Abundance indices of albacore tuna for the Stock Synthesis III by Japanese longline fishery in the North West Pacific Ocean.[1]

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Summary

To operate Stock Synthesis III, I calculated area and seasonal dependent abundance indices of albacore tuna in the North West Pacific Ocean. All results were available alternative abundance indices for the Stock Synthesis III.

Introduction

Japanese longline indices for albacore stock assessment in April 2014 were submitted in data preparatory meeting in November 2013 (Ijima et al, 2013 c). As a result of discussion during the meeting and subsequent discussion via e-mail, these indices were changed these geographical areas and were indicated seasonal difference. The purpose of this document is to present revised indices and describe change for each index.

Data and Methods

In this analysis, I used catch and effort data sets given by Japanese longline log books. These data sets are configured three operational type fisheries that are Offshore, Distant water and Coastal fishery and are including catch, effort (hooks) and hooks per basket with 1°x 1° grid cells. We picked up data sets between1975 and 2012 because hooks per basket data are available after 1975. Hooks per basket data express gear effect (deep sets or not) and that effectiveness is significantly large for the CPUE standardization.

Generalized linear models

Generalized linear models (GLMs) were used for the analysis of the standardize catch per unit effort (CPUE) (Maunder and Punt, 2004; Walters, 2003). CPUE was assumed as albacore abundance indices in the previous analysis (Ijima et al., 2013a, Ijima et al., 2013b, Ijima et al., 2013c). I analyzed Japanese longline albacore CPUE that based on four area and quarterly definitions above. Using negative binominal model, I chose five main effects a combination of year, quarter, a fishing gear effect (hooks per basket), 5°x 5° fishing area effect and fishery feet type and did not use interaction term. The model examined for standardization of CPUE was:

$$
\begin{aligned}
&Catch_i \sim NB(\mu_i, k),\\
&E(Catch_i) = \mu_i,\\
&\log(\mu_i) = \alpha + \beta_1 yr_i + \beta_2 qtr_i + \beta_3 latlon + \beta_4 hpb_i + \beta_5 fleet_i + \log(hooks_i),
\end{aligned}
$$

where $Catch_i$ is the albacore catch number in condition *i*. μ_i is expected value and *k* is variance of Negative Binomial distribution. α is an intercept. β_x are coefficients. yr_i is year effect in the condition *i*. qtr_i is quarterly effect in the condition *i*. $latlon_i$ is 5°x5° area effect in the condition *i*. hpb_i is fishing

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gear effect in the condition *i* and log($hooks_i$) is offset term of fishing effort respectively. In these GLMs, all explanatory variables were treated as categorical data. A standardized annual CPUE was obtained by calculating the least squares means. To obtain uncertainty of these results, I compute 1,000 times bootstrap sampling. All statistical analysis results were provided by R-2.15.2.

Result and Discussion

To operate Stock Synthesis III (SS3) (Methot and Wetzel, 2012), it need to define size based fishery and that abundance indices are significant for the stock assessment. In North West Pacific Ocean (WPO), Japanese longline fishery shows three important aspect (1) Japanese longliners have caught three type size albacore according fishing area and season. (2) Japanese core longline fishery ground was changed in early 1990's. (3) Fishing gear was changed in late 1980's (shallow sets to deep sets). Hence, we defined four type fishing area that was considering catch at length, core fishing ground by year and fishing gear change as follows;

Area 1: Area coverage is small from 25°N to 35°N and 130°E to 140°E (Figure 1). In this area, coastal and offshore fishery has historically targeted small size albacore (about 80cm) in the first and second quarter (Figure 4, 5). In the third and fourth quarter, catch amount is smaller than first and second quarter and that target size is about 100cm (Figure 6, 7).

Area 2: During 1975 and 1992, main fishery area was high-latitude in WPO (from 20°N to 35°N and 140°E to 180°E) (Figure 1). In this area, offshore and distant water fishery has caught about 100cm albacore. Main fishery season is first and 4th quarter (Figure 4, 7).

Area 3: After 1993, Japanese longline fishery ground expanded south area in the north Pacific Ocean (from 10°N to 35°N and 130°E to 180°E exclude JPNLL small exclude JPNLL small area) (Figure 1). In this area, large size albacore (over 100cm) has been caught by offshore, distant water and coastal fishery (Figure 4-7).

