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Historical trends in catch and effort of south Pacific albacore in Japanese longline fishery

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Abstract

1. This paper represented spatial and temporal trends in catch, effort and the size for Japanese longline (JPLL) fishery on south pacific Albacore tuna (ALB).
2. High ALB catch was found in off Australian coastal areas and tropical and subtropical areas in the eastern Pacific Ocean in quarters 2 & 3. Large individuals were found in low latitude areas, whereas small individuals were in high latitude areas, which well explained the current knowledge of ALB distribution through their life history.
3. To check an effect of other commercially important tunas on the ALB fishery grounds, we compared spatial grounds of yellowfin, bigeye, and southern bluefin tunas and discussed how targets of JPLL changes.

Introduction

Understanding the background of fishery data is crucial for interpreting stock assessment outcomes. The South Pacific albacore tuna (*Thunnus alalunga*) in the Pacific Ocean is harvested by several countries, including Japan. This document provides fundamental information on the Japanese longline fishery, with a focus on spatial and historical catch, effort, nominal CPUE (Catch Per Unit Effort), and size data.

Materials and Methods

Japanese longline logbook

The JPLL logbook data spans from 1972 to 2023. The operational logbook contains daily information on fishing activities, including dates, locations (1°×1° grid), catch amounts in metric tons and numbers by species, vessel tonnage, sea surface temperature (SST), and the number of hooks used. We examined spatial trends in catch, effort (hooks), and nominal CPUE (Catch Per Unit Effort, catch/effort) for south Pacific albacore tuna. To specifically focus on operations involving South Pacific albacore tuna, we analyzed records with a positive catch of this species (>0).

Size data

The size data for South Pacific albacore tuna (ALB) in the JPLL logbook was primarily collected through port samplings, observers and Research Vessels from 1965 to 2020. We assessed the representativeness of this size data across different spatial and temporal scales by comparing it with the spatial trends in size derived from the JPLL logbook data. As the JPLL logbook records catch amounts, body weights, and locations, we were able to calculate spatial trends in the size of ALB by dividing the total body weight by the number of catches in each grid. For this analysis, size data measured in 1 cm bins was utilized.

Results and discussions

Spatial and temporal trends in JPLL catch and effort

Historical changes in catch and effort were shown in **Figure 1**. Overall, the majority of catches and efforts occur in quarters 2 and 3. In the 1970s, the catch was at its lowest (around 1,500 metric tons) in the recorded periods. The catch and effort gradually increased until the 1990s. However, the trend turned downward after 1998, and recent catches have stabilized around 2,000 metric tons with a slight decreasing trend in effort. High catch and effort areas for albacore tuna (ALB) were found off the eastern Australian coast and widely spread across tropical and subtropical areas in the eastern Pacific Ocean

(**Figures 2 and 3**). However, these features are less pronounced when examining CPUE (Catch Per Unit Effort). Hotspots were identified in narrower northern areas off the eastern Australian coast (10°S-20°S, 150°E-160°E) and in the western and central Pacific Oceans (10°S-40°S, 180°E-200°E). When analyzing effort by quarter, Q1 and Q4 were concentrated in the eastern Pacific Ocean. In addition to these, high efforts were found off the Australian coast in Q2 and Q3. However, these are not remarkable in nominal CPUE, likely due to targeting issues.

We further examined JPLL fishery grounds for other species, such as yellowfin tuna (YFT, **Figure 4**), bigeye tuna (BET, **Figure 5**), and southern bluefin tuna (SBT, **Figure 6**). Interestingly, the fishery grounds for YFT are close to those for ALB (**Figures 3 and 4**), but the grounds for BET are concentrated in the eastern Pacific Ocean throughout the year. Fishery grounds for SBT were found off the southern Australian coast (30°S-50°S), particularly in Q2 and Q3. These fishery grounds for BET and SBT overlap with areas of high effort but low CPUE in the ALB fishery. This suggests that albacore tuna (ALB) is likely caught as bycatch in fisheries targeting more commercially valuable species, such as southern bluefin tuna (SBT) and bigeye tuna (BET). This is supported by the species composition data (**Figure 7**), which reveal that a substantial portion of the catch consists of BET, particularly in the Eastern Pacific Ocean (EPO) regions (Hasegawa et al., 2024).

Trends in size distribution

Size data is a crucial input for the selectivity of this gear. To provide size data with an understanding of its background, we first examined the spatial distribution of averaged size data in each grid using JPLL logbook data, which records the total amount of catch in number and weight per operation (**Figure 8**). Clear latitudinal trends in size were observed, showing large ALB (average weight >20 kg) in the northern equator (10°N-0°) and mid-latitude areas around 20°S, and smaller ALB (average weight <10 kg) in the high latitude areas. These trends were broadly consistent with the current knowledge of albacore distribution through their life history (Nikolic et al., 2017). These trends did not change drastically through the seasons (**Figure 8**).

