Shift of fishing efforts for Pacific bluefin tuna and target shift occurred in Japanese coastal longliners in recent years

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1. Introduction

Ichinokawa and Takeuchi (2012) provided standardized CPUE of Pacific bluefin tuna (PBF) for Japanese coastal longliners throughout the period of 1994-2011 (**Fig. 1**). This CPUE series, while having fluctuated until 2005, showed drastic decline since 2006. Not only PBF but also Yellowfin tuna (YFT) and Albacore (ALB) are important species for the longline fishery operated in the sea near Japan. Hence, not all fishing efforts have been targeted to harvest of PBF. Although the decline of CPUE certainly should reflect partially the abundance of spawning stock of PBF, it is possible that changes in the longline fishery also have caused decrease of CPUE in recent years.

According to interviews from the longline fishermen and local scientists, the longliners targets not only PBF but also YFT and ALB in the same season and area. Additionally, for many longliners, capture of PBF is like a lottery, because proportion of PBF catch in total number of catch of tunas and tuna-like species was just 1.2% for five recent years. There are four possible factors influencing the behavior of longliners: abundance of target species, fish price, fuel price and distance between fishing grounds and landing ports. Especially, global increase in fuel price since 2006 had provided incentives to choose a strategy to make a steady profit. In addition, prices of YFT are relatively constant through the period, whereas that of PBF displayed increase trend in recent years (Appendix 1). Even though PBF is valuable compared with other tuna, price of PBF is at most 3-5 times higher than that of YFT. Hence, it is easy to assume that the longliners will give up targeting PBF under a situation of low harvest of PBF and switch their main target to YFT.

Figure 2 illustrates possible structure of longline fishing efforts targeting and their targets in two periods, one with a relatively high abundance of PBF and another with lower abundance of PBF. In this model, longliners aspiring to harvest PBF have been confirmed efforts into a limited area in response to depletion of abundance of PBF, while others changed their targets to other tuna species than PBF.

This document includes two main chapters of analysis. In the first chapter, we examined the structures shown in Fig. 2 on the possible changes in the longliners behavior, i.e. shifting target species in recent years. In the second chapter, we re-estimated standardized CPUE based on results from the first chapter.

2. Changes in longline fishery in recent years

2.1. Materials and methods

Set by set data from logbooks of Japanese coastal longline fisheries operated from 1994 to 2011 were used for exploring possible changes of this fishery. The data were filtered through the criteria applied by Ichinokawa et al.and Takeuchi (2012), summarized as follows;

- ✓ Spawning season of April to June (2nd quarter)
- ✓ 1x1 degree grids in latitude and longitude where at least one PBF per year have been caught in more than 9 years.

The logbook data used by Ichinokawa and Takeuchi (2012) were updated before January 2012, whereas the data used in this analysis were updated in June 2012. Number of data used in this study increased 3% from that in the previous study.

A generalized liner model (GLM) was used in order to figure out spatial distribution of standardized CPUE for PBF, YFT and ALB. The GLM was given as follows:

$$\begin{aligned}\mathrm{LN}(\mathrm{CPUE}+\mathrm{Const.})\\ &= \mathrm{Year}+\mathrm{Month}+\mathrm{Ship\ name}+\mathrm{Latitude}+\mathrm{Longitude}+\mathrm{Year}*\mathrm{Month}\\ &+\mathrm{Latitude}*\mathrm{Longitude}+\mathrm{Error}\end{aligned}$$

where LN(CPUE + Const.) is response variable explained by main and interaction effects of Year, Month, Ship name, Latitude, Longitude, Year*Month and Latitude*Longitude and Error term distributed as $N(0,\sigma^2)$. CPUE is (catch in number) / 1000 hooks. Const. equals to 10% of overall mean CPUE through the period of 1994 through 2011. All main effects are categorical variables. Significance of the main and interaction effects included in GLM procedure was tested by likelihood analysis. The GLM analysis was carried out through SAS 9.3. Least square mean (LSMEAN) was calculated for the interaction term of Latitude and Longitude.

2.2. Results

2.2.1. CPUE by 1x1 degree grid in latitude and longitude

All main effects and interaction effects were significant ($p < 0.001$) (Table 1). **Figure 3** shows LSMEAN of CPUE by 1x1 degree grid during 1994-2011 for PBF, YFT and ALB. The LSMEAN for respective species were classified into four quartile classes of 1st quartile (Q1), 2nd quartile (Q2), 3rd quartile (Q3) and 4th quartile (Q4) in ascending order.

Three areas were defined based on distributions of the PBF CPUE and historical changes in geographical distribution pattern of the longline sets (See Appendix 2). Area 1, where in almost all grids PBF CPUE were categorized into the highest CPUE class (Q4) can be regarded as a core area for PBF distribution, because this area includes a major spawning ground of this species (Suzuki et al. 2011). Additionally, this area was also the highest YFT CPUE zone. Area 2 included the grids of the highest CPUE classes (Q4) for PBF, YFT and ALB. The grids of higher PBF CPUE (Q3 and Q4) were located at southern part in this area. In the northern part of Area 1 (26-29°N, 125-128°E), bordering to the Area 2, the grids were with the highest YFT CPUE class, but with the low PBF CPUE classes (Q1 and Q2). In Area 3, all grids except for one grid were categorized as low PBF CPUE classes (Q1 and Q2). There were clear differences in gradients of CPUE among three tuna species of PBF, YFT and ALB, although these species were caught in all the grids of Areas 1-3. Especially in Area 2, the gradients of PBF CPUE were clearly reverse to those of YFT CPUE (Spearman's rank correlation test, $p < 0.001$). Consequently, it is suggested that the longliners select their fishing ground in accordance with their targets among PBF, YFT and ALB. In addition, they seem to target not only one species but also multi- species which may vary depending on area.

2.2.2. Fishing efforts, PBF catch in number and CPUE by area

Number of sets in Area 2 was dominant throughout 1994-2011, although it declined after 2006. (**Fig. 4**). On the other hand, the number of sets in Area 1 apparently increased after 2006. Area 2 was also the dominant area for f PBF catch (in number) until 2005, although sharply decreased since 2006. The PBF catch (in number) in Area 1 has exceeded that in Area 2 since 2007. Consequently, it is suggested that the main fishing ground for PBF was shifted into Area 1 from Area 2 in 2007 and then after. Area 3 has been minor in both in number of sets and PBF catch. PBF CPUE in Area 1 indicated very sharp changes in its levels between the periods, whereas CPUE in Area 2 displayed decreasing trend from 1994 to 2011. CPUE in Area 1 remained still above 0.2 in 2011. On the other hand, CPUE in Area 2 had been below 0.1 since 2009. It may indicate that definite difference in catchability for PBF has occurred between Areas 1 and 2 in recent 6 years.

