REVIEW OF BIGEYE TUNA CATCH INCLUDING FISH
SIZE BY JAPANESE LONGLINE FISHERY IN THE ATLANTIC OCEAN

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SUMMARY

Status of effort, bigeye tuna catch, CPUE and catch at size were summarized for Japanese longline fishery operating in the Atlantic Ocean including recent trends. Bigeye tuna was usually main target especially in the tropical area by Japanese longline except for early period. Fishing effort fluctuated and it is decreasing in recent years. Bigeye tuna catch peaked in 1989, and decreased after that, although it was comparatively stable in recent years. Size data of bigeye tuna for Japanese longline have been collected from on-board measurement including observer program. Catch at size was created partly by substituting size data from another area/quarter strata. Differences in fish size by season and area were observed, although they were usually not so clear.

RÉSUMÉ

L'état de l'effort, de la prise, de la CPUE et de la prise par taille du thon obèse a été résumé pour la pêcherie palangrière japonaise opérant dans l'océan Atlantique, incluant les tendances récentes. Le thon obèse était généralement la cible principale des palangriers japonais, en particulier dans la zone tropicale, sauf au début de période. L'effort de pêche a fluctué et connaît une tendance à la baisse ces dernières années. La prise de thon obèse a atteint un sommet en 1989 et a diminué par la suite, bien qu'elle ait été relativement stable ces dernières années. Les données de taille du thon obèse capturé par les palangriers japonais proviennent des données de mesures prises à bord, y compris dans le cadre du programme d'observateurs. La prise par taille a été créée en partie en remplaçant les données de taille d'autres strates spatiales/trimestrielle. Des différences en termes de taille des poissons par saison et zone ont été observées, même si elles étaient généralement peu claires.

RESUMEN

Se resumen el estado del esfuerzo, la captura, la CPUE y la talla de los peces de la pesquería de palangre japonesa de patudo que opera en el océano Atlántico, incluidas las tendencias recientes. El patudo ha sido generalmente la especie objetivo de la pesquería de palangre japonesa, sobre todo en la zona tropical, excepto en la fase inicial del periodo. El esfuerzo pequero ha fluctuado y está descendiendo en los últimos años. La captura de patudo alcanzó su punto máximo en 1989 y descendió después, aunque se ha mantenido relativamente estable en los últimos años. Se han recopilado datos de talla de patudo para la pesquería palangrera japonesa a partir de mediciones a bordo realizadas en el marco del programa de observadores. La captura por talla se creó en parte mediante la sustitución de los datos de talla de otros estratos espaciales/trimestrales. Se observaron diferencias en la talla de los peces por temporada y zona, aunque generalmente no estaban tan claras.

KEYWORDS

Catch/effort, Longline, CPUE, Catch at size, Bigeye tuna

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1. Introduction

Longline is the only tuna-fishing gear deployed by Japan at present in the Atlantic Ocean. Other two types of fishery, baitboat and purse seine fisheries, stopped fishing in the Atlantic in 1984 and 1992, respectively (Anonymous, 2012). Bigeye tuna is usually main target especially in the tropical area. Regarding Japanese longline fishery operating in the Atlantic, several regulations have been implemented including catch quotas for bigeye tuna set by Fisheries Agency of Japan. TAC of bigeye tuna for several countries including Japan has been implemented since 2005.

In this document, historical and spatial changes of bigeye tuna catch, CPUE and the fishing effort by Japanese longline fishery are described in conjunction with the catches of the other tunas and tuna-like species. In addition, availability of size data and overview of catch at size of bigeye tuna caught by the longline are shown to see general information of the fish caught. This document is also aimed to provide information for understanding standardized bigeye tuna CPUE by Japanese longline fishery.

2. Data source

In order to count number of hooks and catches in number of tunas and billfishes, basic data used here is the logbook database that have been compiled at National Research Institute of Far Seas Fisheries (NRIFSF) based on the logbook mandatory submitted by the fishermen of the longline vessels larger than 20 gross ton (GRT). The data are so-called "raised" data, which is aggregated by month and 5˚x5° block, and then expanded with coverage rate of the logbook. The basic data is available for 1952-2014. Data for 2014 are preliminary.

Size for bigeye tuna was measured by on board of commercial vessels by crew members or scientific observers. The data were collected and compiled at NRIFSF and are available for 1965-2014. Data for 2014 are very preliminary.

3. Procedure for creating catch at size

The method is the same as that by Satoh et al. (2004) applied for yellowfin tuna. The detail is as follows.

Catch data stratified by 5x5 and month were aggregated by 10 degree of latitude and 20 degree of longitude and month. Size data were aggregated by 10x20 degree square and month. When sample size (the number of measured fish) was larger than 200 fish or sample size was larger than 5% to the total catch in number, no substitution was made. Otherwise size data was substituted from another stratum using the criteria shown below.

Level 1 substitution: Substitution with neighboring rectangle in the same quarter, priority was given in the order following: east, west, lower latitude, higher latitude, lower east, lower west, higher east, higher west.

Level 2 substitution : Same substitution as Level 1 but neighboring quarter, only between second and third quarters and between fourth and first quarters in the following year except first quarter in the first year and fourth quarter in the last year, in which substitution was made between first and second quarters and between third and fourth quarters, respectively.

Level 3 substitution: All available catch-at-size, including Level 1 and 2 substitutions, was summed for four large areas (north of 20 N, between equator and 20 N, between equator and 20 S and south of 20 S, Figure 1) in the Atlantic in same quarter. Substitution was made with one of them to which that stratum belongs.

Level 4 substitution: Same as Level 3 but neighboring quarter (2 to 3 and 4 to 1).

Level 5 substitution: Areas were extended to north and south Atlantic in the same quarter.

Level 6 substitution: Same as Level 5 but neighboring quarter (2 to 3 and 4 to 1).

Level 7 substitution: Area was further extended to total Atlantic in the same quarter

4. Trend of catch and effort

Figure 2 shows annual trend of the catch for each species as well as effort (number of hooks) and nominal CPUE of bigeye tuna. Fishing effort (number of hooks) sharply increased during the early period (late 1950s to early 1960s), got first peak in 1965 (100 million), but sharply decreased after that. It increased again with fluctuation after late 1970s, became historical high in 1996 (123 million), and then decreased with fluctuation. Main reason of the decrease after 1990s is probably because of decrease in the number of distant water longline vessels. The trend of bigeye tuna catch in number is similar to that of fishing effort (**Figure 2a**). It peaked in 1989 (861 thousand fish), became close to the peak in 1993 (856 thousand fish) and then kept decreasing, but it was comparatively stable in recent years. The catch in 2014 (preliminary) was about 300 thousand fish.

Bigeye tuna is usually main component of the catch except for early period, when albacore and/or yellowfin tuna was main component (**Figure 2b, c**). Nominal CPUE for bigeye tuna was fluctuating; it declined between late 1980s and mid 2000s, but it has been increasing with fluctuation after that.

Figure 3 and **Figure 4** show geographical distribution of effort (number of hooks) and bigeye tuna catch by decade, respectively, and **Figure 5** shows geographical distribution of species composition of the catch by decade. **Figure 6 and Figure 7** show annual and quarterly distribution of fishing effort in recent years, respectively. **Figure 8 and Figure 9** show recent annual trend for the distribution of bigeye tuna catch and species composition, respectively.

Japanese longline fishery in the Atlantic commenced in 1950s in the equatorial waters. The main component of the catch was yellowfin tuna (**Figure 2b, c, Figure 5**).

