

UPDATED STANDARDIZED CPUE FOR PELAGIC SHARKS CAUGHT BY JAPANESE LONGLINE FISHERY IN THE ATLANTIC OCEAN

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SUMMARY

Standardized CPUEs on pelagic sharks caught by the Japanese longline fishery in the Atlantic Ocean were updated using logbook data from commercial fishing vessels from 1997 to 1997. The logbooks, by cruise, include more information and data from 80% of the shark catches in the total number of cruises were included in the analysis. The CPUEs were examined for three area units: the North Atlantic, the South Atlantic, and the total Atlantic.

RÉSUMÉ

La CPUE standardisée des requins pélagiques capturés par les palangriers japonais dans l'Atlantique a été actualisée d'après les extraits de livres de bord des bateaux de pêche commerciale de 1971 à 1997. Les carnets de pêche, par sortie, contiennent plus d'information, et les données de 80 % des prises de requins du nombre total de campagnes ont été inclus dans les analyses. La CPUE a été examinée pour trois unités de zone, à savoir Atlantique nord, Atlantique sud et Atlantique entier.

RESUMEN

Por medio de datos de cuadernos de pesca de barcos pesqueros comerciales, de 1971 a 1997, se actualizó la CPUE estandarizada para los tiburones pelágicos capturados por la pesquería japonesa de palangre en el Atlántico. El cuaderno de pesca por marea es mas amplio y en el análisis se utilizó el 80 % de operaciones de pesca de tiburón en relación con el número total de las mismas. Se examinó la CPUE de tres unidades de zona: Atlántico norte, Atlántico sur y Atlántico total.

INTRODUCTION

The standardized CPUE of pelagic sharks caught by Japanese longline fishery in the Atlantic Ocean was introduced previous reports submitted to ICCAT sub-committee on by-catches (Nakano and Honma 1996, Nakano 1997). Since Japanese longline fishery has covered widely in the high seas of the Atlantic Oceans, its fishery statistics must be one of the most valuable resources, which describe stock status of pelagic shark. International concern over the conservation of elasmobranch species has been continued. Therefore, it is useful to examine recent trend of stock status of pelagic

sharks by updating CPUE of tuna fisheries. This paper updated the standardized CPUE of pelagic sharks in the Atlantic Ocean using the logbook data of Japanese longline fishery from 1971 to 1997.

MATERIALS AND METHODS

Nakano and Honma (1996) reviewed CPUE of pelagic shark in the Atlantic Ocean using Japanese longline logbook data with filtering of shark reporting rate, e.g. the ratio of operations shark caught to total number of operations in a cruise. The same filtering was adapted and the data includes more and equal 80% of shark reporting rate was used for analysis. Time series of the data were 26 years from 1971 to 1997.

Standardized CPUE (number of sharks caught per 1,000 hooks) were calculated using Mixed procedure of SAS to eliminate some biases by change of fishing ground and fishing seasons. A Mixed procedure is a generalization of the standard linear model that provides with flexibility of modeling not only the means of the data but their variances and covariances (SAS Institute 1996). Although Mixed procedure can handle random-effect parameters, only fixed-effects parameter was used in this time. Therefore MLM model is same as GLM model for this analysis. It is useful for the model selection which the mixed procedure of SAS produces several information criteria values.

For standardization, CPUE was calculated shot by shot of operations. The area strata used for the analysis were shown in Figure 1. Numbers of branch line between floats were classified into three categories. CPUE of pelagic sharks were obtained for same three geographical units used in the previous report, *i.e.* the north, south and overall Atlantic Ocean. The north unit includes area 1 to 5; the south includes area 7 to 9. The equation for standardizing CPUE was as follows:

$$\ln(\text{CPUE}_{ijkl} + \text{const}) = \ln(\bar{\mu}) + \ln(\text{YR}_i) + \ln(\text{QT}_j) + \ln(\text{AR}_k) + \ln(\text{br}_l) + \ln(\text{INTER}) + \epsilon$$

