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AN UPDATED PRODUCTION MODEL ANALYSIS ON ATLANTIC BIGEYE TUNA AS OF 1986

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SUMMARY

A production model analysis was conducted for bigeye tuna in the entire Atlantic on the basis of CPUE calculated from Japanese longline statistics for the years 1961-1986. The fishing intensity was estimated by the Honma method with adjustment for the deep longline operation. Results showed the stock was still in a healthy condition although it had been highly exploited during recent years.

RESUME

L'analyse du modèle de production a été menée sur le thon obèse de l'Atlantique entier à partir des CPUE calculées avec les statistiques palangrières japonaises pour les années 1961-86. L'intensité de pêche a été estimée par la méthode de Honma en l'ajustant aux opérations de la palangre de profondeur. Les résultats montrent que le stock est encore en bon état, bien qu'il ait été fortement exploité ces dernières années.

RESUMEN

Se efectuó un análisis del modelo de producción para el patudo en todo el Atlántico, en base a la CPUE calculada partiendo de las estadísticas japonesas de palangre del periodo 1961-1986. La intensidad de pesca se estimó por el método Honma, haciendo un ajuste para las operaciones de palangre profundo. Los resultados mostraron que el stock se encuentra aún en buenas condiciones a pesar de la fuerte explotación de los últimos años.

1. Introduction

Bigeye tuna has been the most important species for the Japanese longline fishery in terms of amount of the catches as well as of the values. Besides, this is an only species with which the Japanese longline fishery has a largest catch share, except a few years, in single gear-country category in the Atlantic. Trend of the Atlantic bigeye catch, categorized by major fishery, which also roughly accounts for the size of the fish taken is shown in Figure 1. The catches by longline and bait boat fisheries in Canary-Azores-Madeira islands represent adult large sized fish mostly bigger than 90 cm while purse seine and other baitboat fisheries capture juvenile small fish less than 90 cm (Cayre et al. 1986). Except the Canary-Azores-Madeira baitboat fishery, both large fish and small fish fisheries appear to have been increasing their catch consistently with respect to time series. Therefore, the impact of the fisheries to bigeye stock must have increased for all sizes of the species. The facts that the Japanese longline fishery dominates in the Atlantic bigeye catch and targets this species over the almost entire areas of the distribution of the species have qualified the use of the Japanese statistics as a base of production model analysis to assess the status of stock of this species. The present study updates the previous one (Miyabe, Kiyota and Kume 1988) covering the period from 1961 to 1986.

2. Materials and Methods

Recent studies (e.g. Pereira and Bard 1986) on tagging experiments, distribution by size and spawning activities imply the bigeye tuna in the whole Atlantic Ocean forms a unit stock. Therefore, single stock hypothesis was adopted in this report for production model analysis. However, taking into account a possible separated stock hypothesis, trend of CPUE for the Japanese longline divided by north and south Atlantic at 5° N was monitored as before.

Materials and methods used in this study is essentially the same with the previous work (Miyabe, Kiyota and Kume 1987). The procedure used to estimate the total effective effort and catch of the Atlantic bigeye tuna is outlined as follows.

Step 1. The Japanese longline Task II data were used to compute the effective effort of the species, converting the nominal fishing effort of deep longline operation to that of conventional longline operation on the basis of gear efficiency and deployment rate of deep longline described by Kume (1985). Tables 1 and 2 and Figure 2 give the relevant information mentioned in this step.

Step 2. The Japanese nominal fishing effort thus calculated forms a base to compute effective effort by Honma method (Honma 1973). Average year period to obtain average density index by month and 5 degree squares covers the years from 1967 to 1972. The area south of 45 N and north of 40° S except Mediterranean was chosen for whole Atlantic for the computation of the effective effort, and this was slightly modified from previous work.

Step 3. The effective effort on bigeye by the Japanese longline fleet was raised to the total effective effort of all fishing gears multiplying the ratio of the total catch to the Japanese catch (Table 2).

