

**OUTLOOK ON SOME TUNA SPECIES CAUGHT BY TAIWAN TUNA  
FISHERIES IN THE NORTH PACIFIC OCEAN AND PRELIMINARY STOCK  
STATUS FROM LONGLINE DATA<sup>1</sup>**

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# **OUTLOOK ON SOME TUNA SPECIES CAUGHT BY TAIWAN TUNA FISHERIES IN THE NORTH PACIFIC OCEAN AND PRELIMINARY STOCK STATUS FROM LONGLINE DATA**

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## **1. INTRODUCTION**

Tuna fisheries in Taiwan was fully developed in 1950s, and the Pacific Ocean was the first fishing ground exploited by this fishery. Longline was the only fishing gear at the beginning of the fishery, and large-mesh driftnet and distant-water (DW) purse seine followed later. Annual catch of tuna and tuna-like species in recent three years was approximately 120,000-150,000 MT in the North Pacific Ocean. This report briefly describes the Taiwan tuna fisheries in the North Pacific Ocean and outlooks on the catch status of the four species interested to the ISC: albacore, bigeye, yellowfin and swordfish. A preliminary stock status from the standardized DW longline CPUE was also provided.

## **2. BRIEF REVIEW ON TAIWAN TUNA FISHERIES**

The longline fishery can be roughly classified into "distant-water longline fishery" (DW longline fishery) and "offshore longline fishery" (OS longline fishery) in terms of the size of fishing boats. The DW longline fishery is operated by longliners larger than 100 GRT and mainly fishing in distant waters. Main target species of this fishery include albacore(for cannery), and bigeye, yellowfin and bluefin tunas (for Japanese sashimi market in frozen form). There were 10 vessels operated in the North Pacific Ocean in 1997.

The OS longline fishery, or the traditional small scale longline fishery, includes those vessels operate in the coastal and offshore areas around Island. These vessels in general, are smaller than 100 GRT. Number of these vessels was estimated to be around 1,800~, but actual number of vessels operated in the North Pacific is not clear. These vessels target on yellowfin, bigeye, and seasonally on swordfish, and bluefin tuna (northern bluefin). Catches of the sashimi grade species mostly goes to the Japanese market in fresh form.

Recently, the fishing pattern of the OS longline fishery has been changed. Some of these vessels are now operated not only in coastal and offshore regions but also in distant waters (or foreign countries) depending upon size and facilities of the vessels (Wang, 1994). This has made it difficult to classify the scale of the fishery as some of these vessels were actually operated similar to those DW longline vessels.

DW purse fishery mainly operates in the Western-central Pacific Ocean. Currently, the number of purse seiners in the Pacific Ocean is 42. Skipjack and yellowfin are the two major catch species from the fishery. Based on the logbook information, catches made in the North Pacific Ocean have been decreased recently, from 91% in 1994 to 49% in 1997, indicating a southward movement of the fleet.

Large-mesh driftnet fishery has been operated in the North Pacific Ocean but was banned in 1993. The fishery mainly targeted on the Pacific short-fin squid and the albacore later on.

### **3. CATCH, EFFORT AND SIZE DATA**

Logbooks of DW longline have been routinely collected by Taiwanese fishery agencies. Information on daily catch and effort data were included. Logbook data collected by Honolulu Laboratory of Southwest Fisheries Science Center, NMFS, were also used in combination with Taiwanese database for analysis. Although the data quality and representation has been improved, report shown here remains preliminary as many characteristics of these two datasets have not yet been verified.

Collection of logbook data from OS longline fishery started from late 1996. The coverage rate, however, remains to be very low when compared to the scale of the OS longline fleet and the trips they made. Interviews with fishermen in the main fishing ports in Taiwan were also conducted since 1998 as a supplement information to the logbook data. Catch information of OS fishery shown here (except the total catch) was based on these two sources.

Size data used in this report, for the DW longline fishery, were obtained from fishermen through fishery agencies since 1981. As to OS longline fishery, data were come from port sampling programs conducted by OFDC.

## 4. OUTLOOKS ON THE CATCH STATUS

### 4.1 North Pacific Albacore

#### *Fishery and catch*

Catches of albacore were found in both DW and OS longliners in Taiwan. Most of the DW longline catches were from the South Pacific Ocean although an increase in catches in the North Pacific also was noted since 1995 (Table 1). Albacore caught in the OS longline fishery in Taiwan were mostly located in the North Pacific Ocean (Fig. 1) due to the geological location of the Island. The catches however, only accounted for a small percentage (<4%) of the total catches.

