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Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2012 standardized by generalized 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 2012 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 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, 1.18-1.58 during 2008-2012. 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 and Satoh, 2012). Since 2007, piracy activities 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. At 2012 IOTC WPTT meeting, Matsumoto et al. (2012) conducted CPUE standardization by using area rate without northwest area because no effort was observed in this area due to activities of pirates, and the indices were used for stock assessment.

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), Okamoto (2011a) and Matsumoto et al. (2012) used for 2010, 2011 and 2012 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, 2011 and 2012 analyses. Although stock assessment of Indian Ocean yellowfin tuna is not scheduled this year, the indices will be useful to understand indicator of the stock.

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; Matsumoto et al., 2012). In the standardization, no environmental factor was applied in the model.

Area definition:

Area definition used in this study which consists of five areas is the same as that used in the yellowfin assessment in IOTC WPTT 2010, 2011 and 2012 (Fig. 1), although area 1 was not used because of too little effort. 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 2012 were used. Data used in this study are the catch and effort data sets aggregated by month, 1-degree square, NHF (the number of hooks between floats), and main and branch line materials. 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 1963-2012 and 1980-2012. In addition, annual and quarterly CPUE was also standardized for each of five areas for 1963-2012 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 2012

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 2012

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 2012 (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 2012 (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 2012 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). To see effects of each component (fishing gear and season), the model for year based CPUE in the whole Indian Ocean without 2011 data was used.

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 2012 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 the 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, 1.18-1.58 during 2008-2012. 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 until 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 quarter followed by 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.

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

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Table 1. ANOVA table of GLM for year based CPUE standardization for main fishing ground and whole Indian Ocean (with and without Area2) for 1963-2012.

1963-2012 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	331	70291.3	212.36	254.2	<.0001	0.32
						CV =
yr	49	11616.4	237.1	283.8	<.0001	60.37
qt	3	3261.9	1087.3	1301.5	<.0001	
area	2	2306.4	1153.2	1380.5	<.0001	
nhfcl	5	553.3	110.7	132.5	<.0001	
bl	1	21.1	21.1	25.3	<.0001	
ml	1	139.6	139.6	167.1	<.0001	
yr*qt	147	4898.6	33.3	39.9	<.0001	
qt*area	6	5288.2	881.4	1055.0	<.0001	
yr*area	97	5168.5	53.3	63.8	<.0001	
area*nhfcl	10	743.8	74.4	89.0	<.0001	
nhfcl*ml	5	286.0	57.2	68.5	<.0001	
nhfcl*bl	5	64.4	12.9	15.4	<.0001	

1963-2012 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	389	168494.9	433.1	503.6	<.0001	0.45
						CV =
yr	49	14100.7	287.8	334.6	<.0001	82.39
qt	3	4046.6	1348.9	1568.2	<.0001	
area	3	9502.5	3167.5	3682.5	<.0001	
nhfcl	5	548.3	109.7	127.5	<.0001	
bl	1	50.5	50.5	58.8	<.0001	
ml	1	79.3	79.3	92.2	<.0001	
yr*qt	147	5454.1	37.1	43.1	<.0001	
qt*area	9	6834.2	759.4	882.8	<.0001	
yr*area	146	7960.3	54.5	63.4	<.0001	
area*nhfcl	15	979.9	65.3	76.0	<.0001	
nhfcl*ml	5	393.0	78.6	91.4	<.0001	
nhfcl*bl	5	98.6	19.7	22.9	<.0001	

1963-2012 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	274	44260.4	161.5	177.8	<.0001	0.31
						CV =
yr	49	7121.4	145.3	160.0	<.0001	73.48
qt	3	4510.3	1503.4	1655.1	<.0001	
area	1	1506.0	1506.0	1657.9	<.0001	
nhfcl	5	412.0	82.4	90.7	<.0001	
bl	1	16.6	16.6	18.3	<.0001	
ml	1	74.2	74.2	81.7	<.0001	
yr*qt	147	3696.7	25.1	27.7	<.0001	
qt*area	3	3714.6	1238.2	1363.1	<.0001	
yr*area	49	2787.5	56.9	62.6	<.0001	
area*nhfcl	5	645.5	129.1	142.1	<.0001	
nhfcl*ml	5	220.3	44.1	48.5	<.0001	
nhfcl*bl	5	42.5	8.5	9.4	<.0001	

1963-2012 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	332	126280.7	380.4	395.0	<.0001	0.45
						CV =
yr	49	10914.6	222.7	231.3	<.0001	132.29
qt	3	5679.6	1893.2	1966.2	<.0001	
area	2	7423.3	3711.7	3854.8	<.0001	
nhfcl	5	512.4	102.5	106.4	<.0001	
bl	1	50.0	50.0	51.9	<.0001	
ml	1	21.7	21.7	22.5	<.0001	
yr*qt	147	4814.7	32.8	34.0	<.0001	
qt*area	6	5698.4	949.7	986.4	<.0001	
yr*area	98	4780.9	48.8	50.7	<.0001	
area*nhfcl	10	893.6	89.4	92.8	<.0001	
nhfcl*ml	5	282.3	56.5	58.6	<.0001	
nhfcl*bl	5	76.9	15.4	16.0	<.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 1963-2012.

1963-2012 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	621	76413.7	123.0	153.1	<.0001	0.344184
						CV =
yr	49	9673.1	197.4	245.7	<.0001	59.23271
qt	3	2085.2	695.1	865.0	<.0001	
area	2	1562.1	781.0	971.9	<.0001	
nhfcl	5	502.9	100.6	125.2	<.0001	
bl	1	16.9	16.9	21.1	<.0001	
ml	1	134.6	134.6	167.5	<.0001	
yr*qt*area	540	22570.1	41.8	52.0	<.0001	
area*nhfcl	10	733.0	73.3	91.2	<.0001	
nhfcl*ml	5	244.6	48.9	60.9	<.0001	
nhfcl*bl	5	50.4	10.1	12.5	<.0001	

1963-2012 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	826	178987.2	216.7	265.0	<.0001	0.480903
						CV =
yr	49	11025.8	225.0	275.2	<.0001	80.36211
qt	3	2838.3	946.1	1157.0	<.0001	
area	3	8347.5	2782.5	3402.7	<.0001	
nhfcl	5	449.3	89.9	109.9	<.0001	
bl	1	41.0	41.0	50.1	<.0001	
ml	1	85.5	85.5	104.6	<.0001	
yr*qt*area	739	32090.7	43.4	53.1	<.0001	
area*nhfcl	15	988.1	65.9	80.6	<.0001	
nhfcl*ml	5	328.1	65.6	80.2	<.0001	
nhfcl*bl	5	84.5	16.9	20.7	<.0001	

1963-2012 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	421	47788.6	113.5	129.4	<.0001	0.338845
						CV =
yr	49	15942.9	325.4	370.9	<.0001	72.26792
qt	3	5940.1	1980.0	2257.0	<.0001	
area	1	3204.4	3204.4	3652.6	<.0001	
nhfcl	5	2501.9	500.4	570.4	<.0001	
bl	1	464.7	464.7	529.7	<.0001	
ml	1	163.6	163.6	186.4	<.0001	
yr*qt*area	346	18085.3	52.3	59.6	<.0001	
area*nhfcl	5	1002.6	200.5	228.6	<.0001	
nhfcl*ml	5	449.2	89.8	102.4	<.0001	
nhfcl*bl	5	33.9	6.8	7.7	<.0001	

1963-2012 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	626	134434.4	214.8	234.8	<.0001	0.476716
						CV =
yr	49	8721.1	178.0	194.6	<.0001	129.0153
qt	3	3689.7	1229.9	1344.9	<.0001	
area	2	7036.1	3518.1	3847.1	<.0001	
nhfcl	5	429.7	85.9	94.0	<.0001	
bl	1	37.3	37.3	40.7	<.0001	
ml	1	28.8	28.8	31.5	<.0001	
yr*qt*area	545	24950.6	45.8	50.1	<.0001	
area*nhfcl	10	938.0	93.8	102.6	<.0001	
nhfcl*ml	5	264.5	52.9	57.8	<.0001	
nhfcl*bl	5	72.3	14.5	15.8	<.0001	

Table 3. ANOVA table of GLM for quarterly based CPUE standardization for each area for 1963-2012.

1963-2012 MODEL2010
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	211	23516.90	111.45	152.44	<.0001	0.300
						CV =
yr	48	7426.75	154.72	211.62	<.0001	47.658
qt	3	436.02	145.34	198.79	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.44	27.49	37.60	<.0001	
bl	1	11.06	11.06	15.13	0.0001	
ml	1	0.36	0.36	0.49	0.4857	
yr*qt*area	143	3959.50	27.69	37.87	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	45.54	9.11	12.46	<.0001	
nhfcl*bl	5	51.92	10.38	14.20	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	241	28253.84	117.24	175.46	<.0001	0.361
						CV =
yr	48	6315.89	131.58	196.93	<.0001	45.559
qt	3	227.05	75.68	113.27	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.28	27.46	41.09	<.0001	
bl	1	9.04	9.04	13.53	0.0002	
ml	1	0.10	0.10	0.15	0.6949	
LT5LN5	30	4736.94	157.90	236.32	<.0001	
yr*qt*area	143	3227.04	22.57	33.77	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	42.99	8.60	12.87	<.0001	
nhfcl*bl	5	26.56	5.31	7.95	<.0001	

1963-2012 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	23158.15	107.21	101.39	<.0001	0.284
						CV =
yr	49	5067.77	103.42	97.80	<.0001	72.376
qt	3	6944.44	2314.81	2189.04	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	361.00	72.20	68.28	<.0001	
bl	1	0.01	0.01	0.01	0.9329	
ml	1	8.38	8.38	7.92	0.0049	
yr*qt*area	147	5197.24	35.36	33.43	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	257.09	51.42	48.62	<.0001	
nhfcl*bl	5	26.16	5.23	4.95	0.0002	

1963-2012 MODEL2010 + LT5LN5
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	251	36507.25	145.45	178.18	<.0001	0.448
						CV =
yr	49	2528.22	51.60	63.21	<.0001	63.590
qt	3	1919.20	639.73	783.71	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	158.61	31.72	38.86	<.0001	
bl	1	0.79	0.79	0.97	0.3248	
ml	1	1.75	1.75	2.15	0.1429	
LT5LN5	35	13349.10	381.40	467.24	<.0001	
yr*qt*area	147	2506.11	17.05	20.89	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	120.15	24.03	29.44	<.0001	
nhfcl*bl	5	20.12	4.02	4.93	0.0002	

1963-2012 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	29365.81	135.95	87.23	<.0001	0.255
						CV =
yr	49	8626.58	176.05	112.96	<.0001	−122.646
qt	3	2104.20	701.40	450.02	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	818.95	163.79	105.09	<.0001	
bl	1	27.76	27.76	17.81	<.0001	
ml	1	55.48	55.48	35.60	<.0001	
yr*qt*area	147	9746.19	66.30	42.54	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	72.82	14.56	9.34	<.0001	
nhfcl*bl	5	189.46	37.89	24.31	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	282	62415.89	221.33	230.65	<.0001	0.542
						CV =
yr	49	2948.90	60.18	62.72	<.0001	−96.234
qt	3	470.26	156.75	163.35	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	58.80	11.76	12.26	<.0001	
bl	1	7.31	7.31	7.62	0.0058	
ml	1	4.09	4.09	4.27	0.0389	
LT5LN5	66	33050.08	500.76	521.84	<.0001	
yr*qt*area	147	2763.94	18.80	19.59	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	67.75	13.55	14.12	<.0001	
nhfcl*bl	5	168.41	33.68	35.10	<.0001	

1963-2012 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	24795.14	114.79	179.77	<.0001	0.432
						CV =
yr	49	3921.56	80.03	125.33	<.0001	68.913
qt	3	217.81	72.60	113.70	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	65.88	13.18	20.63	<.0001	
bl	1	16.38	16.38	25.65	<.0001	
ml	1	4.23	4.23	6.63	0.0101	
yr*qt*area	147	1574.42	10.71	16.77	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	23.95	4.79	7.50	<.0001	
nhfcl*bl	5	28.47	5.69	8.92	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	248	25909.66	104.47	169.29	<.0001	0.451
						CV =
yr	49	3851.18	78.60	127.36	<.0001	67.746
qt	3	148.68	49.56	80.31	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	39.74	7.95	12.88	<.0001	
bl	1	9.79	9.79	15.87	<.0001	
ml	1	4.12	4.12	6.67	0.0098	
LT5LN5	32	1114.52	34.83	56.44	<.0001	
yr*qt*area	147	1521.96	10.35	16.78	<.0001	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	26.73	5.35	8.66	<.0001	
nhfcl*bl	5	24.39	4.88	7.91	<.0001	

Table 4. ANOVA table of GLM for year based CPUE standardization for each area for 1963-2012.

1963-2012 MODEL2010
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	211	23516.90	111.45	152.44	<.0001	0.300
						CV =
yr	48	7426.75	154.72	211.62	<.0001	47.658
qt	3	436.02	145.34	198.79	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.44	27.49	37.60	<.0001	
bl	1	11.06	11.06	15.13	0.0001	
ml	1	0.36	0.36	0.49	0.4857	
yr*qt	143	3959.50	27.69	37.87	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	45.54	9.11	12.46	<.0001	
nhfcl*bl	5	51.92	10.38	14.20	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 2

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	241	28253.84	117.24	175.46	<.0001	0.361
						CV =
yr	48	6315.89	131.58	196.93	<.0001	45.559
qt	3	227.05	75.68	113.27	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	137.28	27.46	41.09	<.0001	
bl	1	9.04	9.04	13.53	0.0002	
ml	1	0.10	0.10	0.15	0.6949	
LT5LN5	30	4736.94	157.90	236.32	<.0001	
yr*qt	143	3227.04	22.57	33.77	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	42.99	8.60	12.87	<.0001	
nhfcl*bl	5	26.56	5.31	7.95	<.0001	

1963-2012 MODEL2010
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	23158.15	107.21	101.39	<.0001	0.284
						CV =
yr	49	5067.77	103.42	97.80	<.0001	72.376
qt	3	6944.44	2314.81	2189.04	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	361.00	72.20	68.28	<.0001	
bl	1	0.01	0.01	0.01	0.9329	
ml	1	8.38	8.38	7.92	0.0049	
yr*qt	147	5197.24	35.36	33.43	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	257.09	51.42	48.62	<.0001	
nhfcl*bl	5	26.16	5.23	4.95	0.0002	

1963-2012 MODEL2010 + LT5LN5
Area 3

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	251	36507.25	145.45	178.18	<.0001	0.448
						CV =
yr	49	2528.22	51.60	63.21	<.0001	63.590
qt	3	1919.20	639.73	783.71	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	158.61	31.72	38.86	<.0001	
bl	1	0.79	0.79	0.97	0.3248	
ml	1	1.75	1.75	2.15	0.1429	
LT5LN5	35	13349.10	381.40	467.24	<.0001	
yr*qt	147	2506.11	17.05	20.89	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	120.15	24.03	29.44	<.0001	
nhfcl*bl	5	20.12	4.02	4.93	0.0002	

1963-2012 MODEL2010
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	29365.81	135.95	87.23	<.0001	0.255
						CV =
yr	49	8626.58	176.05	112.96	<.0001	−122.646
qt	3	2104.20	701.40	450.02	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	818.95	163.79	105.09	<.0001	
bl	1	27.76	27.76	17.81	<.0001	
ml	1	55.48	55.48	35.60	<.0001	
yr*qt	147	9746.19	66.30	42.54	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfcl	0	0.00	.	.	.	
nhfcl*ml	5	72.82	14.56	9.34	<.0001	
nhfcl*bl	5	189.46	37.89	24.31	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 4

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	282	62415.89	221.33	230.65	<.0001	0.542
						CV =
yr	49	2948.90	60.18	62.72	<.0001	−96.234
qt	3	470.26	156.75	163.35	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	58.80	11.76	12.26	<.0001	
bl	1	7.31	7.31	7.62	0.0058	
ml	1	4.09	4.09	4.27	0.0389	
LT5LN5	66	33050.08	500.76	521.84	<.0001	
yr*qt	147	2763.94	18.80	19.59	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	67.75	13.55	14.12	<.0001	
nhfcl*bl	5	168.41	33.68	35.10	<.0001	

1963-2012 MODEL2010
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	216	24795.14	114.79	179.77	<.0001	0.432
						CV =
yr	49	3921.56019	80.03184	125.33	<.0001	68.913
qt	3	217.80785	72.60262	113.7	<.0001	
area	0	0	.	.	.	
nhfcl	5	65.87752	13.1755	20.63	<.0001	
bl	1	16.380921	16.38092	25.65	<.0001	
ml	1	4.230873	4.230873	6.63	0.0101	
yr*qt	147	1574.41814	10.71033	16.77	<.0001	
qt*area	0	0	.	.	.	
yr*area	0	0	.	.	.	
area*nhfcl	0	0	.	.	.	
nhfcl*ml	5	23.948561	4.789712	7.5	<.0001	
nhfcl*bl	5	28.465015	5.693003	8.92	<.0001	

1963-2012 MODEL2010 + LT5LN5
Area 5

Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	248	25909.66	104.47	169.29	<.0001	0.451
						CV =
yr	49	3851.18	78.60	127.36	<.0001	67.746
qt	3	148.68	49.56	80.31	<.0001	
area	0	0.00	.	.	.	
nhfcl	5	39.74	7.95	12.88	<.0001	
bl	1	9.79	9.79	15.87	<.0001	
ml	1	4.12	4.12	6.67	0.0098	
LT5LN5	32	1114.52	34.83	56.44	<.0001	
yr*qt	147	1521.96	10.35	16.78	<.0001	
qt*area	0	0.00	.	.	.	
yr*area	0	0.00	.	.	.	
area*nhfc	0	0.00	.	.	.	
nhfcl*ml	5	26.73	5.35	8.66	<.0001	
nhfcl*bl	5	24.39	4.88	7.91	<.0001	

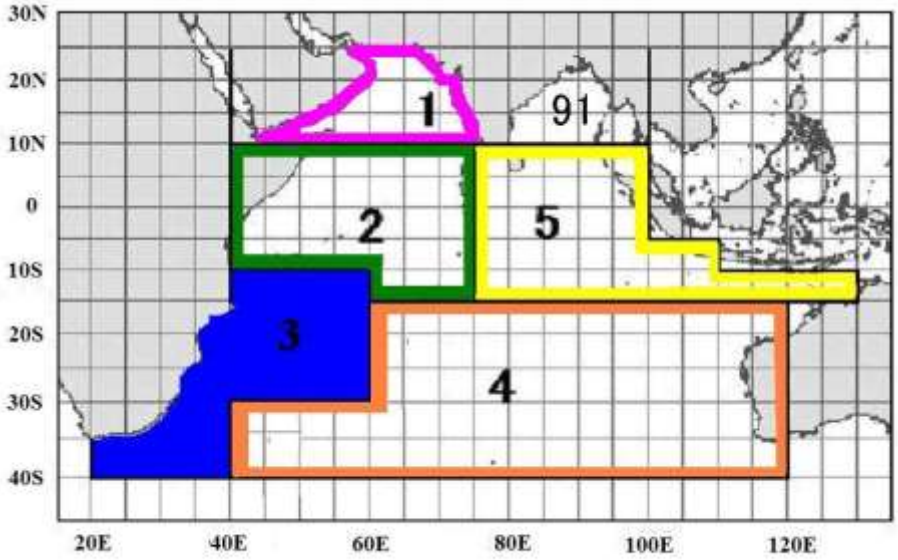


Fig. 1. Definition of sub-areas used in this study. Main fishing ground (areas 2, 3 and 5) and whole Indian Ocean (sub-areas 2-5) categories in this paper.

