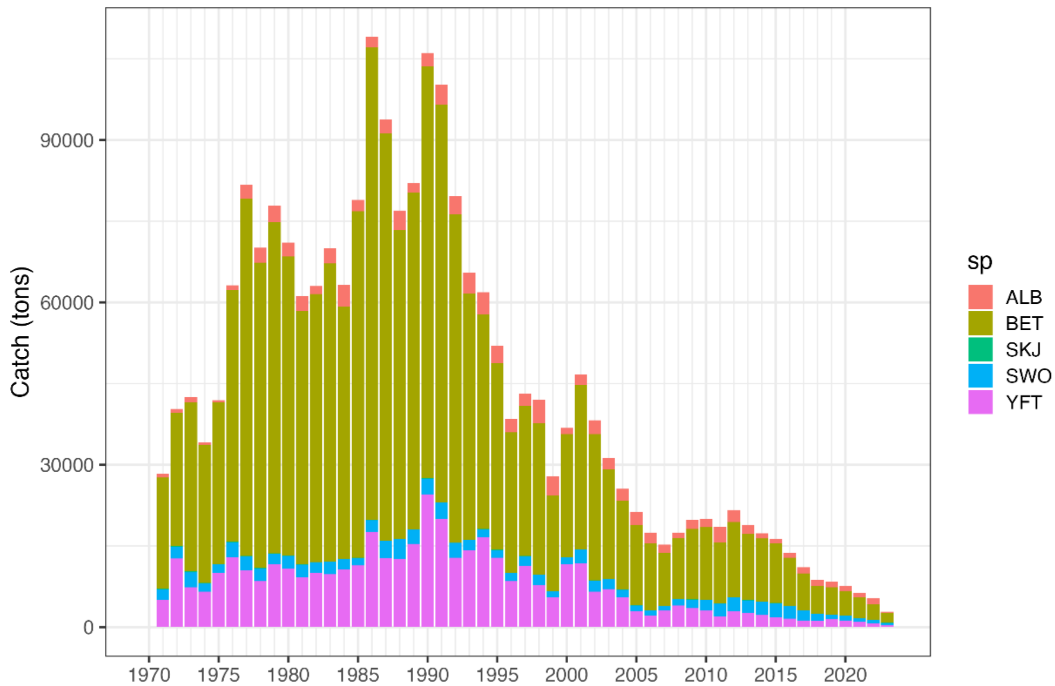

FIGURE 1. Historical catch trends by Japanese longliners in the EPO from 1971 to 2023 for albacore (ALB), bigeye (BET), skipjack (SKJ), swordfish (SWO), and yellowfin (YFT).