Total catches of albacore by DW longliners were estimated to be 19,524 MT in the Pacific Ocean in 1997 (Table 1), in which 80% was from the South Pacific and 20% from the North Pacific Ocean. Percentage of albacore caught in the North Pacific Ocean slightly increased (10% in 1995, 17% in 1996 and 20% in 1997) in the past three years. Catches of albacore by OS longliners seems remained stable (or slightly decreased) in the North Pacific Ocean in recent years. Albacore also were caught in the driftnet fishery in the North Pacific Ocean before the fishery was banned. Total catches was peaked at 16,700 MT in 1990.

#### *Size composition*

Albacore caught in the North Pacific Ocean by DW longline fishery showed two modes distribution pattern (one in 65 cm and the other in 120 cm) in 1980s while only one mode distribution (with a peak in 80 cm) was found in 1990s (Fig. 2). Albacore caught in the OS longline fishery seems larger than those found in the DW longline fishery. A dominant group was ~135-140 cm.

#### *CPUE distribution*

Main CPUE of DW longline fishery for albacore during 1964-1978 period was in the south Pacific Ocean (Fig. 1). However, after 1978 there seems a shift of CPUE from the South to the North Pacific. Major CPUE was located between 155°E and 155°W in the subtropical North Pacific region (Fig. 1). Most of the albacore caught in OS longline fishery, however, were located in southern Taiwan to Philippine (16~23°N) areas although some vessels apparently also operated in the offshore region of Philippine (i.e., ~14-19°N, 135-145°E).

### *Preliminary abundance index*

Due to lacks of sufficient catch information in 1978 and 1984-1994, standardization on the CPUE of DW longline data could not be properly performed. Fig. 3 shows the nominal CPUE from 1975-1997. If the two assumed trends from available information close to real situation, then, after a long series of release of fishing pressure during 1984-1994, the CPUE has shown an increasing trend in recent years.

## 4.2 Pacific bigeye tuna

### *Fishery and catch*

Bigeye tuna was mainly found in the tropical and subtropical regions of the Pacific Ocean. Vertical distribution of this species ranged from 0 to ~250 m and is believed to be associated with depth of the thermocline in the ocean. This species was considered as a unit stock and no differentiation can be found between the North and the South. Catches of bigeye tuna reported to WPYR from DW longline fishery were low (below 2,000 MT) and fluctuated between years (Table 1). The bigeye catches unloaded in ports of Taiwan by OS fishery were also low (under 2,000 MT) before 1990, remained high since then, and reached a peak of 3,500 MT in 1997. Catches from Purse seine fishery were around 1,000 to 4,300 MT in the entire Pacific Ocean between 1989 and 1997. Driftnet catches on this species were minor and all less than 100 MT in the past.

### *Size composition*

Size of bigeye tuna caught in the DW longline fishery showed two modes distribution (one in ~100 cm and the other in ~130 cm) while it was an uni-mode (in 130 cm) in the OS longline fishery (Fig.2). Sizes of the fish caught in both fisheries, however, were similar and ranged from 60 to 180 cm in fork length.

### *CPUE distribution*

Major CPUE of bigeye tuna caught in the longline fishery were located in the central-western Pacific ocean (west of 160°W) and eastern Pacific (east of 130°W) (Fig. 4). High CPUE found in the western side were mainly made by OS longliners based on ports of foreign countries (not indicated in the Figure), as well as those of Taiwan which were concentrated from southern part of Taiwan to both sides of Philippine Islands (~112°E-130°E, ~12°N-24°N).

### *Preliminary abundance index*

Simple standardization on the CPUE of Taiwanese DW longline fishery for 1975-

1997 period was performed through GLM procedure on factors of year and quarter. The preliminary result showed a decreasing trend from 1976 to 1982, and then maintained at such a level during 1982-1989 and 1992-1997 periods. The sharp decreasing trend in the 1970s might be resulted from a bias in the dataset during those years. These data included data from several OS longliners whom target on bigeye in the tropical area during this period and were not included in the later years.

#### 4.3 Pacific yellowfin tuna

##### *Fishery and catch*

Yellowfin tuna is found in tropical and subtropical regions of the major oceans. Although several hypotheses were proposed for its stock structure, differentiation between the North and the South can not be found. Yellowfin catch can be found in both DW and OS longline fisheries as well as in the DW purse seine fishery in Taiwan, the major catches, however, were from DW purse seine fishery (Table 1). The West Pacific catches of DW longline fishery were higher than 2,000 MT before 1980 and fluctuated between 500-1,800 MT thereafter. Catches unloaded in Taiwanese ports by OS fishery has increased significantly since 1973 and has maintained at the level of 10,000-20,000 MT. Peak of catches was found in 1979 at 23,600. Yellowfin is the most abundant tuna species caught in this fishery if dolphinfish was not included in the analysis. There appears to be a slightly decrease in catches in both longline fisheries in 1996-97 period.