Area 4: During 1975 and 1992, large size albacore (about 120cm) was caught in WPO (from 10°N to 20°N and 140°E to 180°E) (Figure 1).

Using these datasets in each area, we standardized annul or seasonal abundance indices of albacore tuna (Table 1).

Relative CPUE targeting small size albacore showed almost same trends (Figure 2). According to the relative CPUE targeting large size albacore, annual and quarter 1 result showed same trend

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approximately (Figure 3). The quarter 2 to 3 trend was different other index. That reason was thought these seasons were not main fishing season and that data sets were poor.

References

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Table1. Fishery definition in this analysis.

Fishery name	Target size	Year	Quarter	Area	Gear
JPNLLS7588qt12	About 80cm	1975-1988	1-2	1	Shallow sets
JPNLLS7588qt34	About 100cm	1975-1988	3-4	1	Shallow sets
JPNLLS8912qt12	About 80cm	1989-2012	1-2	1	Deep sets
JPNLLS8912qt34	About 100cm	1989-2012	3-4	1	Deep sets
JPNLLL7592qt1	About 100cm	1975-1992	1	2	Shallow sets
JPNLLL7592qt23	About 100cm	1975-1992	2-3	2	Shallow sets
JPNLLL7592qt4	About 100cm	1975-1992	4	2	Shallow sets
JPNLLL7592qt14	About 100cm	1975-1992	1-4	2	Shallow sets
JPNLLL7592qt1.4	About 100cm	1975-1992	1, 4	2	Shallow sets
JPNLLL9312qt1	About 100cm	1993-2012	1	3	Deep sets
JPNLLL9312qt23	About 100cm	1993-2012	2-3	3	Deep sets
JPNLLL912qt4	About 100cm	1993-2012	4	3	Deep sets
JPNLLL9312qt14	About 100cm	1993-2012	1-4	3	Deep sets
JPNLLL9312qt1.4	About 100cm	1993-2012	1, 4	3	Deep sets

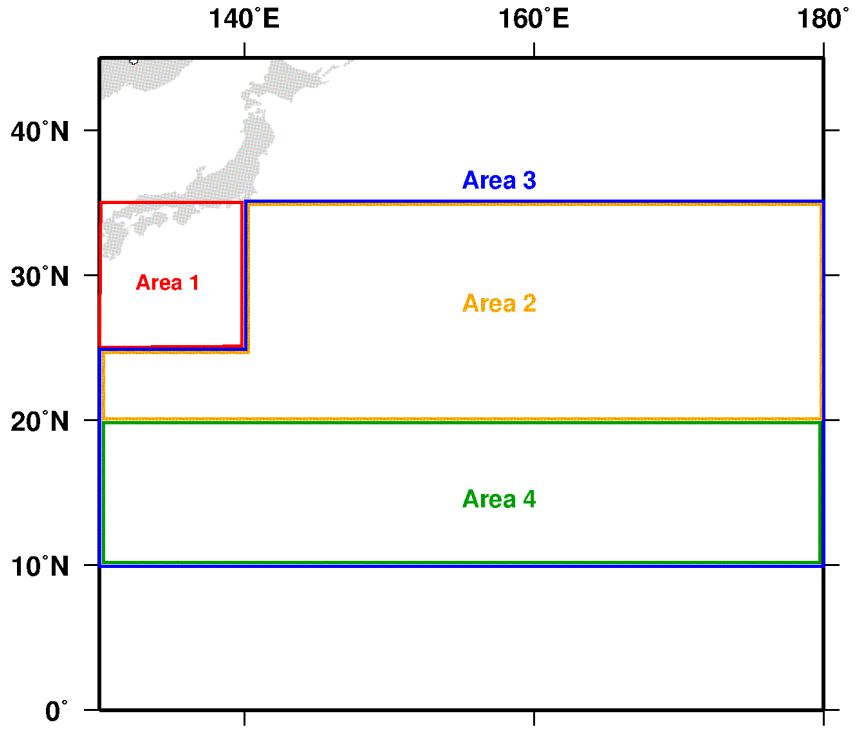

Figure 1. Analysis areas that depend on length of the albacore catch.

