Received: 9 & 17 October, 2012
IOTC–2012–WPTT14–35 Rev_1

Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2011 standardized by general linear model

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Abstract

Japanese longline CPUE (quarterly and annual) for yellowfin tuna in the main fishing ground and whole Indian Ocean, as well as CPUE in each area in each of five areas for SS3 and Multifan-CL, was standardized up to 2011 by GLM (CPUE-LogNormal error structured model). Number of hooks between float (NHF) and material of main line and branch line were applied in the model to standardize the change of the catch rate which has been derived by fishing gear configuration. In order to avoid the bias of CPUE trend which may be caused by critical decrease of effort in the northwestern Indian Ocean, scenarios without Area 2 was also applied.

Basically, two series of standardized CPUEs including and excluding Area2 showed a similar trend. In the main fishing ground, CPUE continuously decreased from around 15 (a nominal scale) in early 1960s to around 5.0 in 1974, and was kept in same level until 1990 with jump to 12.0 in 1977. Thereafter, it declined to about 3.0 in 1994 and has been kept in a low level with fluctuation between about 2 and 3 until 2007. After that, the CPUE declined to historical low level, 1.18-1.54 during 2008-2011. As the declining trend in the resent years was detected in both models including and excluding Area 2, where the piracy activity has been increasing since 2007, the resent declining trend would be reflecting actual change in abundance rather than change in CPUE derived from shift of fishing ground and/or decreased effort caused by increased piracy activity. The trend of standardized CPUE for whole Indian Ocean was similar to that of main fishing ground. Quarterly CPUE trends for main and whole Indian Ocean were similar to that of annual CPUE.

Trends of CPUEs were relatively similar among areas, i.e. large decline to middle 1970s, relatively stable until around 1991 and steadily declining thereafter. Applying LT5LN5 factor (five degree block) in the model showed relatively large effect on the CPUE trend for Area 3 and 4 in which the declining trend until around 1990 was steeper in the model without LT5LN5. Then, the CPUE trend derived from the model with LT5LN5 caused relatively flat trend throughout period analyzed.

1. Introduction

Yellowfin tuna is one of main target species for Japanese longline fishery in the Indian Ocean. Its abundance indices are very important for stock assessment of this species. Yellowfin tuna is mainly caught in the tropical and subtropical areas especially in the western Indian Ocean (Matsumoto et al., 2012). Since 2007, activity of piracy off Somalia has increased and spread to whole northwestern Indian Ocean. Japanese longline effort in the Indian Ocean, especially in the northwestern part, has rapidly decreased to avoid the piracy attack. In the IOTC WPTT meeting in 2010, concern of the effect of the decreased effort on the CPUE trend of the longline fishery was recognized. Okamoto (2011b) estimated the regional effect of the decreased longline effort on the CPUE trend in the Indian Ocean, and suggested that the decreased effort in northwestern Indian Ocean has no more been able to represent the CPUE trend in this region. Therefore, Okamoto (2011a) calculated CPUE trends for both cases including and excluding Area 2 (northwestern area) and found that the trends were similar.

In this study, Japanese longline CPUE for yellowfin tuna in the Indian Ocean was standardized by Generalized Linear Model which is equivalent to those by Okamoto and Shono (2010) and Okamoto (2011a) used for 2010 and 2011 yellowfin assessments, respectively. As with these studies, number of hooks between floats (NHF) and material of main and branch lines were applied in the model to standardize the change of the catchability which has been derived by fishing gear configuration. Area definition used was the same as that used in 2010 and 2011 analyses.

2. Materials and methods

General linear model (GLM) was applied to standardize the Japanese longline CPUE for yellowfin tuna. Principally, the model used for the standardization in this paper is equivalent to that used in the previous studies (Okamoto and Shono, 2010; Okamoto, 2011a). In the standardization, any environmental factor was not applied in the model.

Area definition:

Area definition used in this study which consists of five areas was as same as that used in the yellowfin assessment in IOTC WPTT 2010 and 2011 (Fig. 1), although area 1 was not used because of too little effort in this area. CPUE was standardized for main fishing ground (Area 2, 3 and 5) and whole Indian Ocean (Area 2 - 5) and for both areas excluding Area2.

Catch and effort data used:

The Japanese longline catch (in number) and effort statistics from 1963 up to 2011 were used. Data used in this study was the catch and effort data sets aggregated by month, 1-degree square, NHF (the number of hooks between floats), and main and branch line material. As the NHF information is not available for the period before 1975, NHF was regarded to be 5 in this period because NHF around 1975 was almost 5-7. Main and branch line material was classified into two categories, 1 = Nylon and 2 = other. Although the information on the materials has been collected since 1994, the nylon material was started to be used by distant water longliner in the tropical Indian Ocean in around the late 1980s and spread quickly in the early 1990s (Okamoto 2005). And it seems that the NHF larger than 17 or 18 would have become possible to be used as a result of introduction of the new material. Therefore, the material of NHF 17 or larger was assumed to be nylon since 1990.

GLM (Generalized Linear Model)

CPUE based on the catch in number was used. CPUE is calculated as "the number of fish caught / the number of hooks * 1000". As the model for standardizing CPUE, CPUE-LogNormal error structure was used. The followings are the initial model for each analysis. Based on the result of ANOVA (type III SS), non-significant effects were removed in step-wise from the initial model based on the F-value ($p<0.05$). In the cases in which the factor is not significant as main factor but is significant as interaction with other factor, the main factor was kept in the model.

Annual and quarterly CPUE was standardized for main fishing ground (Area 2, 3 and 5) and whole Indian Ocean (Area 2-5) for 1963-2011 and 1980-2011. In addition, annual and quarterly CPUE was also standardized for each of five areas for 1963-2011 in order to provide CPUE index used for assessment using Multifan-CL software and Stock Synthesis 3 (SS3). In this case, the model in which explanatory factor of each 5 degree latitude and longitude square was also applied.

- Initial Model for Year based CPUE standardization in the main fishing ground and whole Indian Ocean for 1963 through 2011

Log (CPUE+const)=μ+YR +QT +AREA +NHFCL +ML +BL +YR*QT +QT*AREA +YR*AREA +AREA*NHFCL +NHFCL*ML +NHFCL*BL + e

- Initial Model for Quarter based CPUE standardization in the main fishing ground and whole Indian Ocean for 1963 through 2011

Log (CPUE+const)=μ+YR +QT +AREA +NHFCL +ML +BL +YR*QT*AREA +AREA*NHFCL +NHFCL*ML +NHFCL*BL + e

- Initial Model for year or quarter based CPUE standardization in each area from 1963 to 2011 (excluding explanatory factor of each latitude 5 degree and longitude 5 degree square)

Log (CPUE+const)=μ+YR +QT + NHFCL +ML +BL +YR*QT +NHFCL*ML +NHFCL*BL + e

- Initial Model for year or quarter based CPUE standardization in each area from 1963 to 2011 (including explanatory factor of each latitude 5 degree and longitude 5 degree square)

Log (CPUE+const)=μ+YR +QT + NHFCL +ML +BL +LT5LN5 +YR*QT +NHFCL*ML +NHFCL*BL + e

where Log : natural logarithm,
CPUE : catch in number of bigeye per 1000 hooks,
const : 10% of overall mean of CPUE
μ : overall mean,
YR : effect of year,

QT : effect of fishing season (quarter)
Area: effect of area,
NHFCL : effect of gear type (category of the number of hooks between floats),
ML : effect of material of main line,
BL : effect of material of branch line,
LT5LN5: effect of each latitude 5 degree and longitude 5 degree square
YR*QT : interaction term between year and quarter,
QT*Area: interaction term between quarter and area,
YR*Area: interaction term between year and area,
Area*NHFCL: interaction term between area and gear type,
NHFCL*ML: interaction term between material of gear type and main line,
NHFCL*BL: interaction term between material of gear type and branch line,
YR*QT*Area : interaction term between year, quarter and Area,
e : error term.

The number of hooks between float (NHF) was divided into 6 classes (NHFCL 1: 5-7, NHFCL 2: 8-10, NHFCL 3: 11-13, NHFCL 4: 14-16, NHFCL 5: 17-19, NHFCL 6: 20-21) as later explanation.

Effect of year was obtained by the method used in Ogura and Shono (1999) that uses Lsmean of Year-Area interaction as the following equation.

$$CPUEi = \Sigma Wj * (\exp(lsmean(Year\ i * Area\ j)) - const)$$

where CPUEi = CPUE in year i,
Wj = Area proportion of Area j , ($\Sigma Wj = 1$),
lsmean(Year*Areaij) = least square mean of Year-Area interaction in Year i and Area j (As for the quarter based CPUE, least square mean of Year*Quarter*Area was used instead),
const= 10% of overall mean of CPUE.

As for standardized CPUE in the main fishing ground and whole Indian Ocean which includes Area 2, CPUE in 2011 was calculated using area rate without Area 2 because no effort was observed in the Area 2 due to activities of pirates. The yellowfin CPUEs (catch in number per 1000 hooks) in year and quarter bases were standardized for the period from 1963 to 2011 by GLM (CPUE-LogNormal error structured model) for each of area categories, main fishing ground (Area 2, 3 and 5 or Area 3 and 5) and whole Indian Ocean (Areas 2–5, or area 3-5).

3. Results and discussion

CPUE standardizations by GLM:

Trends of annual CPUEs for main fishing ground (with and without Area2) and whole Indian Ocean (with and without Area 2) standardized from 1963 to 2011 are shown in Fig. 2 in real scale overlaying nominal CPUE and in relative scale. Basically, standardized CPUE including and excluding Area2 in the model showed similar trend. In the main fishing ground, CPUE continuously decreased from around 15 (real scale) in early 1960s to around 5.0 in 1974, and was kept in same level until 1990 with jump to 12.0 in 1977. Thereafter, it declined to about 3.0 in 1994 and has been kept in a low level with fluctuation between about 2 and 3 until 2007. After that, the CPUE declined to historical low level, 1.18-1.54 during 2008-2011. As this declining trend in the resent years was detected in both models including and excluding Area 2 where the piracy activity has been increasing since 2007, the resent declining trend would be reflecting actual change in abundance rather than change in CPUE derived from shift of fishing ground and/or decreased effort caused by increased piracy activity. The trend of standardized CPUE for whole Indian Ocean was similar to that of main fishing ground. The quarterly CPUE trends for main and whole Indian Ocean were basically similar to that of annual CPUE (Fig. 3).

Results of ANOVA and distributions of the standard residual for both of annual and quarterly CPUE for main and whole Indian Ocean are shown in Table 1 and Fig. 4 (annual base) and Table 2 and Fig. 5 (quarterly base), respectively. As all explanatory factors included in the initial models were effective significantly in all cases, the final models were equal to the initial models as a result. In all cases, standard residuals did not show remarkable difference

from the normal distribution.

The quarterly and annual CPUEs for each area standardized by the model with and without LT5LN5 are shown in Fig. 6 and Fig. 7, respectively, in real scale overlaying nominal CPUE and in relative scale. ANOVA tables and standard residuals are shown in **Table 3**-4 and Fig. 8-9 respectively. Trends of CPUEs of each area were relatively similar, i.e. large decline to middle 1970s, relatively stable trend until around 1991 and steadily declining trend thereafter. Applying LT5LN5 factor in the model showed relatively large effect on the CPUE trend for area 3 and 4 in which the declining trend until around 1990 was steeper in the model without LT5LN5. Then, the CPUE trend derived from the model with LT5LN5 caused relatively flat trend throughout period analyzed. Fig. 10 indicates that distribution of fishing efforts differ depending on period especially in the Area 3 and 4. It may have caused large difference of CPUE between with and without LT5LN5.

Tables 1 – 7 in appendix show CPUE indices for each scenario.

Effect of each explanatory factors in the model

Historical changes in the proportion of effort by fishing gear (NHFCL and gear materials) are shown in Fig. 11. NHFCL 5-7 was dominant in each area in the early period. NHF increased with time and sudden increase occurred during early 1990s in each area. In recent years, NHFCL 11-13 is dominant in Area 3 and 4, and NHFCL 17-19 and 20-21 in Area 2 and 5. Nylon material for both main and branch lines developed rapidly around mid-1990s, which almost coincided with the change in NHF. Trends of CPUE standardized for each of quarter, NHFCL, gear (main-line and branch-line) materials and interaction of NHFCL and gear materials were shown in Fig. 12. L1 data set and whole Indian Ocean for 1963-2010 were used for this analysis. CPUE was highest in 1st and 4th Quarter. CPUE showed increasing trend with NHFCL, although not fully consistent. As for the gear materials of both of branch and main-lines, nylon showed about 10% higher CPUE than other material. CPUE by NHFCL demonstrated increasing trend for each gear material, and the trend was clearer for "other" materials.

Large difference between nominal and standardized CPUEs was observed after 1990s, in which nominal CPUE was higher than standardized one. Development of fishing gear (NHF and materials) may be one of the causes. Also, it appears that the proportion of fishing effort has become higher in the area where yellowfin tuna CPUE is high (in the tropical and subtropical areas of western Indian Ocean) (Matsumoto and Satoh, 2012). It may also be the cause of the difference of two CPUEs.

4. References

Matsumoto, T. and Satoh, K. (2012): Review of Japanese fisheries and tropical tuna catch in the Indian Ocean. IOTC 2012/WPTT14/17. 28pp.

Okamoto, H. (2005): Recent trend of Japanese longline fishery in the Indian Ocean with special reference to the targeting Is the target shifting from bigeye to yellowfin? IOTC 2005/WPTT/11. 15 pp.

Okamoto, H. and Shono, H. (2010): Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2009 standardized by general linear model. IOTC 2010/WPTT12/30. 27 pp.

Okamoto, H. (2011a): Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2010 standardized by general linear model. IOTC 2011/WPTT13/34. 45 pp.

Okamoto, H. (2011b): Preliminary analysis of the effect of the Piracy activity in the northwestern Indian Ocean on the CPUE trend of bigeye and yellowfin. IOTC 2011/ WPTT13/44. 9pp.

Shono, H. and Ogura, M. (1999): The standardized skipjack CPUE including the effect of searching devices, of the Japanese distant water pole and line fishery in the Western Central Pacific Ocean. ICCAT-SCRS/99/59. 18pp.

Table 1. ANOVA table of GLM for year based CPUE standardization for main fishing ground and whole Indian Ocean (with and without Area2) for 1963-2011 and 1980-2011.

1963-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	325	69377.7	213.5	255.7	<.0001	0.32
						CV =
yr	48	11554.3	240.7	288.4	<.0001	60.12
qt	3	3323.8	1107.9	1327.3	<.0001	
area	2	2209.1	1104.6	1323.3	<.0001	
nhfcl	5	535.8	107.2	128.4	<.0001	
bl	1	19.3	19.3	23.1	<.0001	
ml	1	145.5	145.5	174.3	<.0001	
yr*qt	144	4864.1	33.8	40.5	<.0001	
qt*area	6	5284.0	880.7	1055.0	<.0001	
yr*area	95	5164.4	54.4	65.1	<.0001	
area*nhfcl	10	744.7	74.5	89.2	<.0001	
nhfcl*ml	5	281.3	56.3	67.4	<.0001	
nhfcl*bl	5	57.6	11.5	13.8	<.0001	

1980-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	223	40600.0	182.1	190.1	<.0001	0.25
						CV =
yr	31	5310.9	171.3	178.8	<.0001	79.69
qt	3	2833.8	944.6	986.1	<.0001	
area	2	1903.6	951.8	993.5	<.0001	
nhfcl	5	575.2	115.0	120.1	<.0001	
bl	1	20.5	20.5	21.4	<.0001	
ml	1	168.8	168.8	176.3	<.0001	
yr*qt	93	3763.9	40.5	42.3	<.0001	
qt*area	6	5671.7	945.3	986.8	<.0001	
yr*area	61	2415.0	39.6	41.3	<.0001	
area*nhfcl	10	781.8	78.2	81.6	<.0001	
nhfcl*ml	5	324.7	64.9	67.8	<.0001	
nhfcl*bl	5	63.7	12.7	13.3	<.0001	

1963-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	269	43557.4	161.9	178.5	<.0001	0.31
						CV =
yr	48	7038.9	146.6	161.6	<.0001	73.04
qt	3	4541.8	1513.9	1668.8	<.0001	
area	1	1436.4	1436.4	1583.3	<.0001	
nhfcl	5	395.4	79.1	87.2	<.0001	
bl	1	13.8	13.8	15.2	<.0001	
ml	1	79.9	79.9	88.1	<.0001	
yr*qt	144	3666.6	25.5	28.1	<.0001	
qt*area	3	3720.9	1240.3	1367.1	<.0001	
yr*area	48	2786.6	58.1	64.0	<.0001	
area*nhfcl	5	647.0	129.4	142.6	<.0001	
nhfcl*ml	5	216.0	43.2	47.6	<.0001	
nhfcl*bl	5	36.4	7.3	8.0	<.0001	

1980-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	184	29626.6	161.0	159.3	<.0001	0.28
						CV =
yr	31	3401.2	109.7	108.5	<.0001	97.95
qt	3	3235.9	1078.6	1067.0	<.0001	
area	1	1386.7	1386.7	1371.8	<.0001	
nhfcl	5	415.3	83.1	82.2	<.0001	
bl	1	12.3	12.3	12.2	0.0005	
ml	1	96.6	96.6	95.6	<.0001	
yr*qt	93	2635.8	28.3	28.0	<.0001	
qt*area	3	4186.8	1395.6	1380.5	<.0001	
yr*area	31	970.4	31.3	31.0	<.0001	
area*nhfcl	5	627.9	125.6	124.2	<.0001	
nhfcl*ml	5	252.7	50.5	50.0	<.0001	
nhfcl*bl	5	37.1	7.4	7.3	<.0001	

1963-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	382	166124.3	434.9	505.6	<.0001	0.45
						CV =
yr	48	14008.2	291.8	339.3	<.0001	81.81
qt	3	4107.2	1369.1	1591.8	<.0001	
area	3	9243.9	3081.3	3582.7	<.0001	
nhfcl	5	531.4	106.3	123.6	<.0001	
bl	1	46.3	46.3	53.9	<.0001	
ml	1	84.6	84.6	98.4	<.0001	
yr*qt	144	5413.8	37.6	43.7	<.0001	
qt*area	9	6828.9	758.8	882.2	<.0001	
yr*area	143	7941.4	55.5	64.6	<.0001	
area*nhfcl	15	970.4	64.7	75.2	<.0001	
nhfcl*ml	5	388.9	77.8	90.4	<.0001	
nhfcl*bl	5	87.4	17.5	20.3	<.0001	

1980-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	263	111350.8	423.4	443.0	<.0001	0.41
						CV =
yr	31	6760.8	218.1	228.2	<.0001	116.99
qt	3	3869.5	1289.8	1349.5	<.0001	
area	3	11741.3	3913.8	4094.8	<.0001	
nhfcl	5	578.9	115.8	121.1	<.0001	
bl	1	48.6	48.6	50.8	<.0001	
ml	1	100.9	100.9	105.5	<.0001	
yr*qt	93	4110.1	44.2	46.2	<.0001	
qt*area	9	7434.8	826.1	864.3	<.0001	
yr*area	92	3166.1	34.4	36.0	<.0001	
area*nhfcl	15	1018.3	67.9	71.0	<.0001	
nhfcl*ml	5	456.2	91.2	95.5	<.0001	
nhfcl*bl	5	101.0	20.2	21.1	<.0001	

1963-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	326	124371.4	381.5	396.2	<.0001	0.45
						CV =
yr	48	10786.7	224.7	233.4	<.0001	130.85
qt	3	5713.3	1904.4	1977.9	<.0001	
area	2	7185.0	3592.5	3731.0	<.0001	
nhfcl	5	493.5	98.7	102.5	<.0001	
bl	1	43.4	43.4	45.1	<.0001	
ml	1	25.3	25.3	26.2	<.0001	
yr*qt	144	4777.1	33.2	34.5	<.0001	
qt*area	6	5704.6	950.8	987.4	<.0001	
yr*area	96	4768.8	49.7	51.6	<.0001	
area*nhfcl	10	884.2	88.4	91.8	<.0001	
nhfcl*ml	5	278.8	55.8	57.9	<.0001	
nhfcl*bl	5	65.1	13.0	13.5	<.0001	

1980-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	224	87951.8	392.6	382.6	<.0001	0.43
						CV =
yr	31	5438.5	175.4	170.9	<.0001	220.98
qt	3	4822.8	1607.6	1566.4	<.0001	
area	2	10480.9	5240.5	5106.1	<.0001	
nhfcl	5	523.4	104.7	102.0	<.0001	
bl	1	40.7	40.7	39.7	<.0001	
ml	1	33.7	33.7	32.8	<.0001	
yr*qt	93	3207.6	34.5	33.6	<.0001	
qt*area	6	6519.8	1086.6	1058.8	<.0001	
yr*area	62	1750.3	28.2	27.5	<.0001	
area*nhfcl	10	885.8	88.6	86.3	<.0001	
nhfcl*ml	5	334.3	66.9	65.1	<.0001	
nhfcl*bl	5	72.9	14.6	14.2	<.0001	

Table 2. ANOVA table of GLM for quarter based CPUE standardization for main fishing ground and whole Indian Ocean (with and without Area2) for 1963-2011.

1963-2011 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	610	75302.9	123.4	153.7	<.0001	0.342825
						CV =
yr	48	9605.7	200.1	249.2	<.0001	58.97258
qt	3	2357.5	785.8	978.5	<.0001	
area	2	1524.9	762.5	949.4	<.0001	
nhfcl	5	489.6	97.9	121.9	<.0001	
bl	1	15.9	15.9	19.8	<.0001	
ml	1	138.5	138.5	172.4	<.0001	
yr*qt*area	530	22448.9	42.4	52.7	<.0001	
area*nhfcl	10	731.2	73.1	91.1	<.0001	
nhfcl*ml	5	243.6	48.7	60.7	<.0001	
nhfcl*bl	5	45.3	9.1	11.3	<.0001	

1963-2011 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	413	46923.9	113.6	129.6	<.0001	0.337781
						CV =
yr	48	6306.1	131.4	149.9	<.0001	71.79154
qt	3	3225.3	1075.1	1226.7	<.0001	
area	1	1111.5	1111.5	1268.2	<.0001	
nhfcl	5	374.3	74.9	85.4	<.0001	
bl	1	10.5	10.5	12.0	0.0005	
ml	1	83.6	83.6	95.4	<.0001	
yr*qt*area	339	15052.3	44.4	50.7	<.0001	
area*nhfcl	5	666.1	133.2	152.0	<.0001	
nhfcl*ml	5	218.1	43.6	49.8	<.0001	
nhfcl*bl	5	29.5	5.9	6.7	<.0001	

1963-2011 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	811	176413.0	217.5	266.0	<.0001	0.479606
						CV =
yr	48	10968.1	228.5	279.5	<.0001	79.77122
qt	3	3133.4	1044.5	1277.4	<.0001	
area	3	8145.1	2715.0	3320.4	<.0001	
nhfcl	5	437.8	87.6	107.1	<.0001	
bl	1	38.3	38.3	46.9	<.0001	
ml	1	89.0	89.0	108.8	<.0001	
yr*qt*area	725	31884.0	44.0	53.8	<.0001	
area*nhfcl	15	974.7	65.0	79.5	<.0001	
nhfcl*ml	5	325.0	65.0	79.5	<.0001	
nhfcl*bl	5	74.7	14.9	18.3	<.0001	

1963-2011 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	614	132362.0	215.6	235.7	<.0001	0.476033
						CV =
yr	48	8675.6	180.7	197.7	<.0001	127.5187
qt	3	4190.3	1396.8	1527.4	<.0001	
area	2	6871.2	3435.6	3757.0	<.0001	
nhfcl	5	416.7	83.3	91.1	<.0001	
bl	1	33.5	33.5	36.7	<.0001	
ml	1	30.5	30.5	33.3	<.0001	
yr*qt*area	534	24754.5	46.4	50.7	<.0001	
area*nhfcl	10	923.6	92.4	101.0	<.0001	
nhfcl*ml	5	264.1	52.8	57.8	<.0001	
nhfcl*bl	5	62.1	12.4	13.6	<.0001	

Table 3. ANOVA table of GLM for quarterly based CPUE standardization for each area for 1963-2011.