Subsequently, the sampling locations and histograms of fork length in each decade and quarter by JPLL were shown in **Figures 9 and 10**, respectively. From the 1960s to the 1980s, a large amount of sampling was collected from low latitude areas, resulting in relatively large individuals (around 90 cm FL) being observed. In contrast, smaller individuals collected in high latitude areas around 30°N were observed from the 1990s to the 2020s. It should be noted that the data is somewhat spiky in some bins

(**Figure 10**). Although the reason for this is unclear, it could be due to artificial errors, probably caused by the contamination of data with several size bins other than 1 cm.

Reference

Hasegawa T., Satoh, K., Aoki, Y., and Tsuda Y. (2024). Analysis of Japanese longline fishery data for skipjack in the EPO. Inter-American tropical tuna commission scientific advisory committee 15th meeting La Jolla, California (USA) 10 - 14 June 2024.

Nikolic, N., Morandeau, G., Hoarau, L., West, W., Arrizabalaga, H., Hoyle, S., ... & Fonteneau, A. (2017). Review of albacore tuna, Thunnus alalunga, biology, fisheries and management. Reviews in fish biology and fisheries, 27, 775-810.

Figs

Figure 1. Historical trends in JPLL albacore catch (upper panel) and effort (lower panel) in each quarter (Qtr).

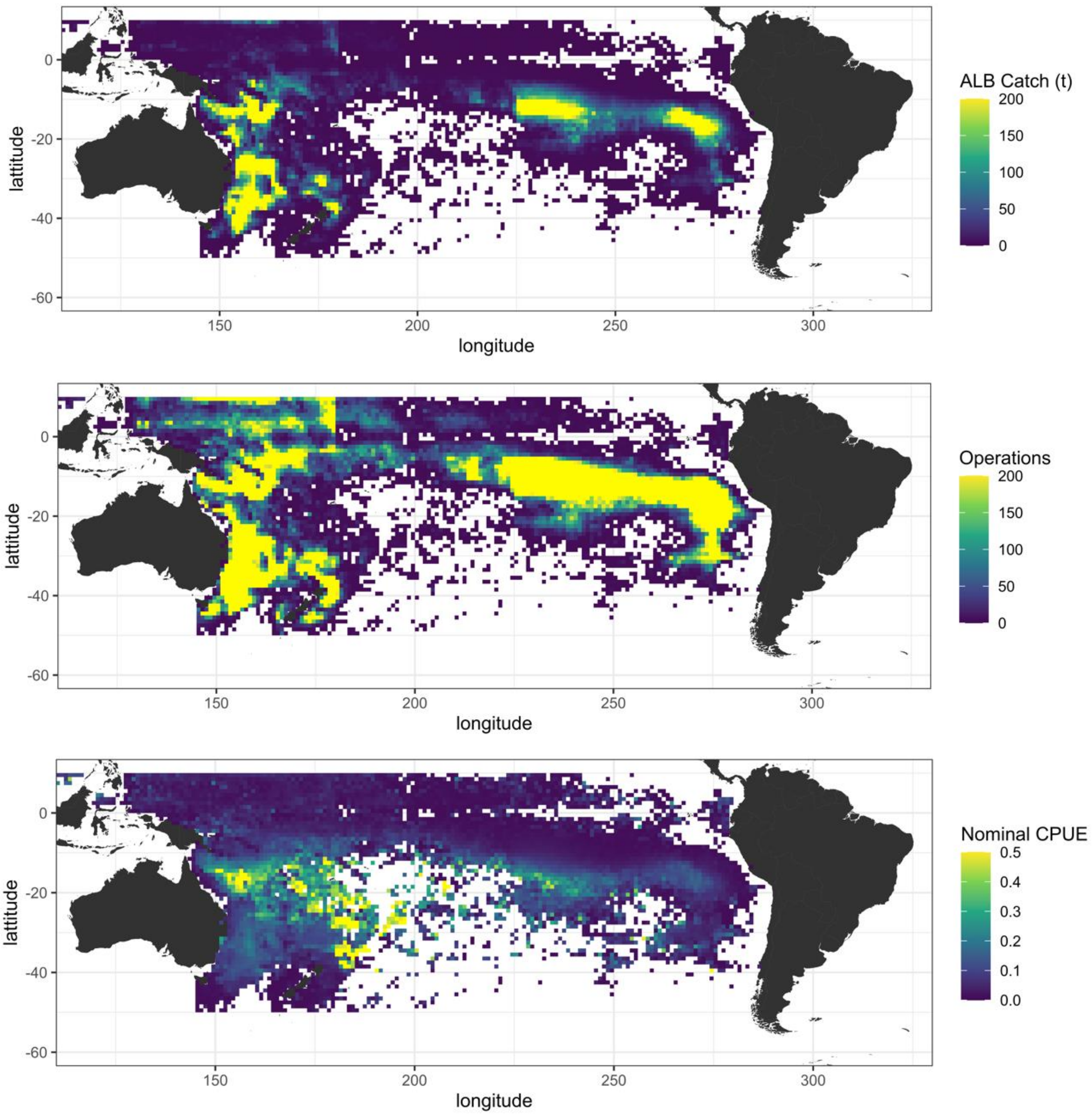

Figure 2. Spatial distribution in JPLL (Japanese longline) catch (Upper panel), effort (middle panel) and nominal CPUE (Lower panel) for south Pacific albacore tuna.