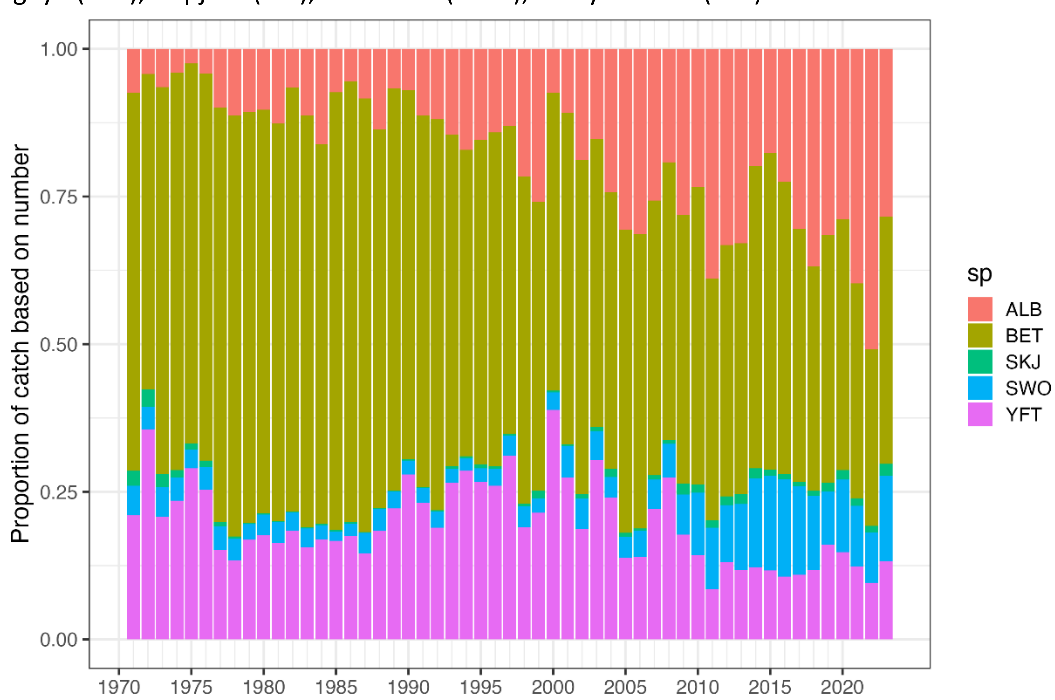

FIGURE 2. Historical trends in catch proportions based on number by species caught by Japanese longliners in the EPO from 1971 to 2023.

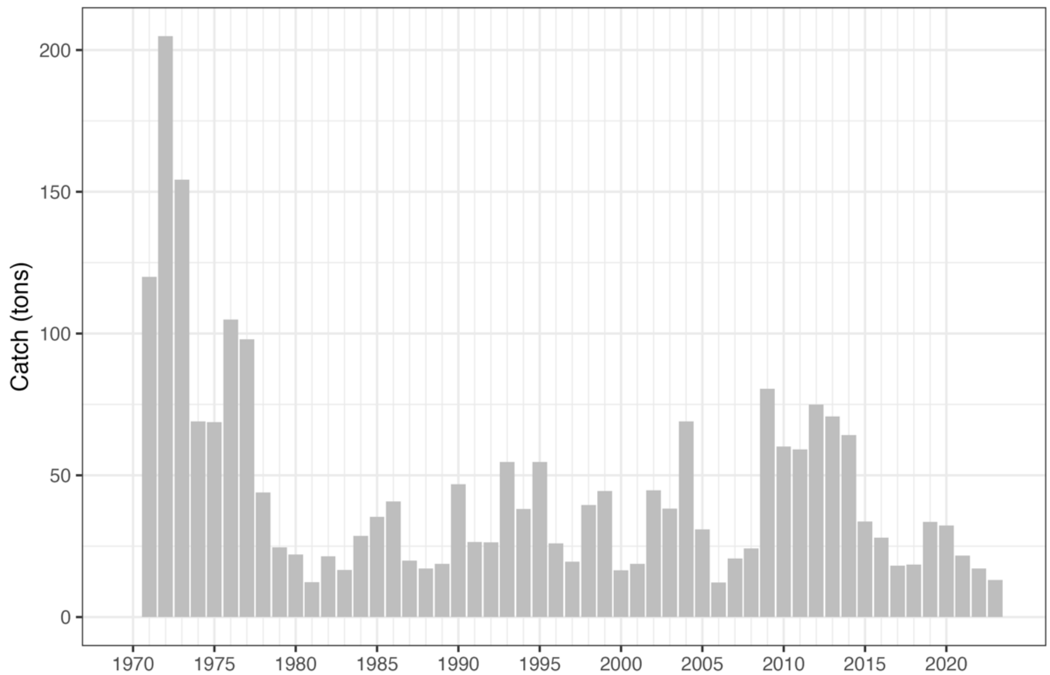

FIGURE 3. Historical catch trends for skipjack caught by Japanese longliners in the EPO from 1971 to 2023.