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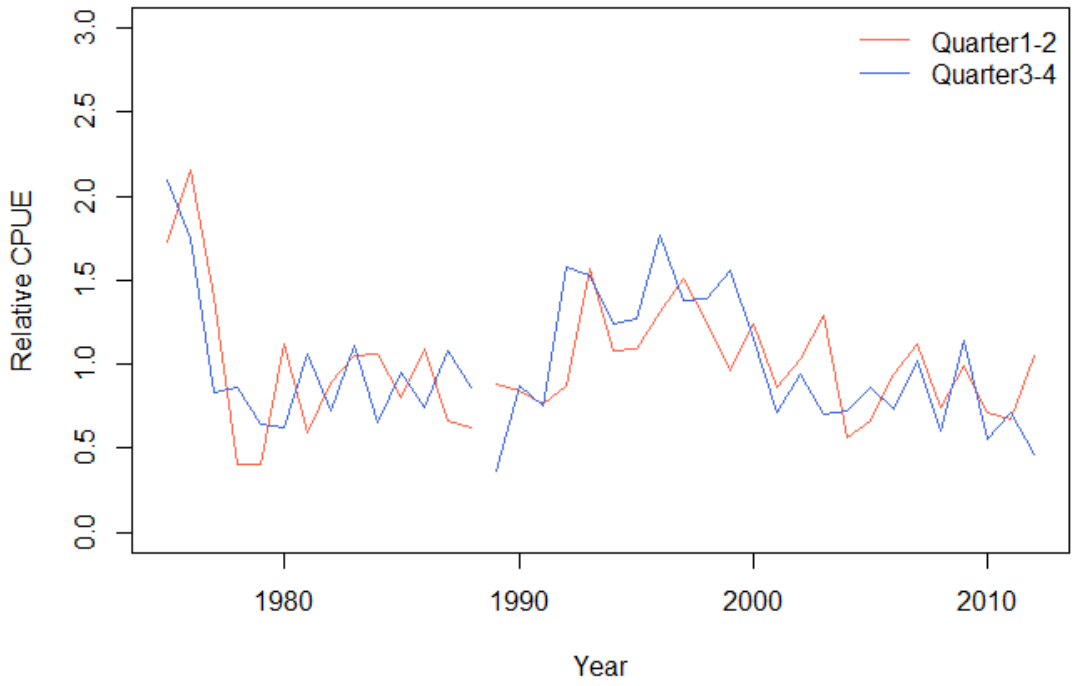

Figure 2. Relative CPUE targeting small size albacore.