In the 1960s, the effort expanded to temperate area. In this period, the total catch of five species of tunas combined, i.e., yellowfin, albacore, bluefin, southern bluefin and bigeye tunas was historical highest, and species-specific catches were also the highest for yellowfin, albacore and bluefin tunas (**Figure 2b**). Albacore and yellowfin tuna were main component of the catch in the temperate and subtropical, and tropical areas, respectively. Bigeye tuna was main component in several regions of tropical areas.

In the period from the late 1960s to the late 1970s, the effort decreased to about 30-60 million hooks, about 50% of the first peak year of 1965 (**Figure 2a**). In this period, catch of yellowfin and albacore drastically decreased compared to that in the previous period (**Figure 2b**). This decrease is probably due to decrease in total effort and shift of the effort to the fishing grounds for bigeye, bluefin and southern bluefin tuna. Bigeye tuna was usually main target in the eastern part of tropical area.

In the period from the late 1970s to the mid 1990s, the effort increased again and reached to historical high (123 million hooks) in 1996 (**Figure 2a**). This increase was seen both in the tropical and temperate areas, targeting bigeye tuna and bluefin tuna, respectively. Main component of the catch was bigeye tuna in this period, which was mainly caught in the eastern part of tropical area.

In the period after mid 1990s, the effort decreased (**Figure 2a**) and total catch also decreased (**Figure 2b**). Bigeye tuna was still main component, but the proportion of albacore increased. Bigeye tuna catch slightly decreased but nominal CPUE increased with fluctuation after 2005 (**Figure 2d**), although data for 2014 are preliminary. High proportion of albacore was observed mainly in the temperate area of south Atlantic (**Figure 9**).

Quarterly distribution of fishing effort in recent years (**Figure 7**) indicates that there was almost no fishing effort in the north Atlantic in the first and second quarter. In the tropical area, fishing effort was deployed all year, but it seems more intense in the first quarter.

5. Size data and catch at size

The number of measurement for bigeye tuna caught by the longline vessel is shown in **Figure 10**. The annual number of samples largely differ depending of years; was less than 10,000 individuals before 1974, roughly 20,000 to 60,000 during 1975-2002, and was usually less than 20,000 after that. On-board measurements by commercial longline vessels had been main data source. Scientific observers have been measuring fish since 1997, and some of the data are under compilation. Measurement rate was roughly 10% or higher during 1975-1983, and more or less 5% after that.

Figure 11 shows the proportion of the degree of substitution of size data to create catch at size in terms of the

number of strata and the number of catch. CAS for more or less 30% of the strata was created without substitution, and more or less 40% with Level 1 substitution. In terms of the number of the catch, more or less 60% of the strata was created without substitution, and more or less 30% with Level 1 substitution. These indicate that most of the CAS was created without substitution or substitution by the nearest strata.

Figure 12 shows length distribution of CAS of bigeye tuna for 2010-2014 stratified by year and quarter. The fish mostly ranged between 80 and 180cm. No major annual change was observed, although the fish was on average a bit smaller in 2012 and a bit larger in 2013. Quarterly length distribution indicates that the proportion of smaller fish (80-110cm) was higher in the third quarter.

Figure 13 shows length distribution of CAS of bigeye tuna for 2010-2014 stratified by area. There was no clear difference of fish size by area, but the proportion of smaller fish (<90cm) in the area 4 (south of 20S) was higher than in the other areas.

