e

Japanese longline CPUE for bigeye tuna in the Indian Ocean up to 2008 standardized by GLM

Hiroaki OKAMOTO, Keisuke Satoh and Hiroshi SHONO

National Research Institute of Far Seas Fisheries
5 chome 7-1, Orido, Shimizu-Ku, Shizuoka-City, 424-8633, Japan

Abstract

Japanese longline CPUE for bigeye tuna from 1960 to 2008 was standardized by GLM (CPUE-LogNormal error structured model). Method of standardization was the same as that used for bigeye assessment in 2006. SST (Sea Surface Temperature) was included in the model as oceanographic factor. NHF (Number of Hooks between Float) and material of main and branch lines were applied to standardize the change in catchability of longline gear.

In the tropical Indian Ocean, CPUE continuously decreased from around 9.0 (real scale) in 1960 to 3.2 in 2002 when it has increased to about 4.4, about the same level as that in the late 1990's. Standardized CPUE in the south area which didn't show clear trend during the period between 1984 and 2000 (CPUE was 3.5 on average), decreased to 2.3 in 2003 and increased to 3.0 in 2004 after when it decreased to 1.7 in 2005 and was kept in this low level thereafter. As a result, CPUE in all Indian Ocean, which had decreased until 2002, increased a little in 2003 and 2004 after when it keep the same level around 3.3.

1. Introduction

. Japanese longline CPUE for bigeye tuna from 1960 to 2008 was standardized by GLM (CPUE-LogNormal error structured model). Method of standardization was the same as that used for bigeye assessment in 2006.

2. Materials and methods

Area definition:

Area definition used in this study (Fig. 1) is the same as that used in the IOTC bigeye assessment in 2006 (Okamoto and Shono, 2006) which consists of seven areas. Main fishing ground of Japanese longline fishery for bigeye was divided into seven areas and CPUE standardization was done for three cases of area combinations, Aropical (areas 1-5), South (areas 6 & 7) and ALL (areas 1-7) Indian Ocean. Area 67 in the south area was not used in this study.

Environmental factors:

As environmental factors, which are available for the analyzed period from 1960 to 2008, SST (Sea Surface Temperature) was applied. The original SST data, whose resolution is 1-degree latitude and 1-degree longitude by month from 1946 to 2008, was downloaded from NEAR-GOOS Regional Real Time Data Base of Japan Meteorological Agency (JMA).

http://goos.kishou.go.jp/rrtdb/database.html

It is necessary to get password to access the data retrieving system. The original data was recompiled into 5-degree latitude and 5-latitude longitude by month from 1960 to 2004 using the procedures described in Okamoto et al. (2001), and used in the analyses.

Catch and effort data used:

The Japanese longline catch (in number) and effort statistics from 1960 up to 2008 were used. 2008 data is preliminary. The catch and effort data set from aggregated by month, 5-degree square, NHF (the number of hooks between floats, and main line material, was used for the analysis. Data in strata in which the number of hooks was less than 5000 were not used for analyses. As the NHF information does not available for the period from 1960 to 1974, NHF was regarded to be 5 in this period. Main line material was categorized in to two, 1 = Nylon and 2 = other. .

GLM (Generalized Linear Model):

CPUEs based on the number of catch was used;

The number of caught fish / the number of hooks * 1000

The model used for GLM analyses (CPUE-LogNormal error structured model) was as follows.

Model (CPUE-LogNormal error structured model):

$$\text{Log}(CPUE_{ijkl} + \text{const}) = \mu + YR_{(i)} + MN_{(j)} + AREA_{(k)} + NHFCL_{(l)} + SST_{(m)} + ML_{(n)} + YR_{(i)}*AREA_{(k)} + MN_{(j)}*AREA_{(k)} + AREA_{(k)}*NHFCL_{(l)} + AREA_{(k)}*SST_{(m)} + NHFCL_{(l)}*ML_{(n)} + e_{(ijkl....)}$$

Where Log : natural logarithm,

CPUE : catch in number of bigeye per 1000 hooks,

Const : 10% of overall mean of CPUE

μ : overall mean (i.e. intercept),

$YR_{(i)}$: effect of year,

$MN_{(j)}$: effect of fishing season (month),

$AREA_{(k)}$: effect of sub-area,

$NHFCL_{(l)}$: effect of gear type (class of the number of hooks between floats),

$SST_{(m)}$: effect of SST,

$ML_{(n)}$: effect of material of main line,

YR (i)*AREA (k) : interaction term between year and sub-area,

MN (j)*AREA (k) : interaction term between fishing season and sub-area,

AREA (k)*NHFCL (l) : interaction term between sub-area and gear type,

AREA(k)*SST (m) : interaction term between sub-area and SST,

NHFCL(l)*ML(n) : interaction term between sub-area and MLD,

$e_{(ijkl..)}$: 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.

$$CPUE_i = \Sigma\ W_j * (\exp(\text{lsmean}(\text{Year } i * \text{Area}_j)) - \text{constant})$$

Where $CPUE_i$ = CPUE in year i,

W_j = Area rate of Area j , ($\Sigma W_j = 1$),

lsmean(Year*$Area_{ij}$) = least square mean of Year-Area interaction in Year i and Area j,

constant = 10% of overall mean of CPUE.

Time period of standardization was 1960-2008 annual CPUE, and three kinds of time period, 1960-2008, 1968-2008, and 1980-2008 were applied for quarter CPUE.

3. Results and discussion

CPUE standardizations by GLM:

The bigeye CPUE (catch in number per 1000 hooks) was standardized by GLM

(CPUE-LogNormal error structured model) for each of three area categories, Tropical (Areas 1 – 5), South (Areas 6 & 7) and All Indian Ocean (Areas 1 – 7) for three periods 1960-2008, 1968-2008 and 1980-2008, as described in the materials and method section. In the result section, results for time period 1960-2008 are explained.

Trends of CPUE in each region category (Tropical, South and All Indian Ocean) were shown in Fig. 2 overlaying Nominal CPUE in real scale and relative scale. In the tropical Indian Ocean, CPUE continuously decreased from around 9.0 (real scale) in 1960 to 3.2 in 2002 when it has increased to about 4.4, about the same level as that in the late 1990's. Standardized CPUE in the south area which didn't show clear trend during the period between 1984 and 2000 (CPUE was 3.5 on average), decreased to 2.3 in 2003 and increased to 3.0 in 2004 after when it decreased to 1.7 in 2005 and was kept in this low level thereafter. As a result, CPUE in all Indian Ocean, which had decreased until 2002, increased a little in 2003 and 2004 after when it keep the same level around 3.3. Results of ANOVA and distributions of the standard residual in each analysis were shown in Table 1 and Fig. 3, respectively. Distributions of the standard residual did not show remarkable difference from the normal distribution. F test showed that the effects of all explanatory variables included in the model were significant in the standardization for tropical Indian Ocean, but Area, ML, AREA*NHFCL, and SST*AREA were not significant in the south area, and ML was not significant in the all Indian Ocean.

Annual values of standardized CPUE by area were listed in Appendix Table 1. Standardized CPUE of each month and each NHFCL by material were compared for tropical and temperate area in Fig. 4 and 5, respectively. In the temperate, CPUE was highest in summer (Jun–Aug) and lowest in winter (Nov-Feb). Although the seasonal trend in tropical was not so clear, that in winter was highest in winter and lowest in March. Regarding the combination of NHFCL with non-nylon main line materials, larger NHFCL shows higher CPUE in the case of non-nylon main line in the South Indian Ocean, while smallest (NHFCL1) and largest (NHFCL 6) classes were rather low in CPUE than other NHFCL 2 – 5 which were about the same level each other in the Tropical Indian Ocean. As for the nylon mainline, CPUE in Tropical Indian Ocean was lowest for NHFCL 2 or 3, while those of other NHFCL (1, and 4-6) are the same level. Nylon material CPUE of South Indian Ocean did not show large difference between NHFCL although highest value was observed for NHFCL 4.

Finally, quarterly CPUE trend from 1960 to 2004 were shown in Fig. 6 overlaid with year trend. As described in Method section, area weighting was not done for quarterly CPUE. Nevertheless, quarterly CPUE showed very similar trend to annual CPUE. The values of quarterly CPUE were listed in Appendix Table 2, 3 and 4 for three kinds of time period, 1960-2008, 1968-2008 and 1980-2008, respectively.

4. Recerences

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

Okamoto, H., Miyabe, N., and Matsumoto, T. (2001): GLM analyses for standardization of Japanese longline CPUE for bigeye tuna in the Indian Ocean applying environmental factors. IOTC-2001/TTWP/21, 38p.

Okamoto, H. Miyabe, N., and Shono, H. (2006): Japanese longline CPUE for bigeye tuna in the Indian Ocean up to 2004 standardized by GLM applying gear material information in the model. IOTC-2006/WPTT/17. 16 pp.

Table 1. ANOVA table of GLM for standardization of Annual CPUE.

All Tropical			1960-2008 Year base			
Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	335	4897.152	14.618	45.870	<.0001	0.363697
						CV =
yr	48	534.918	11.144	34.970	<.0001	30.6514
mn	11	105.058	9.551	29.970	<.0001	
area	4	103.678	25.920	81.330	<.0001	
nhfcl	5	34.897	6.979	21.900	<.0001	
ml	1	2.390	2.390	7.500	0.0062	
sst	1	13.078	13.078	41.040	<.0001	
yr*area	192	493.624	2.571	8.070	<.0001	
mn*area	44	171.538	3.899	12.230	<.0001	
area*nhfcl	20	66.066	3.303	10.370	<.0001	
nhfcl*ml	5	55.939	11.188	35.110	<.0001	
sst*area	4	95.480	23.870	74.900	<.0001	

All South			1960-2008 Year base			
Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	131	4678.742	35.716	62.760	<.0001	0.366982
						CV =
yr	48	623.250	12.984	22.820	<.0001	72.48167
mn	11	591.247	53.750	94.450	<.0001	
area						
nhfcl	5	33.500	6.700	11.770	<.0001	
ml						
sst	1	313.852	313.852	551.520	<.0001	
yr*area	48	235.330	4.903	8.620	<.0001	
mn*area	11	99.354	9.032	15.870	<.0001	
area*nhfcl						
nhfcl*ml	6	16.584	2.764	4.860	<.0001	
sst*area						

All Indian Ocean			1960-2008 Year base			
Source	DF	Type III SS	Mean Square	F Value	Pr > F	R-Square=
Model	467	13173.287	28.208	73.880	<.0001	0.456574
						CV =
yr	48	3460.663	72.097	188.830	<.0001	38.93905
mn	11	475.903	43.264	113.310	<.0001	
area	6	5513.882	918.980	2406.940	<.0001	
nhfcl	5	207.987	41.597	108.950	<.0001	
ml						
sst	1	822.433	822.433	2154.070	<.0001	
yr*area	288	1557.196	5.407	14.160	<.0001	
mn*area	66	835.024	12.652	33.140	<.0001	
area*nhfcl	30	110.089	3.670	9.610	<.0001	
nhfcl*ml	6	62.431	10.405	27.250	<.0001	
sst*area	6	127.678	21.280	55.730	<.0001	

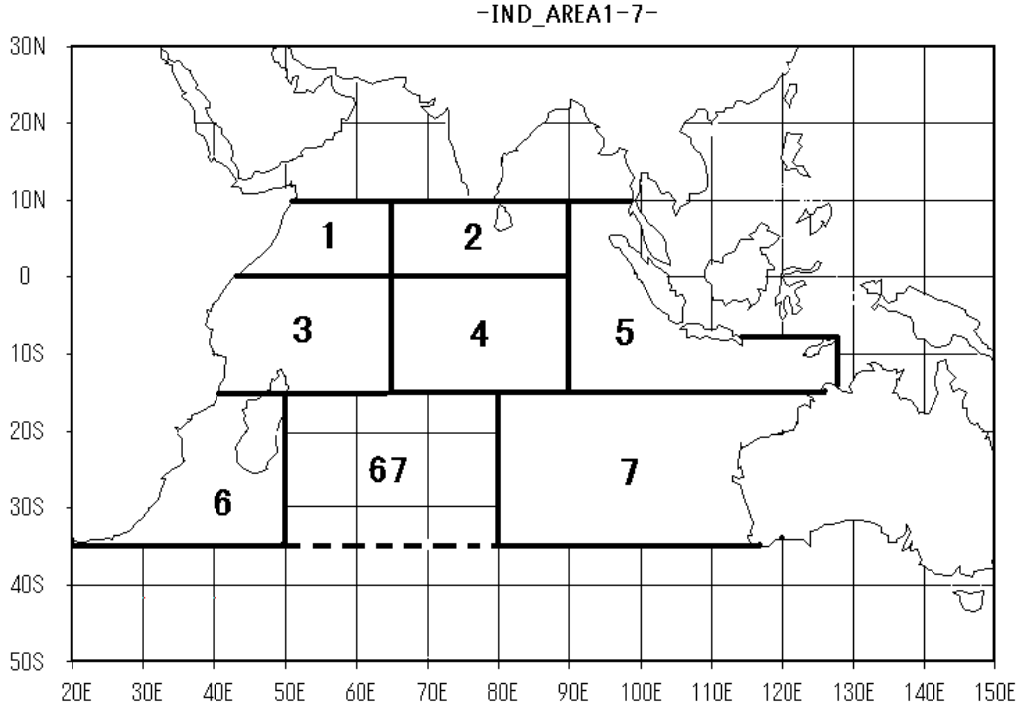

Fig. 1 Definition of sub-areas used in this study. TROPICAL, SOUTH and ALL INDIAN area categories in this paper consist of areas 1-5, areas 6-7 and areas1-7, respectively. Area67 was not used in this study.