2.2.3. Shift of fishing efforts within Area 2

Number of sets in the grids of the highest CPUE class (Q4) for PBF in Area 2 significantly decreased after 2005 and that in the grids of the second highest CPUE class (Q3) decreased after 2006 (**Fig. 5**). Although 64% of the sets in Area 2 were deployed in the higher PBF CPUE grids in 2005, the proportion of number of the sets in those grids decreased to 22% in 2011. On the other hand, number of the sets in Area 1 increased after 2006. This figure suggests that the fishing efforts to expect harvest of PBF had disappeared from Area 2 since 2007, while total efforts continued substantial.

The shift of targeting in area 2 was also evidenced by fishing efforts and CPUE for YFT (**Fig. 6**). Number of sets in the highest YFT CPUE grids (Q4) increased in 1999 and again further increased after 2005. On the other hand, the number of sets in the lowest YFT CPUE grids (Q1) decreased after 2001. Nominal YFT CPUE clearly increased in the highest CPUE grids after 2006, whereas the YFT CPUEs in the grids other than the highest CPUE grids remained the same or decreased until 2009. In 2010, YFT CPUEs in all grids obviously increased. In addition, mean number of hooks per basket (HPB) has decreased since 2002 only in the highest YFT CPUE grids. According to interviews from longline fishermen, the number of hooks per basket is decreased when they target YFT.

As described above, YFT CPUE in the highest in the Area 1. In this area, YFT CPUE mostly did not change until 2009, although it spiked in 2002 (**Fig. 7**). It increased in 2010, while increase trend of YFT CPUE found in the highest YFT CPUE grids in Area 2 did not observed in Area 1.

2.3. Discussion

As shown in **Fig. 3**, Area 2 is the largest. Consequently, PBF CPUE estimated for Area 2 is the most influential for estimate of overall mean CPUE. As shown by year trends of PBF CPUE provided by Ichinokawa and Takeuchi (2012), it is true that stock abundance of PBF declined in recent years, but we clearly found that the following two important changes in the longline fishery occurred in recent years:

- ✓ High PBF catch area has been shifted from Area 2 to Area 1.
- ✓ The major target species has shifted from PBF to YFT in Area 2.

Since 2006, the longliners can be classified roughly into two types. The one is of the longliners targeting PBF and YFT in Area1. The other is of the longliners operating in Area 2, targeting YFT and ALB. In recent years, the longliners that intend to catch PBF operate in the Area 1, where PBF gather to spawn, which would result in higher fishing efficiency of PBF. In the Area 2, many of the longliners had begun to change their target to YFT since 2006 and moved their fishing grounds to the area which promises better harvests of YFT. Especially in recent three years, number of longline sets in the highest YTF CPUE zone, which corresponds to the lowest or the second lowest PBF CPUE zone, became major fishing grounds, whereas the longline sets in the highest PBF CPUE zone became sparse. Consequently, the PBF CPUE has been significantly affected by these changes in fisheries, downwards in recent years.

3. CPUE standardization

3.1. Materials and Methods

CPUE standardization was conducted with the area stratification defined in the previous chapter. The new area stratification defined five areas as shown in **Fig. 8**. Data used for CPUE standardization were exactly same to those used in Ichinokawa and Takeuchi (2012). In addition, the procedure for CPUE standardization also was along Ichinokawa and Takeuchi (2012), delta-type two-step method. Explanatory variables used in this study are as follows:

- ✓ Year: 18 years from 1994 to 2011 in calendar year.
- ✓ Day10: Periods during the fishing season from April to June defined by 10 days interval[1].
- ✓ Area: 5 regions are defined (Fig. 10).
- ✓ Gear: shallow sets (<16 hooks per basket) vs deep sets (>=16 hooks per basket)
- ✓ Ship-type: 3types defined by combination of the number of days per trip and GRT class of fishing boats.

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[1] Last period of May contained 11 days.

- ✓ Ship name as random effects: Random effect of ship name is included only in the binomial model of 1st step.
- ✓ YFT CPUE: 5 levels were defined.
- ✓ ALB CPUE: 5 levels were defined.

All effects except for YFT CPUE and ALB CPUE were incorporated in calculation of CPUE by Ichinokawa and Takeuchi (2012). The effects of YFT CPUE and ALB CPUE were categorical variables used as effect of target shift expected to affect on PBF CPUE. YFT CPUE and ALB CPUE were divided by zero catch and positive catch. YFT CPUE and ALB CPUE of positive catch were further divided into four class based on quartile. The model selection with BIC and the GLM procedure were carried out through SAS 9.3.

3.2. Results

In the binomial model of 1st step, effects of Year, Year*Area, Year*Day10, Ship type*ALB CPUE, Area*YFT CPUE and Day10*ALB CPUE were selected (**Table 2**). The effect of Gear was excluded in this step. Dispersion scale parameter was estimated to be 1.02, which was smaller than 1.22 provided by Ichinokawa and Takeuchi (2012). In addition, in the lognormal model of 2nd step, the effects of Year, Ship type, YFT CPUE, Year*Area and Gear*Day10 were selected. R squared value in the lognormal model were slightly improved from 0.124 (Ichinokawa and Takeuchi 2012) to 0.160.

There were two peaks in all frequency distributions of Pearson residuals by year in the binomial model of 1st step (**Fig. 9**). In addition, frequency of right peak which is located at residual class larger than zero decreased since 2006. The frequency distributions of standardized residuals in the lognormal model of 2nd step displayed right-tailed shape. Two peaks apparently appeared in several years.

Standardized positive catch ratio of PBF in total sets displayed remarkable decrease in recent 6 years, falling from 0.262 in 2005 to 0.0428 in 2011 (**Fig. 10**). On the other hand, CPUE from positive catch of PBF had slightly decreased after 1994 and remained at the same level since 2000. Standardized CPUE indicated marked decrease after 2005, similar trends of CPUE provided by Ichinokawa and Takeuchi (2012).

3.3. Discussion

In the process of CPUE standardization by the previous analysis (Ichinokawa and Takeuchi 2012), possible factors such as ten-days, region and ship type were used for correction of CPUE. However, the standardization model couldn’t fully explain spatial heterogeneity of catchability in the single fishing grounds and did not consider the potential target shift in recent years. Therefore, it is just conceivable that the estimated CPUEs for recent year include significant uncertainties.

There is a commonly-held view that it is difficult to remove the effect of changes in fishery derived from target shift. In this study, we tried to conduct CPUE standardization with new area definition, and additional explanatory variables of YFT and ALB, where differences in catchability among areas and spatial shift of fishing efforts and the effect of target shift were incorporated. Our trial, however, did not complete to correct extreme decrease of CPUE in recent years. As a result, the current procedure of CPUE standardization for PBF could not remove the effect of changes in fishery.