DW purse seine fishery has made significant catches since 1990 in the entire Pacific Ocean. Catches in the North Pacific Ocean were estimated to be around 10,000-25,000 MT during 1994-1997 period.

##### *Size composition*

Size of yellowfin tuna caught in the DW longline fishery were similar to those obtained from OS longliners (Fig. ). Sizes of their catches ranged from ~40 to ~180 cm with a peak in ~120 cm in both fisheries although small fish (less than 80 cm) seems more abundant in the catches of DW longline fishery.

##### *CPUE distribution*

Although catches were low, the CPUE of Taiwanese longline catch for the past years (1975-1997) was mainly concentrated in the West Pacific Ocean (Fig. 4). Catches from DW longline fishery were higher in southern hemisphere than those in the north, while catches in OS longline fishery were mainly concentrated in the north. For DW longline

fishery, high CPUE mainly concentrated in the central and west tropical and subtropical regions of the Pacific Ocean ( $\sim 20^{\circ}\text{N}$  to  $\sim 20^{\circ}\text{S}$ ,  $\sim 120^{\circ}\text{E}$  to  $\sim 140^{\circ}\text{W}$ ). For OS longline fishery based in Taiwan, the CPUE were mostly concentrated in the north Pacific Ocean from southern part of Taiwan to both sides of the Philippine Islands ( $\sim 112^{\circ}\text{E}$ - $130^{\circ}\text{E}$ ,  $12^{\circ}\text{N}$  to  $23^{\circ}\text{N}$ ). (Fig. 4).

#### *Preliminary abundance index*

The CPUE of DW longline fishery was standardized using GLM procedures on factors of year, quarter and catch rate of albacore. Preliminary results (Fig. 3) showed that the relative CPUE increased significantly in 1979 and fluctuated thereafter with a slightly decreasing trend.

### 4.4 North Pacific swordfish

#### *Fishery and catch*

Catches of swordfish can be found in both DW and OS longliners in Taiwan although OS longline fishery was responsible for most of the catches in Taiwan (Table 1). Most of DW longline catches were from South Pacific Ocean while catches in the North Pacific were low historically. Swordfish caught in the OS longline fishery and unloaded in Taiwan ports were mostly located in the North Pacific Ocean due to the geological location of the Island. Such catches however, only accounted for  $\sim 2\%$  of the total OS longline catches during 1996-98 period.

Total catches of swordfish by DW longliners were low and stable ( $\sim 140$  MT) during recent years (1990-1997). Catches of swordfish by OS longliners were much higher than those by the DW longliners (Table 1). Total catches in the North Pacific Ocean remained stable ( $\sim 1,100$ – $1,500$  MT) during 1987 to 1996 period except that a notable increase in catches in 1997 ( $\sim 2,200$  MT) also was founded.

#### *Size composition*

Swordfish caught by DW longliners (Fig. 2) showed multiple modes of size distribution as those found in the OS longline fishery in the North Pacific Ocean. Size of swordfish caught in both fisheries ranged from  $\sim 60$  cm to  $\sim 200$  cm in low jaw fork length.

#### *CPUE distribution*

Main CPUE of DW longline fishery for swordfish during 1964-1978 period was mainly in the South Pacific Ocean (Fig. 5), although some high values also were found

in the central part of the North. However, mean CPUE after 1978 decreased and seems distributed rather scattering when comparing to 1964-1978 period. Catch in the North can still be found but the CPUE was comparatively lower in 1979-1997 than in 1964-1978 period. Some major CPUE were also noted in the southern Taiwan to Philippine islands during 1979-1997 period. This is similar to the OS longline fishery during 1996-1998 period where most CPUE were done in the southern Taiwan to both sides of the Philippine Islands (i.e., ~12-23°N, 110-130°E).

#### *Preliminary abundance index*

The preliminary standardized CPUE through GLM procedure showed that the relative CPUE was low and stable before 1992 (Fig. 3). It increased dramatically and reached a peak in 1994. The value was decreased to low level as found before 1992 since 1995. Reasons for such a trend were unclear, but the notable decrease was coincidence with the significant increases in northern albacore catches (Table 1) suggesting an existence of possible target effect.



