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Preliminary analysis of the effect of the Piracy activity in the northwestern Indian Ocean on the CPUE trend of bigeye and yellowfin.

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Abstract

In this document, historical pattern of distribution of Japanese longline effort and catch was briefly reviewed and the effect of change in the effort distribution and its amount which have been changed after expansion of piracy activity off Somalia on the CPUE trend of bigeye and yellowfin was analyzed.

During the period from 2003 to 2005 when both of purse seine and longline fisheries got historical high catch of yellowfin, the catch of this species exceeded 500 thousand mt. After that, however, yellowfin catch has dramatically decreased. Furthermore as the activity of piracy increased and spread since 2007, many purse seiners and longlinrts have retreated from West Indian Ocean, especially from northern part of it. In 2008, the effort off Somalia decreased and that of north of equator and west of 60oE disappeared in 2009, and most of effort disappeared from North of 10oN and West of 80oE in 2010.

Although the number of strata did not show so large change comparing to that in the effort in general, the number of strata in the NW area after 2007 or 2008 has steeply declined synchronizing with the decline of the effort. Since this large synchronizing drop of the number of strata and effort was detected in other region to some extent, but the change was not so drastic as in the NW region.

In the both cases for bigeye and yellowfin tuna, CPUE calculated by 1991-2005 catch and effort data extracted using active strata for each of 2006 through 2010 showed generally similar trend to the CPUE calculated using all data for the same period. However, the CPUE from the data extracted by strata in 2010 for NW region showed quite different trend from CPUE based on all data nor CPUE calculated extracted data for other years. Although the most of differences between relative CPUEs based on all data and that based on extracted data were less than about 0.2, that of NW region in 2010 showed large fluctuation ranged from -0.8 to 0.5 as for bigeye and from -0.6 to 0.9 as for yellowfin. These results would indicate that the decline of effort and shift of fishing location derived primarily by piracy and/or declined yellowfin CPUE have not critically affected on the yellowfin and bigeye CPUE in the Indian Ocean except for data in 2010 in the NW region. This latest data in NW Indian Ocean seems not to be representative for CPUE trend anymore maybe because of too scarce effort and unusual distribution pattern of effort and should be treated carefully in the CPUE standardization.

Introduction

As Japanese longline fishery has covered long time period since 1952 and also broad area of main fishing ground of the world, its CPUE (catch per unit effort) has often been utilized as the main abundance index for stock assessment of tuna and billfish species. Since 2007, activity of piracy off Somalia has been increased and spread to whole north western Indian Ocean (Chassot et al., 2010). As the number of vessel (fishing vessel, tanker, container, etc.) attacked by piracy has increased, many tuna fisheries including Japanese longliners have retreated from the northwestern Indian Ocean and also from other part of Indian Ocean to

some extent. Because of that it is concerned if the decrease of effort and/or shift of fishing site might cause the bias to Japanese longline CPUE trend in this Ocean (IOTC 2010).

In this study, the effort distribution which has been changed after expansion of piracy activity was applied to the past catch and effort data before the piracy to estimate the effect of the decrease and sift of the effort caused by the piracy on the Japanese longline CPUE trend for yellowfin and bigeye tuna.

Materials and methods

Used data was bigeye and yellowfin catch and effort data of Japanese longline fishery in the Indian Ocean aggregated by 5 degree latitude, 5 degree longitude and month for 1991 through 2010. Data in each strata was summed up through each period 1996-2000 and 2001-2005, and data of common strata with that of each year from 2006 to 2010 was extracted. The amount of effort, the number of strata and bigeye and yellowfin CPUEs were compared between extracted and original data for each period, 1996-2000 and 2001-2005. To observe the difference of results by area, analyses were conducted by each of four areas, NW, SW, NE, SE Indian Ocean separated by West-East boundary of 80°E and North-South boundary of 10°S.

Results and discussion

General description of Japanese longline fishery in the Indian Ocean.