According to catch information from the logbook data, annual mean PBF catch in number per set with PBF-positive set fluctuated between 1.3 and 1.9 from 1994 through 2011. Consequently, the ratio of PBF-positive set has a great effect on estimated of annual PBF CPUE. Positive PBF set ratio decreased significantly after 2005, to below 20% in 2009 and below 10% in 2011 (**Fig. 11**). In recent three years, more than 80% of longline sets did not catch PBF. Predominant number of sets with zero PBF catch represents not only low abundance of PBF but also changes in fishery. It is true that the dispersion scale parameter evidently decreased to 1.02 in the binomial model, but the frequency distributions of Pearson residuals showed bimodal shape, remarkably different from normal distribution. In addition, the Pearson residual distribution pattern by Ichinokawa and Takeuchi (2012) also did not show normal distribution, displaying right-tailed shape. Hence, a result from the Pearson residuals indicates that the effects that should be considered are not incorporated into the binomial model. Although we mentioned the target shift to YFT in recent years in the previous chapter, ALB is consistently predominant species in catch, accounting for 77.8% in total catch in number of tunas and billfish caught by Japanese longline fishery during the period of 1994-2011. The effect of target to ALB might have effects on positive-catch/zero-catch of PBF in longline set, because the effect of ALB CPUE connected to two interaction terms in the binomial model of 1^{st} step. In order to reduce uncertainty of the standardized PBF CPUE, the effects such as target to ALB should be examined and appropriately incorporated into CPUE standardization for this species in future.

4. Conclusions

It is concluded that the Japanese coastal longline fishery for PBF has been changed since 2006, based on the following facts:

- ✓ The main fishing ground targeting PBF moved to Area 1 from Area 2 after 2006.
- ✓ A portion of fishing efforts which had targeted PBF in Area 2 has moved to Area 1 since 2006.
- ✓ Another portion of fishing effort which had targeted PBF in Area 2 has shifted target to YFT since 2006.

Consequently, PBF CPUE decline after 2005 might be overrepresented by the shift of target species. Although current standardization method and available fishery data could not correct the possible bias, our analysis qualitatively suggested that uncertainty of the standardized CPUE has increased since 2006. Therefore, in the stock assessment model (SS3), it is recommended that base case model run reflect increased uncertainty of recent part of Japanese coastal longline CPUE (JLL CPUE). The following three options are lined up for handling of JLL CPUE in recent years.

- ✓ Remove JLL CPUE in the period of 2006-2011.
- ✓ Separate JLL CPUE into two time series of 1994-2005 and 2006-2011.
- ✓ Enlarge coefficient of variation (CV) of JLL CPUE in the period of 2006-2011.

The one option is considered to be not acceptable, because information on year trend of SSB in recent years will be lost. The changes in fishery represented by target shift have progressed since 2006 as shown in Chapter 2, thereby catchability might decrease gradually. Therefore, the second option seems not to be appropriate, because it is difficult to quantify changing catchability. Consequently, we recommend that the third option is a realistic approach as a candidate to handle JLL CPUE in recent years. The gradual decrease of catchability in recent years can be represented by gradual increase of CV of JLL CPUE.

In addition, Appendix 3 shows estimation of CV of JLL CPUE in recent years using annual nominal CPUE by area as an example. The CV of CPUE displayed apparent increased trend since 2006 when the longline fishery started to change. Mean CV of CPUE for the period of 2006-2011 was 0.38. This value might be used as a reference value for decision of value of CV of JLL CPUE in recent year.

5. References cited

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Suzuki, N., Doi, W., Ashida, H., Tanabe, T. and Aonuma, Y. 2011. Annual change of abundance of the Pacific bluefin tuna larvae from 2007 to 2010 around the Ryukyu archipelago. ISC/11-1/PBFWG/12. 1-11.

Table 1 Results of type III analysis of the explanatory variables.

Effects	DF	Type III SS	Mean Square	F value	Pr > F
PBF					
year	17	7083.14	416.66	200.75	<.0001
month	2	1349.01	674.50	324.98	<.0001
shipname	421	6770.66	16.08	7.75	<.0001
lat	11	655.94	59.63	28.73	<.0001
lon	20	456.80	22.84	11.00	<.0001
lat*lon	54	1286.01	23.81	11.47	<.0001
year*month	34	1768.29	52.01	25.06	<.0001
YFT					
year	17	6680.70	392.98	327.59	<.0001
month	2	1076.72	538.36	448.77	<.0001
shipname	421	5212.48	12.38	10.32	<.0001
lat	11	2133.92	193.99	161.71	<.0001
lon	20	5940.72	297.04	247.61	<.0001
lat*lon	54	1710.37	31.67	26.40	<.0001
year*month	34	3658.82	107.61	89.70	<.0001
ALB					
year	17	2382.59	140.15	246.50	<.0001
month	2	11364.66	5682.33	9993.91	<.0001
shipname	421	5158.27	12.25	21.55	<.0001
lat	11	408.52	37.14	65.32	<.0001
lon	20	3238.41	161.92	284.78	<.0001
lat*lon	54	1220.22	22.60	39.74	<.0001
year*month	34	1671.33	49.16	86.46	<.0001

Table 2 Results of type III analysis of the explanatory variables.

(1) Binomial model (first step)

Effects	Num DF	Den DF	Chi squared value	F value	Pr>Chi	Pr>F
Year	17	49025	1130.09	66.48	<.0001	<.0001
Year*Area	68	49025	514.03	7.56	<.0001	<.0001
Year*Day10	136	49025	1118.86	8.23	<.0001	<.0001
Ship type*ALB CPUE	10	49025	225.05	22.51	<.0001	<.0001
Area*YFT CPUE	20	49025	240.33	12.02	<.0001	<.0001
Day10*ALB CPUE	32	49025	183.84	5.75	<.0001	<.0001

(2) Lognormal model (second step)

Effects	DF	Type III SS	Mean Square	F value	Pr > F
Year	17	153.83	9.05	36.66	<.0001
Shiptype	2	106.88	53.44	216.48	<.0001
YFT CPUE	4	14.62	3.66	14.81	<.0001
Year*Area	72	247.30	3.43	13.91	<.0001
Gear*Day10	17	248.50	14.62	59.22	<.0001

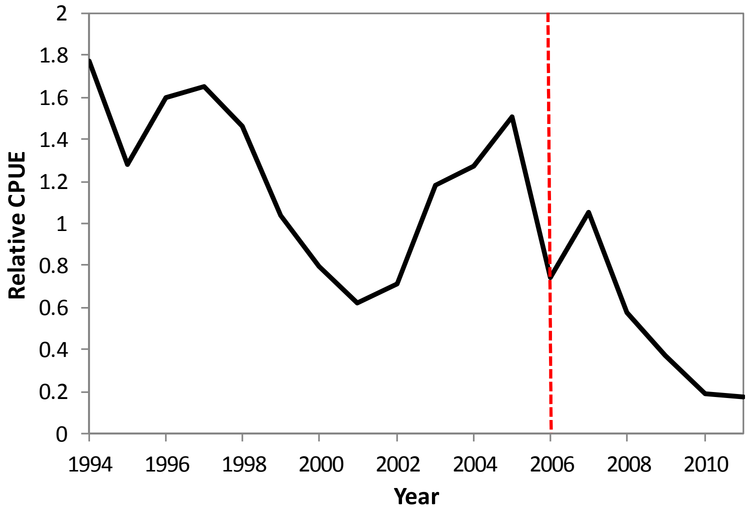

Fig. 1 Yearly trend of CPUE for PBF from Japanese coastal longlienrs estimated by Ichinokawa and Takeuchi (2012).

