ASSESSMENT OF SOUTH ATLANTIC ALBACORE RESOURCE BY USING SURPLUS MODELS ON TAIWANESE 1968-1993 LONGLINE DATA

S. Y. Yeh[1] and C. L. Wu[1]

ABSTRACT

Based on the 1968-1993 Taiwanese longline catch and effort data series provided by the Tuna Research Center of the Institute of Oceanography, National Taiwan University, an updated assessment of the south Atlantic albacore resource was made by using the ASPIC algorithms. Standardization of south Atlantic albacore yearly abundance index or CPUE series was achieved by applying GLM methods with area-time-species factors adjustment to the Taiwanese longline data set.

The south Atlantic albacore CPUE series thus obtained indicated that there was a significant CPUE decline from 1968 to 1972, which then leveled off and stabilized until 1987. It was followed by a period of moderate decline in CPUE from 1988, when a significant portion of the fleet was equipped with super freezers capable of keeping sashimi quality catches, until 1992, when a slight increase in CPUE was observed.

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

The current catch (around 28,000 MT in 1992) level is slightly above the MSY level given by the ASPIC model yet within the MSY level given by the traditional model. As the catch level has reached the maximum potential yield of the stock since the mid-1980s, and the catch rate of Taiwanese longline fishery indicated a drop in CPUE of about 20% since 1987, it is therefore suggested that a careful monitoring of the stock is needed.

RESUME

A partir des séries de données de prise et d'effort de la palangre taïwanaise fournies par le Centre de Recherche sur les Thonidés de l'Institut d'Océanographie de l'Université de Taïwan, une évaluation actualisée des ressources de germon de l'Atlantique Sud a été effectuée avec les algorithmes ASPIC. La standardisation de la série de CPUE ou de l'indice d'abondance annuel du germon de l'Atlantique Sud a été effectuée en appliquant les méthodes GLM avec des facteurs d'ajustement zone - période - espèce sur le jeu de données de la palangre taïwanaise.

Les séries CPUE du germon de l'Atlantique Sud ainsi obtenues indiquaient un déclin significatif de la CPUE entre 1968 et 1972, suivi d'une pause et d'une stabilisation au même niveau environ, jusqu'en 1987. On a ensuite observé une période de déclin modéré de la CPUE à partir de 1988, au moment où une partie importante de la flottille s'est équipée de "super freezers" capables de conserver la qualité des prises de sashimi. Ce déclin a duré jusqu'en 1992, lorsque la CPUE a recommencé à augmenter légèrement.

Les résultats des analyses des modèles de production montrent que : (1) le modèle traditionnel de production généralisé avec un paramètre m de 1,001 et une classe annuelle significative k égale à 3 semblait être le meilleur ajustement du jeu de données. L'estimation de la PME est d'environ 30.000 TM par an avec F_{PME} à 140 millions d'hameçons effectifs par an ; le modèle de production ASPIC donne une PME d'environ 24.000 - 26.000 TM par an.

[1] Institute of Oceanography, National Taiwan University, P.O.Box 23-13, Taipei, Taiwan

Le niveau actuel de prise (environ 28.000 TM en 1992) était légèrement supérieur au niveau de la PME donnée par le modèle ASPIC. Avec le modèle traditionnel, la capture était au même niveau que la PME. Dans la mesure où le niveau de capture a atteint le rendement potentiel maximum du stock depuis le milieu des années 80 et où le taux de capture de la pêcherie palangrière taïwanaise indiquait une baisse de la CPUE d'environ 20% depuis 1987, il est par conséquent suggéré que le stock soit suivi avec beaucoup d'attention.

RESUMEN

Basándose en las series de datos de captura y esfuerzo del palangre taiwanés en el período 1968-1993, facilitados por el "Tuna Research Center" del Instituto de Oceanografía de la Universidad Nacional de Taiwan, se llevó a cabo una evaluación actualizada del recurso de atún blanco en el Atlántico sur, por medio de algoritmos ASPIC. La estandarización del índice de abundancia anual del atún blanco del Atlántico sur o de las series de CPUE, se hizo aplicando métodos GLM con factores de ajuste zona/tiempo/especie sobre el conjunto de datos del palangre japonés.

Las series de CPUE del atún blanco del Atlántico así obtenidas, indicaban que en el período 1968-1972 se había producido un importante descenso en la CPUE, que después se niveló y estabilizó aproximadamente en el mismo nivel hasta 1987. Siguió un período de descenso moderado de la CPUE a partir de 1988, cuando una importante parte de la flota fue equipada con buenos congeladores, capaces de mantener la calidad de las capturas para el sashimi, hasta 1992 año a partir del cual se observó un ligero aumento en la CPUE.