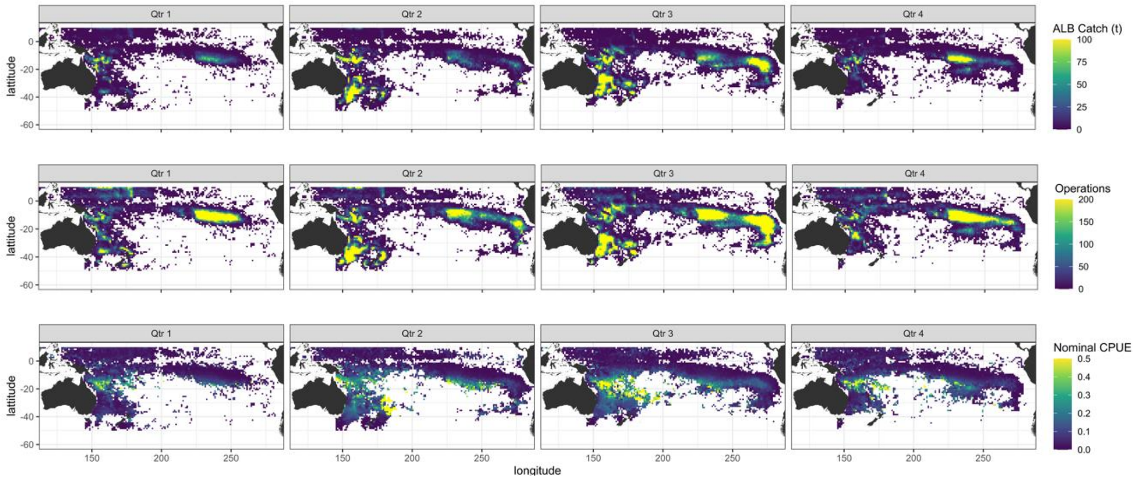

Figure 3. Quarterly spatial distribution in JPLL (Japanese longline) catch (Upper panel), effort (middle panel) and nominal CPUE (Lower panel) for south Pacific albacore tuna.