1963-2010 MODEL2010
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	208	23446.68	112.72	154.11	<.0001	0.300
						CV =
yr	47	7404.50	157.54	215.38	<.0001	47.636
qt	3	408.50	136.17	186.15	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.60	27.52	37.62	<.0001	
bl	1	11.07	11.07	15.13	0.0001	
ml	1	0.35	0.35	0.48	0.4904	
yr*qt*area	141	3947.66	28.00	38.28	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	44.72	8.94	12.23	<.0001	
nhfcl*bl	5	51.76	10.35	14.15	<.0001	

1963-2010 MODEL2010 + LT5LN5
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	238	28176.15	118.39	177.10	<.0001	0.361
						CV =
yr	47	6281.23	133.64	199.92	<.0001	45.539
qt	3	218.61	72.87	109.01	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.49	27.50	41.13	<.0001	
bl	1	9.04	9.04	13.53	0.0002	
ml	1	0.11	0.11	0.16	0.6887	
LT5LN5	30	4729.47	157.65	235.83	<.0001	
yr*qt*area	141	3213.96	22.79	34.10	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	41.80	8.36	12.50	<.0001	
nhfcl*bl	5	26.43	5.29	7.91	<.0001	

1963-2011 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	22880.18	107.93	102.15	<.0001	0.285
						CV =
yr	48	5003.63	104.24	98.67	<.0001	72.064
qt	3	6843.13	2281.04	2159.03	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	357.55	71.51	67.68	<.0001	
bl	1	0.02	0.02	0.02	0.8863	
ml	1	8.81	8.81	8.34	0.0039	
yr*qt*area	144	5127.03	35.60	33.70	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	262.86	52.57	49.76	<.0001	
nhfcl*bl	5	22.25	4.45	4.21	0.0008	

1963-2011 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	247	36008.53	145.78	178.72	<.0001	0.448
						CV =
yr	48	2485.17	51.77	63.47	<.0001	63.321
qt	3	1910.85	636.95	780.85	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	157.68	31.54	38.66	<.0001	
bl	1	0.87	0.87	1.07	0.3015	
ml	1	1.85	1.85	2.27	0.132	
LT5LN5	35	13128.35	375.10	459.84	<.0001	
yr*qt*area	144	2481.48	17.23	21.13	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	122.15	24.43	29.95	<.0001	
nhfcl*bl	5	19.21	3.84	4.71	0.0003	

1963-2011 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	28929.42	136.46	87.47	<.0001	0.254
						CV =
yr	48	8544.35	178.01	114.10	<.0001	-124.193
qt	3	2029.08	676.36	433.53	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	811.37	162.27	104.01	<.0001	
bl	1	27.24	27.24	17.46	<.0001	
ml	1	60.62	60.62	38.86	<.0001	
yr*qt*area	144	9678.27	67.21	43.08	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	72.22	14.44	9.26	<.0001	
nhfcl*bl	5	196.37	39.27	25.17	<.0001	

1963-2011 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	278	61683.06	221.88	231.48	<.0001	0.542
						CV =
yr	48	2953.34	61.53	64.19	<.0001	-97.345
qt	3	463.77	154.59	161.28	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	55.24	11.05	11.53	<.0001	
bl	1	5.38	5.38	5.61	0.0179	
ml	1	4.08	4.08	4.25	0.0392	
LT5LN5	66	32753.64	496.27	517.74	<.0001	
yr*qt*area	144	2743.56	19.05	19.88	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	67.13	13.43	14.01	<.0001	
nhfcl*bl	5	169.20	33.84	35.31	<.0001	

1963-2011 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	24186.94	114.09	178.57	<.0001	0.428
						CV =
yr	48	3908.83	81.43	127.46	<.0001	68.234
qt	3	210.07	70.02	109.60	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	62.43	12.49	19.54	<.0001	
bl	1	16.09	16.09	25.19	<.0001	
ml	1	4.65	4.65	7.27	0.007	
yr*qt*area	144	1565.65	10.87	17.02	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	18.21	3.64	5.70	<.0001	
nhfcl*bl	5	28.18	5.64	8.82	<.0001	

1963-2011 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	244	25298.88	103.68	167.96	<.0001	0.448
						CV =
yr	48	3837.41	79.95	129.51	<.0001	67.071
qt	3	142.74	47.58	77.08	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	34.88	6.98	11.30	<.0001	
bl	1	9.37	9.37	15.17	<.0001	
ml	1	4.65	4.65	7.54	0.006	
LT5LN5	32	1111.94	34.75	56.29	<.0001	
yr*qt*area	144	1513.61	10.51	17.03	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	20.86	4.17	6.76	<.0001	
nhfcl*bl	5	24.73	4.95	8.01	<.0001	

Table 4. ANOVA table of GLM for year based CPUE standardization for each area for 1963-2011.

1963-2010 MODEL2010
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	208	23446.68	112.72	154.11	<.0001	0.300
						CV =
yr	47	7404.50	157.54	215.38	<.0001	47.636
qt	3	408.50	136.17	186.15	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.60	27.52	37.62	<.0001	
bl	1	11.07	11.07	15.13	0.0001	
ml	1	0.35	0.35	0.48	0.4904	
yr*qt	141	3947.66	28.00	38.28	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	44.72	8.94	12.23	<.0001	
nhfcl*bl	5	51.76	10.35	14.15	<.0001	

1963-2010 MODEL2010 + LT5LN5
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	238	28176.15	118.39	177.10	<.0001	0.361
						CV =
yr	47	6281.23	133.64	199.92	<.0001	45.539
qt	3	218.61	72.87	109.01	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.49	27.50	41.13	<.0001	
bl	1	9.04	9.04	13.53	0.0002	
ml	1	0.11	0.11	0.16	0.6887	
LT5LN5	30	4729.47	157.65	235.83	<.0001	
yr*qt	141	3213.96	22.79	34.10	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	41.80	8.36	12.50	<.0001	
nhfcl*bl	5	26.43	5.29	7.91	<.0001	

1963-2011 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	22880.18	107.93	102.15	<.0001	0.285
						CV =
yr	48	5003.63	104.24	98.67	<.0001	72.064
qt	3	6843.13	2281.04	2159.03	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	357.55	71.51	67.68	<.0001	
bl	1	0.02	0.02	0.02	0.8863	
ml	1	8.81	8.81	8.34	0.0039	
yr*qt	144	5127.03	35.60	33.70	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	262.86	52.57	49.76	<.0001	
nhfcl*bl	5	22.25	4.45	4.21	0.0008	

1963-2011 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	247	36008.53	145.78	178.72	<.0001	0.448
						CV =
yr	48	2485.17	51.77	63.47	<.0001	63.321
qt	3	1910.85	636.95	780.85	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	157.68	31.54	38.66	<.0001	
bl	1	0.87	0.87	1.07	0.3015	
ml	1	1.85	1.85	2.27	0.132	
LT5LN5	35	13128.35	375.10	459.84	<.0001	
yr*qt	144	2481.48	17.23	21.13	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	122.15	24.43	29.95	<.0001	
nhfcl*bl	5	19.21	3.84	4.71	0.0003	

1963-2011 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	28929.42	136.46	87.47	<.0001	0.254
						CV =
yr	48	8544.35	178.01	114.10	<.0001	−124.193
qt	3	2029.08	676.36	433.53	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	811.37	162.27	104.01	<.0001	
bl	1	27.24	27.24	17.46	<.0001	
ml	1	60.62	60.62	38.86	<.0001	
yr*qt	144	9678.27	67.21	43.08	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	72.22	14.44	9.26	<.0001	
nhfcl*bl	5	196.37	39.27	25.17	<.0001	

1963-2011 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	278	61683.06	221.88	231.48	<.0001	0.542
						CV =
yr	48	2953.34	61.53	64.19	<.0001	−97.345
qt	3	463.77	154.59	161.28	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	55.24	11.05	11.53	<.0001	
bl	1	5.38	5.38	5.61	0.0179	
ml	1	4.08	4.08	4.25	0.0392	
LT5LN5	66	32753.64	496.27	517.74	<.0001	
yr*qt	144	2743.56	19.05	19.88	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	67.13	13.43	14.01	<.0001	
nhfcl*bl	5	169.20	33.84	35.31	<.0001	

1963-2011 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	212	24186.94	114.09	178.57	<.0001	0.428
						CV =
yr	48	3908.83	81.43	127.46	<.0001	68.234
qt	3	210.07	70.02	109.60	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	62.43	12.49	19.54	<.0001	
bl	1	16.09	16.09	25.19	<.0001	
ml	1	4.65	4.65	7.27	0.007	
yr*qt	144	1565.65	10.87	17.02	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	18.21	3.64	5.70	<.0001	
nhfcl*bl	5	28.18	5.64	8.82	<.0001	

1963-2011 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	244	25298.88	103.68	167.96	<.0001	0.448
						CV =
yr	48	3837.41	79.95	129.51	<.0001	67.071
qt	3	142.74	47.58	77.08	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	34.88	6.98	11.30	<.0001	
bl	1	9.37	9.37	15.17	<.0001	
ml	1	4.65	4.65	7.54	0.006	
LT5LN5	32	1111.94	34.75	56.29	<.0001	
yr*qt	144	1513.61	10.51	17.03	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	20.86	4.17	6.76	<.0001	
nhfcl*bl	5	24.73	4.95	8.01	<.0001	

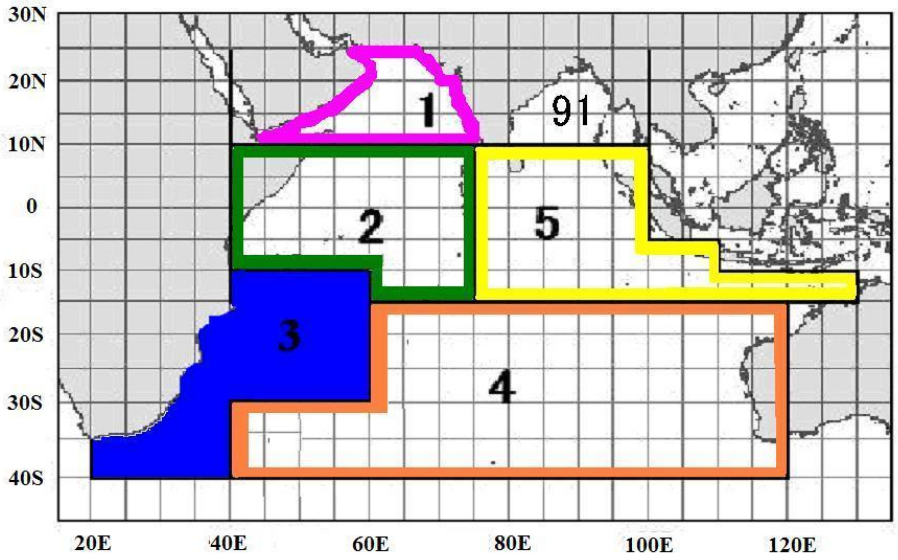


Fig. 1. Definition of sub-areas used in this study. Main fishing ground (areas 2, 3 and 5) and whole Indian Ocean (sub-areas 2-5) categories in this paper.

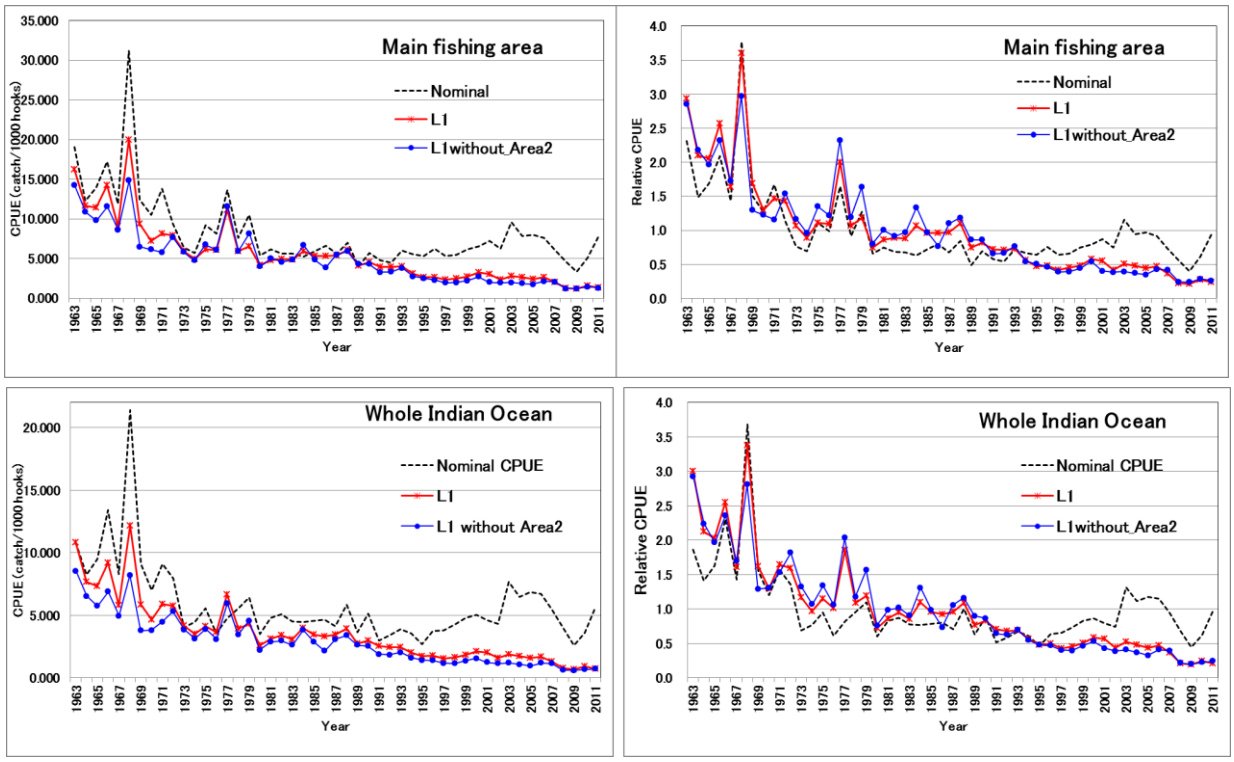


Fig. 2. Annual based CPUE in number from 1963 to 2011 standardized for main fishing ground (top) and whole (bottom) Indian Ocean expressed in real (left figure) and relative (right figure) scale overlaid with nominal CPUE.

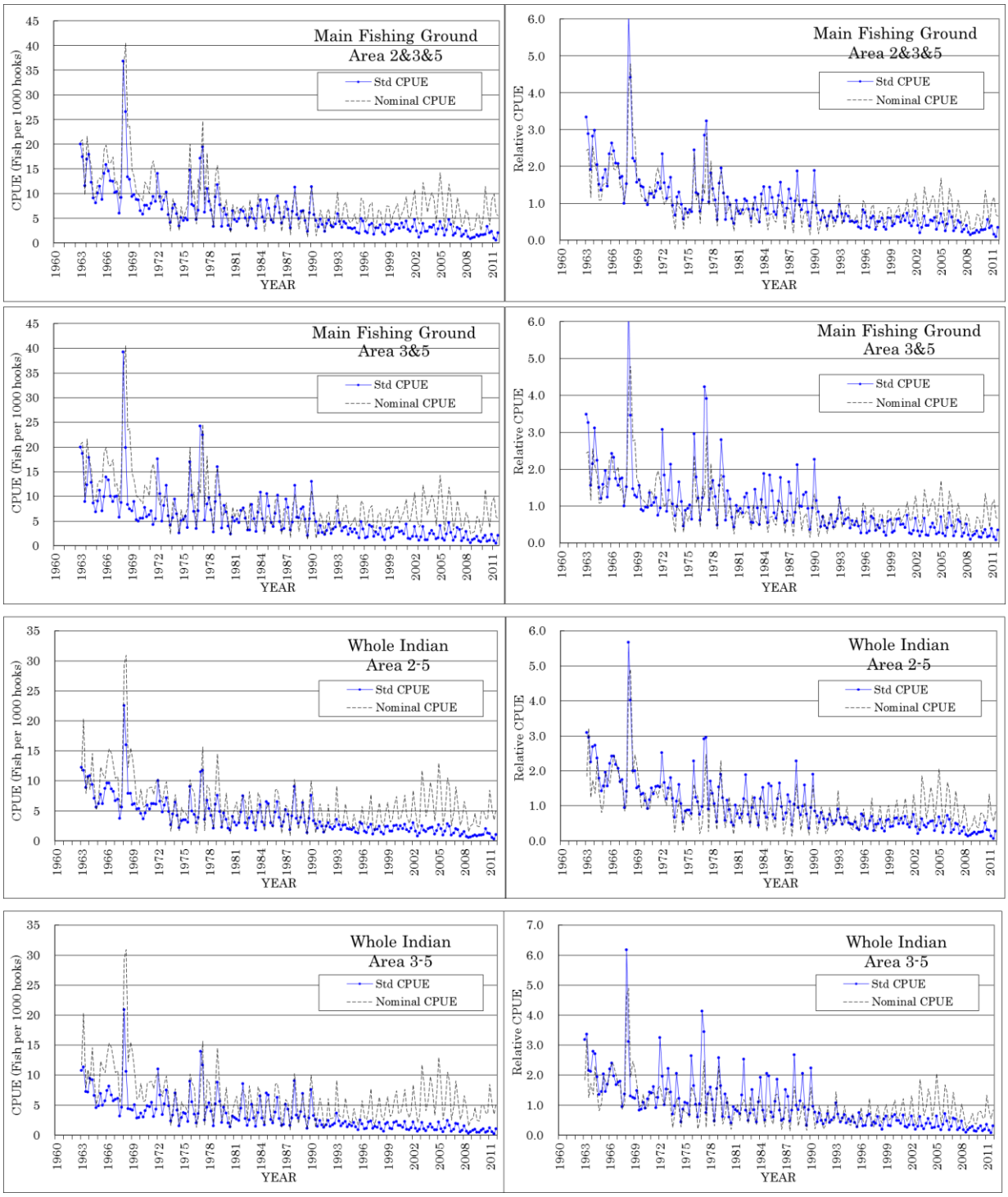
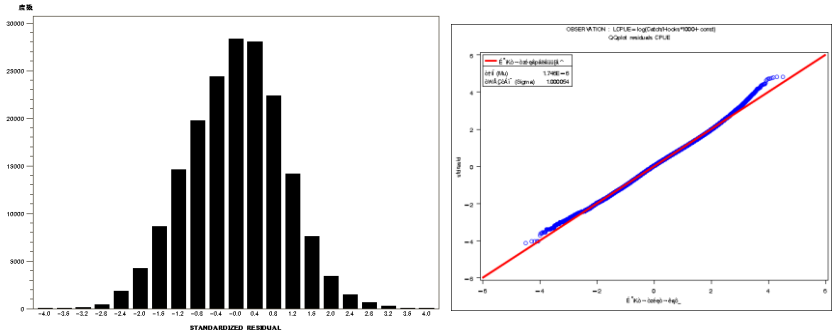
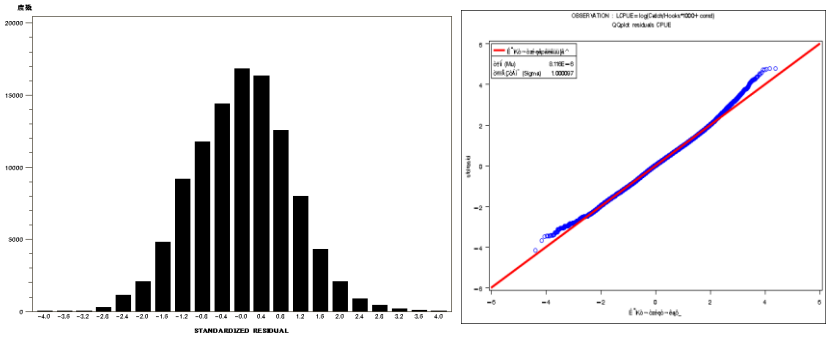


Fig. 3. Quarter based CPUE in number from 1963 to 2011 standardized for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2) expressed in relative (left figure) and real (right figure) scale overlaid with nominal CPUE.

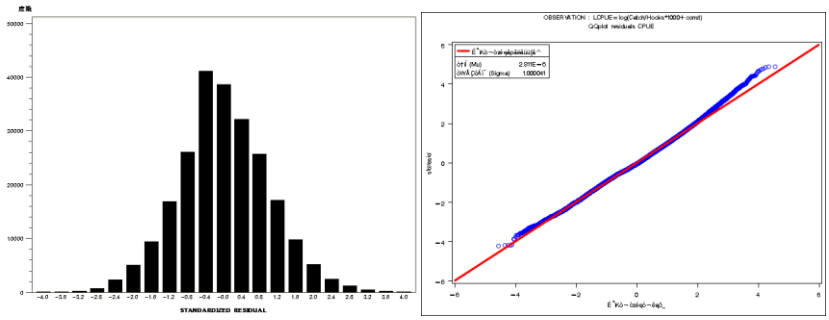
1963-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)



1963-2011 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)



1963-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)



1963-2011 Year base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

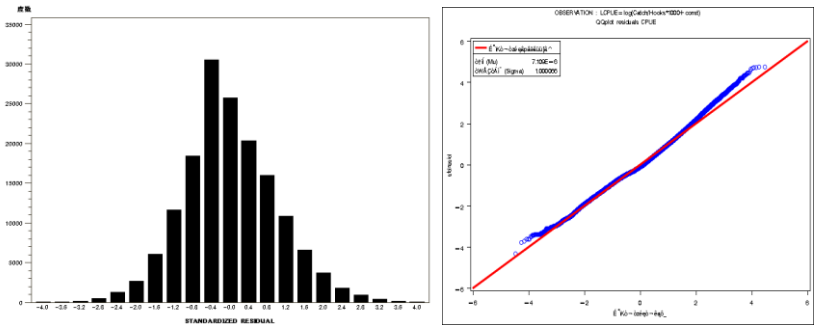
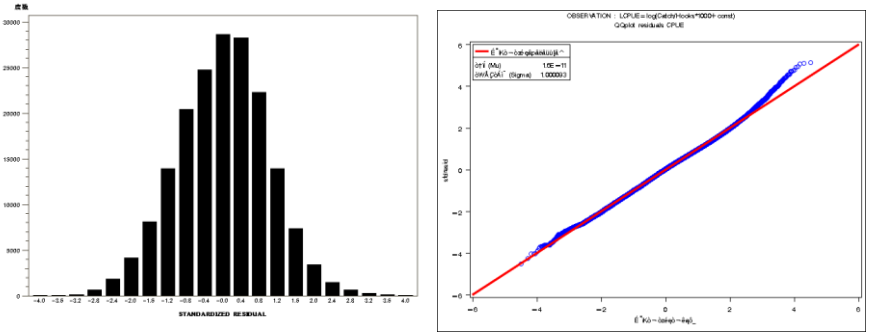
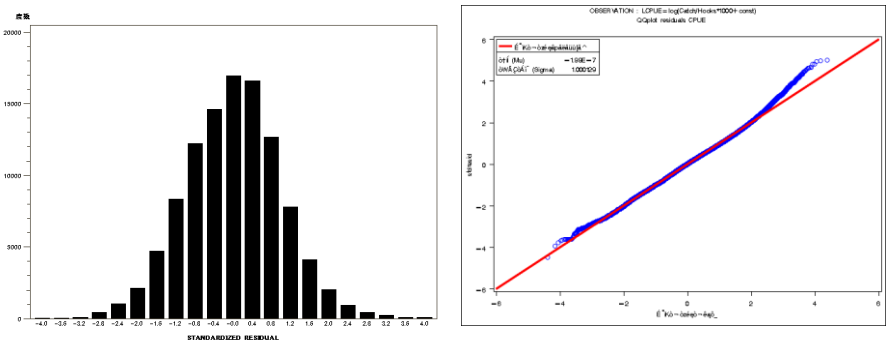


Fig. 4. Standardized residuals of annual based CPUE standardization for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2).