Table 1. Catch statistics of Taiwan tuna fisheries in the North Pacific Ocean.

| Year | Albacore |       |        |        | Bigeye |       |       |     |       |
|------|----------|-------|--------|--------|--------|-------|-------|-----|-------|
|      | DWLL     | OSLL* | DN     | TOTAL  | DWLL** | OSLL* | DWPS  | DN  | TOTAL |
|      | NP       | NP    | NP     | NP     | WP     | NP    | PAC   | PAC |       |
| 1964 | -        | 26    |        | 26     | 53     |       |       |     | 53    |
| 1965 | -        | 261   |        | 261    | 377    |       |       |     | 377   |
| 1966 | -        | 271   |        | 271    | 918    |       |       |     | 918   |
| 1967 | 330      | 305   |        | 635    | 1,045  | 347   |       |     | 1,392 |
| 1968 | 216      | 482   |        | 698    | 1,390  | 579   |       |     | 1,969 |
| 1969 | 65       | 569   |        | 634    | 986    | 710   |       |     | 1,696 |
| 1970 | 34       | 1,482 |        | 1,516  | 1,673  | 207   |       |     | 1,880 |
| 1971 | 20       | 1,739 |        | 1,759  | 1,429  | 418   |       |     | 1,847 |
| 1972 | 187      | 2,904 |        | 3,091  | 1,704  | 676   |       |     | 2,380 |
| 1973 | -        | 128   |        | 128    | 1,653  | 825   |       |     | 2,478 |
| 1974 | 486      | 84    |        | 570    | 1,496  | 721   |       |     | 2,217 |
| 1975 | 1,240    | 254   |        | 1,494  | 897    | 1,361 |       |     | 2,258 |
| 1976 | 686      | 565   |        | 1,251  | 801    | 544   |       |     | 1,345 |
| 1977 | 572      | 301   |        | 873    | 1,073  | 760   |       |     | 1,833 |
| 1978 | 6        | 278   |        | 284    | 998    | 890   |       |     | 1,888 |
| 1979 | 81       | 106   |        | 187    | 1,240  | 1,605 |       |     | 2,845 |
| 1980 | 279      | 39    |        | 318    | 1,468  | 878   |       |     | 2,346 |
| 1981 | 143      | 196   |        | 339    | 943    | 509   |       |     | 1,452 |
| 1982 | 38       | 521   |        | 559    | 468    | 457   |       |     | 925   |
| 1983 | 8        | 512   |        | 520    | 295    | 713   | 276   |     | 1,284 |
| 1984 | -        | 471   |        | 471    | 475    | 899   | 427   |     | 1,801 |
| 1985 | -        | 109   |        | 109    | 298    | 1,868 | 508   |     | 2,674 |
| 1986 | -        |       |        | -      | 181    | 742   | 724   |     | 1,647 |
| 1987 | -        |       | 2,514  | 2,514  | 220    | 813   | 955   |     | 1,988 |
| 1988 | -        | 38    | 7,389  | 7,427  | 186    | 1,455 | 780   | 53  | 2,474 |
| 1989 | 40       | 504   | 8,350  | 8,894  | 347    | 375   | 2,268 | 65  | 3,055 |
| 1990 | 4        | 283   | 16,701 | 16,988 | 810    | 1,089 | 2,546 | 90  | 4,535 |
| 1991 | 12       | 341   | 3,398  | 3,751  | 800    | 2,053 | 3,175 | 11  | 6,039 |
| 1992 | -        | 300   | 7,866  | 8,166  | 1,891  | 1,788 | 4,331 | 14  | 8,024 |
| 1993 | 5        | 489   |        | 494    | 359    | 1,908 | 2,733 |     | 5,000 |
| 1994 | 83       | 503   |        | 586    | 733    | 2,569 | 1,758 |     | 5,060 |
| 1995 | 2,025    | 479   |        | 2,504  | 548    | 2,215 | 1,389 |     | 4,152 |
| 1996 | 3,210    | 384   |        | 3,594  | 330    | 1,358 | 1,017 |     | 2,705 |
| 1997 | 3,862    | 337   |        | 4,199  | 707    | 3,507 | 2,311 |     | 6,525 |

DWLL: Distant-water longline fishery

OSLL: Offshore longline fishery

DN: Driftnet fishery

DWPS: Distant-water purse seine fishery

\* Offshore longline catches do not include the catches unloaded in the ports of foreign states

\*\* Bigeye and yellowfin data adopted from WPYR report and may be revised

Table 1. (continued)