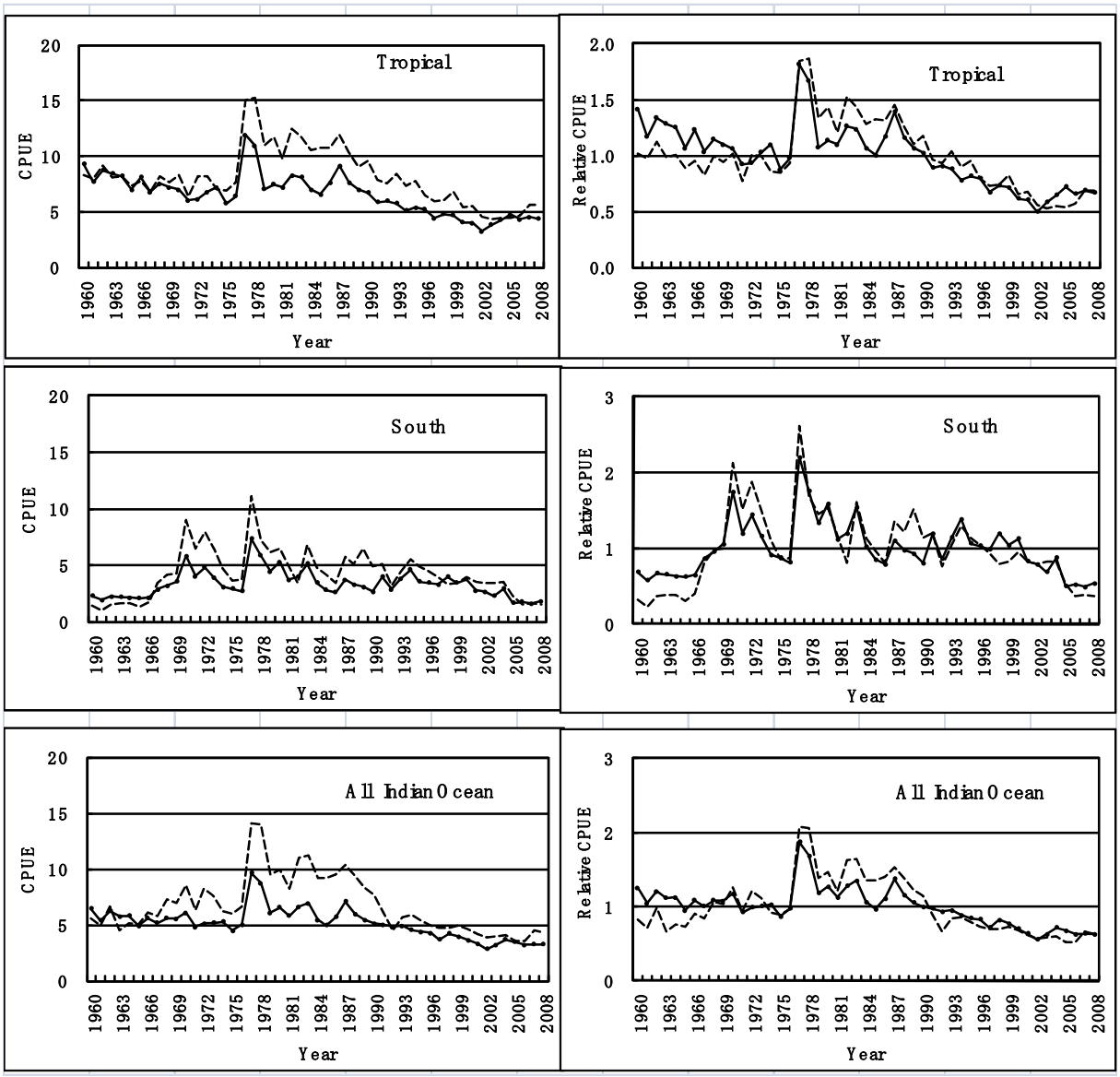

Fig. 2. Standardized CPUEs in real (left) and relative (right) scales for Tropical (top), South (middle) and ALL (bottom) Indian.

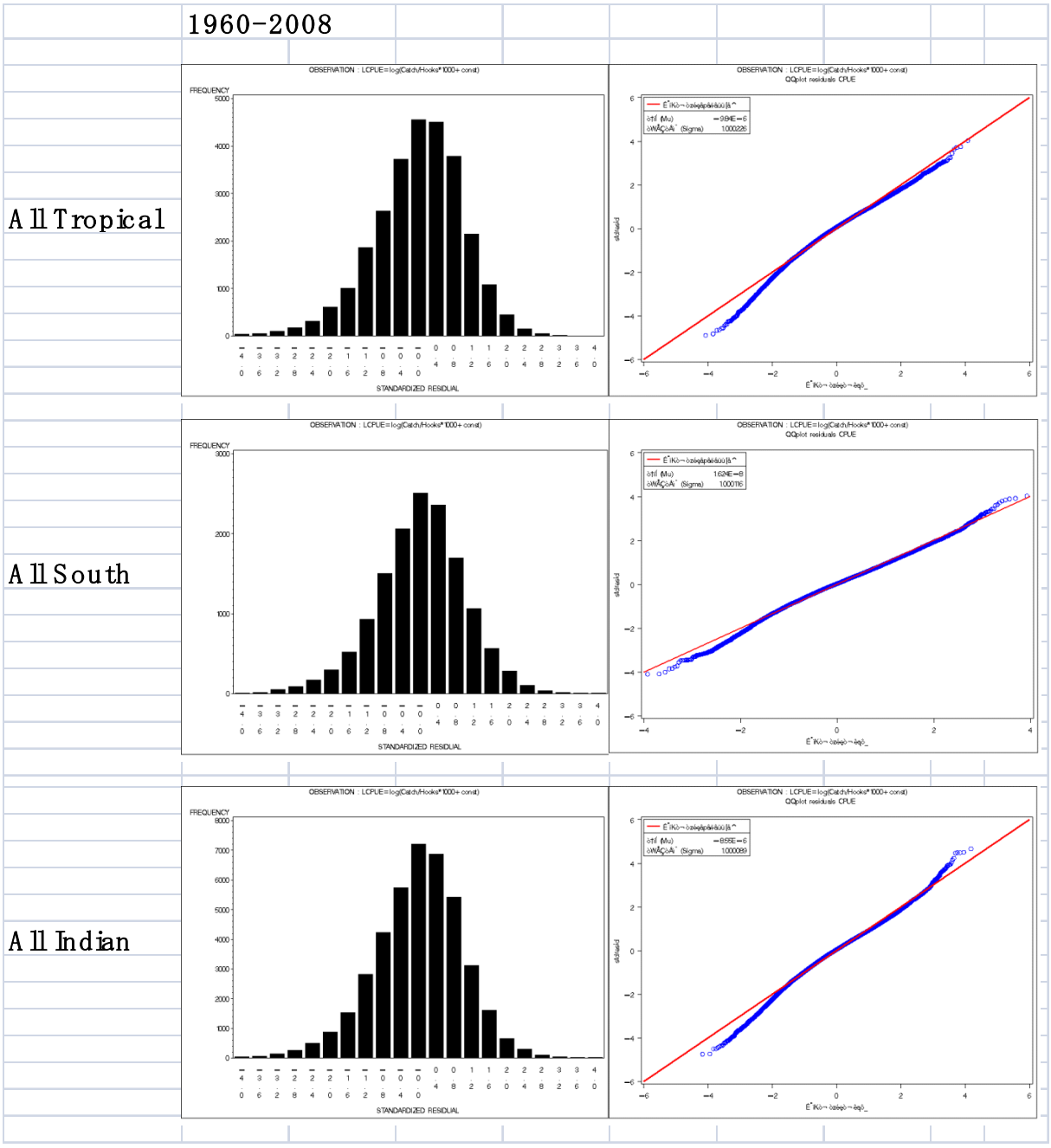

Fig. 3. Standardized residuals of year based standardization for each area expressed as histograms (upper figures) and QQ plots (bottom figures).

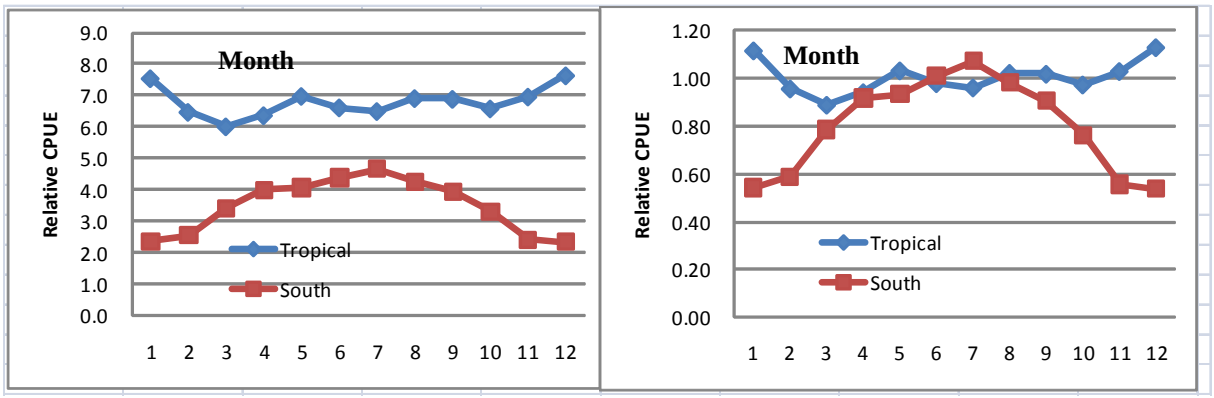

Fig. 4. Standardized CPUE in real scale by month for Tropical and Temperate Indian Ocean. Unit of CPUE is catch in number per 1000 hooks.