where \ln : natural logarithm, CPUE_{ijkl} : nominal CPUE (catch in number per 1,000 hooks, in year i , quarter j , area k , branch line criteria l), const : 1/10 of overall mean, $\bar{\mu}$: overall mean, YR_i : effect of year i , QT_j : effect of quarter j , AR_k : effect of area k , br_l : branch line criteria l , INTER : any combination of two way interaction, and ϵ : normal error term. The same effects selected for previous report including interaction terms were used for analysis. The interactions included for the models were QT^*AREA , QT^*br and AREA^*br for the North, and QT^*AREA and QT^*br for the South and overall Atlantic. Analysis was made through the mixed procedure of computer software, 'SAS System for windows Ver. 6.12'.

RESULTS AND DISCUSSION

Table 1 shows number of observation in each year by geographical unit. North unit of 1979 has no observations, which includes more and equal 80% of shark reporting rate. Type III analysis revealed that all main effects and interaction of selected models were significant (Table 2).

Figure 2 show the standardized CPUE for the North, South and overall units. The values of CPUE ranged around 1.0 to 8.0 and were in the range of reported CPUE for pelagic sharks caught by longline fishery. The reported CPUE of pelagic sharks (number of caught per 1,000 hooks) were 1.31 -38.8 (Strasburg 1958, Lopez et al. 1979, Witzell 1985, Hazin et al. 1990, Taniuchi 1990, Bonfil 1994). The results indicate high level of standardized CPUE for 1980 in the North unit and between 1977 to 1980 in the South and overall units. The CPUE for North unit indicates increasing trend in the recent years, but it for the South decreasing recently. The CPUE for the overall Atlantic revealed relatively

stable state after 1981. Although such CPUE revealed different trends between North and South, fluctuations of CPUE were relatively small comparing with some tunas and billfishes caught by Atlantic fisheries. Therefore results of the analysis suggests that stock status of pelagic sharks have not changed drastically during more than two decades in high sea area of the Atlantic Ocean.

The sharks caught in high seas are mainly consisted of blue shark (Strasburg 1958, Hazin et al. 1990, Bonfil 1994, Matsunaga and Nakano 1996, Nakano and Honma 1996). Therefore, the stock status of blue shark in the Atlantic Oceans might not change during the periods. However, there is few information of long-term stock status for the other shark species, which inhabits in the high sea area. It is necessary to conduct further research activities on board, such as observer program, to examine the population dynamics for each species.

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Table 1. Number of observations by geographical unit in each year.

Year	North	South	overall
71	812	893	1705
72	422	347	769
73	452	510	962
74	889	332	1221
75	596	158	754
76	529	26	555
77	287	293	580
78	386	179	565
79	0	262	262
80	99	425	524
81	401	145	546
82	283	777	1060
83	363	146	509
84	455	896	1351
85	385	1208	1593
86	237	957	1194
87	481	980	1461
88	363	665	1028
89	521	1577	2098
90	343	1550	1893
91	260	1895	2155
92	779	789	1568
93	909	1750	2659
94	1480	3347	4827
95	1865	1859	3724
96	1220	1670	2890
97	798	1272	2070
Total	15615	24908	40523

Table 2. Outputs of Type III analysis for the models selected in each unit.

NDF is the numerator degrees of freedom, and DDF is the denominator degrees of freedom.

North:									
Tests of Fixed Effects									
Source	NDF	DDF	Type III ChiSq	Type III F	Pr > ChiSq	Ord ChiSq	Pr > F	Ord F	
YR	25	1.60E+04	1404.43	56.18	0.0001	0	0.0001	0	
QT	3	1.60E+04	40.22	13.41	0.0001	0	0.0001	0	
AREA	4	1.60E+04	185.24	46.31	0.0001	0	0.0001	0	
BR	2	1.60E+04	132.42	66.21	0.0001	0	0.0001	0	
QT*AREA	12	1.60E+04	109.63	9.14	0.0001	0	0.0001	0	
QT*BR	6	1.60E+04	128.36	21.39	0.0001	0	0.0001	0	
AREA*BR	8	1.60E+04	57.68	7.21	0.0001	0	0.0001	0	