References

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Satoh, K., H. Okamoto, H. Shono, N. Miyabe. 2004. Attempt for improvement of the size data substitution method to create catch-at-size of yellowfin caught by the Japanese longline fishery in the Atlantic. Col. Vol. Sci. Pap. ICCAT, 56(2): 560-569.
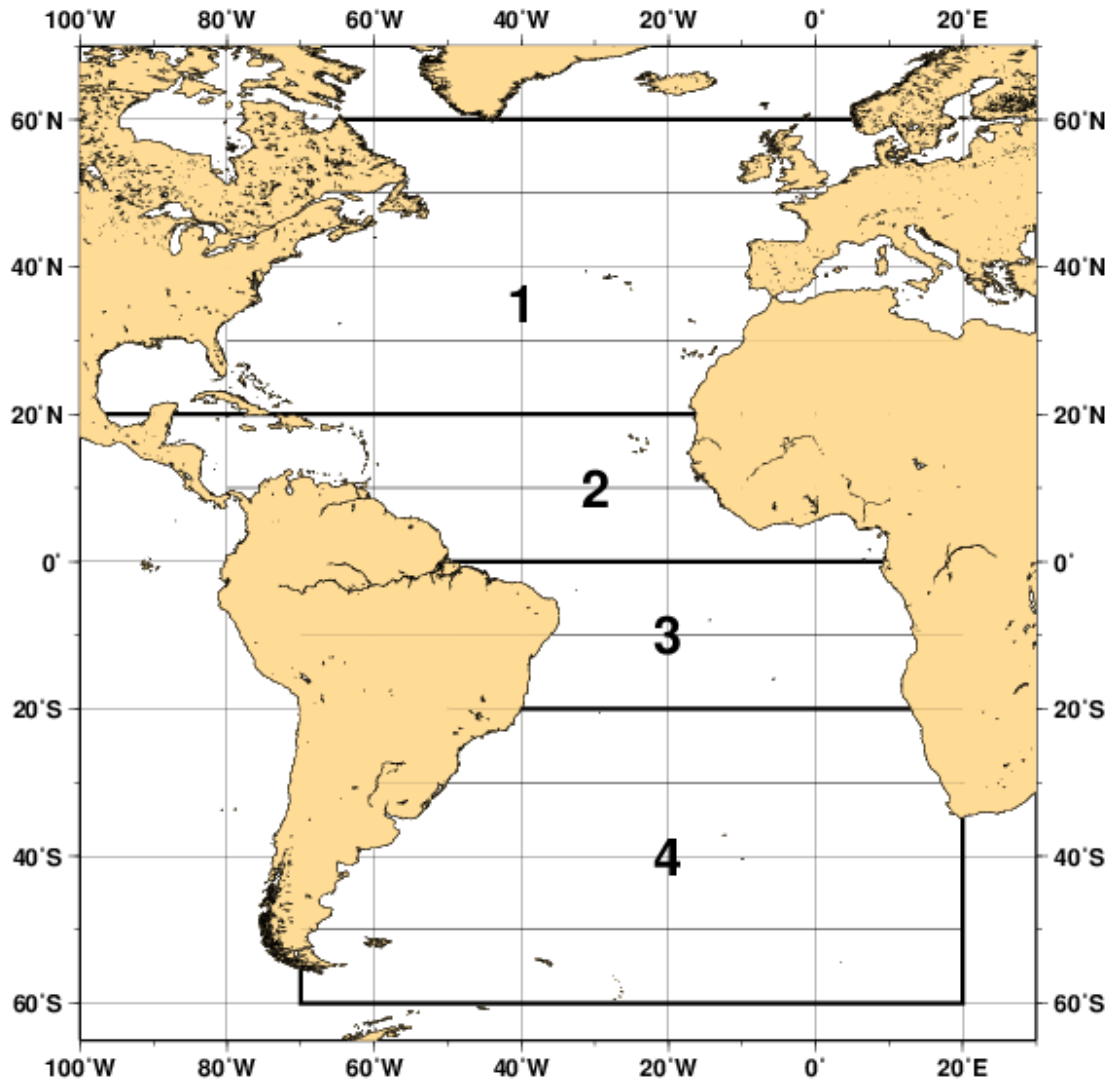
Figure 1. Area definition for summarizing and substituting size data of bigeye tuna (Level 3 and 4) when creating catch at size.