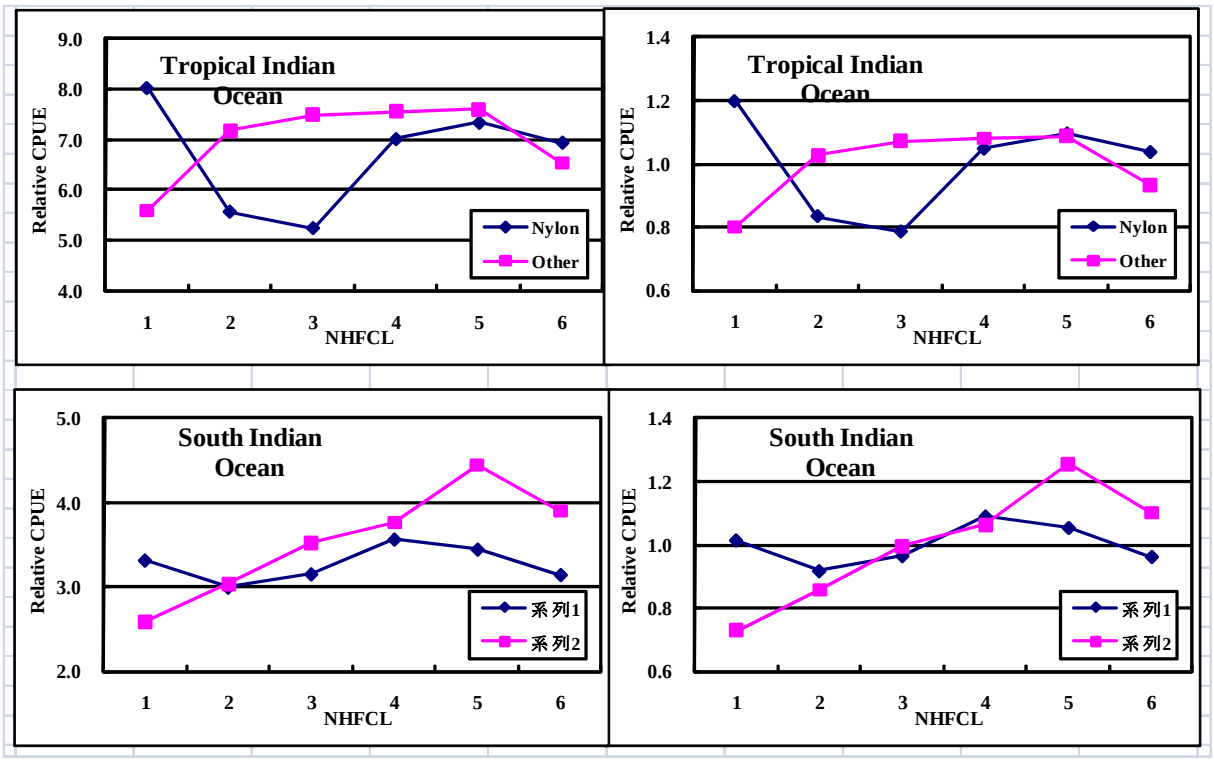

Fig. 5. Standardized CPUE expressed in real (left) and relative (right) scale by NHFCL and mainline materials for Tropical (top) and South (bottom) Indian Ocean. Unit of CPUE is catch in number per 1000 hooks.

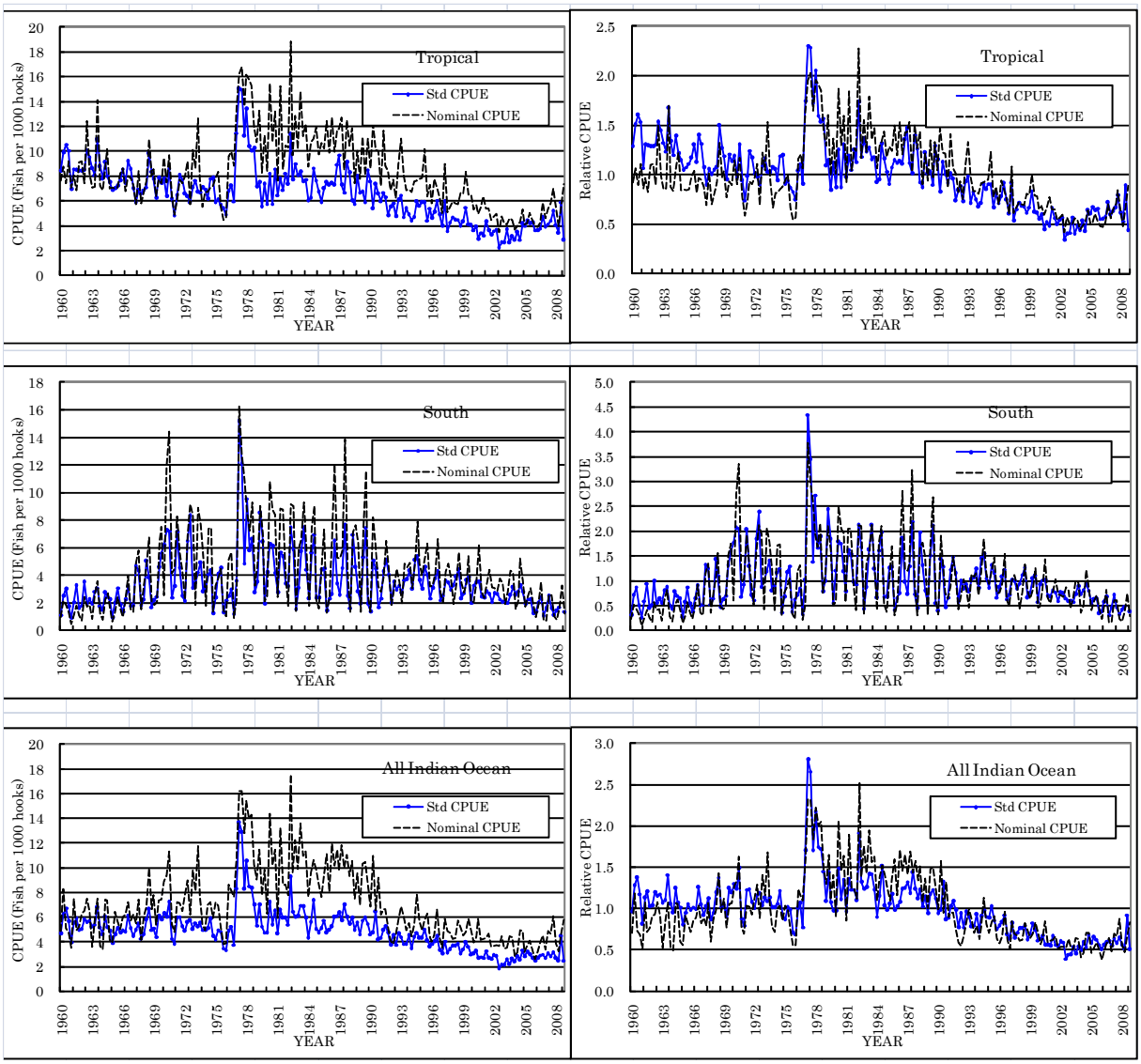

Fig. 6. Quarterly CPUE trend (blue line and dot) from 1960 to 2004 overlaid with yearly CPUE (red dot). Area weighting was not done for quarterly CPUE.

Appendix Table 1. Annual value of standardized Bigeye CPUE in Tropical, South and All Indian Ocean from 1960-2008 expressed in real and relative scale in which the average from 1960 to 2008 is 1.0, with deviation.

All tropical 1960-2008

	LSMEAN		Relative
year	cpue_p	dev_t	CPUE
1960	9.2873	0.0013	1.4181
1961	7.6544	0.0014	1.1687
1962	8.7615	0.0011	1.3378
1963	8.3984	0.0012	1.2823
1964	8.2179	0.0012	1.2548
1965	6.9972	0.0010	1.0684
1966	8.0762	0.0009	1.2332
1967	6.7804	0.0009	1.0353
1968	7.5194	0.0012	1.1481
1969	7.1944	0.0010	1.0985
1970	6.9544	0.0013	1.0619
1971	6.0322	0.0011	0.9211
1972	6.1078	0.0017	0.9326
1973	6.7550	0.0017	1.0314
1974	7.2070	0.0015	1.1004
1975	5.7401	0.0013	0.8765
1976	6.3975	0.0022	0.9768
1977	11.8989	0.0028	1.8168
1978	10.9362	0.0013	1.6698
1979	7.0292	0.0030	1.0733
1980	7.4425	0.0017	1.1364
1981	7.1821	0.0011	1.0966
1982	8.2681	0.0008	1.2625
1983	8.1129	0.0011	1.2388
1984	6.9697	0.0013	1.0642
1985	6.5720	0.0011	1.0035
1986	7.6382	0.0007	1.1663
1987	9.1105	0.0008	1.3911
1988	7.6157	0.0010	1.1628
1989	6.9863	0.0011	1.0667
1990	6.7232	0.0010	1.0266
1991	5.8424	0.0013	0.8921
1992	5.9482	0.0017	0.9082
1993	5.7730	0.0012	0.8815
1994	5.1134	0.0010	0.7808
1995	5.3555	0.0008	0.8177
1996	5.2019	0.0006	0.7943
1997	4.3932	0.0004	0.6708
1998	4.7849	0.0005	0.7306
1999	4.6889	0.0005	0.7159
2000	4.0123	0.0004	0.6126
2001	3.9713	0.0006	0.6064
2002	3.2558	0.0005	0.4971
2003	3.8309	0.0011	0.5849
2004	4.2366	0.0007	0.6469
2005	4.7358	0.0013	0.7231
2006	4.3107	0.0006	0.6582
2007	4.5064	0.0004	0.6881
2008	4.3844	0.0014	0.6695

All south 1960-2008

	LSMEAN		Relative
year	cpue_p	dev_t	CPUE
1960	2.2881	0.0092	0.6861
1961	1.9129	0.0067	0.5736
1962	2.2519	0.0057	0.6753
1963	2.1928	0.0053	0.6575
1964	2.1206	0.0053	0.6359
1965	2.0796	0.0047	0.6236
1966	2.1505	0.0053	0.6449
1967	2.8919	0.0034	0.8672
1968	3.1725	0.0037	0.9514
1969	3.5291	0.0043	1.0583
1970	5.8215	0.0047	1.7457
1971	4.0038	0.0046	1.2006
1972	4.8165	0.0082	1.4444
1973	3.8641	0.0068	1.1587
1974	3.0615	0.0049	0.9181
1975	2.9188	0.0046	0.8753
1976	2.7080	0.0113	0.8120
1977	7.3589	0.0170	2.2068
1978	5.8450	0.0067	1.7528
1979	4.4272	0.0065	1.3276
1980	5.2951	0.0063	1.5879
1981	3.7207	0.0048	1.1157
1982	3.9940	0.0074	1.1977
1983	5.1565	0.0058	1.5463
1984	3.4242	0.0039	1.0268
1985	2.8317	0.0041	0.8492
1986	2.6240	0.0055	0.7869
1987	3.6906	0.0048	1.1067
1988	3.2682	0.0072	0.9801
1989	3.1005	0.0074	0.9298
1990	2.6819	0.0050	0.8042
1991	3.9672	0.0026	1.1896
1992	2.8633	0.0038	0.8586
1993	3.8153	0.0026	1.1441
1994	4.6169	0.0016	1.3845
1995	3.5356	0.0013	1.0602
1996	3.4529	0.0014	1.0354
1997	3.2854	0.0016	0.9852
1998	3.9951	0.0026	1.1980
1999	3.4725	0.0024	1.0413
2000	3.7486	0.0019	1.1241
2001	2.7622	0.0016	0.8283
2002	2.6326	0.0017	0.7894
2003	2.2839	0.0031	0.6849
2004	2.9126	0.0033	0.8734
2005	1.6739	0.0035	0.5020
2006	1.7505	0.0033	0.5249
2007	1.6314	0.0032	0.4892
2007	1.7996	0.0263	0.5397