South:									
Tests of Fixed Effects									
Source	NDF	DDF	Type III ChiSq	Type III F	Pr > ChiSq	Ord ChiSq	Pr > F	Ord F	
YR	26	2.50E+04	3159.64	121.52	0.0001	0	0.0001	0	
QT	3	2.50E+04	34.76	11.59	0.0001	0	0.0001	0	
AREA	3	2.50E+04	144.25	48.08	0.0001	0	0.0001	0	
BR	2	2.50E+04	66	33	0.0001	0	0.0001	0	
QT*AREA	9	2.50E+04	29.94	3.33	0.0004	0	0.0005	0.0016	
QT*BR	6	2.50E+04	63.65	10.61	0.0001	0	0.0001	0	

overall Atlantic:									
Tests of Fixed Effects									
Source	NDF	DDF	Type III ChiSq	Type III F	Pr > ChiSq	Ord ChiSq	Pr > F	Ord F	
YR	26	4.10E+04	2774.26	106.7	0.0001	0	0.0001	0	
QT	3	4.10E+04	73.31	24.44	0.0001	0	0.0001	0	
AREA	8	4.10E+04	704.97	88.12	0.0001	0	0.0001	0	
BR	2	4.10E+04	95.78	47.89	0.0001	0	0.0001	0	
QT*AREA	24	4.10E+04	289.09	12.05	0.0001	0	0.0001	0	
QT*BR	6	4.10E+04	186.54	31.09	0.0001	0	0.0001	0	

Table 3. Annual, standardized CPUE from the models selected in each unit.

Year	North:			South:			overall Atlantic:		
	CPUE	upper	lower	CPUE	upper	lower	CPUE	upper	lower
71	1.001279	1.165809	0.853813	1.697253	1.858776	1.54767	1.312575	1.402738	1.227017
72	1.758506	2.056313	1.496507	1.33742	1.512584	1.17894	1.549381	1.688428	1.419761
73	1.333328	1.564577	1.129018	2.373029	2.625454	2.14219	1.754515	1.894781	1.622965
74	3.499356	3.949833	3.095312	1.647621	1.862541	1.453804	2.803793	2.995505	2.623025
75	2.582419	2.964072	2.243801	1.151279	1.364632	0.964846	2.022861	2.201649	1.856539
76	1.133469	1.332714	0.956868	1.704107	2.474561	1.145586	1.078889	1.201203	0.966143
77	3.228827	3.792912	2.740262	8.161935	9.152893	7.274571	5.039139	5.491452	4.621774
78	2.767617	3.205967	2.382253	5.102737	5.877271	4.424904	3.263574	3.562135	2.987726
79	N.A.	N.A.	N.A.	8.352845	9.273435	7.520536	8.605619	9.548041	7.752814
80	6.335019	7.905978	5.060454	6.570557	7.210292	5.985125	6.551813	7.134952	6.014029
81	3.264375	3.768809	2.82068	1.614077	1.910955	1.356593	2.683406	2.936157	2.450022
82	2.396506	2.830072	2.02077	4.306883	4.646667	3.990314	3.816329	4.071677	3.575686
83	2.38063	2.771929	2.037292	3.774931	4.392827	3.237939	2.773236	3.038099	2.529002
84	1.562703	1.823938	1.331873	3.487099	3.750789	3.240463	2.704819	2.871776	2.54648
85	1.73603	2.043545	1.466893	2.465723	2.639532	2.3021	2.364977	2.504845	2.231932
86	2.316449	2.75441	1.938902	2.601775	2.796573	2.419128	2.54141	2.70755	2.384261
87	2.347332	2.704594	2.030913	3.668419	3.929507	3.423348	3.219353	3.404462	3.04334
88	1.741507	2.043469	1.476551	3.212621	3.487347	2.957685	2.626897	2.81086	2.453599
89	1.798519	2.080394	1.548415	2.568412	2.728391	2.416811	2.458571	2.583232	2.339185
90	2.060542	2.414523	1.75076	2.526958	2.690103	2.372636	2.607368	2.745559	2.475322
91	1.85226	2.20733	1.545168	2.182748	2.317272	2.05507	2.341604	2.461314	2.226969
92	2.335603	2.641404	2.060344	2.392516	2.584791	2.21294	2.509034	2.652382	2.372502
93	3.383355	3.814416	2.996171	2.319016	2.467454	2.178464	2.820626	2.951653	2.694779
94	3.25274	3.638367	2.903752	2.197772	2.31779	2.083202	2.681386	2.781227	2.584715
95	2.732732	3.050944	2.443689	1.72812	1.842155	1.620081	2.295816	2.38997	2.204884
96	3.123337	3.508794	2.775693	1.471568	1.574458	1.374248	2.188284	2.288166	2.092166
97	2.782125	3.163396	2.441416	1.598887	1.717665	1.487011	2.131911	2.244516	2.02417