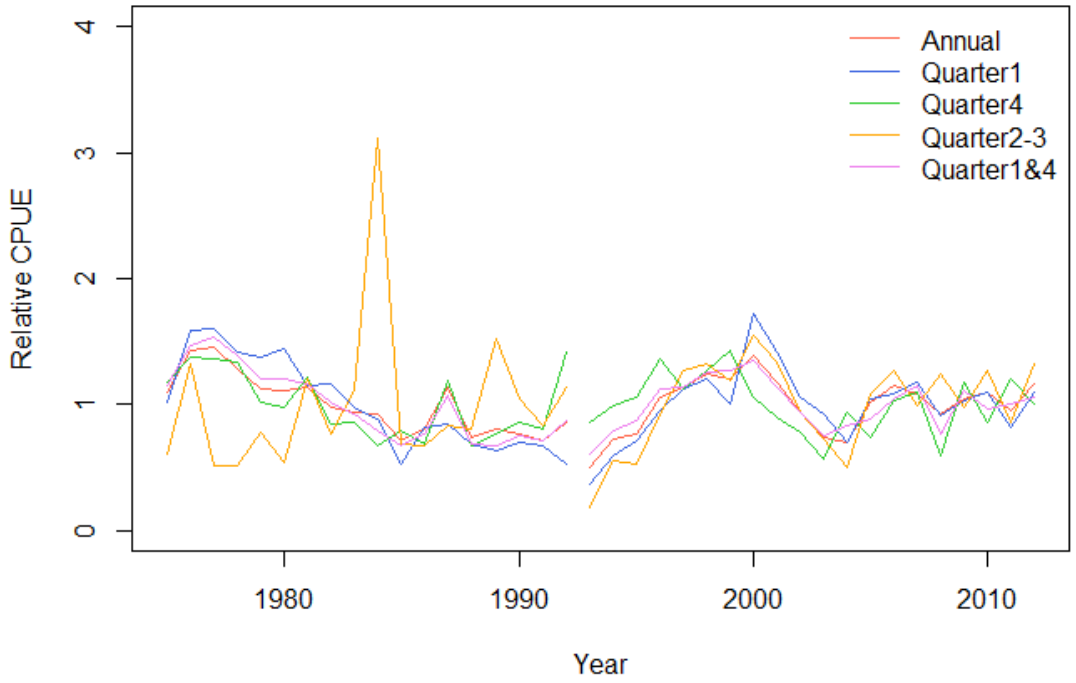

Figure 3. Relative CPUE targeting large size albacore.

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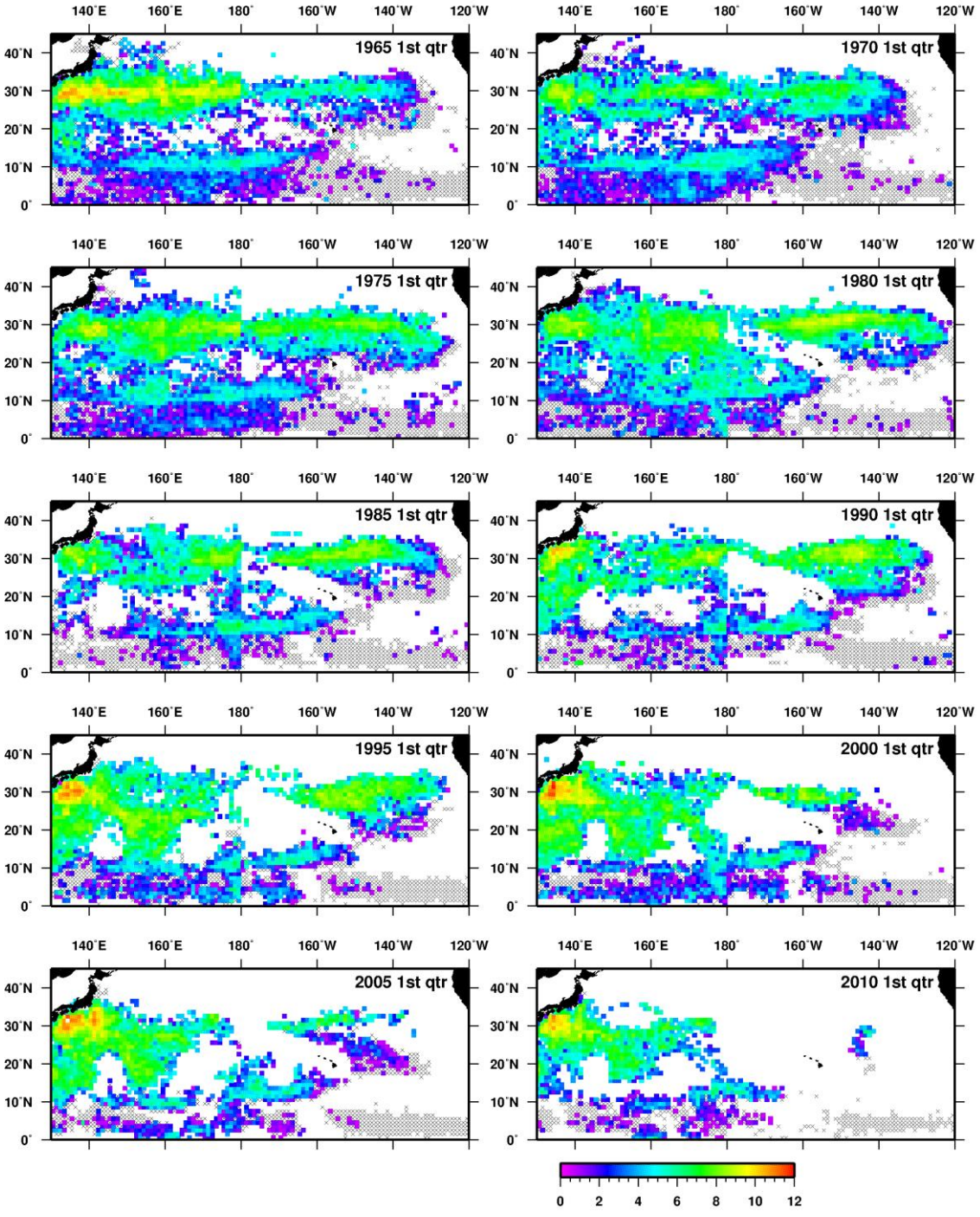