All Indian Ocean 1960-2008

	LSMEAN		Relative
year	cpue_p	dev_t	CPUE
1960	6.4869	0.0015	1.2575
1961	5.4039	0.0013	1.0476
1962	6.2244	0.0011	1.2066
1963	5.7918	0.0011	1.1228
1964	5.8332	0.0011	1.1308
1965	4.9189	0.0009	0.9535
1966	5.6004	0.0010	1.0857
1967	5.1819	0.0008	1.0045
1968	5.6260	0.0009	1.0906
1969	5.5660	0.0010	1.0790
1970	6.0731	0.0011	1.1773
1971	4.7955	0.0010	0.9296
1972	5.1078	0.0016	0.9902
1973	5.1773	0.0015	1.0036
1974	5.3138	0.0012	1.0301
1975	4.4904	0.0010	0.8705
1976	5.0478	0.0021	0.9785
1977	9.6789	0.0030	1.8763
1978	8.7295	0.0013	1.6923
1979	6.0939	0.0021	1.1813
1980	6.5538	0.0014	1.2705
1981	5.8104	0.0010	1.1264
1982	6.5998	0.0012	1.2794
1983	6.9610	0.0011	1.3494
1984	5.4662	0.0010	1.0597
1985	4.9735	0.0009	0.9641
1986	5.7127	0.0009	1.1074
1987	7.1143	0.0009	1.3791
1988	5.9793	0.0012	1.1591
1989	5.4429	0.0012	1.0551
1990	5.1570	0.0010	0.9997
1991	5.0108	0.0009	0.9714
1992	4.8054	0.0012	0.9315
1993	4.8996	0.0009	0.9498
1994	4.5527	0.0007	0.8826
1995	4.3696	0.0006	0.8471
1996	4.2893	0.0005	0.8315
1997	3.7026	0.0004	0.7178
1998	4.2394	0.0006	0.8218
1999	3.9863	0.0005	0.7728
2000	3.6285	0.0005	0.7034
2001	3.3031	0.0005	0.6403
2002	2.8696	0.0005	0.5563
2003	3.2294	0.0009	0.6260
2004	3.7082	0.0007	0.7188
2005	3.4849	0.0010	0.6756
2006	3.2379	0.0006	0.6277
2007	3.2711	0.0006	0.6341
2007	3.2661	0.0032	0.6332

Appendix Table 2. Quarterly value of standardized bigeye CPUE in Tropical, South and All Indian Ocean from **1960-2008** expressed in real and relative scale in which the average from 1960 to 2004 is 1.0, with deviation.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1960	1	8.4612	0.0037	1.2912	1.1129	0.0472	0.3173	4.7063	0.0041	0.9667
1960	2	9.9190	0.0037	1.5136	2.5244	0.0900	0.7198	6.2409	0.0046	1.2819
1960	3	10.5189	0.0063	1.6052	3.0501	0.0368	0.8697	6.7153	0.0057	1.3794
1960	4	10.0450	0.0046	1.5329	1.7813	0.0267	0.5079	5.7071	0.0042	1.1723
1961	1	6.9685	0.0039	1.0634	0.9285	0.0364	0.2648	3.9594	0.0040	0.8133
1961	2	8.5629	0.0047	1.3067	2.0699	0.0909	0.5902	5.5299	0.0054	1.1359
1961	3	8.5209	0.0071	1.3003	3.3109	0.0249	0.9441	5.8867	0.0057	1.2092
1961	4	8.4677	0.0054	1.2922	1.6088	0.0144	0.4587	4.9989	0.0040	1.0268
1962	1	8.4693	0.0033	1.2924	1.8073	0.0160	0.5153	5.0434	0.0028	1.0359
1962	2	8.5320	0.0033	1.3020	3.5354	0.0237	1.0081	5.8187	0.0032	1.1952
1962	3	10.0764	0.0054	1.5377	1.9693	0.0156	0.5615	5.6249	0.0041	1.1554
1962	4	9.4849	0.0030	1.4474	2.2667	0.0158	0.6463	5.7113	0.0027	1.1731
1963	1	8.6462	0.0031	1.3194	1.9393	0.0129	0.5530	5.2229	0.0026	1.0728
1963	2	8.0685	0.0039	1.2313	2.8292	0.0291	0.8067	5.3800	0.0038	1.1051
1963	3	11.0091	0.0069	1.6800	3.0678	0.0166	0.8748	6.8336	0.0049	1.4037
1963	4	8.8065	0.0047	1.3439	1.7798	0.0144	0.5075	5.1657	0.0036	1.0611
1964	1	7.8358	0.0043	1.1957	1.5240	0.0175	0.4346	4.6327	0.0036	0.9516
1964	2	9.1361	0.0033	1.3942	2.7769	0.0268	0.7918	6.0818	0.0032	1.2492
1964	3	7.9844	0.0047	1.2184	2.4381	0.0173	0.6952	5.2158	0.0038	1.0714

1964	4	7.5343	0.0041	1.1497	2.2767	0.0125	0.6492	4.9233	0.0032	1.0113
1965	1	6.9006	0.0027	1.0530	0.9564	0.0190	0.2727	3.9328	0.0026	0.8078
1965	2	7.0317	0.0030	1.0730	2.0457	0.0273	0.5833	4.6169	0.0030	0.9483
1965	3	7.2565	0.0036	1.1073	3.0650	0.0127	0.8740	5.1361	0.0029	1.0550
1965	4	7.6914	0.0033	1.1737	1.9052	0.0156	0.5433	4.7670	0.0029	0.9792
1966	1	8.5652	0.0028	1.3071	1.3714	0.0184	0.3911	4.9246	0.0026	1.0115
1966	2	7.4224	0.0030	1.1327	2.2809	0.0235	0.6504	4.8330	0.0029	0.9927
1966	3	9.2220	0.0034	1.4073	3.2216	0.0206	0.9186	6.1368	0.0030	1.2605
1966	4	8.5920	0.0028	1.3111	1.7908	0.0126	0.5106	5.1084	0.0024	1.0493
1967	1	7.0605	0.0025	1.0774	1.8278	0.0103	0.5212	4.4744	0.0021	0.9191
1967	2	5.8860	0.0027	0.8982	4.6716	0.0093	1.3321	4.9909	0.0022	1.0252
1967	3	6.9307	0.0032	1.0576	4.3742	0.0113	1.2473	5.4737	0.0026	1.1243
1967	4	6.6184	0.0030	1.0100	1.8183	0.0119	0.5185	4.2294	0.0025	0.8687
1968	1	6.8769	0.0033	1.0494	2.2549	0.0167	0.6430	4.6200	0.0029	0.9490
1968	2	7.0683	0.0036	1.0786	5.0825	0.0121	1.4493	5.8177	0.0029	1.1950
1968	3	9.8466	0.0048	1.5026	3.8646	0.0115	1.1020	6.6908	0.0034	1.3743
1968	4	8.3452	0.0032	1.2735	1.6861	0.0124	0.4808	4.9381	0.0026	1.0143
1969	1	7.7893	0.0027	1.1887	2.2280	0.0131	0.6353	5.0816	0.0024	1.0438
1969	2	6.2548	0.0034	0.9545	2.4354	0.0127	0.6944	4.3937	0.0029	0.9025
1969	3	7.9057	0.0038	1.2064	4.6284	0.0113	1.3198	6.1063	0.0029	1.2543
1969	4	7.4495	0.0035	1.1368	5.6009	0.0208	1.5971	5.8111	0.0032	1.1936
1970	1	7.8250	0.0034	1.1941	6.2020	0.0419	1.7685	6.3156	0.0036	1.2973
1970	2	6.4013	0.0045	0.9768	7.2807	0.0141	2.0761	6.0441	0.0036	1.2415

1970	3	8.5821	0.0060	1.3096	7.1982	0.0144	2.0525	7.2721	0.0043	1.4937
1970	4	6.2041	0.0040	0.9467	2.3764	0.0151	0.6776	4.2515	0.0033	0.8733
1971	1	4.8339	0.0029	0.7377	3.2431	0.0143	0.9248	3.8517	0.0026	0.7912
1971	2	6.4723	0.0038	0.9877	7.1809	0.0175	2.0476	5.9669	0.0034	1.2256
1971	3	8.1378	0.0048	1.2418	4.5676	0.0158	1.3024	6.0174	0.0037	1.2360
1971	4	7.7068	0.0042	1.1761	2.5252	0.0267	0.7201	5.2521	0.0039	1.0788
1972	1	6.6234	0.0045	1.0107	2.1400	0.0563	0.6102	4.8930	0.0048	1.0050
1972	2	6.4075	0.0052	0.9778	6.4942	0.0288	1.8518	5.6436	0.0048	1.1592
1972	3	5.8804	0.0050	0.8974	8.3773	0.0219	2.3888	5.7698	0.0043	1.1851
1972	4	7.1028	0.0072	1.0839	3.1007	0.0286	0.8842	5.0643	0.0061	1.0402

Appendix Table 2. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1973	1	7.6392	0.0057	1.1657	3.4791	0.1173	0.9921	5.5109	0.0065	1.1320
1973	2	6.7801	0.0074	1.0346	4.2170	0.0290	1.2025	5.2897	0.0062	1.0865
1973	3	6.7001	0.0052	1.0224	4.9455	0.0216	1.4102	5.5392	0.0044	1.1378
1973	4	7.0896	0.0052	1.0819	2.8360	0.0192	0.8087	4.9480	0.0042	1.0163
1974	1	6.9342	0.0040	1.0582	3.1336	0.0195	0.8935	4.9476	0.0035	1.0163
1974	2	6.1775	0.0066	0.9427	4.0971	0.0162	1.1683	5.1372	0.0048	1.0552
1974	3	7.7917	0.0042	1.1890	4.3546	0.0175	1.2417	5.9090	0.0035	1.2137
1974	4	7.8801	0.0043	1.2025	1.2573	0.0187	0.3585	4.5022	0.0036	0.9248
1975	1	5.9327	0.0036	0.9053	2.3944	0.0270	0.6828	4.2164	0.0033	0.8661
1975	2	6.1180	0.0040	0.9336	4.1168	0.0148	1.1739	4.9528	0.0033	1.0173
1975	3	5.6931	0.0032	0.8688	4.5462	0.0128	1.2963	4.7996	0.0026	0.9859
1975	4	5.4042	0.0042	0.8247	1.3283	0.0247	0.3788	3.4677	0.0038	0.7123
1976	1	4.9052	0.0043	0.7485	2.1949	0.0462	0.6259	3.3253	0.0042	0.6830
1976	2	6.8266	0.0067	1.0417	2.5040	0.0495	0.7140	4.9100	0.0064	1.0085
1976	3	7.2634	0.0100	1.1084	2.9704	0.0422	0.8470	5.2235	0.0082	1.0729
1976	4	5.9509	0.0139	0.9081	1.1856	0.3063	0.3381	3.7393	0.0153	0.7681
1977	1	11.4415	0.0097	1.7460	3.6146	0.0985	1.0307	8.3211	0.0102	1.7092
1977	2	15.0745	0.0111	2.3004	15.2111	0.0628	4.3374	13.6753	0.0104	2.8090
1977	3	14.9581	0.0092	2.2826	12.1039	0.0744	3.4514	12.9278	0.0092	2.6554
1977	4	11.2823	0.0065	1.7217	4.8535	0.0615	1.3840	8.3204	0.0071	1.7090
1978	1	13.4645	0.0031	2.0547	9.5450	0.0286	2.7217	10.5688	0.0032	2.1709
1978	2	10.4424	0.0034	1.5935	5.8278	0.0273	1.6618	8.4975	0.0035	1.7454
1978	3	10.0646	0.0035	1.5359	6.6521	0.0275	1.8968	8.3898	0.0035	1.7233
1978	4	10.2816	0.0040	1.5690	2.7905	0.0357	0.7957	7.0437	0.0041	1.4468
1979	1	7.1899	0.0053	1.0972	3.5365	0.0198	1.0084	5.3124	0.0043	1.0912
1979	2	7.5393	0.0080	1.1505	8.5663	0.0215	2.4427	7.0354	0.0061	1.4451
1979	3	5.5543	0.0059	0.8476	6.4735	0.0225	1.8459	5.2404	0.0049	1.0764
1979	4	7.3791	0.0074	1.1261	1.9445	0.0262	0.5545	4.7450	0.0060	0.9746
1980	1	5.7473	0.0044	0.8770	4.2362	0.0203	1.2079	4.7573	0.0038	0.9772
1980	2	8.2020	0.0057	1.2516	6.3056	0.0360	1.7980	7.2401	0.0054	1.4872
1980	3	5.7318	0.0068	0.8747	6.1526	0.0296	1.7544	5.4105	0.0058	1.1113
1980	4	8.5528	0.0038	1.3052	4.2037	0.0186	1.1987	6.5445	0.0033	1.3443
1981	1	6.4352	0.0026	0.9820	2.7975	0.0126	0.7977	4.7124	0.0024	0.9679
1981	2	7.8368	0.0059	1.1959	5.6712	0.0259	1.6171	6.5938	0.0052	1.3544
1981	3	6.8624	0.0054	1.0472	5.3979	0.0148	1.5392	5.9586	0.0040	1.2239
1981	4	8.2106	0.0028	1.2529	3.4245	0.0151	0.9765	5.9653	0.0025	1.2253
1982	1	7.3733	0.0023	1.1252	3.2367	0.0132	0.9229	5.3820	0.0021	1.1055
1982	2	11.3877	0.0048	1.7378	7.4758	0.0298	2.1317	9.3138	0.0047	1.9131
1982	3	7.7296	0.0033	1.1795	5.8870	0.0322	1.6787	6.4376	0.0035	1.3223
1982	4	8.9722	0.0021	1.3692	1.5439	0.0463	0.4402	6.0304	0.0026	1.2387