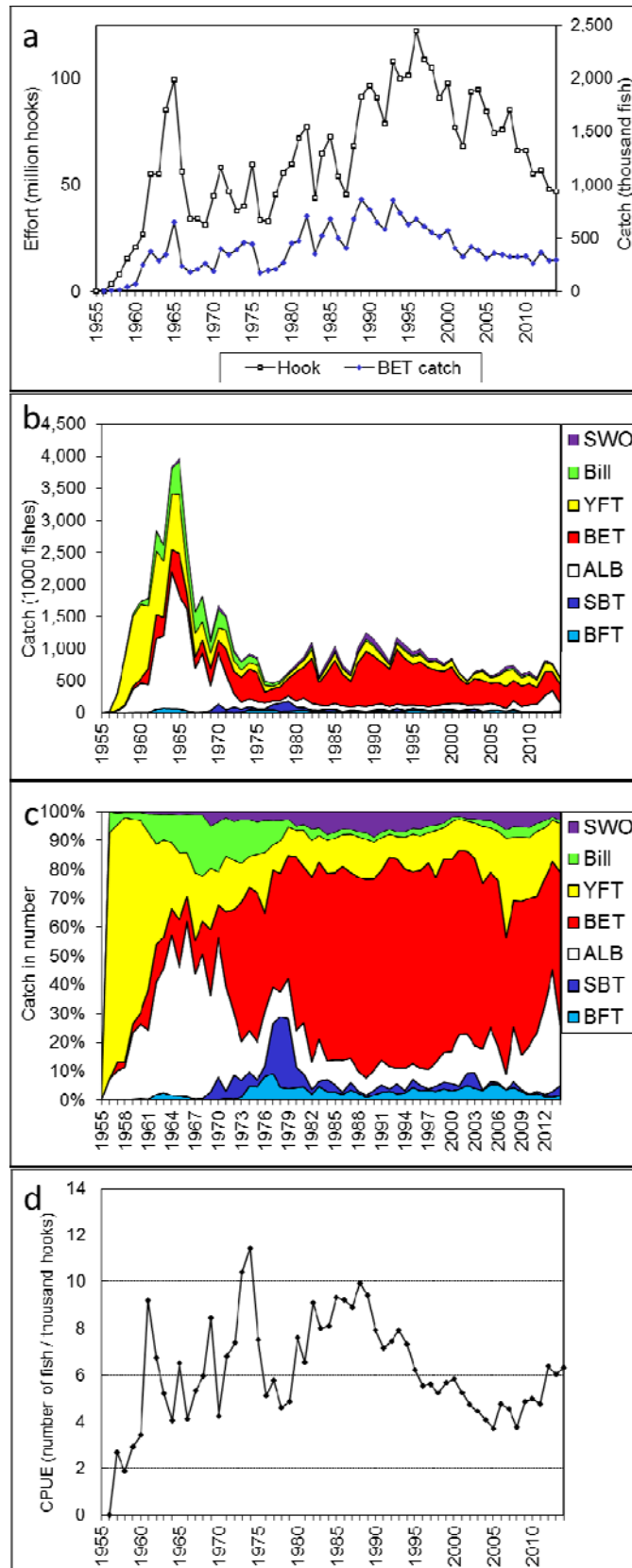
Figure 2. The number of hooks employed and bigeye tuna catch (a), catch by species (b), species composition (c), and nominal CPUE of bigeye tuna (d) caught by Japanese longline fishery.
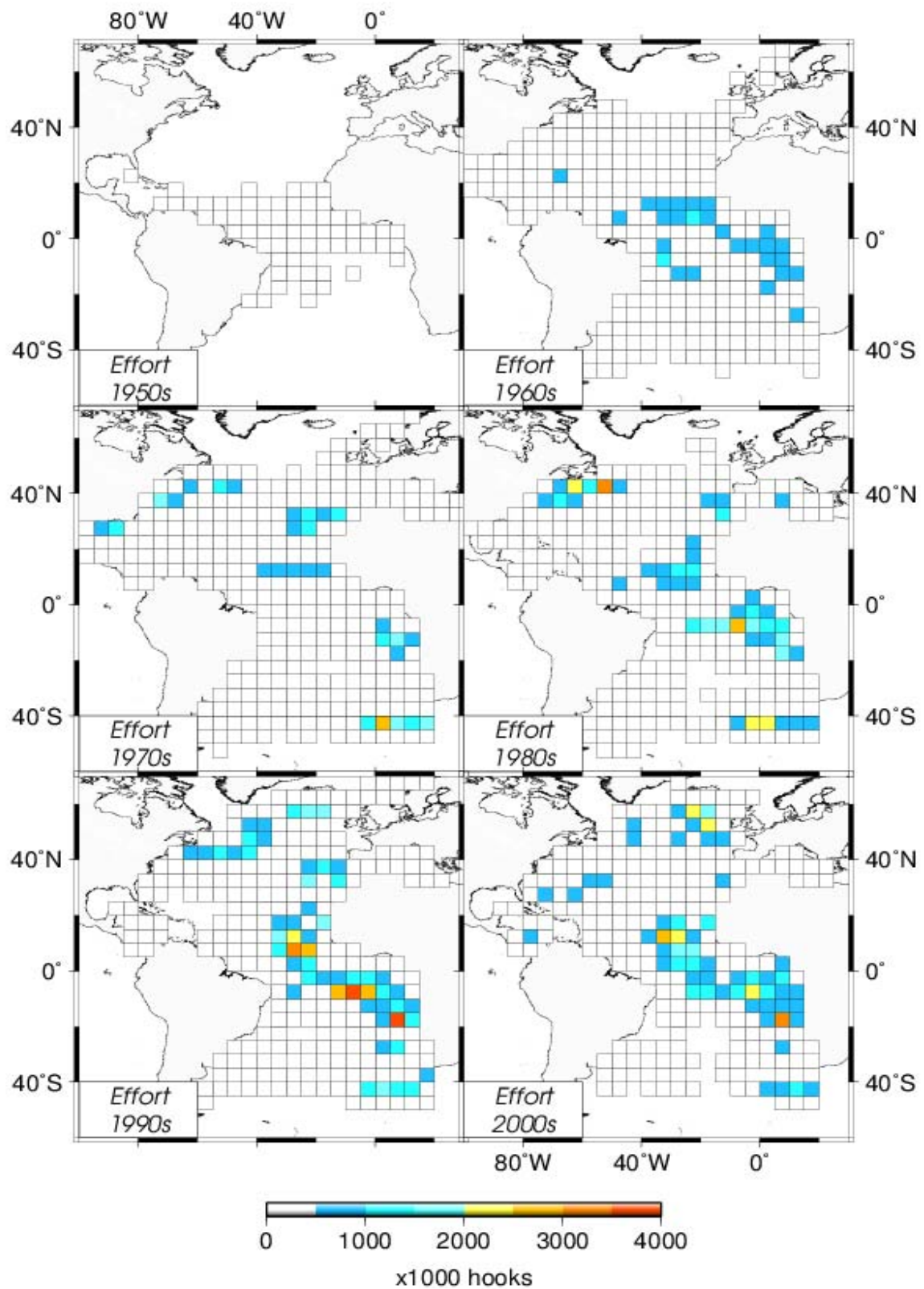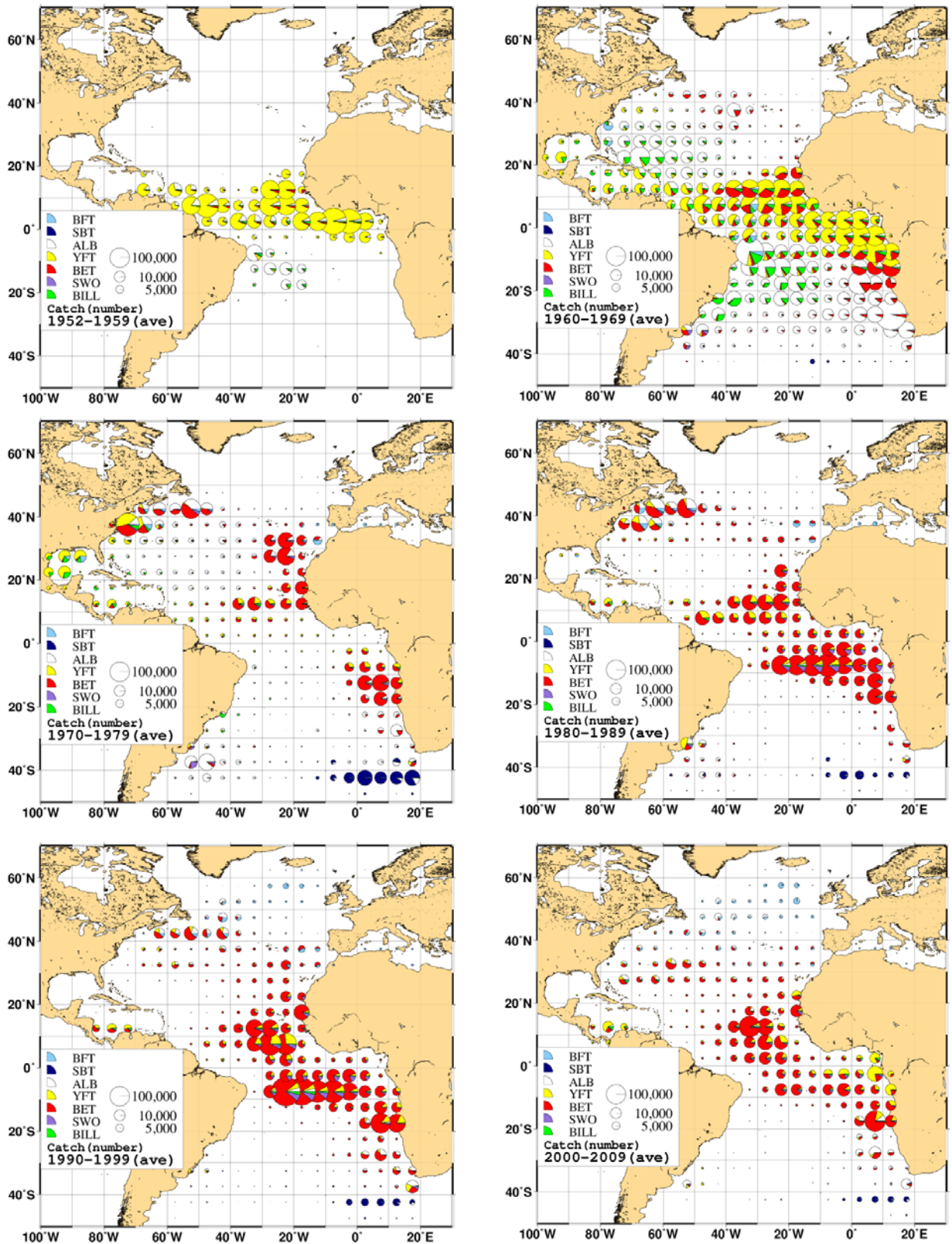
Figure 3. The average distribution of the effort (number of hooks) for each decadal period by Japanese longline fishery.