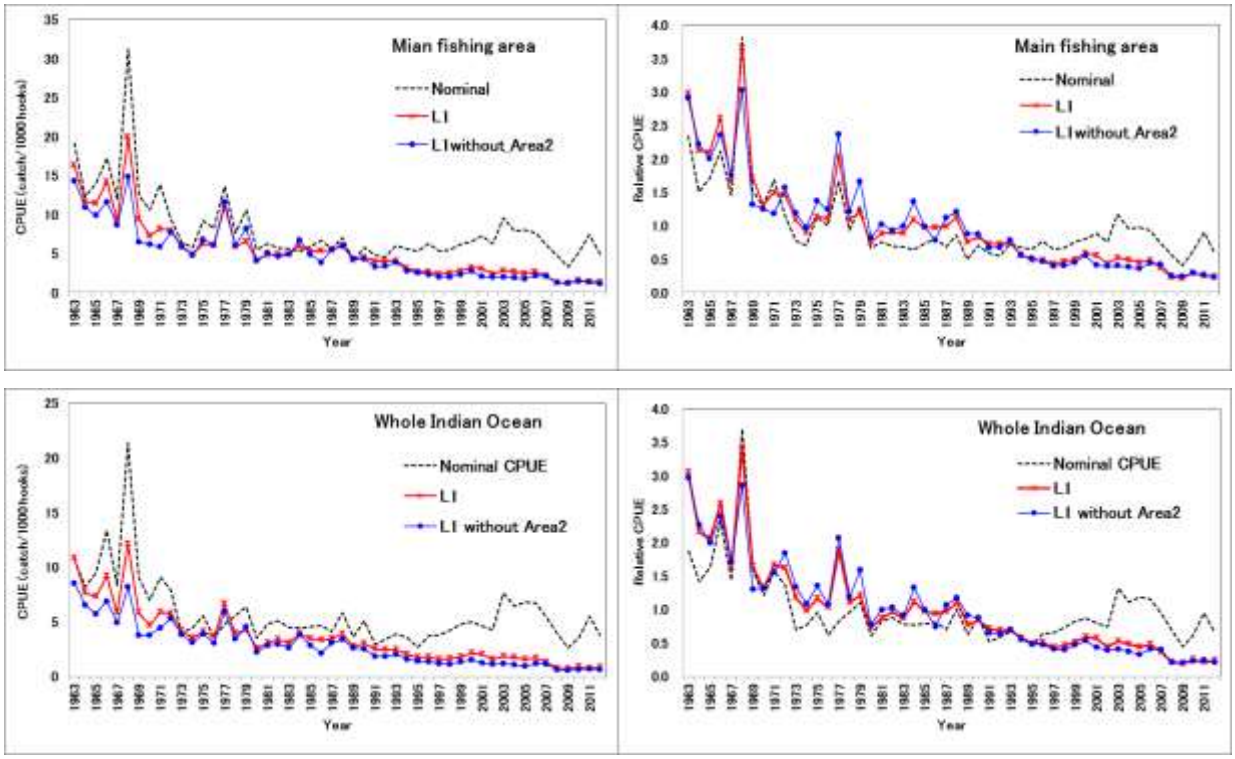


Fig. 2. Annual based area aggregated CPUE in number for 1963-2012 standardized for main fishing ground (top) and whole (bottom) Indian Ocean expressed in real (left figure) and relative (right figure) scale overlaid with nominal CPUE.

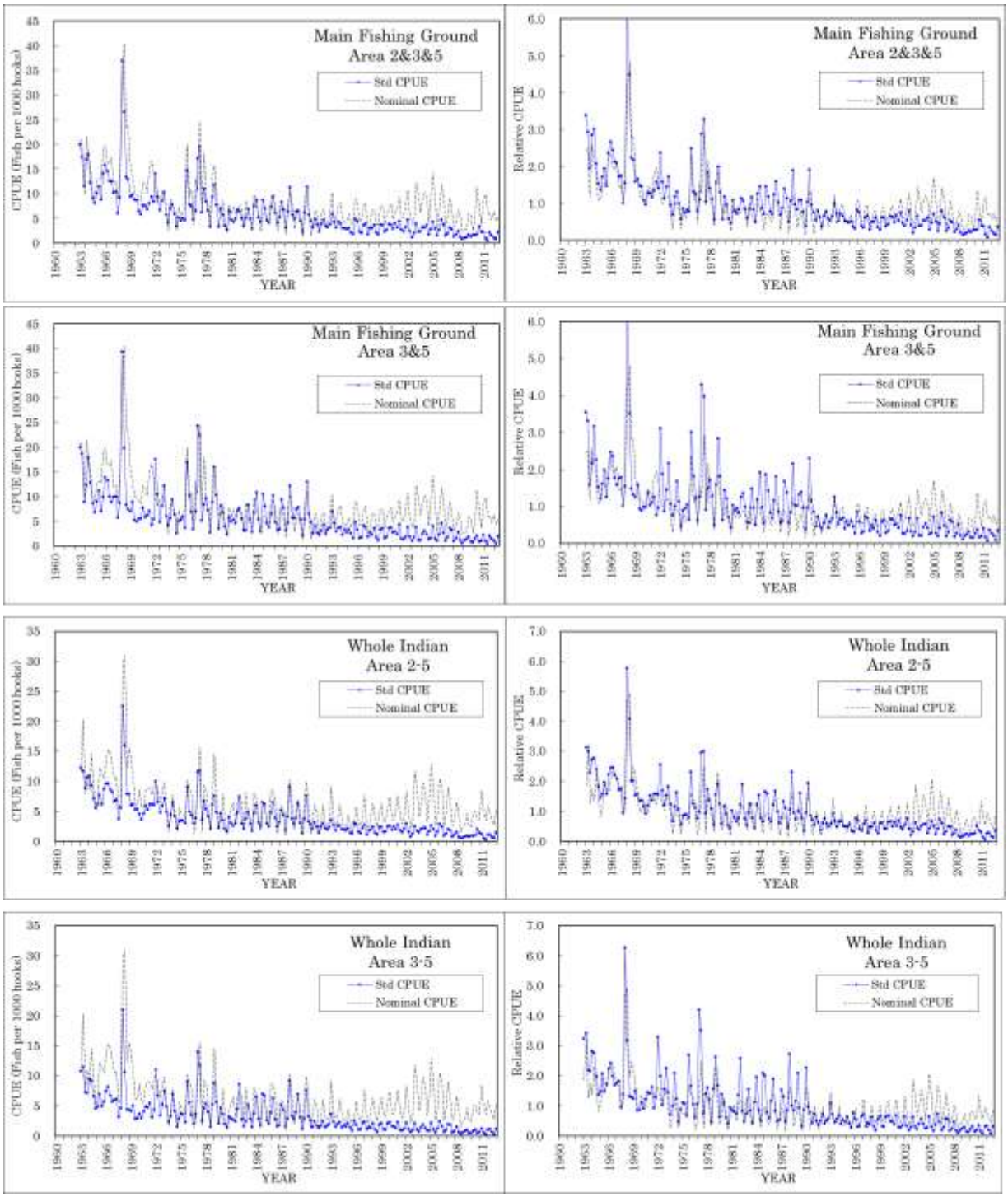
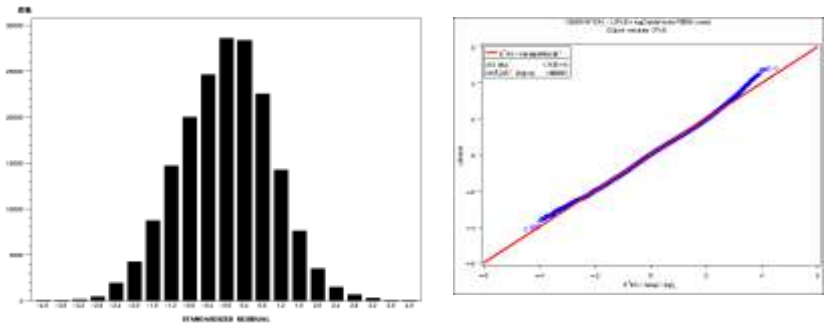
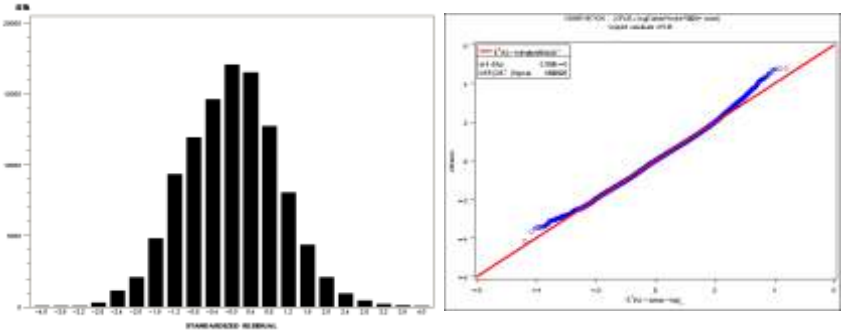


Fig. 3. Quarter based CPUE in number for 1963-2012 standardized for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2) expressed in relative (left figure) and real (right figure) scale overlaid with nominal CPUE.

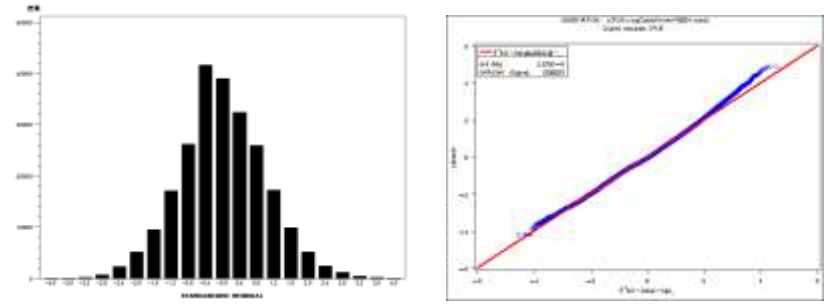
1963-2012 Year base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)



1963-2012 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)



1963-2012 Year base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

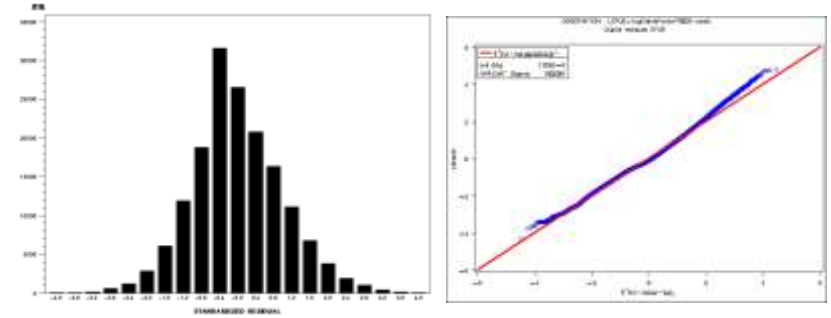
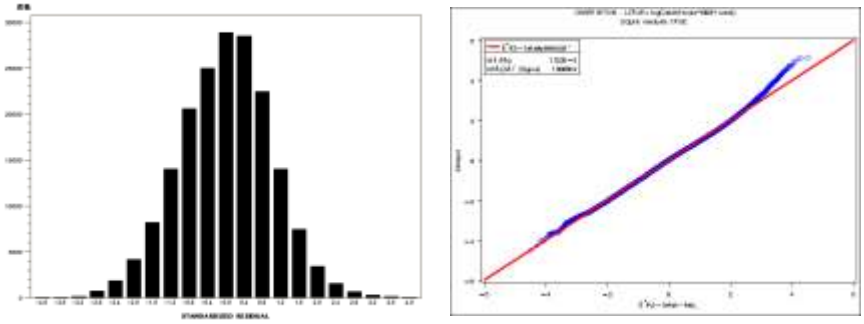
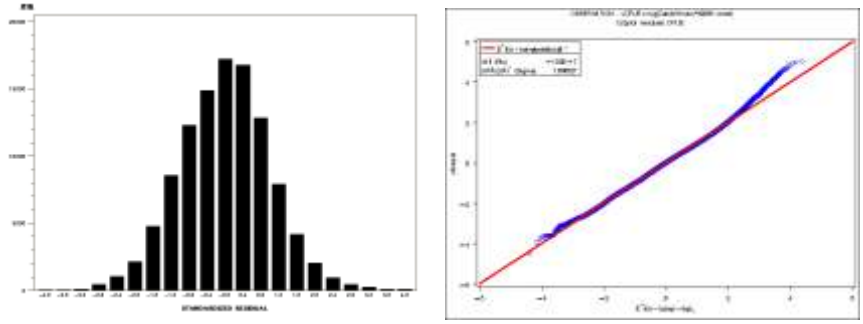


Fig. 4. Standardized residuals of annual based CPUE standardization for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2).

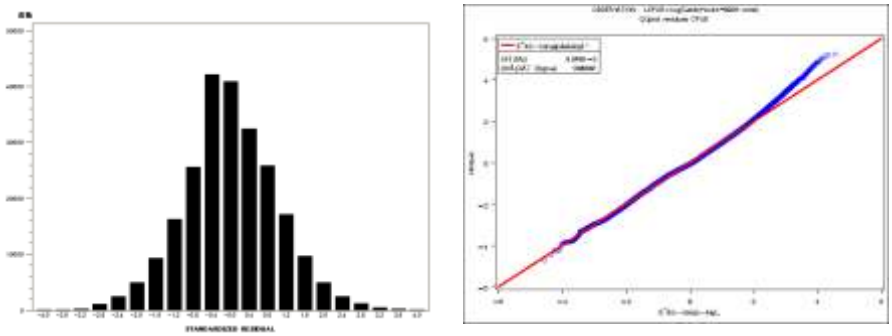
1963-2012 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 2&3&5)



1963-2012 Quarter base (1 degree X 1 degree X month)
Main Fishing Ground (Area 3&5)



1963-2012 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 2-5)



1963-2012 Quarter base (1 degree X 1 degree X month)
Whole Indian (Area 3-5)

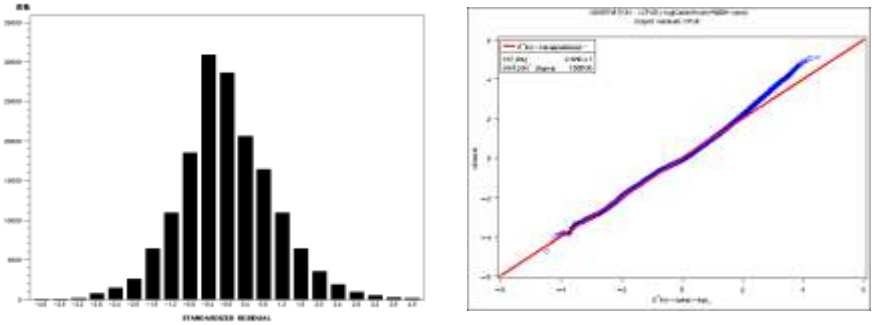


Fig. 5. Standardized residuals of quarter based CPUE standardization for main fishing ground (with and without area 2) and whole Indian Ocean (with and without area 2).

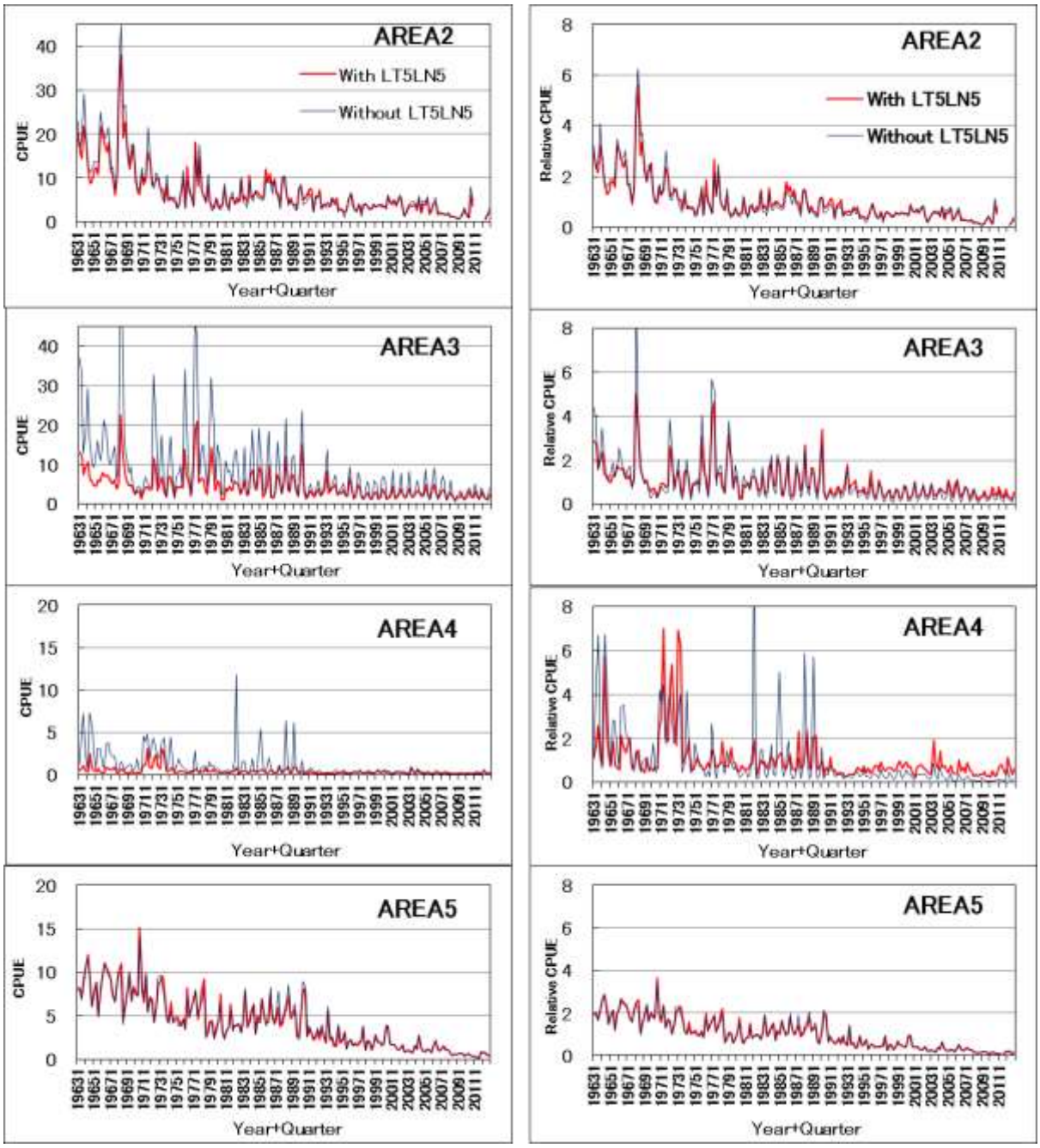


Fig. 6. Standardized quarter based CPUE in number for 1963-2012 for each five areas (with and without LT5LN5） expressed in relative (left figure) and real (right figure) scale.

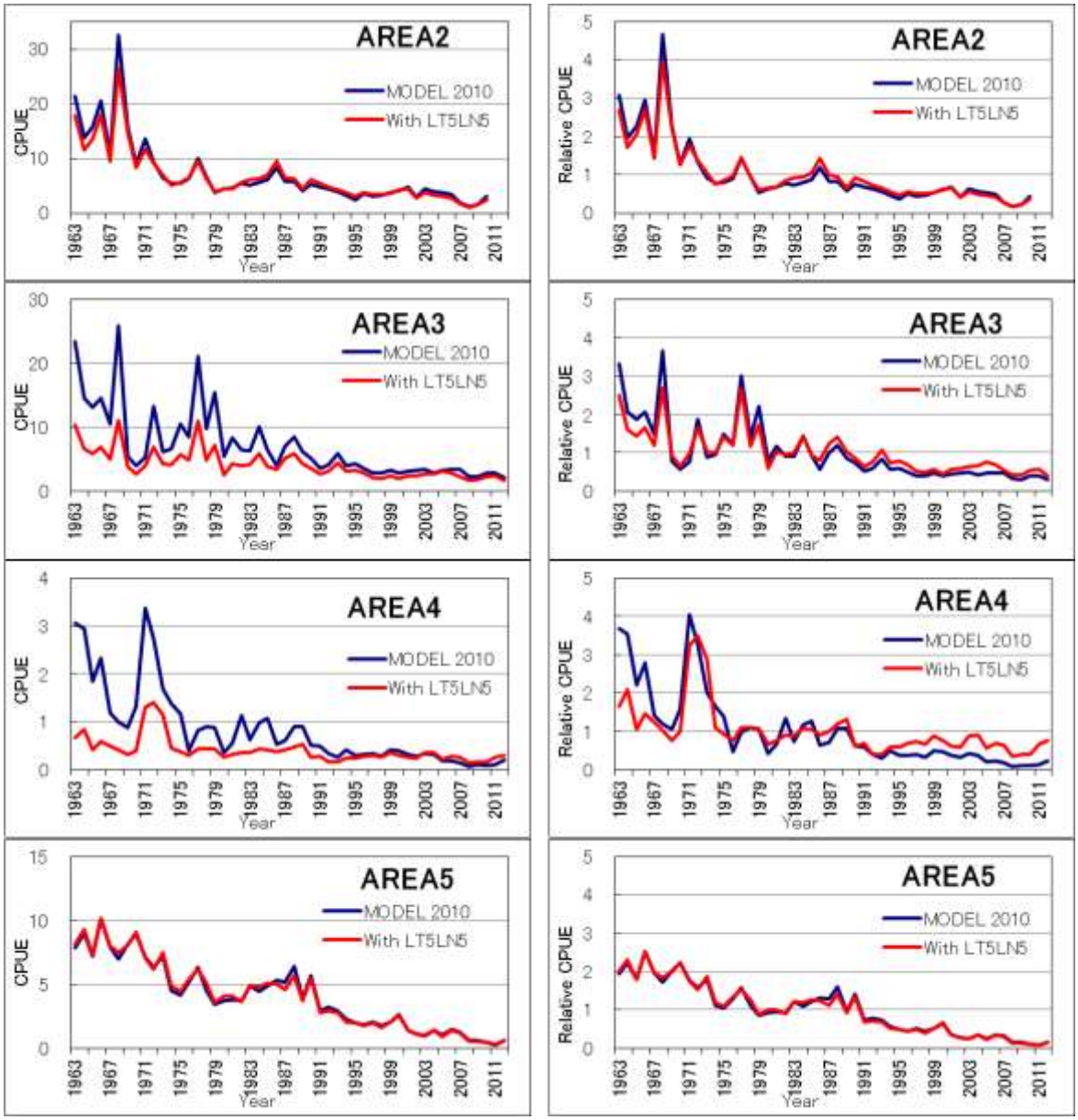


Fig. 7. Standardized quarter based CPUE in number for 1963-2012 (up to 2010 for Area 2) for each five areas with and without LT5LN5 expressed in relative (left figure) and real (right figure) scale.

