AGE SPECIFIC CPUE FOR ATLANTIC BIGEYE TUNA STANDARDIZED BY GENERALIZED LINEAR MODEL

SCRS/1997/107 Rev.

Col.Vol.Sci.Pap. ICCAT, 48 (2) : 307-310 (1998)

Okamoto, H.[1], *N. Miyabe*[1]

SUMMARY

Age-specific CPUE of bigeye tuna caught by Japanese longline vessels in the Atlantic Ocean were standardized by two types of GLM (generalized linear model) using catch-at-size data. Both results showed similar trends. When all age groups were pooled, the CPUE showed a gradual and steady declining trend from 1988. The declining trend is obvious from 1988 for age 3 and age 4 fish, while the CPUE was stable and continued flat from 1980 for older age groups.

RÉSUMÉ

Les CPUE spécifiques de l'âge des thons obèses pris par les palangriers japonais dans l'Atlantique ont été standardisées en appliquant deux types de GLM (modèle linéaire généralisé) aux données de prise par taille. Les résultats issus des deux types ont présenté des tendances similaires. Quand tous les groupes d'âge furent regroupés, la CPUE a présenté une tendance déclinante graduelle et constante à partir de 1988. Cette tendance déclinante est évidente à partir de 1988 pour le poisson d'âge 3 et 4, alors que la CPUE était stable et est resté invariable à partir de 1980 pour les groupes d'âge plus élevé.

RESUMEN

La CPUE específica de la edad de patudo capturado por palangreros japoneses en el océano Atlántico se estandarizó mediante dos tipos de GLM (modelo lineal generalizado) empleando datos de captura por clases de talla. Ambos resultados mostraron tendencias similares. Cuando se agruparon todos los grupos de edad, la CPUE mostró una tendencia al descenso, gradual y estable, desde 1988. La tendencia al declive es obvia desde 1988 para las edades 3 y 4, mientras que la CPUE se mantuvo estable y se mantuvo al mismo nivel desde 1980 para grupos de edad más viejos.

[1] National Research Institute of Far Seas Fisheries, 5 Chome 7-1, Orido, Shimizu, 424 Japan.

Introduction

CPUE of bigeye tuna has been standardized but size data were not incorporated. In order to grasp CPUE trend by age or age groups, catch-at-size data was used to age CPUE. In this analysis, two different assumptions of error structure (Lognormal and Poisson distribution) were adopted and their results were compared.

Materials and methods

Area definition used in this study was shown in Fig.1. Central fishing area for bigeye by the Japanese longline fishery in the Atlantic was defined with 4 sub-areas as used in the past analysis (ICCAT 1997).

In order to standardize bigeye CPUE, two models, which have different error structure (lognormal distribution and Poisson distribution) were used.
The models adopted for two GLMs were as follows.

1) log normal error structure assumption
ln (CPUE + 10% of overall mean)= μ +year + month + area + main + bran + ed +bran*area+ ed*month + ed*area + month*area

2) Poisson with log link error structure assumption
E(C)=H exp (μ + year + month + area + main +bran + ed + bran*area + ed*month + ed*area + month*area)

where main = materials of main line of longline gear;
bran = materials of branch line of longline gear;
ed = the number of branch line between floats,
CPUE = catch / hooks * 1000,

H = the number of hooks (offset parameter),
E(C) = expected catch.

Catch-at-size data by Miyabe and Okamoto (1997) were used. This data was sliced into each age group (from 1 to 10 age groups) by knife-edge type slicing methods using age-length relationships of Cayre and Diouf (1984) in order to decompose CPUE or catch. Two sets of catch and effort data, which were different in their time series, were standardized. One of which covers from 1965 to 1975, and the other covers from 1976 to 1996. Since former data dose not include information on the number of branch between floats, all branch numbers were supposed to be tentatively six, which is the typical number used. The relative CPUE calculated from two series were joined at 1976 by making both relative CPUE=1.0.

Results and discussion

Frequencies of the number of individuals in the total catch number were shown in Table 1 by each age group and each year. Since most of individuals caught by longline gear are older than 3 years old (most of the frequency of the first two age groups were lower than 0.05; 0.0000-0.0001 at age 0, 0.0000-0.0178 at age 1 and 0.0018-0.1648 at age2), only age 3 to age 10 were used for analysis.