| Year | Yellowfin |        |        |        | Swordfish |       |       |
|------|-----------|--------|--------|--------|-----------|-------|-------|
|      | DWLL**    | OSLL*  | DWPS   | TOTAL  | DWLL      | OSLL* | TOTAL |
|      | WP        | NP     | PAC    |        | NP        | NP    | NP    |
| 1964 | 124       |        |        | 124    | -         |       | -     |
| 1965 | 686       |        |        | 686    | -         |       | -     |
| 1966 | 2,115     |        |        | 2,115  | -         |       | -     |
| 1967 | 1,402     | 2,243  |        | 3,645  | -         | 261   | 261   |
| 1968 | 3,715     | 2,492  |        | 6,207  | -         | 281   | 281   |
| 1969 | 4,457     | 2,080  |        | 6,537  | 0         | 292   | 292   |
| 1970 | 3,305     | 2,070  |        | 5,375  | -         | 182   | 182   |
| 1971 | 6,939     | 2,021  |        | 8,960  | -         | 257   | 257   |
| 1972 | 6,826     | 1,613  |        | 8,439  | -         | 352   | 352   |
| 1973 | 5,383     | 8,225  |        | 13,608 | -         | 460   | 460   |
| 1974 | 3,758     | 9,724  |        | 13,482 | 1         | 460   | 461   |
| 1975 | 2,337     | 10,665 |        | 13,002 | 29        | 470   | 499   |
| 1976 | 2,534     | 10,915 |        | 13,449 | 23        | 487   | 510   |
| 1977 | 2,336     | 15,837 |        | 18,173 | 36        | 527   | 563   |
| 1978 | 3,755     | 19,032 |        | 22,787 | -         | 436   | 436   |
| 1979 | 3,523     | 23,600 |        | 27,123 | 7         | 608   | 615   |
| 1980 | 3,707     | 19,166 |        | 22,873 | 10        | 679   | 689   |
| 1981 | 1,850     | 17,747 |        | 19,597 | 2         | 567   | 569   |
| 1982 | 916       | 16,263 |        | 17,179 | 1         | 758   | 759   |
| 1983 | 750       | 15,986 | 1,884  | 18,620 | 0         | 798   | 798   |
| 1984 | 890       | 16,747 | 3,413  | 21,050 | -         | 954   | 954   |
| 1985 | 897       | 14,328 | 3,972  | 19,197 | -         | 742   | 742   |
| 1986 | 582       | 11,668 | 4,876  | 17,126 | -         | 652   | 652   |
| 1987 | 821       | 17,127 | 6,325  | 24,273 | 3         | 1,515 | 1,518 |
| 1988 | 1,530     | 17,920 | 8,340  | 27,790 | -         | 1,041 | 1,041 |
| 1989 | 827       | 12,683 | 13,732 | 27,242 | 50        | 1,491 | 1,541 |
| 1990 | 1,504     | 13,845 | 20,494 | 35,843 | 143       | 1,309 | 1,452 |
| 1991 | 1,116     | 10,122 | 32,025 | 43,263 | 40        | 1,390 | 1,430 |
| 1992 | 1,384     | 11,814 | 46,269 | 59,467 | 21        | 1,473 | 1,494 |
| 1993 | 582       | 14,133 | 58,642 | 73,357 | 77        | 1,174 | 1,251 |
| 1994 | 1,771     | 12,915 | 43,065 | 57,751 | 21        | 1,155 | 1,176 |
| 1995 | 1,523     | 16,122 | 30,504 | 48,149 | 142       | 1,135 | 1,277 |
| 1996 | 833       | 10,031 | 16,372 | 27,236 | 21        | 1,130 | 1,151 |
| 1997 | 1,079     | 9,419  | 48,792 | 59,290 | 20        | 2,177 | 2,197 |