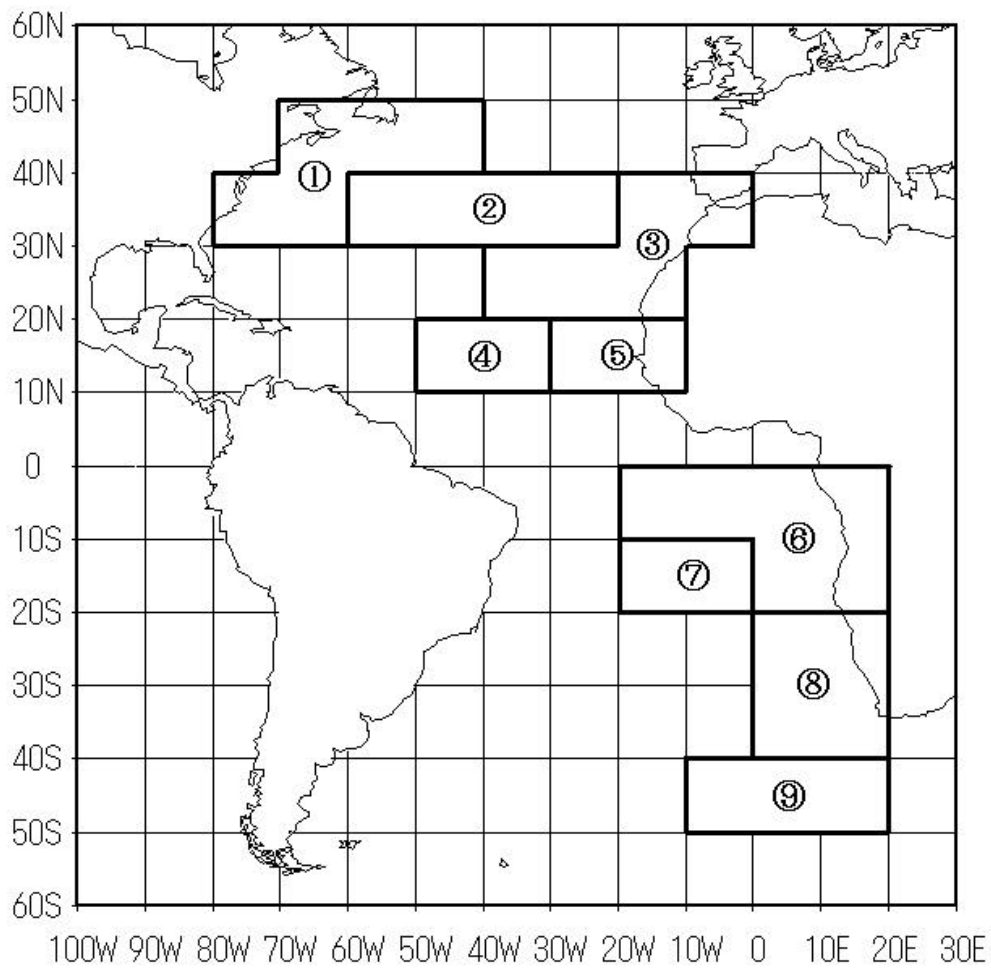


Figure 1. Area classification used for the analysis.