Nominal CPUE were shown in Fig.2. CPUE were relatively stable among 10 to 15 (individuals per 1000 hooks) from 1968 to 1985 with some fluctuation, and after rising up to about 17 in 1987, it continuously came down to about 8 in 1996. In Fig. 3, the standardized CPUE derived from Lognormal and Poisson models were shown. Since, in these analyses, data of age 3 to age 10 were combined, these results should be almost similar to the former analysis in which no separation for specific age or age group was made. Results of both models showed similar trend of CPUE. Until 1988, relative CPUE were roughly the same level, while declining trend is obvious from that year through those from 1992 to 1994 were almost flat in level.

Relative CPUE calculated by Lognormal and Poisson models for each age group was shown in Fig.4. Declining CPUE trend from 1988 were very obvious in age 3 and age 4 group. Relative CPUE were about 20% of the early 80's level for age 3, and 30% for age 4 groups. On the other hand, CPUE levels were stable for other age groups though slight decline was observed in age 5 from 1988. Same analysis was done with pooling several age groups (Fig.5). In the figure of age 3-4, age 5-6, age 7-10, and age 4-7, the results by Poisson model are also drawn. These results also shown same trend of CPUE of age separated analysis in Fig.4. Younger age (specially 3 and 4 age) showed clearer declining trend than older age groups.

These results indicate that stock of younger bigeye has reduced since about 10 years ago. Although it is expected that the decrease of younger age fish should bring decrease of older fish, no such declining trend was observed in CPUE of older fish. What cause this phenomenon is not clear now, though the changes in operating area and/or the effect of other fisheries, i.e., purse seine catch increase, on younger bigeye, are supposed as the possible factors.

Reference

ICCAT (1997): Report of Ad Hoc Working Group on Bigeye Tuna. Madrid, Apr.9-11, 1997.

Cayre , P. and T. Diouf (1984): Croissance du thon obese (Thunnus obesus) de l'Atlantique d'apres l es resultats de marquage. ICCAT, Rec. Doc. Sci., 20 (1): 180-187.

Miyabe N. and H. Okamoto (1997): Creation of bigeye tuna catch-at-size caught by the Japanese longline fishery in Atlantic. SCRS/97/104

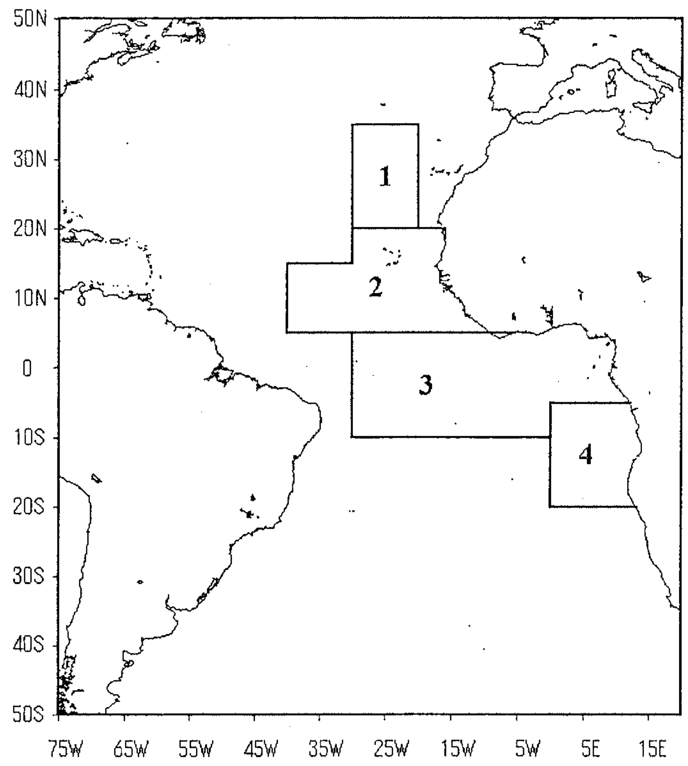

Fig.1 Area definition used in this study.