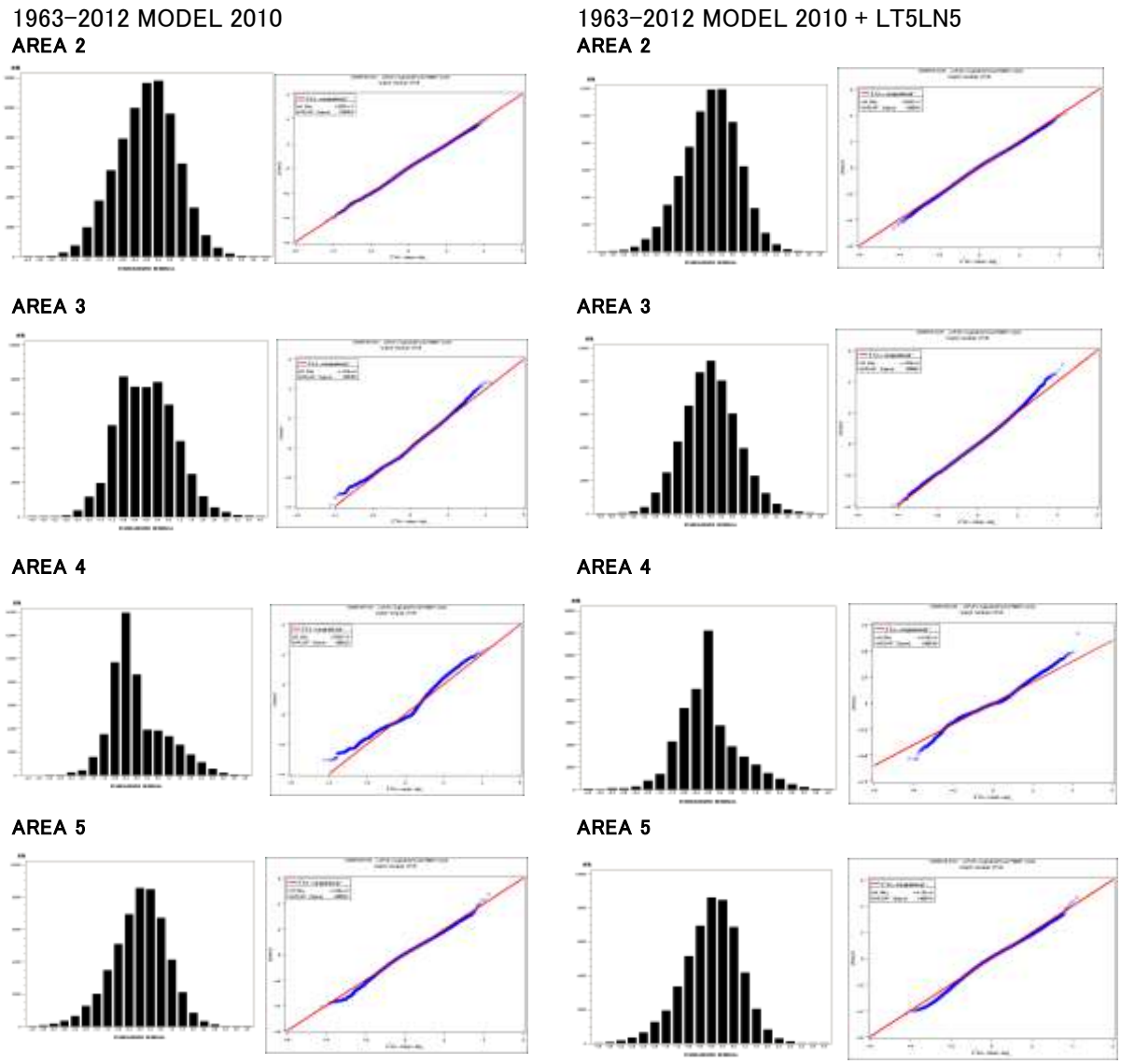


Fig. 8. Standardized residuals of quarter based CPUE standardization for each of five areas with and without LT5LN5 expressed as histograms and QQ plots.

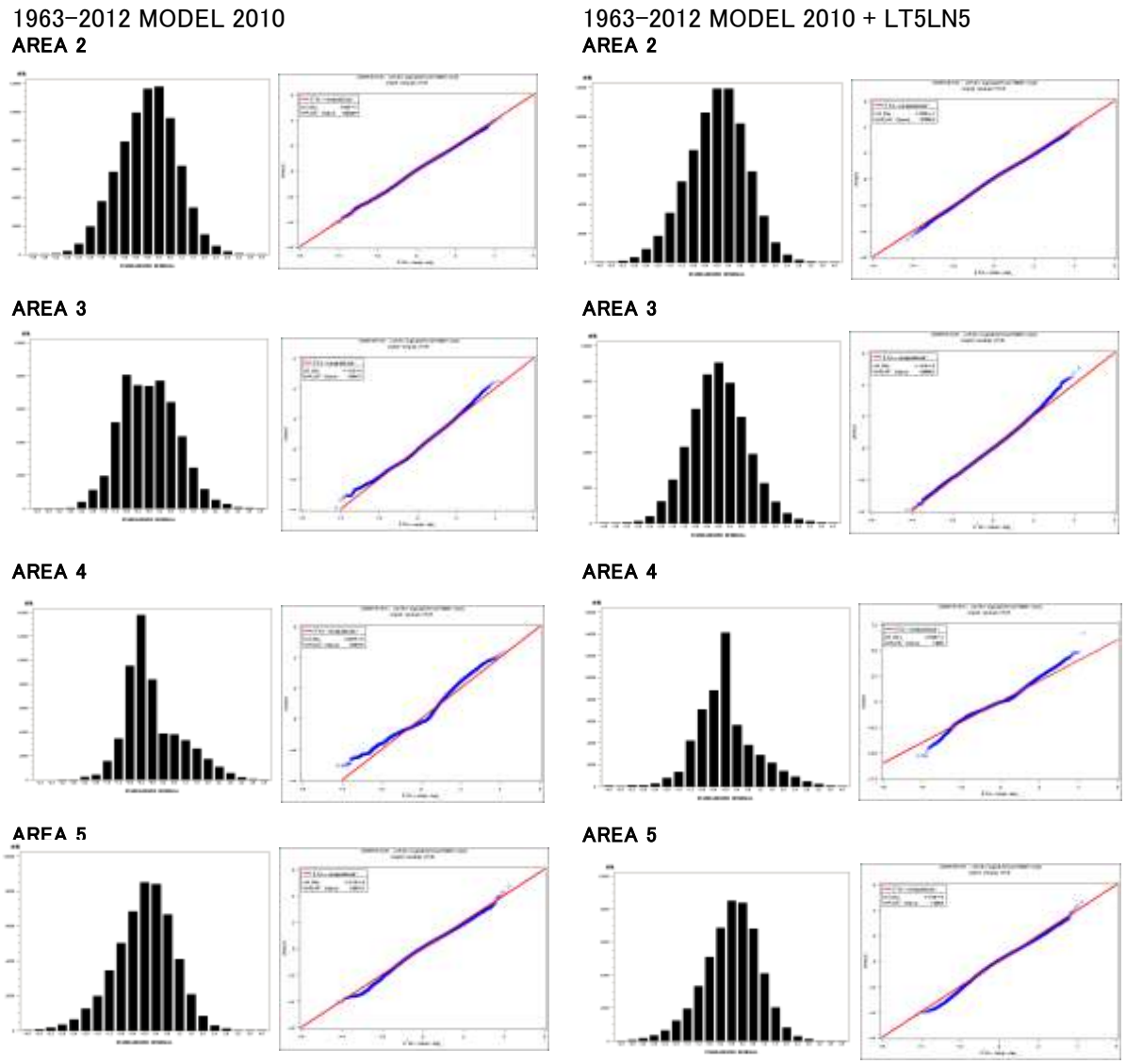


Fig. 9. Standardized residuals of annual based CPUE standardization for each of five areas with and without LT5LN5 expressed as histograms and QQ plots.

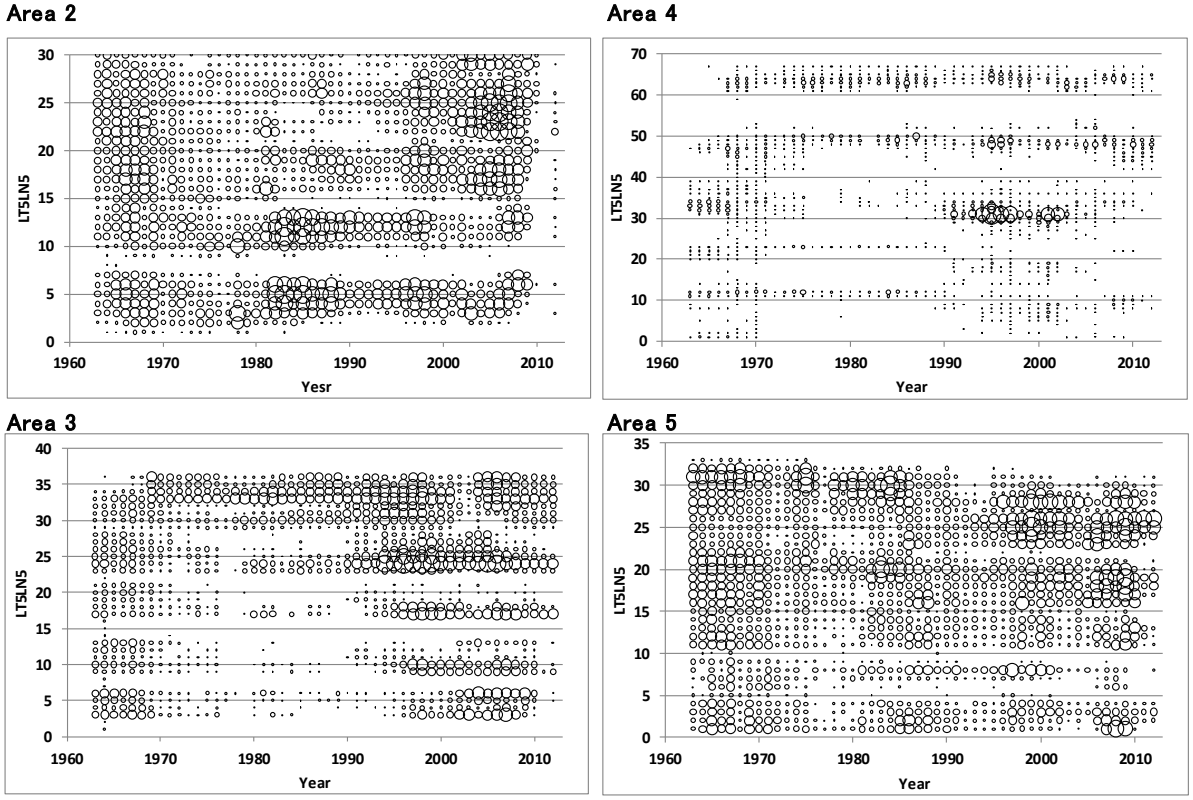


Fig. 10. Historical change in the number of observation of each LT5LN5 factor in each area.

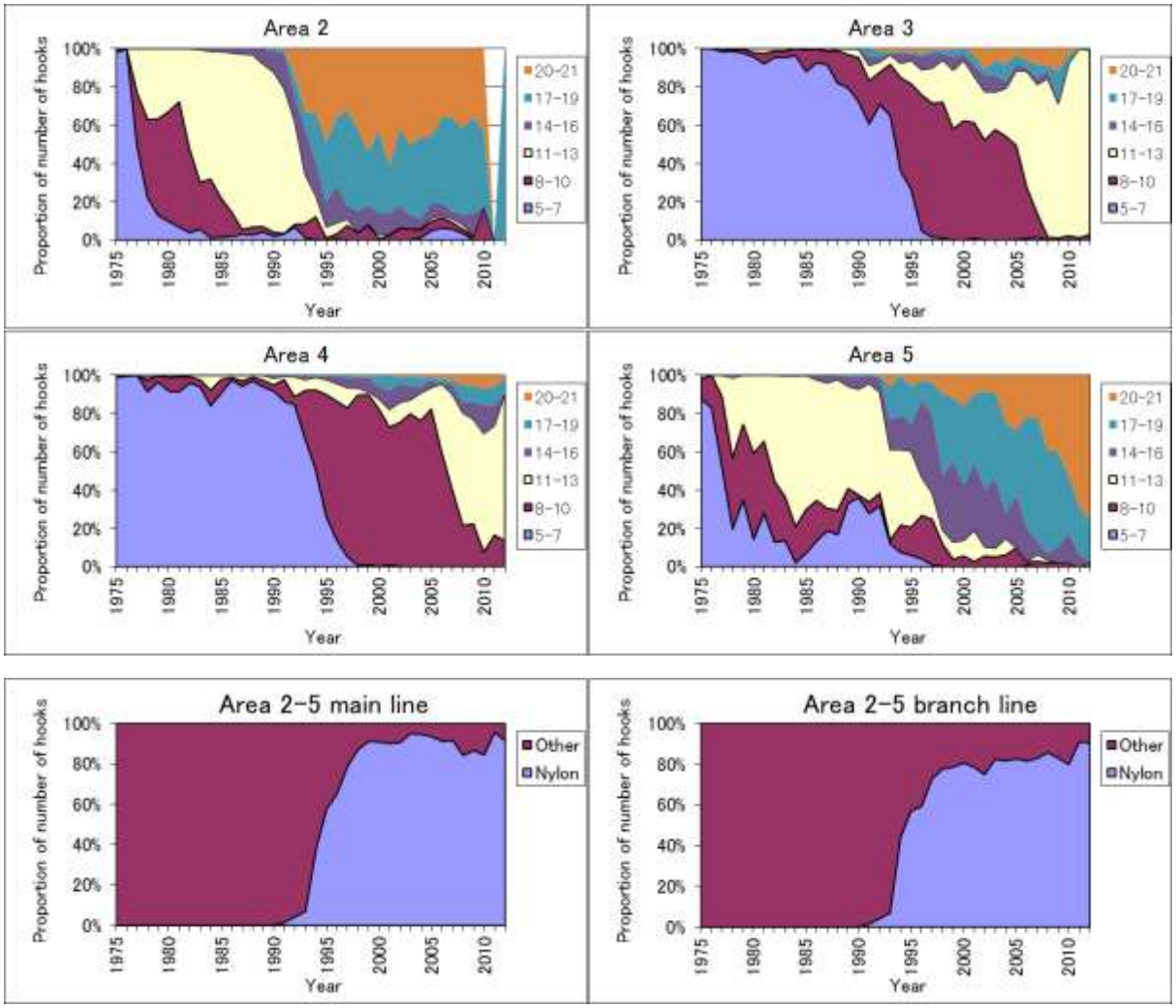
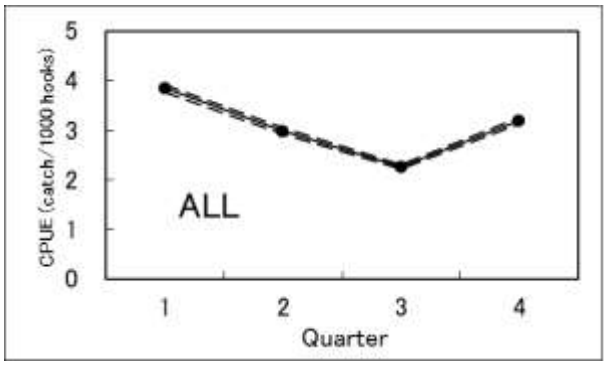
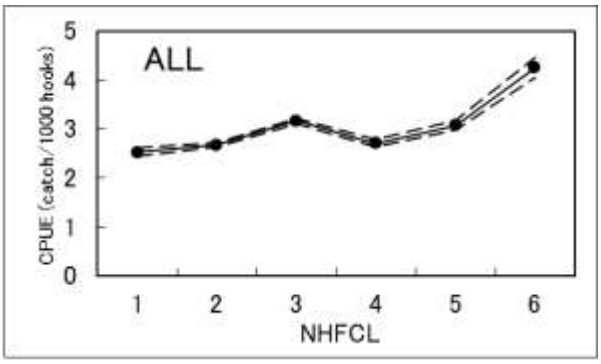


Fig. 11. Historical changes in the proportion of fishing effort by fishing gear (NHFCL and gear materials).

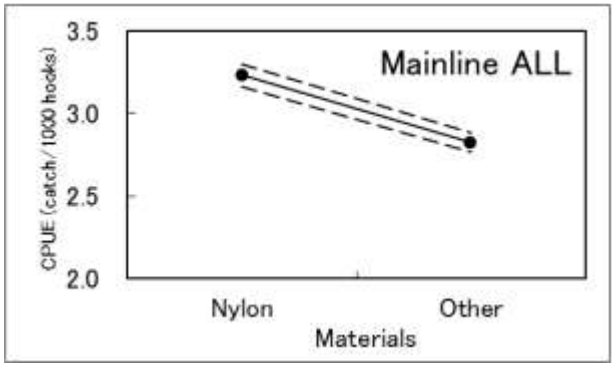
Quarter



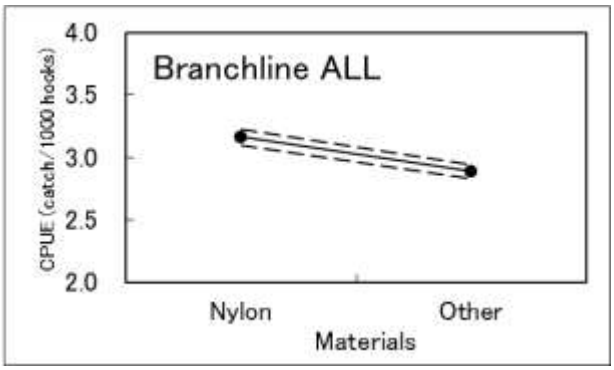
NHFCL



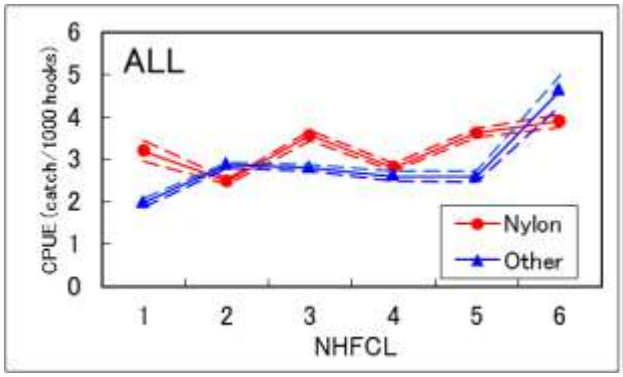
Mainline materials



Branch line materials



NHFCL*Mainline materials



NHFCL*Branchline materials

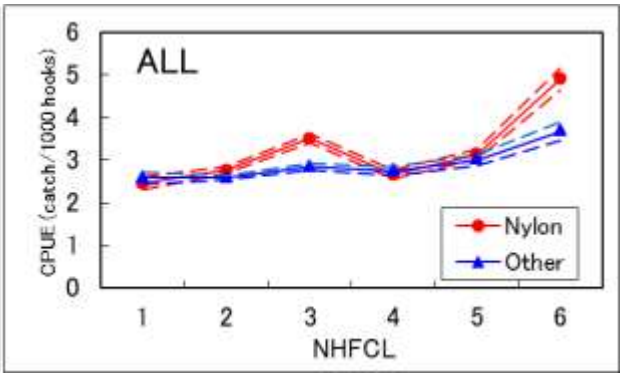


Fig. 12. Trends of CPUE standardized for each of quarter, NHFCL, gear (main-line and branch-line) materials and interaction of NHFCL and gear materials (whole area, 1963-2012).