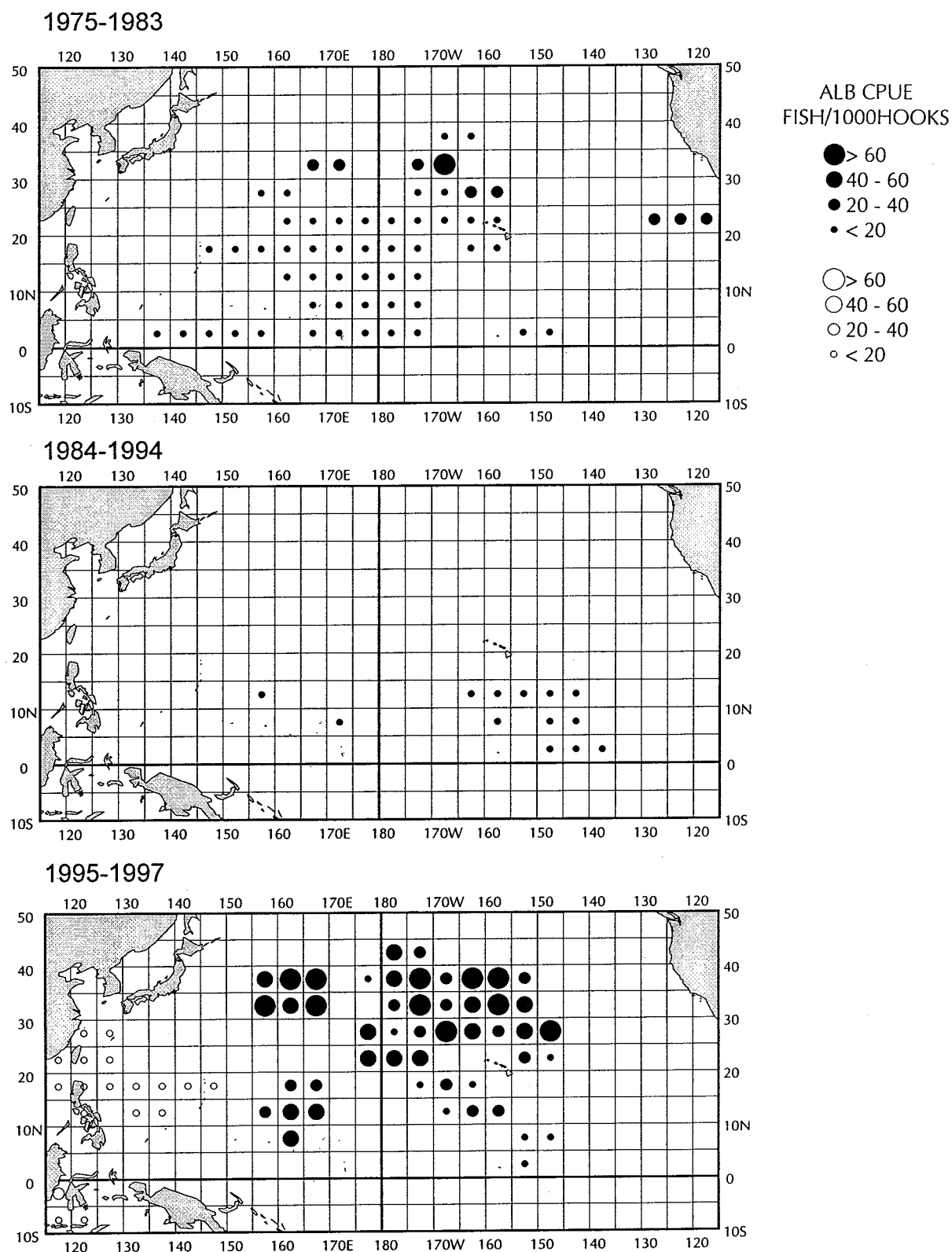


Fig. 1. North Pacific albacore CPUE distribution of Taiwan distant-water longline fishery (solid circle) and offshore longline fishery (empty circle) of 1975-1983, 1984-1994, 1995-1997.

