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The Description of Catch and Effort of the Taiwanese Albacore Longline Fishery in Atlantic Ocean

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ABSTRACT

The spatial and temporal characteristics of Taiwanese longline fishery in the Atlantic Ocean was examined using the catch and effort data, aggregated by month, by 5×5 degree statistical block and by species from 1967 to 2002. Taiwanese longline fishery in the Atlantic Ocean is directed mainly at albacore. In the last decade (1993-2002) the albacore average catch of Taiwan's longline fleet accounted for more than 65% in South Atlantic Ocean and for 14% in North Atlantic Ocean for all flags. After late-1980s, the deep longline operation was introduced. Some longliners improved the freezing facilities and shifted the target from temperate albacore to the tropical bigeye tuna, yellowfin tuna and swordfish more or less. The fishing strategy of Taiwanese longline fishery has been transformed since then. Moreover, while the joining of the non-albacore directed effort, it may result of the decreasing trends of albacore's catch rate in the both North and South Atlantic Oceans since late-1980s.

***Key words**: Catch, Effort, Albacore, Longline fisheries, Atlantic Ocean.*

INTRODUCTION

The history of the Taiwanese longline fishery in the Atlantic Ocean is almost as long as 40 years. At the beginning of the fishery, the effort is undertaken mainly in the equatorial Atlantic Ocean, and subsequently further to the temperate waters of the North and South Atlantic to catch albacore (Wu *et al.*, 1996).

On the basis of the biological information available, for assessment purposes the existence of three stocks is assumed: i.e., North Atlantic albacore (NAA) and South Atlantic albacore (SAA) (separated at 5°N), and Mediterranean stock (ICCAT, 2001).

The northern stock is exploited by surface and longline fisheries. Surface fisheries include Spanish trolling and baitboats and Portuguese baitboats mainly target juveniles (30-50 cm FL) and sub-adults (50-90 cm FL). In addition, Taiwan is few countries using longline gear to catch sub-adult and adult albacore (60-120 cm). The annual average catch from Taiwan in the North Atlantic was about 4 thousand tonnages, accounting for 14% of the total catch for all flags from 1993 to 2002 (Anon, 2005).

As for southern stock, there are four fisheries, namely the surface baitboat fleets from South Africa and Namibia, and the longline fleets from Brazil and Taiwan to utilize this resource. Historically, Taiwan longline fleet exerts more substantial effort in the South Atlantic than North Atlantic. The annual average catch of SAA by Taiwanese longline fishery reached to the peak at 28,790 t in 1987, accounting for 72% of the albacore catch in the region (Wu and Yeh,

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2002). However the catch of SAA became less in recent years and occupied around 60% of the global catch of albacore for Taiwanese longline fishery. Other albacore by-catches are made by Japanese, Spanish, South African and Namibian longliners (Anon, 2005).

The CPUE, either of the SAA or NAA, shows significant decreasing trends since late-1980s. The CPUE of SAA fell off from averaging about 32 fish per thousand hooks in 1986 to 13 fish in 1991, and about 28 fish in 1988 to 4 fish in 1992 for NAA. Both CPUEs of SAA and NAA were still at low levels which were 10.4 and 6.9 fish in 2002, respectively. Meanwhile, the efforts of the Taiwanese longliners increased abruptly in North and South Atlantic since late-1980s (Fig. 1). Two questions may arise from the decrease of the CPUEs of NAA and SAA: first, where did the increasing effort go to, and second, for which kinds of target species were aimed from the increasing effort?

This paper reviews the history of the Taiwanese longline fishery in the Atlantic Ocean and describes the transition of the fishing characteristics in the late-1980s, which may refer to the changes: such as the spatio-temporal distributions of the effort, catch composition and catch rate of albacore. It will help to understand the basic characteristics of this fishery in time and space. More precisely, the objective is to study the possible reasons why the CPUE trends of SAA and NAA appeared such great declinations.

MATERIALS AND METHODS

The analyzed catch and effort data, aggregated by month, by 5 × 5 degree statistical block and by species was provided by Oversea Fisheries Development Council. (OFDC), the Republic of China from 1967 to 2002, and the 2002 data was preliminary. This data set is identical to TASK-II which was submitted to ICCAT for stock assessment use. The 20°E longitudinal line was considered as the boundary between the South Atlantic and the Indian Ocean. Observations with the fishing locality eastward beyond the 20°E longitudinal line were not used. Also, The catch statistics data was divided into two data sets by 5°N latitude, which was the assumed geographic boundary for northern (including 5°N latitude) and southern Atlantic albacore stocks (ICCAT, 2001).