1983	1	8.0842	0.0018	1.2337	3.0918	0.0263	0.8816	6.1315	0.0021	1.2594
1983	2	8.3661	0.0046	1.2767	5.7515	0.0292	1.6400	6.9326	0.0045	1.4240
1983	3	7.5974	0.0029	1.1594	7.4711	0.0195	2.1304	6.8846	0.0029	1.4141
1983	4	7.7216	0.0028	1.1783	4.3961	0.0196	1.2535	5.9927	0.0028	1.2309
1984	1	6.0744	0.0024	0.9270	2.3339	0.0118	0.6655	4.3660	0.0021	0.8968
1984	2	6.2624	0.0046	0.9556	5.6594	0.0182	1.6138	5.6122	0.0039	1.1528
1984	3	8.6330	0.0036	1.3174	6.9449	0.0174	1.9803	7.4047	0.0032	1.5210
1984	4	7.6341	0.0036	1.1650	2.3796	0.0130	0.6785	5.0702	0.0029	1.0414
1985	1	6.7487	0.0020	1.0299	2.4278	0.0150	0.6923	4.7823	0.0020	0.9823
1985	2	5.9375	0.0038	0.9061	4.4426	0.0119	1.2668	5.1488	0.0031	1.0576
1985	3	7.0380	0.0029	1.0740	4.5083	0.0129	1.2855	5.7205	0.0025	1.1750
1985	4	7.5348	0.0028	1.1498	1.4436	0.0212	0.4116	4.7931	0.0028	0.9845

Appendix Table 2. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1986	1	7.3275	0.0013	1.1182	2.3034	0.0093	0.6568	4.9952	0.0013	1.0260
1986	2	7.4803	0.0038	1.1415	2.6657	0.0206	0.7601	5.2515	0.0036	1.0787
1986	3	7.3060	0.0038	1.1149	6.5468	0.0400	1.8668	6.0534	0.0039	1.2434
1986	4	8.9174	0.0020	1.3608	3.4382	0.0579	0.9804	6.0862	0.0025	1.2501
1987	1	9.6824	0.0014	1.4775	2.6032	0.0097	0.7423	6.4184	0.0014	1.3184
1987	2	7.3204	0.0049	1.1171	4.5311	0.0354	1.2920	5.7823	0.0050	1.1877
1987	3	6.6619	0.0092	1.0166	7.6955	0.0233	2.1943	7.0309	0.0067	1.4442
1987	4	9.1777	0.0023	1.4005	2.5526	0.0192	0.7279	6.0446	0.0024	1.2416
1988	1	8.2930	0.0016	1.2655	1.6157	0.0163	0.4607	5.4782	0.0018	1.1252
1988	2	6.0561	0.0065	0.9242	6.9448	0.0223	1.9803	5.9919	0.0053	1.2308
1988	3	5.7407	0.0057	0.8760	4.6283	0.0222	1.3197	4.9884	0.0048	1.0246
1988	4	8.0594	0.0024	1.2299	2.8381	0.0274	0.8093	5.5789	0.0026	1.1459
1989	1	6.6471	0.0019	1.0144	1.9506	0.0184	0.5562	4.5957	0.0021	0.9440
1989	2	6.7738	0.0054	1.0337	5.3224	0.0236	1.5177	5.7394	0.0047	1.1789
1989	3	5.8726	0.0089	0.8962	7.4485	0.0282	2.1239	5.9554	0.0069	1.2233
1989	4	8.4874	0.0041	1.2952	1.9502	0.0247	0.5561	5.4554	0.0039	1.1206
1990	1	7.5725	0.0022	1.1556	1.4092	0.0117	0.4018	4.5966	0.0021	0.9442
1990	2	5.4389	0.0075	0.8300	5.0720	0.0359	1.4463	4.7783	0.0068	0.9815
1990	3	7.4009	0.0079	1.1294	4.5165	0.0083	1.2879	6.4518	0.0039	1.3252
1990	4	6.6139	0.0027	1.0093	1.6732	0.0242	0.4771	4.2277	0.0028	0.8684
1991	1	6.0058	0.0021	0.9165	2.3165	0.0113	0.6605	4.3020	0.0020	0.8837
1991	2	6.6443	0.0096	1.0139	4.2916	0.0134	1.2237	4.9898	0.0054	1.0249
1991	3	6.3003	0.0092	0.9614	5.1739	0.0052	1.4753	5.3085	0.0032	1.0904
1991	4	4.8772	0.0047	0.7443	4.0698	0.0071	1.1605	4.7867	0.0028	0.9832
1992	1	5.5470	0.0037	0.8465	2.0328	0.0096	0.5796	3.7730	0.0027	0.7750
1992	2	5.8124	0.0117	0.8870	3.5472	0.0092	1.0115	4.5794	0.0049	0.9406
1992	3	4.7946	0.0191	0.7317	2.9795	0.0077	0.8496	3.7409	0.0050	0.7684
1992	4	6.1158	0.0045	0.9333	3.2546	0.0135	0.9280	4.7116	0.0035	0.9678
1993	1	6.4496	0.0037	0.9842	2.7557	0.0124	0.7858	4.3885	0.0030	0.9014
1993	2	4.6945	0.0070	0.7164	3.6389	0.0093	1.0376	3.8083	0.0039	0.7822
1993	3	5.4092	0.0065	0.8254	3.7325	0.0057	1.0643	3.8460	0.0029	0.7900
1993	4	4.9215	0.0033	0.7510	4.3894	0.0093	1.2516	4.5383	0.0025	0.9322
1994	1	4.4540	0.0022	0.6797	3.0227	0.0051	0.8619	3.4898	0.0015	0.7168
1994	2	4.6969	0.0059	0.7167	5.1196	0.0039	1.4598	4.4390	0.0022	0.9118
1994	3	5.9673	0.0085	0.9106	5.4183	0.0037	1.5450	4.7411	0.0022	0.9738
1994	4	5.5987	0.0022	0.8544	3.6645	0.0048	1.0449	4.3679	0.0015	0.8972
1995	1	5.9283	0.0023	0.9047	3.0322	0.0034	0.8646	4.3473	0.0013	0.8930
1995	2	5.8982	0.0069	0.9001	4.6301	0.0034	1.3203	5.0216	0.0021	1.0315
1995	3	4.3898	0.0063	0.6699	4.0472	0.0028	1.1540	4.1460	0.0017	0.8516
1995	4	5.3786	0.0017	0.8208	2.3209	0.0043	0.6618	3.6557	0.0013	0.7509

1996	1	4.6656	0.0017	0.7120	3.0922	0.0033	0.8817	3.8661	0.0011	0.7941
1996	2	5.1359	0.0043	0.7837	3.8227	0.0033	1.0900	4.0842	0.0017	0.8389
1996	3	6.0179	0.0038	0.9183	4.2974	0.0032	1.2254	4.4657	0.0015	0.9173
1996	4	4.9100	0.0014	0.7493	2.1957	0.0041	0.6261	3.3598	0.0011	0.6901
1997	1	3.9976	0.0010	0.6100	2.5343	0.0048	0.7226	3.0796	0.0010	0.6326
1997	2	6.0083	0.0026	0.9169	3.5977	0.0042	1.0259	4.0352	0.0016	0.8288
1997	3	3.5500	0.0026	0.5417	3.4873	0.0034	0.9944	3.1318	0.0014	0.6433
1997	4	4.2501	0.0011	0.6486	2.9502	0.0040	0.8412	3.4278	0.0010	0.7041
1998	1	4.6937	0.0009	0.7163	3.3068	0.0057	0.9429	3.7039	0.0010	0.7608
1998	2	4.4884	0.0020	0.6849	3.9284	0.0052	1.1202	3.7119	0.0016	0.7624
1998	3	4.4705	0.0027	0.6822	4.4421	0.0055	1.2667	3.8554	0.0018	0.7919
1998	4	4.0308	0.0017	0.6151	2.3583	0.0050	0.6725	3.0607	0.0013	0.6287

Appendix Table 2. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1999	1	4.3736	0.0015	0.6674	2.6878	0.0054	0.7664	3.3841	0.0013	0.6951
1999	2	5.4624	0.0042	0.8336	3.6843	0.0048	1.0506	3.9913	0.0022	0.8198
1999	3	4.1122	0.0026	0.6275	3.9070	0.0050	1.1141	3.6139	0.0017	0.7423
1999	4	4.0684	0.0014	0.6208	1.9998	0.0059	0.5702	2.9605	0.0012	0.6081
2000	1	3.6323	0.0011	0.5543	3.2665	0.0058	0.9314	3.0718	0.0010	0.6310
2000	2	3.9483	0.0017	0.6025	3.5534	0.0053	1.0132	3.2847	0.0014	0.6747
2000	3	2.9715	0.0028	0.4535	3.5622	0.0044	1.0158	2.7361	0.0017	0.5620
2000	4	3.4177	0.0021	0.5215	2.4796	0.0057	0.7071	2.7472	0.0016	0.5643
2001	1	3.1999	0.0017	0.4883	2.4214	0.0050	0.6905	2.6800	0.0014	0.5505
2001	2	4.3688	0.0023	0.6667	2.8414	0.0055	0.8102	3.2476	0.0018	0.6671
2001	3	3.6670	0.0031	0.5596	2.6821	0.0038	0.7648	2.7105	0.0017	0.5567
2001	4	3.2885	0.0024	0.5018	2.0684	0.0048	0.5898	2.6198	0.0016	0.5381
2002	1	3.5511	0.0016	0.5419	2.7196	0.0044	0.7755	2.9387	0.0013	0.6036
2002	2	3.6865	0.0026	0.5626	2.6714	0.0070	0.7617	2.8680	0.0021	0.5891
2002	3	2.2670	0.0023	0.3459	2.2547	0.0038	0.6429	1.8910	0.0014	0.3884
2002	4	2.6624	0.0012	0.4063	2.0927	0.0061	0.5967	2.1373	0.0012	0.4390
2003	1	2.6989	0.0023	0.4119	2.1238	0.0095	0.6056	2.1635	0.0020	0.4444
2003	2	3.7317	0.0045	0.5695	1.9970	0.0109	0.5694	2.6031	0.0035	0.5347
2003	3	2.6616	0.0051	0.4062	2.5976	0.0058	0.7407	2.2023	0.0030	0.4524
2003	4	3.1766	0.0026	0.4848	3.1661	0.0121	0.9028	2.6265	0.0022	0.5395
2004	1	2.8837	0.0018	0.4401	2.6020	0.0083	0.7420	2.4213	0.0016	0.4973
2004	2	3.5405	0.0031	0.5403	2.8243	0.0122	0.8053	2.8764	0.0028	0.5908
2004	3	2.8543	0.0025	0.4356	3.3005	0.0050	0.9411	2.5813	0.0018	0.5302
2004	4	4.2106	0.0021	0.6425	2.8105	0.0080	0.8014	3.3109	0.0018	0.6801
2005	1	3.9760	0.0021	0.6067	1.9269	0.0072	0.5494	2.8288	0.0017	0.5810
2005	2	4.4191	0.0031	0.6744	2.2562	0.0114	0.6433	3.2101	0.0027	0.6594
2005	3	4.2073	0.0033	0.6420	2.2980	0.0076	0.6553	3.0205	0.0024	0.6204
2005	4	4.3128	0.0023	0.6581	1.2547	0.0058	0.3578	2.7095	0.0018	0.5565
2006	1	3.6161	0.0012	0.5518	1.3773	0.0053	0.3927	2.4722	0.0011	0.5078
2006	2	3.6525	0.0014	0.5574	2.0433	0.0077	0.5826	2.7278	0.0015	0.5603
2006	3	3.7564	0.0021	0.5732	2.4142	0.0070	0.6884	2.9063	0.0017	0.5970
2006	4	4.7371	0.0012	0.7229	1.0865	0.0089	0.3098	2.9706	0.0012	0.6102
2007	1	3.9556	0.0008	0.6036	1.6463	0.0078	0.4694	2.6727	0.0010	0.5490
2007	2	4.1295	0.0010	0.6302	2.5272	0.0065	0.7206	3.0923	0.0012	0.6352
2007	3	4.4130	0.0019	0.6734	1.6353	0.0053	0.4663	2.8318	0.0015	0.5817
2007	4	5.2019	0.0014	0.7938	1.1459	0.0113	0.3267	3.1773	0.0015	0.6526
2008	1	4.0501	0.0020	0.6180	1.4678	0.0153	0.4185	2.7258	0.0021	0.5599
2008	2	3.4515	0.0050	0.5267	1.6816	0.0536	0.4795	2.4989	0.0057	0.5133
2008	3	5.8756	0.0215	0.8966				4.4653	0.0268	0.9172
2008	4	2.9051	0.1121	0.4433	1.3692	0.1095	0.3904	2.4666	0.0463	0.5067