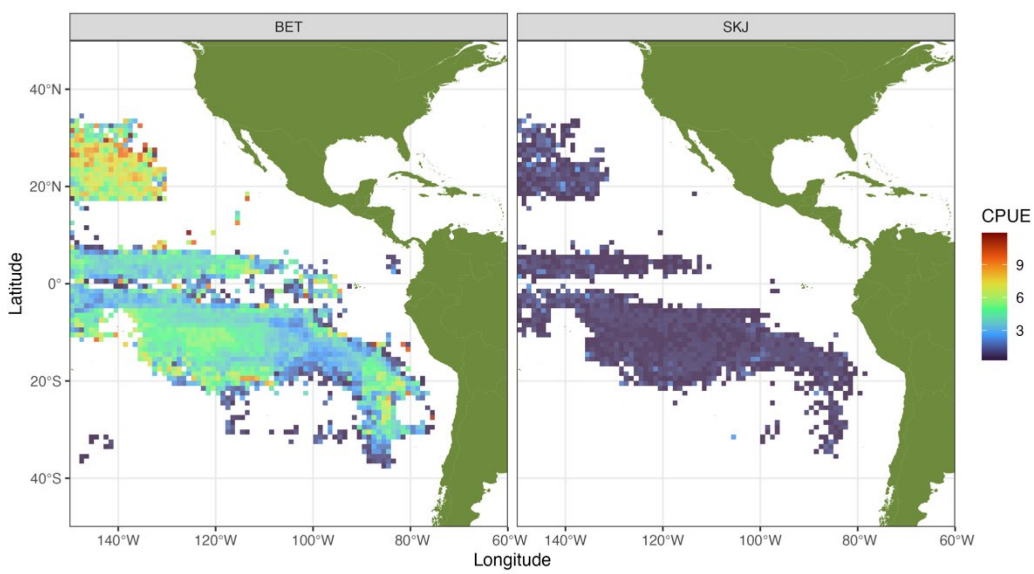

FIGURE 4. Spatial distributions of mean CPUE (catch in numbers per 1000 hooks) for bigeye (left) and skipjack (right) by Japanese longliners from 2006 to 2023. The fishing grounds for skipjack overlap with those for bigeye, and the skipjack CPUE is consistently low compared to bigeye.