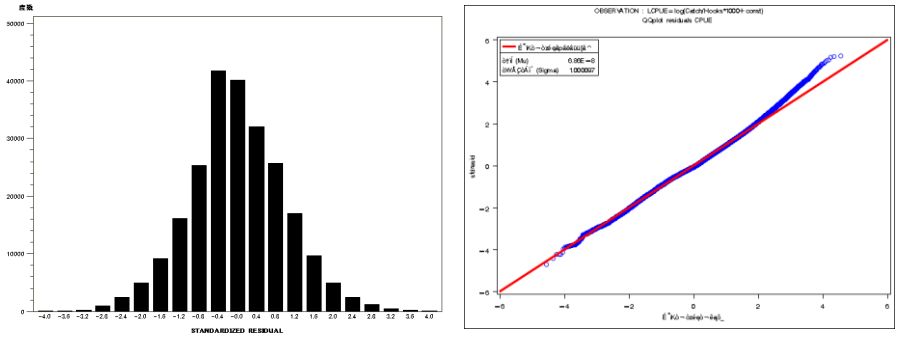
1963-2011 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)



1963-2011 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)



1963-2011 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)



1963-2011 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

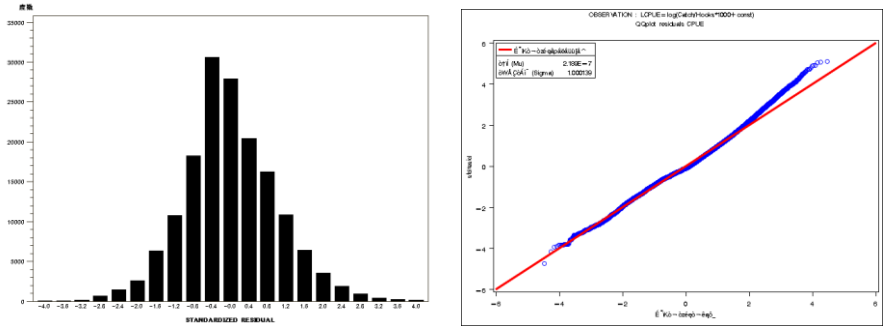


Fig. 5. Standardized residuals of quarter based CPUE standardization for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2).

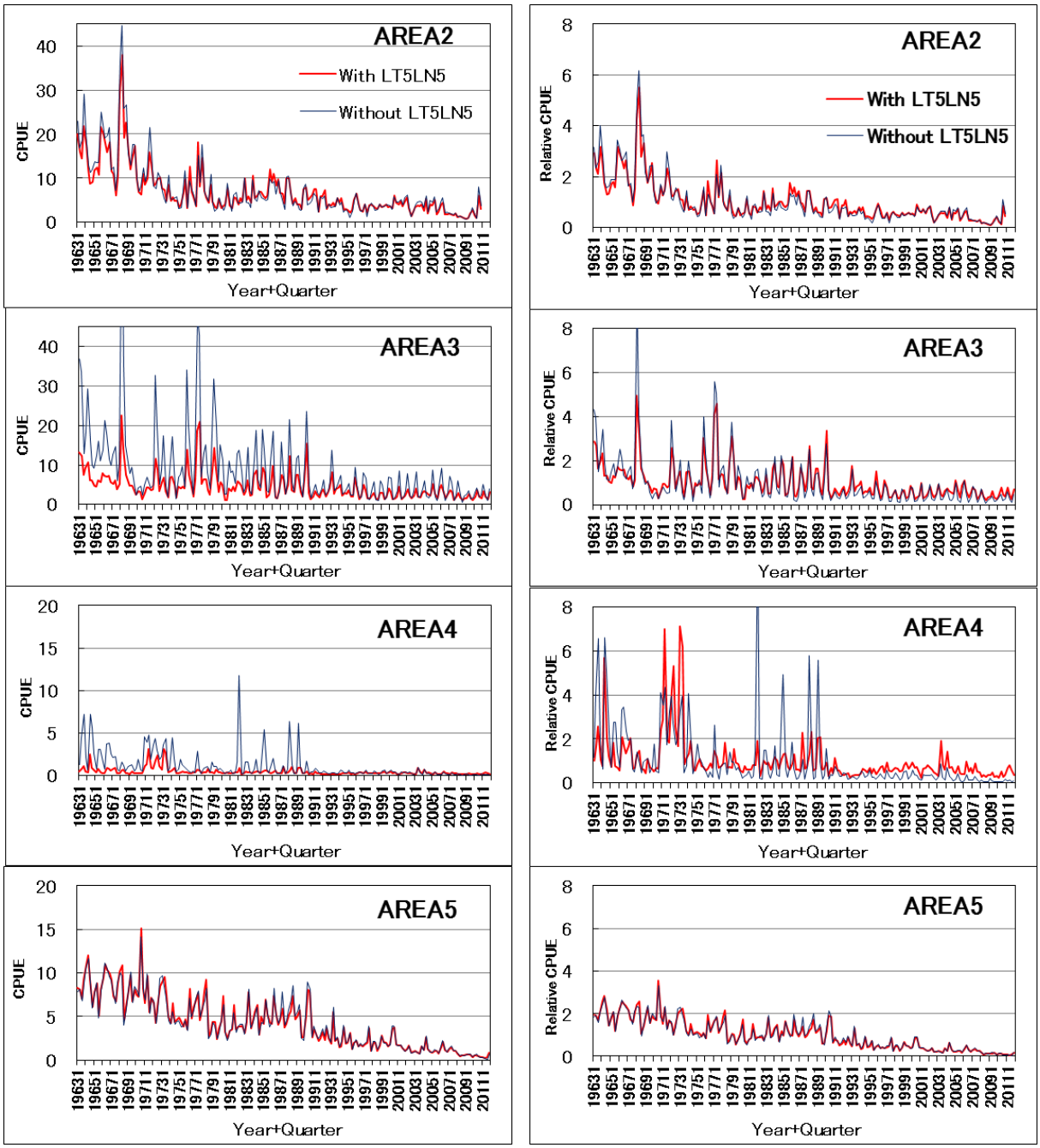


Fig. 6. Standardized quarter based CPUE in number from 1963 to 2011 (up to 2010 for Area 2) for each five areas (with and without LT5LN5） expressed in relative (left figure) and real (right figure) scale.

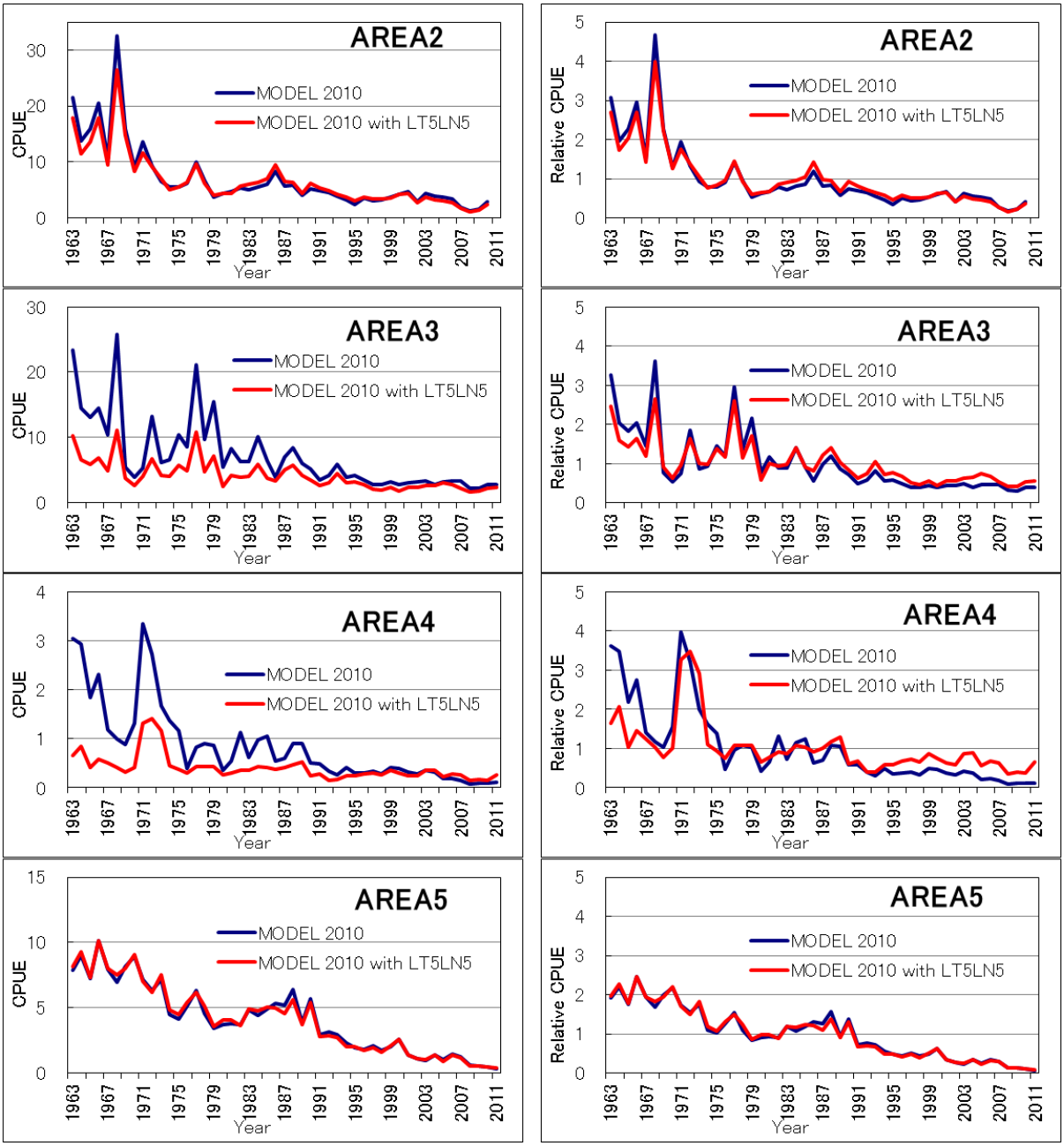


Fig. 7. Standardized quarter based CPUE in number from 1963 to 2011 (up to 2010 for Area 2) for each five areas with and without LT5LN5 expressed in relative (left figure) and real (right figure) scale.

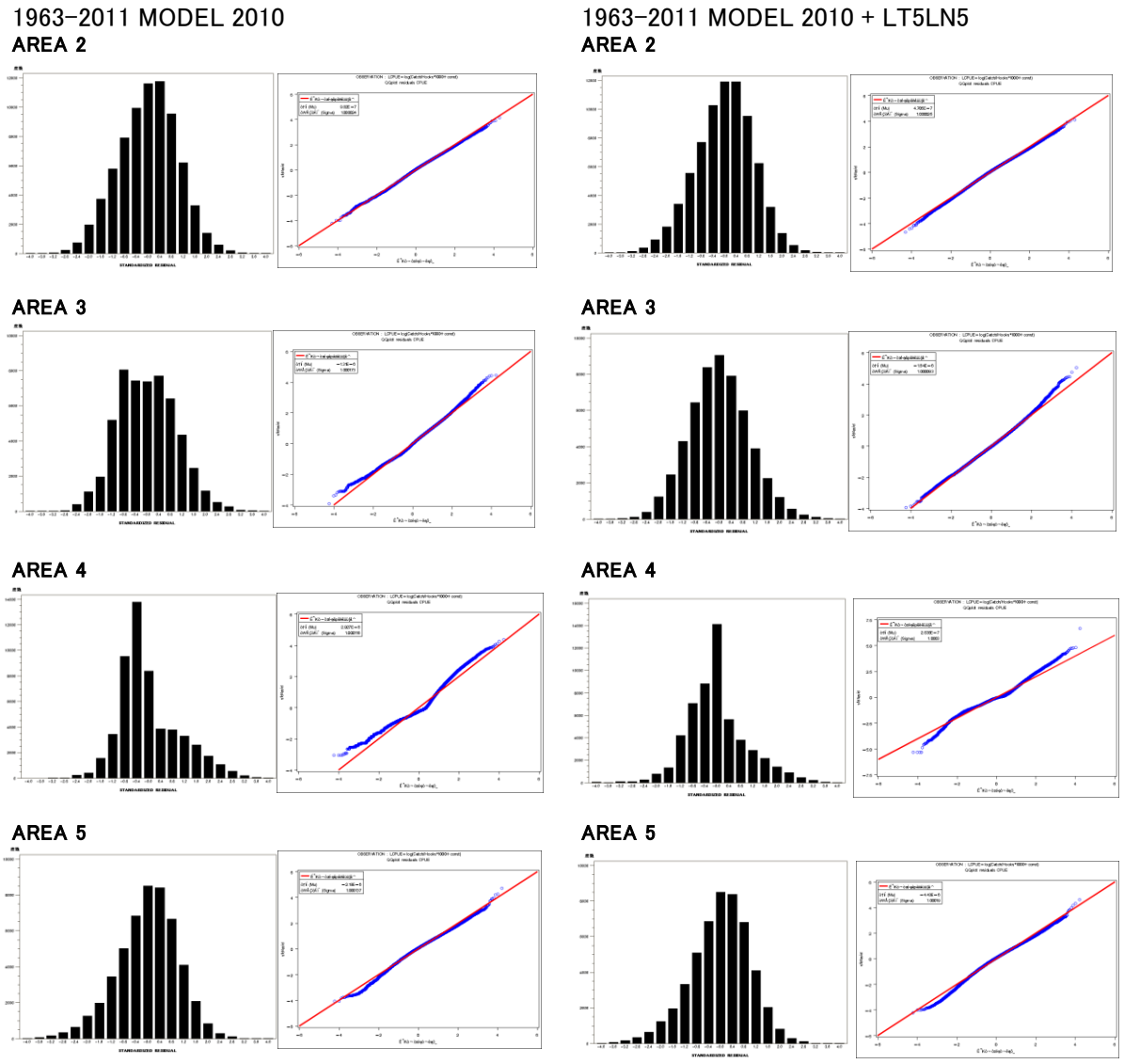


Fig. 8. Standardized residuals of quarter based CPUE standardization for each of five areas with and without LT5LN5 expressed as histograms and QQ plots.

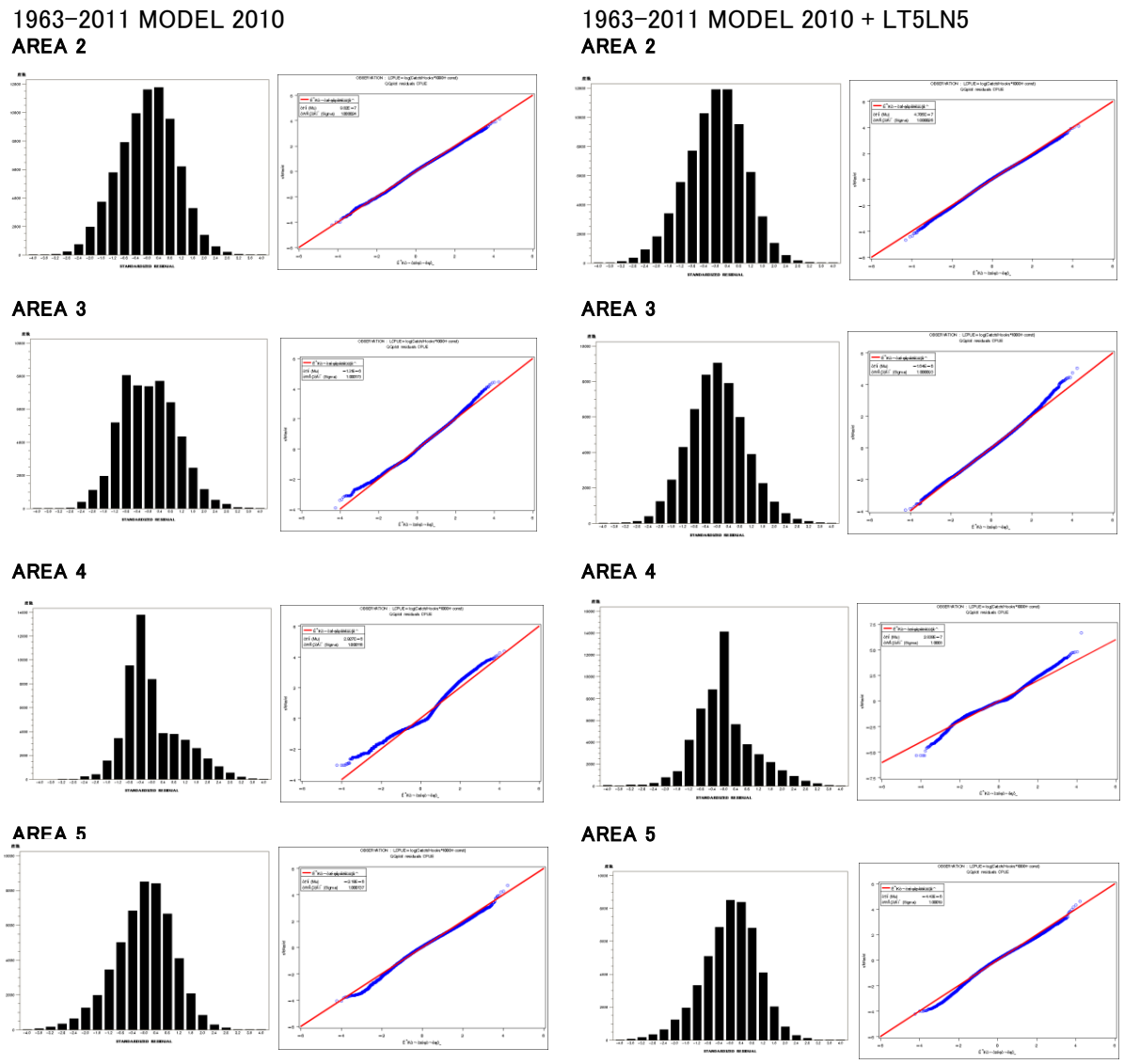


Fig. 9. Standardized residuals of annual based CPUE standardization for each of five areas with and without LT5LN5 expressed as histograms and QQ plots.

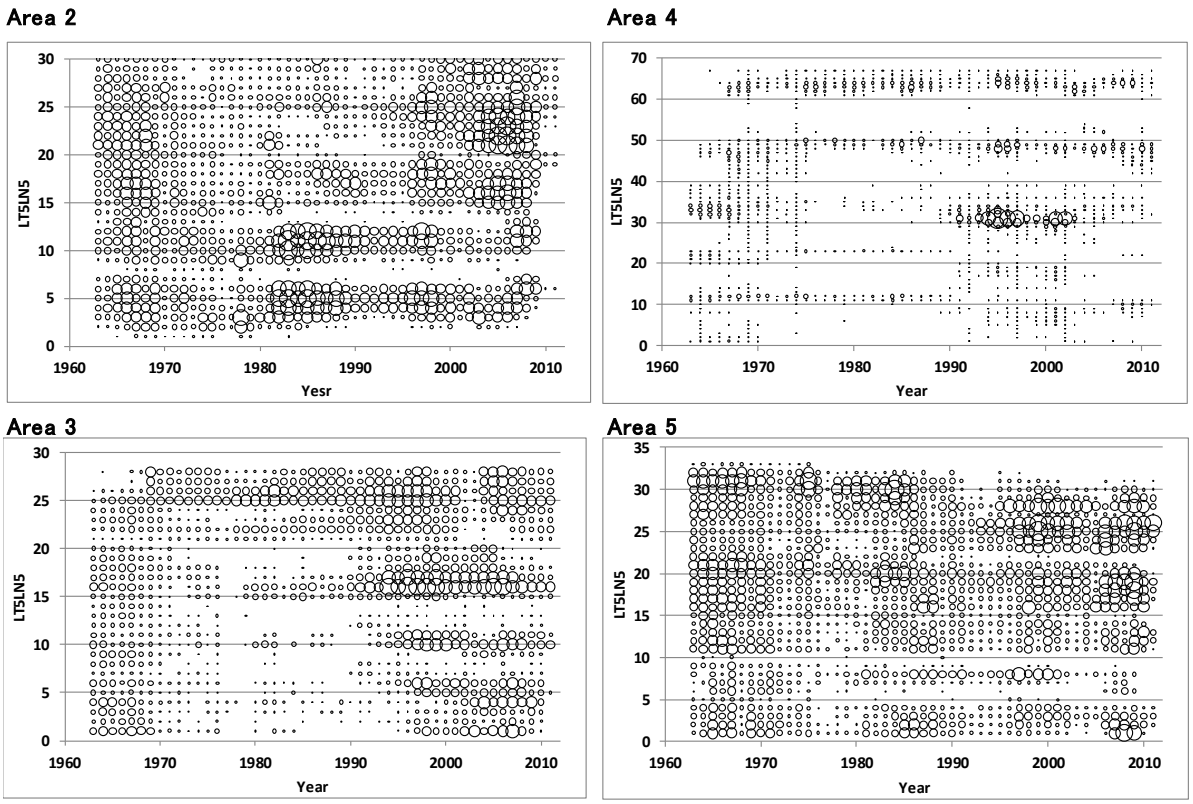


Fig. 10. Historical change in the number of observation of each LT5LN5 factor in each area.

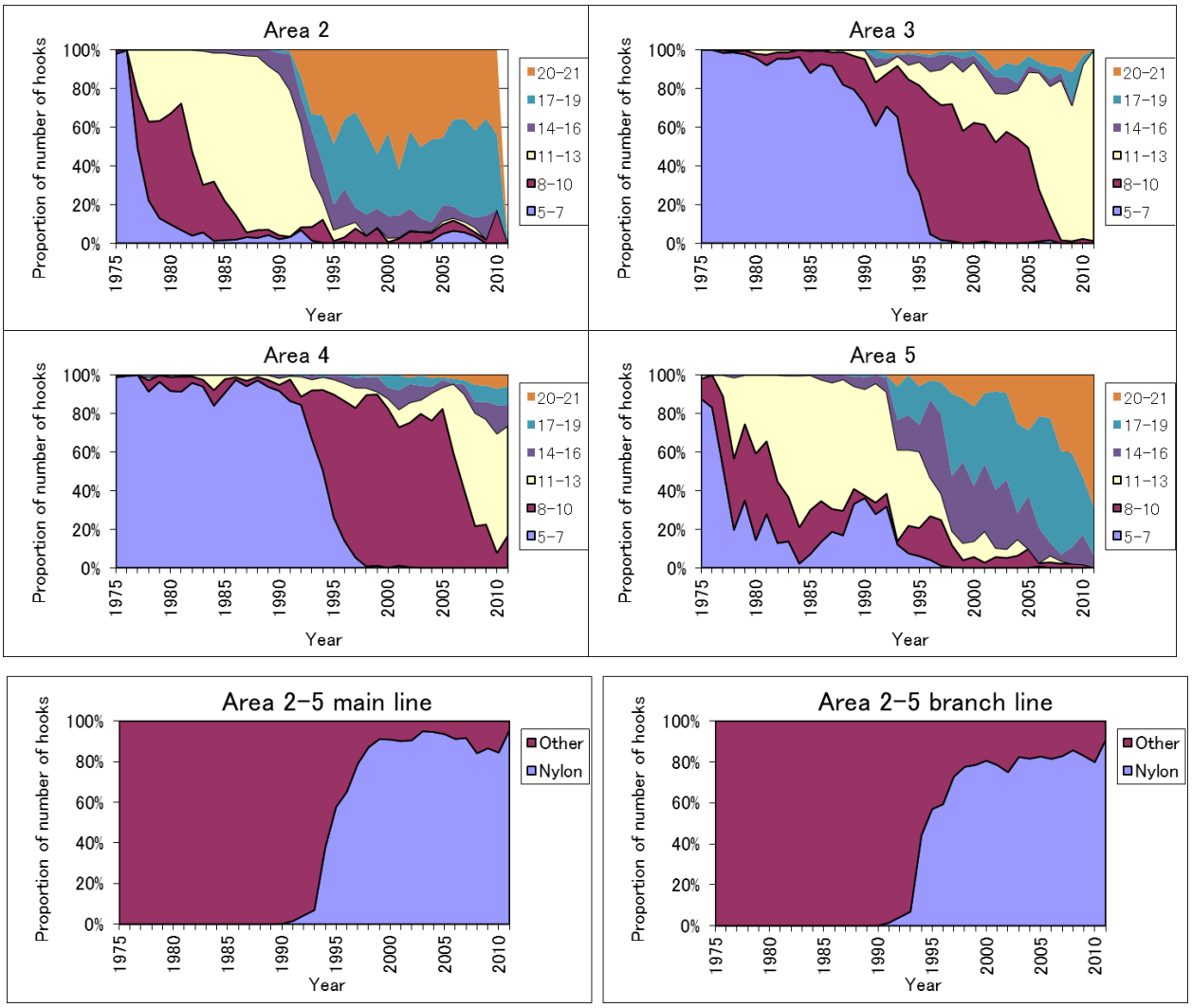
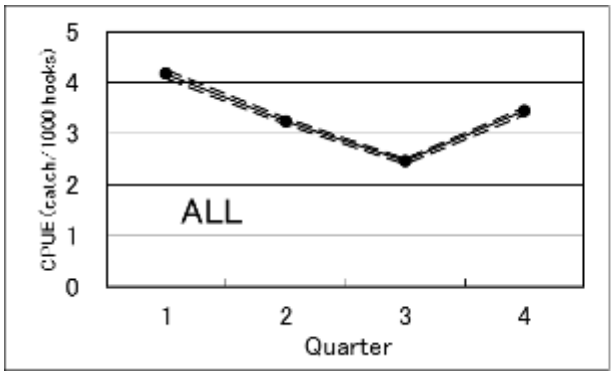
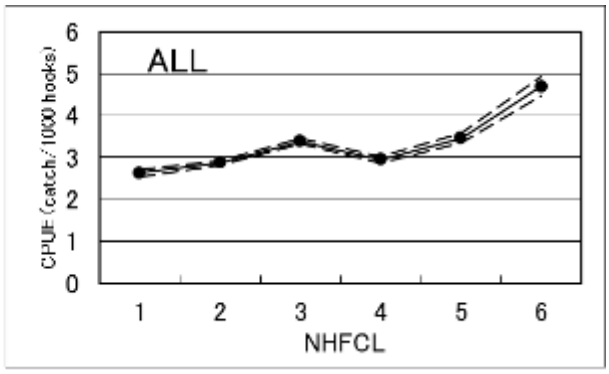


Fig. 11. Historical changes in the proportion of fishing effort by fishing gear (NHFCL and gear materials).

