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AN UPDATED STOCK ASSESSMENT ON ATLANTIC BIGEYE TUNA BY CPUE AND PRODUCTION MODEL

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SUMMARY

Through adjusting the Japanese catch and effort data up to 1984, the stock status of Atlantic bigeye tuna was assessed on the basis of standardized CPUE and by production model analysis.

RESUME

L'ajustement des données japonaises de prise et effort jusqu'à 1984 a permis d'évaluer l'état du stock de thon obèse atlantique à partir de la CPUE standardisée et par l'analyse du modèle de production.

RESUMEN

Ajustando los datos japoneses de captura y esfuerzo hasta 1984 se evalua el estado de la población de patudo atlántico, en base a la CPUE normalizada y análisis del modelo de producción.

1. Introduction

The Atlantic bigeye tuna, which is most likely to be comprised of a single stock, has been highly utilized in recent years, and the latest assessment estimated the status of the stock to be close to or at the maximum sustainable yield (MSY) level since 1980 (ICCAT 1986). A production model analysis has been conducted as one of various stock assessment techniques. This report presents the follow-up analyses on trends of catch-per-unit-of effort (cpue) and a production model analysis by updating catch and effort data of Japanese longline fishery in 1984 which cover widely the bigeye stock.

2. Material and method

2-1. Catch data : The latest catch information by ICCAT (1985) was referred to the data up to 1984.

2-2. Catch and effort data : Japanese catch and effort data up to

1984 were employed as basic data, which cover almost entire area of bigeye catch distribution and share large portion of the longline catch.

2-3. Effort standardization : Effort standardization was made for Japanese longline data. Efficiency of deep longlining for 1984 data was calculated following the method described by Kume (1985). Annual rate of deployment of deep longline operation and gear efficiency of deep longlining over conventional longlining in 1984 are listed in Table 1. Using these factors, effective effort in 1984 was calculated by Honma's method (1973) as shown in Table 2. As input data in production model, estimated total effort, catch and hook rates are shown in Table 3 for the years 1961-84. The same procedure was repeated to calculate cpue's in north and south Atlantic.

2-4. Production model : Generalized production model "PRODFIT" by Fox (1975) was employed. The number of year classes in the catch (parameter k) was chosen as 4, and shape parameters in the model runs were m = 0, 1, 2 and variable.

3. CPUE trends.

As shown in Fig. 1, the Japanese longline data cover widely the bigeye distribution in time and space. Therefore, cpue (catch in number per 100 hooks) is a good index of relative abundance of the stock. The cpue trends are also important in understanding the results of production model analysis. The cpue is calculated based on standardized effort as explained in the section 2-3. The annual changes in cpue's of the whole Atlantic and of north and south Atlantic for the years 1961-84 are shown in Fig. 2. Each of the cpue's in three areas indicates similar long-term trend in the gradual decline until late 1970s. The level of the cpue's in recent years has been stable but declined at about 60-65 % of the initial exploitation. This trend indicates the recent level of adult or spawning biomass, because the longline catch has been composed of medium- and large-sized individuals (Kume 1985).

4. Production model results.

The results on population parameters derived from the computation of the fitting the data to the model are summarized in Table 4 and Fig. 3. The input data fitted best to the cases of m = 0 and m = variable, corresponding maximum sustainable yields (MSY or Y-max) being 155,200 and 155,300 MT, respectively. Estimates of MSY for m = 1 and 2 are 79,500 MT and 68,900 MT, respectively. These results are very similar to those obtained in the previous analysis (Kume 1986). It is still uncertain which one of presently estimated curves will describe the stock behavior in the future. Considering the range of recent catches, 62,200- 72,900 MT in 1981-84, it is suggested that the bigeye fishery in the Atlantic has been recently operating at the level close to or at the MSY level, but never exceeded beyond this level.

References

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Table 1. Annual rate of deployment of deep longline operation and its gear efficiency factor over conventional longline in 1984.

Area*	1	2	3	4
Annual rate (%)	10	63	90	50
Gear efficiency	1.59	1.58	1.15	0.98

*Area is referred to Fig. 1 of Kume 1985

Table 2. Catch, effort and CPUE (hook rate) on Atlantic bigeye tuna by the Japanese longline fleet, 1961-84. For 1980-84, deep longline efficiency is adjusted.