The geographical d stributions of fishing effort, albacore CPUE and catch species composition by 5 × 5° statistical block for the Taiwanese longline fishery in Atlantic Ocean in 1970, 1980, 1990 and 2000 were selected arbitrarily and used to iliustrate the development of the fishery. CPUE is defined as catch (in no.) divided by thousand hooks.

RESULTS

Fishing effort

The fluctuations of annual fishing efforts, in terms of nominal hook numbers, for Taiwanese longline fishery in North and South Atlantic Ocean are illustrated in Fig. 1. In the beginning of the fishery in North Atlantic, the fishing effort increased yearly, and reached the peaks of 31 million hooks in 1977, decreased then, and up to the historic highest amount at 55 million hooks in 1986. However Because the cost of supply for fleet became higher, and fish selling price was low; many Taiwanese longliners moved from North Atlantic into South Atlantic in 1987 (Yang, 2002). The efforts then fell to the lowest level at 5 million hooks in 1989, and the number of exerted hooks was around 30 million hooks onwards.

On the other hand, before 1986 the fishery in South Atlantic fluctuated between 30 million and 40 million hooks, and boomed to 120 million hooks in 2001. Comparing the annual efforts of Taiwanese longline fishery exerted between North Atlantic and South Atlantic, it shows fleet deployed more efforts in South Atlantic, especially in the last two decades (1983-2002).

The annual geographical distributions of fishing effort in North and South Atlantic Oceans are shown in Figs. 2 and 3, respectively. In 1970, the fishing effort has been widely covered almost the whole Atlantic Ocean and extended further to the 45°N and 40°S. In 1980, very few operations happened