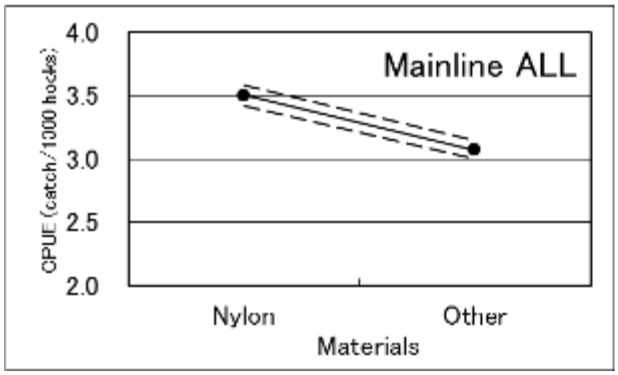
Quarter



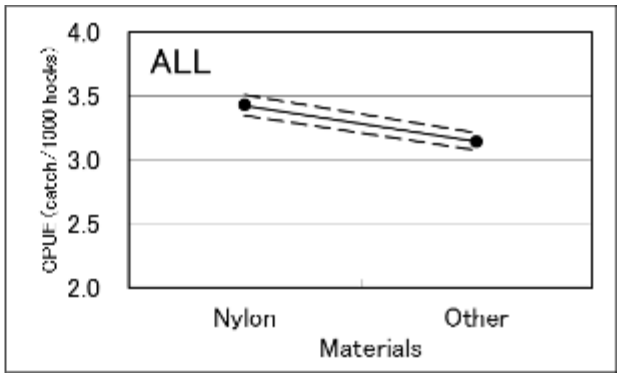
NHFCL



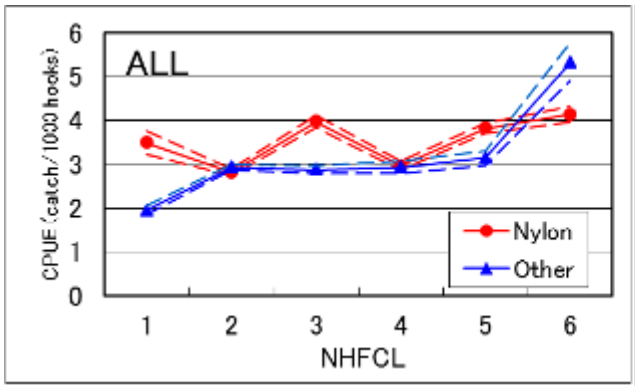
Mainline materials



Branch line materials



NHFCL*Mainline materials



NHFCL*Branchline materials

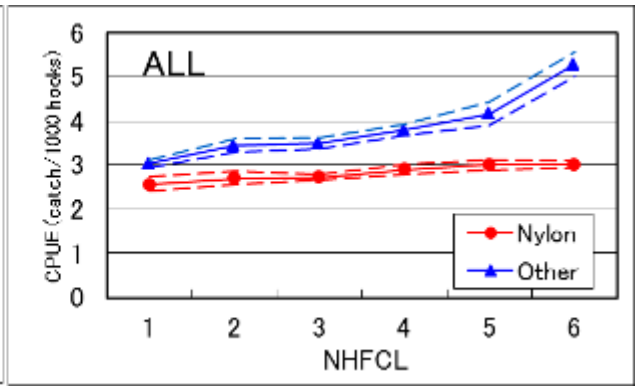


Fig. 12. Trends of CPUE standardized for each of quarter, NHFCL, gear (main-line and branch-line) materials and interaction of NHFCL and gear materials (whole area, 1963-2010).

Appendix table 1. Annual value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2011.

	Main fishing ground						Whole Indian Ocean					
	CPUE (real scale)			Relative CPUE			CPUE (real scale)			Relative CPUE		
Year	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)
1963	19.081	16.252	14.235	2.311	2.935	2.854	10.813	10.826	8.531	1.858	3.005	2.922
1964	12.284	11.624	10.874	1.488	2.099	2.180	8.222	7.660	6.531	1.413	2.126	2.237
1965	13.940	11.392	9.811	1.688	2.057	1.967	9.483	7.304	5.735	1.630	2.027	1.964
1966	17.257	14.233	11.569	2.090	2.570	2.320	13.400	9.185	6.888	2.303	2.550	2.359
1967	11.863	9.060	8.610	1.437	1.636	1.726	8.292	5.806	4.947	1.425	1.612	1.695
1968	31.186	19.974	14.830	3.777	3.607	2.973	21.392	12.157	8.196	3.676	3.375	2.807
1969	12.451	9.371	6.465	1.508	1.692	1.296	9.089	5.841	3.762	1.562	1.621	1.288
1970	10.523	7.184	6.116	1.274	1.297	1.226	6.996	4.668	3.806	1.202	1.296	1.304
1971	13.778	8.150	5.782	1.669	1.472	1.159	9.091	5.911	4.466	1.562	1.641	1.530
1972	9.392	7.944	7.689	1.137	1.435	1.542	7.923	5.751	5.309	1.362	1.596	1.818
1973	6.349	5.922	5.828	0.769	1.069	1.168	4.028	4.188	3.856	0.692	1.162	1.321
1974	5.712	4.920	4.770	0.692	0.889	0.956	4.477	3.491	3.116	0.769	0.969	1.067
1975	9.191	6.176	6.725	1.113	1.115	1.348	5.534	4.140	3.902	0.951	1.149	1.337
1976	8.134	6.042	6.080	0.985	1.091	1.219	3.555	3.652	3.090	0.611	1.014	1.059
1977	13.610	11.088	11.594	1.648	2.002	2.325	4.754	6.678	5.942	0.817	1.854	2.035
1978	7.590	5.920	5.933	0.919	1.069	1.190	5.548	3.927	3.434	0.953	1.090	1.176
1979	10.539	6.528	8.154	1.276	1.179	1.635	6.404	4.300	4.573	1.101	1.194	1.566
1980	5.422	4.130	4.010	0.657	0.746	0.804	3.514	2.596	2.225	0.604	0.721	0.762
1981	6.182	4.787	5.009	0.749	0.864	1.004	4.812	3.097	2.874	0.827	0.860	0.984
1982	5.630	4.913	4.566	0.682	0.887	0.916	5.088	3.418	2.969	0.874	0.949	1.017
1983	5.609	4.860	4.852	0.679	0.878	0.973	4.511	3.084	2.634	0.775	0.856	0.902
1984	5.238	5.912	6.668	0.634	1.068	1.337	4.443	3.958	3.819	0.763	1.099	1.308
1985	5.934	5.303	4.848	0.719	0.958	0.972	4.542	3.461	2.874	0.780	0.961	0.984
1986	6.578	5.320	3.835	0.797	0.961	0.769	4.658	3.321	2.143	0.801	0.922	0.734
1987	5.615	5.376	5.479	0.680	0.971	1.099	4.111	3.456	3.080	0.706	0.959	1.055
1988	6.966	6.088	5.907	0.844	1.099	1.184	5.835	3.917	3.381	1.003	1.087	1.158
1989	4.018	4.120	4.299	0.487	0.744	0.862	3.629	2.749	2.625	0.624	0.763	0.899
1990	5.709	4.523	4.281	0.691	0.817	0.858	5.108	2.991	2.525	0.878	0.830	0.865
1991	4.763	3.972	3.270	0.577	0.717	0.656	2.983	2.546	1.872	0.513	0.707	0.641
1992	4.504	3.953	3.316	0.545	0.714	0.665	3.412	2.446	1.830	0.586	0.679	0.627
1993	5.977	4.021	3.820	0.724	0.726	0.766	3.879	2.464	2.025	0.667	0.684	0.694
1994	5.527	3.083	2.723	0.669	0.557	0.546	3.544	2.031	1.591	0.609	0.564	0.545
1995	5.294	2.610	2.519	0.641	0.471	0.505	2.705	1.733	1.394	0.465	0.481	0.477
1996	6.243	2.639	2.286	0.756	0.477	0.458	3.722	1.783	1.370	0.640	0.495	0.469
1997	5.276	2.318	1.944	0.639	0.419	0.390	3.787	1.554	1.173	0.651	0.432	0.402
1998	5.454	2.515	1.970	0.660	0.454	0.395	4.247	1.641	1.148	0.730	0.455	0.393
1999	6.141	2.679	2.215	0.744	0.484	0.444	4.791	1.816	1.355	0.823	0.504	0.464
2000	6.550	3.222	2.709	0.793	0.582	0.543	5.027	2.107	1.543	0.864	0.585	0.528
2001	7.184	3.034	2.005	0.870	0.548	0.402	4.597	2.035	1.249	0.790	0.565	0.428
2002	6.200	2.321	1.918	0.751	0.419	0.385	4.310	1.566	1.132	0.741	0.435	0.388
2003	9.571	2.824	1.954	1.159	0.510	0.392	7.636	1.871	1.195	1.312	0.520	0.409
2004	7.812	2.666	1.861	0.946	0.481	0.373	6.464	1.724	1.075	1.111	0.479	0.368
2005	7.975	2.440	1.735	0.966	0.441	0.348	6.847	1.566	0.955	1.177	0.435	0.327
2006	7.573	2.630	2.131	0.917	0.475	0.427	6.696	1.704	1.190	1.151	0.473	0.407
2007	6.047	2.004	2.065	0.732	0.362	0.414	5.448	1.308	1.150	0.936	0.363	0.394
2008	4.655	1.238	1.213	0.564	0.223	0.243	3.969	0.760	0.626	0.682	0.211	0.214
2009	3.289	1.177	1.190	0.398	0.213	0.239	2.603	0.694	0.581	0.447	0.193	0.199
2010	5.068	1.543	1.422	0.614	0.279	0.285	3.590	0.892	0.663	0.617	0.248	0.227
2011	7.738	1.340	1.298	0.937	0.242	0.260	5.629	0.742	0.712	0.967	0.206	0.244

Appendix table 2. Annual value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1980-2011.

	Main fishing ground						Whole Indian Ocean					
	CPUE (real scale)			Relative CPUE			CPUE (real scale)			Relative CPUE		
Year	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)
1980	5.422	4.010	3.933	3.514	2.501	2.154	3.514	2.501	2.154	0.770	1.149	1.211
1981	6.182	4.744	5.032	4.812	3.037	2.847	4.812	3.037	2.847	1.054	1.395	1.600
1982	5.630	4.838	4.561	5.088	3.312	2.903	5.088	3.312	2.903	1.114	1.522	1.631
1983	5.609	4.747	4.824	4.511	2.989	2.585	4.511	2.989	2.585	0.988	1.373	1.453
1984	5.238	5.839	6.661	4.443	3.871	3.764	4.443	3.871	3.764	0.973	1.778	2.115
1985	5.934	5.292	4.908	4.542	3.429	2.888	4.542	3.429	2.888	0.995	1.575	1.623
1986	6.578	5.318	3.914	4.658	3.284	2.150	4.658	3.284	2.150	1.020	1.509	1.209
1987	5.615	5.402	5.746	4.111	3.437	3.173	4.111	3.437	3.173	0.900	1.579	1.783
1988	6.966	6.152	6.202	5.835	3.917	3.488	5.835	3.917	3.488	1.278	1.799	1.960
1989	4.018	4.080	4.372	3.629	2.692	2.621	3.629	2.692	2.621	0.795	1.237	1.473
1990	5.709	4.534	4.448	5.108	2.960	2.564	5.108	2.960	2.564	1.119	1.360	1.441
1991	4.763	3.996	3.407	2.983	2.561	1.931	2.983	2.561	1.931	0.653	1.176	1.085
1992	4.504	3.974	3.465	3.412	2.445	1.899	3.412	2.445	1.899	0.747	1.123	1.067
1993	5.977	4.026	3.919	3.879	2.460	2.078	3.879	2.460	2.078	0.849	1.130	1.168
1994	5.527	3.082	2.811	3.544	2.016	1.625	3.544	2.016	1.625	0.776	0.926	0.913
1995	5.294	2.594	2.556	2.705	1.712	1.407	2.705	1.712	1.407	0.592	0.786	0.791
1996	6.243	2.617	2.328	3.722	1.757	1.386	3.722	1.757	1.386	0.815	0.807	0.779
1997	5.276	2.272	1.975	3.787	1.521	1.184	3.787	1.521	1.184	0.829	0.699	0.665
1998	5.454	2.440	1.966	4.247	1.595	1.145	4.247	1.595	1.145	0.930	0.733	0.644
1999	6.141	2.625	2.189	4.791	1.771	1.329	4.791	1.771	1.329	1.049	0.814	0.747
2000	6.550	3.092	2.586	5.027	2.025	1.478	5.027	2.025	1.478	1.101	0.930	0.830
2001	7.184	2.921	1.915	4.597	1.962	1.205	4.597	1.962	1.205	1.007	0.901	0.677
2002	6.200	2.232	1.873	4.310	1.502	1.099	4.310	1.502	1.099	0.944	0.690	0.618
2003	9.571	2.742	1.942	7.636	1.818	1.187	7.636	1.818	1.187	1.672	0.835	0.667
2004	7.812	2.574	1.832	6.464	1.668	1.055	6.464	1.668	1.055	1.415	0.766	0.593
2005	7.975	2.374	1.709	6.847	1.522	0.944	6.847	1.522	0.944	1.499	0.699	0.530
2006	7.573	2.550	2.100	6.696	1.647	1.169	6.696	1.647	1.169	1.466	0.756	0.657
2007	6.047	1.939	2.023	5.448	1.265	1.127	5.448	1.265	1.127	1.193	0.581	0.633
2008	4.655	1.182	1.185	3.969	0.729	0.612	3.969	0.729	0.612	0.869	0.335	0.344
2009	3.289	1.118	1.157	2.603	0.669	0.575	2.603	0.669	0.575	0.570	0.307	0.323
2010	5.068	1.470	1.398	3.590	0.859	0.659	3.590	0.859	0.659	0.786	0.395	0.370
2011	7.738	1.349	1.321	5.629	0.729	0.708	5.629	0.729	0.708	1.233	0.335	0.398

Appendix table 3. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2011.

		Main			Whole		
Year	QT	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)
1963	1	20.56	20.05	20.00	11.66	12.25	10.77
1963	2	20.92	17.39	18.69	20.31	11.74	11.37
1963	3	9.79	11.54	8.92	7.89	8.91	7.28
1963	4	21.61	16.92	12.32	10.96	10.65	7.21
1964	1	17.98	17.90	17.87	8.57	10.81	9.43
1964	2	15.38	12.31	12.79	14.61	9.36	9.19
1964	3	9.14	9.11	8.61	8.86	7.11	6.58
1964	4	9.25	8.13	6.87	5.15	5.64	4.56
1965	1	12.66	10.12	9.08	6.82	6.19	4.90
1965	2	13.20	11.50	11.22	12.34	7.74	6.92
1965	3	12.75	8.75	7.09	11.29	6.19	4.92
1965	4	18.97	14.06	9.94	10.43	8.76	5.74
1966	1	19.84	15.83	13.92	13.23	9.59	7.45
1966	2	16.24	14.53	13.30	15.37	9.62	8.13
1966	3	16.17	12.59	10.03	14.64	8.64	6.67
1966	4	17.45	12.43	8.95	12.47	8.19	5.68
1967	1	12.03	10.15	9.95	10.44	6.71	5.95
1967	2	12.62	10.40	10.05	10.76	6.93	6.10
1967	3	8.97	5.98	5.74	5.40	3.77	3.20
1967	4	13.81	9.17	8.73	6.74	5.60	4.65
1968	1	34.88	36.88	39.25	29.37	22.50	20.93
1968	2	40.51	26.61	19.82	30.98	15.96	10.57
1968	3	23.44	13.35	8.37	12.21	7.92	4.43
1968	4	23.70	12.91	7.43	15.54	7.92	4.27
1969	1	14.73	9.42	7.07	13.70	5.99	4.14
1969	2	13.43	9.81	8.93	10.70	6.18	5.02
1969	3	10.06	8.79	5.24	6.00	5.28	2.82
1969	4	9.85	8.66	5.00	6.31	5.36	2.90
1970	1	9.19	6.47	5.55	8.68	4.54	3.68
1970	2	8.51	5.77	5.51	5.63	3.63	3.04
1970	3	12.33	7.62	7.79	5.76	4.65	4.08
1970	4	11.69	7.57	5.82	8.63	5.97	4.85
1971	1	10.09	6.91	6.27	8.91	5.32	4.75
1971	2	15.07	7.95	7.07	8.98	6.16	5.45
1971	3	16.60	9.36	4.30	7.78	6.21	3.10
1971	4	13.85	8.36	5.46	9.77	6.10	4.28
1972	1	10.37	14.07	17.58	10.33	9.99	10.98
1972	2	8.20	9.34	10.57	7.80	6.61	6.66
1972	3	9.34	6.75	4.92	6.40	4.77	3.43
1972	4	9.86	8.61	8.17	8.61	5.97	5.18
1973	1	10.03	10.23	12.22	9.88	7.13	7.53
1973	2	6.17	5.67	6.01	5.68	4.84	4.87
1973	3	2.39	4.10	4.20	1.59	2.64	2.36
1973	4	8.94	6.99	5.67	4.32	4.49	3.32
1974	1	7.54	7.80	9.45	7.72	6.40	6.99
1974	2	6.97	5.85	6.42	5.40	4.21	4.14
1974	3	2.55	3.39	2.58	1.72	2.16	1.50
1974	4	7.34	5.11	5.04	5.65	3.35	2.93
1975	1	4.98	4.49	5.35	4.70	3.51	3.72
1975	2	6.39	4.97	5.92	4.70	3.47	3.61
1975	3	7.71	4.62	3.66	3.75	3.10	2.29
1975	4	20.00	14.74	16.95	10.21	9.02	8.96
1976	1	9.20	7.76	10.22	8.74	4.92	5.56
1976	2	10.91	7.51	6.96	8.00	4.41	3.49
1976	3	3.77	4.68	3.50	1.28	2.97	2.04
1976	4	13.05	6.56	7.06	2.90	3.89	3.55
1977	1	10.55	17.11	24.25	9.25	11.54	13.98
1977	2	24.65	19.42	22.40	15.64	11.74	11.70
1977	3	7.91	6.20	5.16	1.67	3.61	2.52
1977	4	18.21	10.95	8.41	9.31	6.79	4.64
1978	1	9.15	8.38	9.71	8.72	5.36	5.40
1978	2	7.60	6.58	7.22	5.67	4.23	4.02
1978	3	3.20	3.31	2.76	1.99	2.13	1.57
1978	4	13.65	9.26	8.93	8.63	6.12	5.24
1979	1	15.74	11.78	16.02	14.51	7.54	8.76
1979	2	10.34	7.68	10.30	7.36	4.90	5.58
1979	3	6.07	3.36	3.54	2.32	2.30	2.11
1979	4	6.46	7.00	8.10	4.06	4.60	4.61
1980	1	8.75	5.75	6.83	7.98	3.57	3.64
1980	2	4.97	3.48	3.99	4.13	2.10	2.03
1980	3	2.05	2.71	2.43	1.24	1.74	1.37
1980	4	7.81	6.47	5.78	4.14	4.04	3.17

Appendix table 3. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2011.(continued)

		Main			Whole		
Year	QT	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4
1981	1	5.77	4.70	5.01	5.45	3.09	2.89
1981	2	7.31	4.29	5.32	6.53	2.59	2.70
1981	3	5.75	4.95	4.66	3.10	3.02	2.44
1981	4	6.70	6.72	7.10	6.51	4.77	4.51
1982	1	7.46	6.38	7.68	7.56	7.47	8.59
1982	2	6.75	5.03	5.54	6.51	3.01	2.79
1982	3	3.03	3.52	3.22	2.41	2.11	1.64
1982	4	8.70	5.13	3.14	8.20	3.78	2.47
1983	1	5.23	6.91	8.36	5.20	4.88	5.15
1983	2	4.55	4.95	5.46	4.03	3.04	2.84
1983	3	3.93	2.91	2.83	2.24	1.77	1.47
1983	4	9.92	7.48	6.72	8.10	4.75	3.73
1984	1	7.16	8.67	10.78	7.09	6.06	6.54
1984	2	5.89	5.18	5.50	4.43	3.15	2.83
1984	3	2.36	4.27	3.11	1.72	2.63	1.68
1984	4	5.91	8.65	10.50	5.48	6.51	6.98
1985	1	6.06	6.96	8.08	6.18	6.22	6.67
1985	2	4.48	4.65	4.68	3.28	2.97	2.61
1985	3	4.10	4.13	3.83	2.31	2.53	2.02
1985	4	9.56	7.30	6.51	8.45	4.77	3.84
1986	1	9.13	9.44	10.19	8.66	6.54	6.29
1986	2	7.04	6.06	4.86	6.76	3.89	2.79
1986	3	2.34	4.05	3.17	1.25	2.42	1.62
1986	4	7.53	5.19	3.43	3.45	3.13	1.79
1987	1	7.24	8.27	9.44	5.92	5.21	5.13
1987	2	5.73	6.78	7.72	5.48	4.42	4.34
1987	3	1.63	3.00	3.14	0.89	1.83	1.61
1987	4	7.98	6.39	4.78	5.47	4.13	2.80
1988	1	10.40	11.24	12.17	10.28	9.03	9.09
1988	2	7.60	5.74	5.77	6.83	3.77	3.35
1988	3	2.84	4.93	5.69	1.94	2.93	2.85
1988	4	5.79	6.44	7.46	4.14	3.92	3.86
1989	1	6.77	6.47	7.85	6.94	6.33	6.96
1989	2	3.79	4.55	5.39	3.70	3.06	3.12
1989	3	1.25	2.28	2.11	1.06	1.40	1.10
1989	4	8.95	6.14	5.45	6.04	3.76	2.88
1990	1	11.27	11.35	12.97	10.04	7.57	7.55
1990	2	6.20	5.65	6.54	5.91	3.37	3.27
1990	3	1.46	4.49	4.82	1.29	2.83	2.60
1990	4	4.15	3.22	2.57	3.52	2.08	1.49
1991	1	6.66	4.79	4.08	6.18	3.19	2.46
1991	2	5.24	3.70	2.68	4.47	2.47	1.66
1991	3	2.21	2.28	2.27	1.28	1.48	1.27
1991	4	6.09	3.90	3.07	2.10	2.43	1.68
1992	1	6.89	4.64	4.33	6.12	2.97	2.40
1992	2	3.02	3.55	2.45	2.76	2.29	1.43
1992	3	3.75	3.19	3.33	2.87	1.94	1.72
1992	4	6.94	3.83	3.77	3.12	2.33	1.96
1993	1	10.31	5.85	7.04	9.12	3.60	3.66
1993	2	3.62	4.31	4.67	3.26	2.65	2.38
1993	3	5.02	3.13	2.96	3.11	1.89	1.50
1993	4	7.73	4.28	3.66	2.96	2.62	1.92
1994	1	8.28	3.90	3.88	6.19	2.65	2.29
1994	2	4.69	3.03	2.28	3.72	2.02	1.38
1994	3	4.10	3.06	3.42	2.36	1.94	1.80
1994	4	4.55	2.84	2.74	2.01	1.87	1.55
1995	1	5.85	3.05	3.41	4.49	2.17	2.11
1995	2	3.93	2.16	2.58	2.86	1.41	1.40
1995	3	3.97	1.87	1.56	1.72	1.25	0.91
1995	4	9.13	4.91	4.85	2.86	3.05	2.55
1996	1	8.45	4.44	3.34	5.82	2.82	1.85
1996	2	4.17	2.34	1.55	2.96	1.61	1.02
1996	3	4.86	2.03	1.83	2.60	1.38	1.09
1996	4	7.56	3.62	4.16	4.10	2.27	2.19
1997	1	8.16	3.93	3.82	7.74	2.74	2.35
1997	2	2.97	1.70	1.91	2.50	1.15	1.09
1997	3	3.12	2.98	2.73	1.73	1.87	1.46
1997	4	6.55	3.00	2.29	4.40	1.93	1.29
1998	1	6.61	3.62	3.54	6.32	2.43	2.07
1998	2	3.74	2.11	1.74	3.32	1.44	1.07
1998	3	4.09	1.73	1.15	2.54	1.09	0.63
1998	4	7.49	3.67	3.35	4.83	2.33	1.82

