

ASSESSMENT OF SOUTH ATLANTIC ALBACORE RESOURCE BY ADAPTING PRODUCTION  
MODELS ON TAIWANESE 1968-91 LONGLINE DATA

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RESUME

SUMMARY

Based on Taiwanese longline historic catch information, the central-western part of the south Atlantic Ocean is believed to be one of the major east-west bound transoceanic movement passages and the spawning grounds for south Atlantic albacore. A proper compilation of the catch and effort information in this area alone will thus provide a good indication of the stock abundance in the whole south Atlantic. In addition to the traditional surplus production analyses, the GLM method and the ASPIC algorithm were used in this study to assess the stock conditions.

The standardized CPUE trend obtained by the GLM method indicates that there is a declining trend with significant variation from the late 1960's to the early 1970's, which leveled off since mid-1970 and has kept at about the same level until 1986. Since 1987, however, the CPUE appeared to drop from 29 fish per thousand hooks to about 15 fish.

The results of production model analyses show that: (1) traditional generalized production model with  $m = 1.001$  and significant year class  $k=3$  appeared to be the best fit of the data set and the MSY estimate is about 30,000 MT per year with  $f_{MSY}$  at 140 million effective hooks per year; (2) the ASPIC model gives an MSY of about 24,000-26,000 MT per year with  $f_{MSY}$  at 105-115 million effective hooks per year.

Current catch (around 25,000 MT in 1991) and effort (90 million effective hooks in 1991) levels were close to the MSY and  $f_{MSY}$  levels given by the ASPIC model, yet within the MSY level given by the traditional model. Since the catch level has reached the maximum potential yield of the stock since the mid-1980's (and in some years may have already surpassed the level according to the ASPIC model estimates) and the catch rate of the Taiwanese longline fishery indicated a CPUE drop of about 25% since 1987, it is suggested that a careful monitoring of the stock is needed.

En se fondant sur l'information historique concernant les prises palangrières taiwanaises, il est estimé que la partie centre-ouest de l'Atlantique sud constitue l'une des zones principales de déplacement transocéanique est-ouest, et la zone de frai du germon sud-atlantique. Une compilation adéquate de l'information sur la prise et l'effort dans cette seule zone fournira donc un bon indicateur de l'abondance du stock dans l'ensemble de l'Atlantique sud. Outre les analyses traditionnelles de la production excédentaire, la méthode GLM et l'algorithme ASPIC ont été utilisés dans la présente étude pour évaluer les conditions du stock.

La tendance de la CPUE standardisée obtenue par la méthode GLM indique qu'il existe une tendance décroissante avec une variation significative de la fin des années soixante au début des années soixante-dix, qui s'est nivelée depuis le milieu des années soixante-dix, et s'est maintenue à peu près au même niveau jusqu'en 1986. Depuis 1987, cependant, il semblerait que la CPUE ait baissé de 20 poissons par millier d'hameçons à environ 15 poissons.

Les résultats des analyses du modèle de production montrent que: (1) le modèle de production généralisé traditionnel avec le paramètre  $m = 1.001$  et la classe annuelle significative  $k = 3$  semble être le meilleur ajustement du jeu de données, et la PME estimée est environ 30.000 TM/an avec un  $f_{PME}$  de 140 millions d'hameçons effectifs/an; (2) le modèle ASPIC donne une PME d'environ 24.000-26.000 TM/an avec un  $f_{PME}$  de 105-115 millions d'hameçons effectifs/an.

Les niveaux actuels de capture (environ 25.000 TM en 1991) et d'effort (90 millions d'hameçons effectifs en 1991) étaient proches des niveaux de PME et de  $f_{PME}$  donnés par le modèle ASPIC, mais encore dans le cadre du niveau de PME indiqué par le modèle traditionnel. Etant donné que le niveau de capture a atteint la production potentielle maximale du stock depuis le milieu des années quatre-vingt (et peut-être au-delà de ce niveau certaines années, selon les estimations du modèle ASPIC) et que le taux de capture de la pêcherie palangrière taiwanaise indiquait une chute d'environ 25 % de la CPUE depuis 1987, il est suggéré qu'il est nécessaire de suivre ce stock de près.

## RESUMEN

Basándose en la información sobre la captura histórica del palangre de Taiwan, se cree que el oeste de la zona central del Atlántico sur es una de las principales zonas de paso de los movimientos transoceánicos este/oeste y la zona de desove del atún blanco del Atlántico sur. Por tanto, una recopilación adecuada de la información sobre captura y esfuerzo en esta sola zona, facilitará una buena indicación de la abundancia del stock en el conjunto del Atlántico sur. En este estudio, para evaluar las condiciones del stock, además del análisis tradicional de la producción excedente se empleó el método GLM y el algoritmo ASPIC.