Japanese longline fishing effort exerted into each of West and East Indian Ocean had been about the same level until 2002 (Anonymous 2010) after when the effort has been concentrated to the western Indian Ocean targeting yellowfin tuna, especially to African offshore region from Somalia to south off Madagascar (Fig. 1). During the period from 2003 to 2005 when both of purse seine and longline fisheries got historical high catch of yellowfin, the catch of this species exceeded 500 thousand mt. In this period, yellowfin catch by Japanese longline fishery at the western Indian Ocean reached 21 thousand mt (Fig. 2). After that, however, yellowfin catch has dramatically decreased. Furthermore as the activity of piracy increased and spread since 2007, many purse seiners and longlinrts have retreated from West Indian Ocean, especially from northern part of it. Geographical distributions of Japanese longline effort were shown in Fig. 3 by year from 2006 to 2010. In 2008, the effort off Somalia decreased and that of north of equator and west of 60°E disappeared in 2009, and most of effort disappeared from North of 10°N and West of 80°E in 2010.

Historical change of effort and the number of strata with fishing activity

The annual total amount of effort (the number of hooks) and annual total number of strata (5 degree square by month) in which effort existed was shown in Fig. 4 for 1991 through 2010.

Although the number of strata did not show so large change comparing to that in the effort in general, the number of strata in the NW area after 2007 or 2008 has steeply declined synchronizing with the decline of the effort. Since this large synchronizing drop of the number of strata and effort was detected in other region to some extent, but the change was not so drastic as in the NW region.

Next, the change in the ratio of common strata between 1991-2000 (and 2001-2005) and each year from 2006 to 2010 was observed in each area. The ratio of common strata between 1991-2000 and each year from 2006-2010, and that between 2001-2005 and each year of the same period showed quite similar trends (Fig. 5). There was no remarkable change in the ratio of common strata in SE region, and the ratio in SW and NE regions was kept around 40–50 % until 2009 and decreased to 30-35% in 2010. On the other hand, ratio in the NW region which was kept in around 70% declined steeply to 40% in 2009 and 10% in 2010.

Effect of the change in the effort on the CPUE trend

Effect of the change in the effort on the bigeye and yellowfin CPUE was estimated. From the bigeye and yellowfin catch and effort data from 1991 to 2005, common strata with each year from 2006 to 2010 were extracted and nominal CPUE of both species were calculated. Nominal CPUE for both species for the same period were also calculated using all data and resulted CPUE were compared with that derived from extracted data. In the left of Figs. 6 and 7 (bigeye and yellowfin, respectively), CPUE derived from all data and CPUEs derived from extracted data were overlaid in relative scale in which the average from 1991 to 2005 was set to 1.0. The differences of both relative CPUE (CPUE calculated using data in the extracted strata − CPUE calculated using all data) were shown for each year (2006-2010) in the right of Figs. 6 and 7. In the both cases for bigeye and yellowfin tuna, CPUE calculated by 1991-2005 catch and effort data extracted using active strata for each of 2006 through 2010 showed generally similar trend to the CPUE calculated using all data for the same period. However, the CPUE derived from the data extracted by strata in 2010 for NW region showed quite different trend from CPUE based on all data nor CPUE calculated extracted data for other years. Although the most of differences between relative CPUEs based on all data and that based on extracted data were less than about 0.2 except NW region in 2010 in which the difference showed large fluctuation ranged from -0.8 to 0.5 as for bigeye and from -0.6 to 0.9 as for yellowfin. One another exception was NE region for yellowfin in which the fluctuation of difference was relatively large (ranged from -1.1 to 0.6), but not only for 2010 but all years used for data extraction. Therefore, this fluctuation in NE region would not be caused by Piracy activity. These results would indicate that the decline of effort and shift of fishing location derived primarily by piracy and/or declined yellowfin CPUE may not affect critically on the yellowfin and bigeye CPUE

in the Indian Ocean except data in 2010 in the NW region. This latest data in NW Indian Ocean seems not to be representative for CPUE trend anymore maybe because of too scarce effort and unusual distribution pattern of effort and should be treated carefully in the CPUE standardization.