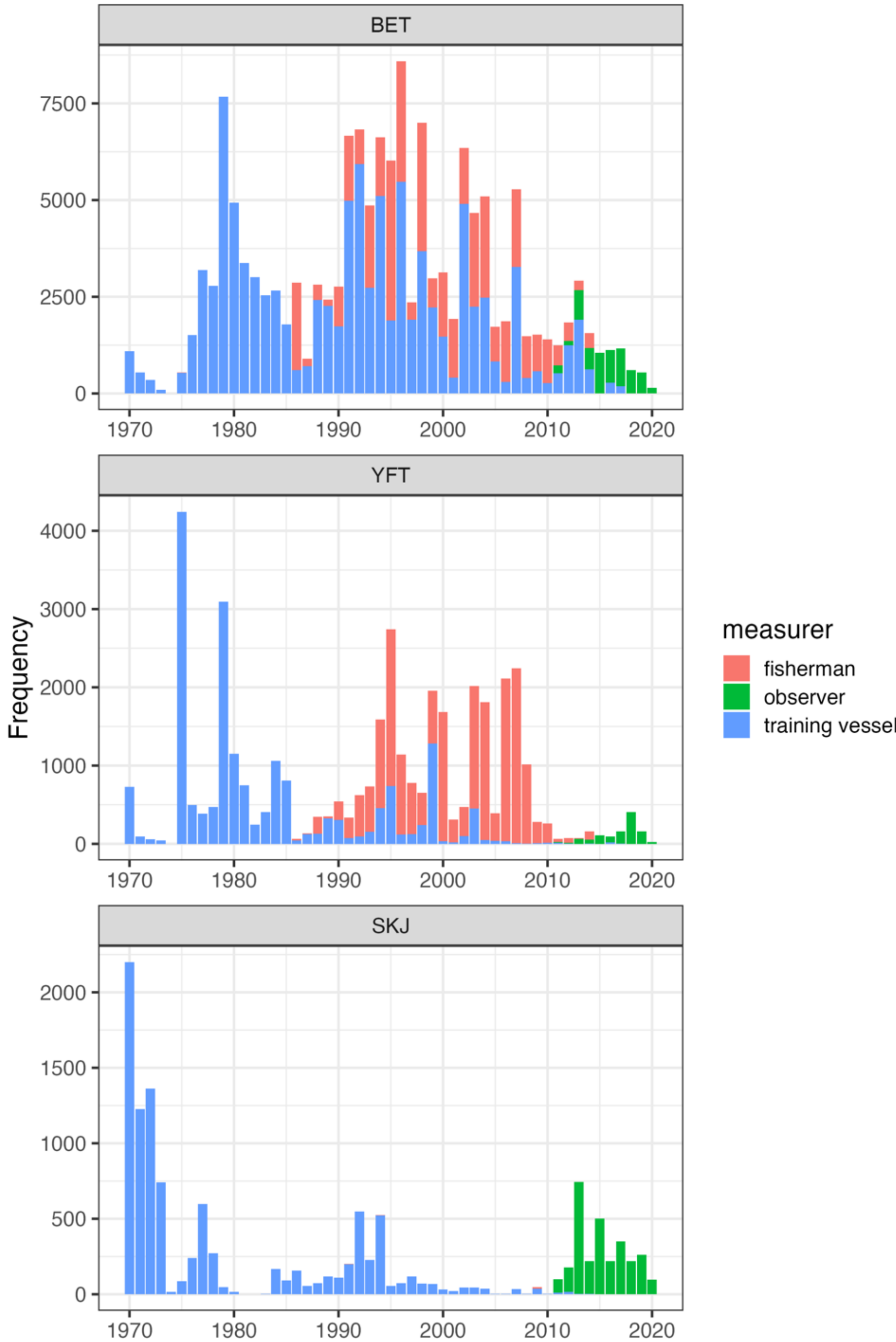

FIGURE 5. Historical trends in the number of length composition data available for bigeye, yellowfin, and skipjack collected by Japanese fleets in the EPO since 1970. No data were available for the EPO after 2021 due to the pandemic.