Appendix Table 3. Quarterly value of standardized bigeye CPUE in Tropical, South and All Indian Ocean from **1968-2008** expressed in real and relative scale in which the average from 1968 to 2008 is 1.0, with deviation.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1968	1	6.7961	0.0033	1.0943	2.1912	0.0167	0.5830	4.5981	0.0029	0.9475
1968	2	7.1368	0.0035	1.1492	5.0816	0.0121	1.3521	5.9161	0.0030	1.2192
1968	3	9.9058	0.0048	1.5950	3.8613	0.0115	1.0274	6.7709	0.0035	1.3953
1968	4	8.2363	0.0031	1.3262	1.6922	0.0124	0.4503	4.9298	0.0026	1.0159
1969	1	7.7600	0.0027	1.2495	2.2520	0.0131	0.5992	5.1337	0.0024	1.0579
1969	2	6.3208	0.0033	1.0178	2.4535	0.0127	0.6528	4.4795	0.0029	0.9231
1969	3	7.9295	0.0038	1.2768	4.6344	0.0113	1.2331	6.1741	0.0029	1.2723
1969	4	7.3774	0.0034	1.1879	5.6248	0.0208	1.4967	5.8112	0.0032	1.1975
1970	1	7.8122	0.0033	1.2579	6.2512	0.0419	1.6633	6.4086	0.0036	1.3206
1970	2	6.4842	0.0044	1.0441	7.2846	0.0141	1.9383	6.1535	0.0037	1.2681
1970	3	8.8440	0.0060	1.4240	7.2255	0.0144	1.9226	7.4970	0.0044	1.5449
1970	4	6.1362	0.0039	0.9880	2.3883	0.0151	0.6355	4.2561	0.0033	0.8771
1971	1	4.7908	0.0029	0.7714	3.2587	0.0143	0.8671	3.8724	0.0026	0.7980
1971	2	6.5260	0.0038	1.0508	7.2109	0.0175	1.9187	6.0650	0.0035	1.2498
1971	3	8.1880	0.0047	1.3184	4.6294	0.0158	1.2318	6.1307	0.0037	1.2634
1971	4	7.6622	0.0041	1.2338	2.5514	0.0267	0.6789	5.2757	0.0040	1.0872
1972	1	6.6404	0.0045	1.0692	2.2141	0.0564	0.5891	5.0023	0.0048	1.0308
1972	2	6.4408	0.0051	1.0371	6.4601	0.0288	1.7189	5.7135	0.0049	1.1774
1972	3	5.8917	0.0050	0.9487	8.3884	0.0219	2.2320	5.8374	0.0044	1.2029
1972	4	7.0785	0.0071	1.1398	3.1157	0.0286	0.8290	5.1035	0.0062	1.0517
1973	1	7.6324	0.0056	1.2290	3.5735	0.1174	0.9508	5.6218	0.0065	1.1585
1973	2	6.8646	0.0073	1.1053	4.2081	0.0290	1.1197	5.3906	0.0063	1.1109
1973	3	6.7315	0.0052	1.0839	4.9850	0.0216	1.3264	5.6252	0.0045	1.1592
1973	4	6.9790	0.0051	1.1237	2.8408	0.0192	0.7559	4.9323	0.0043	1.0164
1974	1	6.8470	0.0040	1.1025	3.1539	0.0196	0.8392	4.9660	0.0035	1.0234
1974	2	6.2558	0.0065	1.0073	4.1219	0.0162	1.0968	5.2528	0.0049	1.0825
1974	3	7.8221	0.0042	1.2595	4.4052	0.0175	1.1722	6.0070	0.0035	1.2379
1974	4	7.7050	0.0042	1.2406	1.2679	0.0188	0.3374	4.4601	0.0036	0.9191
1975	1	5.7652	0.0035	0.9283	2.3891	0.0271	0.6357	4.1677	0.0034	0.8589
1975	2	6.1850	0.0040	0.9959	4.1284	0.0148	1.0985	5.0506	0.0034	1.0408
1975	3	5.7039	0.0032	0.9184	4.5850	0.0128	1.2200	4.8677	0.0027	1.0031
1975	4	5.3021	0.0041	0.8537	1.3388	0.0247	0.3562	3.4395	0.0038	0.7088
1976	1	4.8659	0.0042	0.7835	2.2799	0.0463	0.6066	3.3729	0.0042	0.6951
1976	2	6.9094	0.0066	1.1125	2.5078	0.0495	0.6673	5.0147	0.0065	1.0334
1976	3	7.4071	0.0098	1.1927	3.0287	0.0423	0.8059	5.3933	0.0082	1.1114
1976	4	5.8043	0.0137	0.9346	1.2117	0.3067	0.3224	3.6717	0.0154	0.7566
1977	1	11.3766	0.0095	1.8318	3.5919	0.0986	0.9557	8.3639	0.0103	1.7236
1977	2	15.5221	0.0110	2.4993	15.1732	0.0629	4.0373	14.0985	0.0105	2.9053
1977	3	15.5793	0.0091	2.5085	12.1863	0.0745	3.2426	13.5562	0.0093	2.7936

1977	4	11.1456	0.0064	1.7946	4.9022	0.0616	1.3044	8.2855	0.0071	1.7074
1978	1	13.3841	0.0031	2.1551	9.5983	0.0287	2.5539	10.6784	0.0032	2.2005
1978	2	10.4468	0.0034	1.6821	5.8566	0.0274	1.5583	8.5906	0.0035	1.7703
1978	3	10.3626	0.0035	1.6686	6.7827	0.0275	1.8048	8.7310	0.0036	1.7992
1978	4	9.9664	0.0040	1.6048	2.8385	0.0357	0.7553	6.9079	0.0042	1.4235
1979	1	7.0499	0.0052	1.1352	3.5958	0.0198	0.9568	5.3189	0.0044	1.0961
1979	2	7.5292	0.0079	1.2123	8.5557	0.0215	2.2765	7.1142	0.0062	1.4661
1979	3	5.6252	0.0058	0.9058	6.5166	0.0225	1.7340	5.3629	0.0049	1.1052
1979	4	7.0156	0.0073	1.1296	1.9572	0.0262	0.5208	4.5936	0.0061	0.9466
1980	1	5.6886	0.0044	0.9160	4.3328	0.0204	1.1529	4.8027	0.0039	0.9897
1980	2	8.3564	0.0057	1.3455	6.3022	0.0360	1.6769	7.4186	0.0055	1.5288
1980	3	5.9570	0.0068	0.9592	6.2064	0.0296	1.6514	5.6458	0.0059	1.1635
1980	4	8.4916	0.0037	1.3673	4.2349	0.0186	1.1268	6.5709	0.0034	1.3541

Appendix Table 3. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1981	1	6.4713	0.0026	1.0420	2.8480	0.0127	0.7578	4.8102	0.0024	0.9913
1981	2	7.9116	0.0058	1.2739	5.6687	0.0259	1.5083	6.7164	0.0053	1.3841
1981	3	6.7808	0.0053	1.0918	5.4039	0.0148	1.4379	5.9640	0.0040	1.2290
1981	4	8.1659	0.0027	1.3149	3.4534	0.0152	0.9189	5.9942	0.0026	1.2353
1982	1	7.4025	0.0023	1.1919	3.3092	0.0133	0.8805	5.4952	0.0022	1.1324
1982	2	11.4473	0.0048	1.8432	7.4565	0.0299	1.9841	9.4466	0.0048	1.9467
1982	3	7.7281	0.0032	1.2444	5.9209	0.0322	1.5755	6.5081	0.0035	1.3412
1982	4	8.9411	0.0021	1.4397	1.5947	0.0464	0.4243	6.0602	0.0026	1.2489
1983	1	8.0996	0.0017	1.3042	3.1072	0.0264	0.8268	6.2426	0.0021	1.2864
1983	2	8.3333	0.0045	1.3418	5.7521	0.0293	1.5305	6.9963	0.0046	1.4418
1983	3	7.7768	0.0028	1.2522	7.5530	0.0195	2.0097	7.1168	0.0029	1.4666
1983	4	7.6010	0.0027	1.2239	4.4277	0.0197	1.1781	5.9683	0.0028	1.2299
1984	1	6.0379	0.0024	0.9722	2.3473	0.0118	0.6246	4.3986	0.0022	0.9064
1984	2	6.2594	0.0045	1.0079	5.6755	0.0182	1.5102	5.6830	0.0040	1.1711
1984	3	8.7828	0.0035	1.4142	6.9514	0.0175	1.8497	7.5901	0.0032	1.5641
1984	4	7.4163	0.0036	1.1942	2.4181	0.0130	0.6434	5.0329	0.0030	1.0372
1985	1	6.7334	0.0020	1.0842	2.4450	0.0150	0.6506	4.8412	0.0020	0.9976
1985	2	5.9493	0.0037	0.9579	4.4446	0.0119	1.1826	5.2229	0.0031	1.0763
1985	3	7.0658	0.0028	1.1377	4.4998	0.0129	1.1973	5.7940	0.0025	1.1940
1985	4	7.4569	0.0028	1.2007	1.4604	0.0213	0.3886	4.7958	0.0028	0.9883
1986	1	7.3244	0.0013	1.1794	2.3213	0.0093	0.6177	5.0578	0.0014	1.0423
1986	2	7.4395	0.0037	1.1979	2.6820	0.0206	0.7136	5.2912	0.0036	1.0904
1986	3	7.2832	0.0037	1.1727	6.4330	0.0401	1.7117	6.0745	0.0040	1.2518
1986	4	8.9158	0.0019	1.4356	3.5241	0.0580	0.9377	6.1161	0.0025	1.2604
1987	1	9.6878	0.0014	1.5599	2.6119	0.0098	0.6950	6.4954	0.0014	1.3385
1987	2	7.2244	0.0048	1.1633	4.5399	0.0354	1.2080	5.7792	0.0050	1.1909
1987	3	6.6006	0.0091	1.0628	7.6161	0.0233	2.0265	7.0388	0.0068	1.4505
1987	4	9.2026	0.0023	1.4818	2.5938	0.0192	0.6902	6.1119	0.0025	1.2595
1988	1	8.3288	0.0016	1.3411	1.6436	0.0163	0.4373	5.5883	0.0019	1.1516
1988	2	5.9666	0.0064	0.9607	6.9294	0.0223	1.8438	6.0147	0.0054	1.2395
1988	3	5.7030	0.0056	0.9183	4.5392	0.0222	1.2078	4.9815	0.0049	1.0266
1988	4	8.0461	0.0024	1.2956	2.8585	0.0274	0.7606	5.6110	0.0027	1.1563
1989	1	6.6522	0.0019	1.0711	1.9694	0.0185	0.5240	4.6677	0.0021	0.9619
1989	2	6.7149	0.0053	1.0812	5.2995	0.0237	1.4101	5.7661	0.0048	1.1882
1989	3	5.9461	0.0088	0.9574	7.3519	0.0282	1.9562	6.0354	0.0070	1.2437
1989	4	8.4710	0.0040	1.3640	1.9674	0.0247	0.5235	5.4998	0.0039	1.1334
1990	1	7.5757	0.0022	1.2198	1.4201	0.0117	0.3779	4.6512	0.0021	0.9585
1990	2	5.3765	0.0074	0.8657	5.0541	0.0360	1.3448	4.7914	0.0069	0.9874
1990	3	7.4806	0.0078	1.2045	4.4938	0.0083	1.1957	6.5399	0.0040	1.3477
1990	4	6.5911	0.0026	1.0613	1.6893	0.0242	0.4495	4.2423	0.0028	0.8742