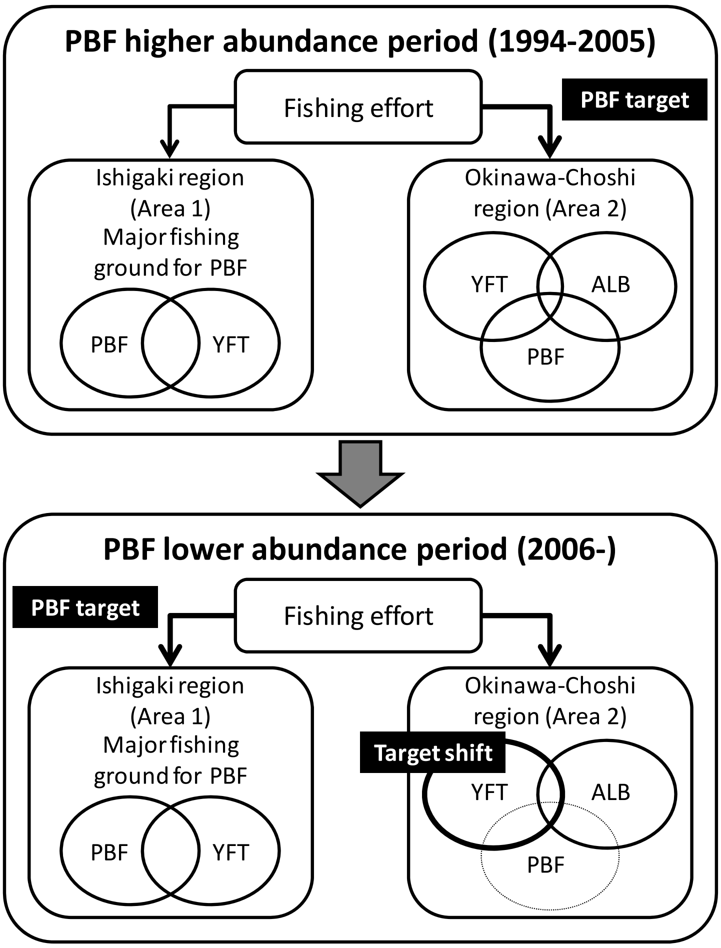

Fig. 2 Schematic view of hypothesis on shifts of fishing efforts for PBF and target shift in accordance with stock status of PBF. Areas 1 and 2 are defined in fig.3.

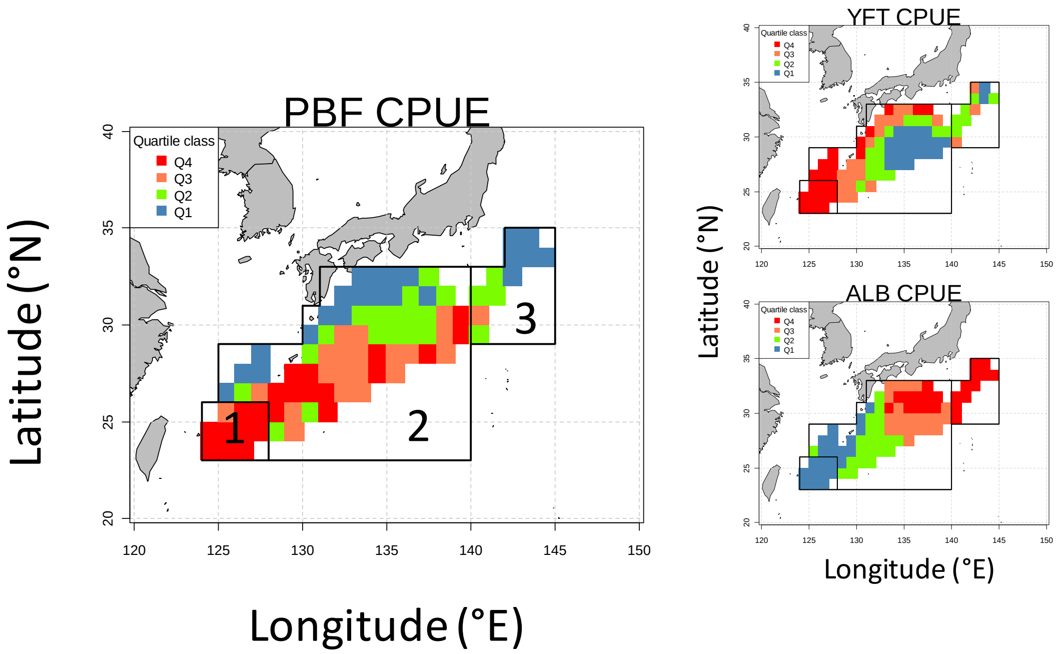

Fig. 3 Geographic distribution of standardized CPUE by 1x1 degree grid in latitude and longitude for PBF, YFT and ALB. Colors in each grid indicate quartile classes of CPUE for each species. Q1, lowest CPUE class; Q2, second lowest CPUE class; Q3, second highest CPUE class; Q4, highest CPUE class. Blue, green, orange and red indicates Q1, Q2, Q3 and Q4, respectively.