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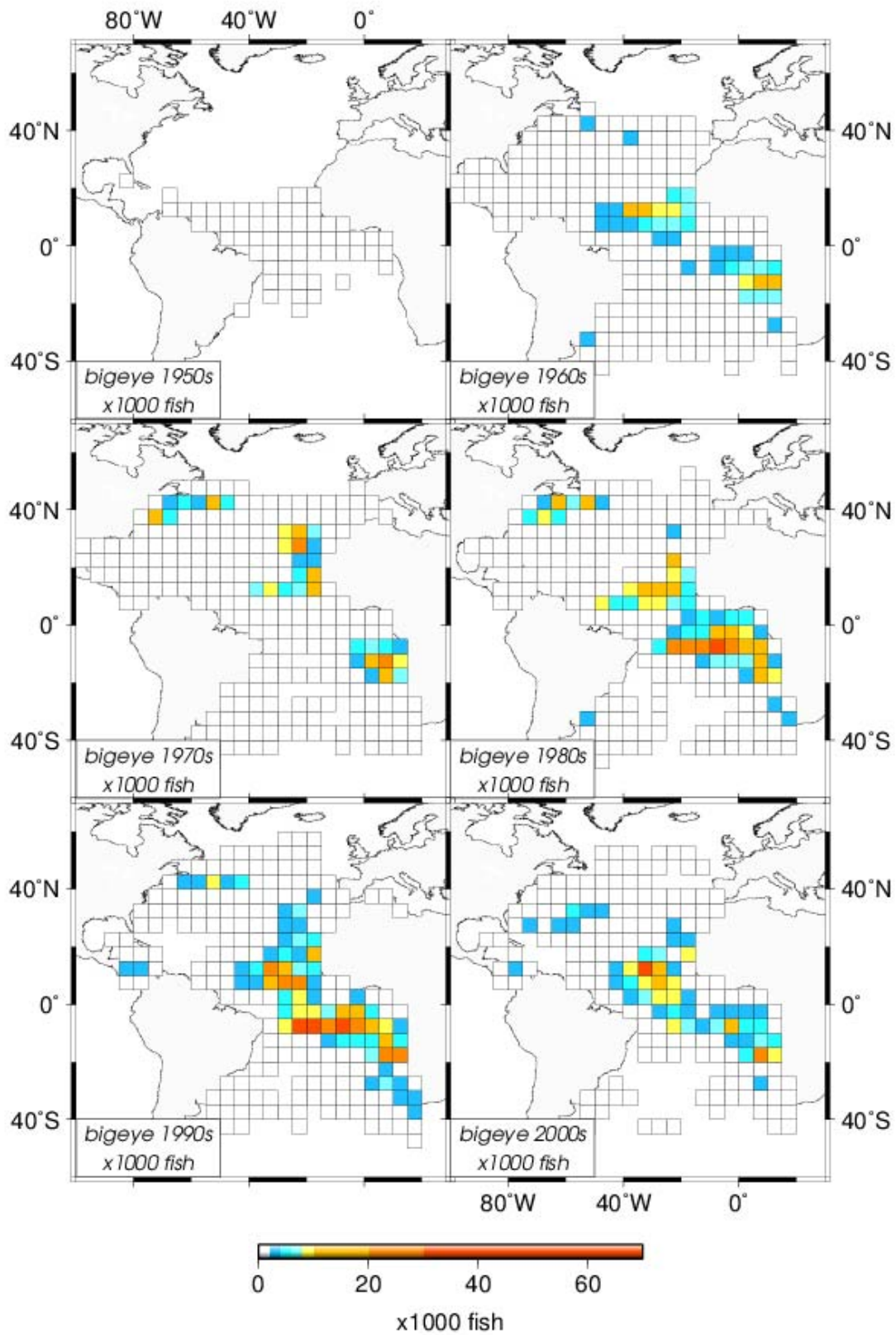
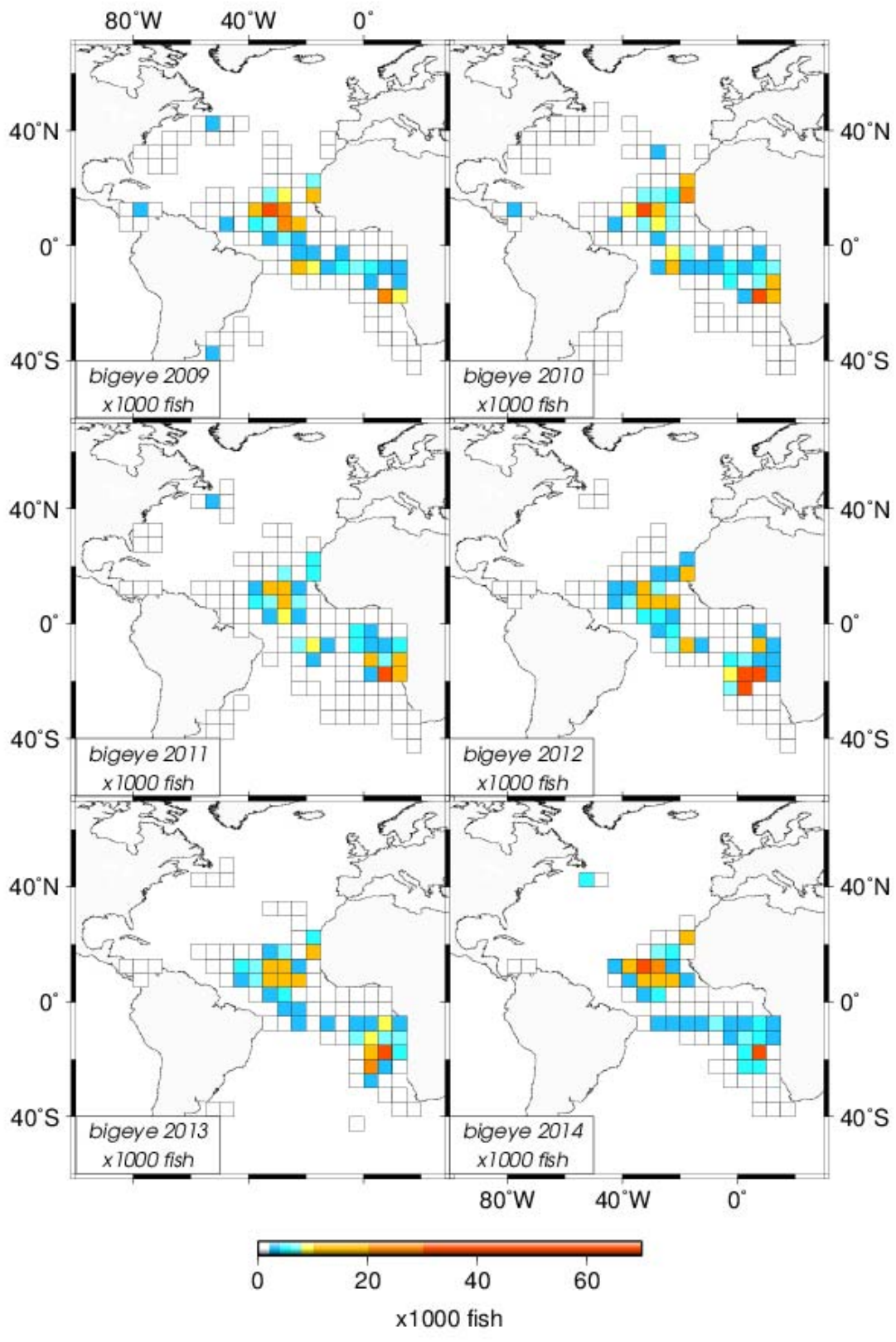**Figure 4.** The average distribution of bigeye tuna catch (number of fish) for each decadal period by Japanese longline fishery.