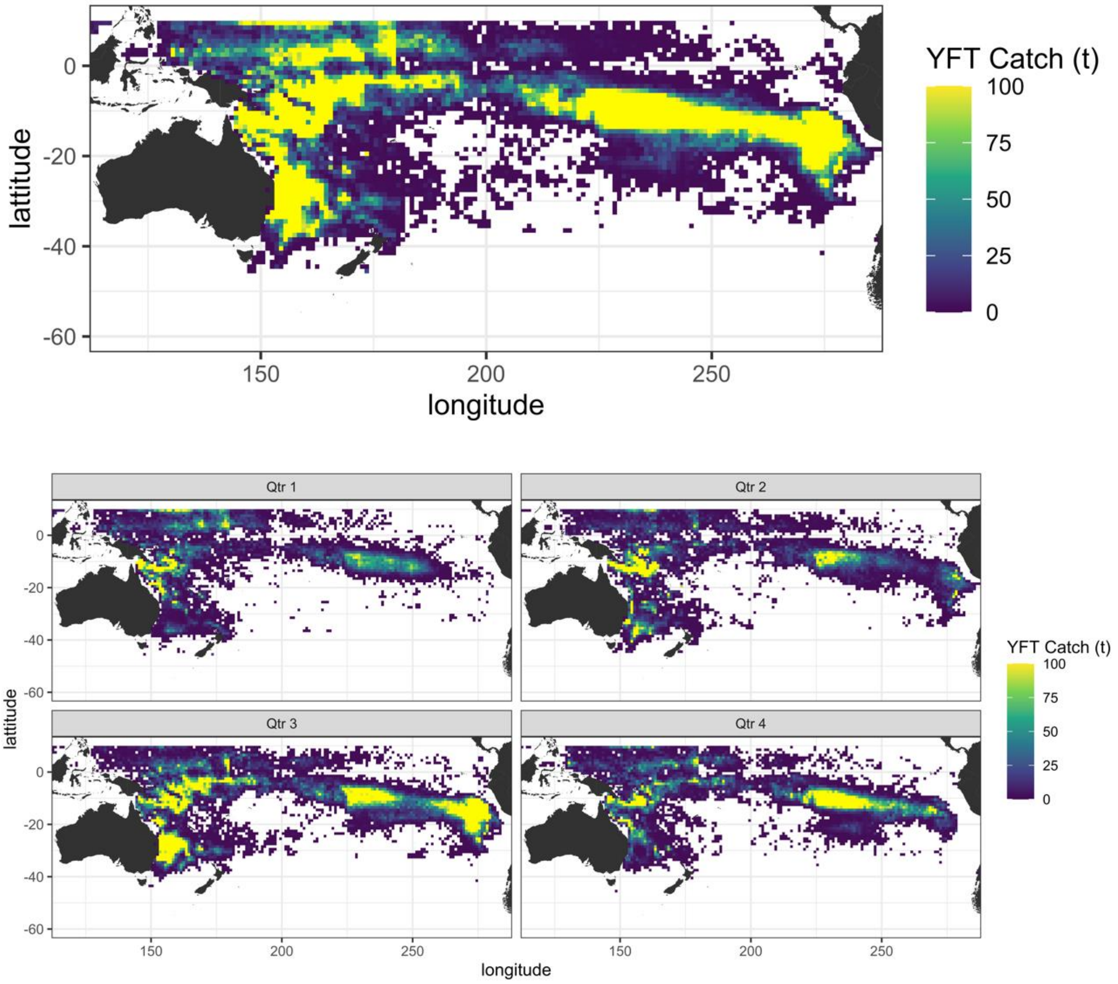

Figure 4. Spatial distribution of catches in YFT (yellowfin tuna) by JPLL (Japanese longline) and its seasonal trends.

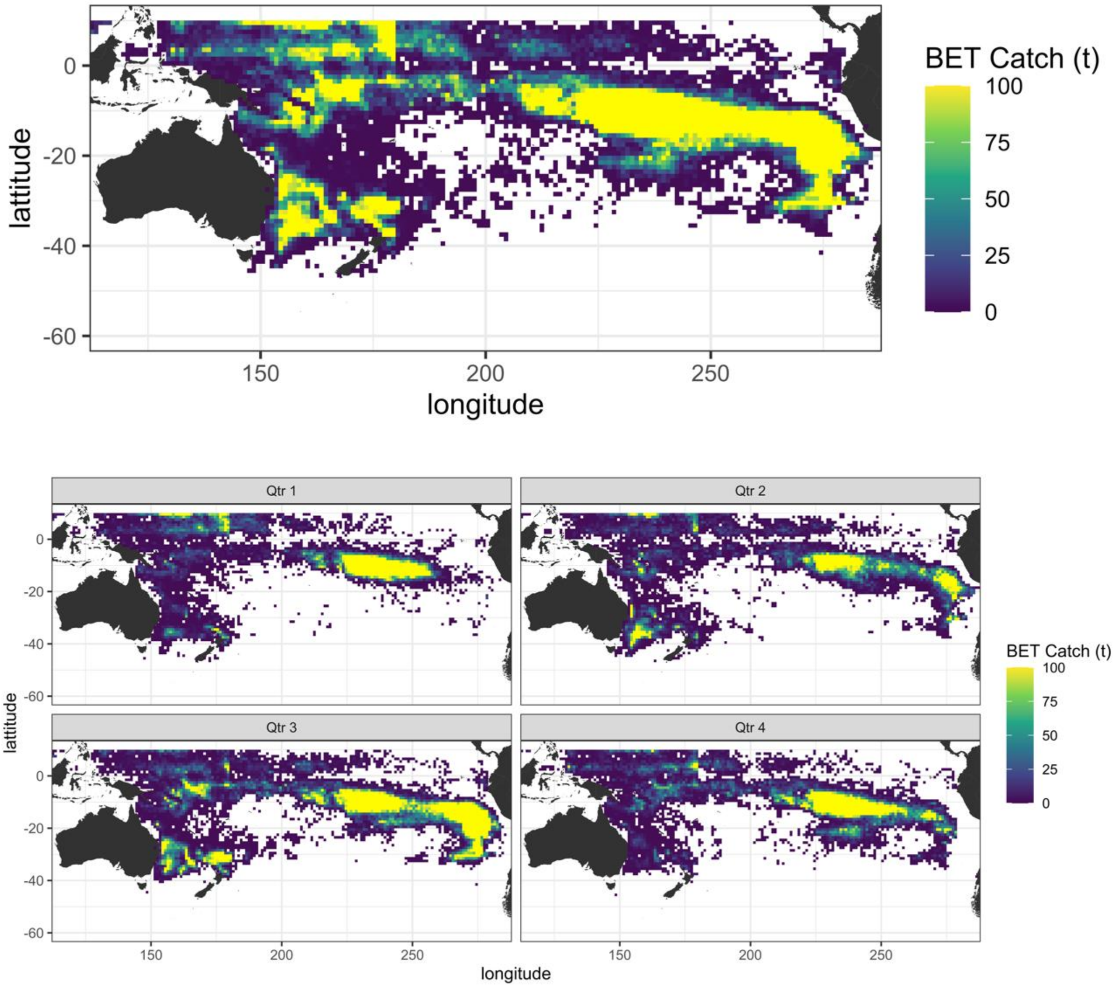

Figure 5. Spatial distribution of catches in BET (bigeye tuna) by JPLL (Japanese longline) and its seasonal trends.