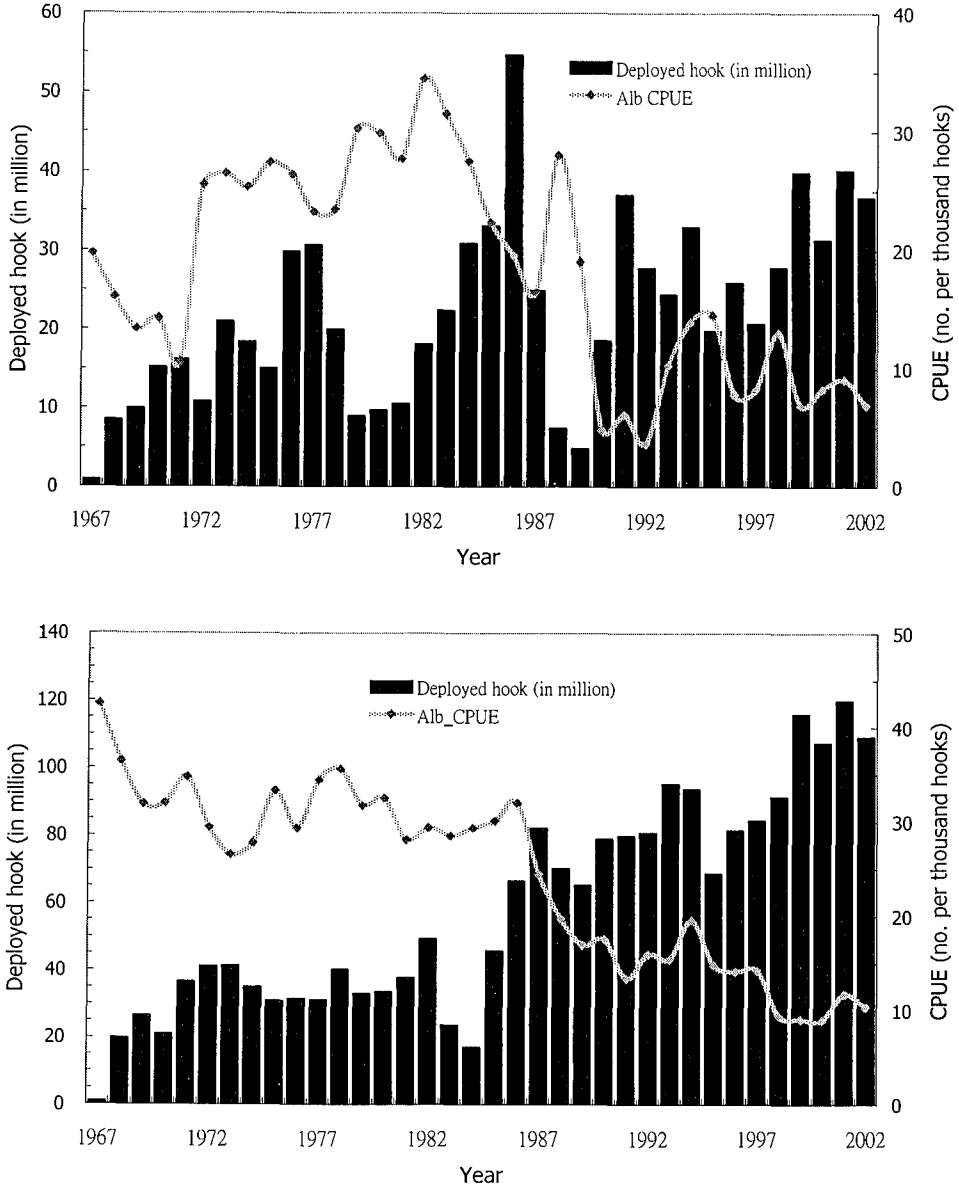


Fig. 1. Annual fishing effort and catch rate of albacore for Taiwanese longline fishery in North Atlantic (above) and South Atlantic (bottom).

in the tropical waters. The effort was distributed mainly along the southwestern waters off South Africa and eastern and southeastern waters off South America. In the years of 1990 and 2000, more and more effort was exerted in the tropical waters again, and the fishing effort grew rapidly extended to almost the whole Ocean.

Catches

The Task-II recorded the catch of 14 fish species (including 'the other' category). Among them, the fish species can group into three

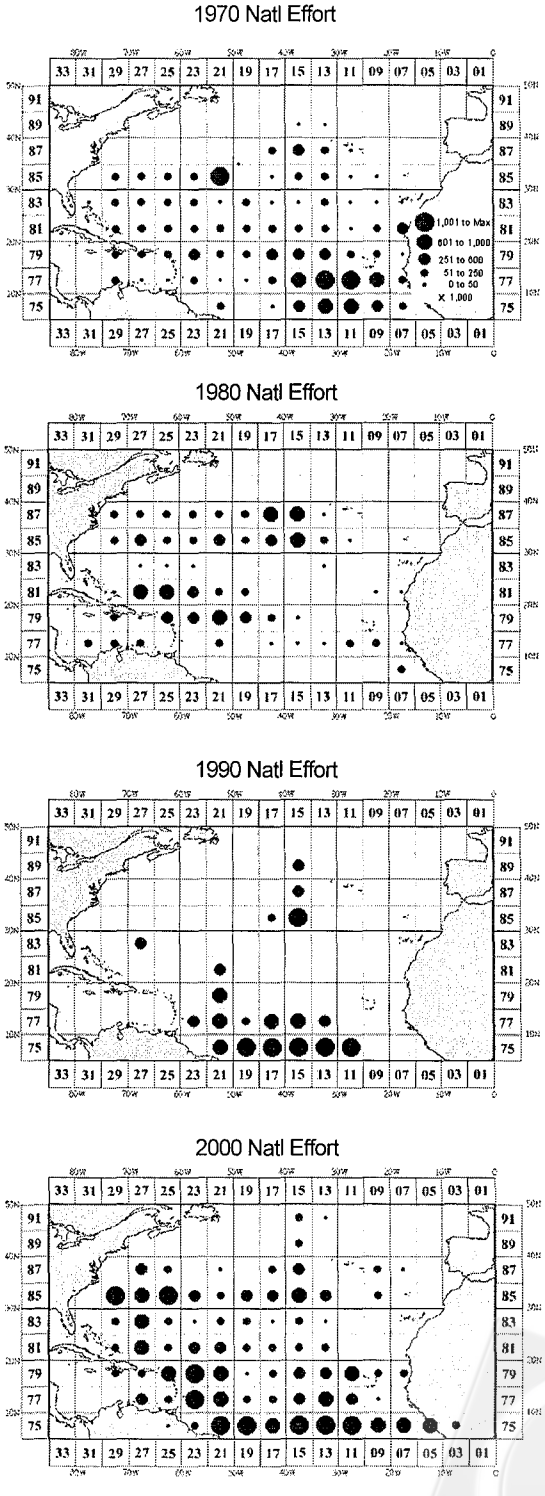


Fig. 2. Geographical distributions of effort from Taiwanese longline fishery in North Atlantic Ocean in 1970, 1980, 1990 and 2000, respectively.

