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Standardized CPUE for blue sharks caught by the Japanese tuna longline fishery in the Indian Ocean, 1971-2005

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Summary

The standardized CPUE for blue shark caught by the Japanese tuna longline fishery in the Indian Ocean was calculated using logbook data during 1971-2005 whose reporting rates were more than 80%. For much of this period, shark catches were not recorded by species, therefore all sharks are assumed to be blue sharks. Blue shark CPUE shows some fluctuations and relatively stable trends during the past three decades for the Indian Ocean.

1 Introduction

The standardized CPUE of blue shark caught by the Japanese longline fishery in the Atlantic Ocean was reported in the documents submitted to the ICCAT Sub-committee on By-catches (Nakano 1998, 1999, 2001, Nakano and Clarke 2004) using the filtering method of Nakano and Honma (1996), which filters the logbook data by shark reporting rate (the ratio of operations in which sharks were reported to the total operations in a cruise) in order to avoid the underestimate caused from the under reporting by the fishermen. Shiode and Nakano (2001) and Nakano and Clarke (2006) examined this method through comparison to records of shark catch by Japanese observers and concluded that standardized CPUE calculated from filtered logbook data could be used as an abundance index of blue shark. Since the Japanese longline fishery has widely covered the high seas area of the Indian Oceans, its fishery statistics should be one of the most valuable means of describing the stock status of pelagic sharks. There is international concern over the stock management and sustainable use of elasmobranch species, therefore it is useful to examine recent trends in the stock status of blue shark using the most recent logbook data from tuna fisheries. In this report, the standardized CPUE of blue shark in the Indian Ocean was calculated by the same method as done in the Atlantic Ocean (Nakano 1998, 1999, 2001, Nakano and Clarke 2004) using the logbook data of the Japanese tuna longline fishery from 1971 to 2005.

2 Materials and Methods

The same filtering method of Nakano & Honma (1996) was adopted and data with reporting rates

greater than 80% were used in this analysis. This reporting rate was recommended by Nakano and Clarke (2006). The time series of the data extends for 35 years from 1971 to 2005, but data for 2005 is provisional.

In order to standardize CPUE of sharks, generalized linear models were used in this analysis. I used the CPUE model with lognormal error. The calculation was performed through GLM procedure of SAS/STAT package (Version 9.1.3). The following forms were assumed as full models.

$$E(\log(CPUE + constant)) = INTERC + yr + season + ar + br + INTERA \qquad \log(CPUE + constant) \sim N(\mu, \sigma^2)$$

where log: natural logarithm, CPUE: nominal CPUE (catch in number per 1,000 hooks), INTERC: intercept, yr: effect of year, season: effect of quarter, ar: effect of area, br: effect of branch line criteria (number of branch lines between buoys; <9, 9-14, 14<), INTERA: any combination of two way interactions. The area strata used for the analysis are shown in Fig.1, which was determined based on the distribution of sharks and fishing effort. Shark catches were not recorded by species before 1993, therefore all sharks are assumed to be blue sharks in this analysis.

I made the variable selection using the stepwise F-test and Chi-square-test (Dobson 1990). Significant level was set at 5 %.

3 Results and Discussion

As a result, the following models with many explanatory variables were finally selected.

$$\log(CPUE + 1) = INTERC + yr + season + ar + br + (season*ar) + (season*br) + ERROR$$

The results of ANOVA for the model selection are shown in Table 1. Figure 2 shows the standardized CPUEs and 95% confidence intervals. The values of CPUE ranged around 1.4 to 4.6 and were in the range of nominal CPUE values reported by onboard observers in the longline fishery in the high sea (Hazin et al. 1990, Bonfil 1994, Senba and Nakano 2004). The results from the analysis using Japanese logbook data indicate relatively stable levels with some fluctuations and high level of CPUE observed in 1999. Overall, the results of this analysis suggest that the stock status of blue sharks has not changed drastically over the past three decades in the high seas area of the Indian Ocean.

The sharks caught in Indian high seas are supposed to be mainly consist of blue shark as in the other Oceans (Hazin et al. 1990, Bonfil 1994, Nakano and Honma 1996, Senba and Nakano 2004) but the verification of the filtering method through comparison to the observer data of shark catch has not been conducted yet in the Indian Ocean. Moreover, it is thought to be difficult to apply the method to the calculation of CPUE for other pelagic shark species with little information of the long-term stock status. It is necessary to conduct further onboard research activities and accumulate scientific information.