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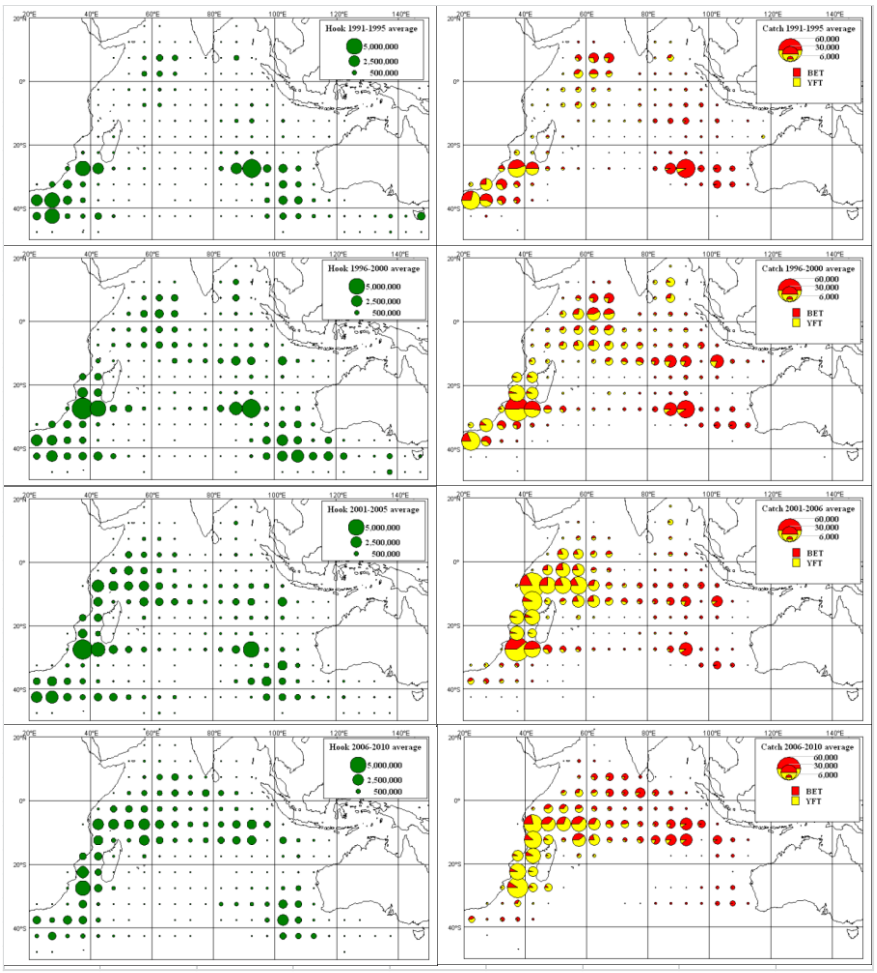

Fig. 1 Distribution of longline fishing effort (left) and catch by species (bigeye and yellowfin, right) averaged for each five years from 1991 to 2010.

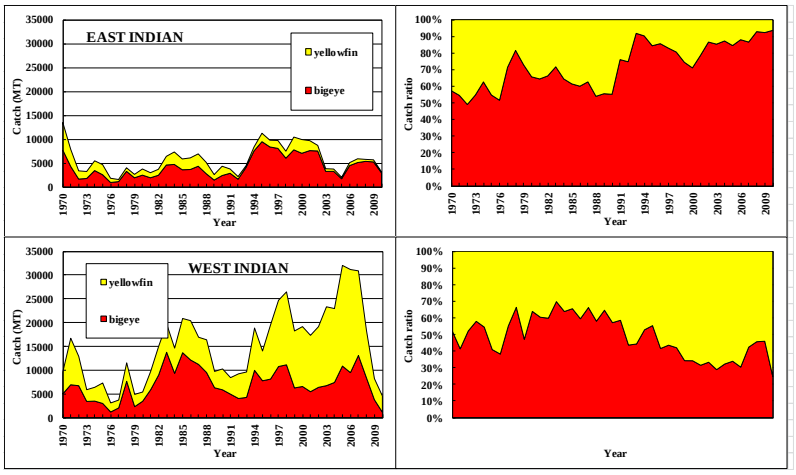

Fig. 2 Historical change in catch amount and ratio of bigeye and yellowfin in the East and West Indian Ocean.