Figure 4. Albacore catch in the quarter 1.

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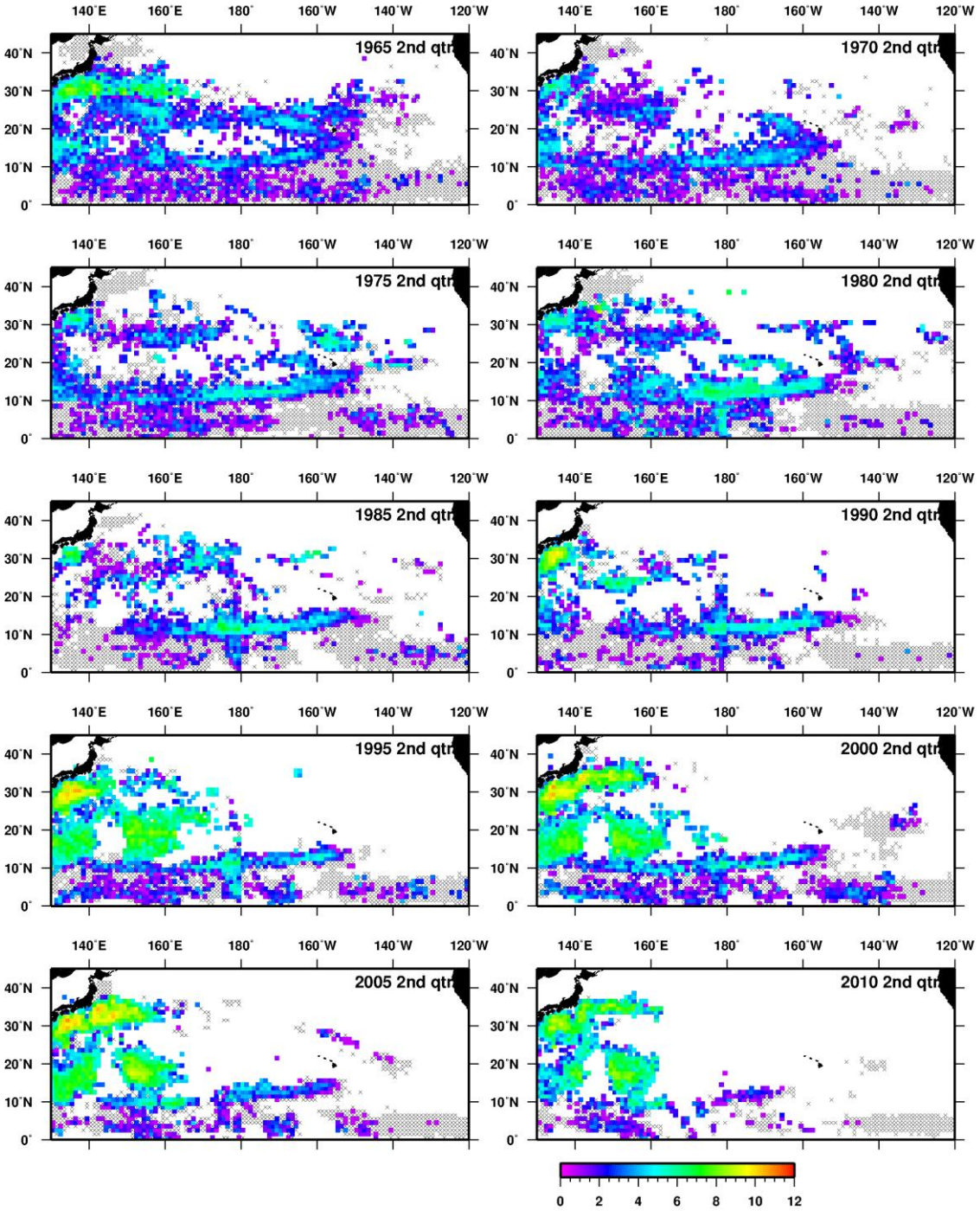

Figure 5. Albacore catch in the quarter 2.