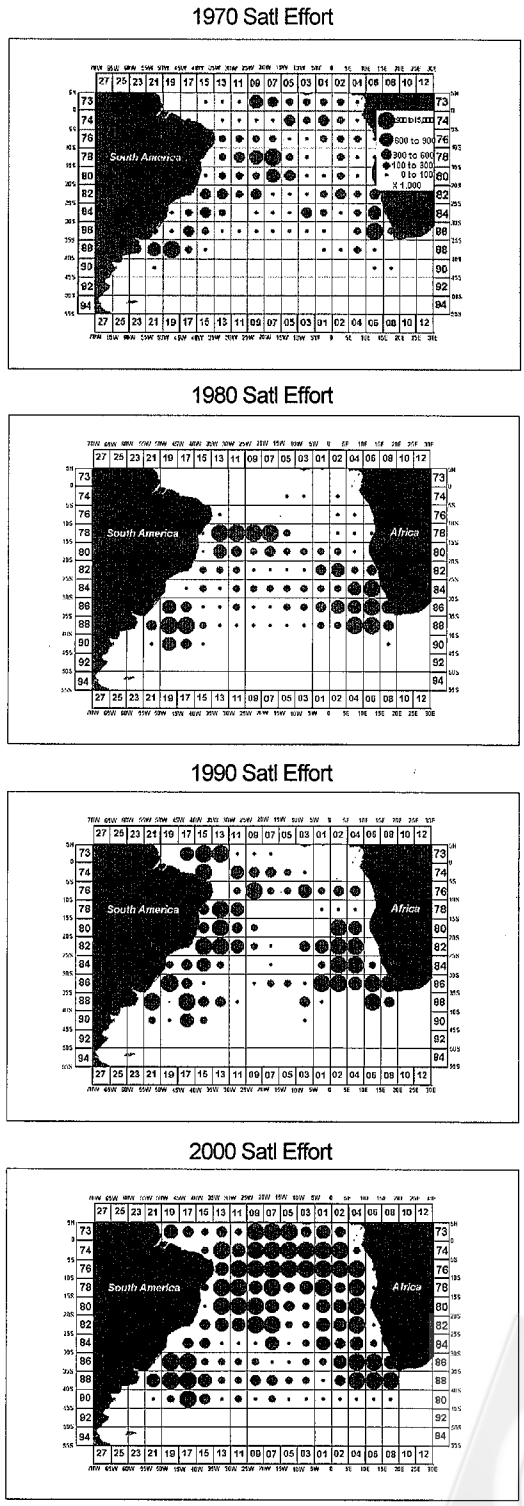


Fig. 3. Geographical distributions of effort from Taiwanese longline fishery in South Atlantic Ocean in 1970, 1980, 1990 and 2000, respectively.