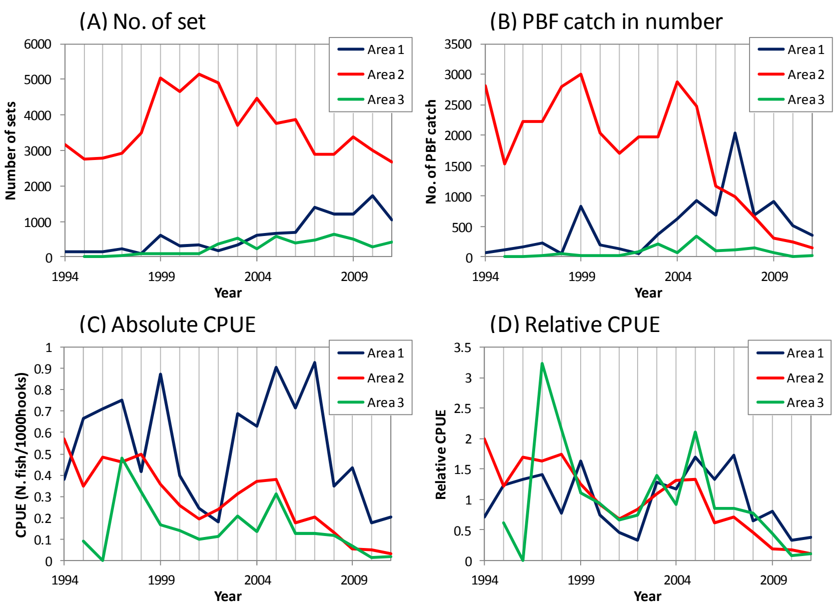

Fig. 4 Annual number of sets (A), PBF catch in number (B) and nominal CPUE (C, D) by area.

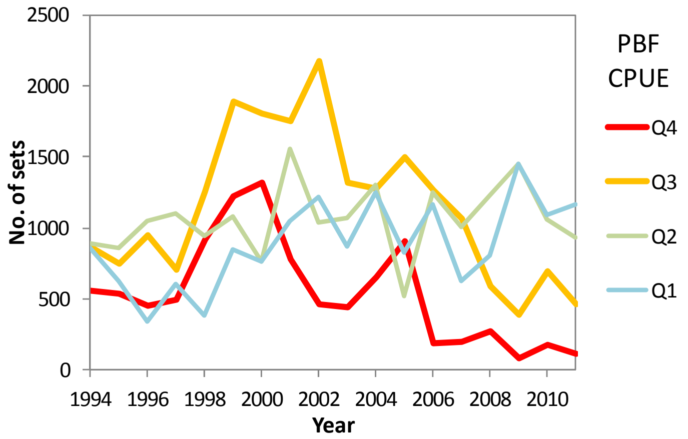

Fig. 5 Yearly changes in number of sets in the grids of each CPUE quartile class for PBF in Area 2. Q1, lowest CPUE class; Q2, second lowest CPUE class; Q3, second highest CPUE class; Q4, highest CPUE class.

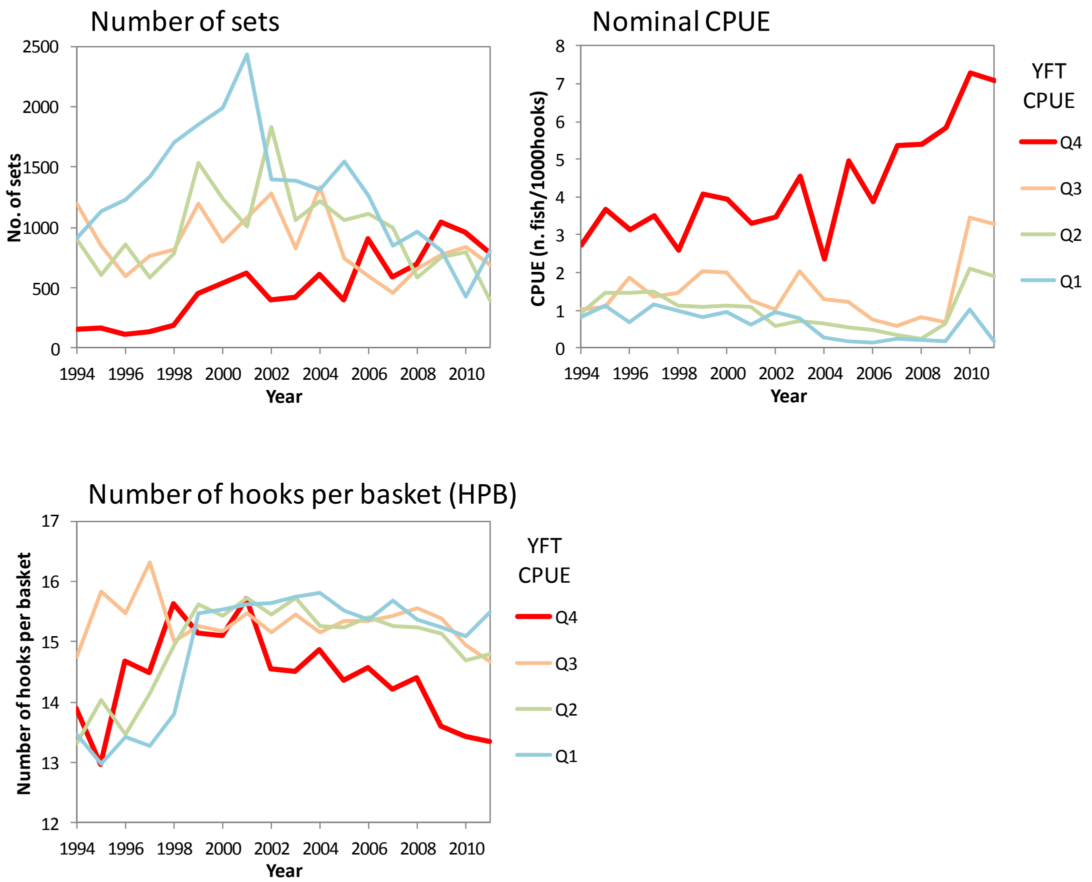

Fig. 6 Yearly changes in number of sets, nominal YFT CPUE and number of hooks per basket in the grids of each CPUE quartile class for YFT in Area 2. Q1, lowest CPUE class; Q2, second lowest CPUE class; Q3, second highest CPUE class; Q4, highest CPUE class.

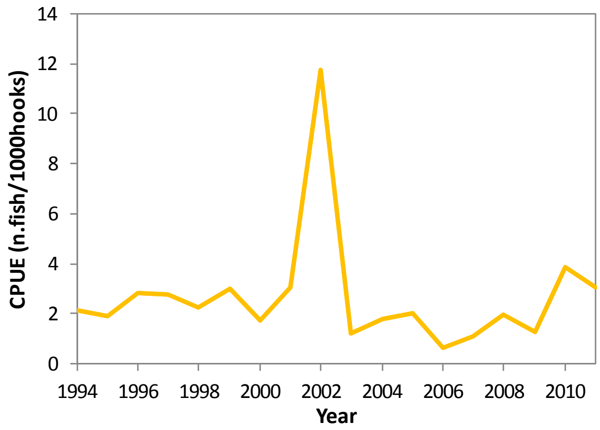

Fig. 7 Yearly changes in nominal YFT CPUE in Area 1.