Appendix table 1. Annual value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2012.

	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	16.260	14.252	2.332	2.981	2.901	10.813	10.829	8.539	1.872	3.053	2.970
1964	12.284	11.629	10.883	1.501	2.132	2.216	8.222	7.661	6.536	1.424	2.160	2.273
1965	13.940	11.395	9.818	1.703	2.089	1.999	9.483	7.303	5.737	1.642	2.059	1.996
1966	17.257	14.235	11.573	2.109	2.610	2.356	13.400	9.183	6.889	2.320	2.589	2.396
1967	11.863	9.061	8.616	1.450	1.661	1.754	8.292	5.805	4.949	1.436	1.637	1.722
1968	31.186	19.973	14.835	3.811	3.662	3.020	21.392	12.152	8.197	3.704	3.426	2.851
1969	12.451	9.370	6.467	1.522	1.718	1.317	9.089	5.838	3.762	1.574	1.646	1.309
1970	10.523	7.186	6.122	1.286	1.318	1.246	6.996	4.667	3.807	1.211	1.316	1.324
1971	13.778	8.150	5.787	1.684	1.494	1.178	9.091	5.911	4.471	1.574	1.666	1.555
1972	9.392	7.942	7.687	1.148	1.456	1.565	7.923	5.749	5.311	1.372	1.621	1.847
1973	6.349	5.921	5.828	0.776	1.086	1.186	4.028	4.186	3.856	0.697	1.180	1.341
1974	5.712	4.920	4.771	0.698	0.902	0.971	4.477	3.490	3.116	0.775	0.984	1.084
1975	9.191	6.173	6.722	1.123	1.132	1.368	5.534	4.137	3.900	0.958	1.166	1.357
1976	8.134	6.045	6.085	0.994	1.108	1.239	3.555	3.652	3.091	0.616	1.029	1.075
1977	13.610	11.086	11.592	1.663	2.033	2.360	4.754	6.674	5.940	0.823	1.881	2.066
1978	7.590	5.922	5.938	0.928	1.086	1.209	5.548	3.927	3.436	0.961	1.107	1.195
1979	10.539	6.533	8.163	1.288	1.198	1.662	6.404	4.302	4.578	1.109	1.213	1.592
1980	5.422	4.131	4.014	0.663	0.757	0.817	3.514	2.595	2.226	0.608	0.732	0.774
1981	6.182	4.788	5.014	0.755	0.878	1.021	4.812	3.097	2.876	0.833	0.873	1.000
1982	5.630	4.914	4.570	0.688	0.901	0.930	5.088	3.418	2.971	0.881	0.964	1.033
1983	5.609	4.860	4.853	0.685	0.891	0.988	4.511	3.082	2.634	0.781	0.869	0.916
1984	5.238	5.913	6.670	0.640	1.084	1.358	4.443	3.957	3.820	0.769	1.116	1.329
1985	5.934	5.301	4.849	0.725	0.972	0.987	4.542	3.459	2.874	0.786	0.975	1.000
1986	6.578	5.319	3.837	0.804	0.975	0.781	4.658	3.319	2.143	0.807	0.936	0.746
1987	5.615	5.376	5.482	0.686	0.986	1.116	4.111	3.454	3.080	0.712	0.974	1.071
1988	6.966	6.089	5.911	0.851	1.116	1.203	5.835	3.915	3.382	1.010	1.104	1.176
1989	4.018	4.119	4.298	0.491	0.755	0.875	3.629	2.747	2.624	0.628	0.774	0.913
1990	5.709	4.523	4.283	0.698	0.829	0.872	5.108	2.990	2.525	0.884	0.843	0.878
1991	4.763	3.971	3.270	0.582	0.728	0.666	2.983	2.544	1.871	0.516	0.717	0.651
1992	4.504	3.950	3.316	0.550	0.724	0.675	3.412	2.444	1.829	0.591	0.689	0.636
1993	5.977	4.020	3.821	0.730	0.737	0.778	3.879	2.463	2.025	0.672	0.694	0.704
1994	5.527	3.083	2.724	0.675	0.565	0.555	3.544	2.031	1.592	0.614	0.573	0.554
1995	5.294	2.611	2.522	0.647	0.479	0.513	2.705	1.733	1.396	0.468	0.489	0.485
1996	6.243	2.640	2.289	0.763	0.484	0.466	3.722	1.784	1.371	0.644	0.503	0.477
1997	5.276	2.319	1.945	0.645	0.425	0.396	3.787	1.555	1.174	0.656	0.438	0.408
1998	5.454	2.515	1.970	0.666	0.461	0.401	4.247	1.640	1.148	0.735	0.462	0.399
1999	6.141	2.680	2.217	0.750	0.491	0.451	4.791	1.817	1.356	0.829	0.512	0.472
2000	6.550	3.221	2.707	0.800	0.590	0.551	5.027	2.106	1.543	0.870	0.594	0.537
2001	7.184	3.035	2.006	0.878	0.556	0.408	4.597	2.035	1.250	0.796	0.574	0.435
2002	6.200	2.324	1.923	0.758	0.426	0.391	4.310	1.567	1.134	0.746	0.442	0.394
2003	9.571	2.825	1.957	1.170	0.518	0.398	7.636	1.872	1.196	1.322	0.528	0.416
2004	7.812	2.667	1.864	0.955	0.489	0.380	6.464	1.726	1.077	1.119	0.486	0.375
2005	7.975	2.441	1.737	0.975	0.448	0.354	6.847	1.567	0.956	1.185	0.442	0.333
2006	7.573	2.631	2.132	0.925	0.482	0.434	6.696	1.705	1.192	1.159	0.481	0.415
2007	6.047	2.003	2.065	0.739	0.367	0.420	5.448	1.309	1.151	0.943	0.369	0.400
2008	4.655	1.236	1.210	0.569	0.227	0.246	3.969	0.759	0.626	0.687	0.214	0.218
2009	3.289	1.176	1.188	0.402	0.216	0.242	2.603	0.694	0.581	0.451	0.196	0.202
2010	5.068	1.580	1.420	0.619	0.290	0.289	3.590	0.915	0.664	0.622	0.258	0.231
2011	7.361	1.339	1.298	0.900	0.245	0.264	5.520	0.743	0.713	0.956	0.210	0.248
2012	4.907	1.307	1.108	0.600	0.240	0.226	3.762	0.854	0.624	0.651	0.241	0.217

Appendix table 2. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2012.

		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	20.02	11.66	12.25	10.78
1963	2	20.92	17.40	18.70	20.31	11.74	11.38
1963	3	9.79	11.54	8.92	7.89	8.91	7.29
1963	4	21.61	16.91	12.33	10.96	10.65	7.21
1964	1	17.98	17.90	17.89	8.57	10.81	9.44
1964	2	15.38	12.31	12.79	14.61	9.36	9.20
1964	3	9.14	9.11	8.61	8.86	7.11	6.59
1964	4	9.25	8.13	6.87	5.15	5.64	4.57
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	6.93
1965	3	12.75	8.75	7.09	11.29	6.19	4.93
1965	4	18.97	14.05	9.94	10.43	8.76	5.74
1966	1	19.84	15.83	13.93	13.23	9.59	7.45
1966	2	16.24	14.53	13.31	15.37	9.62	8.13
1966	3	16.17	12.58	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	9.96	10.44	6.70	5.95
1967	2	12.62	10.40	10.05	10.76	6.93	6.10
1967	3	8.97	5.97	5.73	5.40	3.77	3.20
1967	4	13.81	9.17	8.73	6.74	5.60	4.64
1968	1	34.88	36.90	39.29	29.37	22.51	20.95
1968	2	40.51	26.60	19.83	30.98	15.96	10.58
1968	3	23.44	13.34	8.37	12.21	7.91	4.43
1968	4	23.70	12.90	7.43	15.54	7.91	4.27
1969	1	14.73	9.41	7.07	13.70	5.99	4.14
1969	2	13.43	9.81	8.93	10.70	6.18	5.01
1969	3	10.06	8.79	5.24	6.00	5.27	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	7.61	7.78	5.76	4.64	4.07
1970	4	11.69	7.57	5.81	8.63	5.97	4.85
1971	1	10.09	6.91	6.27	8.91	5.32	4.76
1971	2	15.07	7.95	7.06	8.98	6.16	5.45
1971	3	16.60	9.36	4.29	7.78	6.20	3.09
1971	4	13.85	8.35	5.46	9.77	6.10	4.28
1972	1	10.37	14.08	17.60	10.33	10.00	10.99
1972	2	8.20	9.34	10.57	7.80	6.61	6.66
1972	3	9.34	6.74	4.91	6.40	4.77	3.42
1972	4	9.86	8.60	8.17	8.61	5.96	5.17
1973	1	10.03	10.23	12.22	9.88	7.13	7.53
1973	2	6.17	5.66	6.01	5.68	4.84	4.86
1973	3	2.39	4.09	4.20	1.59	2.63	2.36
1973	4	8.94	6.99	5.67	4.32	4.49	3.31
1974	1	7.54	7.81	9.46	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	2.57	1.72	2.15	1.49
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	4.61	3.65	3.75	3.10	2.29
1975	4	20.00	14.74	16.97	10.21	9.03	8.97
1976	1	9.20	7.77	10.23	8.74	4.93	5.56
1976	2	10.91	7.50	6.95	8.00	4.41	3.48
1976	3	3.77	4.67	3.49	1.28	2.97	2.04
1976	4	13.05	6.55	7.06	2.90	3.89	3.55
1977	1	10.55	17.13	24.28	9.25	11.55	13.99
1977	2	24.65	19.42	22.42	15.64	11.74	11.71
1977	3	7.91	6.20	5.15	1.67	3.61	2.52
1977	4	18.21	10.94	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	3.30	2.76	1.99	2.13	1.57
1978	4	13.65	9.25	8.93	8.63	6.12	5.24
1979	1	15.74	11.78	16.03	14.51	7.55	8.77
1979	2	10.34	7.68	10.31	7.36	4.90	5.58
1979	3	6.07	3.36	3.54	2.32	2.29	2.11
1979	4	6.46	7.01	8.11	4.06	4.60	4.62
1980	1	8.75	5.74	6.83	7.98	3.57	3.63
1980	2	4.97	3.47	3.99	4.13	2.10	2.03
1980	3	2.05	2.71	2.42	1.24	1.73	1.36
1980	4	7.81	6.47	5.78	4.14	4.03	3.17

Appendix table 2. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2012.(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	2.58	2.70
1981	3	5.75	4.94	4.65	3.10	3.02	2.44
1981	4	6.70	6.72	7.10	6.51	4.77	4.51
1982	1	7.46	6.37	7.68	7.56	7.47	8.60
1982	2	6.75	5.03	5.54	6.51	3.00	2.79
1982	3	3.03	3.52	3.22	2.41	2.11	1.63
1982	4	8.70	5.13	3.13	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	10.79	7.09	6.07	6.55
1984	2	5.89	5.17	5.49	4.43	3.15	2.83
1984	3	2.36	4.27	3.11	1.72	2.63	1.68
1984	4	5.91	8.66	10.51	5.48	6.51	6.99
1985	1	6.06	6.96	8.08	6.18	6.22	6.68
1985	2	4.48	4.65	4.68	3.28	2.96	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	4.85	6.76	3.88	2.79
1986	3	2.34	4.04	3.16	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	9.45	5.92	5.21	5.13
1987	2	5.73	6.77	7.72	5.48	4.42	4.34
1987	3	1.63	2.99	3.13	0.89	1.83	1.61
1987	4	7.98	6.38	4.77	5.47	4.13	2.80
1988	1	10.40	11.24	12.17	10.28	9.03	9.09
1988	2	7.60	5.73	5.77	6.83	3.77	3.34
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	6.46	7.84	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	11.36	12.98	10.04	7.57	7.56
1990	2	6.20	5.65	6.54	5.91	3.36	3.26
1990	3	1.46	4.49	4.82	1.29	2.83	2.60
1990	4	4.15	3.22	2.57	3.52	2.07	1.49
1991	1	6.66	4.78	4.07	6.18	3.19	2.46
1991	2	5.24	3.69	2.68	4.47	2.46	1.66
1991	3	2.21	2.28	2.27	1.28	1.48	1.26
1991	4	6.09	3.90	3.07	2.10	2.43	1.68
1992	1	6.89	4.64	4.33	6.12	2.96	2.40
1992	2	3.02	3.55	2.44	2.76	2.29	1.43
1992	3	3.75	3.19	3.32	2.87	1.93	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	4.66	3.26	2.65	2.37
1993	3	5.02	3.12	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	3.91	3.88	6.19	2.65	2.30
1994	2	4.69	3.02	2.27	3.72	2.02	1.37
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	1.56
1995	1	5.85	3.05	3.41	4.49	2.17	2.11
1995	2	3.93	2.16	2.57	2.86	1.41	1.40
1995	3	3.97	1.87	1.55	1.72	1.25	0.91
1995	4	9.13	4.92	4.85	2.86	3.05	2.55
1996	1	8.45	4.44	3.35	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	3.83	7.74	2.75	2.35
1997	2	2.97	1.70	1.90	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	3.55	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 2. Quarterly value of yellowfin CPUE for main fishing ground and whole Indian Ocean with and without area 2 for 1963-2012.(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	2.60	1.86	3.43	1.65	1.03
1999	4	6.87	3.85	3.72	5.69	2.53	2.11
2000	1	7.95	3.74	3.72	7.43	2.62	2.30
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	4.42	4.32	7.69	2.75	2.26
2001	2	5.28	2.75	1.53	4.12	1.85	0.99
2001	3	5.11	2.30	1.42	2.89	1.55	0.90
2001	4	8.07	3.22	1.90	4.09	2.14	1.18
2002	1	10.79	4.69	3.86	8.36	3.01	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	2.37	1.22	8.68	1.79	1.07
2003	3	6.23	2.35	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	3.04	9.75	2.20	1.90
2004	2	9.13	3.63	2.37	7.99	2.29	1.33
2004	3	4.08	1.72	1.40	3.30	1.16	0.84
2004	4	9.45	2.79	1.63	7.04	1.72	0.86
2005	1	14.29	4.27	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	0.94	0.59
2005	4	6.74	2.66	2.36	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	6.71	2.41	2.91	6.56	1.54	1.57
2008	2	5.68	1.23	1.20	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	1.53	5.00	0.97	0.77
2010	2	11.40	1.74	2.09	5.05	1.06	1.06
2010	3	7.34	3.32	0.90	3.72	2.02	0.46
2010	4	3.72	2.33	1.09	3.63	1.47	0.63
2011	1	8.68	2.27	2.26	8.46	1.22	1.21
2011	2	9.88	0.95	0.95	5.06	0.55	0.54
2011	3	5.87	0.43	0.42	3.51	0.25	0.24
2011	4	6.21	2.09	2.06	6.06	1.09	1.07
2012	1	4.72	1.50	1.49	4.67	1.16	1.13
2012	2	6.37	1.06	1.13	3.44	0.70	0.63
2012	3	4.40	0.83	0.48	2.75	0.52	0.25
2012	4	5.35	2.21	1.95	5.35	1.44	1.09

Appendix table 3. Annual value of yellowfin CPUE for 1963-2012 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	3.07	23.38	0.0021	0.05	3.32	3.06	0.0048	0.07	3.68	7.85	0.0014	0.04	1.95
1964	13.75	0.0015	0.04	1.97	14.53	0.0017	0.04	2.06	2.94	0.0034	0.06	3.54	9.00	0.0013	0.04	2.23
1965	15.85	0.0013	0.04	2.27	13.14	0.0021	0.05	1.87	1.84	0.0033	0.06	2.21	7.23	0.0012	0.03	1.79
1966	20.60	0.0012	0.03	2.95	14.55	0.0023	0.05	2.07	2.32	0.0034	0.06	2.79	10.11	0.0013	0.04	2.51
1967	10.49	0.0012	0.04	1.50	10.43	0.0015	0.04	1.48	1.18	0.0018	0.04	1.42	7.93	0.0012	0.04	1.97
1968	32.62	0.0012	0.04	4.68	25.85	0.0023	0.05	3.67	0.99	0.0019	0.04	1.19	6.95	0.0014	0.04	1.72
1969	15.85	0.0013	0.04	2.27	5.43	0.0018	0.04	0.77	0.88	0.0022	0.05	1.05	8.15	0.0015	0.04	2.02
1970	8.95	0.0021	0.05	1.28	3.88	0.0027	0.05	0.55	1.31	0.0024	0.05	1.57	8.94	0.0013	0.04	2.22
1971	13.57	0.0015	0.04	1.95	5.30	0.0031	0.06	0.75	3.36	0.0022	0.05	4.04	7.15	0.0016	0.04	1.77
1972	9.28	0.0016	0.04	1.33	13.21	0.0044	0.07	1.88	2.73	0.0143	0.12	3.28	6.33	0.0027	0.05	1.57
1973	6.50	0.0020	0.04	0.93	6.19	0.0040	0.06	0.88	1.68	0.0071	0.08	2.02	7.20	0.0025	0.05	1.79
1974	5.47	0.0018	0.04	0.78	6.60	0.0030	0.05	0.94	1.37	0.0028	0.05	1.64	4.50	0.0017	0.04	1.12
1975	5.53	0.0017	0.04	0.79	10.43	0.0041	0.06	1.48	1.16	0.0026	0.05	1.39	4.17	0.0014	0.04	1.03
1976	6.28	0.0035	0.06	0.90	8.49	0.0048	0.07	1.21	0.39	0.0062	0.08	0.47	5.15	0.0024	0.05	1.28
1977	9.95	0.0032	0.06	1.43	21.10	0.0095	0.10	2.99	0.82	0.0069	0.08	0.98	6.35	0.0072	0.08	1.58
1978	6.69	0.0015	0.04	0.96	9.75	0.0041	0.06	1.38	0.90	0.0042	0.06	1.08	4.54	0.0025	0.05	1.13
1979	3.71	0.0021	0.05	0.53	15.48	0.0035	0.06	2.20	0.86	0.0051	0.07	1.04	3.41	0.0019	0.04	0.85
1980	4.40	0.0018	0.04	0.63	5.46	0.0033	0.06	0.77	0.36	0.0056	0.07	0.43	3.72	0.0016	0.04	0.92
1981	4.68	0.0011	0.03	0.67	8.29	0.0026	0.05	1.18	0.55	0.0039	0.06	0.66	3.81	0.0018	0.04	0.95
1982	5.45	0.0008	0.03	0.78	6.35	0.0025	0.05	0.90	1.12	0.0073	0.09	1.34	3.71	0.0015	0.04	0.92
1983	5.05	0.0009	0.03	0.72	6.34	0.0039	0.06	0.90	0.61	0.0043	0.07	0.74	4.85	0.0014	0.04	1.20
1984	5.61	0.0010	0.03	0.80	10.04	0.0037	0.06	1.43	0.98	0.0027	0.05	1.17	4.44	0.0011	0.03	1.10
1985	6.07	0.0008	0.03	0.87	6.44	0.0029	0.05	0.91	1.06	0.0030	0.05	1.27	4.88	0.0012	0.03	1.21
1986	8.35	0.0008	0.03	1.20	3.95	0.0037	0.06	0.56	0.54	0.0032	0.06	0.64	5.32	0.0014	0.04	1.32
1987	5.76	0.0010	0.03	0.83	7.04	0.0030	0.06	1.00	0.59	0.0037	0.06	0.71	5.18	0.0052	0.07	1.29
1988	5.84	0.0010	0.03	0.84	8.44	0.0029	0.05	1.20	0.90	0.0044	0.07	1.08	6.41	0.0046	0.07	1.59
1989	4.08	0.0023	0.05	0.59	6.09	0.0028	0.05	0.86	0.89	0.0062	0.08	1.07	3.83	0.0022	0.05	0.95
1990	5.27	0.0017	0.04	0.76	5.11	0.0033	0.06	0.72	0.50	0.0060	0.08	0.60	5.69	0.0025	0.05	1.41
1991	4.82	0.0021	0.05	0.69	3.54	0.0023	0.05	0.50	0.49	0.0032	0.06	0.58	2.94	0.0033	0.06	0.73
1992	4.49	0.0025	0.05	0.64	4.13	0.0029	0.05	0.59	0.33	0.0032	0.06	0.39	3.18	0.0089	0.09	0.79
1993	3.87	0.0011	0.03	0.56	5.81	0.0028	0.05	0.82	0.25	0.0041	0.06	0.30	2.94	0.0034	0.06	0.73
1994	3.31	0.0010	0.03	0.47	3.96	0.0011	0.03	0.56	0.41	0.0015	0.04	0.50	2.29	0.0155	0.12	0.57
1995	2.48	0.0015	0.04	0.36	4.20	0.0014	0.04	0.60	0.30	0.0010	0.03	0.36	1.98	0.0021	0.05	0.49
1996	3.55	0.0006	0.03	0.51	3.47	0.0008	0.03	0.49	0.30	0.0010	0.03	0.37	1.81	0.0031	0.06	0.45
1997	3.00	0.0004	0.02	0.43	2.79	0.0008	0.03	0.40	0.33	0.0018	0.04	0.40	2.07	0.0024	0.05	0.51
1998	3.30	0.0004	0.02	0.47	2.77	0.0007	0.03	0.39	0.27	0.0024	0.05	0.33	1.77	0.0012	0.03	0.44
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	0.46	2.62	0.0008	0.03	0.65
2001	4.76	0.0008	0.03	0.68	3.09	0.0011	0.03	0.44	0.31	0.0014	0.04	0.37	1.38	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	3.41	0.0013	0.04	0.48	0.34	0.0031	0.06	0.41	0.98	0.0021	0.05	0.24
2004	3.90	0.0005	0.02	0.56	2.85	0.0010	0.03	0.40	0.31	0.0035	0.06	0.37	1.39	0.0015	0.04	0.35
2005	3.74	0.0003	0.02	0.54	3.23	0.0009	0.03	0.46	0.17	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	0.0030	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	0.47	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	0.15
2009	1.53	0.0013	0.04	0.22	2.17	0.0012	0.03	0.31	0.09	0.0038	0.06	0.11	0.57	0.0007	0.03	0.14
2010	3.05	0.0083	0.09	0.44	2.73	0.0014	0.04	0.39	0.09	0.0043	0.07	0.10	0.46	0.0017	0.04	0.11
2011					2.74	0.0020	0.05	0.39	0.10	0.0066	0.08	0.12	0.27	0.0252	0.16	0.07