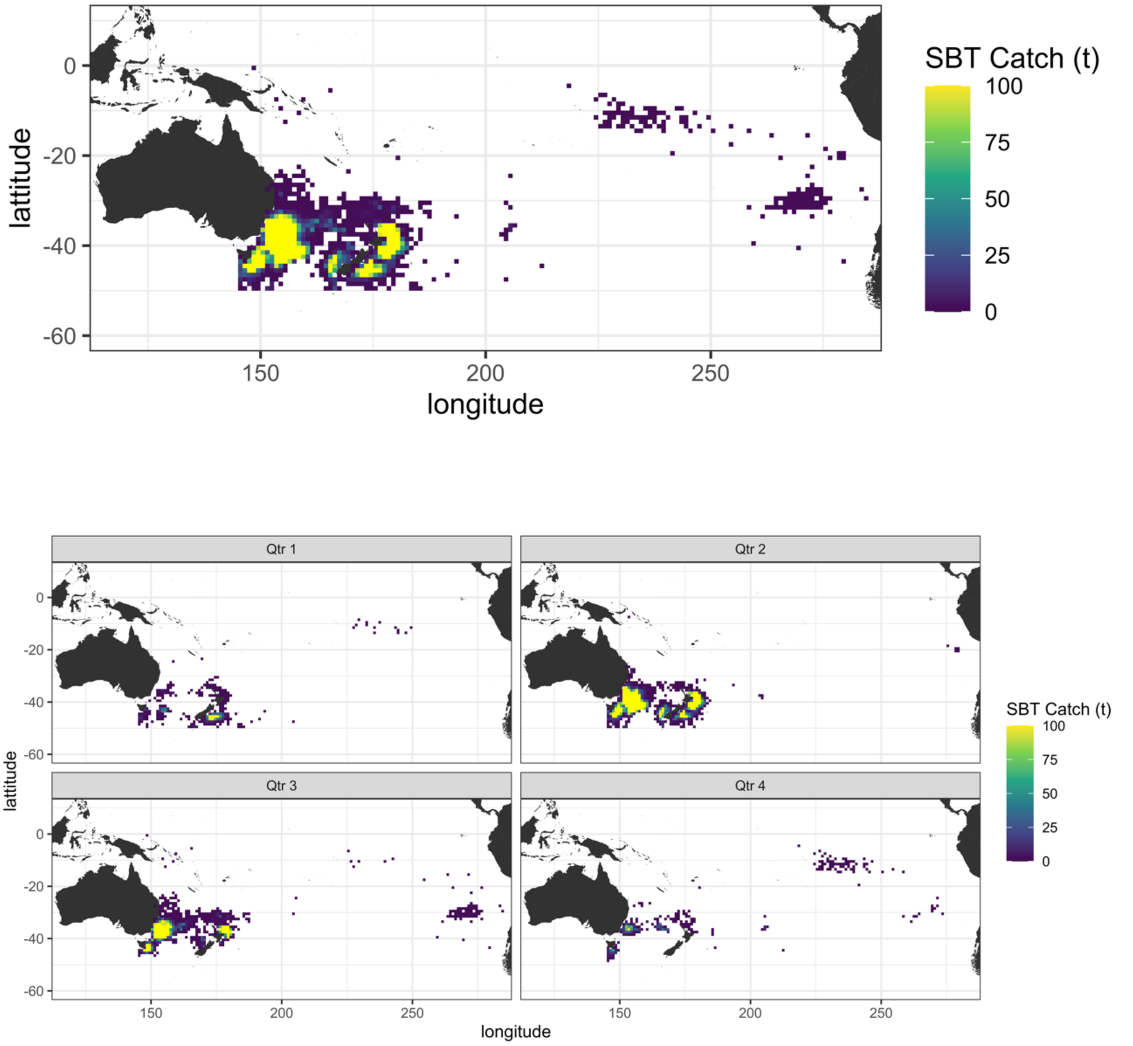

Figure 6. Spatial distribution of catches in SBT (southern bluefin tuna) by JPLL (Japanese longline) and its seasonal trends.