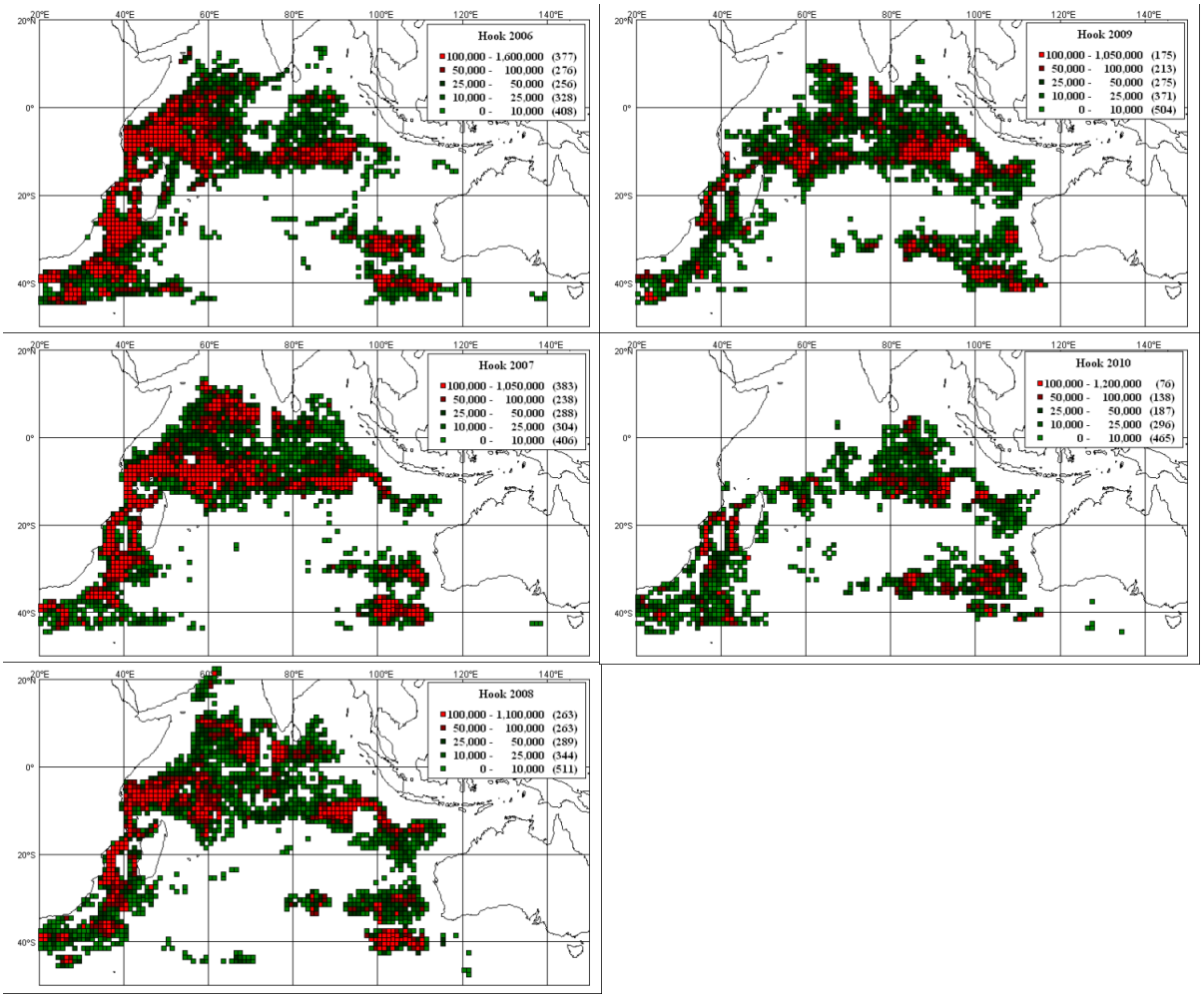

Fig. 3 Distribution of Japanese longline effort in the Indian Ocean by year from 2006 to 2010.