2012		2.07	0.0018	0.04	0.29	0.18	0.0176	0.13	0.22	0.54	0.0058	0.08	0.13

Appendix table 4. Annual value of yellowfin CPUE for 1963-2012 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	10.26	0.0037	0.06	2.49	0.65	0.0032	0.06	1.64	8.15	0.0014	0.04	2.01
1964	11.48	0.0016	0.04	1.73	6.59	0.0033	0.06	1.60	0.83	0.0023	0.05	2.08	9.32	0.0013	0.04	2.31
1965	13.59	0.0015	0.04	2.05	5.90	0.0037	0.06	1.43	0.41	0.0023	0.05	1.04	7.30	0.0012	0.04	1.80
1966	17.95	0.0013	0.04	2.71	6.82	0.0039	0.06	1.66	0.58	0.0023	0.05	1.45	10.17	0.0013	0.04	2.52
1967	9.46	0.0014	0.04	1.43	4.95	0.0032	0.06	1.20	0.49	0.0012	0.04	1.24	7.99	0.0012	0.04	1.98
1968	26.38	0.0014	0.04	3.98	11.04	0.0039	0.06	2.68	0.41	0.0013	0.04	1.03	7.51	0.0014	0.04	1.86
1969	14.79	0.0015	0.04	2.23	3.76	0.0034	0.06	0.91	0.31	0.0015	0.04	0.77	8.05	0.0015	0.04	1.99
1970	8.31	0.0022	0.05	1.25	2.58	0.0041	0.06	0.63	0.40	0.0016	0.04	1.00	9.07	0.0014	0.04	2.24
1971	11.70	0.0017	0.04	1.76	4.01	0.0044	0.07	0.97	1.30	0.0015	0.04	3.26	7.04	0.0016	0.04	1.74
1972	9.21	0.0017	0.04	1.39	6.81	0.0055	0.07	1.65	1.39	0.0089	0.09	3.50	6.20	0.0026	0.05	1.53
1973	6.95	0.0021	0.05	1.05	4.17	0.0051	0.07	1.01	1.15	0.0045	0.07	2.89	7.51	0.0025	0.05	1.86
1974	5.04	0.0019	0.04	0.76	4.09	0.0044	0.07	0.99	0.44	0.0019	0.04	1.10	4.86	0.0017	0.04	1.20
1975	5.60	0.0018	0.04	0.84	5.76	0.0052	0.07	1.40	0.37	0.0018	0.04	0.93	4.46	0.0014	0.04	1.10
1976	6.42	0.0034	0.06	0.97	4.89	0.0057	0.08	1.19	0.30	0.0040	0.06	0.76	5.40	0.0024	0.05	1.33
1977	9.60	0.0032	0.06	1.45	10.94	0.0094	0.10	2.65	0.44	0.0044	0.07	1.09	6.17	0.0070	0.08	1.53
1978	6.26	0.0016	0.04	0.94	4.82	0.0052	0.07	1.17	0.43	0.0027	0.05	1.08	5.12	0.0025	0.05	1.27
1979	3.99	0.0022	0.05	0.60	7.12	0.0048	0.07	1.73	0.43	0.0033	0.06	1.08	3.59	0.0019	0.04	0.89
1980	4.39	0.0019	0.04	0.66	2.44	0.0046	0.07	0.59	0.26	0.0036	0.06	0.66	4.06	0.0016	0.04	1.00
1981	4.46	0.0013	0.04	0.67	4.19	0.0041	0.06	1.02	0.31	0.0025	0.05	0.77	4.07	0.0018	0.04	1.01
1982	5.66	0.0010	0.03	0.85	3.90	0.0040	0.06	0.95	0.36	0.0047	0.07	0.91	3.66	0.0015	0.04	0.90
1983	6.11	0.0011	0.03	0.92	4.13	0.0051	0.07	1.00	0.35	0.0028	0.05	0.88	4.90	0.0014	0.04	1.21
1984	6.31	0.0012	0.03	0.95	5.89	0.0049	0.07	1.43	0.43	0.0018	0.04	1.08	4.79	0.0011	0.03	1.19
1985	6.99	0.0010	0.03	1.05	3.78	0.0043	0.07	0.92	0.42	0.0020	0.04	1.05	5.07	0.0012	0.04	1.25
1986	9.53	0.0010	0.03	1.44	3.36	0.0049	0.07	0.82	0.36	0.0021	0.05	0.91	5.03	0.0014	0.04	1.24
1987	6.54	0.0012	0.03	0.99	5.11	0.0044	0.07	1.24	0.40	0.0025	0.05	1.01	4.55	0.0051	0.07	1.13
1988	6.31	0.0012	0.03	0.95	5.81	0.0043	0.07	1.41	0.47	0.0029	0.05	1.19	5.65	0.0046	0.07	1.40
1989	4.40	0.0023	0.05	0.66	4.25	0.0042	0.07	1.03	0.52	0.0040	0.06	1.30	3.74	0.0021	0.05	0.92
1990	6.17	0.0018	0.04	0.93	3.54	0.0046	0.07	0.86	0.25	0.0038	0.06	0.62	5.44	0.0025	0.05	1.34
1991	5.46	0.0022	0.05	0.82	2.62	0.0038	0.06	0.64	0.27	0.0021	0.05	0.67	2.78	0.0032	0.06	0.69
1992	4.86	0.0026	0.05	0.73	3.09	0.0043	0.07	0.75	0.15	0.0021	0.05	0.39	2.89	0.0087	0.09	0.72
1993	4.29	0.0013	0.04	0.65	4.40	0.0042	0.06	1.07	0.15	0.0027	0.05	0.39	2.75	0.0034	0.06	0.68
1994	3.78	0.0012	0.03	0.57	3.06	0.0029	0.05	0.74	0.23	0.0011	0.03	0.59	2.04	0.0151	0.12	0.50
1995	3.06	0.0016	0.04	0.46	3.24	0.0031	0.06	0.79	0.23	0.0008	0.03	0.59	2.00	0.0021	0.05	0.49
1996	3.78	0.0009	0.03	0.57	2.79	0.0027	0.05	0.68	0.27	0.0008	0.03	0.69	1.76	0.0031	0.06	0.44
1997	3.42	0.0007	0.03	0.51	2.10	0.0026	0.05	0.51	0.29	0.0013	0.04	0.72	1.97	0.0024	0.05	0.49
1998	3.43	0.0006	0.03	0.52	1.97	0.0026	0.05	0.48	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	0.57	0.35	0.0014	0.04	0.88	2.08	0.0009	0.03	0.51
2000	4.21	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	0.63
2001	4.36	0.0010	0.03	0.66	2.30	0.0029	0.05	0.56	0.25	0.0010	0.03	0.62	1.40	0.0010	0.03	0.35
2002	2.81	0.0008	0.03	0.42	2.37	0.0030	0.05	0.57	0.24	0.0011	0.03	0.60	1.13	0.0012	0.03	0.28
2003	3.72	0.0008	0.03	0.56	2.58	0.0031	0.06	0.62	0.35	0.0021	0.05	0.88	1.01	0.0021	0.05	0.25
2004	3.30	0.0007	0.03	0.50	2.68	0.0028	0.05	0.65	0.36	0.0023	0.05	0.89	1.39	0.0015	0.04	0.34
2005	3.05	0.0006	0.02	0.46	3.09	0.0027	0.05	0.75	0.22	0.0018	0.04	0.55	0.92	0.0020	0.04	0.23
2006	2.82	0.0006	0.02	0.42	2.82	0.0026	0.05	0.68	0.27	0.0020	0.04	0.69	1.37	0.0008	0.03	0.34
2007	1.79	0.0005	0.02	0.27	2.25	0.0027	0.05	0.55	0.25	0.0024	0.05	0.64	1.21	0.0009	0.03	0.30
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	0.14
2009	1.51	0.0015	0.04	0.23	1.72	0.0030	0.05	0.42	0.16	0.0025	0.05	0.39	0.54	0.0008	0.03	0.13
2010	2.56	0.0079	0.09	0.39	2.19	0.0031	0.06	0.53	0.15	0.0028	0.05	0.38	0.46	0.0017	0.04	0.11
2011					2.35	0.0036	0.06	0.57	0.26	0.0043	0.07	0.66	0.34	0.0244	0.16	0.08

2012		1.61	0.0035	0.06	0.39	0.27	0.0110	0.10	0.69	0.56	0.0057	0.08	0.14

Appendix table 5. Quarterly value of yellowfin CPUE standardized from 1963-2012 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	3.19	36.99	0.0066	0.0813	4.40	1.25	0.0063	0.0796	1.16	7.81	0.0025	0.0500	1.88
1963	2	16.85	0.0039	0.0627	2.35	33.73	0.0069	0.0829	4.02	4.43	0.0455	0.2133	4.10	8.10	0.0032	0.0563	1.95
1963	3	18.71	0.0142	0.1191	2.61	12.87	0.0042	0.0651	1.53	7.23	0.0075	0.0866	6.69	6.77	0.0036	0.0596	1.63
1963	4	29.16	0.0030	0.0546	4.06	18.39	0.0064	0.0799	2.19	2.11	0.0054	0.0731	1.95	8.86	0.0030	0.0547	2.13
1964	1	20.37	0.0028	0.0527	2.84	29.24	0.0073	0.0854	3.48	0.67	0.0060	0.0773	0.62	10.47	0.0029	0.0540	2.51
1964	2	12.85	0.0021	0.0463	1.79	16.40	0.0056	0.0747	1.95	7.28	0.0220	0.1484	6.74	11.66	0.0030	0.0549	2.80
1964	3	11.38	0.0057	0.0758	1.59	9.89	0.0026	0.0511	1.18	5.61	0.0116	0.1075	5.19	8.91	0.0021	0.0462	2.14
1964	4	11.94	0.0027	0.0515	1.66	9.19	0.0037	0.0611	1.09	2.50	0.0041	0.0636	2.32	5.99	0.0021	0.0456	1.44
1965	1	13.68	0.0021	0.0456	1.91	12.30	0.0067	0.0819	1.47	0.75	0.0051	0.0713	0.70	7.81	0.0020	0.0446	1.87
1965	2	13.57	0.0023	0.0483	1.89	15.95	0.0090	0.0948	1.90	3.05	0.0232	0.1524	2.83	8.87	0.0019	0.0430	2.13
1965	3	13.54	0.0034	0.0580	1.89	10.94	0.0036	0.0600	1.30	3.04	0.0093	0.0962	2.81	4.86	0.0027	0.0522	1.17
1965	4	24.93	0.0029	0.0539	3.47	13.87	0.0053	0.0730	1.65	1.56	0.0042	0.0649	1.44	8.04	0.0027	0.0515	1.93
1966	1	22.14	0.0019	0.0432	3.09	21.43	0.0165	0.1285	2.55	0.77	0.0054	0.0736	0.71	9.41	0.0022	0.0466	2.26
1966	2	19.02	0.0018	0.0427	2.65	18.17	0.0048	0.0695	2.16	3.69	0.0232	0.1524	3.41	11.14	0.0029	0.0540	2.68
1966	3	19.77	0.0027	0.0517	2.76	11.47	0.0034	0.0584	1.37	3.81	0.0106	0.1029	3.53	10.39	0.0027	0.0518	2.50
1966	4	21.61	0.0019	0.0432	3.01	9.94	0.0041	0.0637	1.18	2.57	0.0038	0.0616	2.38	9.59	0.0023	0.0480	2.30
1967	1	11.84	0.0017	0.0410	1.65	12.72	0.0048	0.0690	1.52	2.14	0.0049	0.0699	1.98	9.16	0.0019	0.0434	2.20
1967	2	12.47	0.0020	0.0449	1.74	14.76	0.0032	0.0562	1.76	2.20	0.0052	0.0720	2.03	7.55	0.0018	0.0418	1.81
1967	3	7.23	0.0030	0.0547	1.01	6.04	0.0031	0.0561	0.72	0.69	0.0040	0.0634	0.64	6.43	0.0027	0.0519	1.54
1967	4	11.23	0.0023	0.0475	1.57	10.27	0.0043	0.0654	1.22	0.56	0.0032	0.0567	0.52	8.88	0.0030	0.0551	2.13
1968	1	36.66	0.0021	0.0457	5.11	78.51	0.0117	0.1084	9.35	1.54	0.0056	0.0748	1.43	9.95	0.0019	0.0434	2.39
1968	2	44.74	0.0022	0.0470	6.24	34.89	0.0058	0.0762	4.16	1.15	0.0051	0.0714	1.07	9.68	0.0036	0.0598	2.32
1968	3	25.88	0.0027	0.0522	3.61	14.90	0.0044	0.0666	1.77	0.50	0.0036	0.0596	0.46	4.01	0.0037	0.0612	0.96
1968	4	26.60	0.0021	0.0456	3.71	10.56	0.0062	0.0790	1.26	1.03	0.0040	0.0631	0.96	5.93	0.0028	0.0527	1.42
1969	1	15.68	0.0020	0.0444	2.19	7.75	0.0052	0.0722	0.92	1.14	0.0081	0.0898	1.05	7.82	0.0022	0.0473	1.88
1969	2	12.87	0.0028	0.0529	1.79	9.48	0.0047	0.0685	1.13	1.23	0.0060	0.0773	1.14	10.07	0.0026	0.0507	2.42
1969	3	17.58	0.0029	0.0538	2.45	4.86	0.0036	0.0598	0.58	0.50	0.0039	0.0623	0.46	6.61	0.0045	0.0667	1.59
1969	4	17.73	0.0030	0.0543	2.47	2.23	0.0062	0.0788	0.27	0.82	0.0050	0.0708	0.76	8.46	0.0038	0.0618	2.03
1970	1	9.17	0.0030	0.0549	1.28	4.20	0.0095	0.0977	0.50	1.93	0.0129	0.1134	1.78	7.89	0.0026	0.0506	1.90
1970	2	6.99	0.0043	0.0652	0.97	4.69	0.0078	0.0882	0.56	0.60	0.0057	0.0756	0.56	7.25	0.0033	0.0571	1.74
1970	3	8.06	0.0129	0.1135	1.12	2.29	0.0084	0.0919	0.27	0.48	0.0044	0.0664	0.44	14.15	0.0025	0.0502	3.40
1970	4	12.31	0.0032	0.0569	1.72	4.87	0.0092	0.0958	0.58	4.54	0.0044	0.0666	4.20	7.83	0.0027	0.0521	1.88
1971	1	9.15	0.0029	0.0540	1.28	6.92	0.0061	0.0779	0.82	3.91	0.0081	0.0901	3.62	6.89	0.0028	0.0525	1.66
1971	2	10.83	0.0042	0.0651	1.51	5.47	0.0119	0.1089	0.65	4.78	0.0050	0.0708	4.43	9.92	0.0031	0.0558	2.38
1971	3	21.55	0.0038	0.0616	3.00	4.27	0.0089	0.0941	0.51	1.89	0.0036	0.0602	1.75	5.31	0.0042	0.0647	1.27
1971	4	15.67	0.0030	0.0548	2.18	4.83	0.0148	0.1218	0.58	3.58	0.0070	0.0839	3.31	7.15	0.0051	0.0711	1.72
1972	1	8.23	0.0035	0.0594	1.15	32.66	0.0173	0.1313	3.89	4.34	0.1741	0.4173	4.02	6.89	0.0045	0.0669	1.65
1972	2	7.60	0.0040	0.0636	1.06	20.01	0.0228	0.1509	2.38	3.00	0.0195	0.1397	2.78	4.20	0.0050	0.0710	1.01
1972	3	11.33	0.0035	0.0595	1.58	5.03	0.0073	0.0852	0.60	1.92	0.0087	0.0933	1.78	5.84	0.0083	0.0910	1.40
1972	4	10.40	0.0040	0.0636	1.45	8.72	0.0143	0.1195	1.04	2.20	0.0149	0.1219	2.04	9.36	0.0145	0.1202	2.25
1973	1	6.98	0.0062	0.0790	0.97	17.46	0.0219	0.1479	2.08	3.65	0.0752	0.2742	3.38	9.72	0.0055	0.0741	2.33
1973	2	5.43	0.0061	0.0780	0.76	4.63	0.0173	0.1313	0.55	4.32	0.0148	0.1214	4.00	8.48	0.0088	0.0935	2.04
1973	3	4.31	0.0047	0.0683	0.60	1.84	0.0072	0.0849	0.22	0.51	0.0069	0.0829	0.47	7.19	0.0108	0.1041	1.73
1973	4	10.65	0.0045	0.0672	1.48	8.37	0.0092	0.0958	1.00	0.88	0.0053	0.0729	0.81	4.48	0.0051	0.0713	1.07
1974	1	5.26	0.0042	0.0651	0.73	17.13	0.0109	0.1044	2.04	4.47	0.0120	0.1096	4.14	4.10	0.0029	0.0539	0.98
1974	2	5.24	0.0051	0.0717	0.73	8.84	0.0146	0.1210	1.05	1.99	0.0066	0.0810	1.84	5.54	0.0064	0.0798	1.33
1974	3	5.60	0.0039	0.0625	0.78	1.45	0.0071	0.0840	0.17	0.44	0.0057	0.0756	0.40	4.11	0.0044	0.0666	0.99
1974	4	5.80	0.0048	0.0692	0.81	6.96	0.0068	0.0823	0.83	0.78	0.0087	0.0931	0.72	4.38	0.0027	0.0518	1.05