Los resultados de los análisis de producción muestran: (1) que el modelo de producción generalizado tradicional con el parámetro m igual a 1.001 y una clase anual significativa k igual a 3, parecía ser el mejor ajuste para el conjunto de datos, y que la estimación de RMS es de unas 30.000 t anuales con Frms en 140 millones de anzuelos efectivos por años; (2) que el modelo ASPIC da una RMS de aproximadamente 24.000-26.000 t por año.

Los niveles actuales de captura (alrededor de 28 mil t en 1992) se situaban ligeramente por encima del nivel de RMS obtenido con el modelo ASPIC, pero dentro del nivel de RMS obtenido con el modelo tradicional. Dado que el nivel de captura ha alcanzado el nivel potencial máximo del stock desde mediados de los años 80 y que la tasa de captura de la pesquería de palangre taiwanesa señalaba un descenso de la CPUE del 20% desde 1987, se sugiere que se vigile atentamente el stock.

1. INTRODUCTION

Albacore (*Thunnus alalunga*) is one of the most economically important and abundant tuna resources in the south Atlantic. Japanese longliners began in the early 1950s to fish the resource but have switched their targets to bigeye and bluefin tunas since the early 1970s. Taiwanese longliners started fishing operations in the south Atlantic Ocean in the early 1960s and began targeting albacore in the late 1960s. The size of the Taiwanese longline fleet rapidly increased in the early 1970s and then leveled off in the mid-1970s. Taiwanese catch of albacore, which comprised the majority of albacore harvested in the south Atlantic, has ranged from 10,000 to 29,000 MT per year in the past two decades. The South African baitboat fishery, which mainly targets pre-adult albacore of about 80 cm in fork length, started in the late 1970s and was rapidly developed in the mid 1980s. In recent years, the South African baitboat fishery has taken a considerable amount of albacore in the south Atlantic.

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 1984; Yeh *et al.* 1991, 1994). The main purpose of this study is thus to assess the current stock condition by using updated 1968-1993 catch and effort data.

2. MATERIALS AND METHODS

ICCAT Statistical Bulletins (1968-1993) are the major sources of data for albacore catch and effort statistics in the South Atlantic. Detailed 1968-1993 catch and effort data sets of Taiwanese longline fishery (provided by the Tuna Research Center of the Institute of Oceanography, National Taiwan University) are the major sources of data for

albacore stock assessment. GLM methods with area-time-species factors adjustment were used to standardize the albacore *CPUE* series and the ASPIC algorithm together with traditional production models were both used to assess the stock condition.

3. RESULTS AND DISCUSSION

The standardized Taiwanese longline *CPUE* series of south Atlantic albacore, obtained by applying GLM methods with 3 levels of areas, 25 levels of years, 4 levels of season, 4 levels each of bigeye, yellowfin, and other species taken as by-catches, and interactions between area-season-species combinations, is shown in Figure 1 (Wu *et al.* 1996).

The *CPUE* series, as shown in Figure 1, indicated that there was a significant *CPUE* decline from 1968 to 1972 which then leveled off and stabilized until 1987. This was followed by a period of moderate decline of *CPUE* from 1988, when a significant portion of the fleet was equipped with super freezers capable of keeping sashimi quality catches, to 1992, when a slight increase in *CPUE* was observed.

Historic series of Taiwanese longline nominal and adjusted catch rate together with the yearly total landing in weight and the yearly average size of south Atlantic albacore, are shown in Table 1. 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 *MSY* of about 24,000-26,000 mt per year.

Current catch levels (around 28 thousand mt in 1992) were slightly over the *MSY* given by ASPIC model but within the *MSY* level given by traditional model. Since the catch level has reached the maximum potential yield of the stock since mid-1980s and the catch rate of Taiwanese longline fishery indicated a drop in *CPUE* of about 20% since 1987, it is therefore suggested that careful monitoring of the stock is needed.

Yeh *et al.* (1994) indicated the size of albacore caught in the central part of the south Atlantic ranged from 10 to 15 kg per fish (which is about 80-90 cm in fork length) and the fishing season is mainly 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 mainly from June to September. In the northwestern part of the south Atlantic, the size was usually greater then 20kg 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 suggests there is a significant East-West bound trans-Atlantic movement of pre-adult albacore in the central part of the Ocean and a spawning migration towards the northwest of the Ocean. Assuming that the albacore targetted by longline 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 albacore stock abundance in the south Atlantic Ocean. Yeh *et al.* (1994) used this simple idea of "area window for albacore" to analyze the data set for the improvement of acquiring the true albacore abundance indices. By comparing the results obtained from (1) GLM with area-time-species justification and (2) area window idea, it is interesting to note that the *CPUE* trends derived from the two methods are quite similar. Nevertheless, model justification for an ever shifting target species fishery has its limits. Particularly, for instance, when some unquantified elements of (1) skill improvement in catching target species and (2) the influence of economic motif toward a captain's determination to select catch and target species are very difficult to detect. It is therefore suggested that research surveys maybe needed if better abundance indices are desired.