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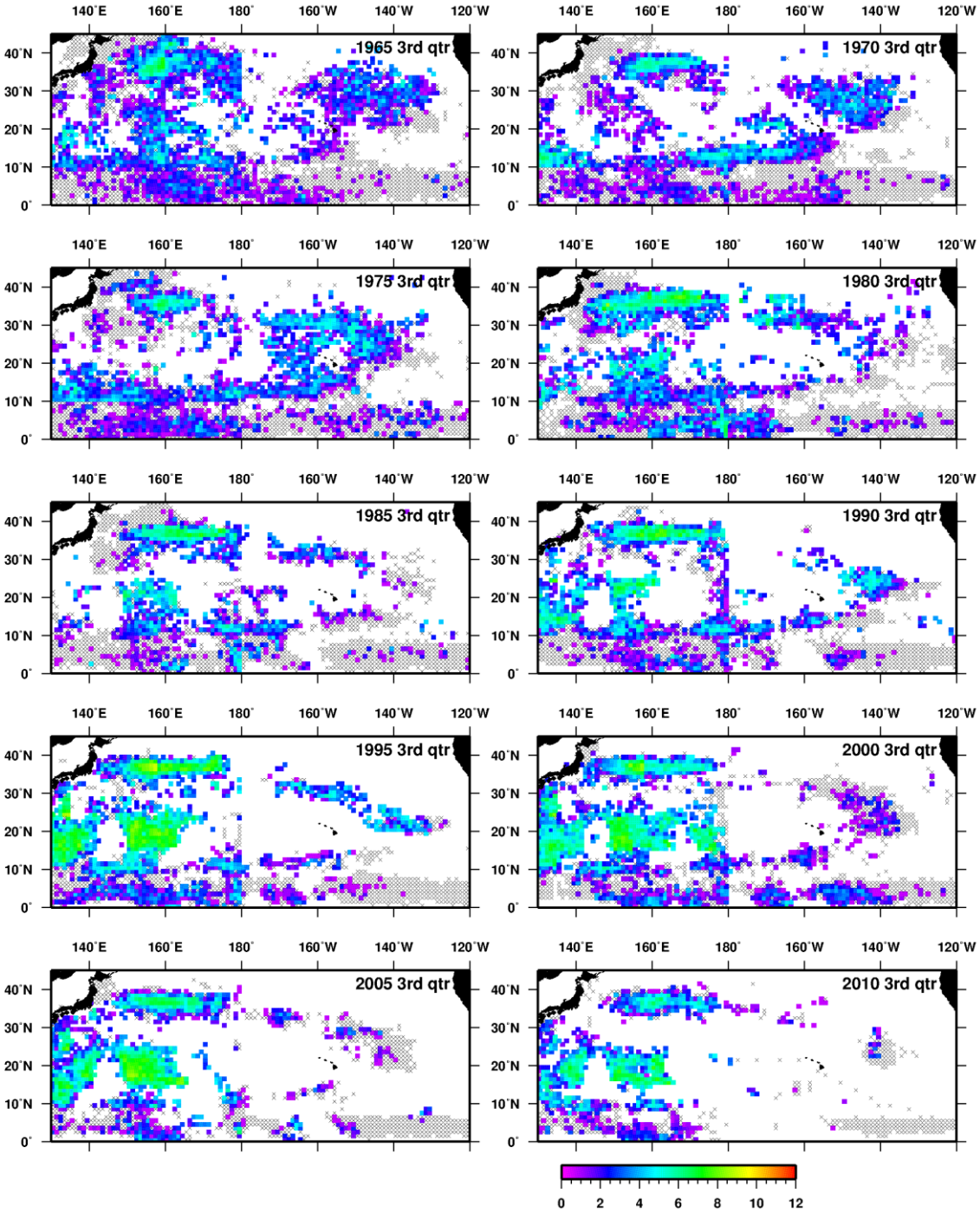

Figure 6. Albacore catch in the quarter 3.

