

STOCK ASSESSMENT OF ATLANTIC ALBACORE BY PRODUCTION MODEL ANALYSIS

by

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SUMMARY

Using the data of the longline and surface fisheries in the Atlantic Ocean from 1956 to 1973, production model analysis was carried out. Maximum sustainable yield for the North and South stocks was estimated at 80,000-90,000 tons and about 30,000 tons, respectively. The recent catch has not yet reached the level of maximum sustainable yield in the North stock, but almost reaches it in the South stock.

RESUME

L'analyse de modèle global a été effectuée au moyen de données atlantiques de palangre et de surface de 1956 à 1973. La production maximale soutenue des stocks nord et sud a été estimée respectivement à 80-90 et 30 milliers de tonnes. Les prises récentes n'atteignent pas encore ce niveau dans le stock nord, mais y parviennent presque dans le stock sud.

RESUMEN

Se efectúa un análisis del modelo de producción con datos de las pesquerías de palangre y superficie en el Atlántico, correspondientes al periodo 1956-1973. La producción máxima sostenible de los stocks Norte y Sur, se estima en 80.000-90.000 toneladas y en unas 30.000 toneladas respectivamente. En el stock Norte, la captura reciente no alcanza el nivel de producción máxima sostenible, mientras que en el stock Sur se le aproxima bastante.

The North Atlantic albacore have been harvested both by the surface fishery and the longline fishery and the South Atlantic albacore by the longline fishery only. Production model analysis was fitted to data from these fisheries. Yield in weight and fishing effort data from Bard (1974) and Shiohama (ms) were employed and analyzed using the computer program PRODFIT by Fox (1975).

1 Albacore stock in the North Atlantic

The longline CPUE was given as yield in weight per 10,000 hooks (effective number of hooks) and the surface CPUE as yield in weight per fishing day. These CPUE statistic for each fishery were standardized by the following procedure giving an annual CPUE index S_k .

$$S_k = R_k / \frac{1}{n} \sum_{k=1}^n R_k \text{ -----(1)}$$

Where, R_k is an annual CPUE. Data employed covered for 17 years from 1956 to 1972. Relative standardized fishing effort f_k for both fisheries was obtained by dividing a respective annual yield W_k by S_k and added together (Table 1).

Yield and relative standardized effort values were fitted to PRODFIT with the number of significant age groups being set at three over the period in one case (A) and set at five after 1962 when the longline fishery expanded widely and at three in earlier years in the other (B) (Table 2).

Values of a maximum sustainable yield differ considerably depending on m , a PRODFIT parameter. In Figure 1, the equilibrium curve with m equal to 1.001 is drawn, as the situation with this value of m seems to be the most likely. The level of maximum sustainable yield is 90,000 tons in case A and 80,000 tons in case B. To achieve this level, fishing effort of 2.5 to 3 times the recent effort level would be required.

2 Albacore stock in the South Atlantic

Longline effective effort and yield values for 18 years from 1956 to 1973 (Table 3) were processed with the number of significant age groups being set at three for 1956-1962 and four for 1963-1973 except for 1965 to be set at five, according to Morita (ms) (Table 4).

The level of maximum sustainable yield is 30,000 - 40,000 tons, not very different among four possible values of m . Figure 2 presents the curve with m being variable, as this might be the most likely. Although the level of fishing effort equivalent to maximum sustainable yield is roughly threefold of the recent effort level on the values obtained, yield in recent years is nearing the level of maximum sustainable yield, suggesting little substantial increase in yield with the increasing fishing effort.

References

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Table 1. Annual yield, cpue and relative standardized effort of albacore for the surface and longline fisheries in the North Atlantic.