YEAR	CATCH IN NUMBER (1000)	YIELD IN WEIGHT (1000 MT)	EFFECTIVE HOOKS (MILLION)	HOOK RATE
1961	243.7	11.0	29.8	0.818
1962	367.9	15.7	54.0	0.681
1963	285.3	14.5	47.4	0.602
1964	343.7	17.3	61.1	0.563
1965	648.3	28.5	117.9	0.550
1966	232.1	17.6	48.1	0.483
1967	180.9	8.5	31.5	0.574
1968	204.6	10.3	31.2	0.656
1969	263.6	10.3	38.1	0.692
1970	187.3	9.0	33.5	0.559
1971	394.9	20.3	85.7	0.461
1972	346.0	18.1	79.5	0.435
1973	391.3	20.0	77.1	0.508
1974	457.3	20.9	69.0	0.663
1975	449.1	17.4	113.5	0.396
1976	171.0	7.3	50.6	0.338
1977	189.6	9.2	36.5	0.519
1978	209.2	9.3	48.9	0.428
1979	270.4	12.0	62.1	0.435
1980	451.3	20.5	98.6	0.458
1981	469.0	21.0	127.3	0.368
1982	698.7	32.9	149.1	0.469
1983	351.4	15.1	77.5	0.453
1984	524.3	24.3	107.7*	0.487

Table 3. Input fishery data in the production model analyses for Atlantic bigeye tuna, 1961-84. Deep longline effort was adjusted for 1980-84.

YEAR	HOOK RATE (NO/100 HOOKS)	MEAN WEIGHT (KG)	HOOK RATE (KG/100 HOOKS)	TOTAL CATCH (1000 MT)	TOTAL EFFORT (MILLION)
1961	0.818	45	36.8	17.0	46.2
1962	0.681	43	29.3	23.1	78.9
1963	0.602	51	30.7	26.0	84.7
1964	0.564	50	28.2	23.5	83.3
1965	0.550	50	27.5	39.2	142.5
1966	0.481	48	23.1	25.0	108.3
1967	0.567	50	28.4	21.7	87.1
1968	0.654	48	31.4	23.0	73.3
1969	0.691	44	30.4	35.4	116.4
1970	0.559	49	27.4	41.5	151.5
1971	0.462	47	21.7	54.9	252.8
1972	0.434	44	19.1	46.3	242.5
1973	0.508	40	20.3	56.3	277.1
1974	0.664	47	31.2	63.5	203.5
1975	0.396	50	19.8	60.6	306.1
1976	0.338	47	15.9	44.6	280.8
1977	0.519	49	25.4	54.1	212.7
1978	0.428	45	19.3	51.7	268.4
1979	0.435	44	19.1	45.1	235.6
1980	0.458	45	20.6	62.7	304.2
1981	0.368	45	16.6	67.1	405.2
1982	0.469	47	22.0	73.0	331.2
1983	0.453	43	19.5	62.2	319.3
1984	0.487	46	22.4	64.7	288.8

Table 4. Estimated population parameters obtained from production model analyses for Atlantic bigeye tuna, 1961-84.

m (shape parameter)	Degree of fit index	f-optimum (million hooks)	Y-max (1,000 MT)	1981-84 Catch (1,000 MT)
variable	.493	-	155.2	
0	.493	-	155.3	62.2-72.9
1.001	.488	667	79.5	
2	.480	493	68.9	

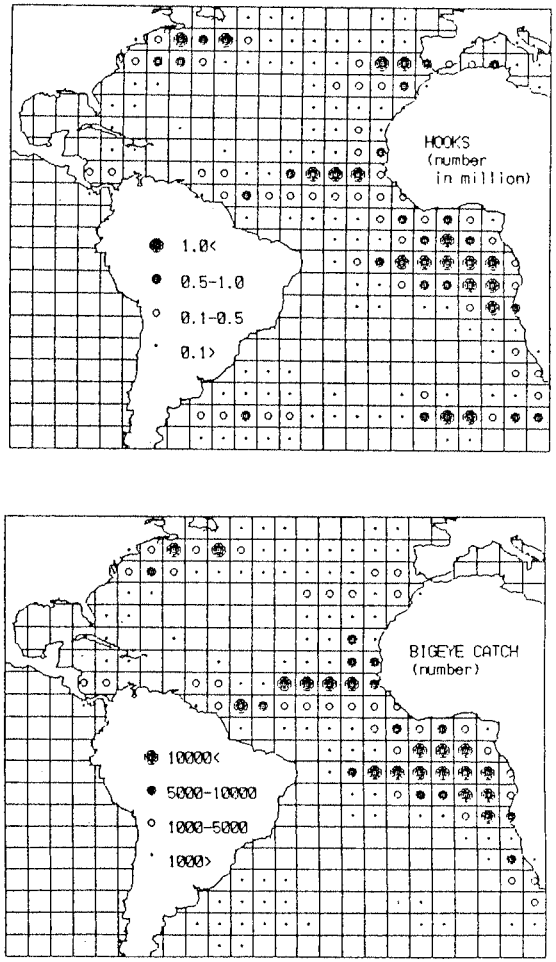

Fig. 1 Annual effort and bigeye catch distribution of Japanese longline fishery, 1982-84 average.