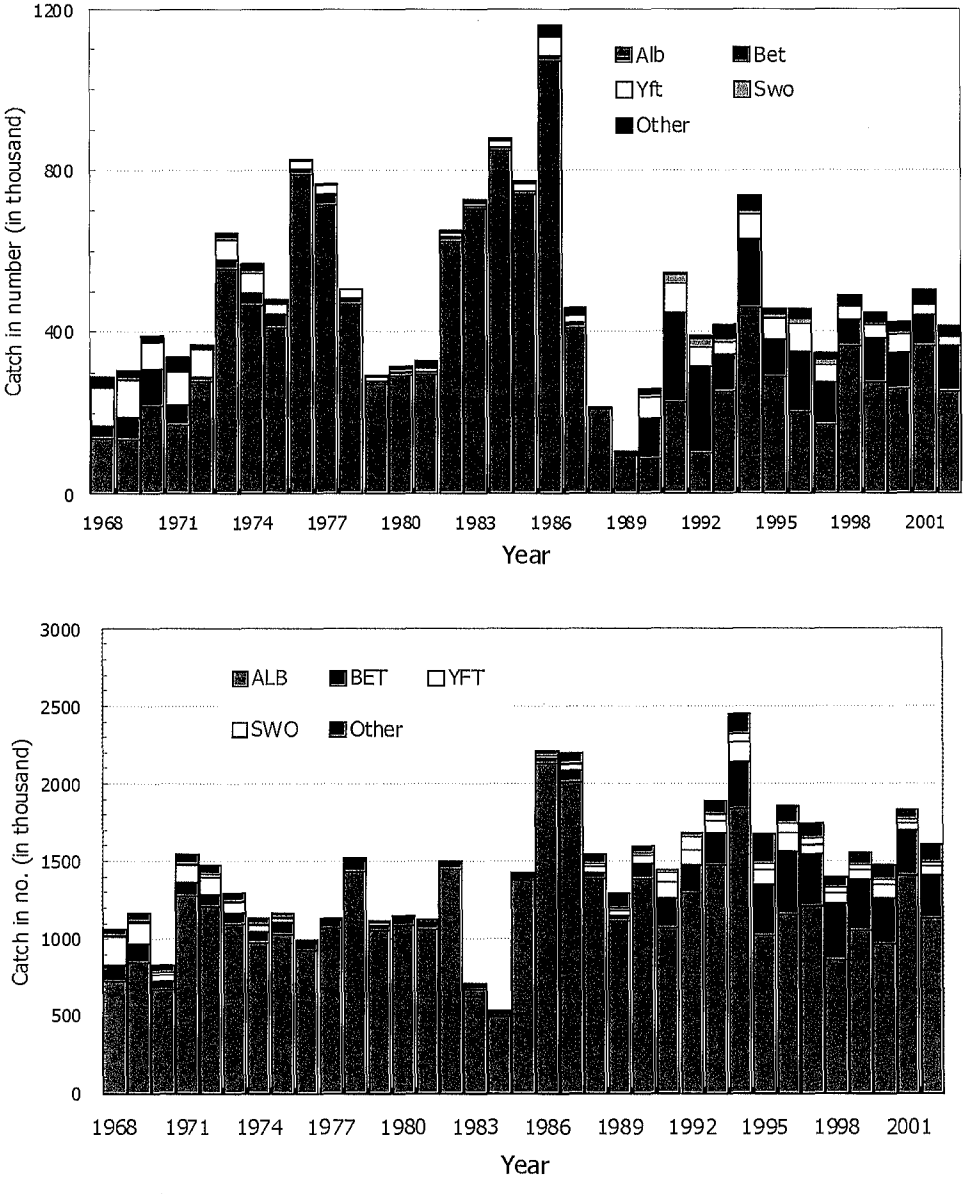


Fig. 4. Annual catch of Taiwanese longline fishery in North (top) and South (bottom) Atlantic Ocean.

categories: tunas, billfishes and sharks. Three tuna species, namely albacore, bigeye tuna and yellowfin tuna, with the swordfish are the most important and abundant target species for Taiwanese longline fishery. The annual catch (in number), which was composed of the above four fish species, of the Taiwanese longline fisheries in North and South Atlantic Oceans are graphed in Fig. 4. Albacore is the dominant species caught in North and South Atlantic Oceans. The catch of NAA increased from around 135 thousand fish in the late-1960s to the first peak at 789 thousand fish in 1976, again to the historic highest level at 1071 thousand fish in 1986. However due to a few fishing vessels trans-

ferred to South Atlantic in late-1980, the historic lowest catch occurred at 89 thousand fish in 1990, and remained about 260-360 thousand fish in recent decade (1993-2002).

In South Atlantic, the annual catch of albacore caught by Taiwanese longliners ranged from 672 thousand fish to 1450 thousand fish during 1968-82, with the lowest level of 503 thousand fish in 1984, and then increased to the average catch of 1211 thousand individuals in recent decade. The proportion of albacore was quite stable among years, averaging higher to 94% from 1976 to 1988, and remained to about 70% after then. While bigeye tuna became the second dominant catch species of the fishery since then, contributing from 10 to 26% of the catch, with an average of 17%. Yellowfin tuna was occasionally caught, and representing 5% of the catch and swordfish is very sporadic and constituting 3%.

Geographical distribution of albacore CPUE

In this study, top 16.7% of the albacore annual CPUE, calculated from the total of 5 × 5 statistical blocks during 1968-2002, is referred as "the highest level of CPUE". Highest CPUE was denoted as ">30 fish per thousand hooks" for NAA and ">40 fish" for SAA. It is evident that more "highest CPUE" of the NAA and SAA occurred before 1980 (Figs. 5 and 6). This result also agreed with the fluctuations of the annual CPUEs of the NAA and SAA as shown in Fig. 1. The geographical distributions of the "highest CPUE" of albacore appeared on the subtropical and temperate waters, which lied between 15-45° of the boreal and southern Atlantic.

Geographical distribution of species composition of the catches

Figs. 7 and 8 show the annual geographical distributions of the catch composition by number from the Taiwanese longline fishery in North and South Atlantic Oceans, respectively. The species composition in five-degree square has shown the geographical discrepancy. The higher albacore catch composition was found in the waters lying between 15-45° of the boreal and southern Atlantic Oceans, whereas bigeye tuna and yellowfin tuna were more abundant in the tropical waters. It demonstrate a geographical boundary, located in 10-15° latitudinal band in either North or South Atlantic, may evidently separate the distributions of the albacore from bigeye tuna and yellowfin tuna.

DISCUSSION

Taiwanese longline fishery in Atlantic Ocean presents a distinct fishing pattern, characterized by a concentration of fishing effort in different areas over the years (Wu *et. al.*, 2002). Longliners fished in the tropical waters in the initiation period of the fishery, and then fishing effort evenly distributed the whole Atlantic Ocean. An absent of fishing efforts in tropical waters was noted in 1980. However even more and more effort exerted in tropical waters again, still the effort in subtropical and temperate waters of the Atlantic Ocean remained the high level (Figs. 2 and 3). It is worth to mention that almost all of this effort was applied in tropical waters, in which the catch compositions of bigeye tuna and yellowfin were always higher in relation with the compositions of these two species obtained from other waters (Figs. 7 and 8). It has also been observed that annual bigeye tuna catch taken by Taiwanese longline fleet has shown an increasing trend since 1991 (Fig. 4). Concluded from the above results, it is obvious that the increasing effort in tropical waters aimed for bigeye tuna, yellowfin tuna and some swordfish since late-1980s. One of the reasons why the CPUEs of NAA and SAA show the drastic declinations is from the non-albacore directed effort joined to the fishery.