Appendix table 5. Quarterly value of yellowfin CPUE standardized from 1963-2012 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	7.50	0.0237	0.1540	0.89	1.92	0.0130	0.1141	1.78	4.48	0.0023	0.0475	1.08
1975	2	3.34	0.0060	0.0773	0.47	9.72	0.0150	0.1225	1.16	1.29	0.0061	0.0782	1.19	3.75	0.0043	0.0656	0.90
1975	3	7.13	0.0030	0.0548	0.99	4.41	0.0055	0.0744	0.53	0.99	0.0047	0.0682	0.91	3.94	0.0026	0.0513	0.95
1975	4	11.61	0.0036	0.0600	1.62	34.13	0.0130	0.1141	4.07	0.72	0.0068	0.0826	0.67	4.56	0.0037	0.0607	1.09
1976	1	3.40	0.0044	0.0662	0.47	19.75	0.0079	0.0887	2.35	0.57	0.0529	0.2300	0.53	3.42	0.0040	0.0635	0.82
1976	2	9.43	0.0056	0.0747	1.31	8.59	0.0259	0.1610	1.02	0.27	0.0188	0.1370	0.25	7.06	0.0072	0.0849	1.69
1976	3	7.84	0.0142	0.1191	1.09	2.67	0.0084	0.0916	0.32	0.55	0.0064	0.0801	0.51	4.97	0.0093	0.0963	1.19
1976	4	5.97	0.0207	0.1437	0.83	10.39	0.0253	0.1591	1.24	0.26	0.0099	0.0995	0.24	5.77	0.0089	0.0944	1.39
1977	1	3.77	0.0143	0.1194	0.53	47.71	0.0467	0.2161	5.68	2.87	0.0512	0.2263	2.66	6.99	0.0097	0.0986	1.68
1977	2	15.24	0.0129	0.1135	2.12	43.13	0.0564	0.2375	5.14	0.71	0.0304	0.1742	0.65	7.98	0.0645	0.2540	1.92
1977	3	8.96	0.0133	0.1155	1.25	6.95	0.0094	0.0967	0.83	0.20	0.0076	0.0873	0.19	4.97	0.0091	0.0956	1.19
1977	4	17.74	0.0037	0.0606	2.47	13.17	0.0309	0.1757	1.57	0.83	0.0100	0.0998	0.77	5.84	0.0244	0.1560	1.40
1978	1	6.60	0.0015	0.0389	0.92	15.10	0.0107	0.1036	1.80	0.95	0.0283	0.1682	0.88	6.76	0.0066	0.0811	1.62
1978	2	5.75	0.0021	0.0455	0.80	8.13	0.0172	0.1313	0.97	1.01	0.0101	0.1002	0.94	8.19	0.0189	0.1374	1.97
1978	3	4.77	0.0107	0.1035	0.67	3.93	0.0097	0.0984	0.47	0.41	0.0070	0.0839	0.38	2.44	0.0023	0.0484	0.59
1978	4	10.86	0.0049	0.0703	1.51	17.71	0.0189	0.1375	2.11	1.56	0.0113	0.1065	1.44	2.99	0.0048	0.0695	0.72
1979	1	4.04	0.0035	0.0592	0.56	31.95	0.0076	0.0869	3.81	1.03	0.0355	0.1884	0.96	4.33	0.0052	0.0721	1.04
1979	2	2.55	0.0067	0.0820	0.36	19.77	0.0175	0.1323	2.35	1.04	0.0158	0.1258	0.96	4.00	0.0067	0.0820	0.96
1979	3	3.21	0.0054	0.0735	0.45	5.74	0.0076	0.0870	0.68	0.65	0.0069	0.0828	0.60	2.41	0.0070	0.0835	0.58
1979	4	5.56	0.0133	0.1154	0.78	15.18	0.0146	0.1208	1.81	0.79	0.0133	0.1154	0.73	3.18	0.0048	0.0691	0.76
1980	1	4.03	0.0042	0.0645	0.56	11.21	0.0056	0.0747	1.34	0.52	0.0398	0.1994	0.48	4.32	0.0049	0.0699	1.04
1980	2	2.71	0.0044	0.0663	0.38	2.47	0.0158	0.1258	0.29	0.22	0.0248	0.1574	0.21	6.40	0.0056	0.0745	1.54
1980	3	3.63	0.0126	0.1123	0.51	2.53	0.0067	0.0820	0.30	0.30	0.0081	0.0897	0.28	2.98	0.0037	0.0606	0.72
1980	4	8.87	0.0030	0.0546	1.24	10.98	0.0162	0.1272	1.31	0.43	0.0066	0.0814	0.40	2.23	0.0044	0.0662	0.53
1981	1	4.64	0.0017	0.0417	0.65	8.00	0.0048	0.0695	0.95	0.61	0.0169	0.1299	0.56	3.32	0.0035	0.0595	0.80
1981	2	2.40	0.0043	0.0657	0.33	8.60	0.0106	0.1030	1.02	0.24	0.0230	0.1516	0.22	3.60	0.0053	0.0730	0.86
1981	3	6.12	0.0040	0.0635	0.85	5.25	0.0050	0.0704	0.63	0.33	0.0053	0.0725	0.31	5.46	0.0095	0.0976	1.31
1981	4	6.70	0.0024	0.0490	0.93	12.84	0.0145	0.1202	1.53	1.56	0.0076	0.0872	1.44	3.20	0.0031	0.0557	0.77
1982	1	4.37	0.0016	0.0397	0.61	13.75	0.0048	0.0690	1.64	11.78	0.0217	0.1472	10.91	3.75	0.0035	0.0587	0.90
1982	2	4.34	0.0030	0.0551	0.60	8.61	0.0097	0.0983	1.03	0.23	0.0587	0.2422	0.21	4.08	0.0066	0.0810	0.98
1982	3	4.50	0.0022	0.0471	0.63	3.06	0.0042	0.0650	0.36	0.20	0.0088	0.0938	0.18	4.11	0.0039	0.0620	0.99
1982	4	10.04	0.0016	0.0395	1.40	4.15	0.0145	0.1203	0.49	1.61	0.0174	0.1319	1.49	3.00	0.0032	0.0565	0.72
1983	1	4.53	0.0011	0.0337	0.63	14.37	0.0114	0.1067	1.71	1.61	0.0307	0.1752	1.49	4.38	0.0022	0.0470	1.05
1983	2	4.25	0.0015	0.0391	0.59	3.44	0.0211	0.1451	0.41	0.44	0.0127	0.1125	0.41	8.09	0.0092	0.0960	1.94
1983	3	3.32	0.0043	0.0654	0.46	2.57	0.0053	0.0727	0.31	0.23	0.0064	0.0802	0.21	3.73	0.0018	0.0429	0.90
1983	4	9.68	0.0022	0.0468	1.35	11.22	0.0174	0.1318	1.34	0.73	0.0092	0.0957	0.68	4.11	0.0027	0.0516	0.99
1984	1	5.14	0.0016	0.0404	0.72	18.81	0.0120	0.1093	2.24	1.87	0.0121	0.1098	1.73	5.21	0.0022	0.0471	1.25
1984	2	4.79	0.0025	0.0496	0.67	6.32	0.0203	0.1425	0.75	0.41	0.0078	0.0883	0.38	6.02	0.0038	0.0620	1.45
1984	3	7.13	0.0041	0.0643	0.99	4.18	0.0050	0.0705	0.50	0.31	0.0066	0.0814	0.29	2.82	0.0022	0.0468	0.68
1984	4	5.61	0.0024	0.0493	0.78	19.14	0.0134	0.1156	2.28	3.00	0.0072	0.0848	2.78	4.32	0.0027	0.0523	1.04
1985	1	5.31	0.0016	0.0394	0.74	13.86	0.0117	0.1081	1.65	5.44	0.0183	0.1352	5.04	4.22	0.0015	0.0390	1.01
1985	2	4.95	0.0021	0.0457	0.69	3.39	0.0085	0.0923	0.40	0.69	0.0055	0.0740	0.64	6.86	0.0039	0.0621	1.65
1985	3	5.19	0.0022	0.0465	0.72	3.09	0.0039	0.0628	0.37	0.29	0.0049	0.0699	0.27	5.10	0.0026	0.0507	1.22
1985	4	9.78	0.0015	0.0382	1.36	10.72	0.0148	0.1218	1.28	0.90	0.0094	0.0967	0.83	3.82	0.0046	0.0677	0.92
1986	1	8.80	0.0012	0.0348	1.23	18.50	0.0073	0.0855	2.20	2.05	0.0086	0.0927	1.90	4.41	0.0013	0.0365	1.06
1986	2	9.18	0.0019	0.0439	1.28	2.15	0.0079	0.0886	0.26	0.74	0.0216	0.1469	0.69	8.25	0.0084	0.0914	1.98
1986	3	6.33	0.0030	0.0551	0.88	1.45	0.0046	0.0681	0.17	0.17	0.0055	0.0744	0.16	5.26	0.0040	0.0630	1.26

1986	4	9.46	0.0018	0.0430	1.32	3.20	0.0326	0.1807	0.38	0.21	0.0059	0.0766	0.20	4.15	0.0025	0.0504	1.00	

Appendix table 5. Quarterly value of yellowfin CPUE standardized from 1963-2012 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	0.91	15.91	0.0118	0.1088	1.89	0.57	0.0068	0.0823	0.53	5.07	0.0017	0.0407	1.22
1987	2	5.24	0.0019	0.0432	0.73	9.07	0.0106	0.1031	1.08	1.20	0.0297	0.1723	1.11	7.80	0.0586	0.2420	1.87
1987	3	2.96	0.0053	0.0727	0.41	2.54	0.0039	0.0621	0.30	0.20	0.0059	0.0768	0.18	4.02	0.0153	0.1238	0.96
1987	4	10.26	0.0028	0.0526	1.43	6.08	0.0156	0.1249	0.72	0.77	0.0075	0.0865	0.71	4.50	0.0021	0.0457	1.08
1988	1	10.42	0.0013	0.0362	1.45	21.58	0.0128	0.1131	2.57	6.35	0.0186	0.1365	5.88	5.78	0.0017	0.0414	1.39
1988	2	6.01	0.0021	0.0459	0.84	5.57	0.0081	0.0901	0.66	1.26	0.0231	0.1521	1.17	6.86	0.0587	0.2422	1.65
1988	3	3.73	0.0046	0.0681	0.52	3.32	0.0038	0.0617	0.39	0.17	0.0079	0.0889	0.15	8.53	0.0053	0.0725	2.05
1988	4	4.78	0.0026	0.0506	0.67	11.65	0.0143	0.1195	1.39	0.30	0.0106	0.1029	0.27	4.98	0.0022	0.0469	1.20
1989	1	4.07	0.0014	0.0374	0.57	12.42	0.0163	0.1277	1.48	6.17	0.0212	0.1456	5.71	5.51	0.0033	0.0570	1.32
1989	2	2.98	0.0030	0.0546	0.41	5.11	0.0076	0.0869	0.61	1.07	0.0468	0.2163	0.99	6.40	0.0139	0.1178	1.54
1989	3	2.77	0.0231	0.1521	0.39	1.87	0.0037	0.0606	0.22	0.17	0.0108	0.1039	0.16	2.57	0.0064	0.0799	0.62
1989	4	7.82	0.0045	0.0670	1.09	10.02	0.0117	0.1083	1.19	0.35	0.0101	0.1002	0.33	2.27	0.0048	0.0691	0.55
1990	1	8.73	0.0022	0.0469	1.22	23.71	0.0097	0.0982	2.82	1.72	0.0089	0.0943	1.59	5.19	0.0020	0.0442	1.25
1990	2	4.02	0.0037	0.0607	0.56	4.77	0.0083	0.0913	0.57	0.20	0.0586	0.2420	0.18	8.97	0.0226	0.1503	2.15
1990	3	4.32	0.0135	0.1160	0.60	1.61	0.0035	0.0593	0.19	0.40	0.0057	0.0758	0.37	8.09	0.0061	0.0784	1.94
1990	4	4.97	0.0030	0.0552	0.69	2.93	0.0251	0.1585	0.35	0.37	0.0121	0.1099	0.34	2.68	0.0029	0.0540	0.64
1991	1	6.58	0.0020	0.0452	0.92	5.14	0.0076	0.0874	0.61	0.81	0.0129	0.1135	0.75	3.90	0.0023	0.0481	0.94
1991	2	5.78	0.0096	0.0980	0.81	3.01	0.0057	0.0756	0.36	0.66	0.0206	0.1436	0.61	2.88	0.0252	0.1586	0.69
1991	3	2.34	0.0099	0.0995	0.33	2.42	0.0031	0.0559	0.29	0.31	0.0037	0.0610	0.29	2.45	0.0138	0.1176	0.59
1991	4	5.73	0.0095	0.0972	0.80	4.04	0.0142	0.1190	0.48	0.31	0.0038	0.0615	0.28	2.70	0.0044	0.0661	0.65
1992	1	5.40	0.0039	0.0625	0.75	6.11	0.0048	0.0693	0.73	0.52	0.0168	0.1298	0.48	3.60	0.0040	0.0632	0.86
1992	2	5.98	0.0057	0.0757	0.83	2.45	0.0040	0.0633	0.29	0.44	0.0119	0.1089	0.41	2.78	0.1070	0.3271	0.67
1992	3	3.06	0.0247	0.1570	0.43	3.19	0.0022	0.0469	0.38	0.20	0.0067	0.0818	0.19	4.03	0.0178	0.1336	0.97
1992	4	4.04	0.0036	0.0599	0.56	5.83	0.0307	0.1752	0.69	0.22	0.0068	0.0825	0.21	2.52	0.0078	0.0883	0.61
1993	1	3.31	0.0046	0.0675	0.46	13.86	0.0057	0.0755	1.65	0.32	0.0308	0.1754	0.29	2.01	0.0037	0.0607	0.48
1993	2	3.42	0.0035	0.0595	0.48	3.52	0.0047	0.0685	0.42	0.28	0.0187	0.1366	0.26	6.02	0.0323	0.1798	1.44
1993	3	3.59	0.0059	0.0766	0.50	4.10	0.0025	0.0503	0.49	0.17	0.0038	0.0613	0.16	2.25	0.0082	0.0906	0.54
1993	4	5.46	0.0024	0.0492	0.76	5.37	0.0269	0.1640	0.64	0.26	0.0045	0.0670	0.24	2.62	0.0060	0.0777	0.63
1994	1	3.92	0.0023	0.0482	0.55	7.27	0.0032	0.0563	0.87	0.60	0.0075	0.0863	0.55	1.56	0.0032	0.0567	0.38
1994	2	4.48	0.0032	0.0565	0.62	2.65	0.0018	0.0427	0.32	0.50	0.0052	0.0718	0.47	2.18	0.2154	0.4641	0.52
1994	3	2.31	0.0077	0.0879	0.32	2.95	0.0017	0.0410	0.35	0.27	0.0034	0.0581	0.25	4.00	0.0224	0.1497	0.96
1994	4	2.88	0.0022	0.0472	0.40	4.13	0.0069	0.0833	0.49	0.35	0.0025	0.0497	0.32	1.93	0.0044	0.0666	0.46
1995	1	2.31	0.0036	0.0596	0.32	5.34	0.0024	0.0489	0.64	0.62	0.0033	0.0577	0.58	2.17	0.0028	0.0530	0.52
1995	2	1.15	0.0058	0.0761	0.16	2.36	0.0019	0.0441	0.28	0.27	0.0041	0.0640	0.25	3.05	0.0169	0.1300	0.73
1995	3	2.47	0.0118	0.1087	0.34	2.35	0.0023	0.0481	0.28	0.26	0.0019	0.0434	0.24	1.15	0.0067	0.0815	0.28
1995	4	5.01	0.0020	0.0443	0.70	9.40	0.0123	0.1110	1.12	0.17	0.0020	0.0442	0.15	1.95	0.0031	0.0552	0.47
1996	1	6.52	0.0022	0.0471	0.91	4.94	0.0019	0.0440	0.59	0.33	0.0033	0.0571	0.31	2.33	0.0026	0.0505	0.56
1996	2	3.78	0.0029	0.0536	0.53	1.57	0.0020	0.0449	0.19	0.44	0.0033	0.0571	0.41	1.49	0.0282	0.1678	0.36
1996	3	2.47	0.0033	0.0575	0.34	1.94	0.0017	0.0413	0.23	0.32	0.0023	0.0480	0.30	1.91	0.0127	0.1125	0.46
1996	4	2.44	0.0012	0.0340	0.34	8.15	0.0039	0.0625	0.97	0.17	0.0025	0.0501	0.16	1.59	0.0029	0.0540	0.38
1997	1	4.09	0.0013	0.0355	0.57	6.66	0.0017	0.0416	0.79	0.62	0.0133	0.1152	0.57	1.98	0.0013	0.0366	0.48
1997	2	1.23	0.0013	0.0359	0.17	1.42	0.0019	0.0439	0.17	0.32	0.0057	0.0756	0.30	2.11	0.0260	0.1613	0.51
1997	3	3.33	0.0024	0.0488	0.46	1.20	0.0018	0.0426	0.14	0.24	0.0020	0.0446	0.22	3.89	0.0055	0.0744	0.94
1997	4	4.26	0.0009	0.0294	0.59	4.24	0.0028	0.0529	0.50	0.25	0.0032	0.0563	0.23	1.03	0.0020	0.0449	0.25
1998	1	3.63	0.0008	0.0275	0.51	5.69	0.0016	0.0395	0.68	0.50	0.0171	0.1307	0.46	2.15	0.0013	0.0366	0.52
1998	2	2.72	0.0010	0.0314	0.38	1.16	0.0019	0.0431	0.14	0.37	0.0073	0.0854	0.34	2.18	0.0075	0.0864	0.52
1998	3	2.81	0.0021	0.0456	0.39	1.09	0.0018	0.0428	0.13	0.12	0.0035	0.0590	0.11	1.23	0.0045	0.0671	0.30

1998	4	4.19	0.0017	0.0409	0.58	6.02	0.0024	0.0492	0.72	0.21	0.0042	0.0645	0.20	1.67	0.0020	0.0442	0.40

Appendix table 5. Quarterly value of yellowfin CPUE standardized from 1963-2012 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	0.48	5.15	0.0020	0.0442	0.61	0.55	0.0101	0.1005	0.51	2.78	0.0016	0.0397	0.67
1999	2	3.55	0.0039	0.0624	0.50	1.26	0.0022	0.0464	0.15	0.58	0.0057	0.0756	0.53	1.96	0.0053	0.0728	0.47
1999	3	3.98	0.0040	0.0632	0.56	1.90	0.0024	0.0494	0.23	0.20	0.0033	0.0574	0.18	1.97	0.0021	0.0459	0.47
1999	4	3.92	0.0012	0.0346	0.55	6.99	0.0026	0.0513	0.83	0.38	0.0075	0.0868	0.35	1.56	0.0012	0.0344	0.38
2000	1	3.70	0.0011	0.0334	0.52	6.66	0.0023	0.0477	0.79	0.64	0.0113	0.1061	0.59	1.71	0.0015	0.0389	0.41
2000	2	2.99	0.0028	0.0531	0.42	1.30	0.0038	0.0614	0.16	0.42	0.0049	0.0697	0.39	3.91	0.0016	0.0401	0.94
2000	3	5.86	0.0030	0.0545	0.82	1.65	0.0025	0.0504	0.20	0.37	0.0031	0.0555	0.34	3.90	0.0026	0.0514	0.94
2000	4	4.60	0.0018	0.0422	0.64	3.51	0.0030	0.0548	0.42	0.20	0.0061	0.0778	0.18	1.72	0.0028	0.0529	0.41
2001	1	4.49	0.0032	0.0568	0.63	8.43	0.0024	0.0486	1.00	0.14	0.0066	0.0814	0.13	1.64	0.0014	0.0379	0.39
2001	2	5.05	0.0024	0.0489	0.70	1.41	0.0041	0.0638	0.17	0.42	0.0056	0.0750	0.39	1.76	0.0028	0.0533	0.42
2001	3	3.98	0.0037	0.0611	0.55	1.85	0.0025	0.0497	0.22	0.35	0.0022	0.0468	0.33	1.26	0.0036	0.0600	0.30
2001	4	5.64	0.0023	0.0484	0.79	3.44	0.0037	0.0611	0.41	0.38	0.0025	0.0503	0.35	0.96	0.0036	0.0603	0.23
2002	1	6.15	0.0015	0.0385	0.86	7.86	0.0020	0.0448	0.94	0.36	0.0057	0.0753	0.33	1.22	0.0037	0.0607	0.29
2002	2	3.30	0.0022	0.0467	0.46	2.23	0.0046	0.0675	0.27	0.39	0.0083	0.0911	0.37	1.65	0.0062	0.0784	0.40
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	0.34	3.25	0.0056	0.0749	0.39	0.15	0.0031	0.0552	0.14	0.89	0.0013	0.0355	0.21
2003	1	3.83	0.0013	0.0363	0.53	8.24	0.0025	0.0500	0.98	0.33	0.0216	0.1470	0.30	0.96	0.0020	0.0444	0.23
2003	2	4.57	0.0020	0.0444	0.64	1.96	0.0047	0.0688	0.23	0.93	0.0143	0.1195	0.86	0.84	0.0177	0.1330	0.20
2003	3	4.64	0.0030	0.0548	0.65	1.85	0.0037	0.0611	0.22	0.27	0.0039	0.0628	0.25	0.69	0.0081	0.0902	0.16
2003	4	4.60	0.0011	0.0327	0.64	3.96	0.0059	0.0765	0.47	0.12	0.0046	0.0678	0.11	1.58	0.0027	0.0521	0.38
2004	1	3.23	0.0010	0.0321	0.45	6.07	0.0025	0.0498	0.72	0.78	0.0311	0.1764	0.72	1.05	0.0033	0.0577	0.25
2004	2	5.94	0.0018	0.0422	0.83	2.16	0.0042	0.0650	0.26	0.34	0.0108	0.1041	0.31	2.75	0.0104	0.1018	0.66
2004	3	2.30	0.0022	0.0467	0.32	1.65	0.0018	0.0425	0.20	0.25	0.0040	0.0630	0.23	1.32	0.0044	0.0662	0.32
2004	4	5.00	0.0013	0.0365	0.70	2.77	0.0033	0.0574	0.33	0.10	0.0050	0.0706	0.09	0.91	0.0025	0.0495	0.22
2005	1	4.64	0.0009	0.0296	0.65	8.66	0.0024	0.0485	1.03	0.18	0.0117	0.1080	0.17	0.94	0.0030	0.0550	0.23
2005	2	5.74	0.0012	0.0351	0.80	1.98	0.0026	0.0514	0.24	0.45	0.0141	0.1186	0.42	1.23	0.0086	0.0926	0.30
2005	3	2.27	0.0014	0.0376	0.32	1.04	0.0016	0.0401	0.12	0.11	0.0081	0.0902	0.10	1.13	0.0120	0.1094	0.27
2005	4	3.08	0.0009	0.0300	0.43	4.70	0.0033	0.0573	0.56	0.07	0.0046	0.0677	0.07	0.81	0.0039	0.0625	0.19
2006	1	4.59	0.0008	0.0290	0.64	9.28	0.0021	0.0453	1.11	0.08	0.0086	0.0930	0.08	1.53	0.0018	0.0425	0.37
2006	2	5.51	0.0008	0.0274	0.77	3.42	0.0020	0.0445	0.41	0.42	0.0207	0.1439	0.39	2.25	0.0032	0.0569	0.54
2006	3	2.17	0.0018	0.0422	0.30	0.99	0.0017	0.0410	0.12	0.16	0.0048	0.0691	0.14	1.22	0.0024	0.0494	0.29
2006	4	2.26	0.0009	0.0308	0.32	3.07	0.0021	0.0458	0.37	0.15	0.0085	0.0921	0.14	0.94	0.0017	0.0407	0.23
2007	1	2.08	0.0007	0.0269	0.29	7.17	0.0019	0.0434	0.85	0.13	0.0268	0.1638	0.12	1.27	0.0015	0.0381	0.31
2007	2	1.85	0.0006	0.0247	0.26	5.76	0.0028	0.0529	0.69	0.31	0.0105	0.1024	0.28	1.66	0.0026	0.0506	0.40
2007	3	1.76	0.0015	0.0392	0.24	0.96	0.0019	0.0433	0.11	0.13	0.0042	0.0649	0.12	1.12	0.0034	0.0581	0.27
2007	4	2.09	0.0011	0.0337	0.29	2.33	0.0036	0.0599	0.28	0.07	0.0108	0.1037	0.06	1.07	0.0017	0.0414	0.26
2008	1	1.30	0.0012	0.0340	0.18	6.10	0.0026	0.0511	0.73	0.16	0.0169	0.1299	0.15	0.74	0.0014	0.0378	0.18
2008	2	1.26	0.0009	0.0303	0.18	2.31	0.0039	0.0621	0.28	0.05	0.0051	0.0711	0.04	0.51	0.0036	0.0602	0.12
2008	3	1.32	0.0019	0.0437	0.18	0.60	0.0025	0.0500	0.07	0.03	0.0036	0.0603	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	0.1020	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	0.30	0.23	0.0384	0.1960	0.21	0.61	0.0011	0.0329	0.15
2009	2	1.00	0.0018	0.0426	0.14	3.55	0.0047	0.0682	0.42	0.10	0.0055	0.0739	0.09	0.73	0.0024	0.0491	0.18
2009	3	1.90	0.0099	0.0994	0.26	1.43	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	0.45	1.62	0.0044	0.0665	0.19	0.05	0.0126	0.1121	0.05	0.33	0.0011	0.0338	0.08

