

## PRODUCTION MODEL ANALYSIS OF THE SOUTH ATLANTIC ALBACORE, 1967-1982

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## SUMMARY

The generalized production model was used to evaluate the status of the albacore stock in the south Atlantic Ocean. Analysis was made in two cases. In Case 1, the effective effort was expressed in effective hooks; and in Case 2, the effective effort was expressed in effective fishing intensity. The estimated MSY of albacore ranged from 23,420 MT to 26,090 MT for Case 1, and from 23,360 MT to 25,790 MT for Case 2. The actual catch in 1982 was 27,500 MT.

## RESUME

Le modèle global a été utilisé pour évaluer l'état du stock de germon de l'Atlantique sud. L'analyse portait sur deux cas. Premier cas: effort effectif exprimé en hameçons effectifs; et deuxième cas: effort effectif exprimé en intensité effective de pêche. La PME estimée du germon oscillait entre 23.420 et 26.090 TM dans le 1er cas et entre 23.360 et 25.790 TM dans le 2ème cas. La prise de 1982 s'élevait en fait à 27.500 TM.

## RESUMEN

Se utilizó el modelo de producción generalizada para evaluar la situación del stock de atún blanco en el Atlántico Sur. El análisis se llevó a cabo utilizando dos procedimientos: en el primer caso, se expresaba el esfuerzo efectivo en anzuelos efectivos; en el segundo, el esfuerzo efectivo se expresaba en intensidad de pesca efectiva. El RMS estimado de atún blanco osciló de 23.420 t. a 26.090 t. para el primer caso, y de 23.360 t. a 25.790 t. para el segundo caso. La captura real en 1982 fue de 27.500 t.

## Introduction

The south Atlantic albacore stock was exploited predominantly by longline gear. Recently, albacore has also been taken in small, but increasing amounts by surface gear (Fig. 1). In this report, the production model was fitted to data from both fisheries to evaluate the status of south Atlantic albacore for 1967-1982.

## Data and Analytical Method

The computer program PRODFIT (Fox, 1975) was used to fit the generalized production models ( $m=0.0$ ,  $m=1.0$  and  $m=2.0$ ) from the catch and effort data. The number of significant year classes contributing to the catch of albacore fishery in the south Atlantic Ocean was set first at 3 ( $K=3$ ) then at 4 ( $K=4$ ), following Bartoo and Coan (1983). Two types of data were needed for PRODFIT (Fox, 1975):

### 1) Total annual catch.

Annual catch data of albacore in the south Atlantic Ocean from 1967 to 1981 were compiled from ICCAT Statistical Bulletins (ICCAT, 1976, 1981, 1982). Preliminary catch data for 1982 was provided by ICCAT (pers. commun.). These data were shown in Fig. 1 and Table 1.

### 2) Standardization of effort.

In Case-1, the effective effort was expressed in effective hooks; and in Case-2, the effective effort was expressed in effective fishing intensity (unit in effective hooks /  $5^{\circ}$  square). The detailed procedures for the standardization of fishing effort using Honma's method (1973) were given by Sun and Yang (1984). The standardized effort for Case-1 and Case-2 were shown in Table 1.

## Result

### Case-1

The results of the calculated MSY and optimum fishing effort ( $f_{opt}$ ) were compared in Table 2 with the observed catch and effort in 1982. Table 2 also listed the degree of fit index ( $r^2$ ). Estimated yield curves for  $K=4$  were shown in Fig. 2. The best fitted model ( $r^2=0.601$ ) for  $K=3$  was  $m=0.0$  with a predicted MSY of 23,850MT with infinite fishing effort. The poorest fitted model ( $r^2=0.514$ ) was  $m=2.0$  with an estimated MSY of 24,590MT with  $f_{opt}$  at  $84.14 \times 10^6$  effective hooks. For  $K=4$ , when  $m=0.0$  ( $r^2=0.466$ ), the estimated MSY was 26,090MT and  $f_{opt}$  was infinite. At  $m=2.0$  ( $r^2=0.431$ ), the estimated MSY was 23,600MT and the  $f_{opt}$  was  $89.10 \times 10^6$  effective hooks. The actual catch in 1982 was 27,500MT with the effective effort at  $103.24 \times 10^6$  hooks. Both catch and effort in 1982 were slightly larger than the estimated MSY and  $f_{opt}$ .