Appendix table 3. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2011.(continued)

		Main			Whole		
Year	QT	Nominal	CPUE (Area 2,3 and 5)	CPUE without Area2 (Area 3 and 5)	Nominal	CPUE (Area 2,3 4 and 5)	CPUE without Area2 (Area 3, 4 and 5)
1999	1	7.37	3.61	3.62	6.46	2.45	2.14
1999	2	3.72	2.27	1.59	3.18	1.62	1.09
1999	3	5.80	2.59	1.86	3.43	1.65	1.03
1999	4	6.87	3.85	3.71	5.69	2.52	2.11
2000	1	7.95	3.73	3.72	7.43	2.62	2.29
2000	2	4.71	2.90	2.81	3.66	1.94	1.63
2000	3	6.01	3.97	2.93	3.67	2.55	1.64
2000	4	6.94	3.16	2.37	5.26	2.00	1.29
2001	1	9.43	4.41	4.32	7.69	2.75	2.26
2001	2	5.28	2.75	1.52	4.12	1.85	0.99
2001	3	5.11	2.30	1.42	2.89	1.55	0.90
2001	4	8.07	3.21	1.89	4.09	2.14	1.18
2002	1	10.79	4.69	3.85	8.36	3.00	2.15
2002	2	5.78	2.38	1.85	4.75	1.62	1.14
2002	3	3.80	1.17	1.07	2.10	0.81	0.66
2002	4	4.45	2.02	1.78	3.28	1.28	0.97
2003	1	12.27	3.88	3.83	11.74	2.50	2.11
2003	2	9.47	2.36	1.22	8.68	1.79	1.06
2003	3	6.23	2.34	1.14	4.07	1.54	0.73
2003	4	8.77	3.22	2.49	6.07	2.01	1.33
2004	1	10.20	3.14	3.03	9.75	2.19	1.89
2004	2	9.13	3.62	2.36	7.99	2.29	1.32
2004	3	4.08	1.72	1.40	3.30	1.15	0.84
2004	4	9.45	2.79	1.63	7.04	1.72	0.86
2005	1	14.29	4.26	4.04	12.97	2.68	2.16
2005	2	8.56	2.94	1.50	8.16	2.00	1.01
2005	3	2.89	1.48	1.08	2.58	0.93	0.59
2005	4	6.74	2.65	2.35	4.81	1.63	1.22
2006	1	11.93	4.67	4.67	10.56	2.88	2.43
2006	2	9.26	3.71	2.71	9.02	2.41	1.58
2006	3	3.15	1.48	1.10	2.51	0.95	0.62
2006	4	5.41	1.96	1.76	4.92	1.27	0.98
2007	1	9.17	3.14	3.63	9.02	1.99	1.94
2007	2	6.43	2.86	3.29	6.03	1.87	1.83
2007	3	3.27	1.30	1.03	2.56	0.84	0.57
2007	4	3.99	1.76	1.55	3.63	1.09	0.81
2008	1	6.70	2.41	2.91	6.56	1.54	1.57
2008	2	5.68	1.23	1.21	4.47	0.73	0.59
2008	3	2.36	0.85	0.59	1.55	0.52	0.30
2008	4	2.68	1.08	1.14	2.47	0.66	0.59
2009	1	2.85	1.17	1.36	2.87	0.82	0.81
2009	2	5.98	1.59	1.85	4.61	0.99	0.97
2009	3	5.56	1.29	0.94	2.51	0.77	0.46
2009	4	2.55	1.64	0.83	2.36	1.00	0.43
2010	1	5.32	1.62	1.54	5.00	0.97	0.78
2010	2	11.42	1.75	2.10	5.05	1.06	1.06
2010	3	7.34	3.32	0.90	3.72	2.02	0.46
2010	4	3.65	2.00	1.09	3.57	1.27	0.63
2011	1	8.68	2.27	2.26	8.46	1.23	1.21
2011	2	9.88	0.96	0.95	5.08	0.55	0.54
2011	3	5.87	0.50	0.48	3.51	0.28	0.26
2011	4	5.53	2.07	2.04	5.39	1.08	1.06

Appendix table 4. Annual value of yellowfin CPUE for 1963-2011 for each of five areas without LT5LN5 expressed in real and relative scale with standard error of log CPUE. Dev: square of CV (std_err).

	AREA2				AREA3				AREA4				AREA5			
yr	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1963	21.43	0.0022	0.05	3.08	23.37	0.0021	0.05	3.27	3.05	0.0048	0.07	3.61	7.85	0.0014	0.04	1.92
1964	13.75	0.0015	0.04	1.97	14.52	0.0017	0.04	2.03	2.93	0.0035	0.06	3.47	9.00	0.0013	0.04	2.19
1965	15.85	0.0013	0.04	2.27	13.14	0.0021	0.05	1.84	1.83	0.0033	0.06	2.17	7.23	0.0012	0.03	1.76
1966	20.60	0.0012	0.03	2.96	14.55	0.0023	0.05	2.03	2.31	0.0034	0.06	2.74	10.11	0.0013	0.04	2.47
1967	10.49	0.0012	0.04	1.50	10.43	0.0015	0.04	1.46	1.18	0.0018	0.04	1.40	7.93	0.0012	0.04	1.93
1968	32.62	0.0012	0.04	4.68	25.84	0.0023	0.05	3.61	0.99	0.0019	0.04	1.17	6.95	0.0014	0.04	1.70
1969	15.85	0.0013	0.04	2.27	5.43	0.0018	0.04	0.76	0.87	0.0022	0.05	1.04	8.15	0.0015	0.04	1.99
1970	8.95	0.0021	0.05	1.28	3.89	0.0027	0.05	0.54	1.31	0.0024	0.05	1.55	8.94	0.0013	0.04	2.18
1971	13.57	0.0015	0.04	1.95	5.30	0.0031	0.06	0.74	3.35	0.0022	0.05	3.97	7.15	0.0016	0.04	1.74
1972	9.28	0.0016	0.04	1.33	13.22	0.0044	0.07	1.85	2.72	0.0143	0.12	3.22	6.33	0.0027	0.05	1.54
1973	6.50	0.0020	0.04	0.93	6.20	0.0040	0.06	0.87	1.68	0.0071	0.08	1.99	7.20	0.0025	0.05	1.76
1974	5.47	0.0018	0.04	0.79	6.61	0.0030	0.05	0.92	1.36	0.0028	0.05	1.62	4.50	0.0017	0.04	1.10
1975	5.53	0.0017	0.04	0.79	10.43	0.0041	0.06	1.46	1.16	0.0026	0.05	1.37	4.17	0.0014	0.04	1.02
1976	6.29	0.0035	0.06	0.90	8.50	0.0048	0.07	1.19	0.39	0.0062	0.08	0.46	5.15	0.0024	0.05	1.26
1977	9.95	0.0032	0.06	1.43	21.11	0.0095	0.10	2.95	0.82	0.0069	0.08	0.97	6.35	0.0072	0.08	1.55
1978	6.70	0.0015	0.04	0.96	9.76	0.0041	0.06	1.36	0.90	0.0042	0.06	1.07	4.55	0.0025	0.05	1.11
1979	3.71	0.0021	0.05	0.53	15.49	0.0035	0.06	2.17	0.86	0.0052	0.07	1.02	3.41	0.0019	0.04	0.83
1980	4.40	0.0018	0.04	0.63	5.46	0.0033	0.06	0.76	0.36	0.0056	0.07	0.42	3.72	0.0016	0.04	0.91
1981	4.69	0.0011	0.03	0.67	8.29	0.0026	0.05	1.16	0.55	0.0039	0.06	0.65	3.81	0.0018	0.04	0.93
1982	5.45	0.0008	0.03	0.78	6.35	0.0025	0.05	0.89	1.11	0.0073	0.09	1.32	3.71	0.0015	0.04	0.90
1983	5.05	0.0009	0.03	0.72	6.35	0.0039	0.06	0.89	0.61	0.0043	0.07	0.73	4.85	0.0014	0.04	1.18
1984	5.61	0.0010	0.03	0.81	10.05	0.0037	0.06	1.41	0.97	0.0027	0.05	1.15	4.44	0.0011	0.03	1.08
1985	6.07	0.0008	0.03	0.87	6.44	0.0029	0.05	0.90	1.05	0.0030	0.05	1.25	4.89	0.0012	0.03	1.19
1986	8.35	0.0008	0.03	1.20	3.95	0.0037	0.06	0.55	0.53	0.0033	0.06	0.63	5.32	0.0014	0.04	1.30
1987	5.76	0.0010	0.03	0.83	7.04	0.0030	0.06	0.99	0.59	0.0038	0.06	0.70	5.18	0.0052	0.07	1.26
1988	5.84	0.0010	0.03	0.84	8.44	0.0029	0.05	1.18	0.90	0.0045	0.07	1.06	6.41	0.0046	0.07	1.56
1989	4.08	0.0023	0.05	0.59	6.10	0.0028	0.05	0.85	0.89	0.0062	0.08	1.06	3.83	0.0022	0.05	0.93
1990	5.28	0.0017	0.04	0.76	5.11	0.0033	0.06	0.72	0.50	0.0060	0.08	0.59	5.69	0.0025	0.05	1.39
1991	4.82	0.0021	0.05	0.69	3.54	0.0023	0.05	0.50	0.48	0.0032	0.06	0.57	2.95	0.0033	0.06	0.72
1992	4.49	0.0025	0.05	0.64	4.14	0.0029	0.05	0.58	0.33	0.0032	0.06	0.39	3.18	0.0089	0.09	0.78
1993	3.87	0.0011	0.03	0.56	5.82	0.0028	0.05	0.81	0.25	0.0042	0.06	0.30	2.94	0.0034	0.06	0.72
1994	3.31	0.0010	0.03	0.48	3.96	0.0011	0.03	0.55	0.41	0.0016	0.04	0.49	2.29	0.0155	0.12	0.56
1995	2.48	0.0015	0.04	0.36	4.19	0.0014	0.04	0.59	0.30	0.0011	0.03	0.36	1.98	0.0021	0.05	0.48
1996	3.55	0.0006	0.03	0.51	3.47	0.0008	0.03	0.48	0.30	0.0011	0.03	0.36	1.80	0.0031	0.06	0.44
1997	3.00	0.0004	0.02	0.43	2.79	0.0008	0.03	0.39	0.34	0.0018	0.04	0.40	2.06	0.0024	0.05	0.50
1998	3.30	0.0004	0.02	0.47	2.77	0.0007	0.03	0.39	0.28	0.0024	0.05	0.33	1.77	0.0012	0.03	0.43
1999	3.72	0.0008	0.03	0.53	3.20	0.0008	0.03	0.45	0.40	0.0021	0.05	0.48	2.03	0.0009	0.03	0.50
2000	4.18	0.0006	0.02	0.60	2.78	0.0010	0.03	0.39	0.38	0.0019	0.04	0.45	2.62	0.0008	0.03	0.64
2001	4.76	0.0008	0.03	0.68	3.08	0.0011	0.03	0.43	0.31	0.0014	0.04	0.37	1.37	0.0009	0.03	0.34
2002	2.92	0.0005	0.02	0.42	3.20	0.0012	0.03	0.45	0.27	0.0016	0.04	0.32	1.11	0.0011	0.03	0.27
2003	4.40	0.0005	0.02	0.63	3.40	0.0013	0.04	0.48	0.34	0.0032	0.06	0.41	0.98	0.0021	0.05	0.24
2004	3.91	0.0005	0.02	0.56	2.85	0.0010	0.03	0.40	0.31	0.0036	0.06	0.37	1.39	0.0015	0.04	0.34
2005	3.74	0.0003	0.02	0.54	3.23	0.0009	0.03	0.45	0.18	0.0028	0.05	0.21	1.02	0.0020	0.04	0.25
2006	3.40	0.0003	0.02	0.49	3.34	0.0007	0.03	0.47	0.18	0.0031	0.06	0.22	1.43	0.0008	0.03	0.35
2007	1.94	0.0003	0.02	0.28	3.31	0.0009	0.03	0.46	0.15	0.0036	0.06	0.18	1.26	0.0008	0.03	0.31
2008	1.19	0.0004	0.02	0.17	2.26	0.0010	0.03	0.32	0.07	0.0025	0.05	0.08	0.59	0.0008	0.03	0.14
2009	1.53	0.0013	0.04	0.22	2.17	0.0012	0.03	0.30	0.10	0.0038	0.06	0.11	0.57	0.0007	0.03	0.14
2010	2.87	0.0091	0.10	0.41	2.73	0.0014	0.04	0.38	0.09	0.0043	0.07	0.10	0.46	0.0017	0.04	0.11
2011					2.74	0.0021	0.05	0.38	0.10	0.0066	0.08	0.12	0.30	0.0131	0.11	0.07

Appendix table 5. Annual value of yellowfin CPUE for 1963-2011 for each of five areas with LT5LN5 expressed in real and relative scale with standard error of log CPUE. Dev: square of CV (std_err).

	AREA2				AREA3				AREA4				AREA5			
yr	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1963	17.84	0.0022	0.05	2.69	10.29	0.0037	0.06	2.47	0.66	0.0032	0.06	1.63	8.14	0.0014	0.04	1.98
1964	11.48	0.0016	0.04	1.73	6.61	0.0033	0.06	1.58	0.83	0.0023	0.05	2.07	9.32	0.0013	0.04	2.27
1965	13.60	0.0015	0.04	2.05	5.91	0.0037	0.06	1.42	0.41	0.0023	0.05	1.03	7.29	0.0012	0.04	1.77
1966	17.96	0.0014	0.04	2.71	6.83	0.0039	0.06	1.64	0.58	0.0023	0.05	1.44	10.16	0.0013	0.04	2.47
1967	9.46	0.0014	0.04	1.43	4.96	0.0032	0.06	1.19	0.50	0.0012	0.04	1.24	7.99	0.0012	0.04	1.94
1968	26.39	0.0014	0.04	3.98	11.06	0.0039	0.06	2.65	0.42	0.0013	0.04	1.03	7.50	0.0014	0.04	1.82
1969	14.79	0.0015	0.04	2.23	3.76	0.0034	0.06	0.90	0.31	0.0015	0.04	0.77	8.04	0.0015	0.04	1.96
1970	8.31	0.0022	0.05	1.25	2.58	0.0041	0.06	0.62	0.40	0.0017	0.04	1.00	9.06	0.0014	0.04	2.20
1971	11.71	0.0017	0.04	1.77	4.01	0.0044	0.07	0.96	1.31	0.0015	0.04	3.26	7.03	0.0016	0.04	1.71
1972	9.22	0.0018	0.04	1.39	6.79	0.0055	0.07	1.63	1.40	0.0089	0.09	3.48	6.19	0.0026	0.05	1.51
1973	6.95	0.0021	0.05	1.05	4.16	0.0052	0.07	1.00	1.17	0.0045	0.07	2.91	7.50	0.0025	0.05	1.82
1974	5.04	0.0019	0.04	0.76	4.08	0.0044	0.07	0.98	0.44	0.0019	0.04	1.10	4.86	0.0017	0.04	1.18
1975	5.60	0.0018	0.04	0.84	5.74	0.0053	0.07	1.38	0.37	0.0018	0.04	0.93	4.46	0.0014	0.04	1.08
1976	6.42	0.0034	0.06	0.97	4.88	0.0057	0.08	1.17	0.30	0.0040	0.06	0.75	5.39	0.0024	0.05	1.31
1977	9.60	0.0032	0.06	1.45	10.89	0.0094	0.10	2.61	0.44	0.0044	0.07	1.08	6.17	0.0070	0.08	1.50
1978	6.27	0.0017	0.04	0.94	4.79	0.0052	0.07	1.15	0.43	0.0028	0.05	1.07	5.11	0.0025	0.05	1.24
1979	3.99	0.0022	0.05	0.60	7.09	0.0048	0.07	1.70	0.43	0.0033	0.06	1.06	3.59	0.0019	0.04	0.87
1980	4.40	0.0019	0.04	0.66	2.44	0.0046	0.07	0.58	0.26	0.0036	0.06	0.65	4.06	0.0016	0.04	0.99
1981	4.46	0.0013	0.04	0.67	4.17	0.0041	0.06	1.00	0.31	0.0025	0.05	0.76	4.06	0.0018	0.04	0.99
1982	5.66	0.0010	0.03	0.85	3.89	0.0040	0.06	0.93	0.36	0.0047	0.07	0.90	3.65	0.0015	0.04	0.89
1983	6.11	0.0011	0.03	0.92	4.11	0.0051	0.07	0.99	0.35	0.0028	0.05	0.87	4.89	0.0014	0.04	1.19
1984	6.31	0.0012	0.03	0.95	5.88	0.0049	0.07	1.41	0.43	0.0018	0.04	1.06	4.78	0.0011	0.03	1.16
1985	7.00	0.0010	0.03	1.06	3.78	0.0043	0.07	0.91	0.42	0.0020	0.04	1.04	5.06	0.0012	0.04	1.23
1986	9.53	0.0010	0.03	1.44	3.36	0.0049	0.07	0.81	0.36	0.0021	0.05	0.91	5.02	0.0014	0.04	1.22
1987	6.54	0.0012	0.03	0.99	5.10	0.0044	0.07	1.22	0.40	0.0025	0.05	1.00	4.54	0.0051	0.07	1.11
1988	6.31	0.0012	0.03	0.95	5.81	0.0043	0.07	1.39	0.47	0.0029	0.05	1.18	5.64	0.0046	0.07	1.37
1989	4.40	0.0023	0.05	0.66	4.25	0.0042	0.07	1.02	0.52	0.0040	0.06	1.29	3.73	0.0021	0.05	0.91
1990	6.17	0.0018	0.04	0.93	3.54	0.0046	0.07	0.85	0.25	0.0038	0.06	0.61	5.43	0.0025	0.05	1.32
1991	5.46	0.0022	0.05	0.82	2.62	0.0038	0.06	0.63	0.27	0.0021	0.05	0.67	2.77	0.0032	0.06	0.67
1992	4.86	0.0026	0.05	0.73	3.09	0.0043	0.07	0.74	0.15	0.0021	0.05	0.38	2.89	0.0087	0.09	0.70
1993	4.29	0.0013	0.04	0.65	4.40	0.0042	0.06	1.06	0.16	0.0027	0.05	0.39	2.76	0.0034	0.06	0.67
1994	3.78	0.0012	0.03	0.57	3.06	0.0029	0.05	0.73	0.24	0.0011	0.03	0.58	2.04	0.0151	0.12	0.50
1995	3.06	0.0016	0.04	0.46	3.24	0.0031	0.06	0.78	0.23	0.0008	0.03	0.58	2.00	0.0021	0.05	0.49
1996	3.78	0.0009	0.03	0.57	2.79	0.0027	0.05	0.67	0.27	0.0008	0.03	0.68	1.76	0.0031	0.06	0.43
1997	3.42	0.0007	0.03	0.52	2.10	0.0026	0.05	0.50	0.29	0.0013	0.04	0.71	1.96	0.0024	0.05	0.48
1998	3.43	0.0006	0.03	0.52	1.98	0.0026	0.05	0.47	0.26	0.0016	0.04	0.66	1.63	0.0012	0.03	0.40
1999	3.59	0.0010	0.03	0.54	2.33	0.0027	0.05	0.56	0.35	0.0014	0.04	0.87	2.08	0.0009	0.03	0.51
2000	4.22	0.0008	0.03	0.64	1.86	0.0028	0.05	0.45	0.30	0.0013	0.04	0.75	2.57	0.0008	0.03	0.62
2001	4.36	0.0010	0.03	0.66	2.30	0.0029	0.05	0.55	0.25	0.0010	0.03	0.62	1.40	0.0010	0.03	0.34
2002	2.81	0.0008	0.03	0.42	2.37	0.0030	0.05	0.57	0.24	0.0011	0.03	0.59	1.12	0.0012	0.03	0.27
2003	3.73	0.0008	0.03	0.56	2.58	0.0031	0.06	0.62	0.35	0.0021	0.05	0.87	1.01	0.0021	0.05	0.25
2004	3.31	0.0007	0.03	0.50	2.69	0.0028	0.05	0.64	0.36	0.0023	0.05	0.89	1.38	0.0015	0.04	0.34
2005	3.05	0.0006	0.02	0.46	3.10	0.0027	0.05	0.74	0.22	0.0018	0.04	0.55	0.92	0.0020	0.04	0.22
2006	2.82	0.0006	0.02	0.42	2.82	0.0026	0.05	0.68	0.27	0.0020	0.05	0.68	1.36	0.0008	0.03	0.33
2007	1.79	0.0006	0.02	0.27	2.26	0.0027	0.05	0.54	0.25	0.0024	0.05	0.63	1.20	0.0009	0.03	0.29
2008	1.10	0.0006	0.02	0.17	1.70	0.0028	0.05	0.41	0.14	0.0017	0.04	0.35	0.55	0.0009	0.03	0.13
2009	1.51	0.0015	0.04	0.23	1.72	0.0030	0.05	0.41	0.16	0.0025	0.05	0.39	0.54	0.0008	0.03	0.13
2010	2.41	0.0086	0.09	0.36	2.20	0.0032	0.06	0.53	0.15	0.0028	0.05	0.38	0.46	0.0017	0.04	0.11
2011					2.34	0.0037	0.06	0.56	0.26	0.0043	0.07	0.66	0.38	0.0128	0.11	0.09