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Table 1 Results of ANOVA for the finally selected model in the analysis of blue shark.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	65	1398.44	21.51	49.3	<.0001
Error	27491	11997.59	0.44		
Total	27556	13396.03			

R-Square	Coeff Var	Root MSE	logCPUE Mean
0.104392	56.82163	0.66062	1.162621

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yr	34	492.94	14.50	33.22	<.0001
season	3	6.95	2.32	5.31	0.0012
ar	5	172.06	34.41	78.85	<.0001
br	2	25.25	12.63	28.93	<.0001
season*ar	15	129.01	8.60	19.71	<.0001
season*br	6	33.00	5.50	12.60	<.0001

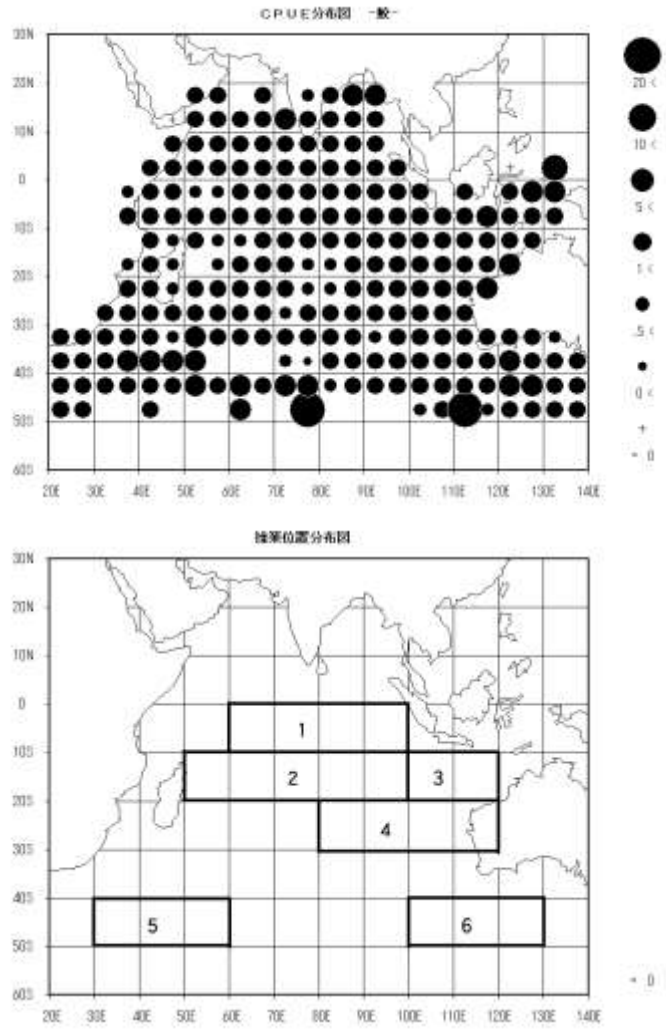

Fig.1 CPUE distribution of blue shark and area classification used for the analysis.

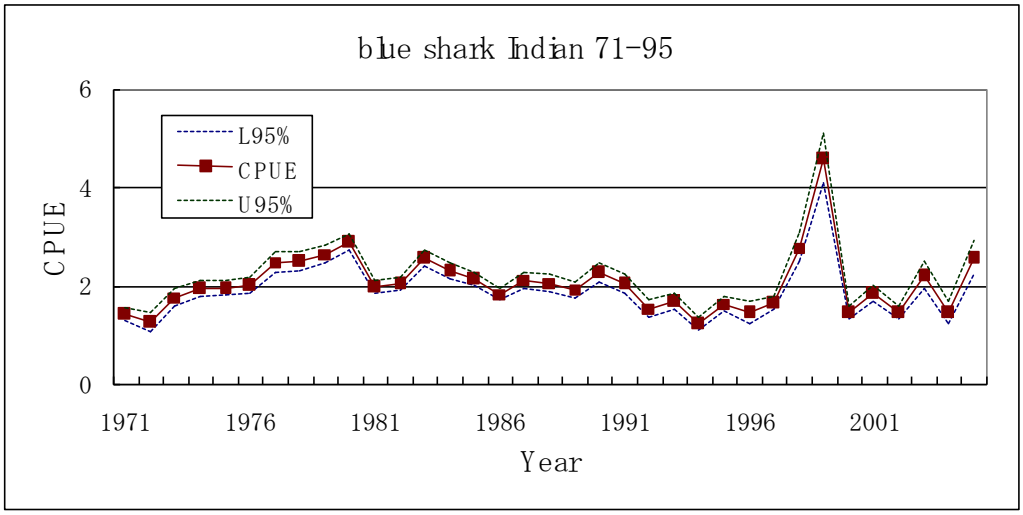

Fig.2 Standardized CPUE and 95% confidence intervals for blue shark based on the logbook data of Japanese longline fishery in the Indian Ocean.