### Case-2

The results shown in Table 3 and Fig. 3 were similar to those in Case-1. For  $K=3$ , the best fitted model ( $r^2=0.611$ ) was  $m=0.0$  with an estimated MSY of 23,860MT with infinite fishing effort. The poorest fitted model ( $r^2=0.522$ ) was  $m=2.0$  with a predicted MSY 24,600MT with the  $f_{opt}$  at  $106.49 \times 10^4$  hooks per  $5^{\circ}$  square. For  $K=4$ , when  $m=0.0$  ( $r^2=0.497$ ), the estimated MSY was 25,790MT and  $f_{opt}$  was infinite. At  $m=2.0$  ( $r^2=0.440$ ), the estimated MSY was 23,550MT and  $f_{opt}$  was  $113.47 \times 10^4$  hooks per  $5^{\circ}$  square. The actual catch in 1982 was 27,500MT with effective fishing intensity at  $132.20 \times 10^4$  hooks per  $5^{\circ}$  square. Also, both the catch and fishing effort in 1982 were a slightly larger than the estimated MSY and  $f_{opt}$ .

Table 1 Catch, effective effort and fishing intensity data for the total south Atlantic albacore fishery, 1967-1982.

References

Fox, W.W. Jr. (1975) Fitting the generalized stock production model by least squares and equilibrium approximation. Fish. Bull. U.S. 73(1): 23-37.

Bartoo, N.W. & A.L. Coan (1983) Production model analysis of the south Atlantic albacore stock and effects of data accuracy. ICCAT/SCRS/82/52, Coll. Vol. Sci. Papers 18(2): 421-427.

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ICCAT (1976) Statistical Bulletin, Vol. 7

ICCAT (1981) Statistical Bulletin, Vol. 11

ICCAT (1982) Statistical Bulletin, Vol. 12

ICCAT (1983) ICCAT preliminary catch estimates.

Year	Catch* (10 <sup>3</sup> tons)	Effective effort (10 <sup>6</sup> hooks)	Fishing intensity (10 <sup>4</sup> hooks/5 <sup>0</sup> sq.)
1967	19.80	27.88	34.63
1968	27.84	53.83	70.19
1969	34.56	71.19	89.77
1970	23.65	63.97	80.97
1971	25.02	68.53	87.73
1972	33.20	88.99	114.05
1973	28.23	93.20	118.87
1974	19.70	70.63	90.31
1975	17.52	69.97	89.65
1976	19.18	73.76	94.45
1977	21.10	76.28	97.40
1978	22.95	88.66	114.06
1979	22.20	74.50	94.72
1980	21.99	81.11	103.11
1981	23.59	114.88	146.16
1982	27.50	103.24	132.19

\* ICCAT report catch (see text)

Table 2 Estimated production model parameters for south Atlantic albacore, 1967-1982. (Case-1)

Number of significant year classes (K)	m	MSY (10 <sup>3</sup> tons)	1982 Actual catch (10 <sup>3</sup> tons)	f <sub>opt</sub> (10 <sup>6</sup> effective hooks)	1982 Effort (10 <sup>6</sup> effective effort)	Degree of fit index (r <sup>2</sup> )
3	0.0	23.85	27.50	∞	103.24	0.601
3	1.0	24.18	27.50	78.57	103.24	0.559
3	2.0	24.59	27.50	84.14	103.24	0.514
4	0.0	26.09	27.50	∞	103.24	0.466
4	1.0	23.42	27.50	92.83	103.24	0.451
4	2.0	23.60	27.50	89.10	103.24	0.431