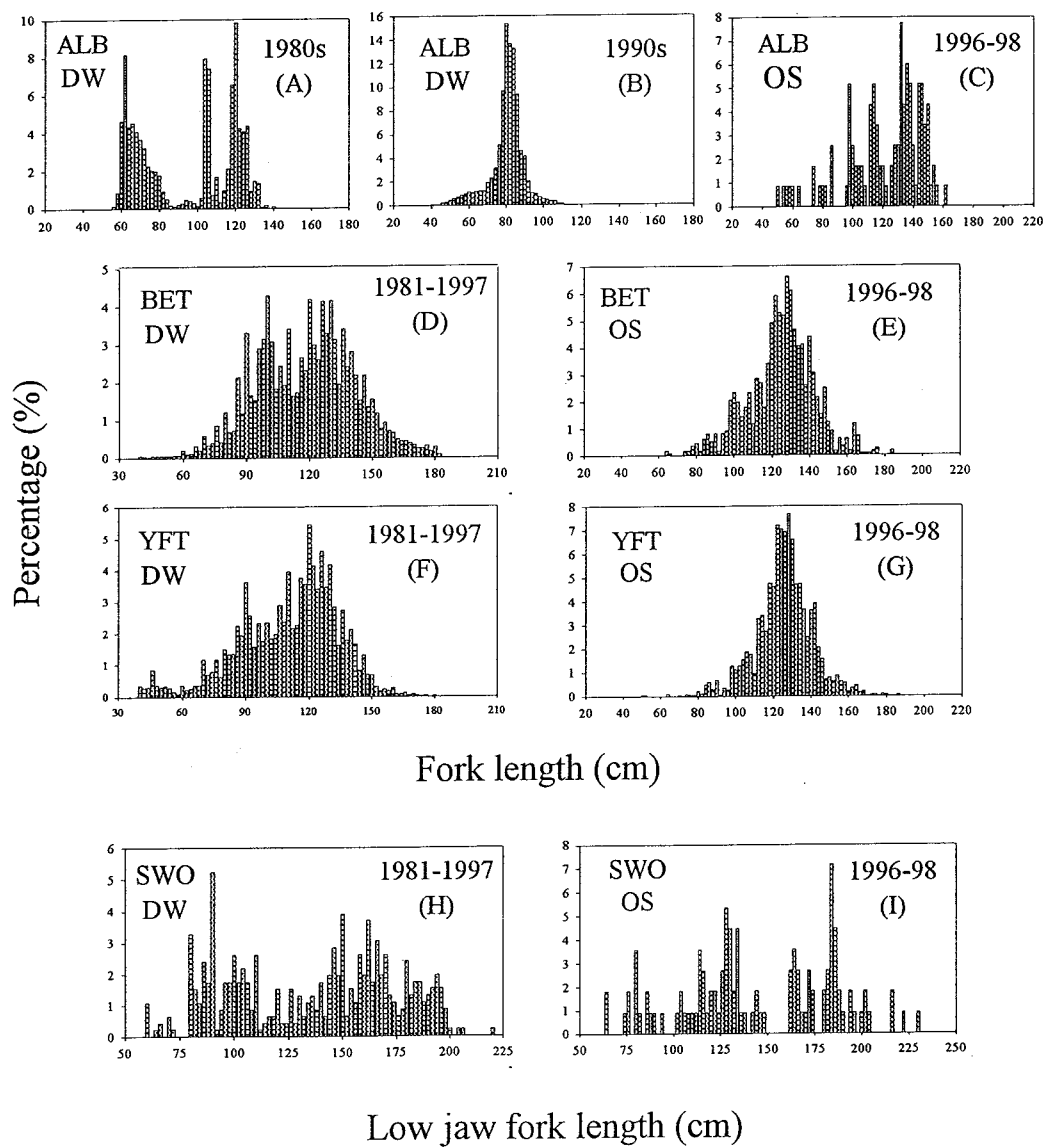


Fig. 2. Length frequency distribution of North Pacific albacore (A-C), Pacific bigeye (D-E), yellowfin (F-G) and North Pacific swordfish (H-I) caught in the Taiwan distant-water (DW) and offshore (OS) longline fisheries during different time periods.