4. ACKNOWLEDGEMENTS

The authors would like to express their thanks to Dr. C.C. Hsu, Dr. Shui-Kai Chang, Mr. Dai-Jen Chu, and Mr. Trong-Der Tseng for their time and effort devoted to the preparation of the data. Thanks are also extended to Mr. Ding-Rong Lin, Miss J.J. Wu, Miss H.R. Shih, and Miss I.C. Chen for their secretarial work.

Table 1. **South Atlantic albacore 1968-1993 nominal and GLM adjusted CPUE series derived from Taiwanese longline data.**

Year	Taiwan Longline Fishery				All Fisheries
	Nominal CPUE in Number per 1000 hooks	Adjusted CPUE in Number per 1000 hooks	Mean Weight per Fish in Kg	Catch in Weight (1000 Kg)	Catch in Weight (1000 Kg)
1968	36.47	19.74	14.30	6,800	25,700
1969	32.38	23.57	15.80	12,500	28,400
1970	29.83	18.66	15.80	12,200	23,600
1971	34.36	17.81	15.20	17,500	24,900
1972	29.22	12.92	14.70	25,000	33,300
1973	26.55	12.65	13.90	22,200	28,200
1974	27.93	12.57	14.90	16,700	19,800
1975	33.39	14.18	14.60	13,400	17,700
1976	34.19	13.91	12.80	14,600	19,500
1977	31.68	12.82	14.40	16,100	21,700
1978	35.66	15.37	13.60	20,500	23,200
1979	32.45	15.21	13.60	20,300	22,600
1980	32.77	13.73	14.70	18,700	22,900
1981	28.23	11.19	14.10	18,200	24,100
1982	30.24	11.28	13.60	22,800	29,600
1983	28.67	12.19	14.50	9,500	15,100
1984	29.48	12.19	17.50	7,900	13,800
1985	30.16	12.41	12.40	19,600	29,700
1986	32.07	12.29	13.20	27,600	36,200
1987	24.48	12.35	13.90	28,800	39,800
1988	19.78	9.48	15.50	20,700	28,900
1989	17.01	8.56	17.00	18,400	26,700
1990	17.51	7.94	15.60	21,900	28,000
1991	13.80	7.57	15.00	19,500	24,800
1992	15.97	8.01	14.70	20,400	30,400
1993	19.46	-	15.60	19,300	28,200

Footnote: Taiwanese longline data set were provided by the Tuna Research Center, Instititute of Oceanography, National Taiwan University, Taipei, Taiwan.

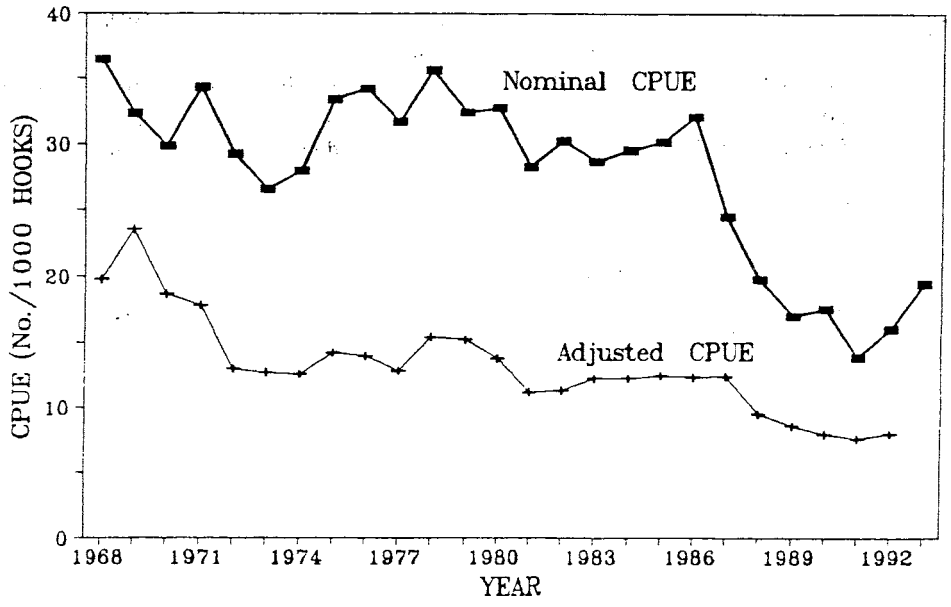

Fig. 1. Trends of albacore nominal and GLM adjusted CPUEs derived from the South Atlantic Taiwanese longline data set.