1991	1	6.0153	0.0021	0.9686	2.3290	0.0113	0.6197	4.3566	0.0020	0.8978
1991	2	6.6658	0.0095	1.0733	4.3087	0.0134	1.1465	5.1096	0.0055	1.0530
1991	3	6.2834	0.0090	1.0117	5.1575	0.0052	1.3723	5.3578	0.0033	1.1041
1991	4	4.9013	0.0046	0.7892	4.0623	0.0071	1.0809	4.8641	0.0028	1.0024
1992	1	5.5374	0.0037	0.8916	2.0774	0.0097	0.5528	3.8217	0.0027	0.7876
1992	2	5.7540	0.0116	0.9265	3.5512	0.0093	0.9449	4.6658	0.0049	0.9615
1992	3	4.8513	0.0189	0.7811	2.9384	0.0077	0.7819	3.7305	0.0051	0.7688
1992	4	6.1201	0.0044	0.9854	3.2589	0.0136	0.8671	4.7656	0.0035	0.9821
1993	1	6.4648	0.0037	1.0410	2.8114	0.0124	0.7481	4.4623	0.0030	0.9196
1993	2	4.6787	0.0069	0.7534	3.6428	0.0093	0.9693	3.8784	0.0040	0.7992
1993	3	5.4644	0.0064	0.8799	3.7320	0.0057	0.9930	3.8933	0.0029	0.8023
1993	4	4.9308	0.0032	0.7939	4.3907	0.0093	1.1683	4.5945	0.0025	0.9468

Appendix Table 3. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1994	1	4.4529	0.0022	0.7170	3.0700	0.0051	0.8169	3.5263	0.0016	0.7267
1994	2	4.6497	0.0058	0.7487	5.1293	0.0039	1.3648	4.5284	0.0023	0.9332
1994	3	5.9277	0.0084	0.9545	5.4006	0.0037	1.4370	4.7508	0.0023	0.9790
1994	4	5.6203	0.0022	0.9050	3.6744	0.0048	0.9777	4.4317	0.0016	0.9133
1995	1	5.9369	0.0023	0.9559	3.0608	0.0034	0.8144	4.3693	0.0014	0.9004
1995	2	5.9376	0.0068	0.9561	4.6409	0.0034	1.2349	5.1638	0.0022	1.0641
1995	3	4.5137	0.0062	0.7268	4.0577	0.0029	1.0797	4.2245	0.0018	0.8706
1995	4	5.3662	0.0017	0.8641	2.3265	0.0044	0.6190	3.7037	0.0013	0.7632
1996	1	4.6922	0.0016	0.7555	3.1259	0.0034	0.8318	3.8969	0.0011	0.8031
1996	2	5.1549	0.0042	0.8300	3.8279	0.0033	1.0185	4.1746	0.0018	0.8603
1996	3	5.8793	0.0038	0.9467	4.2856	0.0032	1.1403	4.4637	0.0015	0.9199
1996	4	4.9095	0.0014	0.7905	2.2044	0.0041	0.5866	3.4055	0.0011	0.7018
1997	1	4.0012	0.0010	0.6443	2.6253	0.0048	0.6985	3.1477	0.0010	0.6487
1997	2	5.9896	0.0026	0.9644	3.6053	0.0042	0.9593	4.0976	0.0017	0.8444
1997	3	3.5402	0.0025	0.5700	3.4979	0.0034	0.9307	3.1596	0.0014	0.6511
1997	4	4.3070	0.0011	0.6935	2.9613	0.0040	0.7880	3.4988	0.0010	0.7210
1998	1	4.7345	0.0009	0.7623	3.4262	0.0057	0.9117	3.8132	0.0010	0.7858
1998	2	4.4950	0.0020	0.7238	3.9377	0.0052	1.0478	3.7688	0.0017	0.7767
1998	3	4.4542	0.0027	0.7172	4.4070	0.0055	1.1726	3.8620	0.0019	0.7959
1998	4	4.0312	0.0017	0.6491	2.3707	0.0050	0.6308	3.0973	0.0014	0.6383
1999	1	4.3732	0.0015	0.7042	2.7663	0.0055	0.7361	3.4457	0.0013	0.7101
1999	2	5.4970	0.0042	0.8851	3.6947	0.0048	0.9831	4.0793	0.0022	0.8406
1999	3	4.1982	0.0025	0.6760	3.9007	0.0050	1.0379	3.6854	0.0017	0.7595
1999	4	4.0809	0.0014	0.6571	2.0143	0.0059	0.5360	3.0014	0.0013	0.6185
2000	1	3.6347	0.0011	0.5853	3.3377	0.0058	0.8881	3.1281	0.0011	0.6446
2000	2	3.9981	0.0016	0.6438	3.5725	0.0053	0.9506	3.3601	0.0015	0.6924
2000	3	2.9894	0.0028	0.4813	3.5738	0.0044	0.9509	2.7784	0.0017	0.5726
2000	4	3.4487	0.0021	0.5553	2.4924	0.0057	0.6632	2.8029	0.0016	0.5776
2001	1	3.1789	0.0017	0.5119	2.4636	0.0050	0.6555	2.7051	0.0014	0.5575
2001	2	4.4117	0.0023	0.7104	2.8643	0.0055	0.7621	3.3203	0.0018	0.6842
2001	3	3.6729	0.0030	0.5914	2.7092	0.0038	0.7209	2.7556	0.0017	0.5679
2001	4	3.3200	0.0024	0.5346	2.0820	0.0048	0.5540	2.6728	0.0017	0.5508
2002	1	3.5794	0.0016	0.5763	2.7565	0.0044	0.7335	2.9843	0.0013	0.6150
2002	2	3.6920	0.0025	0.5945	2.6953	0.0070	0.7172	2.9185	0.0021	0.6014
2002	3	2.2615	0.0022	0.3641	2.2669	0.0038	0.6032	1.9158	0.0015	0.3948
2002	4	2.6784	0.0012	0.4313	2.1080	0.0062	0.5609	2.1724	0.0012	0.4477
2003	1	2.7121	0.0023	0.4367	2.1996	0.0096	0.5853	2.2267	0.0021	0.4589
2003	2	3.7413	0.0045	0.6024	2.0082	0.0109	0.5343	2.6423	0.0036	0.5445
2003	3	2.6396	0.0051	0.4250	2.5983	0.0058	0.6914	2.2125	0.0031	0.4559
2003	4	3.2074	0.0025	0.5164	3.1655	0.0122	0.8423	2.6721	0.0023	0.5507

2004	1	2.8965	0.0018	0.4664	2.6861	0.0084	0.7147	2.4864	0.0017	0.5124
2004	2	3.5130	0.0031	0.5657	2.8419	0.0123	0.7562	2.8967	0.0028	0.5969
2004	3	2.8160	0.0025	0.4534	3.2758	0.0050	0.8716	2.5724	0.0018	0.5301
2004	4	4.2511	0.0021	0.6845	2.8070	0.0080	0.7469	3.3654	0.0018	0.6935
2005	1	3.9978	0.0020	0.6437	1.9710	0.0072	0.5245	2.8959	0.0018	0.5968
2005	2	4.4073	0.0030	0.7097	2.2485	0.0114	0.5983	3.2267	0.0028	0.6649
2005	3	4.0918	0.0033	0.6589	2.2650	0.0076	0.6027	2.9721	0.0025	0.6125
2005	4	4.3660	0.0023	0.7030	1.2550	0.0058	0.3339	2.7632	0.0018	0.5694
2006	1	3.6176	0.0012	0.5825	1.4053	0.0054	0.3739	2.5135	0.0012	0.5180
2006	2	3.6368	0.0014	0.5856	2.0310	0.0077	0.5404	2.7361	0.0015	0.5638
2006	3	3.7079	0.0021	0.5970	2.4015	0.0070	0.6390	2.9044	0.0018	0.5985
2006	4	4.7954	0.0012	0.7721	1.0839	0.0089	0.2884	3.0269	0.0013	0.6238

Appendix Table 3. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
2007	1	3.9833	0.0008	0.6414	1.7162	0.0078	0.4567	2.7553	0.0010	0.5678
2007	2	4.1442	0.0010	0.6673	2.5270	0.0066	0.6724	3.1284	0.0012	0.6447
2007	3	4.3522	0.0019	0.7008	1.6284	0.0053	0.4333	2.8271	0.0016	0.5826
2007	4	5.2190	0.0013	0.8404	1.1522	0.0114	0.3066	3.2192	0.0015	0.6634
2008	1	4.0695	0.0019	0.6553	1.4816	0.0153	0.3942	2.7723	0.0022	0.5713
2008	2	3.4070	0.0049	0.5486	1.6275	0.0537	0.4331	2.4640	0.0058	0.5078
2008	3	5.7214	0.0212	0.9212				4.3584	0.0270	0.8982
2008	4	2.8215	0.1105	0.4543	1.3173	0.1097	0.3505	2.4471	0.0466	0.5043