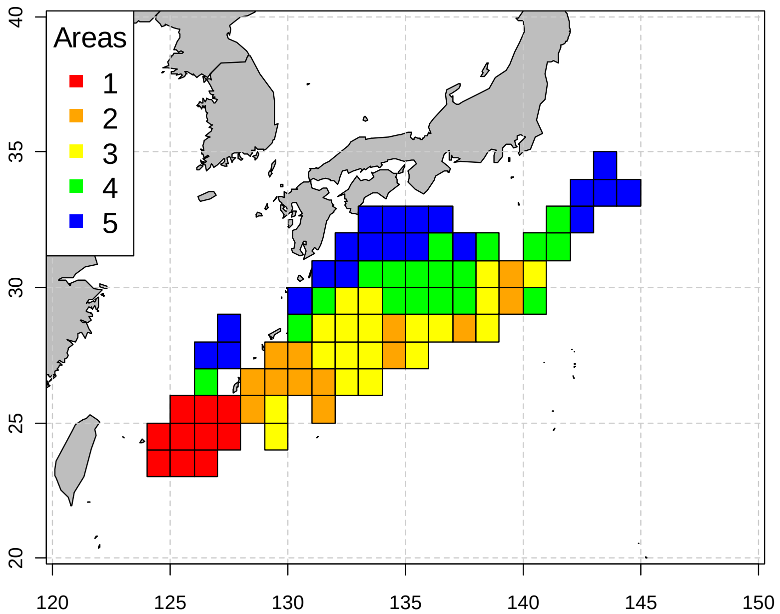

Fig. 8 Area definition for CPUE standardization.

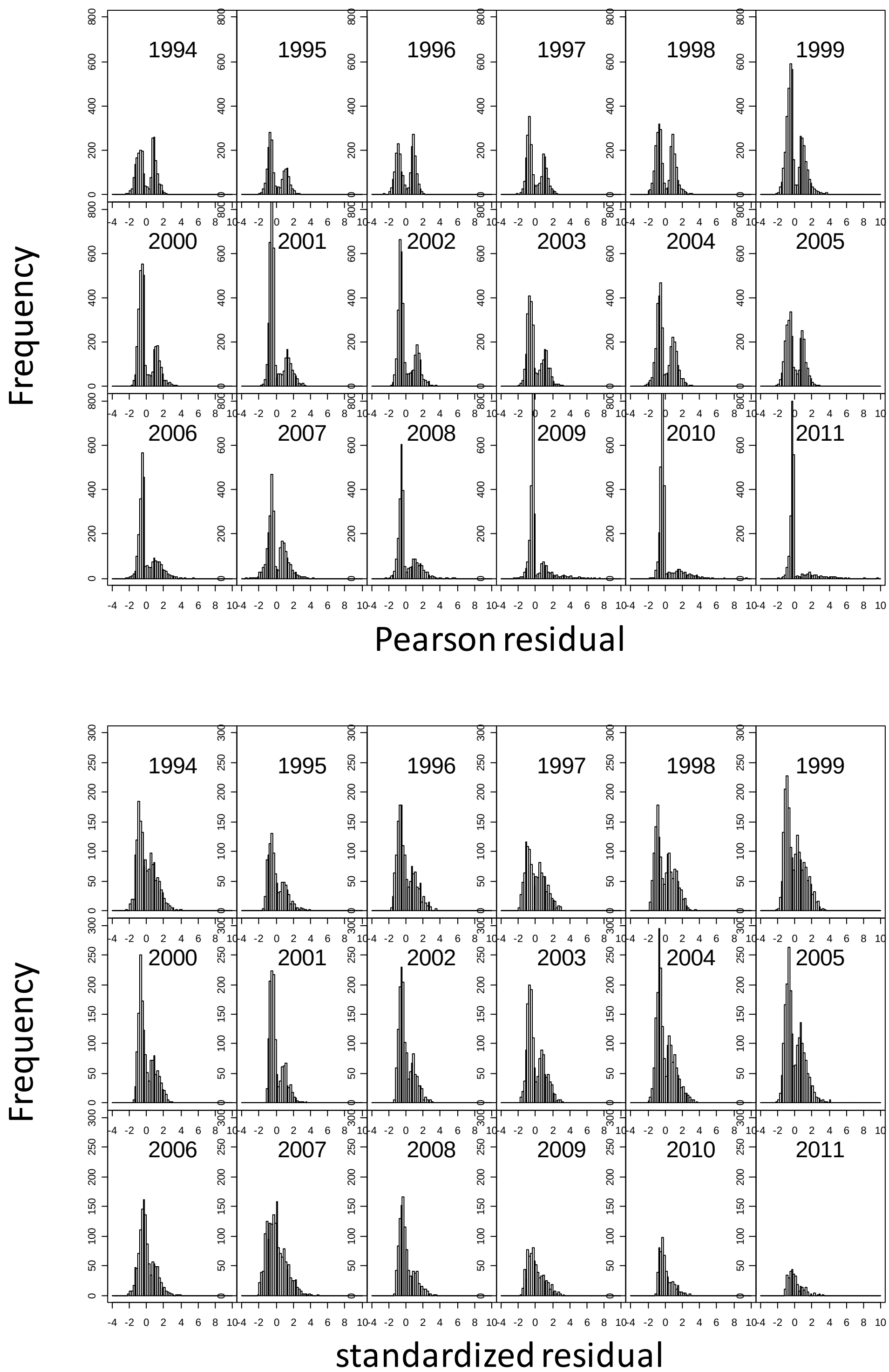

Fig. 9 Residual distributions by year. Upper panel, Pearson residuals from the binomial model of 1st step of binomial morel; lowe panel, standardized residual from the lognormal model of 2nd step of lognormal model.