Appendix table 5. Quarterly value of yellowfin CPUE standardized from 1963-2012 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
2010	1	1.72	0.0103	0.1014	0.24	3.04	0.0032	0.0567	0.36	0.07	0.0136	0.1167	0.07	0.56	0.0014	0.0370	0.14
2010	2	0.95	0.0111	0.1055	0.13	4.21	0.0056	0.0747	0.50	0.07	0.0035	0.0592	0.07	0.70	0.0063	0.0796	0.17
2010	3	8.02	0.0733	0.2707	1.12	1.77	0.0047	0.0683	0.21	0.04	0.0045	0.0672	0.04	0.35	0.0127	0.1125	0.08
2010	4	4.75	0.0367	0.1916	0.66	2.34	0.0046	0.0675	0.28	0.18	0.0444	0.2106	0.17	0.28	0.0021	0.0462	0.07
2011	1					5.13	0.0084	0.0918	0.61	0.11	0.0396	0.1991	0.10	0.30	0.0028	0.0526	0.07
2011	2					2.12	0.0071	0.0841	0.25	0.14	0.0049	0.0699	0.13	0.20	0.0715	0.2673	0.05
2011	3					1.07	0.0040	0.0634	0.13	0.07	0.0069	0.0832	0.07	0.01	0.3200	0.5657	0.00
2011	4					4.08	0.0077	0.0875	0.49	0.08	0.0481	0.2193	0.07	0.73	0.0036	0.0597	0.18

Appendix table 6. Quarterly value of yellowfin CPUE for 1963-2012 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	0.0517	2.95	13.09	0.0072	0.0848	2.92	0.46	0.0042	0.0644	1.04	8.25	0.0025	0.0497	1.98
1963	2	15.94	0.0039	0.0621	2.35	12.28	0.0074	0.0861	2.74	0.73	0.0283	0.1683	1.67	8.12	0.0031	0.0559	1.95
1963	3	14.50	0.0133	0.1152	2.14	7.44	0.0053	0.0730	1.66	1.13	0.0050	0.0706	2.59	7.10	0.0035	0.0592	1.70
1963	4	21.85	0.0030	0.0549	3.22	9.22	0.0071	0.0842	2.05	0.46	0.0036	0.0596	1.05	9.25	0.0030	0.0543	2.22
1964	1	17.56	0.0028	0.0530	2.59	10.66	0.0078	0.0882	2.38	0.33	0.0039	0.0622	0.76	10.97	0.0029	0.0538	2.63
1964	2	12.11	0.0022	0.0469	1.79	6.03	0.0064	0.0797	1.34	2.52	0.0139	0.1177	5.75	12.00	0.0030	0.0545	2.88
1964	3	8.76	0.0055	0.0743	1.29	5.99	0.0036	0.0599	1.33	0.90	0.0074	0.0862	2.06	9.26	0.0021	0.0459	2.22
1964	4	9.23	0.0027	0.0519	1.36	4.82	0.0049	0.0703	1.07	0.54	0.0028	0.0524	1.23	6.16	0.0021	0.0454	1.48
1965	1	11.72	0.0022	0.0464	1.73	4.42	0.0074	0.0857	0.98	0.32	0.0033	0.0578	0.73	7.77	0.0020	0.0445	1.86
1965	2	12.38	0.0024	0.0490	1.82	6.04	0.0091	0.0951	1.35	0.81	0.0145	0.1206	1.86	8.82	0.0019	0.0430	2.11
1965	3	10.78	0.0033	0.0571	1.59	5.68	0.0048	0.0696	1.27	0.34	0.0060	0.0777	0.79	5.10	0.0027	0.0521	1.22
1965	4	21.65	0.0029	0.0541	3.19	7.91	0.0063	0.0796	1.76	0.30	0.0028	0.0533	0.68	8.06	0.0026	0.0512	1.93
1966	1	20.03	0.0020	0.0444	2.95	7.22	0.0149	0.1220	1.61	0.25	0.0036	0.0596	0.58	9.42	0.0022	0.0464	2.26
1966	2	17.85	0.0019	0.0439	2.63	7.11	0.0058	0.0762	1.58	0.93	0.0147	0.1213	2.11	11.02	0.0029	0.0538	2.64
1966	3	15.94	0.0027	0.0521	2.35	7.34	0.0047	0.0686	1.64	0.73	0.0069	0.0832	1.67	10.32	0.0027	0.0516	2.47
1966	4	18.22	0.0020	0.0444	2.69	5.73	0.0053	0.0730	1.28	0.59	0.0025	0.0502	1.35	9.99	0.0023	0.0476	2.40
1967	1	11.57	0.0018	0.0423	1.71	5.21	0.0058	0.0759	1.16	0.73	0.0032	0.0567	1.67	9.21	0.0019	0.0432	2.21
1967	2	10.95	0.0021	0.0458	1.61	6.00	0.0045	0.0672	1.34	0.89	0.0034	0.0580	2.02	7.40	0.0017	0.0417	1.77
1967	3	6.05	0.0030	0.0547	0.89	3.74	0.0045	0.0670	0.83	0.28	0.0026	0.0510	0.64	6.78	0.0026	0.0514	1.62
1967	4	10.31	0.0023	0.0482	1.52	5.11	0.0055	0.0739	1.14	0.29	0.0021	0.0463	0.67	8.82	0.0030	0.0547	2.11
1968	1	29.14	0.0022	0.0466	4.30	22.46	0.0113	0.1065	5.01	0.55	0.0036	0.0602	1.25	10.18	0.0019	0.0432	2.44
1968	2	37.96	0.0023	0.0478	5.60	14.20	0.0066	0.0810	3.17	0.64	0.0033	0.0576	1.47	10.94	0.0035	0.0593	2.62
1968	3	19.19	0.0028	0.0526	2.83	7.51	0.0055	0.0741	1.67	0.28	0.0023	0.0483	0.63	4.56	0.0037	0.0609	1.09
1968	4	22.72	0.0022	0.0464	3.35	5.99	0.0070	0.0835	1.33	0.27	0.0026	0.0513	0.61	6.15	0.0028	0.0524	1.47
1969	1	15.83	0.0021	0.0453	2.33	4.68	0.0061	0.0779	1.04	0.20	0.0052	0.0719	0.46	7.94	0.0022	0.0471	1.90
1969	2	12.04	0.0028	0.0531	1.78	4.73	0.0057	0.0753	1.05	0.49	0.0039	0.0620	1.11	9.76	0.0025	0.0504	2.34
1969	3	14.49	0.0029	0.0540	2.14	3.49	0.0048	0.0692	0.78	0.30	0.0025	0.0503	0.69	6.71	0.0044	0.0662	1.61
1969	4	17.28	0.0030	0.0543	2.55	2.52	0.0068	0.0827	0.56	0.28	0.0033	0.0571	0.63	8.06	0.0038	0.0613	1.93
1970	1	10.00	0.0030	0.0550	1.47	3.31	0.0094	0.0970	0.74	0.23	0.0082	0.0907	0.53	7.51	0.0025	0.0504	1.80
1970	2	6.83	0.0042	0.0645	1.01	3.19	0.0081	0.0897	0.71	0.30	0.0037	0.0605	0.69	7.22	0.0032	0.0567	1.73
1970	3	6.31	0.0121	0.1098	0.93	1.41	0.0086	0.0925	0.32	0.28	0.0029	0.0534	0.64	15.15	0.0025	0.0501	3.63
1970	4	10.96	0.0032	0.0568	1.62	2.80	0.0092	0.0957	0.63	1.08	0.0029	0.0541	2.47	8.17	0.0027	0.0518	1.96
1971	1	8.60	0.0029	0.0541	1.27	4.31	0.0067	0.0820	0.96	1.24	0.0052	0.0721	2.84	6.49	0.0027	0.0522	1.56
1971	2	10.02	0.0041	0.0643	1.48	4.32	0.0112	0.1058	0.96	3.07	0.0032	0.0569	7.01	9.64	0.0031	0.0554	2.31
1971	3	15.94	0.0038	0.0613	2.35	3.55	0.0089	0.0943	0.79	0.87	0.0024	0.0487	1.99	5.48	0.0041	0.0641	1.31
1971	4	13.54	0.0030	0.0548	2.00	3.90	0.0134	0.1157	0.87	0.81	0.0046	0.0675	1.86	7.13	0.0050	0.0704	1.71
1972	1	8.26	0.0035	0.0591	1.22	11.70	0.0154	0.1241	2.61	1.88	0.1075	0.3279	4.29	6.49	0.0044	0.0663	1.55
1972	2	8.70	0.0040	0.0631	1.28	8.92	0.0197	0.1403	1.99	2.35	0.0122	0.1104	5.35	4.25	0.0050	0.0704	1.02
1972	3	9.79	0.0035	0.0592	1.44	3.41	0.0077	0.0875	0.76	1.13	0.0055	0.0742	2.58	6.19	0.0081	0.0899	1.48
1972	4	10.24	0.0040	0.0630	1.51	5.77	0.0131	0.1144	1.29	0.73	0.0093	0.0966	1.67	8.55	0.0141	0.1187	2.05
1973	1	7.62	0.0060	0.0771	1.12	6.90	0.0190	0.1378	1.54	3.04	0.0478	0.2186	6.95	8.95	0.0054	0.0733	2.15
1973	2	7.35	0.0058	0.0764	1.08	3.27	0.0154	0.1241	0.73	2.71	0.0093	0.0966	6.18	9.52	0.0086	0.0925	2.28
1973	3	4.84	0.0045	0.0673	0.71	1.80	0.0076	0.0873	0.40	0.36	0.0044	0.0662	0.83	7.48	0.0106	0.1027	1.79
1973	4	8.50	0.0044	0.0664	1.25	6.73	0.0091	0.0956	1.50	0.48	0.0034	0.0587	1.09	4.94	0.0050	0.0706	1.18
1974	1	4.83	0.0041	0.0644	0.71	6.95	0.0105	0.1024	1.55	0.60	0.0077	0.0876	1.36	4.25	0.0029	0.0535	1.02
1974	2	5.65	0.0050	0.0706	0.83	4.89	0.0134	0.1156	1.09	0.85	0.0042	0.0647	1.94	6.52	0.0062	0.0790	1.56
1974	3	4.84	0.0038	0.0620	0.71	1.68	0.0075	0.0866	0.37	0.26	0.0037	0.0605	0.60	4.33	0.0044	0.0660	1.04
1974	4	4.86	0.0047	0.0682	0.72	4.42	0.0073	0.0853	0.99	0.25	0.0055	0.0744	0.56	4.62	0.0027	0.0515	1.11

Appendix table 6. Quarterly value of yellowfin CPUE for 1963-2012 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	0.0672	0.51	4.04	0.0204	0.1428	0.90	0.36	0.0083	0.0910	0.82	4.91	0.0023	0.0474	1.18
1975	2	4.11	0.0058	0.0759	0.61	4.47	0.0137	0.1169	1.00	0.49	0.0039	0.0628	1.12	4.43	0.0043	0.0653	1.06
1975	3	6.66	0.0030	0.0549	0.98	4.15	0.0063	0.0795	0.93	0.34	0.0030	0.0550	0.77	3.86	0.0026	0.0510	0.93
1975	4	9.84	0.0036	0.0596	1.45	13.87	0.0122	0.1103	3.09	0.31	0.0044	0.0663	0.71	4.71	0.0036	0.0603	1.13
1976	1	3.30	0.0043	0.0654	0.49	7.45	0.0082	0.0903	1.66	0.25	0.0330	0.1817	0.56	3.54	0.0040	0.0628	0.85
1976	2	12.58	0.0054	0.0737	1.85	5.41	0.0221	0.1486	1.21	0.28	0.0117	0.1083	0.64	8.21	0.0071	0.0841	1.97
1976	3	6.83	0.0132	0.1151	1.01	2.09	0.0085	0.0924	0.47	0.39	0.0041	0.0642	0.89	4.77	0.0090	0.0951	1.14
1976	4	5.65	0.0192	0.1387	0.83	6.27	0.0216	0.1471	1.40	0.31	0.0063	0.0795	0.70	6.00	0.0087	0.0933	1.44
1977	1	3.63	0.0133	0.1154	0.53	18.81	0.0382	0.1955	4.19	0.64	0.0319	0.1785	1.47	6.95	0.0095	0.0974	1.67
1977	2	18.08	0.0121	0.1099	2.67	21.07	0.0456	0.2136	4.70	0.53	0.0190	0.1377	1.21	7.71	0.0625	0.2499	1.85
1977	3	8.20	0.0125	0.1118	1.21	5.32	0.0093	0.0964	1.19	0.30	0.0049	0.0697	0.68	4.57	0.0089	0.0943	1.10
1977	4	14.64	0.0036	0.0602	2.16	6.45	0.0260	0.1612	1.44	0.34	0.0063	0.0795	0.77	5.88	0.0236	0.1537	1.41
1978	1	7.06	0.0017	0.0410	1.04	6.30	0.0104	0.1021	1.40	0.39	0.0179	0.1336	0.90	7.93	0.0065	0.0803	1.90
1978	2	5.69	0.0022	0.0467	0.84	3.60	0.0154	0.1242	0.80	0.82	0.0064	0.0802	1.88	9.24	0.0183	0.1354	2.21
1978	3	4.39	0.0101	0.1003	0.65	2.49	0.0096	0.0978	0.56	0.31	0.0045	0.0669	0.71	2.74	0.0023	0.0483	0.66
1978	4	8.59	0.0048	0.0692	1.27	8.91	0.0167	0.1293	1.99	0.32	0.0072	0.0850	0.74	3.25	0.0048	0.0689	0.78
1979	1	4.63	0.0035	0.0592	0.68	14.29	0.0079	0.0891	3.19	0.31	0.0221	0.1487	0.71	4.39	0.0051	0.0713	1.05
1979	2	3.34	0.0064	0.0801	0.49	8.94	0.0156	0.1251	1.99	0.70	0.0100	0.1001	1.59	4.39	0.0066	0.0811	1.05
1979	3	3.11	0.0052	0.0721	0.46	3.27	0.0079	0.0891	0.73	0.40	0.0044	0.0663	0.92	2.41	0.0068	0.0825	0.58
1979	4	5.18	0.0125	0.1117	0.76	5.79	0.0134	0.1157	1.29	0.37	0.0084	0.0915	0.85	3.53	0.0047	0.0686	0.85
1980	1	3.20	0.0041	0.0639	0.47	4.98	0.0064	0.0799	1.11	0.25	0.0250	0.1581	0.57	4.45	0.0048	0.0692	1.07
1980	2	3.64	0.0043	0.0655	0.54	1.16	0.0143	0.1196	0.26	0.21	0.0155	0.1244	0.48	7.41	0.0055	0.0739	1.78
1980	3	3.98	0.0118	0.1087	0.59	1.18	0.0073	0.0854	0.26	0.33	0.0051	0.0716	0.76	3.23	0.0036	0.0601	0.77
1980	4	7.76	0.0030	0.0547	1.14	4.16	0.0146	0.1207	0.93	0.27	0.0042	0.0651	0.61	2.47	0.0043	0.0655	0.59
1981	1	3.72	0.0019	0.0432	0.55	3.45	0.0058	0.0762	0.77	0.26	0.0106	0.1032	0.59	3.34	0.0035	0.0591	0.80
1981	2	3.28	0.0042	0.0651	0.48	4.49	0.0103	0.1014	1.00	0.26	0.0144	0.1198	0.60	3.58	0.0052	0.0722	0.86
1981	3	5.74	0.0040	0.0629	0.85	3.37	0.0059	0.0769	0.75	0.36	0.0034	0.0582	0.83	6.37	0.0093	0.0963	1.53
1981	4	5.51	0.0025	0.0496	0.81	5.79	0.0133	0.1151	1.29	0.35	0.0049	0.0700	0.80	3.53	0.0031	0.0553	0.85
1982	1	3.94	0.0017	0.0414	0.58	5.54	0.0057	0.0758	1.23	0.84	0.0138	0.1175	1.93	3.80	0.0034	0.0583	0.91
1982	2	5.40	0.0031	0.0553	0.80	4.79	0.0095	0.0977	1.07	0.13	0.0363	0.1905	0.30	3.82	0.0064	0.0802	0.92
1982	3	4.74	0.0023	0.0479	0.70	2.54	0.0053	0.0730	0.57	0.27	0.0056	0.0747	0.61	3.92	0.0038	0.0616	0.94
1982	4	9.88	0.0017	0.0412	1.46	3.34	0.0132	0.1151	0.74	0.44	0.0110	0.1046	1.00	3.13	0.0032	0.0561	0.75
1983	1	4.99	0.0013	0.0362	0.74	6.13	0.0109	0.1044	1.37	0.37	0.0192	0.1387	0.85	4.40	0.0022	0.0469	1.05
1983	2	5.90	0.0017	0.0412	0.87	2.28	0.0183	0.1354	0.51	0.41	0.0080	0.0894	0.94	7.81	0.0090	0.0949	1.87
1983	3	4.38	0.0042	0.0648	0.65	2.52	0.0061	0.0784	0.56	0.26	0.0041	0.0643	0.59	3.67	0.0018	0.0429	0.88
1983	4	10.50	0.0023	0.0476	1.55	7.53	0.0155	0.1244	1.68	0.37	0.0058	0.0764	0.85	4.51	0.0026	0.0514	1.08
1984	1	5.53	0.0018	0.0420	0.81	8.56	0.0113	0.1064	1.91	0.52	0.0076	0.0873	1.18	5.54	0.0022	0.0470	1.33
1984	2	6.07	0.0025	0.0505	0.89	4.00	0.0178	0.1334	0.89	0.45	0.0050	0.0704	1.02	6.35	0.0038	0.0616	1.52
1984	3	6.79	0.0040	0.0636	1.00	3.63	0.0059	0.0768	0.81	0.29	0.0043	0.0652	0.67	2.96	0.0022	0.0468	0.71
1984	4	6.95	0.0025	0.0500	1.02	9.30	0.0124	0.1114	2.07	0.49	0.0047	0.0688	1.11	5.00	0.0027	0.0522	1.20
1985	1	5.82	0.0017	0.0411	0.86	8.16	0.0111	0.1053	1.82	0.57	0.0116	0.1076	1.30	4.21	0.0015	0.0392	1.01
1985	2	5.48	0.0022	0.0469	0.81	1.81	0.0087	0.0930	0.40	0.59	0.0036	0.0597	1.35	6.92	0.0038	0.0616	1.66
1985	3	6.08	0.0023	0.0474	0.90	2.49	0.0051	0.0715	0.56	0.32	0.0032	0.0561	0.73	5.25	0.0026	0.0505	1.26
1985	4	12.07	0.0016	0.0401	1.78	4.94	0.0135	0.1164	1.10	0.27	0.0060	0.0773	0.61	4.29	0.0045	0.0673	1.03
1986	1	9.22	0.0014	0.0370	1.36	9.80	0.0077	0.0878	2.18	0.39	0.0055	0.0744	0.89	4.20	0.0014	0.0367	1.01
1986	2	10.92	0.0020	0.0452	1.61	1.88	0.0081	0.0901	0.42	0.58	0.0135	0.1160	1.32	7.40	0.0082	0.0903	1.77
1986	3	8.28	0.0031	0.0552	1.22	1.63	0.0056	0.0751	0.36	0.27	0.0036	0.0598	0.62	5.06	0.0039	0.0624	1.21