Production model analysis (Fox 1975) was conducted by the same procedure as the previous work i.e., four cases of shape parameter m, m=0, 1, 2 and variable, parameter K (number of year classes that mainly contribute to the fishery) equals to 4.

3. Results and discussions

CPUE trends

Figure 3 shows bigeye CPUE calculated from the effective fishing effort of the Japanese longline statistics computed by the procedure described in the previous section. Three sets of the CPUE, i.e., for whole, north and south Atlantic Oceans show a similar trend which might be an indication of single stock hypothesis. The CPUE has been stable recently despite of the increased catch. It was significantly high especially for the south Atlantic in 1985, but it returned to the previous level in 1986 both in north and south Atlantic. Average CPUE for the recent five years from 1982 to 1986 is 71% of that for the early five years from 1961 to 1965.

Production model analysis

Addition of the 1986 CPUE in the analysis resulted in lower MSYs than those estimated in the previous work for all cases of parameter m (Table 3 and Fig. 4). The MSY ranges from 67.0 to 138.8 thousand tons depending on the parameter. Since no coservations appear in the right hand rim of the production curves, it is difficult to know which curve is the most likely for this species at present. Judging from the recent level of the fishing effort, it could be said that the catch of the Atlantic bigeye tuna had been close to or less than the level that gives the MSY. However, since the catch of small sized fish has been increased recently, analytical approach that incorporates age-structured model should be done and the careful monitoring of the stock should be continued further.

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Table 1. Annual deployment rate of deep longline operation and its gear efficiency factor over conventional longline for 1980-86.

Year		Area 1	2	3	4
1980	Rate(%)	5	41	75	29
	Efficiency	1.35	1.24	1.32	1.22
1981	Rate(%)	25	49	68	22
	Efficiency	1.78	1.51	1.11	1.21
1982	Rate(%)	29	67	85	38
	Efficiency	1.31	1.14	1.19	0.95
1983	Rate(%)	11	68	82	37
	Efficiency	1.75	1.25	1.16	1.07
1984	Rate(%)	10	63	90	50
	Efficiency	1.59	1.58	1.16	0.98
1985	Rate(%)	12	85	95	59
	Efficiency	1.82	1.62	1.17	0.86
1986	Rate(%)	8	91	96	35
	Efficiency	3.11	1.53	1.72	1.38

Table 2. Catch, effort and CPUE on Atlantic bigeye tuna by the Japanese longline fleet, 1961-1986. For 1980-86, deep longline efficiency was adjusted.

	Japanese L.L. fishery				Atlantic total	
Year	Catch in number (1,000)	Yield in weight (1,000 MT)	Effective effort (million)	Hook rate	Yield in weight (1,000 MT)	Effective effort (million)
1961	243.7	11.0	27.3	0.892	17.0	42.2
1962	367.9	15.7	51.7	0.712	23.1	76.1
1963	285.3	14.5	45.8	0.623	26.0	82.1
1964	343.7	17.3	58.0	0.593	23.5	78.8
1965	648.3	28.5	113.8	0.570	39.2	156.5
1966	232.1	17.6	46.8	0.496	25.0	66.5
1967	180.9	8.5	30.5	0.593	24.7	88.6
1968	204.6	10.3	30.0	0.682	23.0	67.0
1969	263.3	10.3	36.8	0.717	35.4	126.5
1970	187.3	9.0	32.4	0.578	41.5	149.4
1971	394.9	20.3	83.0	0.476	54.9	224.5
1972	346.0	18.1	77.6	0.446	46.4	198.9
1973	391.3	20.0	74.7	0.524	56.4	210.7
1974	457.4	20.9	66.9	0.683	63.6	203.6
1975	449.1	17.4	110.4	0.407	60.7	385.1
1976	171.0	7.3	49.2	0.348	44.6	300.6
1977	190.0	9.2	35.2	0.540	54.1	207.0
1978	209.2	9.3	47.3	0.442	51.7	262.9
1979	270.4	12.0	62.2	0.435	45.1	233.8
1980	451.7	20.5	101.4	0.446	62.7	310.1
1981	469.2	21.0	130.8	0.359	67.1	417.9
1982	699.8	32.9	144.0	0.486	73.0	319.5
1983	351.6	15.1	77.7	0.452	50.6	301.5
1984	524.3	24.3	108.3	0.484	69.0	307.5
1985	674.8	31.6	119.4	0.565	74.2	280.4
1986	499.3	22.8	115.4	0.433	61.1	309.3