Appendix table 6. Quarterly value of yellowfin CPUE standardized from 1963-2010 for each of five areas without LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1963	1	22.88	0.0026	0.0514	3.15	36.96	0.0066	0.0812	4.34	1.25	0.0064	0.0797	1.14	7.81	0.0025	0.0499	1.84
1963	2	16.85	0.0039	0.0627	2.32	33.71	0.0069	0.0829	3.96	4.41	0.0455	0.2134	4.03	8.10	0.0032	0.0563	1.91
1963	3	18.71	0.0142	0.1192	2.58	12.86	0.0042	0.0651	1.51	7.19	0.0075	0.0867	6.57	6.77	0.0035	0.0595	1.60
1963	4	29.16	0.0030	0.0547	4.02	18.38	0.0064	0.0799	2.16	2.10	0.0054	0.0732	1.92	8.87	0.0030	0.0547	2.09
1964	1	20.37	0.0028	0.0528	2.81	29.22	0.0073	0.0854	3.43	0.67	0.0060	0.0773	0.61	10.47	0.0029	0.0540	2.47
1964	2	12.85	0.0021	0.0463	1.77	16.39	0.0056	0.0747	1.92	7.24	0.0221	0.1485	6.62	11.66	0.0030	0.0549	2.75
1964	3	11.38	0.0057	0.0758	1.57	9.89	0.0026	0.0511	1.16	5.58	0.0116	0.1076	5.10	8.91	0.0021	0.0461	2.10
1964	4	11.94	0.0027	0.0515	1.65	9.19	0.0037	0.0611	1.08	2.49	0.0041	0.0637	2.28	5.99	0.0021	0.0456	1.41
1965	1	13.68	0.0021	0.0456	1.88	12.30	0.0067	0.0818	1.44	0.75	0.0051	0.0714	0.69	7.81	0.0020	0.0446	1.84
1965	2	13.57	0.0023	0.0483	1.87	15.94	0.0090	0.0948	1.87	3.04	0.0233	0.1525	2.78	8.87	0.0019	0.0430	2.09
1965	3	13.54	0.0034	0.0580	1.87	10.93	0.0036	0.0600	1.28	3.02	0.0093	0.0963	2.76	4.86	0.0027	0.0522	1.15
1965	4	24.93	0.0029	0.0539	3.44	13.87	0.0053	0.0729	1.63	1.55	0.0042	0.0650	1.42	8.05	0.0026	0.0514	1.90
1966	1	22.14	0.0019	0.0432	3.05	21.42	0.0165	0.1284	2.51	0.76	0.0054	0.0737	0.70	9.41	0.0022	0.0465	2.22
1966	2	19.02	0.0018	0.0427	2.62	18.16	0.0048	0.0694	2.13	3.67	0.0233	0.1525	3.35	11.14	0.0029	0.0540	2.63
1966	3	19.78	0.0027	0.0517	2.73	11.46	0.0034	0.0584	1.35	3.79	0.0106	0.1029	3.47	10.39	0.0027	0.0518	2.45
1966	4	21.61	0.0019	0.0433	2.98	9.94	0.0041	0.0637	1.17	2.56	0.0038	0.0617	2.34	9.59	0.0023	0.0479	2.26
1967	1	11.84	0.0017	0.0410	1.63	12.72	0.0048	0.0690	1.49	2.13	0.0049	0.0700	1.94	9.16	0.0019	0.0434	2.16
1967	2	12.47	0.0020	0.0449	1.72	14.76	0.0032	0.0562	1.73	2.19	0.0052	0.0721	2.00	7.55	0.0018	0.0418	1.78
1967	3	7.24	0.0030	0.0547	1.00	6.04	0.0031	0.0561	0.71	0.69	0.0040	0.0635	0.63	6.43	0.0027	0.0518	1.52
1967	4	11.23	0.0023	0.0475	1.55	10.27	0.0043	0.0654	1.20	0.56	0.0032	0.0569	0.51	8.88	0.0030	0.0551	2.10
1968	1	36.66	0.0021	0.0457	5.05	78.45	0.0117	0.1083	9.21	1.54	0.0056	0.0749	1.41	9.95	0.0019	0.0434	2.35
1968	2	44.74	0.0022	0.0470	6.17	34.88	0.0058	0.0762	4.09	1.15	0.0051	0.0715	1.05	9.68	0.0036	0.0598	2.28
1968	3	25.88	0.0027	0.0522	3.57	14.90	0.0044	0.0666	1.75	0.50	0.0036	0.0596	0.46	4.01	0.0037	0.0611	0.95
1968	4	26.60	0.0021	0.0456	3.67	10.56	0.0062	0.0789	1.24	1.03	0.0040	0.0632	0.94	5.93	0.0028	0.0527	1.40
1969	1	15.68	0.0020	0.0444	2.16	7.75	0.0052	0.0721	0.91	1.13	0.0081	0.0899	1.04	7.82	0.0022	0.0473	1.85
1969	2	12.87	0.0028	0.0529	1.77	9.48	0.0047	0.0684	1.11	1.22	0.0060	0.0773	1.12	10.07	0.0026	0.0507	2.38
1969	3	17.58	0.0029	0.0538	2.42	4.86	0.0036	0.0598	0.57	0.50	0.0039	0.0624	0.46	6.62	0.0045	0.0667	1.56
1969	4	17.73	0.0030	0.0543	2.44	2.23	0.0062	0.0787	0.26	0.81	0.0050	0.0709	0.74	8.47	0.0038	0.0618	2.00
1970	1	9.17	0.0030	0.0549	1.26	4.20	0.0095	0.0976	0.49	1.92	0.0129	0.1135	1.76	7.89	0.0026	0.0505	1.86
1970	2	6.99	0.0043	0.0652	0.96	4.70	0.0078	0.0881	0.55	0.60	0.0057	0.0756	0.55	7.26	0.0033	0.0571	1.71
1970	3	8.06	0.0129	0.1135	1.11	2.30	0.0084	0.0919	0.27	0.48	0.0044	0.0665	0.44	14.15	0.0025	0.0502	3.34
1970	4	12.31	0.0032	0.0569	1.70	4.88	0.0092	0.0958	0.57	4.52	0.0044	0.0666	4.13	7.83	0.0027	0.0521	1.85
1971	1	9.16	0.0029	0.0540	1.26	6.92	0.0061	0.0779	0.81	3.89	0.0081	0.0901	3.56	6.89	0.0028	0.0525	1.63
1971	2	10.83	0.0042	0.0651	1.49	5.48	0.0118	0.1088	0.64	4.76	0.0050	0.0709	4.35	9.92	0.0031	0.0558	2.34
1971	3	21.55	0.0038	0.0616	2.97	4.27	0.0089	0.0941	0.50	1.88	0.0036	0.0603	1.72	5.31	0.0042	0.0647	1.25
1971	4	15.68	0.0030	0.0548	2.16	4.83	0.0148	0.1217	0.57	3.56	0.0071	0.0840	3.26	7.15	0.0051	0.0712	1.69
1972	1	8.23	0.0035	0.0594	1.13	32.64	0.0172	0.1313	3.83	4.32	0.1743	0.4175	3.95	6.89	0.0045	0.0669	1.63
1972	2	7.60	0.0041	0.0636	1.05	20.01	0.0227	0.1508	2.35	2.99	0.0195	0.1398	2.73	4.20	0.0050	0.0710	0.99
1972	3	11.33	0.0035	0.0595	1.56	5.04	0.0072	0.0851	0.59	1.91	0.0087	0.0934	1.75	5.85	0.0083	0.0910	1.38
1972	4	10.41	0.0041	0.0636	1.43	8.73	0.0143	0.1195	1.02	2.20	0.0149	0.1220	2.01	9.36	0.0145	0.1202	2.21
1973	1	6.98	0.0062	0.0790	0.96	17.46	0.0219	0.1478	2.05	3.63	0.0753	0.2743	3.32	9.72	0.0055	0.0741	2.29
1973	2	5.43	0.0061	0.0780	0.75	4.64	0.0172	0.1313	0.54	4.30	0.0148	0.1215	3.93	8.49	0.0088	0.0935	2.00
1973	3	4.31	0.0047	0.0683	0.59	1.85	0.0072	0.0849	0.22	0.51	0.0069	0.0831	0.46	7.19	0.0108	0.1041	1.70
1973	4	10.65	0.0045	0.0672	1.47	8.38	0.0092	0.0958	0.98	0.88	0.0053	0.0730	0.80	4.48	0.0051	0.0714	1.06
1974	1	5.26	0.0042	0.0651	0.72	17.12	0.0109	0.1043	2.01	4.45	0.0120	0.1097	4.07	4.10	0.0029	0.0539	0.97
1974	2	5.24	0.0052	0.0718	0.72	8.84	0.0146	0.1209	1.04	1.98	0.0066	0.0811	1.81	5.54	0.0064	0.0798	1.31
1974	3	5.60	0.0039	0.0625	0.77	1.46	0.0071	0.0840	0.17	0.44	0.0057	0.0757	0.40	4.12	0.0044	0.0666	0.97
1974	4	5.80	0.0048	0.0692	0.80	6.96	0.0068	0.0822	0.82	0.78	0.0087	0.0932	0.71	4.38	0.0027	0.0517	1.03

Appendix table 6. Quarterly value of yellowfin CPUE standardized from 1963-2010 for each of five areas without LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1975	1	3.11	0.0046	0.0679	0.43	7.51	0.0237	0.1539	0.88	1.92	0.0131	0.1142	1.75	4.48	0.0023	0.0476	1.06
1975	2	3.34	0.0060	0.0773	0.46	9.72	0.0150	0.1225	1.14	1.28	0.0061	0.0783	1.17	3.75	0.0043	0.0656	0.88
1975	3	7.13	0.0030	0.0548	0.98	4.42	0.0055	0.0744	0.52	0.99	0.0047	0.0683	0.90	3.94	0.0026	0.0512	0.93
1975	4	11.61	0.0036	0.0600	1.60	34.13	0.0130	0.1141	4.01	0.72	0.0069	0.0827	0.66	4.56	0.0037	0.0608	1.08
1976	1	3.40	0.0044	0.0662	0.47	19.74	0.0079	0.0887	2.32	0.57	0.0530	0.2302	0.52	3.42	0.0040	0.0634	0.81
1976	2	9.43	0.0056	0.0747	1.30	8.59	0.0259	0.1609	1.01	0.27	0.0188	0.1371	0.25	7.06	0.0072	0.0849	1.67
1976	3	7.84	0.0142	0.1192	1.08	2.67	0.0084	0.0916	0.31	0.55	0.0064	0.0802	0.50	4.98	0.0093	0.0963	1.17
1976	4	5.97	0.0207	0.1438	0.82	10.40	0.0253	0.1591	1.22	0.26	0.0099	0.0997	0.23	5.77	0.0089	0.0945	1.36
1977	1	3.77	0.0143	0.1194	0.52	47.68	0.0467	0.2160	5.60	2.86	0.0513	0.2265	2.62	6.99	0.0097	0.0986	1.65
1977	2	15.25	0.0129	0.1135	2.10	43.11	0.0563	0.2373	5.06	0.70	0.0304	0.1744	0.64	7.98	0.0646	0.2541	1.88
1977	3	8.96	0.0133	0.1155	1.23	6.96	0.0093	0.0967	0.82	0.20	0.0076	0.0874	0.19	4.98	0.0091	0.0956	1.17
1977	4	17.74	0.0037	0.0606	2.44	13.17	0.0308	0.1756	1.55	0.83	0.0100	0.0999	0.76	5.85	0.0244	0.1561	1.38
1978	1	6.60	0.0015	0.0389	0.91	15.10	0.0107	0.1036	1.77	0.95	0.0283	0.1683	0.87	6.76	0.0066	0.0811	1.59
1978	2	5.75	0.0021	0.0455	0.79	8.14	0.0172	0.1312	0.95	1.01	0.0101	0.1003	0.92	8.19	0.0189	0.1374	1.93
1978	3	4.77	0.0107	0.1036	0.66	3.93	0.0097	0.0984	0.46	0.41	0.0071	0.0840	0.38	2.45	0.0023	0.0484	0.58
1978	4	10.86	0.0049	0.0703	1.50	17.72	0.0189	0.1374	2.08	1.55	0.0114	0.1066	1.42	2.99	0.0048	0.0695	0.71
1979	1	4.04	0.0035	0.0592	0.56	31.94	0.0076	0.0869	3.75	1.03	0.0356	0.1885	0.94	4.34	0.0052	0.0721	1.02
1979	2	2.55	0.0067	0.0820	0.35	19.77	0.0175	0.1323	2.32	1.04	0.0159	0.1259	0.95	4.00	0.0067	0.0820	0.94
1979	3	3.21	0.0054	0.0735	0.44	5.75	0.0076	0.0870	0.67	0.65	0.0069	0.0829	0.59	2.41	0.0070	0.0835	0.57
1979	4	5.56	0.0133	0.1155	0.77	15.18	0.0146	0.1207	1.78	0.79	0.0133	0.1154	0.72	3.19	0.0048	0.0692	0.75
1980	1	4.03	0.0042	0.0645	0.56	11.22	0.0056	0.0747	1.32	0.52	0.0398	0.1996	0.48	4.32	0.0049	0.0699	1.02
1980	2	2.71	0.0044	0.0663	0.37	2.48	0.0158	0.1258	0.29	0.22	0.0248	0.1575	0.20	6.41	0.0056	0.0745	1.51
1980	3	3.63	0.0126	0.1123	0.50	2.53	0.0067	0.0819	0.30	0.30	0.0081	0.0898	0.28	2.99	0.0037	0.0606	0.70
1980	4	8.87	0.0030	0.0546	1.22	10.98	0.0162	0.1271	1.29	0.43	0.0066	0.0815	0.39	2.23	0.0044	0.0662	0.53
1981	1	4.64	0.0017	0.0417	0.64	8.00	0.0048	0.0695	0.94	0.60	0.0169	0.1300	0.55	3.33	0.0035	0.0595	0.78
1981	2	2.40	0.0043	0.0657	0.33	8.60	0.0106	0.1029	1.01	0.24	0.0230	0.1517	0.22	3.60	0.0053	0.0730	0.85
1981	3	6.12	0.0040	0.0635	0.84	5.26	0.0050	0.0704	0.62	0.33	0.0053	0.0726	0.30	5.46	0.0095	0.0976	1.29
1981	4	6.70	0.0024	0.0490	0.92	12.84	0.0144	0.1202	1.51	1.55	0.0076	0.0873	1.42	3.20	0.0031	0.0556	0.76
1982	1	4.37	0.0016	0.0397	0.60	13.75	0.0048	0.0690	1.61	11.71	0.0217	0.1473	10.71	3.75	0.0035	0.0588	0.89
1982	2	4.34	0.0030	0.0551	0.60	8.62	0.0097	0.0983	1.01	0.23	0.0587	0.2423	0.21	4.08	0.0066	0.0810	0.96
1982	3	4.50	0.0022	0.0471	0.62	3.07	0.0042	0.0649	0.36	0.20	0.0088	0.0939	0.18	4.11	0.0039	0.0621	0.97
1982	4	10.04	0.0016	0.0395	1.38	4.15	0.0145	0.1203	0.49	1.61	0.0174	0.1320	1.47	3.00	0.0032	0.0565	0.71
1983	1	4.54	0.0011	0.0337	0.63	14.37	0.0114	0.1067	1.69	1.60	0.0308	0.1754	1.47	4.38	0.0022	0.0470	1.03
1983	2	4.25	0.0015	0.0391	0.59	3.45	0.0210	0.1451	0.40	0.44	0.0127	0.1126	0.40	8.09	0.0092	0.0960	1.91
1983	3	3.32	0.0043	0.0654	0.46	2.58	0.0053	0.0726	0.30	0.23	0.0065	0.0804	0.21	3.74	0.0018	0.0429	0.88
1983	4	9.68	0.0022	0.0468	1.33	11.23	0.0174	0.1317	1.32	0.73	0.0092	0.0958	0.67	4.11	0.0027	0.0516	0.97
1984	1	5.14	0.0016	0.0405	0.71	18.80	0.0119	0.1093	2.21	1.86	0.0121	0.1099	1.70	5.21	0.0022	0.0471	1.23
1984	2	4.79	0.0025	0.0496	0.66	6.33	0.0203	0.1424	0.74	0.41	0.0078	0.0883	0.37	6.03	0.0038	0.0620	1.42
1984	3	7.13	0.0041	0.0643	0.98	4.18	0.0050	0.0705	0.49	0.31	0.0067	0.0815	0.29	2.83	0.0022	0.0468	0.67
1984	4	5.61	0.0024	0.0493	0.77	19.13	0.0133	0.1155	2.25	2.98	0.0072	0.0849	2.73	4.32	0.0027	0.0523	1.02
1985	1	5.31	0.0016	0.0394	0.73	13.86	0.0117	0.1081	1.63	5.41	0.0183	0.1353	4.95	4.22	0.0015	0.0390	1.00
1985	2	4.95	0.0021	0.0457	0.68	3.39	0.0085	0.0923	0.40	0.69	0.0055	0.0741	0.63	6.86	0.0039	0.0622	1.62
1985	3	5.19	0.0022	0.0465	0.72	3.09	0.0039	0.0628	0.36	0.29	0.0049	0.0699	0.27	5.10	0.0026	0.0507	1.20
1985	4	9.78	0.0015	0.0382	1.35	10.71	0.0148	0.1217	1.26	0.90	0.0094	0.0969	0.82	3.83	0.0046	0.0677	0.90
1986	1	8.81	0.0012	0.0349	1.21	18.49	0.0073	0.0854	2.17	2.04	0.0086	0.0928	1.87	4.41	0.0013	0.0364	1.04
1986	2	9.18	0.0019	0.0439	1.27	2.15	0.0078	0.0886	0.25	0.74	0.0216	0.1470	0.68	8.25	0.0084	0.0914	1.95
1986	3	6.33	0.0030	0.0551	0.87	1.46	0.0046	0.0680	0.17	0.17	0.0056	0.0745	0.16	5.26	0.0040	0.0630	1.24
1986	4	9.46	0.0019	0.0430	1.30	3.20	0.0326	0.1806	0.38	0.21	0.0059	0.0766	0.19	4.15	0.0025	0.0504	0.98

Appendix table 6. Quarterly value of yellowfin CPUE standardized from 1963-2010 for each of five areas without LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1987	1	6.52	0.0013	0.0356	0.90	15.90	0.0118	0.1088	1.87	0.57	0.0068	0.0824	0.52	5.07	0.0017	0.0407	1.20
1987	2	5.24	0.0019	0.0432	0.72	9.08	0.0106	0.1031	1.07	1.19	0.0297	0.1725	1.09	7.80	0.0586	0.2421	1.84
1987	3	2.96	0.0053	0.0727	0.41	2.54	0.0039	0.0621	0.30	0.20	0.0059	0.0769	0.18	4.02	0.0153	0.1238	0.95
1987	4	10.27	0.0028	0.0526	1.41	6.09	0.0156	0.1249	0.71	0.77	0.0075	0.0866	0.70	4.50	0.0021	0.0458	1.06
1988	1	10.42	0.0013	0.0362	1.44	21.58	0.0128	0.1131	2.53	6.33	0.0187	0.1366	5.79	5.78	0.0017	0.0413	1.36
1988	2	6.01	0.0021	0.0459	0.83	5.58	0.0081	0.0901	0.65	1.26	0.0232	0.1522	1.15	6.86	0.0587	0.2423	1.62
1988	3	3.73	0.0046	0.0681	0.51	3.32	0.0038	0.0616	0.39	0.17	0.0079	0.0891	0.15	8.52	0.0053	0.0725	2.01
1988	4	4.79	0.0026	0.0506	0.66	11.65	0.0143	0.1194	1.37	0.29	0.0106	0.1030	0.27	4.98	0.0022	0.0469	1.17
1989	1	4.07	0.0014	0.0374	0.56	12.46	0.0163	0.1276	1.46	6.14	0.0212	0.1457	5.61	5.51	0.0033	0.0570	1.30
1989	2	2.98	0.0030	0.0546	0.41	5.12	0.0075	0.0869	0.60	1.06	0.0468	0.2164	0.97	6.40	0.0139	0.1179	1.51
1989	3	2.77	0.0232	0.1522	0.38	1.87	0.0037	0.0606	0.22	0.17	0.0108	0.1040	0.16	2.57	0.0064	0.0799	0.61
1989	4	7.82	0.0045	0.0670	1.08	10.02	0.0117	0.1083	1.18	0.35	0.0101	0.1004	0.32	2.27	0.0048	0.0691	0.54
1990	1	8.73	0.0022	0.0469	1.20	23.69	0.0096	0.0982	2.78	1.71	0.0089	0.0944	1.57	5.19	0.0020	0.0442	1.23
1990	2	4.02	0.0037	0.0607	0.55	4.77	0.0083	0.0913	0.56	0.19	0.0586	0.2422	0.18	8.97	0.0226	0.1503	2.12
1990	3	4.32	0.0135	0.1160	0.60	1.62	0.0035	0.0593	0.19	0.40	0.0058	0.0758	0.36	8.09	0.0062	0.0784	1.91
1990	4	4.97	0.0031	0.0552	0.69	2.93	0.0251	0.1585	0.34	0.37	0.0121	0.1100	0.34	2.68	0.0029	0.0541	0.63
1991	1	6.58	0.0020	0.0453	0.91	5.15	0.0076	0.0874	0.60	0.80	0.0129	0.1136	0.74	3.90	0.0023	0.0480	0.92
1991	2	5.78	0.0096	0.0980	0.80	3.02	0.0057	0.0756	0.35	0.66	0.0207	0.1437	0.60	2.88	0.0252	0.1586	0.68
1991	3	2.34	0.0099	0.0995	0.32	2.42	0.0031	0.0558	0.28	0.31	0.0037	0.0611	0.29	2.46	0.0139	0.1177	0.58
1991	4	5.73	0.0095	0.0972	0.79	4.05	0.0142	0.1190	0.48	0.31	0.0038	0.0616	0.28	2.70	0.0044	0.0661	0.64
1992	1	5.40	0.0039	0.0625	0.74	6.12	0.0048	0.0692	0.72	0.52	0.0169	0.1299	0.48	3.60	0.0040	0.0632	0.85
1992	2	5.98	0.0057	0.0757	0.82	2.45	0.0040	0.0633	0.29	0.44	0.0119	0.1091	0.40	2.78	0.1071	0.3272	0.66
1992	3	3.06	0.0247	0.1571	0.42	3.20	0.0022	0.0469	0.37	0.20	0.0067	0.0819	0.18	4.03	0.0179	0.1336	0.95
1992	4	4.04	0.0036	0.0599	0.56	5.84	0.0307	0.1752	0.68	0.22	0.0068	0.0826	0.20	2.52	0.0078	0.0883	0.60
1993	1	3.31	0.0046	0.0675	0.46	13.87	0.0057	0.0755	1.63	0.32	0.0308	0.1756	0.29	2.01	0.0037	0.0608	0.48
1993	2	3.42	0.0035	0.0595	0.47	3.52	0.0047	0.0684	0.41	0.28	0.0187	0.1367	0.25	6.02	0.0324	0.1799	1.42
1993	3	3.59	0.0059	0.0766	0.49	4.11	0.0025	0.0503	0.48	0.17	0.0038	0.0614	0.16	2.25	0.0082	0.0906	0.53
1993	4	5.47	0.0024	0.0492	0.75	5.38	0.0269	0.1639	0.63	0.26	0.0045	0.0671	0.23	2.62	0.0060	0.0777	0.62
1994	1	3.92	0.0023	0.0482	0.54	7.27	0.0032	0.0563	0.85	0.60	0.0075	0.0864	0.55	1.56	0.0032	0.0568	0.37
1994	2	4.48	0.0032	0.0565	0.62	2.65	0.0018	0.0427	0.31	0.50	0.0052	0.0719	0.46	2.17	0.2156	0.4643	0.51
1994	3	2.31	0.0077	0.0879	0.32	2.95	0.0017	0.0410	0.35	0.27	0.0034	0.0581	0.24	4.00	0.0224	0.1497	0.94
1994	4	2.88	0.0022	0.0472	0.40	4.12	0.0069	0.0833	0.48	0.35	0.0025	0.0498	0.32	1.93	0.0044	0.0666	0.46
1995	1	2.31	0.0036	0.0597	0.32	5.34	0.0024	0.0489	0.63	0.62	0.0033	0.0578	0.57	2.16	0.0028	0.0530	0.51
1995	2	1.15	0.0058	0.0761	0.16	2.36	0.0019	0.0440	0.28	0.27	0.0041	0.0641	0.24	3.04	0.0169	0.1301	0.72
1995	3	2.47	0.0118	0.1088	0.34	2.35	0.0023	0.0481	0.28	0.26	0.0019	0.0434	0.24	1.15	0.0067	0.0816	0.27
1995	4	5.01	0.0020	0.0443	0.69	9.39	0.0123	0.1110	1.10	0.17	0.0020	0.0443	0.15	1.95	0.0031	0.0553	0.46
1996	1	6.52	0.0022	0.0471	0.90	4.94	0.0019	0.0440	0.58	0.33	0.0033	0.0572	0.30	2.32	0.0026	0.0506	0.55
1996	2	3.79	0.0029	0.0536	0.52	1.57	0.0020	0.0449	0.18	0.44	0.0033	0.0572	0.40	1.49	0.0282	0.1678	0.35
1996	3	2.47	0.0033	0.0575	0.34	1.93	0.0017	0.0413	0.23	0.32	0.0023	0.0481	0.30	1.90	0.0127	0.1125	0.45
1996	4	2.44	0.0012	0.0340	0.34	8.14	0.0039	0.0625	0.96	0.17	0.0025	0.0502	0.15	1.59	0.0029	0.0541	0.38
1997	1	4.09	0.0013	0.0355	0.56	6.65	0.0017	0.0415	0.78	0.62	0.0133	0.1153	0.56	1.98	0.0013	0.0366	0.47
1997	2	1.23	0.0013	0.0359	0.17	1.42	0.0019	0.0439	0.17	0.32	0.0057	0.0757	0.30	2.10	0.0260	0.1614	0.50
1997	3	3.33	0.0024	0.0488	0.46	1.19	0.0018	0.0425	0.14	0.24	0.0020	0.0446	0.22	3.89	0.0055	0.0745	0.92
1997	4	4.26	0.0009	0.0294	0.59	4.23	0.0028	0.0528	0.50	0.25	0.0032	0.0564	0.23	1.03	0.0020	0.0449	0.24
1998	1	3.63	0.0008	0.0275	0.50	5.68	0.0016	0.0395	0.67	0.50	0.0171	0.1308	0.46	2.15	0.0013	0.0366	0.51
1998	2	2.73	0.0010	0.0314	0.38	1.16	0.0019	0.0430	0.14	0.37	0.0073	0.0855	0.34	2.18	0.0075	0.0864	0.51
1998	3	2.81	0.0021	0.0456	0.39	1.09	0.0018	0.0428	0.13	0.13	0.0035	0.0591	0.11	1.23	0.0045	0.0671	0.29
1998	4	4.19	0.0017	0.0409	0.58	6.02	0.0024	0.0491	0.71	0.21	0.0042	0.0646	0.19	1.67	0.0020	0.0442	0.39