La tendencia de CPUE estandarizada, obtenida por el método GLM, indica que existe una tendencia descendente con una variación significativa desde finales de la década de los 60 hasta principios de la década de los 70, nivelándose a partir de mediados de dicha década, y manteniéndose aproximadamente al mismo nivel hasta el año 1986. Sin embargo, desde 1987 se observa un descenso en la CPUE, desde 20 peces por mil anzuelos hasta aproximadamente 15 peces.

Los resultados del análisis del modelo de producción muestran que: (1) el modelo generalizado de producción tradicional, con un parámetro  $m = 1.001$  y una clase anual significativa  $k = 3$ , parece ser el mejor ajuste del conjunto de datos y la estimación del RMS es de aproximadamente 30.000 t/año, con  $F_{rms}$  de 140 millones de anzuelos efectivos/año; (2) el modelo ASPIC da un RMS de aproximadamente 24.000-26.000 t/año, con  $F_{rms}$  de 105-115 millones de anzuelos efectivos/año.

La captura actual (alrededor de 25.000 t en 1991) y los niveles de esfuerzo (90 millones de anzuelos efectivos en 1991) estaban próximos al RMS, y los niveles de  $F_{rms}$  que da el modelo ASPIC se encuentran dentro del nivel del RMS que da el modelo tradicional. Teniendo en cuenta que el nivel de captura ha alcanzado el máximo de rendimiento potencial del stock desde mediados de la década de los 80 (y de acuerdo con las estimaciones del modelo ASPIC, algunos años podría haber estado por encima del nivel), y que la tasa de captura de la pesquería taiwanesa de palangre indicaba un descenso aproximado del 25% en la CPUE a partir de 1987, se sugiere la necesidad de vigilar atentamente el stock.

## INTRODUCTION

Albacore (*Thunnus alalunga*) is one of the most economically important and abundant tunas resources in the South Atlantic. Japanese longliners began in the early 1950s to fish the resource yet have switched their targets to bigeye and bluefin tunas since early 1970s. Taiwanese longliners started fishing operations in the South Atlantic Ocean since early 1960s and became targeting on albacore since late 1960s. Taiwanese longline fleet size has rapidly increased in the early 1970s then leveled off since mid 1970s. Taiwanese catch of albacore, which composed the majority of harvested albacores in the South Atlantic, ranged from 10 to 29 thousand MT in the past two decades. The South African bait boat fishery, which mainly target on pre-adult albacore of about 80 cm in fork length, started in the late 1970s and has rapidly developed in the mid 1980s. In recent years, the South African bait boat fishery has taken a considerable amount of albacore.

Studies on stock assessment of south Atlantic albacore have been carried out based on the catch and effort data set of Taiwanese longline fishery (Yang & Sun 1983; Yeh et. al. 1991). The main purpose of this study is thus to assess the current stock condition by using updated 1968-1992 catch and effort data.

## MATERIALS AND METHODS

ICCAT Statistical Bulletins (1968-1991) are the major source of data for albacore catch and effort statistics in the South Atlantic. Detailed 1968-1992 catch and effort data set of Taiwanese longline fishery are the major source of data for albacore cpue analyses.

Yeh et. al. (SCRS/93/133) indicated the size of albacore caught in the central middle part of South Atlantic ranged from 10 to 15 kg per fish (which is about 80-90 cm in fork length) and the fishing season is mostly from April to August. In the central western part of the South Atlantic, the size ranged from 15-20 kg per fish (which is about 90-100 cm in fork length) and the fishing season mostly from June to September. In the northwestern part of the South Atlantic, the size mostly greater than 20 kg per fish (which is about 110-120 cm in fork length) and the major fishing season is from September to March.

This catch pattern strongly suggested there is a significant East-West bound trans Atlantic movement of pre-adult albacore in the central part of the Ocean and spawning migration of toward northwestern part of the Ocean. Assume that the fishing efforts are randomly distributed in these regions, the catch rates of

albacore from these regions thus obtained may have a better indication of the stock abundance in the South Atlantic Ocean. Particularly, when fishing operation may have changing target in other regions of having different tunas resources highly mixed together.

Cluster analyses were applied to the Taiwanese data set in assistance of selecting the areas of high compatibility in percentage catch composition. GLM method is used to standardize the albacore cpue and ASPIC algorithm in company with traditional production models were both used to assess the stock condition.

#### RESULTS AND DISCUSSION

CPUE trend of South Atlantic albacore obtained from the studied area (Figure 1) by GLM method is shown in Figure 2. The standardized cpue of albacore is quite stable in the period from mid 1970s up to 1986. A cpue drop, however, was observed in 1987 and kept about the same level since then.