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Table 3 Estimated production model parameters for south Atlantic albacore, 1967-1982. (Case-2)

Number of significant year classes (K)	m	MSY (10 <sup>3</sup> tons)	1982 Actual catch (10 <sup>3</sup> tons)	f <sub>opt</sub> (10 <sup>4</sup> hooks/5 <sup>0</sup> sq.)	1982 Effort (10 <sup>4</sup> hooks/5 <sup>0</sup> sq.)	Degree of fit index (r <sup>2</sup> )
3	0.0	23.86	27.50	∞	132.20	0.611
3	1.0	24.21	27.50	98.55	132.20	0.569
3	2.0	24.60	27.50	106.49	132.20	0.522
4	0.0	25.79	27.50	∞	132.20	0.497
4	1.0	23.36	27.50	116.86	132.20	0.460
4	2.0	23.55	27.50	113.47	132.20	0.440

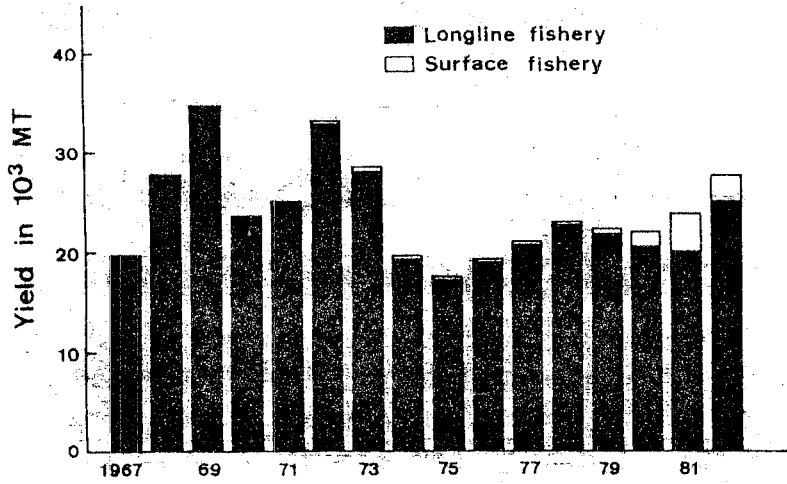
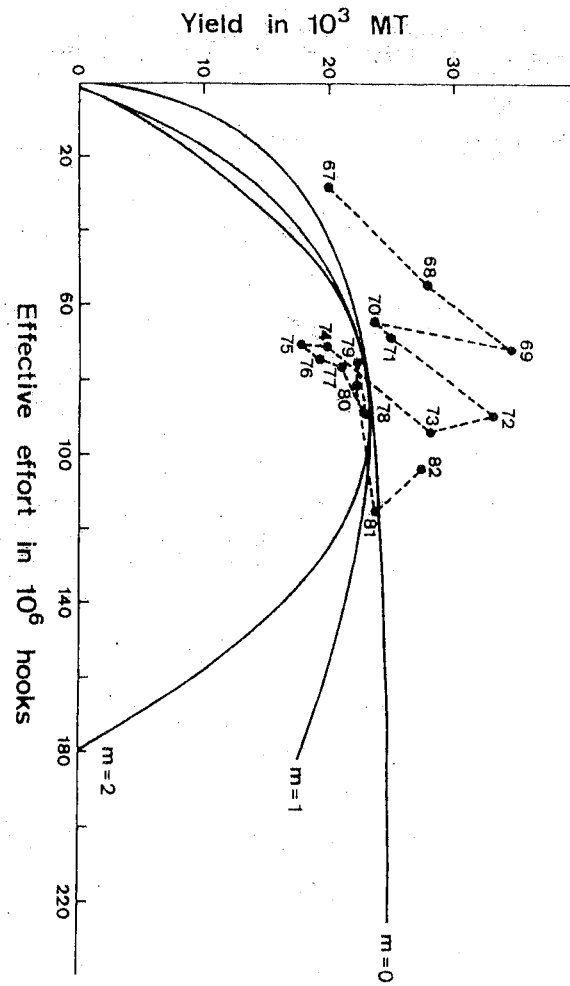


Fig. 1 Yield of albacore by gear in South Atlantic Ocean, 1967-1982.