Figure 5. The averaged distribution of amount of catch in number by species for each decade. Size of circle shows amount of total of catches i.e. bluefin tuna (BFT), southern bluefin tuna (SBT), albacore (ALB), bigeye tuna (BET), yellowfin tuna (YFT), swordfish (SWO) and billfishes (BILL).
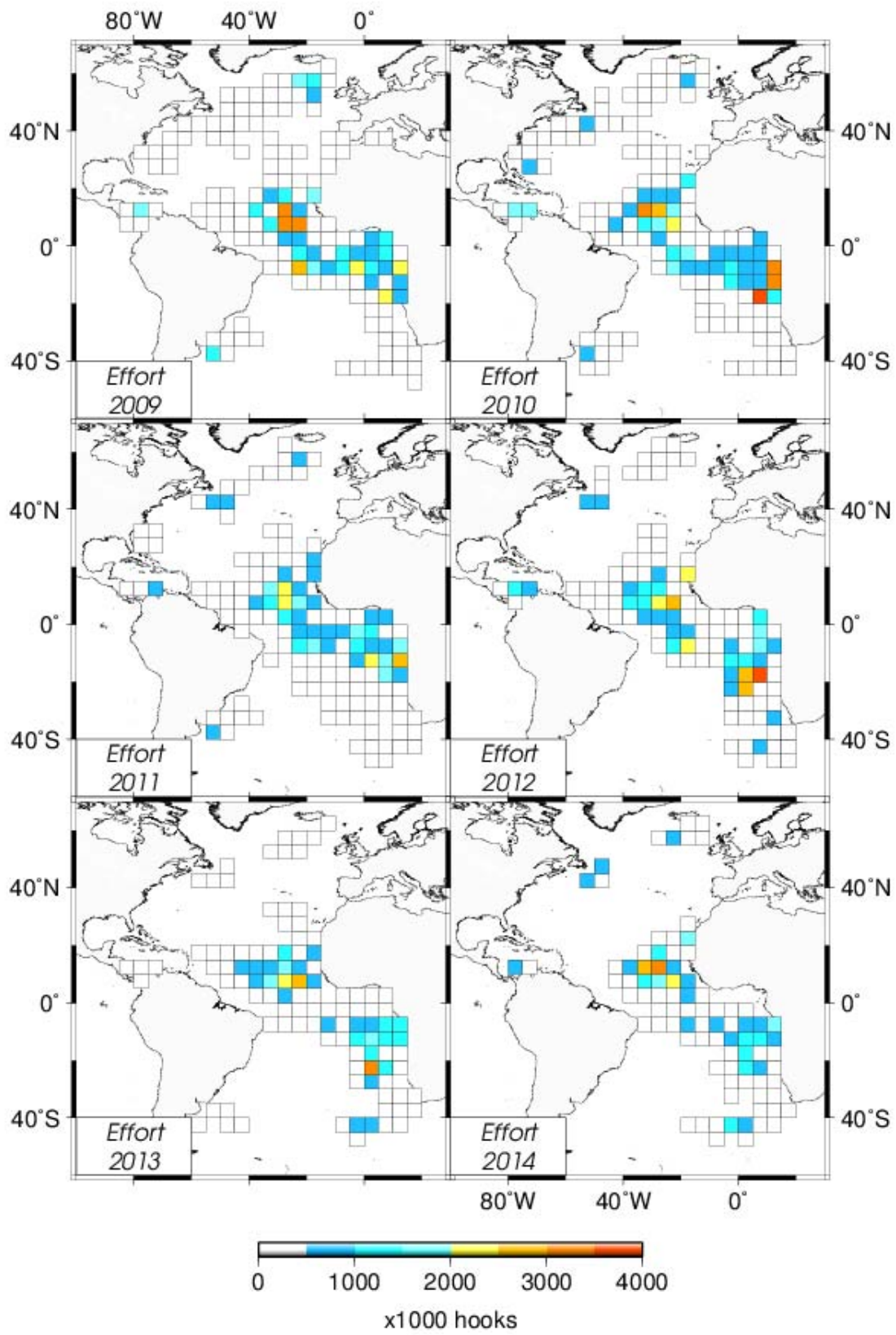
Figure 6. The geographical distribution of the effort (number of hooks) in recent years.
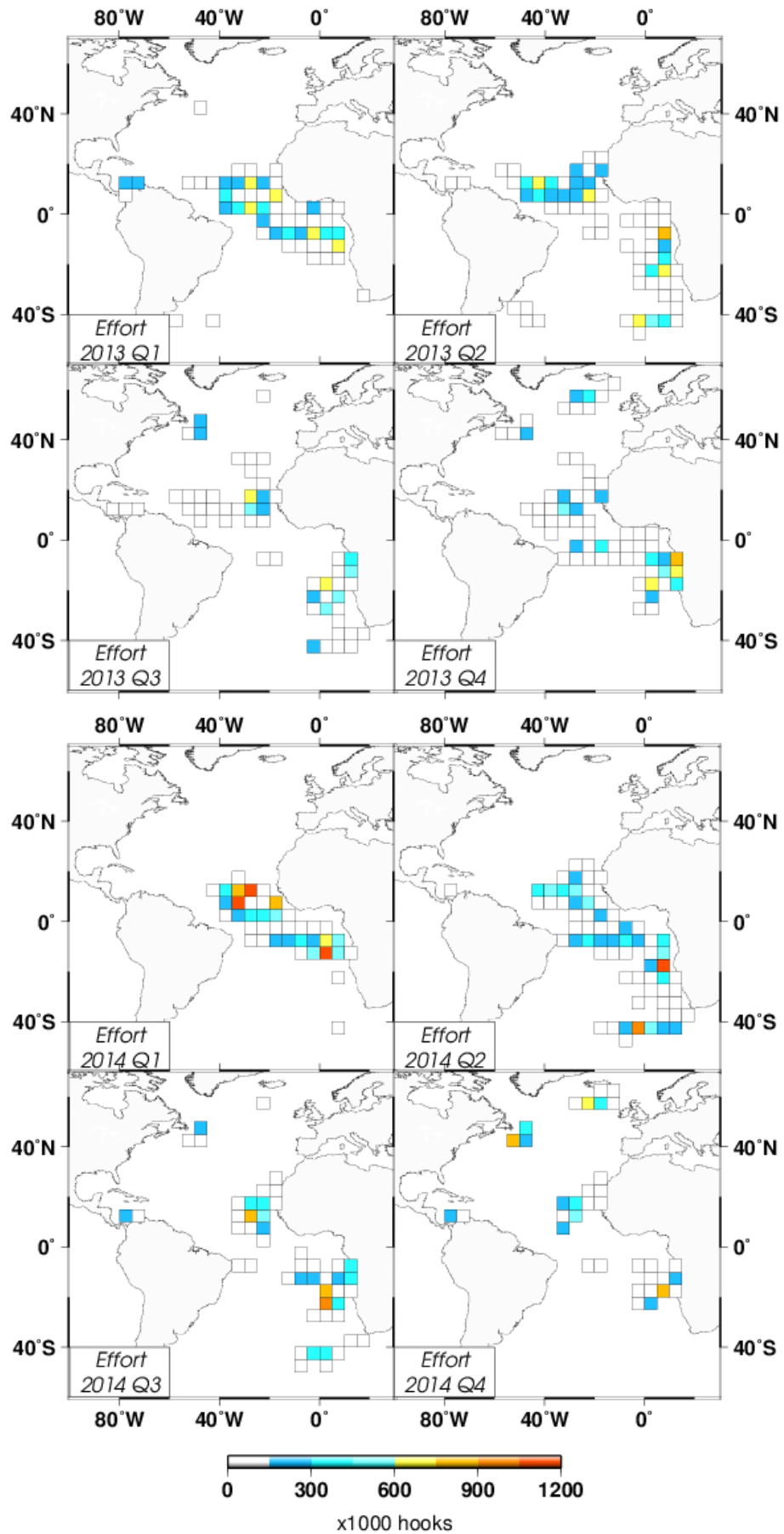
Figure 7. Quarterly geographical distribution of the effort (number of hooks) in recent years.