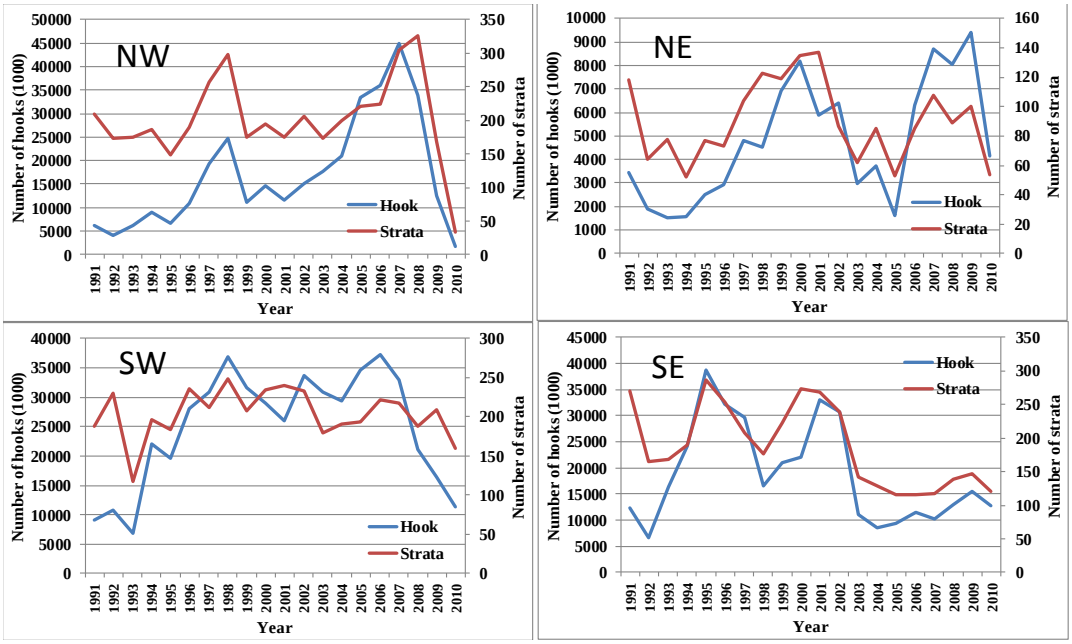

Fig. 4 Number of hooks and active strata used by Japanese longliners in the each fpur region of the Indian Ocean.

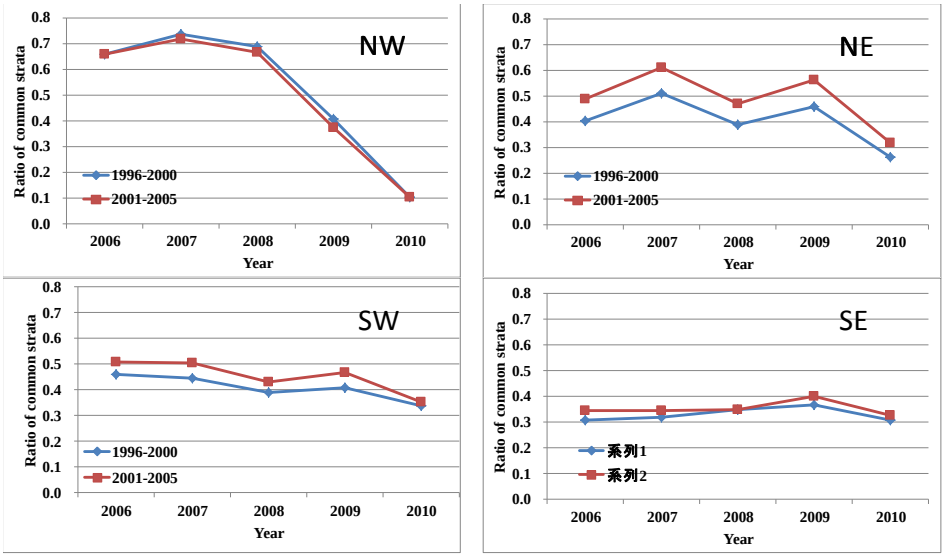

Fig. 5 Ratio of common strata between 1991-2000 (and 2001-2005) and each year from 2006-2010 in each of four regions.