Table 3. Estimated population parameters obtained from production model analyses for Atlantic bigeye tuna, 1961-86.

m (shape parameter)	Degree of fit index	F-optimum (million hooks)	Y-max (1,000 MT)	1982-86 catch (1,000 MT)
variable	0.5392	1879.3	100.0	
0	0.5391	-	130.8	58.6-74.2
1.001	0.5380	566.0	75.1	
2	0.5335	387.0	67.0	

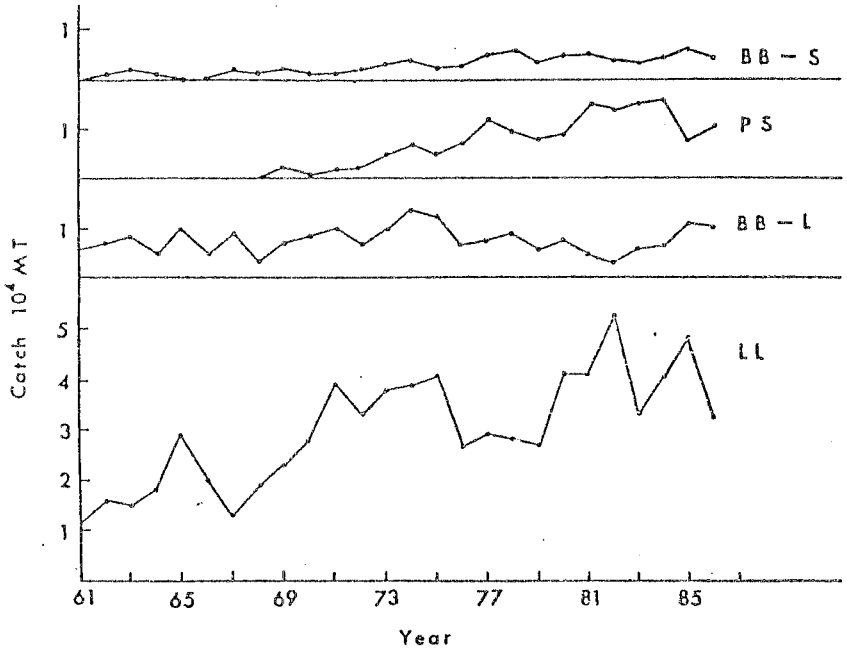

Fig. 1 Bigeye tuna catch in the Atlantic by major fisheries. Data are ICCAT 1982, 1985 and 1988.

BB-S : baitboat fishery for small fish.
PS : purse seine fishery.
BB-L : baitboat fishery for large fish.
LL : longline fishery.

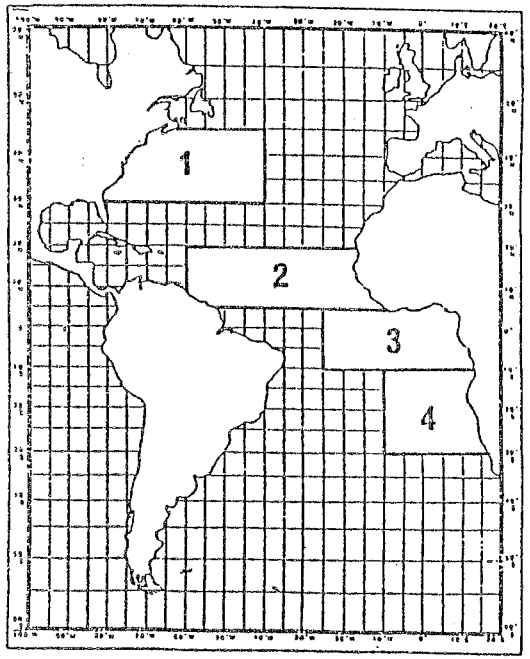

Fig. 2 Area division used for the adjustment of deep longline effort.