Appendix table 6. Quarterly value of yellowfin CPUE standardized from 1963-2010 for each of five areas without LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1999	1	3.43	0.0020	0.0448	0.47	5.14	0.0020	0.0442	0.60	0.56	0.0101	0.1006	0.51	2.77	0.0016	0.0397	0.65
1999	2	3.55	0.0039	0.0624	0.49	1.25	0.0021	0.0463	0.15	0.58	0.0057	0.0757	0.53	1.96	0.0053	0.0728	0.46
1999	3	3.98	0.0040	0.0632	0.55	1.90	0.0024	0.0494	0.22	0.20	0.0033	0.0575	0.18	1.97	0.0021	0.0460	0.46
1999	4	3.92	0.0012	0.0346	0.54	6.99	0.0026	0.0513	0.82	0.38	0.0076	0.0869	0.35	1.56	0.0012	0.0343	0.37
2000	1	3.70	0.0011	0.0334	0.51	6.65	0.0023	0.0477	0.78	0.64	0.0113	0.1061	0.59	1.71	0.0015	0.0389	0.40
2000	2	2.99	0.0028	0.0531	0.41	1.30	0.0038	0.0613	0.15	0.42	0.0049	0.0698	0.38	3.90	0.0016	0.0402	0.92
2000	3	5.86	0.0030	0.0545	0.81	1.64	0.0025	0.0504	0.19	0.37	0.0031	0.0556	0.34	3.90	0.0026	0.0514	0.92
2000	4	4.60	0.0018	0.0422	0.63	3.51	0.0030	0.0548	0.41	0.20	0.0061	0.0780	0.18	1.72	0.0028	0.0529	0.41
2001	1	4.49	0.0032	0.0568	0.62	8.42	0.0024	0.0486	0.99	0.15	0.0066	0.0814	0.13	1.64	0.0014	0.0380	0.39
2001	2	5.05	0.0024	0.0489	0.70	1.41	0.0041	0.0638	0.17	0.43	0.0056	0.0751	0.39	1.76	0.0028	0.0533	0.41
2001	3	3.98	0.0037	0.0612	0.55	1.85	0.0025	0.0497	0.22	0.36	0.0022	0.0469	0.33	1.25	0.0036	0.0600	0.30
2001	4	5.65	0.0023	0.0484	0.78	3.44	0.0037	0.0611	0.40	0.39	0.0025	0.0504	0.35	0.96	0.0037	0.0604	0.23
2002	1	6.16	0.0015	0.0385	0.85	7.85	0.0020	0.0448	0.92	0.36	0.0057	0.0754	0.33	1.22	0.0037	0.0607	0.29
2002	2	3.30	0.0022	0.0467	0.45	2.22	0.0046	0.0675	0.26	0.40	0.0083	0.0912	0.36	1.65	0.0062	0.0785	0.39
2002	3	1.27	0.0027	0.0517	0.18	1.62	0.0030	0.0552	0.19	0.23	0.0025	0.0501	0.21	0.80	0.0031	0.0556	0.19
2002	4	2.41	0.0010	0.0316	0.33	3.25	0.0056	0.0749	0.38	0.15	0.0031	0.0553	0.14	0.89	0.0013	0.0355	0.21
2003	1	3.83	0.0013	0.0363	0.53	8.23	0.0025	0.0500	0.97	0.33	0.0217	0.1471	0.30	0.96	0.0020	0.0444	0.23
2003	2	4.57	0.0020	0.0444	0.63	1.95	0.0047	0.0688	0.23	0.94	0.0143	0.1197	0.86	0.84	0.0177	0.1330	0.20
2003	3	4.64	0.0030	0.0548	0.64	1.85	0.0037	0.0611	0.22	0.27	0.0040	0.0629	0.25	0.69	0.0081	0.0902	0.16
2003	4	4.60	0.0011	0.0327	0.63	3.96	0.0058	0.0765	0.46	0.12	0.0046	0.0679	0.11	1.58	0.0027	0.0521	0.37
2004	1	3.23	0.0010	0.0322	0.45	6.06	0.0025	0.0498	0.71	0.79	0.0311	0.1764	0.72	1.05	0.0033	0.0577	0.25
2004	2	5.94	0.0018	0.0422	0.82	2.16	0.0042	0.0649	0.25	0.34	0.0109	0.1042	0.31	2.73	0.0104	0.1018	0.64
2004	3	2.30	0.0022	0.0467	0.32	1.65	0.0018	0.0425	0.19	0.25	0.0040	0.0631	0.23	1.32	0.0044	0.0662	0.31
2004	4	5.00	0.0013	0.0365	0.69	2.77	0.0033	0.0574	0.33	0.10	0.0050	0.0707	0.09	0.91	0.0025	0.0495	0.21
2005	1	4.64	0.0009	0.0296	0.64	8.66	0.0023	0.0485	1.02	0.19	0.0117	0.1081	0.17	0.94	0.0030	0.0550	0.22
2005	2	5.75	0.0012	0.0351	0.79	1.97	0.0026	0.0514	0.23	0.46	0.0141	0.1187	0.42	1.23	0.0086	0.0926	0.29
2005	3	2.27	0.0014	0.0376	0.31	1.04	0.0016	0.0400	0.12	0.11	0.0082	0.0903	0.10	1.13	0.0120	0.1094	0.27
2005	4	3.08	0.0009	0.0300	0.42	4.70	0.0033	0.0573	0.55	0.07	0.0046	0.0678	0.07	0.80	0.0039	0.0625	0.19
2006	1	4.59	0.0008	0.0290	0.63	9.28	0.0021	0.0453	1.09	0.09	0.0087	0.0931	0.08	1.53	0.0018	0.0426	0.36
2006	2	5.51	0.0008	0.0274	0.76	3.41	0.0020	0.0445	0.40	0.43	0.0208	0.1440	0.39	2.24	0.0033	0.0570	0.53
2006	3	2.17	0.0018	0.0422	0.30	0.99	0.0017	0.0409	0.12	0.16	0.0048	0.0693	0.14	1.22	0.0024	0.0494	0.29
2006	4	2.27	0.0009	0.0308	0.31	3.07	0.0021	0.0458	0.36	0.15	0.0085	0.0922	0.14	0.94	0.0017	0.0408	0.22
2007	1	2.08	0.0007	0.0269	0.29	7.17	0.0019	0.0434	0.84	0.14	0.0269	0.1639	0.12	1.27	0.0015	0.0381	0.30
2007	2	1.85	0.0006	0.0247	0.25	5.76	0.0028	0.0529	0.68	0.31	0.0105	0.1025	0.28	1.66	0.0026	0.0506	0.39
2007	3	1.76	0.0015	0.0392	0.24	0.96	0.0019	0.0432	0.11	0.13	0.0042	0.0650	0.12	1.11	0.0034	0.0581	0.26
2007	4	2.09	0.0011	0.0337	0.29	2.33	0.0036	0.0599	0.27	0.07	0.0108	0.1038	0.06	1.06	0.0017	0.0414	0.25
2008	1	1.30	0.0012	0.0340	0.18	6.10	0.0026	0.0510	0.72	0.16	0.0169	0.1300	0.15	0.74	0.0014	0.0378	0.18
2008	2	1.26	0.0009	0.0303	0.17	2.32	0.0039	0.0621	0.27	0.05	0.0051	0.0712	0.04	0.51	0.0036	0.0603	0.12
2008	3	1.32	0.0019	0.0437	0.18	0.60	0.0025	0.0500	0.07	0.04	0.0037	0.0604	0.03	0.62	0.0030	0.0549	0.15
2008	4	0.92	0.0015	0.0381	0.13	2.12	0.0024	0.0494	0.25	0.05	0.0104	0.1021	0.05	0.50	0.0014	0.0370	0.12
2009	1	0.71	0.0010	0.0313	0.10	2.50	0.0025	0.0497	0.29	0.23	0.0385	0.1962	0.21	0.61	0.0011	0.0329	0.14
2009	2	1.00	0.0018	0.0426	0.14	3.55	0.0047	0.0682	0.42	0.10	0.0055	0.0740	0.09	0.73	0.0024	0.0491	0.17
2009	3	1.90	0.0099	0.0994	0.26	1.44	0.0034	0.0586	0.17	0.04	0.0031	0.0555	0.03	0.64	0.0027	0.0520	0.15
2009	4	3.21	0.0075	0.0867	0.44	1.62	0.0044	0.0665	0.19	0.05	0.0126	0.1121	0.05	0.33	0.0011	0.0337	0.08
2010	1	1.72	0.0103	0.1014	0.24	3.04	0.0032	0.0567	0.36	0.07	0.0137	0.1169	0.07	0.56	0.0014	0.0370	0.13
2010	2	0.95	0.0111	0.1055	0.13	4.24	0.0057	0.0752	0.50	0.07	0.0035	0.0593	0.07	0.70	0.0063	0.0796	0.17
2010	3	8.02	0.0733	0.2708	1.11	1.77	0.0047	0.0682	0.21	0.04	0.0045	0.0672	0.04	0.34	0.0127	0.1125	0.08
2010	4	3.77	0.0489	0.2212	0.52	2.33	0.0046	0.0677	0.27	0.19	0.0445	0.2108	0.17	0.28	0.0021	0.0462	0.07

Appendix table 7. Quarterly value of yellowfin CPUE for 1963-2011 for each of five areas with LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1963	1	20.00	0.0027	0.0518	2.91	13.13	0.0072	0.0848	2.89	0.46	0.0042	0.0645	1.03	8.25	0.0025	0.0496	1.94
1963	2	15.95	0.0039	0.0622	2.32	12.32	0.0074	0.0860	2.71	0.74	0.0283	0.1682	1.67	8.10	0.0031	0.0559	1.91
1963	3	14.50	0.0133	0.1152	2.11	7.45	0.0053	0.0730	1.64	1.14	0.0050	0.0706	2.57	7.10	0.0035	0.0591	1.67
1963	4	21.85	0.0030	0.0549	3.18	9.23	0.0071	0.0842	2.03	0.46	0.0036	0.0596	1.04	9.25	0.0030	0.0543	2.18
1964	1	17.56	0.0028	0.0530	2.56	10.69	0.0078	0.0881	2.35	0.33	0.0039	0.0622	0.76	10.97	0.0029	0.0538	2.59
1964	2	12.12	0.0022	0.0469	1.76	6.05	0.0064	0.0797	1.33	2.52	0.0139	0.1177	5.70	11.99	0.0030	0.0545	2.83
1964	3	8.77	0.0055	0.0743	1.28	6.00	0.0036	0.0599	1.32	0.91	0.0074	0.0862	2.05	9.25	0.0021	0.0459	2.18
1964	4	9.23	0.0027	0.0519	1.34	4.83	0.0049	0.0703	1.06	0.54	0.0028	0.0524	1.23	6.16	0.0021	0.0454	1.45
1965	1	11.72	0.0022	0.0465	1.71	4.43	0.0073	0.0857	0.98	0.32	0.0033	0.0578	0.73	7.77	0.0020	0.0445	1.83
1965	2	12.38	0.0024	0.0491	1.80	6.05	0.0090	0.0951	1.33	0.82	0.0145	0.1205	1.84	8.80	0.0018	0.0430	2.08
1965	3	10.78	0.0033	0.0571	1.57	5.69	0.0048	0.0696	1.25	0.35	0.0060	0.0776	0.78	5.09	0.0027	0.0520	1.20
1965	4	21.66	0.0029	0.0541	3.15	7.94	0.0063	0.0796	1.75	0.30	0.0028	0.0533	0.68	8.06	0.0026	0.0512	1.90
1966	1	20.03	0.0020	0.0444	2.92	7.23	0.0149	0.1220	1.59	0.25	0.0036	0.0596	0.57	9.41	0.0022	0.0463	2.22
1966	2	17.85	0.0019	0.0439	2.60	7.12	0.0058	0.0762	1.57	0.93	0.0147	0.1212	2.09	11.00	0.0029	0.0537	2.59
1966	3	15.94	0.0027	0.0521	2.32	7.36	0.0047	0.0686	1.62	0.74	0.0069	0.0832	1.66	10.31	0.0027	0.0516	2.43
1966	4	18.22	0.0020	0.0444	2.65	5.75	0.0053	0.0730	1.27	0.60	0.0025	0.0502	1.35	9.99	0.0023	0.0477	2.35
1967	1	11.57	0.0018	0.0423	1.68	5.22	0.0058	0.0759	1.15	0.73	0.0032	0.0567	1.66	9.20	0.0019	0.0432	2.17
1967	2	10.95	0.0021	0.0458	1.59	6.01	0.0045	0.0671	1.32	0.90	0.0034	0.0580	2.02	7.39	0.0017	0.0417	1.74
1967	3	6.05	0.0030	0.0548	0.88	3.74	0.0045	0.0670	0.82	0.28	0.0026	0.0510	0.64	6.77	0.0026	0.0514	1.60
1967	4	10.32	0.0023	0.0483	1.50	5.12	0.0055	0.0739	1.13	0.30	0.0021	0.0463	0.67	8.81	0.0030	0.0547	2.08
1968	1	29.15	0.0022	0.0466	4.24	22.51	0.0113	0.1064	4.96	0.56	0.0036	0.0603	1.26	10.17	0.0019	0.0433	2.40
1968	2	37.97	0.0023	0.0478	5.53	14.22	0.0066	0.0809	3.13	0.65	0.0033	0.0577	1.47	10.93	0.0035	0.0593	2.58
1968	3	19.19	0.0028	0.0526	2.79	7.52	0.0055	0.0741	1.66	0.28	0.0023	0.0483	0.63	4.56	0.0037	0.0609	1.08
1968	4	22.72	0.0022	0.0464	3.31	6.00	0.0070	0.0835	1.32	0.27	0.0026	0.0513	0.61	6.14	0.0028	0.0524	1.45
1969	1	15.83	0.0021	0.0453	2.31	4.68	0.0061	0.0779	1.03	0.20	0.0052	0.0719	0.46	7.93	0.0022	0.0471	1.87
1969	2	12.04	0.0028	0.0532	1.75	4.73	0.0057	0.0753	1.04	0.49	0.0039	0.0621	1.11	9.74	0.0025	0.0504	2.30
1969	3	14.49	0.0029	0.0540	2.11	3.50	0.0048	0.0692	0.77	0.31	0.0025	0.0503	0.69	6.71	0.0044	0.0661	1.58
1969	4	17.28	0.0030	0.0544	2.52	2.52	0.0068	0.0827	0.55	0.28	0.0033	0.0571	0.63	8.04	0.0038	0.0613	1.90
1970	1	10.01	0.0030	0.0550	1.46	3.31	0.0094	0.0970	0.73	0.24	0.0082	0.0906	0.54	7.50	0.0025	0.0503	1.77
1970	2	6.83	0.0042	0.0646	0.99	3.18	0.0081	0.0897	0.70	0.31	0.0037	0.0606	0.69	7.21	0.0032	0.0568	1.70
1970	3	6.31	0.0121	0.1098	0.92	1.41	0.0086	0.0925	0.31	0.28	0.0029	0.0534	0.64	15.15	0.0025	0.0501	3.57
1970	4	10.96	0.0032	0.0568	1.60	2.80	0.0092	0.0957	0.62	1.09	0.0029	0.0542	2.45	8.17	0.0027	0.0518	1.93
1971	1	8.60	0.0029	0.0541	1.25	4.31	0.0067	0.0820	0.95	1.27	0.0052	0.0721	2.86	6.49	0.0027	0.0522	1.53
1971	2	10.02	0.0041	0.0643	1.46	4.31	0.0112	0.1058	0.95	3.10	0.0033	0.0570	6.99	9.62	0.0031	0.0554	2.27
1971	3	15.94	0.0038	0.0614	2.32	3.55	0.0089	0.0942	0.78	0.88	0.0024	0.0488	1.98	5.47	0.0041	0.0641	1.29
1971	4	13.54	0.0030	0.0548	1.97	3.90	0.0134	0.1156	0.86	0.82	0.0046	0.0674	1.84	7.12	0.0050	0.0704	1.68
1972	1	8.26	0.0035	0.0591	1.20	11.69	0.0154	0.1241	2.57	1.88	0.1074	0.3277	4.23	6.48	0.0044	0.0662	1.53
1972	2	8.70	0.0040	0.0631	1.27	8.87	0.0197	0.1403	1.95	2.36	0.0122	0.1104	5.33	4.24	0.0050	0.0704	1.00
1972	3	9.79	0.0035	0.0592	1.43	3.40	0.0077	0.0875	0.75	1.14	0.0055	0.0742	2.57	6.19	0.0081	0.0900	1.46
1972	4	10.24	0.0040	0.0630	1.49	5.76	0.0131	0.1144	1.27	0.73	0.0093	0.0966	1.65	8.53	0.0141	0.1187	2.01
1973	1	7.63	0.0060	0.0772	1.11	6.88	0.0190	0.1377	1.52	3.16	0.0478	0.2185	7.14	8.94	0.0054	0.0733	2.11
1973	2	7.35	0.0058	0.0765	1.07	3.26	0.0154	0.1240	0.72	2.74	0.0093	0.0966	6.18	9.50	0.0086	0.0925	2.24
1973	3	4.84	0.0045	0.0674	0.70	1.79	0.0076	0.0873	0.39	0.37	0.0044	0.0662	0.83	7.46	0.0106	0.1027	1.76
1973	4	8.50	0.0044	0.0664	1.24	6.73	0.0091	0.0956	1.48	0.48	0.0034	0.0586	1.08	4.94	0.0050	0.0706	1.16
1974	1	4.83	0.0041	0.0644	0.70	6.95	0.0105	0.1024	1.53	0.60	0.0077	0.0876	1.36	4.25	0.0029	0.0535	1.00
1974	2	5.66	0.0050	0.0706	0.82	4.88	0.0134	0.1156	1.07	0.85	0.0042	0.0647	1.92	6.51	0.0062	0.0790	1.53
1974	3	4.84	0.0038	0.0620	0.71	1.68	0.0075	0.0866	0.37	0.27	0.0037	0.0605	0.60	4.33	0.0044	0.0660	1.02
1974	4	4.86	0.0047	0.0682	0.71	4.41	0.0073	0.0852	0.97	0.25	0.0055	0.0744	0.56	4.62	0.0027	0.0514	1.09