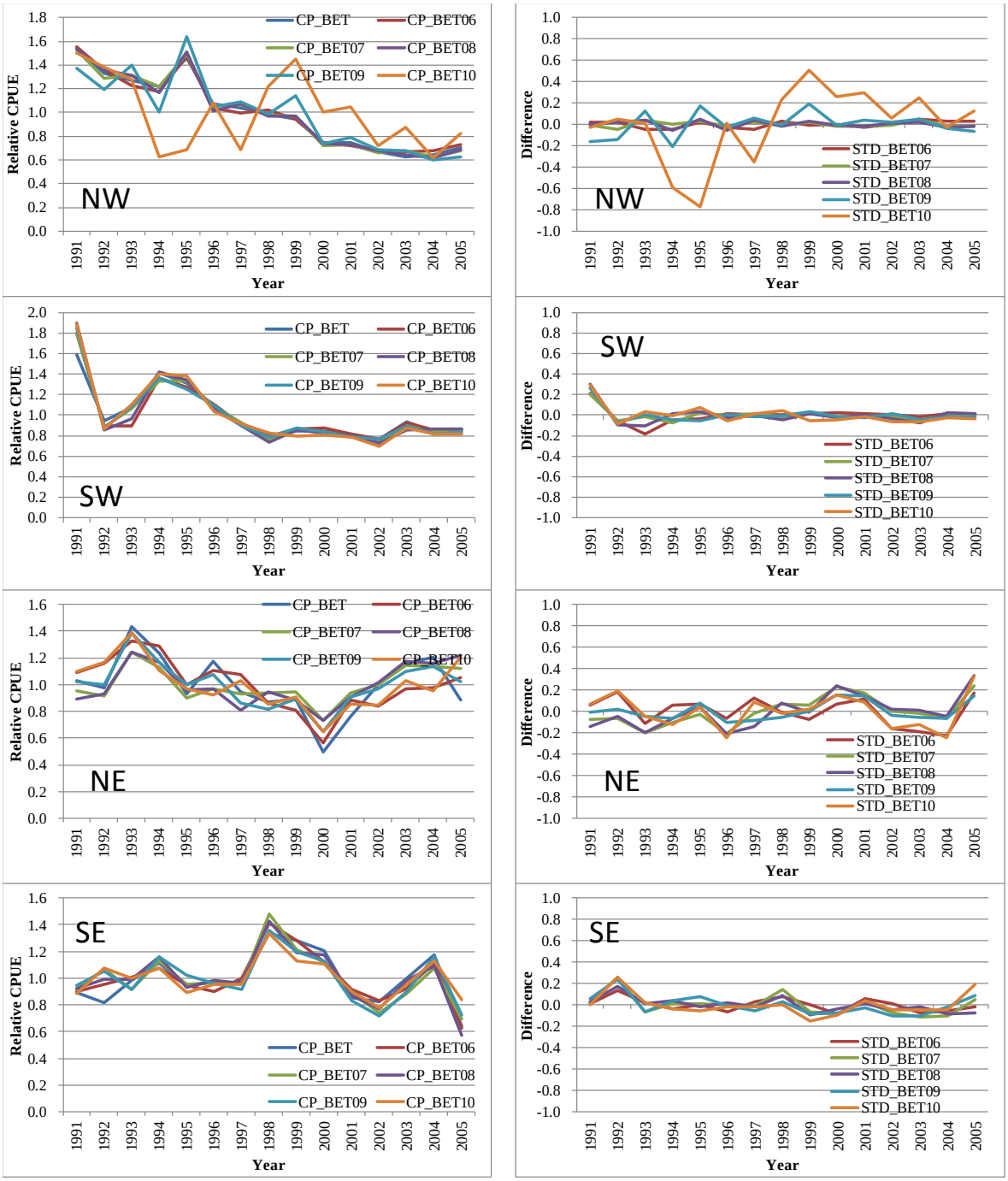

図 6　Bigeye CPUE derived from all data and CPUEs derived from extracted data using common strata with each years from 2006 to 2010. CPUE were overlaid in relative scale in which the average from 1991 to 2005 was set to 1.0 (Left figures). Right figures show the difference between relative CPUE from all data and relative CPUE from extracted data for each year from 2006 to 2010.