Longline fisheries mainly target highly migratory species, including tunas, billfishes and sharks etc, and is considered as multi-species fisheries (Gulland, 1983). On the other hand, tuna fisheries are specific species-directed fishery. The operation program, which includes the gear configuration, bait used and operation area, was closely to the target species. Therefore, if longliners target albacore, will operate in the temperate waters

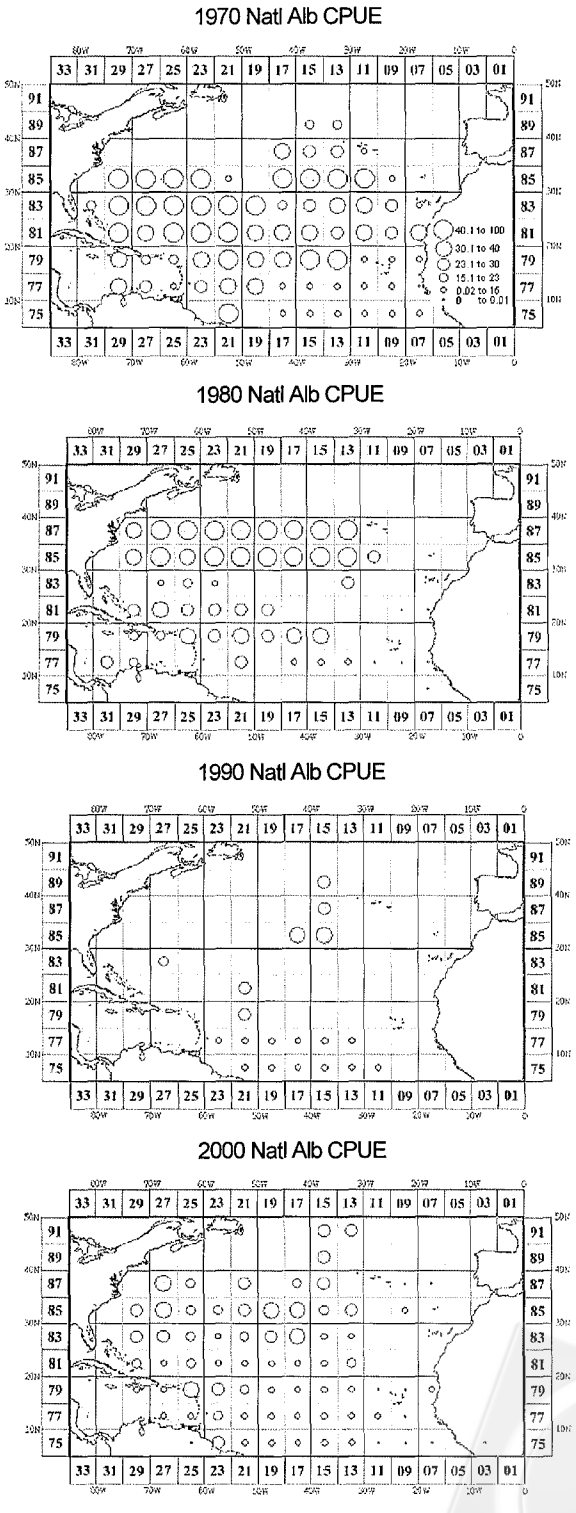
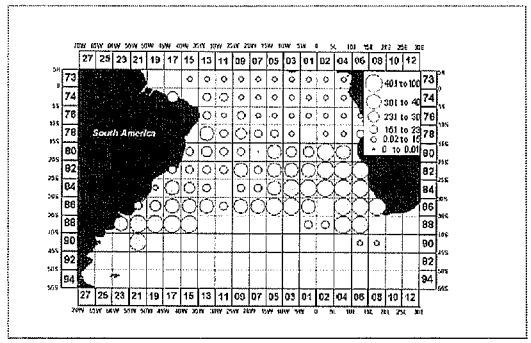
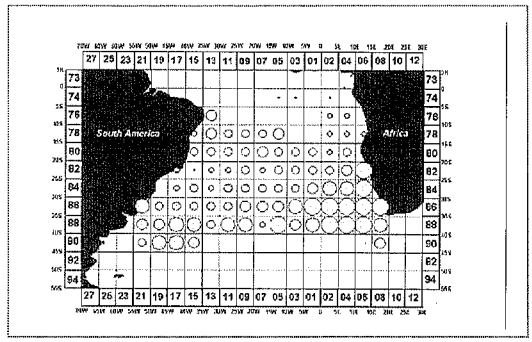


Fig. 5. Geographical distributions of annual CPUE for northern Atlantic albacore.