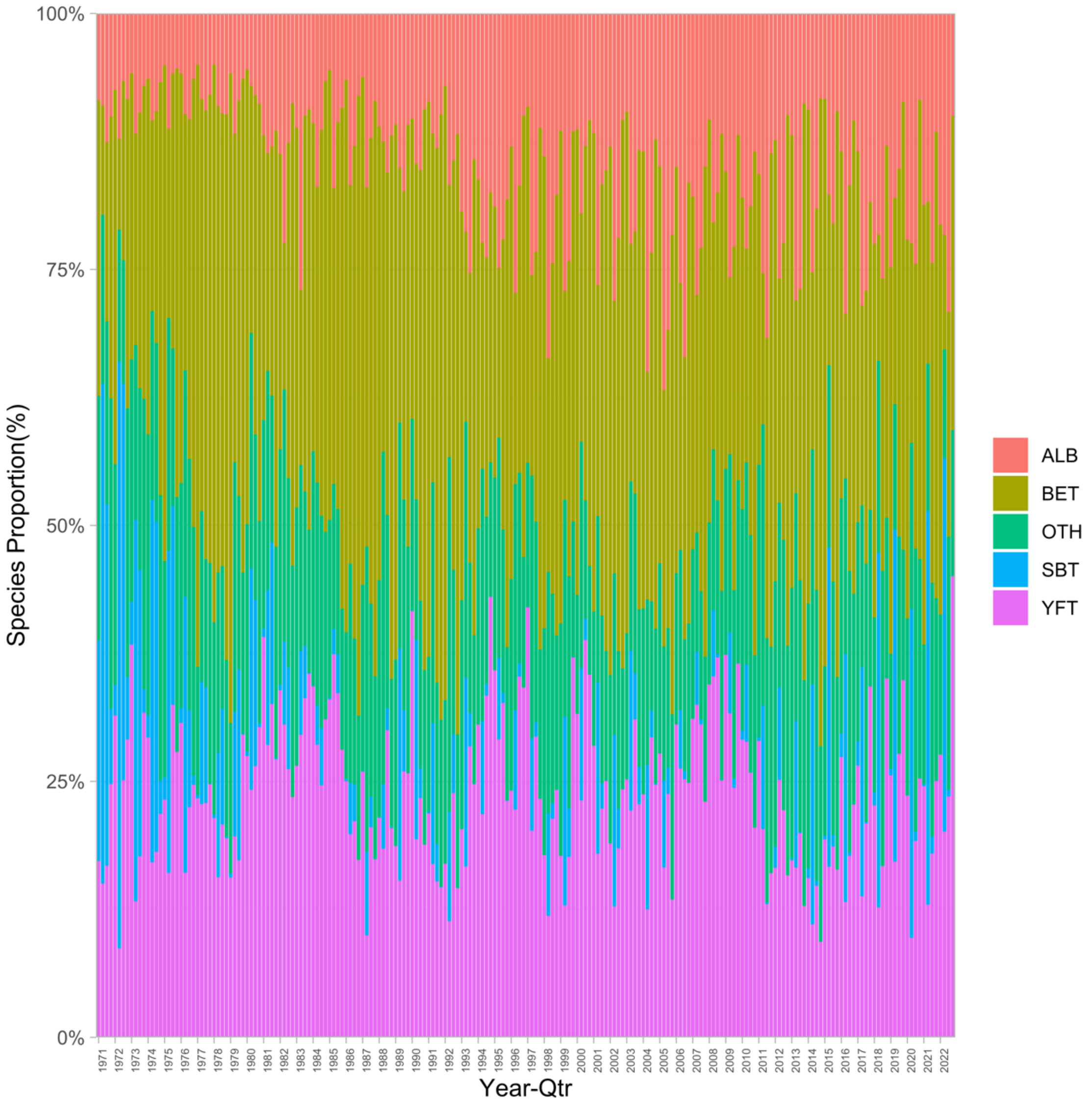

Figure 7. Historical trends in species composition (ALB: albacore tuna, BET: bigeye tuna, OTH: other species, SBT: southern bluefin tuna, YFT: yellowfin tuna) caught by JPLL. Data used in this analysis included only records with ALB catch (ALB>0).