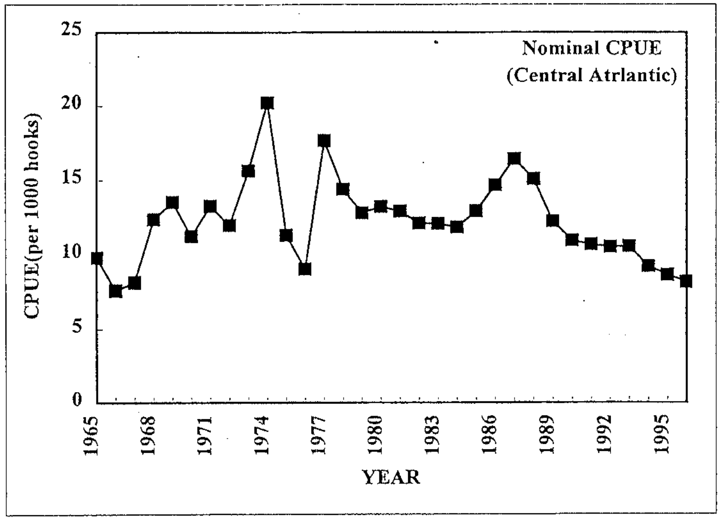

Fig.2 Nominal CPUE of Bigeye caught by Japanese longline vessels.

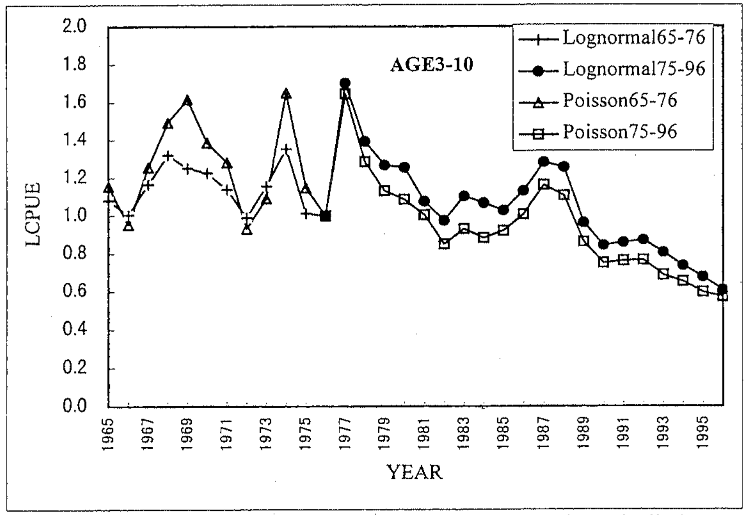

Fig. 3 Bigeye CPUE standerdized by Lognormal(solid line) and Poisson(dot line) error structure assumption model using catch at size data (3-10age data were used).