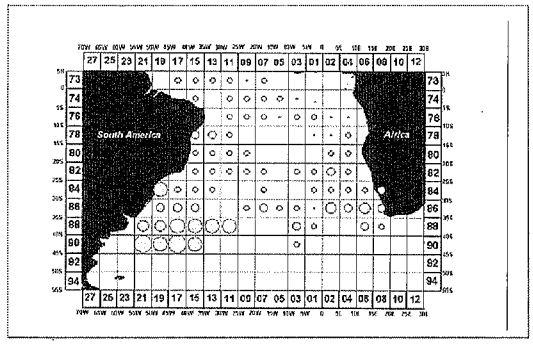
1970 Satl Alb CPUE



1980 Satl Alb CPUE



1990 N Satl Alb CPUE



2000 Satl Alb CPUE

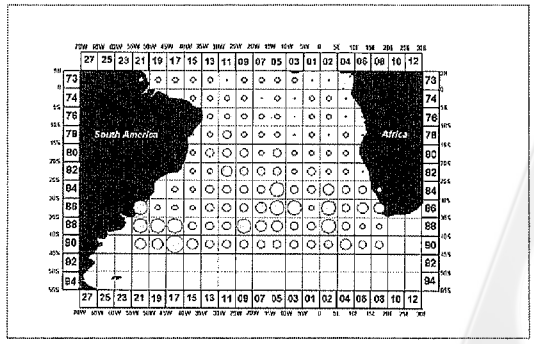


Fig. 6. Geographical distributions of annual CPUE for southern Atlantic albacore.

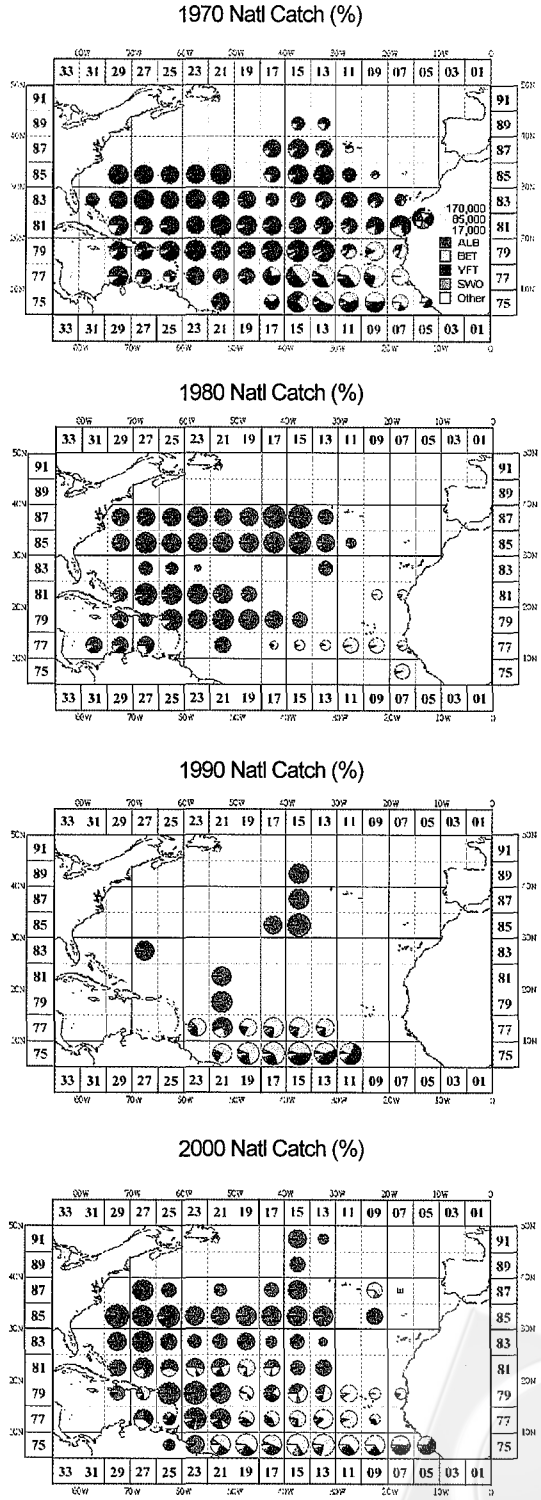


Fig. 7. Geographical distributions of catch species composition of Taiwanese longline fishery in North Atlantic Ocean.