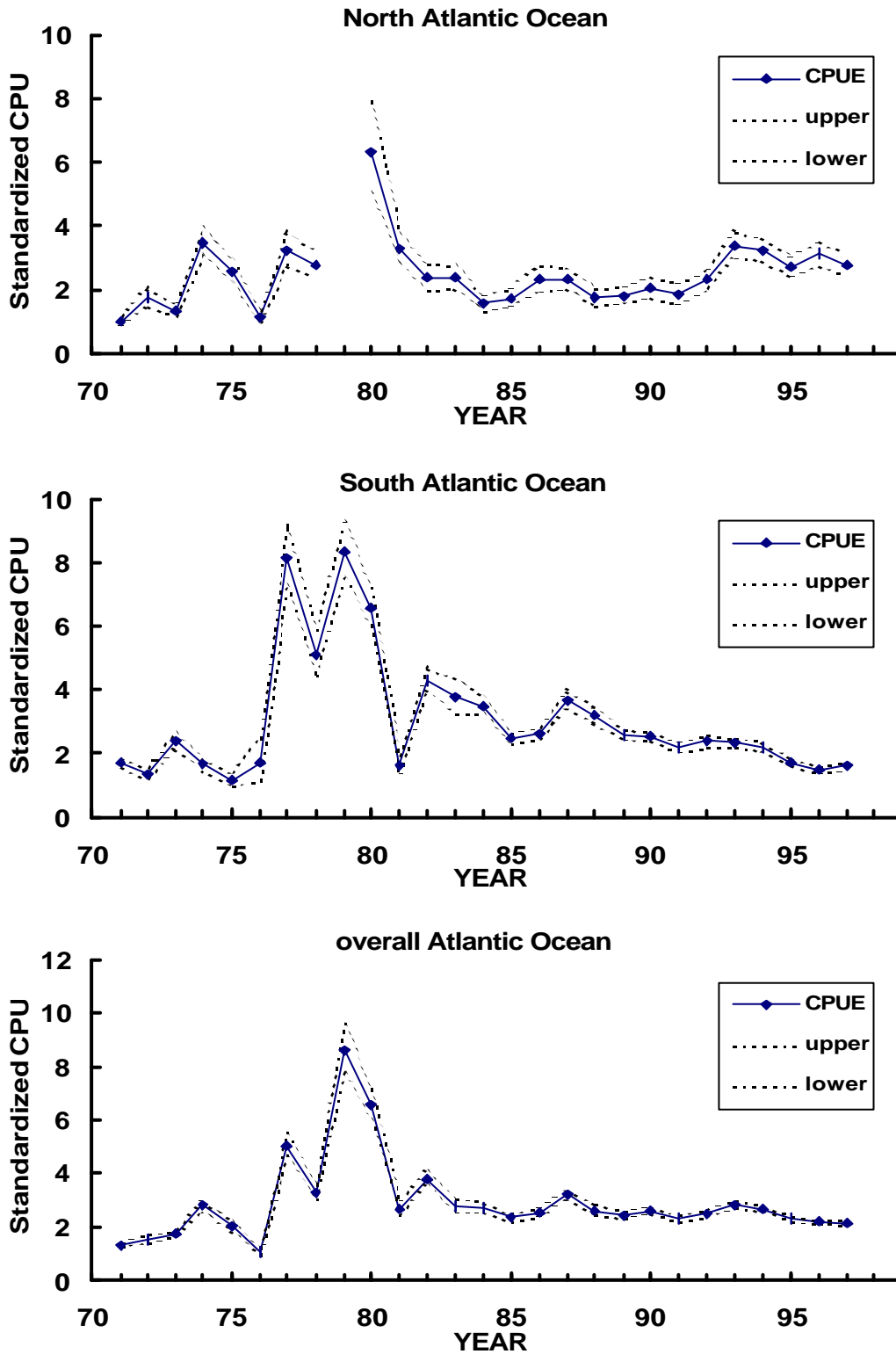


Figure 2. Standardized shark CPUE and 95% confidence intervals based on the logbook data of Japanese longline fishery in the Atlantic Ocean.