Fig. 2 Equilibrium yield curves and observed data for the South Atlantic albacore fishery and assuming four significant year-classes in the catch, 1967-1982. (Case-1)



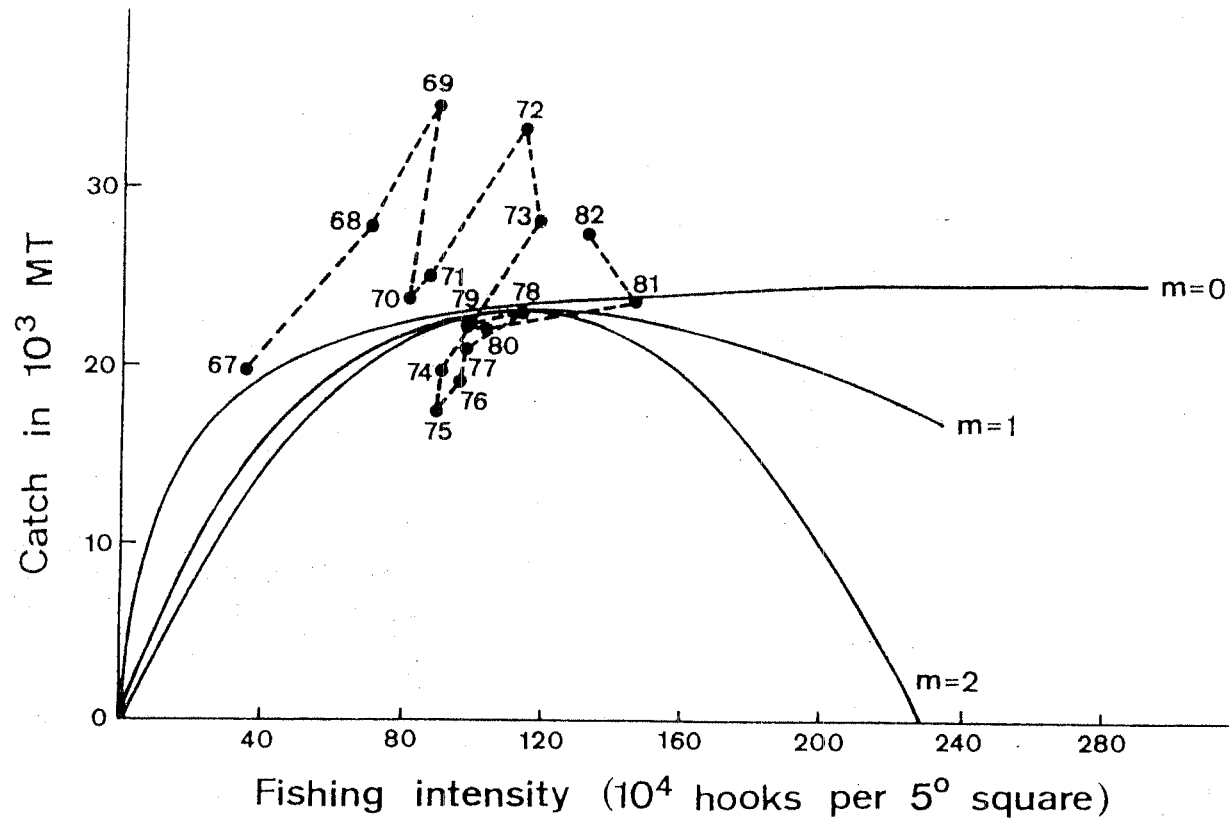


Fig. 3 Equilibrium yield curves and observed data for the South Atlantic albacore fishery and assuming four significant year-classes in the catch, 1967-1982. (Case-2)