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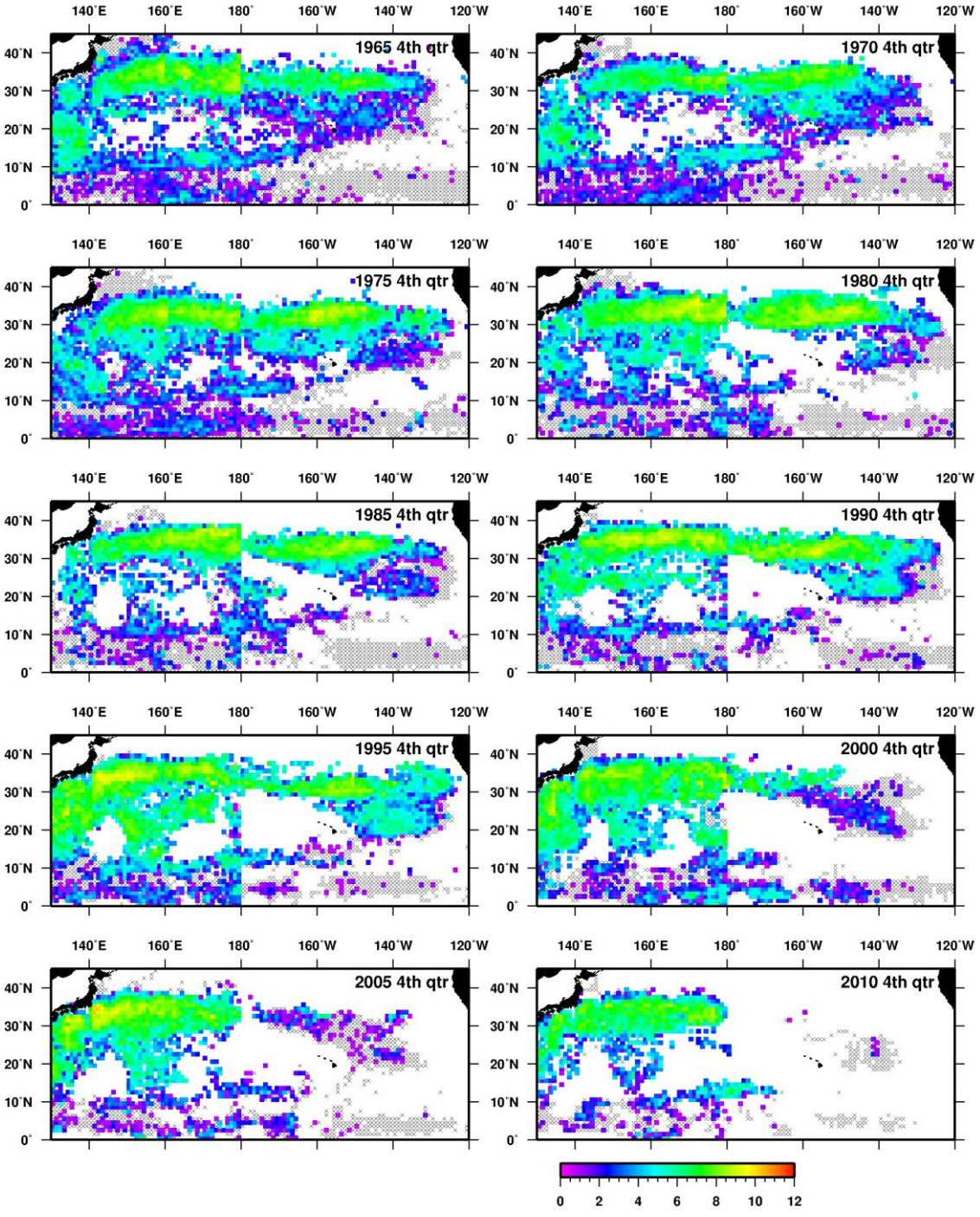

Figure 7. Albacore catch in the quarter 4.

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