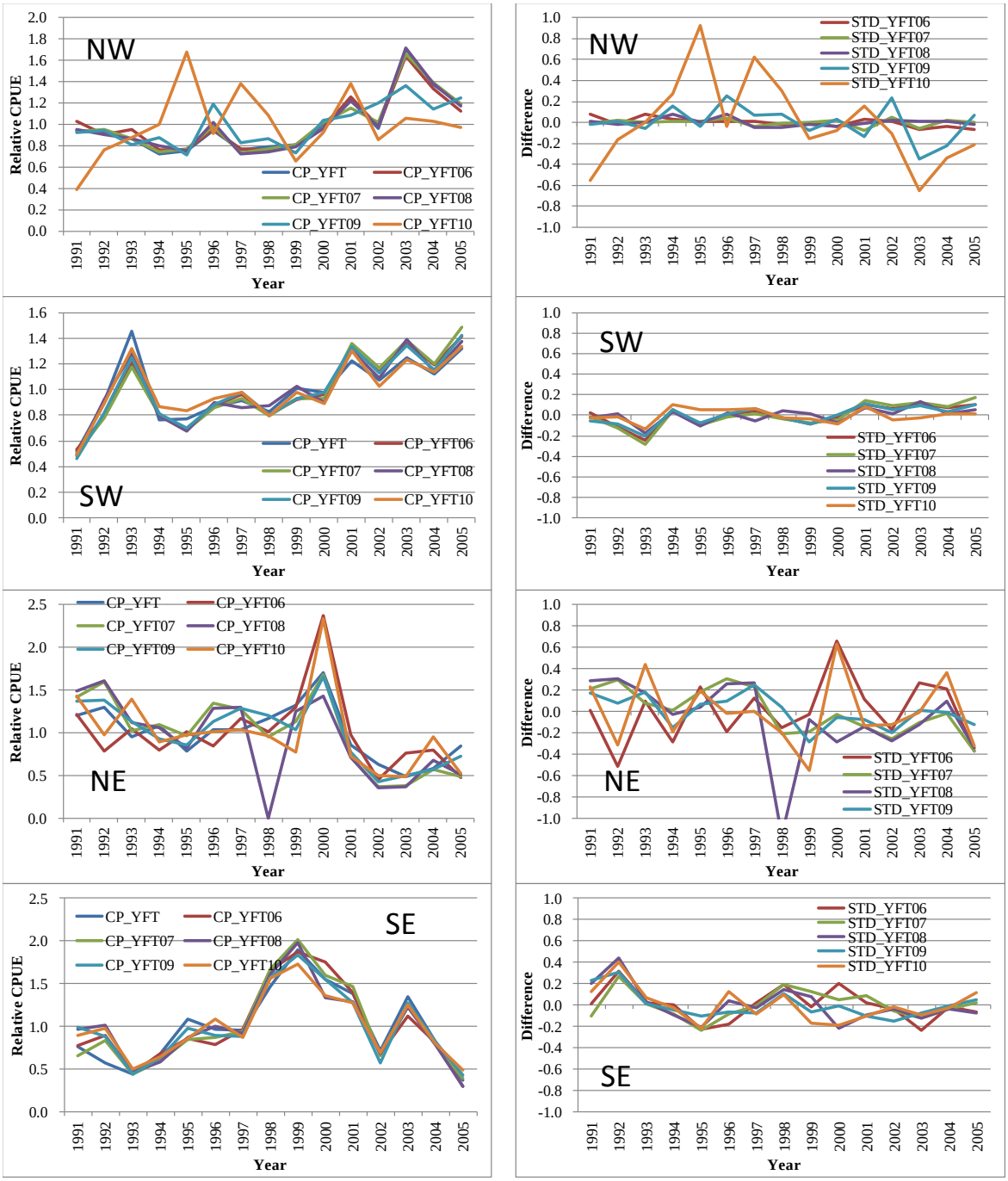

Fig. 7 Yellowfin CPUE derived from all data and CPUEs derived from extracted data using common strata with each years from 2006 to 2010. CPUE were expressed in relative scale in which the average from 1991 to 2005 was set to 1.0 (Left figures). Right figures show the difference between relative CPUE from all data and relative CPUE from extracted data for each year from 2006 to 2010.