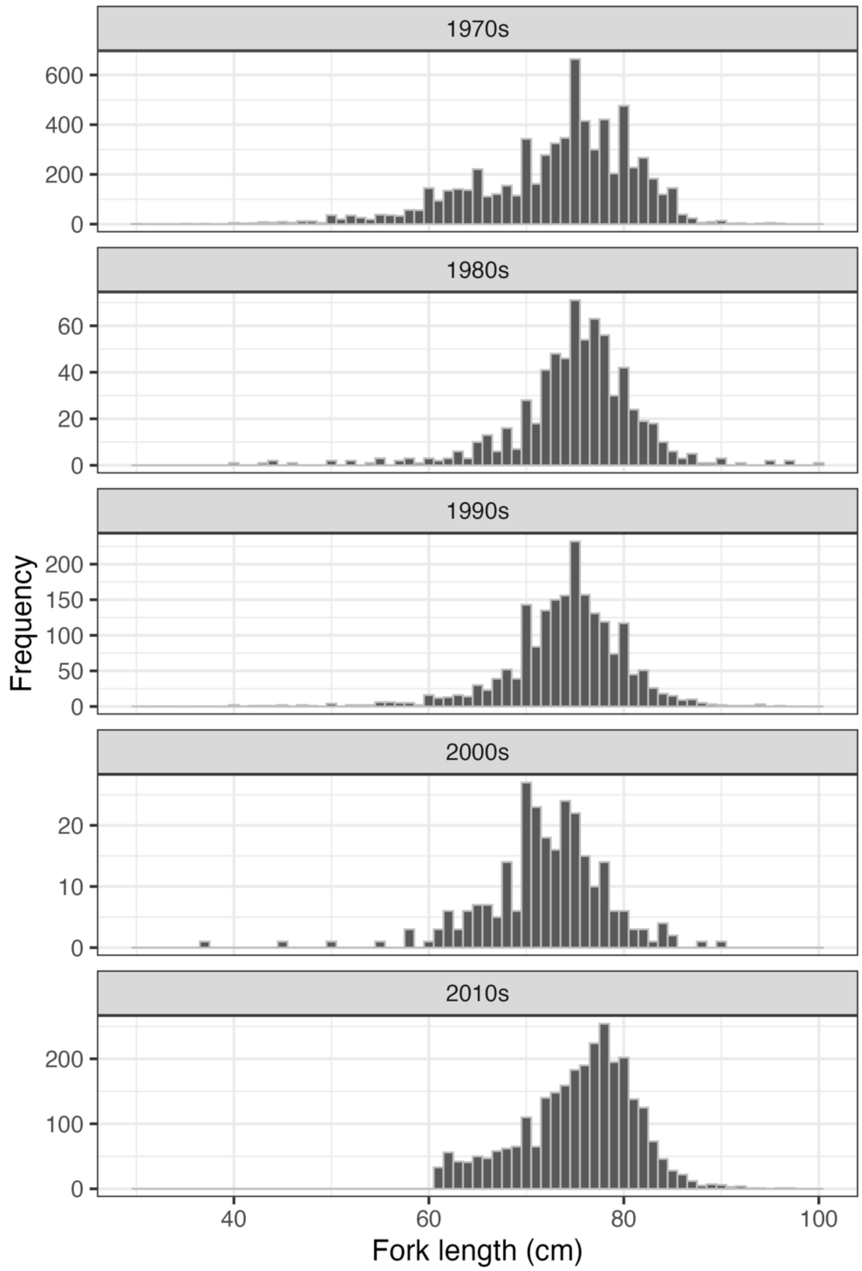

FIGURE 6. Historical trends of measured length composition data for skipjack.

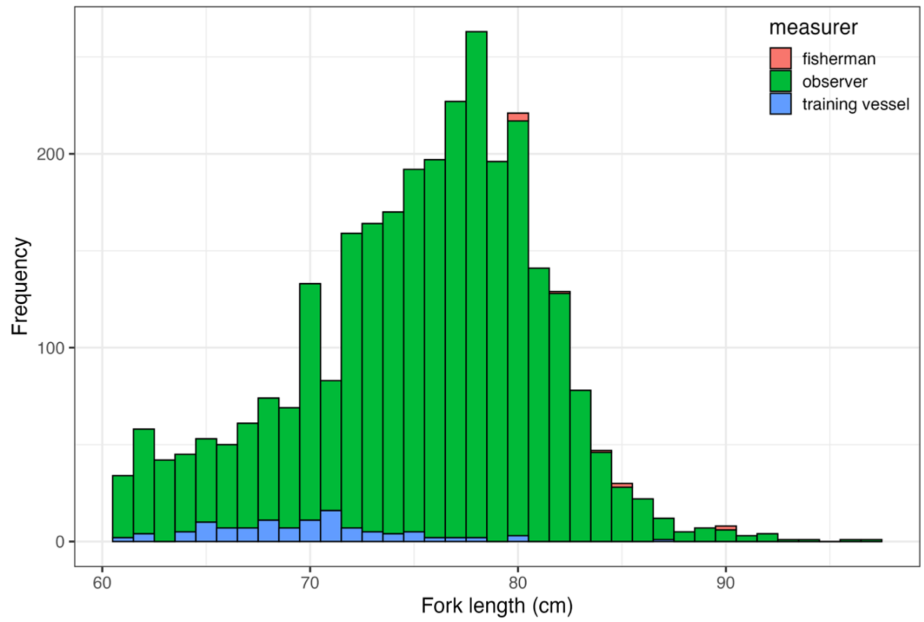

FIGURE 7. Size distribution for skipjack collected during the assessment period (after 2006).