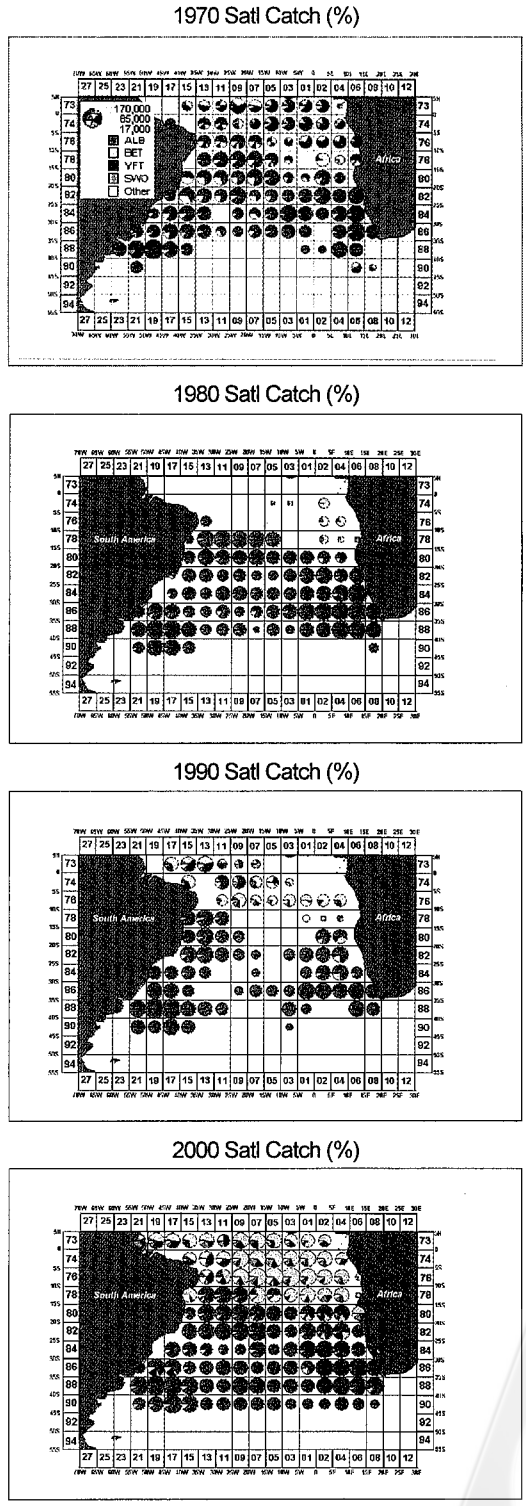


Fig. 8. Geographical distributions of catch species composition of Taiwanese longline fishery in South Atlantic Ocean.

where albacore inhabits in; while in tropical waters for bigeye tuna and yellowfin tuna.

The real world of fisheries statistics is much more heterogeneous; most management programs collect lots of different types of data. Commercial catch data is useful for making predictions for CPUE trends of which is considered as an index of stock abundance (Hilborn and Walters, 1992). Take the Taiwanese longline fishery in Atlantic Ocean for example, if one did not actually understand the transition of this fishery and adopt some corresponding measures to alleviate this problem; it may underestimate the stock abundance and arrive at the more pessimistic view for the NAA and SAA stocks.

When conducting the stock assessment in the first beginning, "know your data" becomes most important. The precedence work includes the temporal and spatial mapping of the catch and effort and species composition etc., as we did in this study.

The stock assessments of NAA and SAA become more complicated, because two stocks are targeted by various fisheries simultaneously or consecutively. Then identifying the fishing effort for which is aimed the two specific stocks are the essential work in the future assessments of the two stocks.

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臺灣的大西洋長鰭鮪延繩釣漁業之漁獲量與努力量概況

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本研究使用 1967-2002 年臺灣的大西洋長鰭鮪漁業之漁獲量與努力量資料探討臺灣大西洋鮪延繩釣漁業的時空特徵。長鰭鮪為臺灣的大西洋鮪延繩釣漁業主要標的魚種，近十年期間(1993-2002 年)，在大西洋南北洋區的長鰭鮪漁獲量分別為各漁業國總產量的 65%及 14%。80 年代後期開始，部分鮪延繩釣漁船，改良冷凍設備並採用深層式漁法於熱帶海域捕捉大目鮪、黃鰭鮪及劍旗魚，使本漁業的作業型態發生顯著變化。由於大西洋鮪延繩釣的漁獲統計資料中含有這些不以長鰭鮪為主要目標魚種的深層式漁獲統計資料，因而影響了南、北長鰭鮪系群釣獲率，使其呈現顯著下降的趨勢。

關鍵詞：漁獲量，努力量，長鰭鮪，延繩釣漁業，大西洋。

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