Appendix table 7. Quarterly value of yellowfin CPUE for 1963-2011 for each of five areas with LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1975	1	3.49	0.0045	0.0673	0.51	4.03	0.0204	0.1428	0.89	0.36	0.0083	0.0910	0.82	4.91	0.0022	0.0474	1.16
1975	2	4.12	0.0058	0.0759	0.60	4.45	0.0137	0.1169	0.98	0.49	0.0039	0.0628	1.11	4.43	0.0043	0.0653	1.04
1975	3	6.66	0.0030	0.0549	0.97	4.15	0.0063	0.0795	0.91	0.34	0.0030	0.0550	0.77	3.86	0.0026	0.0510	0.91
1975	4	9.84	0.0036	0.0597	1.43	13.84	0.0122	0.1103	3.05	0.31	0.0044	0.0662	0.71	4.71	0.0036	0.0603	1.11
1976	1	3.30	0.0043	0.0654	0.48	7.45	0.0081	0.0903	1.64	0.25	0.0330	0.1816	0.56	3.54	0.0040	0.0628	0.84
1976	2	12.58	0.0054	0.0737	1.83	5.40	0.0221	0.1485	1.19	0.28	0.0117	0.1082	0.62	8.20	0.0071	0.0841	1.93
1976	3	6.83	0.0133	0.1151	1.00	2.09	0.0085	0.0923	0.46	0.39	0.0041	0.0642	0.89	4.78	0.0090	0.0951	1.13
1976	4	5.65	0.0192	0.1387	0.82	6.25	0.0216	0.1471	1.38	0.31	0.0063	0.0795	0.70	6.00	0.0087	0.0933	1.42
1977	1	3.63	0.0133	0.1154	0.53	18.69	0.0382	0.1954	4.12	0.65	0.0318	0.1784	1.46	6.94	0.0095	0.0974	1.64
1977	2	18.08	0.0121	0.1099	2.63	20.93	0.0456	0.2136	4.61	0.52	0.0190	0.1377	1.18	7.70	0.0625	0.2500	1.82
1977	3	8.20	0.0125	0.1118	1.19	5.30	0.0093	0.0964	1.17	0.30	0.0049	0.0697	0.68	4.57	0.0089	0.0943	1.08
1977	4	14.64	0.0036	0.0602	2.13	6.43	0.0260	0.1611	1.42	0.34	0.0063	0.0795	0.77	5.88	0.0236	0.1537	1.39
1978	1	7.06	0.0017	0.0410	1.03	6.26	0.0104	0.1020	1.38	0.39	0.0178	0.1336	0.88	7.93	0.0065	0.0803	1.87
1978	2	5.69	0.0022	0.0467	0.83	3.57	0.0154	0.1242	0.79	0.82	0.0064	0.0802	1.84	9.21	0.0184	0.1355	2.17
1978	3	4.39	0.0101	0.1004	0.64	2.48	0.0096	0.0978	0.55	0.31	0.0045	0.0670	0.70	2.74	0.0023	0.0483	0.65
1978	4	8.60	0.0048	0.0692	1.25	8.87	0.0167	0.1292	1.95	0.32	0.0072	0.0850	0.73	3.25	0.0048	0.0689	0.77
1979	1	4.64	0.0035	0.0592	0.68	14.25	0.0079	0.0891	3.14	0.31	0.0221	0.1486	0.70	4.39	0.0051	0.0713	1.03
1979	2	3.34	0.0064	0.0802	0.49	8.88	0.0156	0.1250	1.96	0.69	0.0100	0.1001	1.55	4.38	0.0066	0.0811	1.03
1979	3	3.11	0.0052	0.0721	0.45	3.25	0.0079	0.0891	0.72	0.41	0.0044	0.0662	0.91	2.41	0.0068	0.0825	0.57
1979	4	5.18	0.0125	0.1117	0.75	5.77	0.0134	0.1157	1.27	0.37	0.0084	0.0915	0.84	3.53	0.0047	0.0686	0.83
1980	1	3.20	0.0041	0.0639	0.47	4.99	0.0064	0.0799	1.10	0.25	0.0250	0.1580	0.56	4.44	0.0048	0.0692	1.05
1980	2	3.64	0.0043	0.0656	0.53	1.15	0.0143	0.1196	0.25	0.21	0.0155	0.1243	0.47	7.40	0.0055	0.0739	1.74
1980	3	3.98	0.0118	0.1087	0.58	1.17	0.0073	0.0854	0.26	0.33	0.0051	0.0716	0.75	3.23	0.0036	0.0601	0.76
1980	4	7.76	0.0030	0.0547	1.13	4.16	0.0146	0.1207	0.91	0.27	0.0042	0.0651	0.60	2.47	0.0043	0.0655	0.58
1981	1	3.73	0.0019	0.0432	0.54	3.46	0.0058	0.0761	0.76	0.26	0.0106	0.1031	0.58	3.33	0.0035	0.0590	0.79
1981	2	3.28	0.0042	0.0651	0.48	4.47	0.0103	0.1014	0.98	0.26	0.0144	0.1198	0.58	3.58	0.0052	0.0723	0.84
1981	3	5.74	0.0040	0.0629	0.84	3.36	0.0059	0.0768	0.74	0.37	0.0034	0.0582	0.82	6.37	0.0093	0.0963	1.50
1981	4	5.51	0.0025	0.0496	0.80	5.78	0.0132	0.1151	1.27	0.35	0.0049	0.0700	0.79	3.53	0.0031	0.0553	0.83
1982	1	3.94	0.0017	0.0414	0.57	5.54	0.0057	0.0757	1.22	0.85	0.0138	0.1175	1.91	3.80	0.0034	0.0583	0.90
1982	2	5.40	0.0031	0.0553	0.79	4.77	0.0095	0.0977	1.05	0.13	0.0363	0.1904	0.30	3.82	0.0064	0.0802	0.90
1982	3	4.74	0.0023	0.0479	0.69	2.53	0.0053	0.0730	0.56	0.27	0.0056	0.0747	0.61	3.92	0.0038	0.0617	0.93
1982	4	9.88	0.0017	0.0412	1.44	3.33	0.0132	0.1151	0.73	0.44	0.0110	0.1046	1.00	3.13	0.0032	0.0561	0.74
1983	1	4.99	0.0013	0.0362	0.73	6.10	0.0109	0.1044	1.34	0.37	0.0192	0.1386	0.84	4.39	0.0022	0.0469	1.04
1983	2	5.91	0.0017	0.0412	0.86	2.27	0.0183	0.1354	0.50	0.41	0.0080	0.0894	0.92	7.78	0.0090	0.0949	1.84
1983	3	4.38	0.0042	0.0648	0.64	2.52	0.0061	0.0784	0.55	0.26	0.0041	0.0643	0.59	3.67	0.0018	0.0429	0.87
1983	4	10.50	0.0023	0.0476	1.53	7.51	0.0155	0.1244	1.65	0.37	0.0058	0.0763	0.84	4.50	0.0026	0.0514	1.06
1984	1	5.53	0.0018	0.0420	0.80	8.56	0.0113	0.1063	1.89	0.52	0.0076	0.0873	1.17	5.53	0.0022	0.0470	1.30
1984	2	6.07	0.0025	0.0505	0.88	3.97	0.0178	0.1333	0.87	0.44	0.0050	0.0705	1.00	6.33	0.0038	0.0615	1.49
1984	3	6.80	0.0041	0.0636	0.99	3.63	0.0059	0.0768	0.80	0.29	0.0043	0.0652	0.66	2.95	0.0022	0.0468	0.70
1984	4	6.95	0.0025	0.0500	1.01	9.26	0.0124	0.1114	2.04	0.49	0.0047	0.0688	1.10	4.98	0.0027	0.0523	1.18
1985	1	5.82	0.0017	0.0411	0.85	8.18	0.0111	0.1053	1.80	0.57	0.0116	0.1076	1.28	4.20	0.0015	0.0392	0.99
1985	2	5.49	0.0022	0.0469	0.80	1.80	0.0086	0.0930	0.40	0.59	0.0036	0.0597	1.32	6.91	0.0038	0.0616	1.63
1985	3	6.08	0.0023	0.0474	0.89	2.49	0.0051	0.0714	0.55	0.32	0.0032	0.0562	0.72	5.24	0.0026	0.0505	1.24
1985	4	12.07	0.0016	0.0401	1.76	4.93	0.0135	0.1164	1.08	0.27	0.0060	0.0773	0.61	4.28	0.0045	0.0673	1.01
1986	1	9.22	0.0014	0.0371	1.34	9.84	0.0077	0.0878	2.17	0.39	0.0055	0.0744	0.88	4.20	0.0014	0.0367	0.99
1986	2	10.92	0.0020	0.0452	1.59	1.88	0.0081	0.0901	0.41	0.58	0.0135	0.1160	1.31	7.39	0.0082	0.0903	1.74
1986	3	8.29	0.0031	0.0553	1.21	1.62	0.0056	0.0751	0.36	0.27	0.0036	0.0599	0.62	5.06	0.0039	0.0624	1.19
1986	4	9.86	0.0020	0.0442	1.44	3.55	0.0273	0.1651	0.78	0.27	0.0038	0.0615	0.61	4.02	0.0025	0.0502	0.95

Appendix table 7. Quarterly value of yellowfin CPUE for 1963-2011 for each of five areas with LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1987	1	6.67	0.0014	0.0377	0.97	7.58	0.0112	0.1059	1.67	0.23	0.0045	0.0670	0.52	4.61	0.0017	0.0408	1.09
1987	2	6.48	0.0020	0.0446	0.94	6.29	0.0103	0.1014	1.39	1.02	0.0185	0.1360	2.31	5.91	0.0568	0.2384	1.39
1987	3	4.16	0.0051	0.0716	0.61	2.74	0.0050	0.0710	0.60	0.29	0.0038	0.0616	0.65	3.71	0.0149	0.1221	0.87
1987	4	9.94	0.0028	0.0528	1.45	4.96	0.0141	0.1188	1.09	0.33	0.0048	0.0693	0.73	4.19	0.0021	0.0457	0.99
1988	1	9.95	0.0015	0.0383	1.45	12.21	0.0120	0.1093	2.69	0.59	0.0118	0.1087	1.32	5.14	0.0017	0.0415	1.21
1988	2	6.77	0.0022	0.0471	0.99	3.62	0.0083	0.0913	0.80	1.04	0.0145	0.1202	2.34	5.64	0.0569	0.2385	1.33
1988	3	4.15	0.0045	0.0672	0.60	3.24	0.0050	0.0707	0.71	0.26	0.0050	0.0710	0.58	7.38	0.0052	0.0719	1.74
1988	4	5.54	0.0026	0.0511	0.81	7.43	0.0131	0.1144	1.64	0.28	0.0067	0.0817	0.64	4.69	0.0022	0.0468	1.11
1989	1	4.07	0.0015	0.0393	0.59	7.40	0.0147	0.1213	1.63	0.90	0.0134	0.1157	2.03	5.01	0.0032	0.0567	1.18
1989	2	4.03	0.0030	0.0548	0.59	3.25	0.0079	0.0888	0.72	0.93	0.0289	0.1701	2.09	5.67	0.0135	0.1163	1.34
1989	3	2.91	0.0214	0.1464	0.42	2.03	0.0049	0.0700	0.45	0.26	0.0068	0.0825	0.59	2.59	0.0062	0.0789	0.61
1989	4	7.57	0.0044	0.0661	1.10	6.14	0.0111	0.1056	1.35	0.29	0.0063	0.0796	0.65	2.55	0.0047	0.0682	0.60
1990	1	7.99	0.0023	0.0479	1.16	15.38	0.0095	0.0976	3.39	0.42	0.0057	0.0753	0.94	4.97	0.0020	0.0441	1.17
1990	2	5.13	0.0037	0.0604	0.75	2.96	0.0085	0.0923	0.65	0.13	0.0363	0.1906	0.30	8.10	0.0219	0.1481	1.91
1990	3	5.51	0.0126	0.1122	0.80	1.28	0.0048	0.0690	0.28	0.29	0.0037	0.0606	0.67	7.87	0.0060	0.0775	1.86
1990	4	6.37	0.0031	0.0554	0.93	2.04	0.0215	0.1465	0.45	0.20	0.0076	0.0874	0.46	2.64	0.0029	0.0537	0.62
1991	1	7.51	0.0021	0.0463	1.09	3.34	0.0079	0.0891	0.74	0.50	0.0081	0.0901	1.12	3.48	0.0023	0.0480	0.82
1991	2	7.59	0.0091	0.0952	1.11	2.37	0.0065	0.0804	0.52	0.24	0.0129	0.1137	0.55	3.02	0.0244	0.1563	0.71
1991	3	2.48	0.0093	0.0966	0.36	1.84	0.0045	0.0667	0.40	0.25	0.0024	0.0491	0.57	2.23	0.0135	0.1161	0.52
1991	4	5.89	0.0089	0.0944	0.86	3.16	0.0130	0.1140	0.70	0.15	0.0025	0.0500	0.34	2.51	0.0043	0.0655	0.59
1992	1	5.84	0.0038	0.0619	0.85	3.78	0.0058	0.0759	0.83	0.16	0.0107	0.1033	0.36	3.22	0.0039	0.0627	0.76
1992	2	7.38	0.0055	0.0743	1.07	1.98	0.0051	0.0716	0.44	0.17	0.0075	0.0866	0.38	2.32	0.1036	0.3219	0.55
1992	3	3.03	0.0228	0.1511	0.44	2.91	0.0037	0.0612	0.64	0.19	0.0043	0.0652	0.44	3.68	0.0173	0.1317	0.87
1992	4	4.12	0.0035	0.0595	0.60	4.08	0.0258	0.1605	0.90	0.10	0.0044	0.0661	0.23	2.52	0.0076	0.0873	0.59
1993	1	3.84	0.0044	0.0667	0.56	8.08	0.0064	0.0803	1.78	0.14	0.0191	0.1383	0.32	1.89	0.0037	0.0604	0.45
1993	2	4.37	0.0035	0.0593	0.64	2.76	0.0057	0.0752	0.61	0.16	0.0117	0.1079	0.37	5.50	0.0314	0.1771	1.30
1993	3	3.65	0.0056	0.0751	0.53	3.84	0.0040	0.0633	0.84	0.15	0.0025	0.0496	0.34	2.15	0.0080	0.0895	0.51
1993	4	5.48	0.0025	0.0498	0.80	4.22	0.0228	0.1511	0.93	0.16	0.0030	0.0544	0.37	2.45	0.0059	0.0769	0.58
1994	1	4.43	0.0024	0.0489	0.65	4.96	0.0045	0.0671	1.09	0.20	0.0048	0.0691	0.44	1.46	0.0032	0.0566	0.34
1994	2	5.36	0.0032	0.0565	0.78	2.30	0.0034	0.0587	0.51	0.29	0.0033	0.0578	0.66	1.61	0.2087	0.4569	0.38
1994	3	2.81	0.0073	0.0857	0.41	2.80	0.0033	0.0578	0.62	0.25	0.0022	0.0471	0.57	3.76	0.0218	0.1476	0.89
1994	4	2.99	0.0023	0.0480	0.44	2.65	0.0074	0.0860	0.58	0.21	0.0017	0.0412	0.47	1.87	0.0044	0.0661	0.44
1995	1	2.70	0.0035	0.0594	0.39	3.61	0.0039	0.0624	0.79	0.31	0.0022	0.0471	0.70	2.03	0.0028	0.0529	0.48
1995	2	2.18	0.0056	0.0748	0.32	2.00	0.0035	0.0594	0.44	0.19	0.0027	0.0519	0.44	3.11	0.0164	0.1282	0.73
1995	3	2.85	0.0111	0.1053	0.42	2.02	0.0038	0.0619	0.44	0.28	0.0013	0.0360	0.63	1.21	0.0065	0.0806	0.29
1995	4	5.01	0.0021	0.0454	0.73	6.88	0.0116	0.1075	1.51	0.17	0.0014	0.0369	0.39	2.03	0.0030	0.0550	0.48
1996	1	6.39	0.0023	0.0480	0.93	3.66	0.0035	0.0596	0.81	0.22	0.0022	0.0465	0.50	2.16	0.0026	0.0505	0.51
1996	2	4.46	0.0029	0.0539	0.65	1.41	0.0036	0.0600	0.31	0.32	0.0022	0.0465	0.73	1.57	0.0273	0.1653	0.37
1996	3	2.76	0.0033	0.0574	0.40	2.09	0.0034	0.0580	0.46	0.34	0.0016	0.0395	0.78	1.75	0.0123	0.1110	0.41
1996	4	2.46	0.0013	0.0364	0.36	5.05	0.0051	0.0712	1.11	0.22	0.0017	0.0412	0.50	1.61	0.0029	0.0539	0.38
1997	1	4.09	0.0014	0.0377	0.60	3.54	0.0034	0.0583	0.78	0.42	0.0084	0.0916	0.94	1.78	0.0014	0.0372	0.42
1997	2	2.09	0.0015	0.0383	0.30	1.47	0.0035	0.0594	0.32	0.25	0.0037	0.0607	0.57	1.95	0.0252	0.1589	0.46
1997	3	3.74	0.0025	0.0495	0.54	1.54	0.0034	0.0587	0.34	0.23	0.0014	0.0371	0.53	3.66	0.0054	0.0737	0.86
1997	4	4.12	0.0010	0.0324	0.60	2.26	0.0042	0.0649	0.50	0.26	0.0021	0.0460	0.60	1.08	0.0020	0.0451	0.25
1998	1	3.52	0.0009	0.0308	0.51	3.00	0.0033	0.0571	0.66	0.31	0.0107	0.1036	0.69	1.97	0.0014	0.0369	0.46
1998	2	3.20	0.0012	0.0341	0.47	1.26	0.0035	0.0590	0.28	0.29	0.0047	0.0682	0.65	1.93	0.0073	0.0854	0.46
1998	3	3.05	0.0022	0.0466	0.44	1.25	0.0035	0.0588	0.27	0.23	0.0023	0.0478	0.51	1.06	0.0044	0.0665	0.25
1998	4	4.03	0.0018	0.0423	0.59	2.91	0.0039	0.0626	0.64	0.24	0.0027	0.0521	0.55	1.71	0.0020	0.0442	0.40

Appendix table 7. Quarterly value of yellowfin CPUE for 1963-2011 for each of five areas with LT5LN5 expressed in real scale and relative scale with standard error of log CPUE. Dev: square of CV (std_err).
(continued)

		AREA2				AREA3				AREA4				AREA5			
yr	qt	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative	CPUE	Dev	std_err	Relative
1999	1	3.37	0.0021	0.0458	0.49	2.94	0.0036	0.0597	0.65	0.36	0.0064	0.0799	0.82	2.81	0.0016	0.0401	0.66
1999	2	3.63	0.0038	0.0619	0.53	1.32	0.0037	0.0610	0.29	0.42	0.0037	0.0608	0.94	2.07	0.0052	0.0721	0.49
1999	3	3.95	0.0039	0.0626	0.58	1.77	0.0039	0.0626	0.39	0.29	0.0022	0.0466	0.66	2.00	0.0021	0.0460	0.47
1999	4	3.44	0.0014	0.0368	0.50	3.94	0.0041	0.0639	0.87	0.34	0.0048	0.0694	0.76	1.58	0.0012	0.0348	0.37
2000	1	3.63	0.0013	0.0358	0.53	3.14	0.0038	0.0619	0.69	0.42	0.0071	0.0843	0.94	1.72	0.0015	0.0393	0.41
2000	2	3.17	0.0028	0.0533	0.46	1.21	0.0050	0.0704	0.27	0.30	0.0032	0.0563	0.68	3.64	0.0016	0.0404	0.86
2000	3	6.13	0.0030	0.0547	0.89	1.50	0.0040	0.0633	0.33	0.32	0.0021	0.0453	0.73	3.75	0.0026	0.0512	0.88
2000	4	4.38	0.0019	0.0436	0.64	1.95	0.0044	0.0661	0.43	0.19	0.0039	0.0625	0.43	1.77	0.0028	0.0527	0.42
2001	1	4.02	0.0032	0.0567	0.59	4.56	0.0039	0.0624	1.00	0.10	0.0043	0.0654	0.22	1.66	0.0015	0.0384	0.39
2001	2	4.92	0.0024	0.0495	0.72	1.42	0.0052	0.0721	0.31	0.29	0.0037	0.0604	0.64	1.67	0.0028	0.0531	0.39
2001	3	3.69	0.0037	0.0607	0.54	1.76	0.0040	0.0629	0.39	0.31	0.0015	0.0388	0.70	1.33	0.0036	0.0596	0.31
2001	4	4.92	0.0024	0.0490	0.72	2.24	0.0049	0.0702	0.49	0.36	0.0017	0.0415	0.81	1.02	0.0036	0.0600	0.24
2002	1	5.62	0.0016	0.0402	0.82	3.79	0.0036	0.0603	0.83	0.30	0.0037	0.0606	0.68	1.21	0.0036	0.0603	0.29
2002	2	3.28	0.0023	0.0476	0.48	2.20	0.0056	0.0747	0.48	0.27	0.0053	0.0728	0.60	1.66	0.0060	0.0776	0.39
2002	3	1.27	0.0027	0.0521	0.18	1.57	0.0044	0.0664	0.35	0.22	0.0017	0.0411	0.49	0.83	0.0031	0.0553	0.20
2002	4	2.31	0.0012	0.0344	0.34	2.31	0.0064	0.0801	0.51	0.18	0.0020	0.0449	0.40	0.92	0.0013	0.0359	0.22
2003	1	3.32	0.0015	0.0384	0.48	4.06	0.0040	0.0634	0.89	0.15	0.0136	0.1165	0.33	1.02	0.0020	0.0445	0.24
2003	2	3.88	0.0021	0.0454	0.57	2.07	0.0057	0.0757	0.45	0.85	0.0090	0.0947	1.91	0.88	0.0172	0.1311	0.21
2003	3	3.70	0.0030	0.0550	0.54	1.77	0.0050	0.0704	0.39	0.36	0.0026	0.0508	0.82	0.73	0.0080	0.0892	0.17
2003	4	4.03	0.0012	0.0353	0.59	2.87	0.0066	0.0812	0.63	0.27	0.0030	0.0551	0.60	1.53	0.0027	0.0519	0.36
2004	1	2.65	0.0012	0.0348	0.39	3.31	0.0040	0.0632	0.73	0.63	0.0194	0.1391	1.42	1.14	0.0033	0.0574	0.27
2004	2	5.27	0.0019	0.0435	0.77	2.88	0.0053	0.0729	0.63	0.31	0.0071	0.0843	0.69	2.63	0.0101	0.1005	0.62
2004	3	2.05	0.0023	0.0476	0.30	2.42	0.0034	0.0587	0.53	0.33	0.0026	0.0508	0.74	1.23	0.0043	0.0655	0.29
2004	4	3.94	0.0015	0.0386	0.57	2.23	0.0046	0.0680	0.49	0.24	0.0033	0.0570	0.54	0.91	0.0024	0.0494	0.22
2005	1	3.76	0.0011	0.0327	0.55	5.09	0.0039	0.0624	1.12	0.19	0.0074	0.0860	0.43	0.87	0.0030	0.0548	0.21
2005	2	4.95	0.0014	0.0373	0.72	2.74	0.0041	0.0640	0.60	0.35	0.0091	0.0952	0.78	1.10	0.0084	0.0914	0.26
2005	3	1.80	0.0016	0.0396	0.26	1.57	0.0033	0.0574	0.35	0.19	0.0052	0.0720	0.43	1.04	0.0117	0.1080	0.25
2005	4	2.41	0.0011	0.0331	0.35	3.88	0.0046	0.0678	0.85	0.18	0.0030	0.0546	0.41	0.69	0.0039	0.0623	0.16
2006	1	3.94	0.0010	0.0322	0.57	5.06	0.0037	0.0605	1.11	0.17	0.0055	0.0744	0.39	1.44	0.0018	0.0429	0.34
2006	2	4.53	0.0010	0.0309	0.66	2.90	0.0036	0.0598	0.64	0.44	0.0130	0.1142	0.99	2.09	0.0032	0.0567	0.49
2006	3	1.74	0.0019	0.0437	0.25	1.59	0.0034	0.0580	0.35	0.23	0.0032	0.0562	0.52	1.18	0.0024	0.0493	0.28
2006	4	1.85	0.0011	0.0336	0.27	2.52	0.0037	0.0607	0.56	0.29	0.0054	0.0734	0.66	0.93	0.0017	0.0411	0.22
2007	1	1.91	0.0009	0.0304	0.28	3.50	0.0035	0.0595	0.77	0.20	0.0167	0.1294	0.44	1.24	0.0015	0.0382	0.29
2007	2	1.80	0.0008	0.0286	0.26	3.04	0.0042	0.0650	0.67	0.39	0.0067	0.0815	0.87	1.47	0.0025	0.0504	0.35
2007	3	1.53	0.0017	0.0410	0.22	1.10	0.0035	0.0592	0.24	0.24	0.0028	0.0525	0.54	1.06	0.0033	0.0578	0.25
2007	4	1.93	0.0013	0.0361	0.28	1.98	0.0048	0.0696	0.44	0.22	0.0069	0.0828	0.49	1.07	0.0017	0.0416	0.25
2008	1	1.12	0.0013	0.0364	0.16	3.02	0.0041	0.0640	0.66	0.13	0.0106	0.1031	0.28	0.74	0.0015	0.0381	0.17
2008	2	1.32	0.0011	0.0332	0.19	1.67	0.0050	0.0709	0.37	0.15	0.0033	0.0574	0.35	0.44	0.0036	0.0602	0.10
2008	3	1.13	0.0020	0.0450	0.16	0.99	0.0040	0.0633	0.22	0.12	0.0024	0.0493	0.27	0.53	0.0030	0.0547	0.12
2008	4	0.87	0.0016	0.0399	0.13	1.50	0.0039	0.0628	0.33	0.16	0.0066	0.0814	0.36	0.53	0.0014	0.0374	0.12
2009	1	0.69	0.0012	0.0341	0.10	1.65	0.0040	0.0631	0.36	0.15	0.0241	0.1551	0.35	0.61	0.0011	0.0333	0.14
2009	2	1.03	0.0019	0.0439	0.15	2.74	0.0057	0.0753	0.60	0.21	0.0036	0.0600	0.47	0.61	0.0024	0.0490	0.14
2009	3	2.04	0.0093	0.0966	0.30	1.61	0.0047	0.0686	0.36	0.13	0.0021	0.0456	0.29	0.63	0.0027	0.0518	0.15
2009	4	2.83	0.0072	0.0849	0.41	1.14	0.0055	0.0740	0.25	0.14	0.0080	0.0891	0.32	0.33	0.0012	0.0343	0.08
2010	1	1.61	0.0097	0.0984	0.23	1.94	0.0045	0.0674	0.43	0.11	0.0086	0.0929	0.25	0.55	0.0014	0.0373	0.13
2010	2	0.91	0.0105	0.1024	0.13	3.51	0.0064	0.0801	0.77	0.24	0.0024	0.0485	0.53	0.57	0.0062	0.0789	0.14
2010	3	5.98	0.0675	0.2597	0.87	2.01	0.0057	0.0752	0.44	0.13	0.0030	0.0544	0.29	0.44	0.0124	0.1111	0.10
2010	4	2.95	0.0452	0.2125	0.43	1.64	0.0056	0.0748	0.36	0.15	0.0279	0.1671	0.35	0.30	0.0022	0.0464	0.07