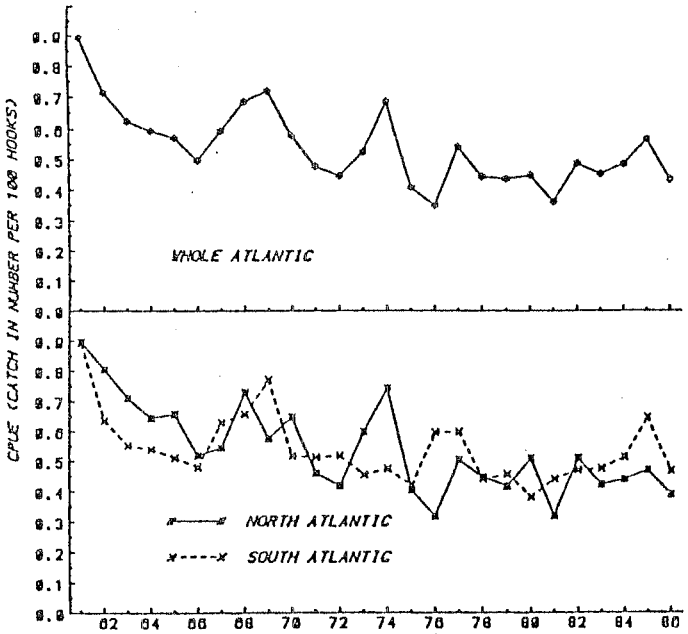

Fig. 3 Trend of annual CPUE of bigeye tuna caught by Japanese longline fishery in the whole Atlantic (upper panel) and in the north and south Atlantic (lower panel), 1961-86.

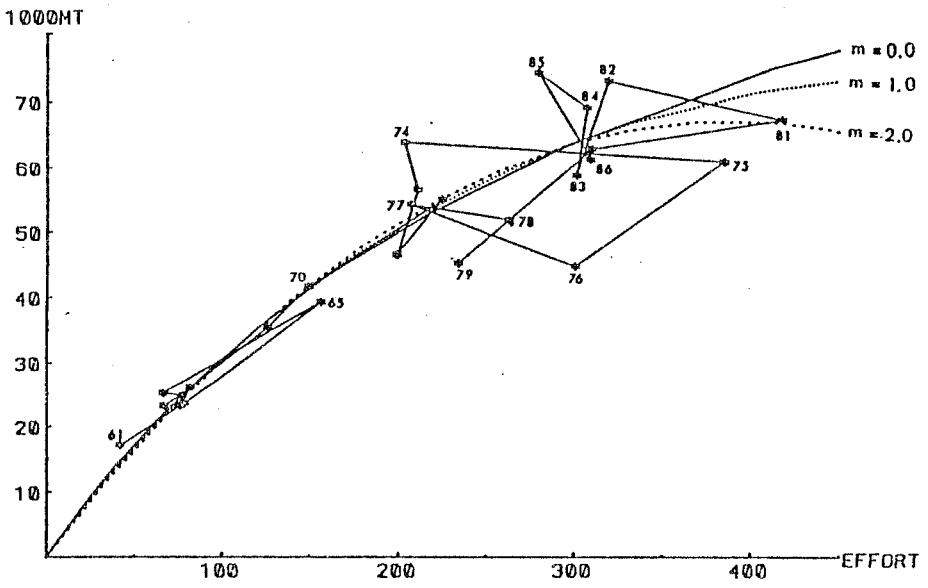

Fig. 4 Yield curves of the production model analysis for bigeye tuna in the whole Atlantic, 1961-86.