Year	cpue		S _k (cpue index)		Yield in tons			Relative fishing effort		
	Longline 1)	Surface 2)	Longline	Surface	Longline	Surface	Total	Longline	Surface	Total
1956	2.70	0.52	0.5455	1.1064	2	42,010	42,012	4	37,970	37,974
1957	19.11	0.52	3.8606	1.1064	135	42,690	42,825	35	38,585	38,620
1958	8.89	0.49	1.7960	1.0426	946	51,600	52,546	527	49,492	50,019
1959	3.38	0.44	0.6828	0.9362	600	54,234	54,834	879	57,930	58,809
1960	7.40	0.46	1.4949	0.9787	1,127	58,240	69,367	754	69,725	70,479
1961	5.40	0.46	1.0909	0.9787	380	43,380	43,760	348	44,324	44,672
1962	4.40	0.54	0.8889	1.1489	5,729	51,790	57,519	6,445	45,078	51,523
1963	5.68	0.42	1.1475	0.8936	14,508	44,880	59,388	12,643	50,224	62,867
1964	3.41	0.42	0.6889	0.8936	15,883	48,000	63,883	23,056	53,715	76,771
1965	3.50	0.59	0.7071	1.2553	14,439	43,890	58,329	20,420	34,964	55,384
1966	2.90	0.40	0.5859	0.8511	8,169	42,020	50,189	13,943	49,371	63,314
1967	3.32	0.48	0.6707	1.0213	5,500	47,480	52,980	8,200	46,490	54,690
1968	3.04	0.38	0.6141	0.8085	5,791	37,400	43,191	9,430	46,259	55,689
1969	3.84	0.37	0.7758	0.7872	7,890	32,500	40,390	10,170	41,286	51,456
1970	2.64	0.38	0.5333	0.8085	11,828	29,960	41,788	22,179	37,056	59,235
1971	2.20	0.50	0.4444	1.0638	10,835	38,800	49,635	24,381	36,473	60,854
1972	2.32	0.54	0.4687	1.1489	9,417	33,650	43,067	20,092	29,289	49,381

1) Longline cpue is given as yield in tons per 10,000 effective hooks.
 2) Surface cpue is yield in tons per fishing day.

Table 2. Generalized production model for the North Atlantic albacore fishery, 1956-1972.

	No. of age group	m	Residual sum of squares	Optimum 1)	Optimum relative fishing effort ₂	M.S.Y.
				cpue	(10 ³)	(10 ⁴ tons)
A	3 over the period	Variable (0.0)	0.2278	-	-	17.9
		0.0	0.2280	-	-	19.4
		1.001	0.2283	0.45	196	8.9
		2.0	0.2288	0.60	121	7.3
B	3 for 1956-61 and 5 for 1962-72	Variable (0.0)	0.2279	-	-	15.7
		0.0	0.2279	-	-	15.8
		1.001	0.2283	0.43	163	7.9
		2.0	0.2288	0.63	106	6.7

1) Optimum cpue is given as yield in 10³ tons per 1,000 relative fishing effort.

Table 3. Annual effective effort and yield of albacore for the longline fishery in the South Atlantic.

Year	Effective effort in 10 ⁶ hooks	Yield in 10 ³ tons
1956	0.03	0.021
1957	0.37	0.725
1958	0.97	1.046
1959	4.86	3.014
1960	9.08	10.477
1961	10.80	10.393
1962	27.63	17.126
1963	19.86	16.702
1964	41.46	25.338
1965	50.70	29.929
1966	68.85	26.464
1967	43.69	19.789
1968	71.40	27.156
1969	89.74	35.286
1970	84.25	27.886
1971	112.86	32.479
1972	129.98	38.959
1973	118.59	28.518

Table 4. generalized production model for the South Atlantic albacore fishery, 1956-1973. 1)

m	Residual sum of squares	Optimum 2) cpue	Optimum effective effort (10 ⁶)	M.S.Y. (10 ⁴ tons)
Variable (0.10)	0.3200	0.09	378	3.3
0.0	0.3216	-	-	3.9
1.001	0.4441	0.36	81	2.9
2.0	0.7793	0.43	79	4.4

1) For this calculation. Number of significant age groups were set at three for 1956-1962 and at four for 1963-1973 except for 1965 to be set at five.
 2) Optimum cpue is given as yield in 10³ tons per effective effort in one million hooks.