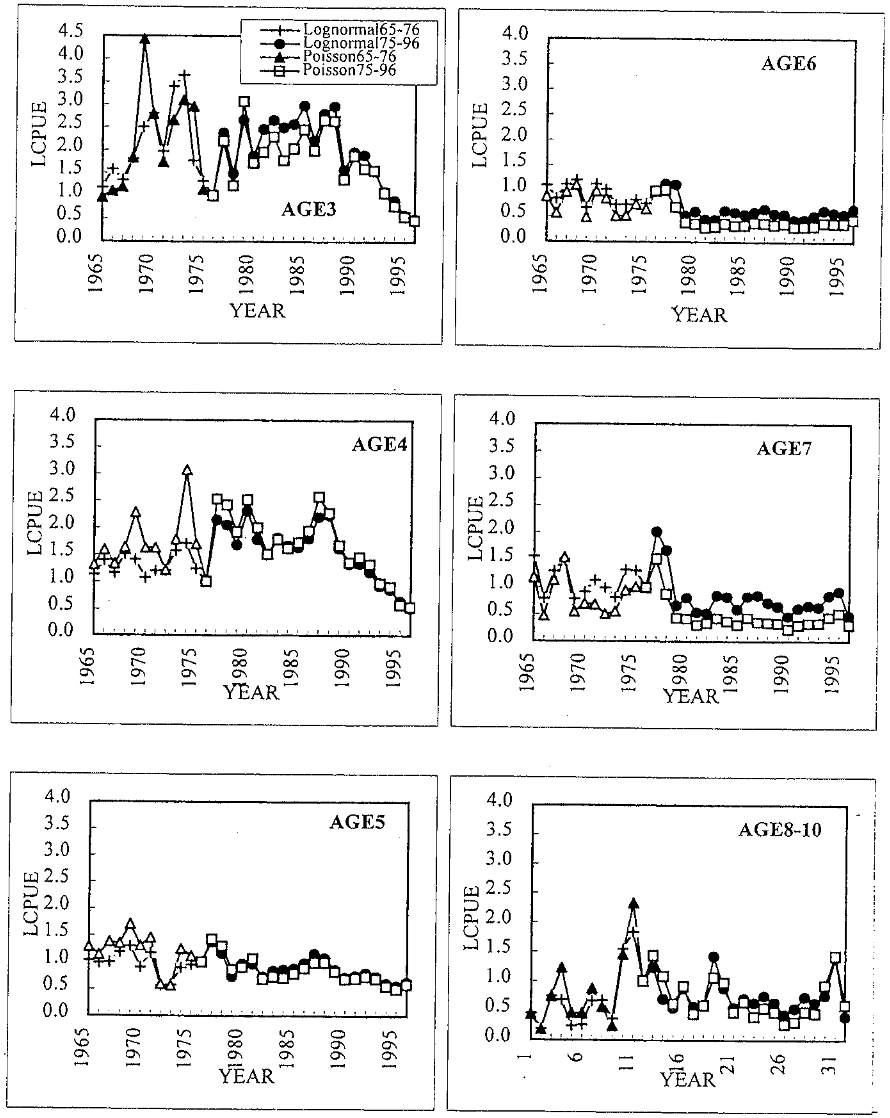

Fig.4 Bigeye CPUE standerdized by Lognormal and Poisson error structure assumption models using catch at size data. Culculated by each age.

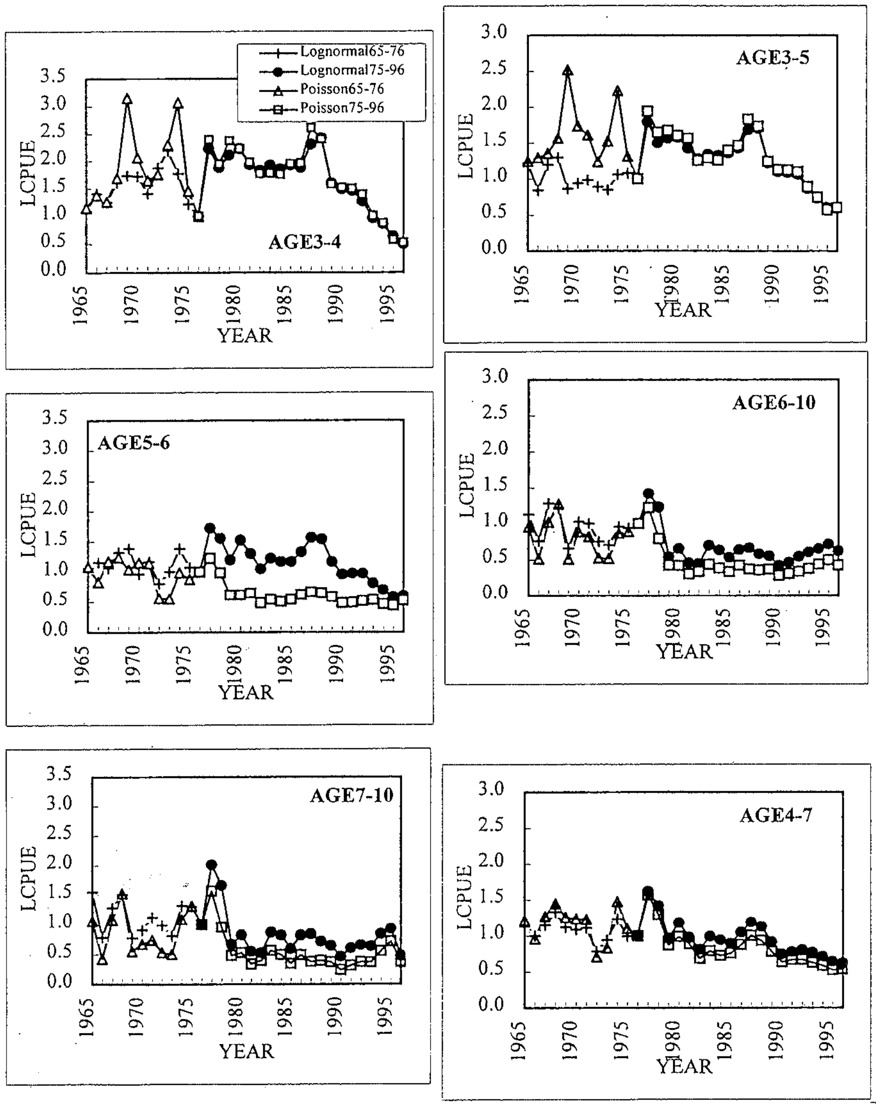

Fig.5 Comparison of relative CPUE derived from Lognormal and Poisson error structure assumption model using catch at size data.