Historic catch and effective effort data, in company with the catch rate and average size of the catch, are shown in Table 1. The plot of albacore catch versus effective effort is shown in Figure 3. Results of production models analyses show that: (1) traditional generalized production model with parameter  $m$  equals 1.001 and significant year class  $k$  equals 3 appeared to be the best fit of the data set and the MSY estimate is about 30,000 mt per year with  $f_{msy}$  at 140 million effective hooks per year; (2) ASPIC model gives a MSY of about 24,000-26,000 mt per year with  $f_{msy}$  at 105-115 million effective hooks per year.

Current catch (around 25 thousand mt in 1991) and effort (90 million effective hooks in 1991) levels were close to the MSY and  $f_{msy}$  levels given by ASPIC model yet within the MSY level given by traditional model. Since catch level has reached the maximum potential yield of the stock since mid-1980s (and may have already in some years over the level according to ASPIC model estimates) and the catch rate of Taiwanese longline fishery indicated a cpue drop of about 25% since 1987, it is suggested that a careful monitoring of the stock is needed.

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Table 1. South Atlantic albacore 1968-1992 catch and effective effort data, adjusted by the Taiwanese longline cpue compiled from the selected areas of mid-central to north-western part of the South Atlantic Ocean.

Year	Taiwan Longline Fishery			All Fisheries	
	Nominal CPUE in Number per 1000 hooks	GLM CPUE in Number per 1000 hooks	Mean Wt./ fish in (kg)	Catch in Weight (x1000 kg)	Effective Effort in (x100000 hooks)
1968	37.95	24.930	14.2	25700	72.599
1969	45.58	49.771	15.7	28500	36.473
1970	27.33	28.807	15.7	23700	52.399
1971	37.53	44.019	15.2	25000	37.364
1972	26.93	18.669	14.7	33300	121.356
1973	19.02	17.082	13.8	28200	119.644
1974	21.43	21.408	14.9	19700	61.755
1975	20.26	16.222	14.6	17500	73.902
1976	22.09	22.186	12.8	19300	67.958
1977	21.12	21.291	14.4	21600	70.450
1978	29.35	27.157	13.6	23100	62.551
1979	23.22	23.166	13.6	22500	71.406
1980	25.17	22.672	14.6	22500	67.976
1981	21.88	23.984	15.0	23600	65.592
1982	19.00	18.765	14.4	29000	107.328
1983	21.37	22.130	13.7	14400	47.493
1984	19.93	18.985	14.8	13200	46.975
1985	21.66	19.729	13.9	28400	103.574
1986	21.59	23.429	13.7	35100	109.346
1987	17.22	19.959	14.4	38200	132.916
1988	13.57	14.049	14.8	27600	132.756
1989	14.21	14.013	15.8	25300	114.273
1990	14.50	14.282	14.4	28600	139.037
1991	17.19	16.744	16.5	25000	90.481
1992	14.05	12.788	15.0	na	na

Footnotes:(1) Catch and effort data set of Taiwanese longline fishery have been revised recently, especially for years 1976-1978;

(2)na: not available currently.

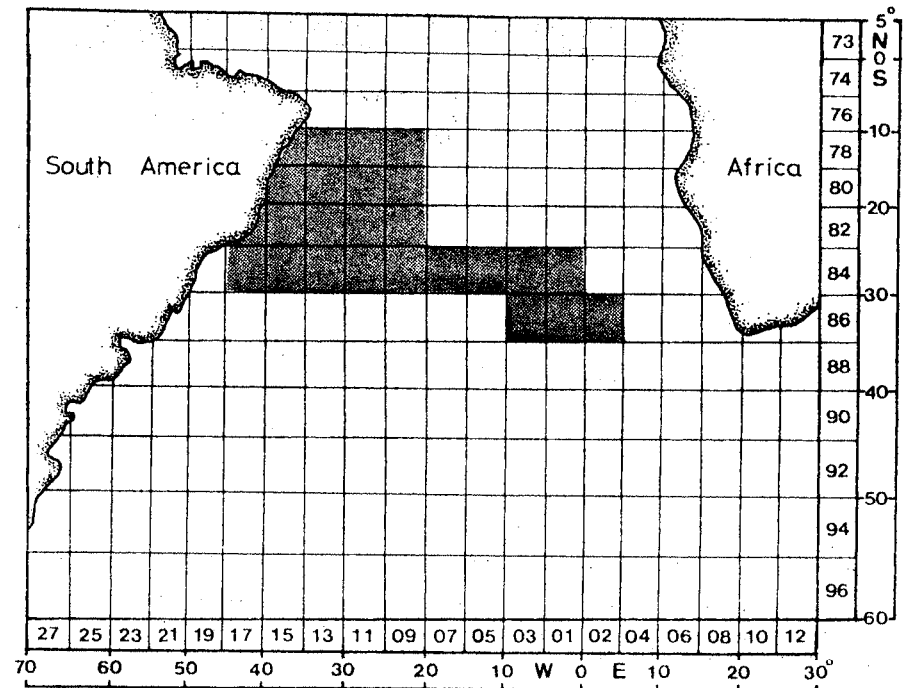


Fig. 1. Selected area (shaded) for this study.