1986	4	9.86	0.0020	0.0442	1.45	3.56	0.0273	0.1651	0.79	0.27	0.0038	0.0615	0.61	4.03	0.0025	0.0502	0.97

Appendix table 6. Quarterly value of yellowfin CPUE for 1963-2012 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	0.98	7.57	0.0112	0.1059	1.69	0.23	0.0045	0.0669	0.54	4.62	0.0017	0.0409	1.11
1987	2	6.48	0.0020	0.0445	0.96	6.32	0.0103	0.1014	1.41	1.03	0.0185	0.1361	2.35	5.94	0.0568	0.2384	1.42
1987	3	4.16	0.0051	0.0715	0.61	2.75	0.0050	0.0710	0.61	0.29	0.0038	0.0616	0.65	3.71	0.0149	0.1220	0.89
1987	4	9.94	0.0028	0.0528	1.47	4.96	0.0141	0.1188	1.11	0.32	0.0048	0.0693	0.74	4.20	0.0021	0.0457	1.01
1988	1	9.95	0.0015	0.0382	1.47	12.15	0.0120	0.1094	2.71	0.59	0.0118	0.1088	1.34	5.16	0.0017	0.0415	1.24
1988	2	6.76	0.0022	0.0470	1.00	3.64	0.0083	0.0914	0.81	1.03	0.0145	0.1202	2.36	5.67	0.0569	0.2385	1.36
1988	3	4.15	0.0045	0.0672	0.61	3.25	0.0050	0.0707	0.72	0.26	0.0050	0.0710	0.58	7.39	0.0052	0.0719	1.77
1988	4	5.54	0.0026	0.0510	0.82	7.44	0.0131	0.1144	1.66	0.28	0.0067	0.0817	0.64	4.70	0.0022	0.0468	1.13
1989	1	4.07	0.0015	0.0393	0.60	7.35	0.0147	0.1214	1.64	0.90	0.0134	0.1158	2.05	5.02	0.0032	0.0567	1.20
1989	2	4.03	0.0030	0.0548	0.59	3.26	0.0079	0.0889	0.73	0.93	0.0290	0.1702	2.12	5.68	0.0135	0.1162	1.36
1989	3	2.91	0.0214	0.1464	0.43	2.04	0.0049	0.0700	0.45	0.26	0.0068	0.0825	0.60	2.59	0.0062	0.0789	0.62
1989	4	7.57	0.0044	0.0661	1.12	6.17	0.0111	0.1056	1.37	0.29	0.0063	0.0796	0.65	2.55	0.0047	0.0683	0.61
1990	1	7.99	0.0023	0.0478	1.18	15.33	0.0095	0.0976	3.42	0.42	0.0057	0.0753	0.95	4.97	0.0020	0.0442	1.19
1990	2	5.13	0.0036	0.0604	0.76	2.97	0.0085	0.0923	0.66	0.13	0.0364	0.1907	0.30	8.11	0.0219	0.1481	1.95
1990	3	5.51	0.0126	0.1122	0.81	1.28	0.0048	0.0690	0.28	0.29	0.0037	0.0606	0.67	7.89	0.0060	0.0775	1.89
1990	4	6.37	0.0031	0.0554	0.94	2.03	0.0215	0.1465	0.45	0.20	0.0076	0.0874	0.46	2.64	0.0029	0.0537	0.63
1991	1	7.51	0.0021	0.0463	1.11	3.34	0.0079	0.0891	0.74	0.49	0.0081	0.0901	1.13	3.49	0.0023	0.0480	0.84
1991	2	7.59	0.0091	0.0952	1.12	2.37	0.0065	0.0804	0.53	0.24	0.0129	0.1137	0.55	3.03	0.0244	0.1563	0.73
1991	3	2.48	0.0093	0.0966	0.37	1.83	0.0045	0.0667	0.41	0.25	0.0024	0.0491	0.58	2.23	0.0135	0.1160	0.53
1991	4	5.88	0.0089	0.0944	0.87	3.15	0.0130	0.1141	0.70	0.15	0.0025	0.0500	0.35	2.51	0.0043	0.0655	0.60
1992	1	5.83	0.0038	0.0619	0.86	3.76	0.0058	0.0759	0.84	0.16	0.0107	0.1033	0.37	3.23	0.0039	0.0627	0.77
1992	2	7.38	0.0055	0.0743	1.09	1.98	0.0051	0.0716	0.44	0.17	0.0075	0.0866	0.38	2.32	0.1036	0.3218	0.56
1992	3	3.03	0.0228	0.1511	0.45	2.91	0.0037	0.0612	0.65	0.19	0.0043	0.0652	0.44	3.68	0.0173	0.1316	0.88
1992	4	4.12	0.0035	0.0595	0.61	4.08	0.0258	0.1605	0.91	0.10	0.0044	0.0661	0.23	2.52	0.0076	0.0872	0.60
1993	1	3.84	0.0044	0.0667	0.57	8.07	0.0065	0.0803	1.80	0.14	0.0191	0.1383	0.32	1.89	0.0037	0.0604	0.45
1993	2	4.37	0.0035	0.0593	0.65	2.76	0.0057	0.0752	0.62	0.16	0.0117	0.1080	0.37	5.50	0.0314	0.1771	1.32
1993	3	3.65	0.0056	0.0751	0.54	3.84	0.0040	0.0633	0.86	0.15	0.0025	0.0495	0.35	2.15	0.0080	0.0894	0.52
1993	4	5.48	0.0025	0.0498	0.81	4.20	0.0228	0.1511	0.94	0.16	0.0030	0.0544	0.37	2.45	0.0059	0.0769	0.59
1994	1	4.43	0.0024	0.0489	0.65	4.95	0.0045	0.0671	1.10	0.20	0.0048	0.0691	0.45	1.45	0.0032	0.0566	0.35
1994	2	5.36	0.0032	0.0565	0.79	2.30	0.0035	0.0587	0.51	0.29	0.0033	0.0578	0.67	1.61	0.2087	0.4568	0.39
1994	3	2.81	0.0073	0.0856	0.41	2.81	0.0033	0.0578	0.63	0.25	0.0022	0.0470	0.57	3.77	0.0218	0.1475	0.90
1994	4	2.99	0.0023	0.0480	0.44	2.65	0.0074	0.0860	0.59	0.21	0.0017	0.0411	0.47	1.87	0.0044	0.0660	0.45
1995	1	2.70	0.0035	0.0594	0.40	3.60	0.0039	0.0624	0.80	0.31	0.0022	0.0470	0.71	2.03	0.0028	0.0528	0.49
1995	2	2.18	0.0056	0.0748	0.32	2.00	0.0035	0.0595	0.45	0.19	0.0027	0.0519	0.44	3.11	0.0164	0.1281	0.74
1995	3	2.85	0.0111	0.1053	0.42	2.02	0.0038	0.0619	0.45	0.28	0.0013	0.0359	0.63	1.20	0.0065	0.0806	0.29
1995	4	5.01	0.0021	0.0454	0.74	6.90	0.0116	0.1075	1.54	0.17	0.0014	0.0369	0.39	2.02	0.0030	0.0550	0.48
1996	1	6.38	0.0023	0.0480	0.94	3.65	0.0036	0.0596	0.81	0.22	0.0022	0.0465	0.51	2.16	0.0026	0.0505	0.52
1996	2	4.45	0.0029	0.0539	0.66	1.41	0.0036	0.0600	0.31	0.32	0.0022	0.0465	0.74	1.58	0.0273	0.1653	0.38
1996	3	2.75	0.0033	0.0574	0.41	2.10	0.0034	0.0580	0.47	0.34	0.0016	0.0395	0.79	1.76	0.0123	0.1110	0.42
1996	4	2.46	0.0013	0.0364	0.36	5.05	0.0051	0.0713	1.13	0.22	0.0017	0.0411	0.50	1.61	0.0029	0.0539	0.39
1997	1	4.09	0.0014	0.0376	0.60	3.54	0.0034	0.0583	0.79	0.42	0.0084	0.0916	0.95	1.78	0.0014	0.0371	0.43
1997	2	2.08	0.0015	0.0383	0.31	1.48	0.0035	0.0594	0.33	0.26	0.0037	0.0607	0.58	1.96	0.0252	0.1588	0.47
1997	3	3.74	0.0025	0.0495	0.55	1.54	0.0034	0.0587	0.34	0.23	0.0014	0.0370	0.53	3.67	0.0054	0.0736	0.88
1997	4	4.12	0.0010	0.0324	0.61	2.25	0.0042	0.0649	0.50	0.26	0.0021	0.0459	0.60	1.08	0.0020	0.0451	0.26
1998	1	3.51	0.0009	0.0308	0.52	2.99	0.0033	0.0571	0.67	0.31	0.0107	0.1036	0.70	1.97	0.0014	0.0369	0.47
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	1.94	0.0073	0.0854	0.46
1998	3	3.05	0.0022	0.0466	0.45	1.25	0.0035	0.0588	0.28	0.22	0.0023	0.0477	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	0.65	0.24	0.0027	0.0521	0.55	1.71	0.0020	0.0443	0.41

Appendix table 6. Quarterly value of yellowfin CPUE for 1963-2012 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	0.50	2.94	0.0036	0.0597	0.65	0.36	0.0064	0.0799	0.82	2.81	0.0016	0.0401	0.67
1999	2	3.63	0.0038	0.0619	0.53	1.31	0.0037	0.0610	0.29	0.42	0.0037	0.0608	0.96	2.08	0.0052	0.0720	0.50
1999	3	3.95	0.0039	0.0626	0.58	1.77	0.0039	0.0627	0.39	0.29	0.0022	0.0466	0.66	2.00	0.0021	0.0459	0.48
1999	4	3.44	0.0014	0.0368	0.51	3.94	0.0041	0.0639	0.88	0.33	0.0048	0.0694	0.76	1.57	0.0012	0.0348	0.38
2000	1	3.63	0.0013	0.0358	0.54	3.14	0.0038	0.0619	0.70	0.42	0.0071	0.0844	0.95	1.73	0.0015	0.0392	0.41
2000	2	3.17	0.0028	0.0533	0.47	1.21	0.0050	0.0705	0.27	0.30	0.0032	0.0563	0.68	3.65	0.0016	0.0404	0.87
2000	3	6.13	0.0030	0.0547	0.90	1.50	0.0040	0.0633	0.34	0.32	0.0021	0.0453	0.73	3.74	0.0026	0.0511	0.90
2000	4	4.38	0.0019	0.0436	0.65	1.95	0.0044	0.0662	0.43	0.19	0.0039	0.0624	0.44	1.76	0.0028	0.0526	0.42
2001	1	4.02	0.0032	0.0567	0.59	4.55	0.0039	0.0624	1.01	0.10	0.0043	0.0653	0.23	1.66	0.0015	0.0383	0.40
2001	2	4.91	0.0024	0.0495	0.72	1.42	0.0052	0.0721	0.32	0.29	0.0037	0.0604	0.65	1.68	0.0028	0.0530	0.40
2001	3	3.68	0.0037	0.0607	0.54	1.76	0.0040	0.0629	0.39	0.31	0.0015	0.0387	0.71	1.32	0.0036	0.0596	0.32
2001	4	4.92	0.0024	0.0490	0.72	2.24	0.0049	0.0702	0.50	0.36	0.0017	0.0415	0.81	1.02	0.0036	0.0600	0.24
2002	1	5.61	0.0016	0.0402	0.83	3.78	0.0036	0.0603	0.84	0.30	0.0037	0.0606	0.69	1.21	0.0036	0.0603	0.29
2002	2	3.28	0.0023	0.0475	0.48	2.19	0.0056	0.0747	0.49	0.27	0.0053	0.0728	0.61	1.67	0.0060	0.0775	0.40
2002	3	1.27	0.0027	0.0521	0.19	1.56	0.0044	0.0664	0.35	0.22	0.0017	0.0411	0.50	0.83	0.0031	0.0553	0.20
2002	4	2.31	0.0012	0.0344	0.34	2.30	0.0064	0.0801	0.51	0.18	0.0020	0.0449	0.40	0.92	0.0013	0.0358	0.22
2003	1	3.32	0.0015	0.0384	0.49	4.05	0.0040	0.0634	0.90	0.15	0.0136	0.1165	0.34	1.02	0.0020	0.0444	0.24
2003	2	3.88	0.0021	0.0454	0.57	2.06	0.0057	0.0757	0.46	0.84	0.0090	0.0947	1.92	0.88	0.0172	0.1311	0.21
2003	3	3.70	0.0030	0.0550	0.55	1.76	0.0050	0.0704	0.39	0.36	0.0026	0.0508	0.83	0.73	0.0079	0.0891	0.18
2003	4	4.03	0.0012	0.0353	0.59	2.86	0.0066	0.0812	0.64	0.27	0.0030	0.0550	0.61	1.53	0.0027	0.0519	0.37
2004	1	2.64	0.0012	0.0348	0.39	3.31	0.0040	0.0632	0.74	0.63	0.0194	0.1392	1.44	1.14	0.0033	0.0574	0.27
2004	2	5.27	0.0019	0.0435	0.78	2.88	0.0053	0.0729	0.64	0.31	0.0071	0.0843	0.70	2.66	0.0101	0.1004	0.64
2004	3	2.05	0.0023	0.0476	0.30	2.42	0.0034	0.0587	0.54	0.33	0.0026	0.0508	0.75	1.23	0.0043	0.0655	0.29
2004	4	3.94	0.0015	0.0386	0.58	2.22	0.0046	0.0680	0.49	0.24	0.0033	0.0570	0.54	0.92	0.0024	0.0494	0.22
2005	1	3.76	0.0011	0.0327	0.55	5.08	0.0039	0.0624	1.13	0.19	0.0074	0.0860	0.44	0.88	0.0030	0.0548	0.21
2005	2	4.95	0.0014	0.0373	0.73	2.74	0.0041	0.0640	0.61	0.34	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	0.0575	0.35	0.19	0.0052	0.0720	0.44	1.04	0.0117	0.1080	0.25
2005	4	2.41	0.0011	0.0331	0.36	3.87	0.0046	0.0678	0.86	0.18	0.0030	0.0546	0.41	0.69	0.0039	0.0623	0.17
2006	1	3.94	0.0010	0.0322	0.58	5.05	0.0037	0.0605	1.13	0.17	0.0055	0.0744	0.40	1.44	0.0018	0.0429	0.35
2006	2	4.53	0.0010	0.0309	0.67	2.90	0.0036	0.0598	0.65	0.44	0.0130	0.1141	1.00	2.10	0.0032	0.0567	0.50
2006	3	1.74	0.0019	0.0436	0.26	1.60	0.0034	0.0580	0.36	0.23	0.0031	0.0560	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	0.0733	0.67	0.93	0.0017	0.0410	0.22
2007	1	1.91	0.0009	0.0304	0.28	3.49	0.0035	0.0595	0.78	0.20	0.0168	0.1295	0.45	1.24	0.0015	0.0382	0.30
2007	2	1.80	0.0008	0.0285	0.26	3.04	0.0042	0.0651	0.68	0.39	0.0066	0.0815	0.89	1.47	0.0025	0.0504	0.35
2007	3	1.53	0.0017	0.0410	0.23	1.10	0.0035	0.0592	0.25	0.24	0.0028	0.0524	0.54	1.06	0.0033	0.0577	0.26
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	0.26
2008	1	1.12	0.0013	0.0363	0.17	3.01	0.0041	0.0640	0.67	0.13	0.0106	0.1032	0.29	0.74	0.0015	0.0381	0.18
2008	2	1.32	0.0011	0.0332	0.20	1.67	0.0050	0.0709	0.37	0.15	0.0033	0.0574	0.35	0.44	0.0036	0.0602	0.11
2008	3	1.13	0.0020	0.0450	0.17	0.99	0.0040	0.0633	0.22	0.12	0.0024	0.0493	0.27	0.53	0.0030	0.0547	0.13
2008	4	0.87	0.0016	0.0399	0.13	1.50	0.0039	0.0628	0.33	0.16	0.0066	0.0814	0.37	0.52	0.0014	0.0374	0.13
2009	1	0.69	0.0012	0.0340	0.10	1.64	0.0040	0.0631	0.37	0.15	0.0241	0.1551	0.35	0.61	0.0011	0.0333	0.15
2009	2	1.03	0.0019	0.0439	0.15	2.74	0.0057	0.0753	0.61	0.20	0.0036	0.0600	0.47	0.61	0.0024	0.0489	0.15
2009	3	2.04	0.0093	0.0965	0.30	1.62	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	0.42	1.14	0.0055	0.0740	0.25	0.14	0.0080	0.0892	0.32	0.33	0.0012	0.0342	0.08
2010	1	1.61	0.0097	0.0984	0.24	1.93	0.0046	0.0675	0.43	0.11	0.0086	0.0928	0.25	0.55	0.0014	0.0373	0.13
2010	2	0.91	0.0105	0.1023	0.13	3.47	0.0064	0.0798	0.77	0.23	0.0024	0.0485	0.53	0.57	0.0062	0.0789	0.14
2010	3	5.97	0.0674	0.2597	0.88	2.01	0.0057	0.0752	0.45	0.13	0.0030	0.0544	0.29	0.44	0.0123	0.1111	0.11

2010	4	3.71	0.0340	0.1844	0.55	1.65	0.0056	0.0747	0.37	0.15	0.0279	0.1670	0.35	0.30	0.0022	0.0464	0.07	

Appendix table 6. Quarterly value of yellowfin CPUE for 1963-2012 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
2011	1					3.47	0.0086	0.0927	0.77	0.30	0.0248	0.1574	0.68	0.31	0.0028	0.0526	0.07
2011	2					2.07	0.0075	0.0867	0.46	0.35	0.0033	0.0570	0.80	0.23	0.0693	0.2632	0.06
2011	3					1.23	0.0052	0.0718	0.27	0.27	0.0044	0.0666	0.61	0.14	0.3096	0.5564	0.03
2011	4					3.16	0.0080	0.0894	0.70	0.16	0.0301	0.1735	0.35	0.79	0.0036	0.0596	0.19
2012	1					1.76	0.0068	0.0824	0.39	0.49	0.0442	0.2103	1.12	0.78	0.0030	0.0544	0.19
2012	2	0.50	0.0339	0.1840	0.07	1.48	0.0062	0.0785	0.33	0.34	0.0028	0.0529	0.78	0.77	0.0481	0.2194	0.18
2012	3	1.51	0.0176	0.1325	0.22	0.99	0.0052	0.0720	0.22	0.16	0.0042	0.0647	0.35	0.29	0.0313	0.1770	0.07
2012	4	1.73	0.0116	0.1079	0.26	2.44	0.0089	0.0944	0.54	0.19	0.1206	0.3472	0.43	0.49	0.0033	0.0570	0.12