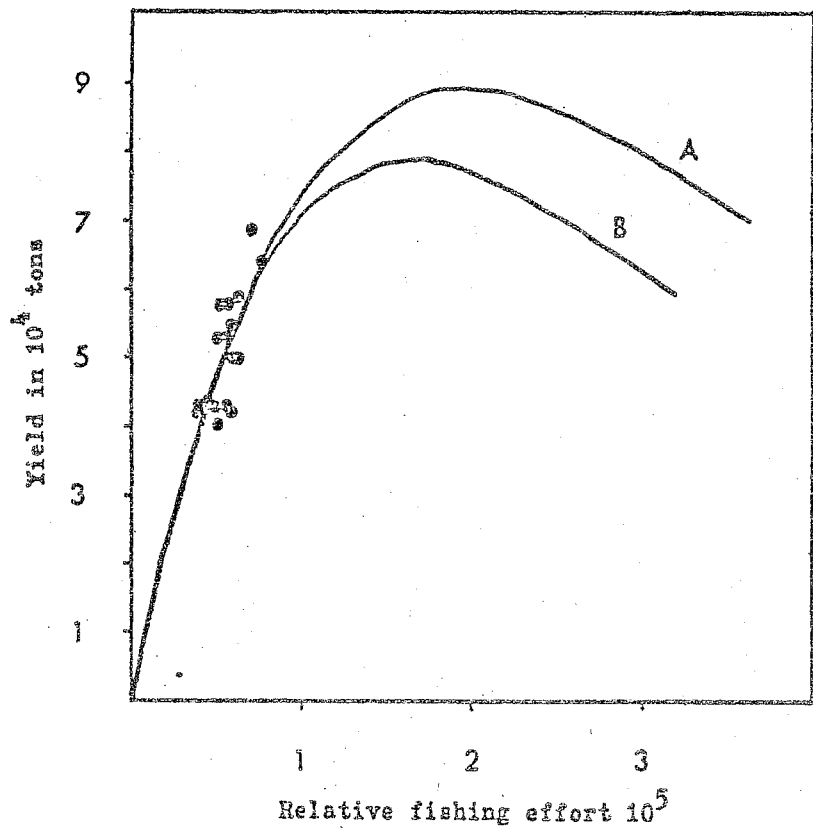


Fig. 1. Production model analysis on the surface and longline fisheries for the North Atlantic albacore (1956-1972). Curves are drawn with m in Fox's formula equal to 1.001 and with the number of significant age groups to be set at three (A) and five (B).

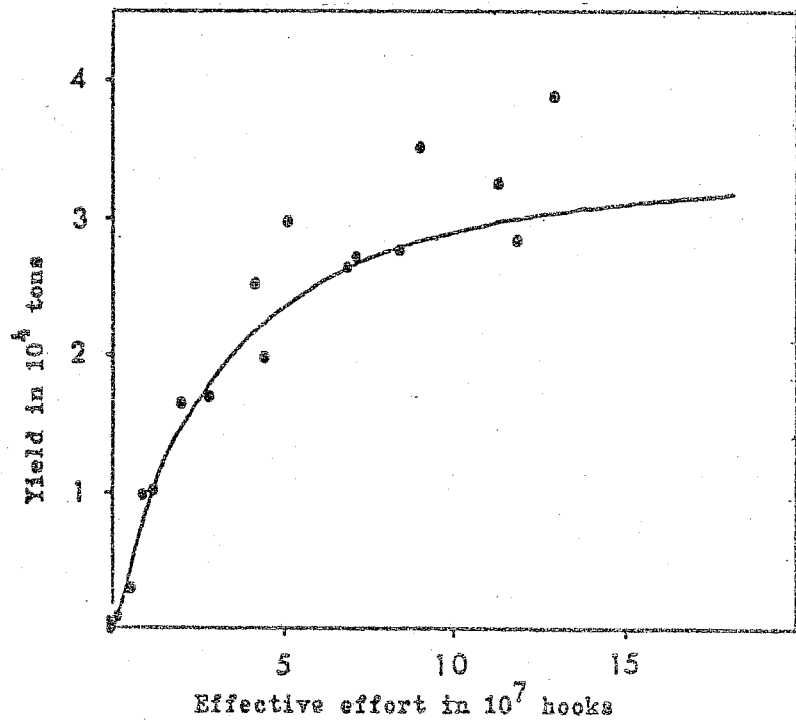


Fig. 2. Production model analysis on the longline fishery for the South Atlantic albacore (1956-1973). A curve is drawn with m being variable. For the number of age groups, see Table 4.