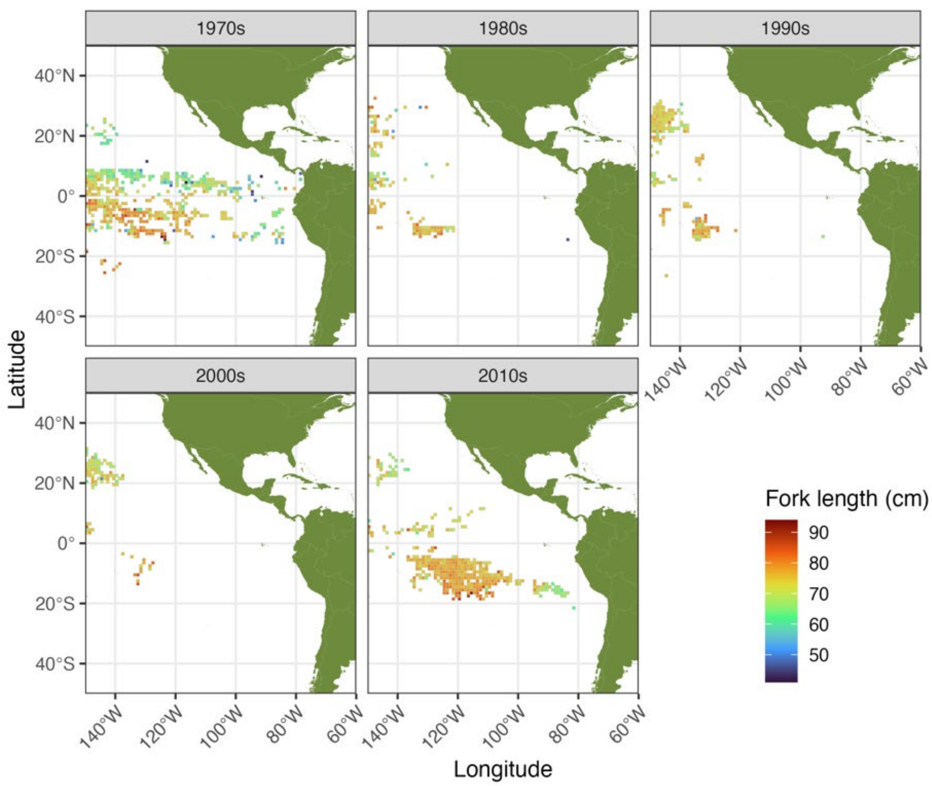

FIGURE 8. Spatio-temporal changes in the size for skipjack collected by Japanese fleets in the EPO.

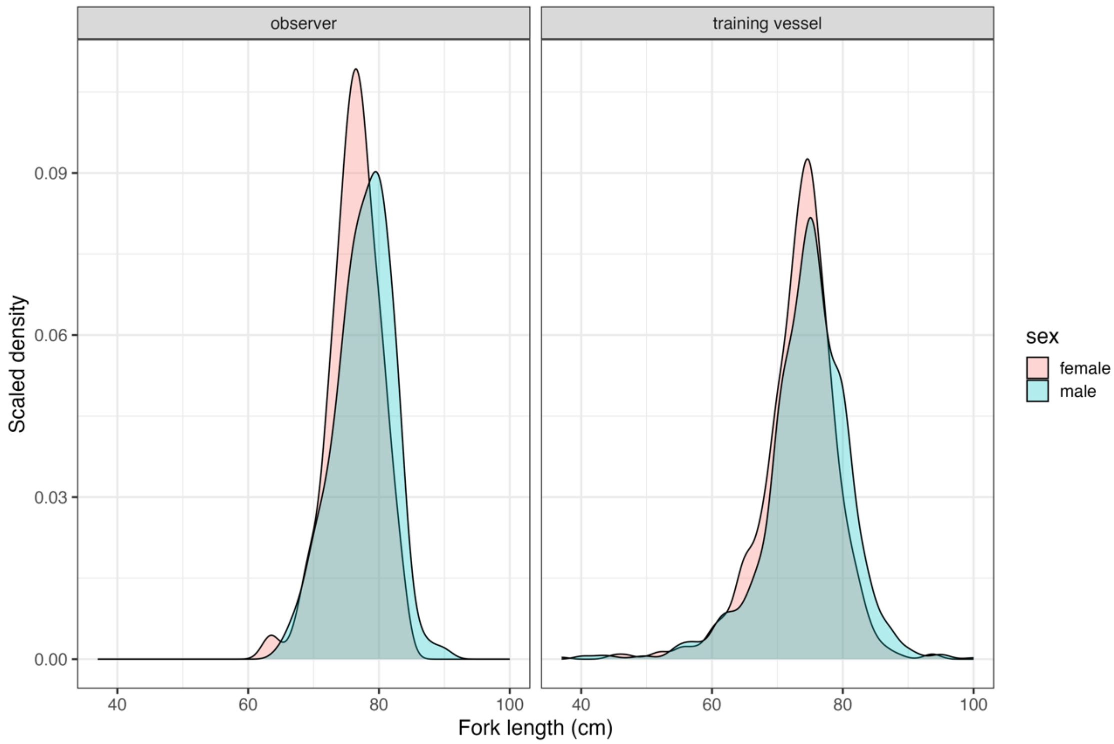

FIGURE 9. Size distribution of skipjack by sex as determined by observer and training vessels.