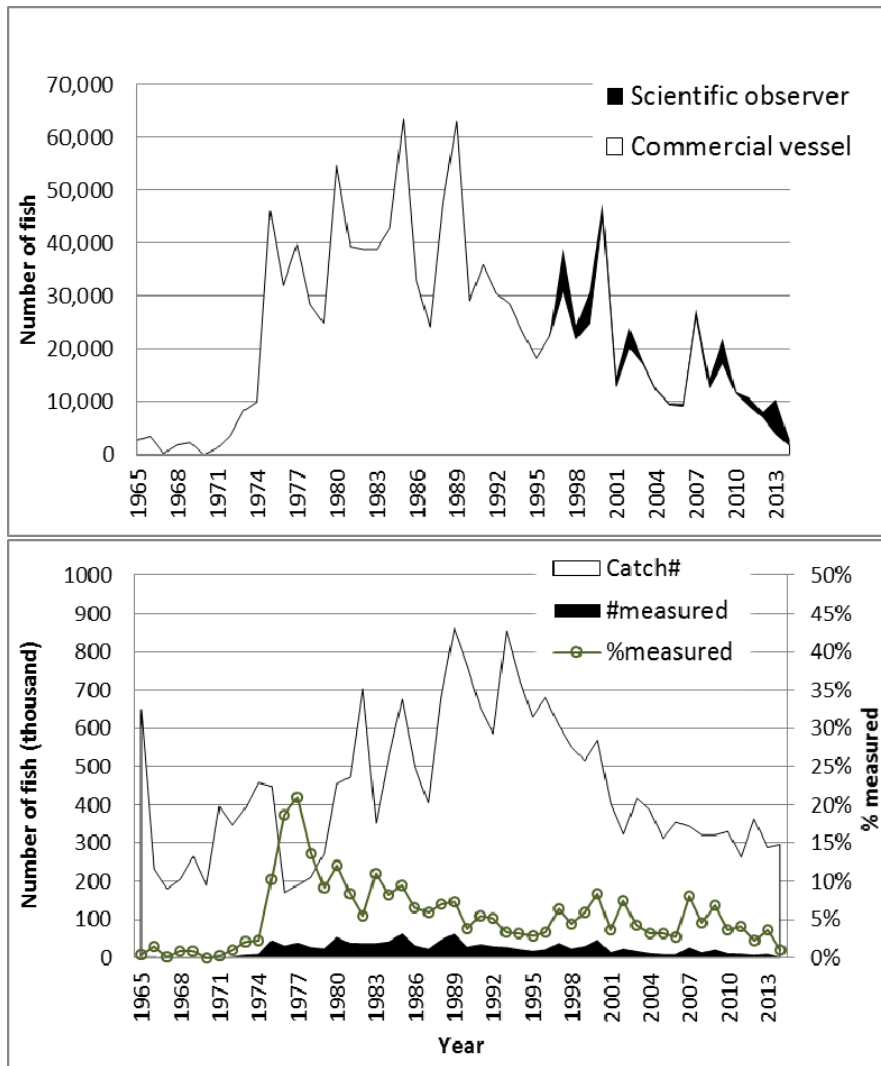
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Figure 8. The geographical distribution of bigeye tuna catch (number of fish) in recent years.
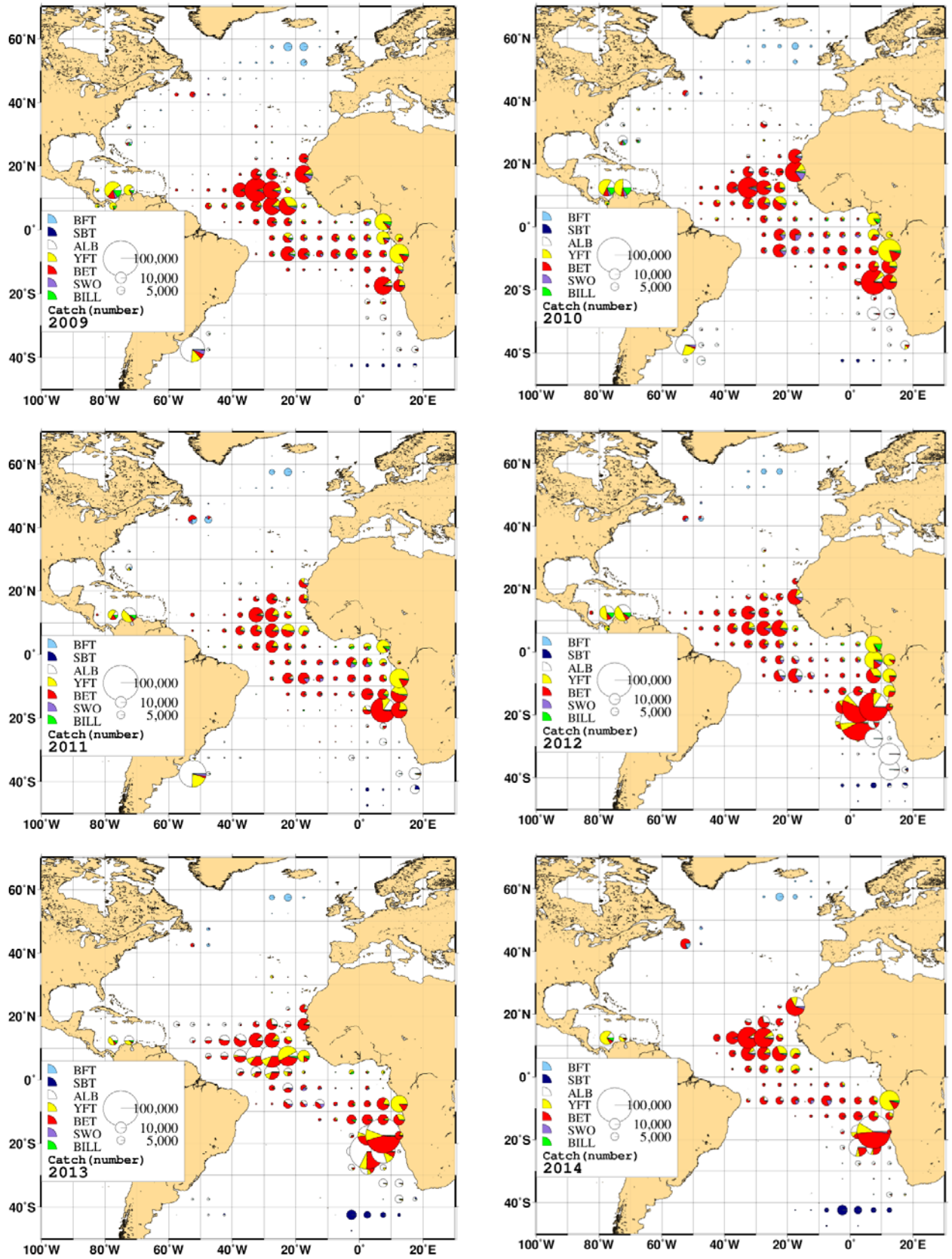
Figure 9. Annual recent distribution of amount of catch in number by species. Size of circle shows amount of total of catches i.e. bluefin tuna (BFT), southern bluefin tuna (SBT), albacore (ALB), bigeye tuna (BET), yellowfin tuna (YFT), swordfish (SWO) and billfishes (BILL).