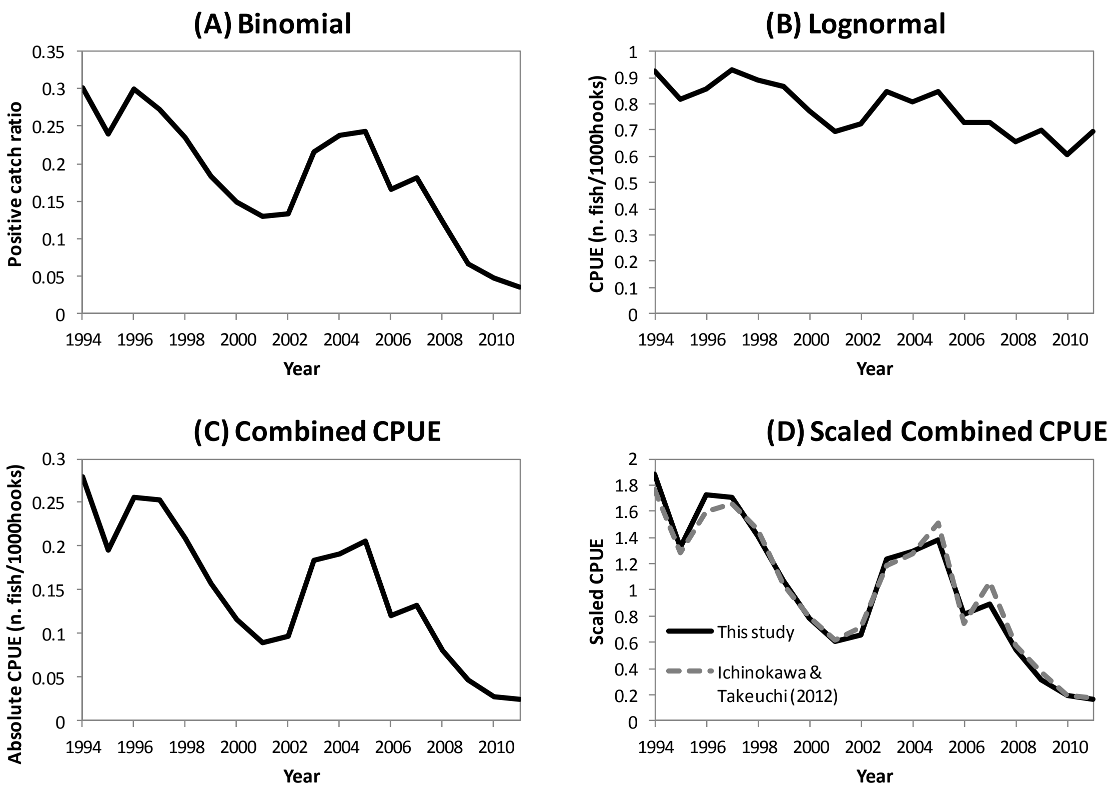

Fig. 10 Yearly changes in positive catch ratio (a), CPUE from positive PBF catch set (b), absolute combined CPUE (c) and scaled combined CPUE (d). Gray broken line indicates scaled CPUE estimated by Ichinokawa and Takeuchi (2012).

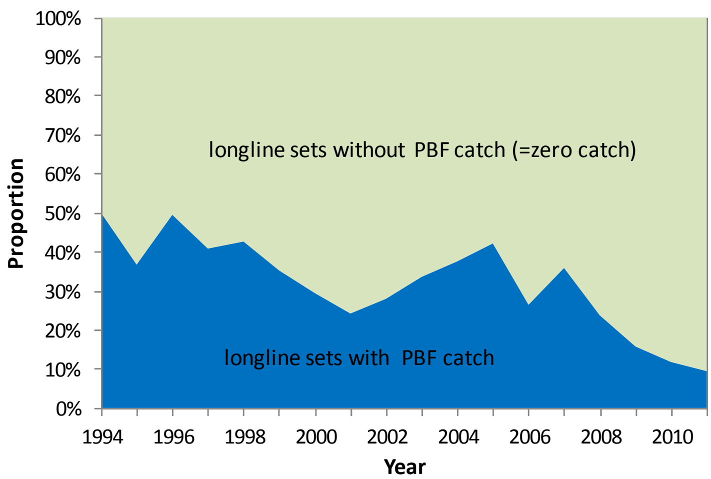

Fig. 11 Yearly change in proportion of number of sets with or without positive PBF catch from 1994 through 2011.

Appendix 1

Fish price and landing in weight of PBF and YFT at major landing ports in Miyazaki and Wakayama Prefectures

Miyazaki and Wakayama Prefectures have major landing ports of longliners, which is Aburatsu and Kiikatsuura ports. Landing data including fish price for PBF and YFT from these two ports were obtained. The landing data between April and June were applied.

Figure A1-1 illustrates annual fish price, landing in weight and total price of PBF and YFT in two ports. Fish price of PBF ranging approximately between 3,000 and 5,000 yen/kg was 3 to 5 times higher than that of YFT around 1,000 yen/kg. Therefore, a value of one PBF corresponds to that of 3 to 5 YFT of the same weight. Year trends of fish price remained at the same levels, whereas fish price of PBF showed increase trends. Landing in weight of PBF decreased in recent year at two ports. In contrast, landing in weight of YFT increased in recent year. Total price of YFT exceeded that of PBF after 2004 in Aburatsu and 2009 in Kiikatusura due to decrease of landing in weight of PBF in recent year.

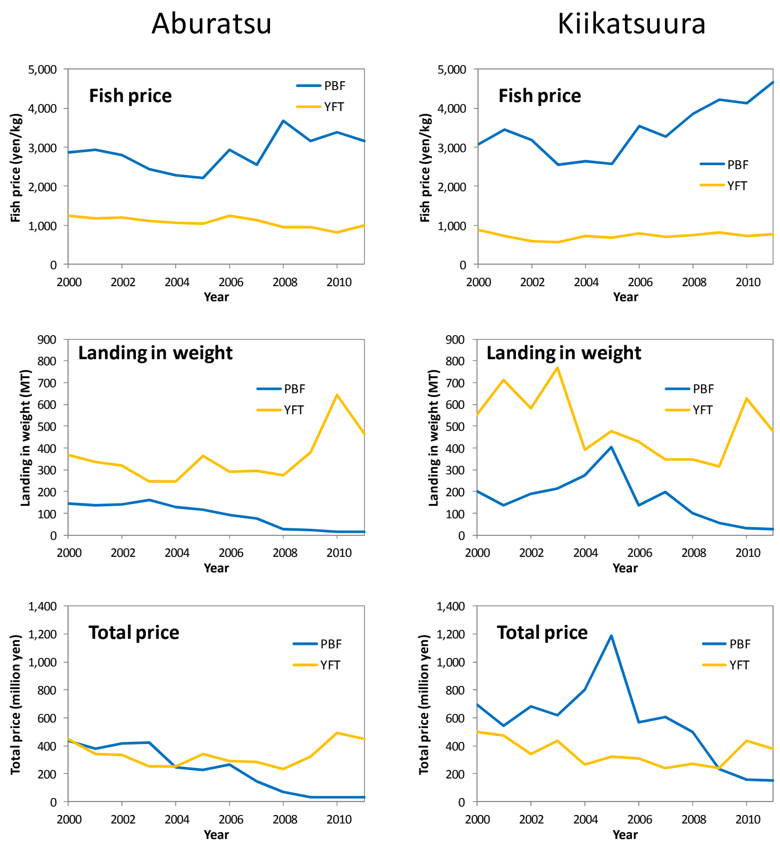

Fig. A1-1 Annual fish price, landing in weight and total price at Aburatsu port in Miyazaki and Kiikatsuura in Wakayama.