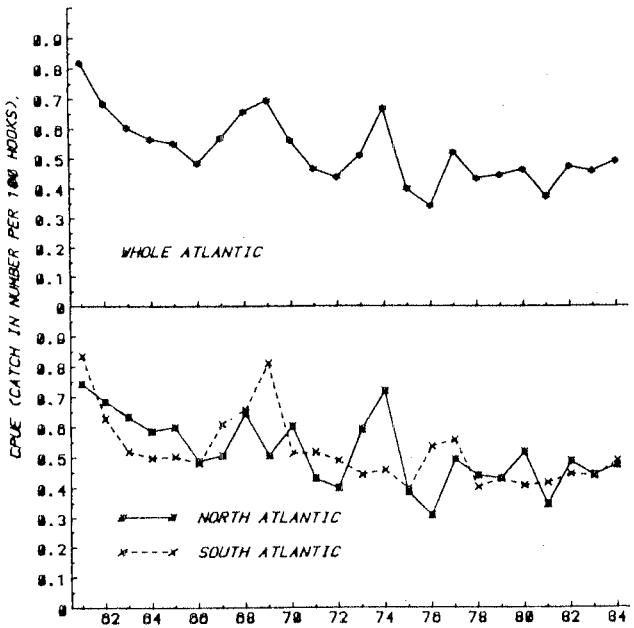

Fig. 2 Trend of annual cpue of bigeye tuna caught by Japanese longline fishery in the whole Atlantic (upper panel) and in the north and south Atlantic (lower panel), 1961-84.

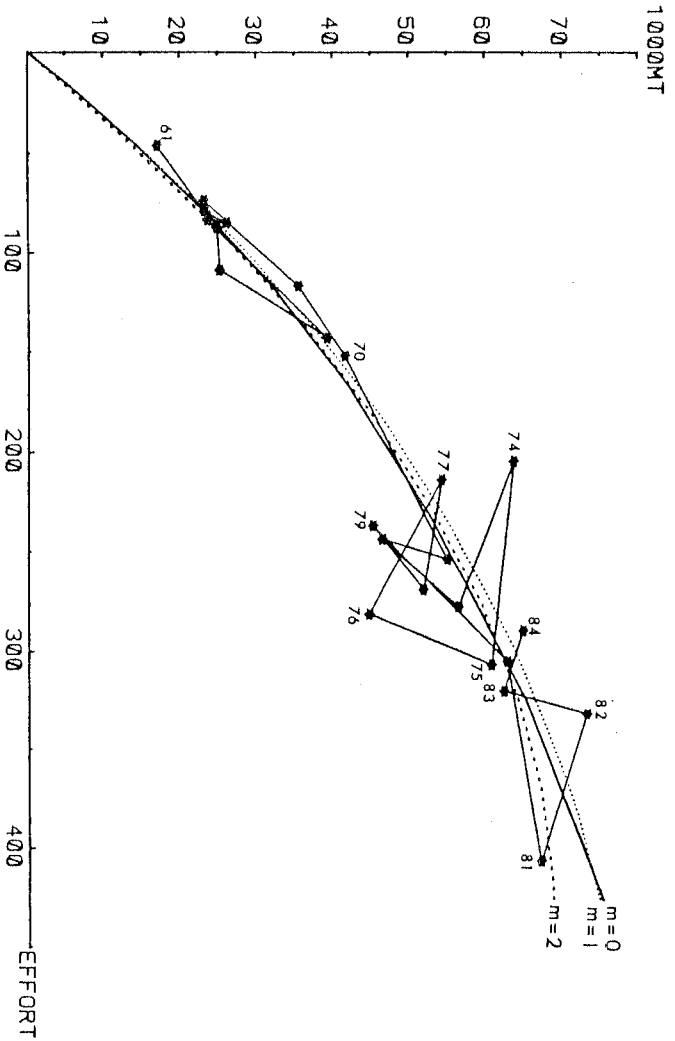

Fig. 3 Yield curves of the production model analysis for bigeye tuna in the whole Atlantic, 1961-84.