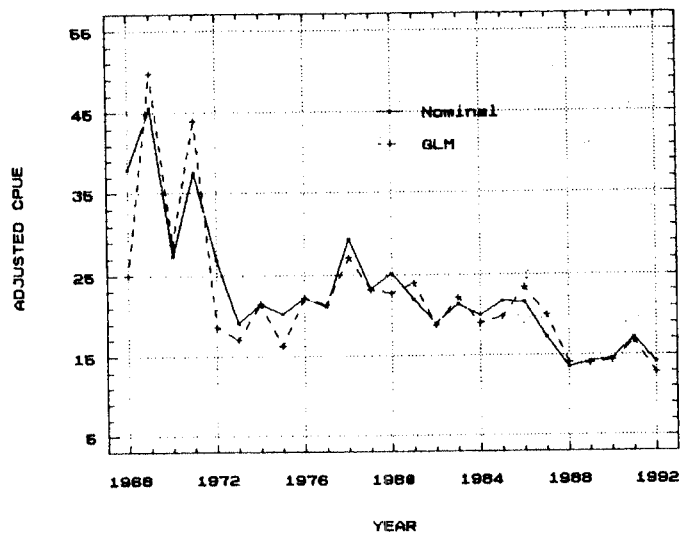


Fig. 2. Trends of albacore nominal and GLM adjusted CPUEs compiled from selected areas of the mid-central to northwestern parts of the South Atlantic Ocean.

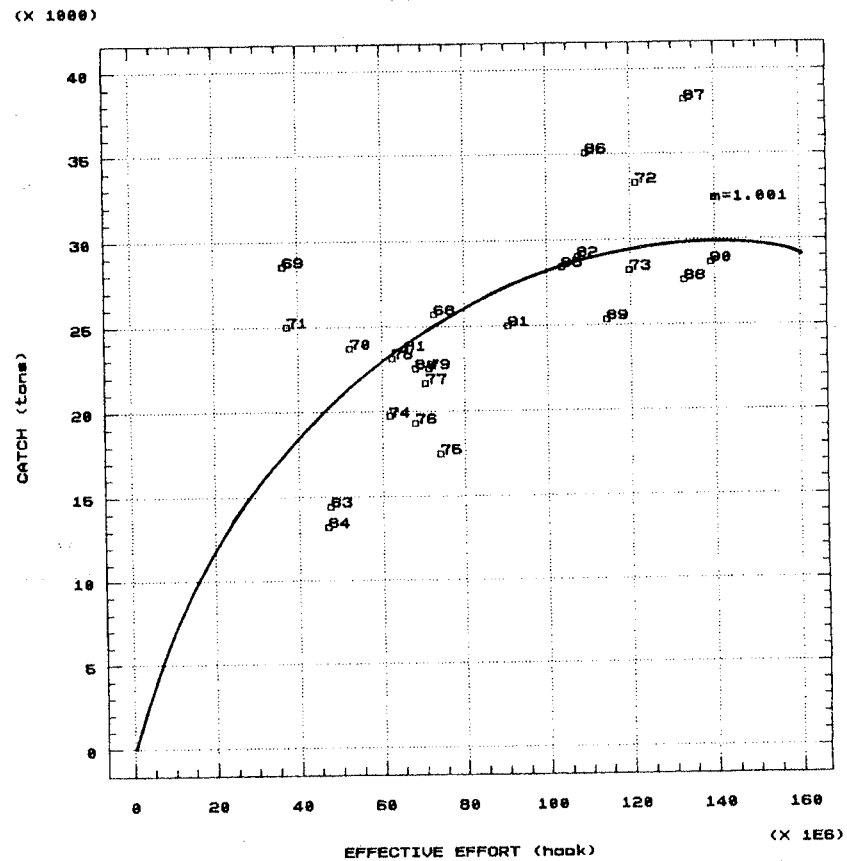


Fig. 3. Plot of total catch of South Atlantic albacore versus effective fishing effort by traditional production model. Estimates of MSY and  $f_{MSY}$  were obtained as follows: by traditional production model, MSY=30,000 mt,  $f_{MSY}=140 \times 10^6$  eff. hooks; by ASPIC model, MSY=24,000 and 26,000 mt,  $f_{MSY}=105 \times 10^6$  and  $115 \times 10^6$  eff. hooks, respectively, corresponding to 1969 and 1970 data inclusive or exclusive.