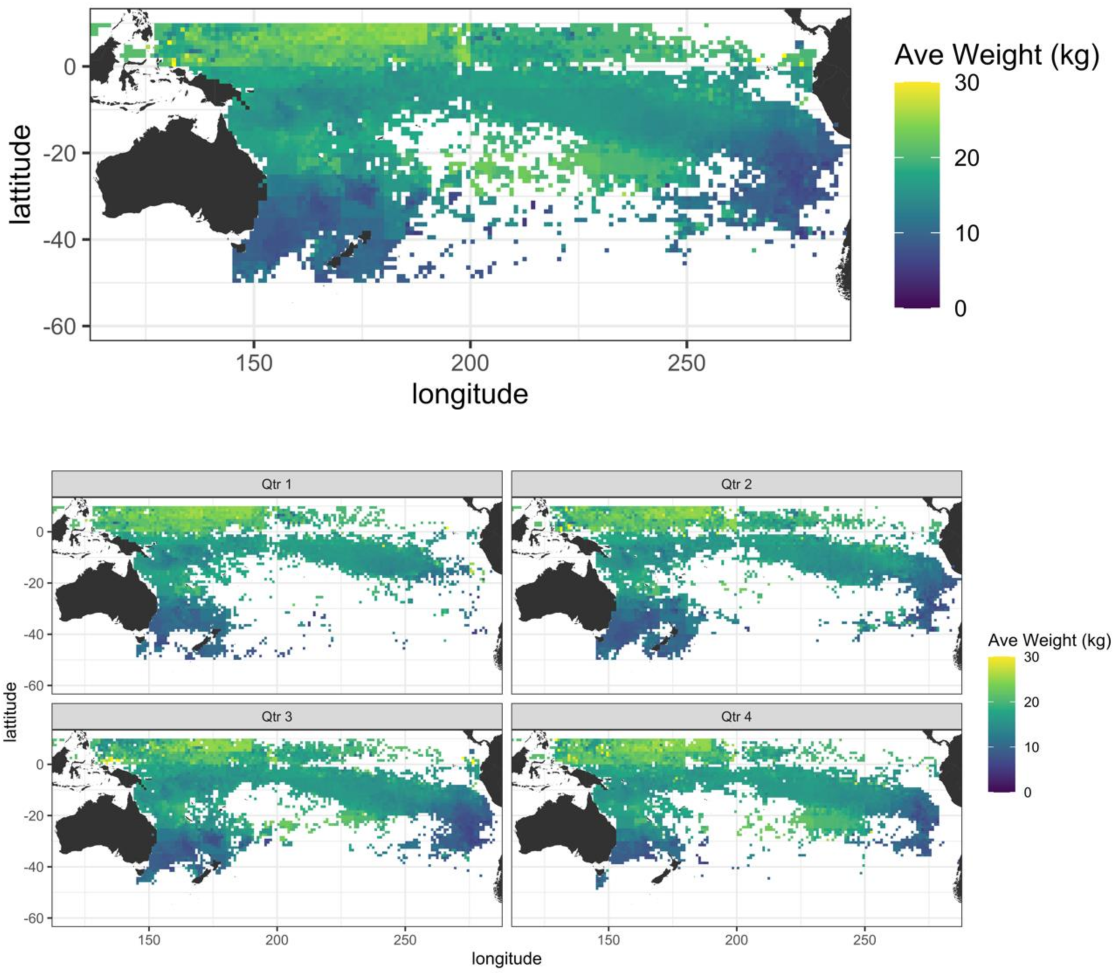

Figure 8. **Spatial distribution of averaged weight of south pacific albacore caught by JPLL (upper) and its seasonal trend (bottom).** Average weight was calculated using a number of catch and its total weight recorded on the JPLL logbook.