Appendix 2

Historical changes of operational area of Japanese coastal longliners

Figure A2-1 shows geographical distributions of longline sets by three years interval in the 2nd quarter (Apr.-Jun.) from 1994 through 2011. In general, historical change in geographic distribution pattern of Japanese coastal longliners was clearly observed in the period of 1994 through 2011. In 1994-1996, the longline sets were concentrated in limited region, the water areas of 127-129°E and 132-137°E. Thereafter, the longline sets expanded in the east-west direction. Three aggregations of the longline sets located in the regions of west of 128°E, 130-140°E and east of 141°E started to occurred in 2003-2005, resulting in there apparent fishing grounds in the last three years interval. In addition, since 2006, number of the longline sets operated in the southern region of 130-140°E have diminished and become sparse in 2009-2011.

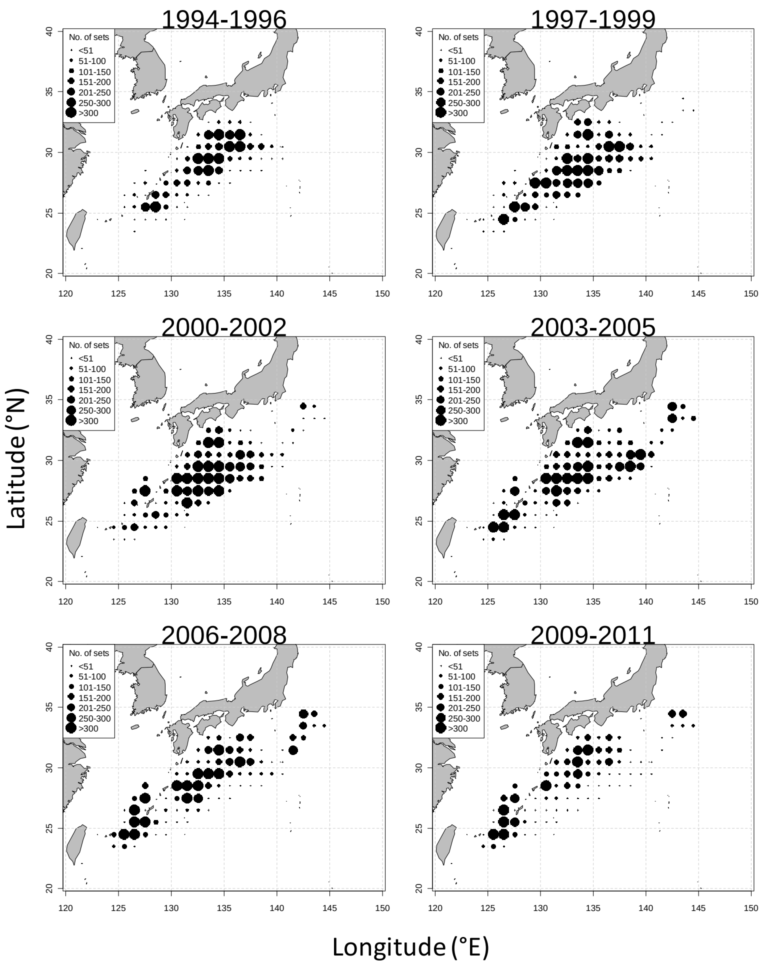

Fig. A2-1 Geographic distributions of longline sets by three years interval from 1994 through 2011. Size of filled circles indicates class of number of longline sets by one-by-one degree grid in latitude and longitude.

Appendix 3

Coefficients of variation of nominal annual CPUE from Japanese coastal longliners

Figure A3-1 shows time series of nominal CPUE by area, yearly changes in mean CPUE and 95% confidence interval and annual coefficient of variation (CV) of CPUE. A thousand time series of CPUE was generated by the bootstrap and 95% confidence interval and CV were calculated. Annual CV of CPUE showed apparent increase trend since 2006. Values of CV for each year are listed in Table A3-1. Mean CV during the period of 2006-2011 was 0.38.

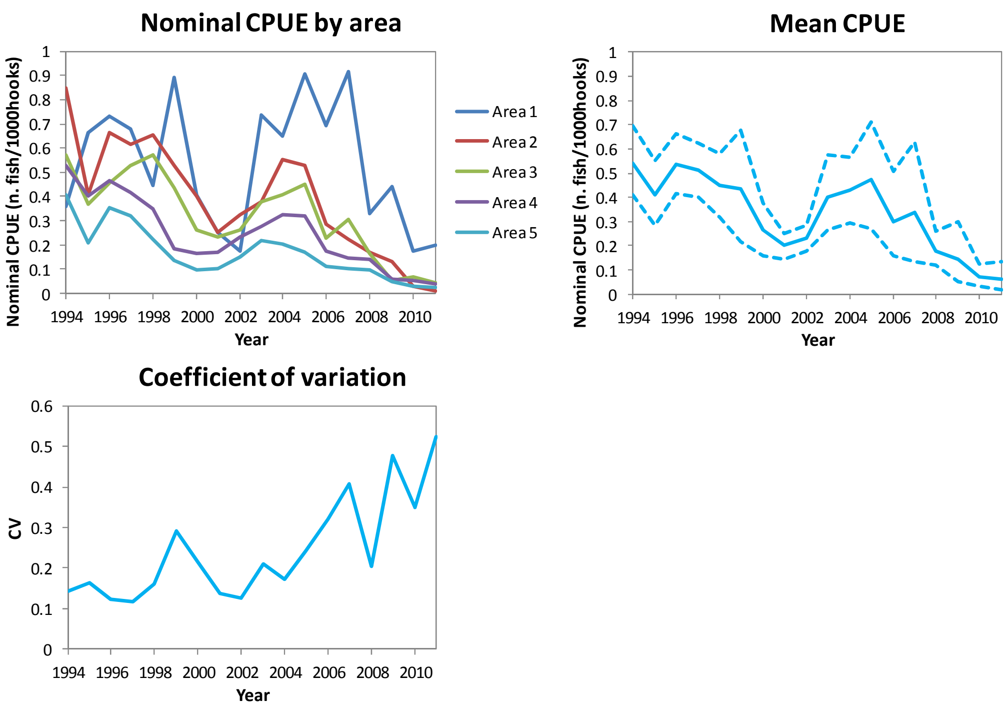

Fig. A3-1 Time series of nominal CPUE by area (upper left), yearly changes in mean CPUE and 95% confidence interval (upper right) and annual coefficient of variation (CV) of CPUE (bottom left).

Table A3-1 Values of coefficient of variation (CV) of CPUE for each year.

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002
CV	0.141249	0.162543	0.121134	0.117452	0.160151	0.29182	0.21404	0.135492	0.124344

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
CV	0.210596	0.171181	0.242547	0.320865	0.407523	0.20435	0.478179	0.349636	0.522519