Table 1. Frequency of the number of individuals for each age in total catch number

YEAR	Total number (thousands)	Frequency (%)										
		AGE0	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8	AGE9	AGE10
65	412	0.0	0.3	3.8	9.4	18.1	28.1	24.4	14.5	1.3	0.1	0.0
66	123	0.0	0.0	9.1	11.0	24.8	28.6	18.4	7.5	0.7	0.0	0.0
67	118	0.0	0.0	0.5	9.8	18.0	29.1	25.7	14.4	2.4	0.0	0.0
68	127	0.0	0.0	4.2	13.3	17.4	23.0	23.6	15.3	3.1	0.1	0.0
69	171	0.0	0.0	5.5	32.3	21.8	25.2	9.2	4.8	1.0	0.0	0.0
70	85	0.0	0.0	2.7	21.4	18.8	24.2	23.6	7.9	1.3	0.1	0.0
71	259	0.0	0.1	5.9	14.6	19.0	29.4	20.6	7.8	2.4	0.2	0.0
72	277	0.0	1.8	9.0	29.7	21.7	13.9	14.7	7.4	1.7	0.1	0.0
73	267	0.0	0.5	16.5	29.2	24.1	11.2	12.0	5.8	0.7	0.0	0.0
74	325	0.0	0.3	3.1	18.0	36.3	20.0	12.4	6.8	2.7	0.4	0.0
75	254	0.0	0.3	4.3	11.8	25.9	24.8	15.5	10.8	6.2	0.3	0.0
76	84	0.0	0.1	1.8	12.6	18.5	25.9	25.6	11.6	3.1	0.6	0.1
77	125	0.0	0.0	0.7	15.1	28.4	22.3	18.9	12.1	2.3	0.2	0.0
78	128	0.0	0.1	1.6	11.0	34.5	25.9	15.6	9.0	2.1	0.2	0.0
79	142	0.0	0.0	3.2	31.4	29.1	18.8	10.4	5.3	1.4	0.2	0.1
80	260	0.0	0.8	3.5	14.6	39.4	22.5	10.6	5.7	1.8	0.6	0.4
81	263	0.0	0.1	3.2	19.1	33.5	28.7	9.3	4.6	1.3	0.2	0.1
82	468	0.0	0.3	3.6	21.1	28.4	23.7	13.0	7.0	2.5	0.3	0.1
83	222	0.0	0.3	1.6	15.9	30.0	23.3	15.2	8.7	3.8	0.9	0.4
84	331	0.0	0.0	2.4	17.5	29.7	24.3	14.0	7.6	3.8	0.4	0.2
85	438	0.0	0.1	2.5	18.7	30.2	26.5	13.8	6.1	1.8	0.2	0.1
86	335	0.0	0.1	2.3	14.3	30.7	26.9	14.7	8.2	2.6	0.3	0.0
87	247	0.0	0.0	1.3	16.4	35.7	26.6	12.5	5.8	1.5	0.1	0.0
88	455	0.0	0.0	1.4	17.8	33.7	27.5	11.8	5.8	1.8	0.2	0.1
89	586	0.0	0.0	1.3	11.6	32.1	29.2	16.4	7.1	2.1	0.2	0.0
90	494	0.0	0.0	1.3	17.4	29.8	28.5	15.8	5.5	1.4	0.2	0.0
91	449	0.0	0.0	0.7	14.7	31.2	28.4	15.8	7.4	1.6	0.2	0.0
92	412	0.0	0.0	1.9	14.4	27.6	29.0	16.2	8.2	2.5	0.3	0.0
93	576	0.0	1.3	6.3	10.4	22.0	29.0	19.9	8.4	2.5	0.2	0.0
94	470	0.0	0.0	1.9	8.0	22.4	26.1	22.9	12.7	5.0	0.9	0.1
95	437	0.0	0.1	2.6	6.5	16.0	24.8	24.2	15.9	8.3	1.3	0.3
96	458	0.0	0.0	0.2	6.0	16.9	31.5	31.0	10.0	3.8	0.6	0.1