Figure 10. The number of bigeye tuna measured by sampling category (top) and the number of fish measured with catch in number and measurement rate (bottom).
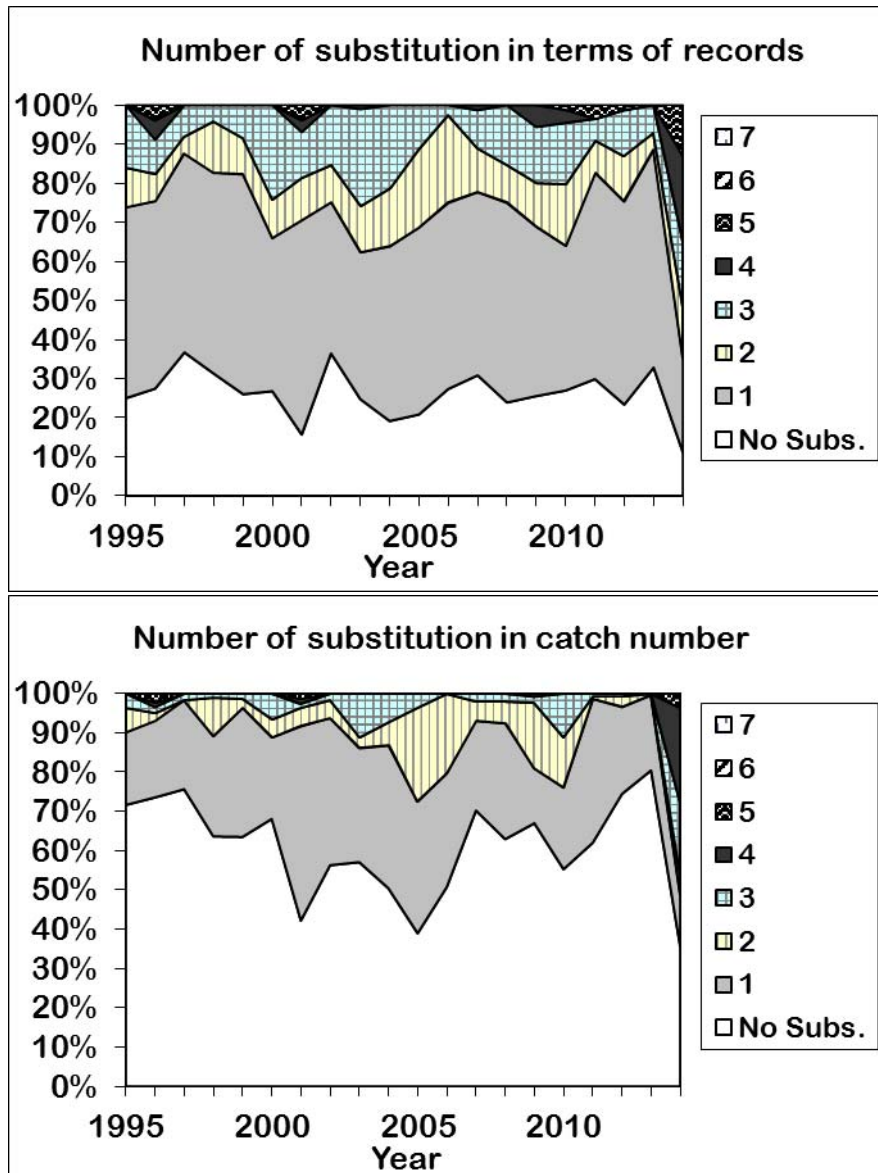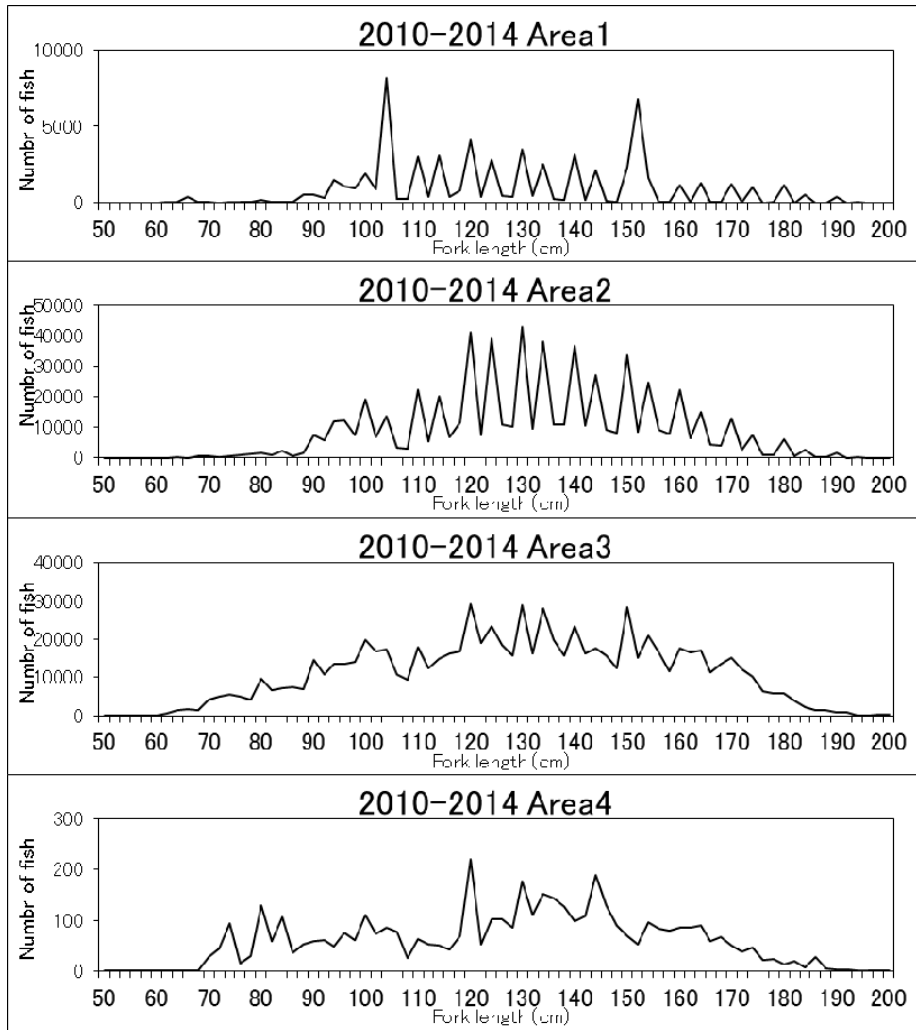
Figure 11. Proportion of the degree of substitution of size data to create catch at size in terms of the number of strata (top) and number of catch (bottom). For legend, see text.
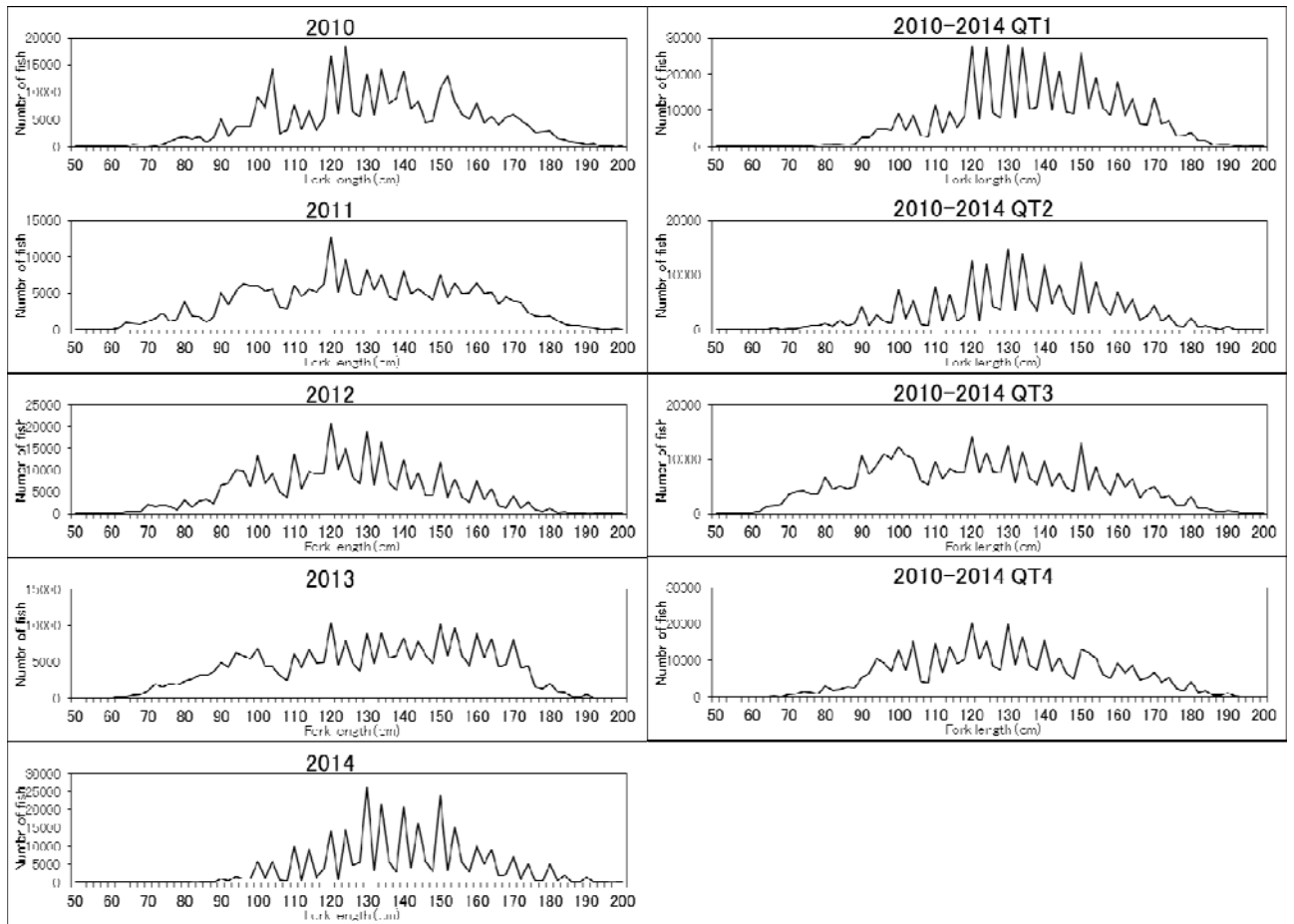
Figure 12. Catch at size of bigeye tuna in the Atlantic Ocean caught by Japanese longline by year (left) and quarter (right) for 2010-2014.

Figure 13. Catch at size of bigeye tuna in the Atlantic Ocean caught by Japanese longline for 2010-2014 by area shown in **Figure 1**.