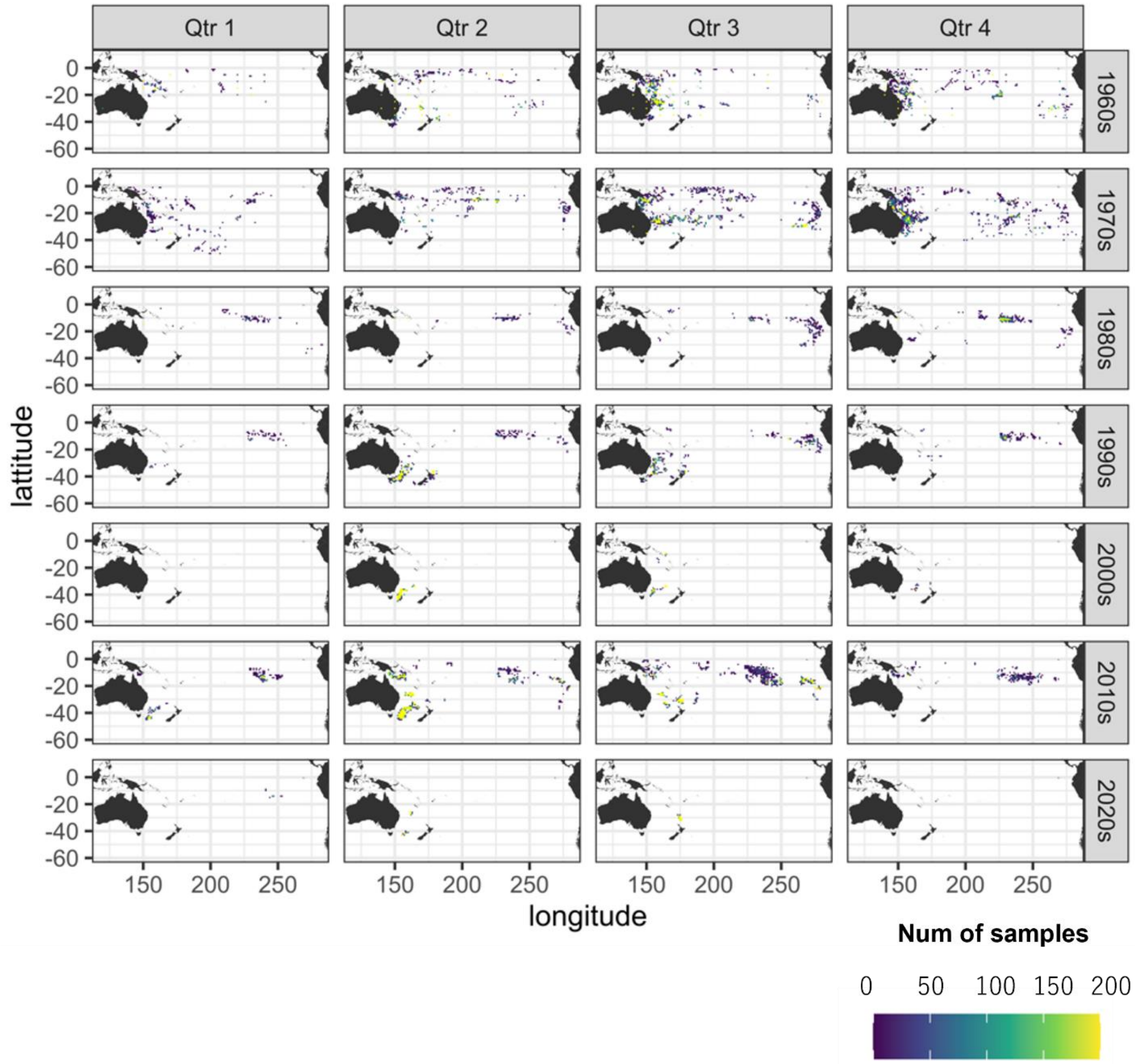

Figure 9. Sampling locations for south pacific albacore caught by JPLL in each decade and quarter (Qtr).

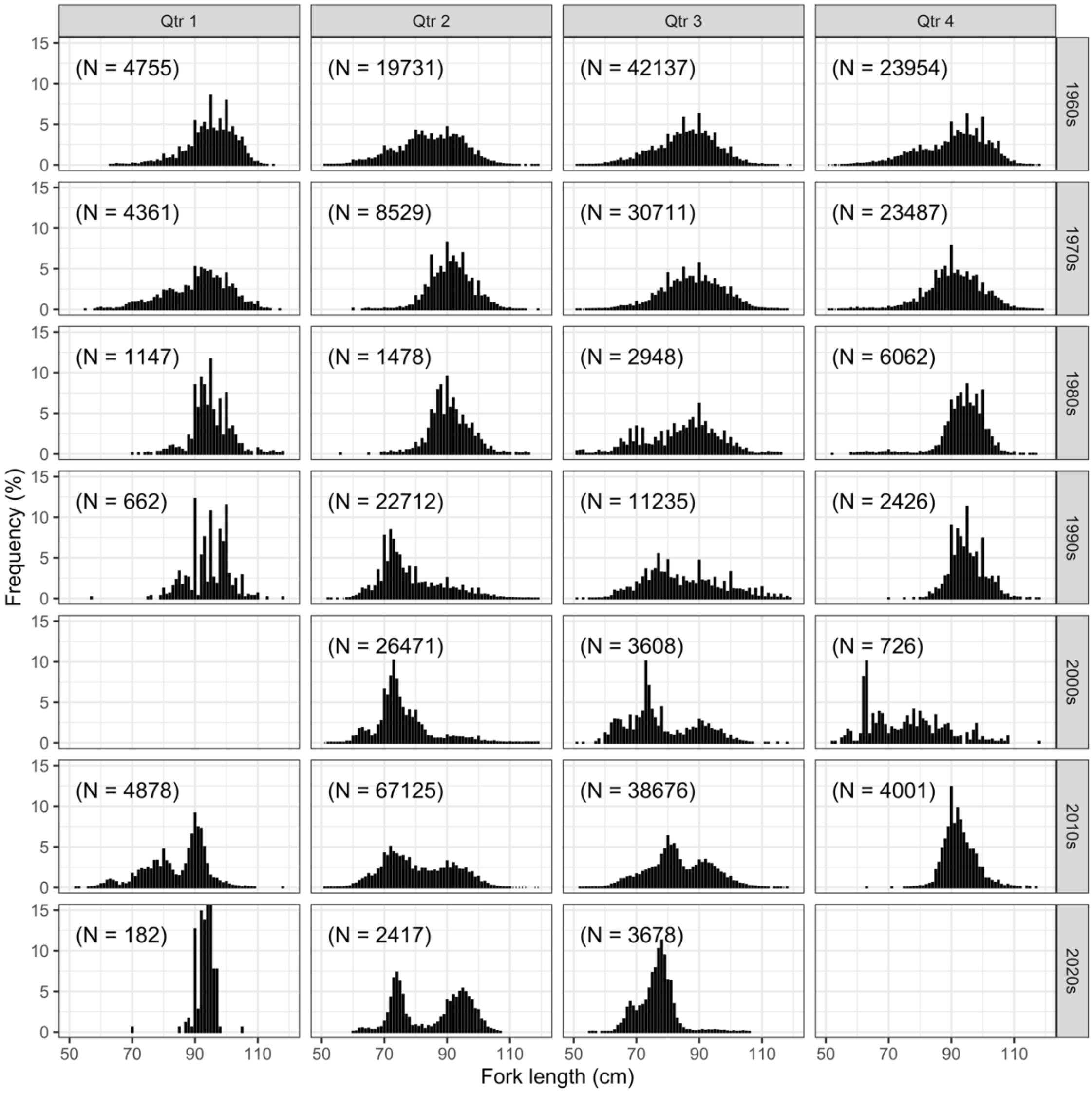

Figure 10. Size distribution of south pacific albacore caught by JPLL in each decade and quarter (Qtr).