Appendix Table 4. Quarterly value of standardized bigeye CPUE in Tropical, South and All Indian Ocean from **1980-2008** expressed in real and relative scale in which the average from 1968 to 2008 is 1.0, with deviation.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1980	1	5.4935	0.0044	0.9962	4.3327	0.0203	1.2749	4.6185	0.0040	1.0773
1980	2	8.5806	0.0057	1.5561	6.5135	0.0359	1.9166	7.5204	0.0057	1.7541
1980	3	6.1846	0.0068	1.1216	6.2025	0.0295	1.8251	5.7966	0.0061	1.3521
1980	4	8.3858	0.0037	1.5207	4.1584	0.0186	1.2236	6.4350	0.0034	1.5010
1981	1	6.4688	0.0026	1.1731	2.7961	0.0127	0.8228	4.7279	0.0025	1.1028
1981	2	7.7668	0.0059	1.4085	5.7217	0.0258	1.6836	6.5762	0.0055	1.5339
1981	3	6.8834	0.0053	1.2483	5.4878	0.0147	1.6148	5.9859	0.0041	1.3962
1981	4	8.0288	0.0027	1.4560	3.3672	0.0151	0.9908	5.8305	0.0027	1.3600
1982	1	7.4504	0.0023	1.3511	3.0985	0.0133	0.9117	5.3653	0.0022	1.2514
1982	2	11.2860	0.0048	2.0467	7.4946	0.0298	2.2053	9.2289	0.0050	2.1526
1982	3	7.7989	0.0033	1.4143	6.1376	0.0321	1.8060	6.5084	0.0036	1.5181
1982	4	8.8043	0.0021	1.5966	1.4465	0.0463	0.4256	5.8616	0.0027	1.3672
1983	1	8.0238	0.0017	1.4551	2.8908	0.0263	0.8506	6.0515	0.0022	1.4115
1983	2	7.9011	0.0046	1.4328	5.8669	0.0292	1.7264	6.6774	0.0047	1.5575
1983	3	7.9448	0.0029	1.4408	7.5536	0.0195	2.2227	7.1666	0.0030	1.6716
1983	4	7.4967	0.0027	1.3595	4.2569	0.0196	1.2526	5.8092	0.0029	1.3550
1984	1	6.0283	0.0024	1.0932	2.2050	0.0118	0.6488	4.2804	0.0022	0.9984
1984	2	6.2624	0.0045	1.1357	5.9396	0.0182	1.7478	5.7095	0.0042	1.3317
1984	3	9.0425	0.0035	1.6398	6.8743	0.0174	2.0228	7.6722	0.0033	1.7895
1984	4	7.2758	0.0036	1.3195	2.2413	0.0130	0.6595	4.8189	0.0031	1.1240
1985	1	6.6652	0.0020	1.2087	2.2372	0.0150	0.6583	4.6644	0.0021	1.0880
1985	2	5.9869	0.0038	1.0857	4.5219	0.0119	1.3306	5.2412	0.0032	1.2225
1985	3	7.1452	0.0028	1.2958	4.5185	0.0129	1.3296	5.8010	0.0026	1.3531
1985	4	7.4412	0.0028	1.3494	1.3738	0.0212	0.4043	4.6929	0.0029	1.0946
1986	1	7.2697	0.0013	1.3183	2.2026	0.0093	0.6481	4.9170	0.0014	1.1469
1986	2	7.0831	0.0037	1.2845	2.7223	0.0206	0.8010	5.0788	0.0038	1.1846
1986	3	7.3652	0.0037	1.3357	6.4116	0.0399	1.8866	6.0745	0.0041	1.4169
1986	4	8.8910	0.0019	1.6124	3.4429	0.0579	1.0131	6.0545	0.0026	1.4122
1987	1	9.6041	0.0014	1.7417	2.5309	0.0097	0.7447	6.3369	0.0015	1.4781
1987	2	6.6197	0.0049	1.2005	4.6891	0.0353	1.3798	5.4181	0.0052	1.2638
1987	3	6.4382	0.0091	1.1676	7.7094	0.0232	2.2685	6.8919	0.0069	1.6075
1987	4	9.1549	0.0023	1.6602	2.4873	0.0192	0.7319	5.9908	0.0025	1.3973
1988	1	8.2284	0.0016	1.4922	1.4950	0.0163	0.4399	5.3931	0.0020	1.2579
1988	2	5.4202	0.0065	0.9829	7.0448	0.0223	2.0730	5.6899	0.0056	1.3272
1988	3	5.6423	0.0056	1.0232	4.4994	0.0221	1.3240	4.8843	0.0050	1.1393
1988	4	8.0095	0.0024	1.4525	2.8102	0.0274	0.8269	5.5260	0.0028	1.2889
1989	1	6.6341	0.0019	1.2031	1.7872	0.0184	0.5259	4.5295	0.0022	1.0565
1989	2	6.3681	0.0053	1.1548	5.3321	0.0236	1.5690	5.5313	0.0049	1.2902
1989	3	6.0409	0.0088	1.0955	7.3997	0.0281	2.1774	6.0514	0.0071	1.4115

1989	4	8.3379	0.0040	1.5121	1.9045	0.0247	0.5604	5.3418	0.0040	1.2460
1990	1	7.4424	0.0022	1.3497	1.3220	0.0117	0.3890	4.4618	0.0022	1.0407
1990	2	4.9742	0.0075	0.9021	5.0535	0.0359	1.4870	4.5152	0.0071	1.0532
1990	3	7.5649	0.0078	1.3719	4.5481	0.0083	1.3383	6.5632	0.0041	1.5309
1990	4	6.4968	0.0026	1.1782	1.6284	0.0242	0.4792	4.1239	0.0029	0.9619
1991	1	5.9309	0.0021	1.0756	2.2395	0.0113	0.6590	4.2172	0.0021	0.9837
1991	2	6.3913	0.0095	1.1590	4.2078	0.0134	1.2382	4.9144	0.0057	1.1463
1991	3	6.2701	0.0090	1.1371	5.2442	0.0052	1.5431	5.3519	0.0034	1.2483
1991	4	4.9036	0.0046	0.8893	4.0708	0.0071	1.1978	4.7754	0.0029	1.1139
1992	1	5.4999	0.0037	0.9974	2.0357	0.0096	0.5990	3.7366	0.0028	0.8716
1992	2	5.3889	0.0116	0.9773	3.5165	0.0092	1.0348	4.5006	0.0051	1.0498
1992	3	4.9192	0.0189	0.8921	2.9710	0.0077	0.8742	3.6904	0.0052	0.8608
1992	4	6.1411	0.0044	1.1137	3.3042	0.0136	0.9723	4.7215	0.0036	1.1013

Appendix Table 4. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
1993	1	6.5125	0.0037	1.1810	2.7763	0.0123	0.8169	4.4172	0.0031	1.0303
1993	2	4.4720	0.0070	0.8110	3.6667	0.0093	1.0789	3.7962	0.0042	0.8855
1993	3	5.5302	0.0064	1.0029	3.8759	0.0057	1.1405	3.9631	0.0030	0.9244
1993	4	4.9431	0.0032	0.8964	4.3174	0.0093	1.2704	4.5023	0.0026	1.0502
1994	1	4.4767	0.0022	0.8118	2.9868	0.0051	0.8789	3.4716	0.0016	0.8097
1994	2	4.3840	0.0058	0.7950	5.0507	0.0039	1.4862	4.4184	0.0024	1.0306
1994	3	5.9365	0.0084	1.0766	5.4504	0.0037	1.6038	4.7566	0.0024	1.1095
1994	4	5.6604	0.0022	1.0265	3.6251	0.0048	1.0667	4.3482	0.0016	1.0142
1995	1	5.9722	0.0023	1.0830	2.9316	0.0035	0.8626	4.2714	0.0014	0.9963
1995	2	5.8421	0.0068	1.0595	4.5983	0.0034	1.3531	5.1293	0.0023	1.1964
1995	3	4.6838	0.0062	0.8494	4.1921	0.0029	1.2335	4.3406	0.0018	1.0124
1995	4	5.3613	0.0017	0.9723	2.3497	0.0044	0.6914	3.6604	0.0014	0.8538
1996	1	4.7323	0.0016	0.8582	3.0526	0.0034	0.8982	3.8414	0.0012	0.8960
1996	2	4.9931	0.0042	0.9055	3.8025	0.0033	1.1189	4.1018	0.0019	0.9567
1996	3	5.8400	0.0038	1.0591	4.4180	0.0032	1.3000	4.5017	0.0016	1.0500
1996	4	4.9353	0.0014	0.8950	2.2024	0.0041	0.6481	3.3591	0.0011	0.7835
1997	1	4.0071	0.0010	0.7267	2.6286	0.0048	0.7735	3.1138	0.0010	0.7263
1997	2	5.6692	0.0026	1.0281	3.6000	0.0042	1.0593	3.9674	0.0018	0.9254
1997	3	3.5644	0.0025	0.6464	3.5764	0.0034	1.0524	3.1614	0.0015	0.7374
1997	4	4.3118	0.0011	0.7819	2.9313	0.0040	0.8625	3.4321	0.0011	0.8005
1998	1	4.7004	0.0009	0.8524	3.3889	0.0058	0.9972	3.7395	0.0011	0.8722
1998	2	4.2657	0.0020	0.7736	3.8923	0.0052	1.1453	3.6072	0.0018	0.8414
1998	3	4.4519	0.0027	0.8073	4.4347	0.0055	1.3049	3.8180	0.0019	0.8905
1998	4	4.0367	0.0017	0.7320	2.3714	0.0050	0.6978	3.0490	0.0015	0.7112
1999	1	4.3320	0.0015	0.7856	2.7331	0.0055	0.8042	3.3841	0.0014	0.7893
1999	2	5.4943	0.0042	0.9964	3.6554	0.0048	1.0756	4.0317	0.0023	0.9404
1999	3	4.3606	0.0026	0.7908	3.9485	0.0050	1.1619	3.7413	0.0018	0.8727
1999	4	4.1100	0.0014	0.7453	1.9783	0.0059	0.5821	2.9684	0.0013	0.6924
2000	1	3.6459	0.0011	0.6612	3.2491	0.0058	0.9561	3.0760	0.0011	0.7175
2000	2	4.0178	0.0016	0.7286	3.4871	0.0053	1.0261	3.3049	0.0016	0.7709
2000	3	3.0628	0.0028	0.5554	3.5864	0.0044	1.0553	2.7966	0.0018	0.6523
2000	4	3.4717	0.0021	0.6296	2.4425	0.0057	0.7187	2.7599	0.0017	0.6437
2001	1	3.0917	0.0017	0.5607	2.3912	0.0050	0.7036	2.6099	0.0015	0.6088
2001	2	4.3578	0.0023	0.7903	2.7824	0.0055	0.8187	3.2243	0.0020	0.7521
2001	3	3.7408	0.0030	0.6784	2.7511	0.0038	0.8095	2.7697	0.0018	0.6460
2001	4	3.2980	0.0024	0.5981	2.0481	0.0048	0.6027	2.6015	0.0018	0.6068
2002	1	3.5712	0.0016	0.6476	2.6766	0.0045	0.7876	2.9245	0.0014	0.6821
2002	2	3.5923	0.0026	0.6515	2.6101	0.0070	0.7680	2.8131	0.0023	0.6562
2002	3	2.3076	0.0023	0.4185	2.3156	0.0038	0.6814	1.9331	0.0015	0.4509
2002	4	2.6724	0.0012	0.4846	2.1080	0.0062	0.6203	2.1409	0.0013	0.4994

2003	1	2.6592	0.0023	0.4822	2.1940	0.0096	0.6456	2.1632	0.0022	0.5046
2003	2	3.5989	0.0045	0.6527	2.0106	0.0109	0.5916	2.5503	0.0038	0.5949
2003	3	2.7109	0.0051	0.4916	2.6527	0.0058	0.7806	2.2232	0.0032	0.5186
2003	4	3.2265	0.0025	0.5851	3.2206	0.0121	0.9477	2.6663	0.0024	0.6219
2004	1	2.8671	0.0018	0.5199	2.6811	0.0083	0.7889	2.4394	0.0017	0.5690
2004	2	3.4025	0.0031	0.6170	2.8001	0.0122	0.8239	2.7901	0.0029	0.6508
2004	3	2.8470	0.0025	0.5163	3.3571	0.0050	0.9878	2.5726	0.0019	0.6001
2004	4	4.2659	0.0021	0.7736	2.8833	0.0080	0.8484	3.3603	0.0019	0.7838
2005	1	3.9912	0.0020	0.7238	1.9683	0.0072	0.5792	2.8575	0.0019	0.6665
2005	2	4.2645	0.0031	0.7734	2.2545	0.0114	0.6634	3.1064	0.0029	0.7246
2005	3	4.1754	0.0033	0.7572	2.2960	0.0076	0.6756	2.9816	0.0026	0.6955
2005	4	4.4430	0.0023	0.8057	1.2952	0.0058	0.3811	2.7789	0.0019	0.6482

Appendix Table 4. Continued.

		Tropical			South			All Indian Ocean		
Year	QT	CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE	Tropical CPUE	t-dev	Relative CPUE
2006	1	3.6432	0.0012	0.6607	1.4094	0.0054	0.4147	2.5018	0.0012	0.5835
2006	2	3.5170	0.0014	0.6378	2.0503	0.0077	0.6033	2.6433	0.0016	0.6165
2006	3	3.8092	0.0021	0.6908	2.4751	0.0070	0.7283	2.9434	0.0018	0.6865
2006	4	4.8698	0.0012	0.8831	1.0997	0.0089	0.3236	3.0449	0.0014	0.7102
2007	1	3.9584	0.0008	0.7178	1.7466	0.0078	0.5139	2.7219	0.0011	0.6349
2007	2	3.9955	0.0011	0.7246	2.5826	0.0066	0.7599	3.0219	0.0014	0.7049
2007	3	4.4211	0.0019	0.8018	1.6757	0.0053	0.4931	2.8355	0.0016	0.6614
2007	4	5.2544	0.0014	0.9529	1.1702	0.0113	0.3443	3.2264	0.0016	0.7526
2008	1	4.0610	0.0019	0.7365	1.4362	0.0153	0.4226	2.7158	0.0022	0.6335
2008	2	3.2230	0.0050	0.5845	1.5601	0.0536	0.4591	2.3131	0.0060	0.5395
2008	3	5.7455	0.0212	1.0419				4.3111	0.0274	1.0056
2008	4	2.9177	0.1105	0.5291	1.2674	0.1094	0.3729	2.3842	0.0471	0.5561