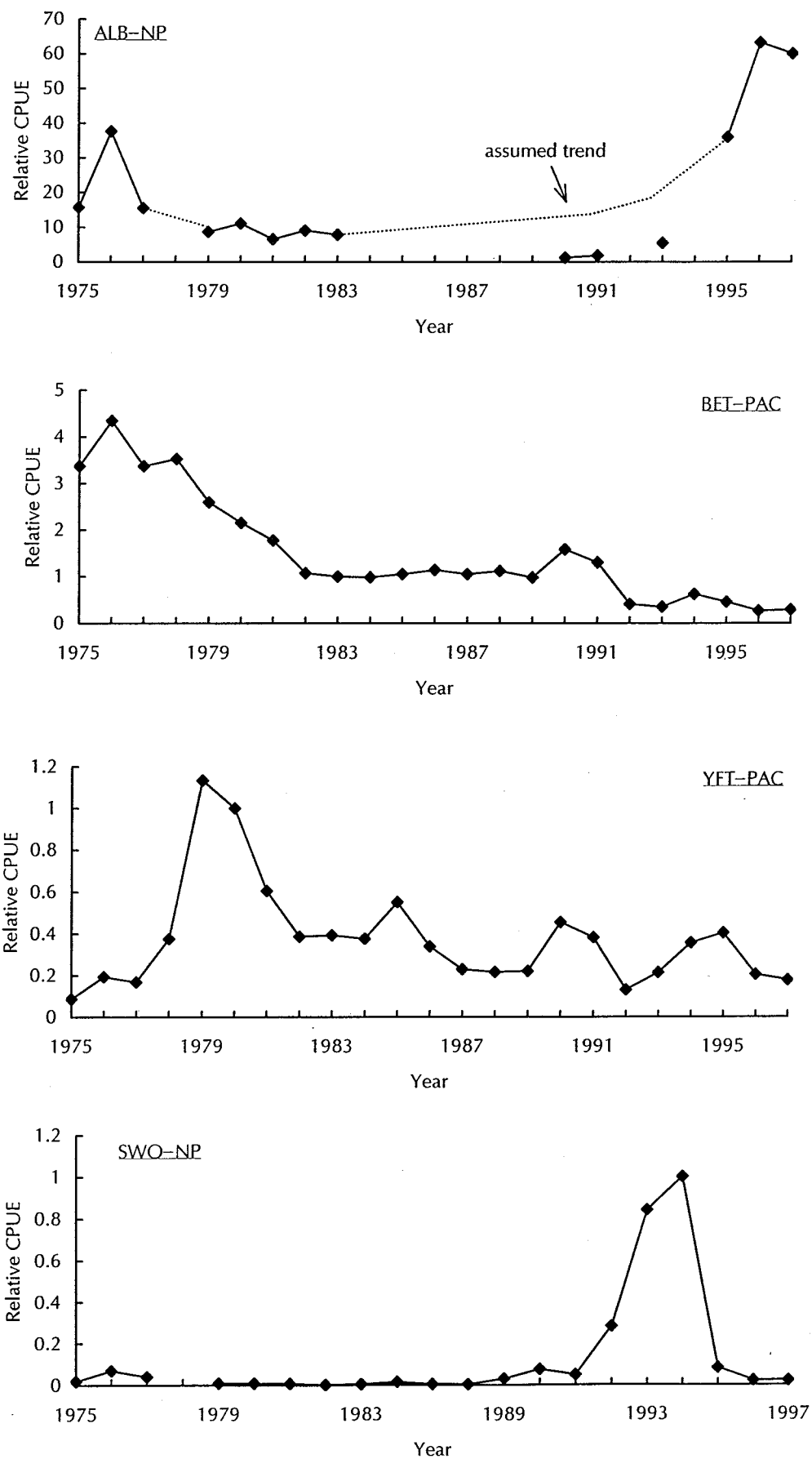


Fig. 3. Relative CPUE of albacore (North Pacific), bigeye (whole Pacific), yellowfin (whole Pacific), and swordfish (North Pacific). Except for albacore, the other CPUEs have been standardized.  
(Preliminary results)

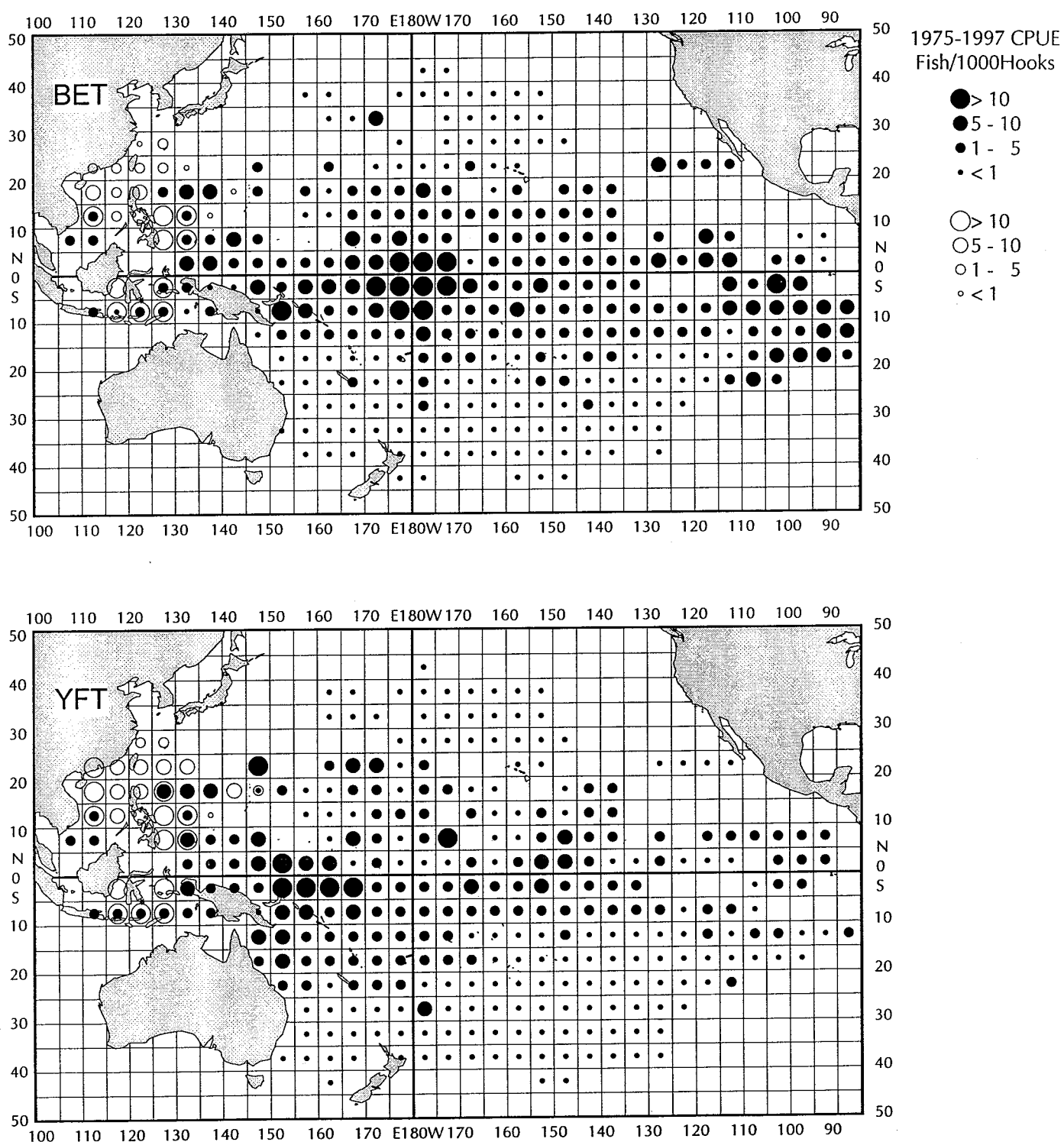
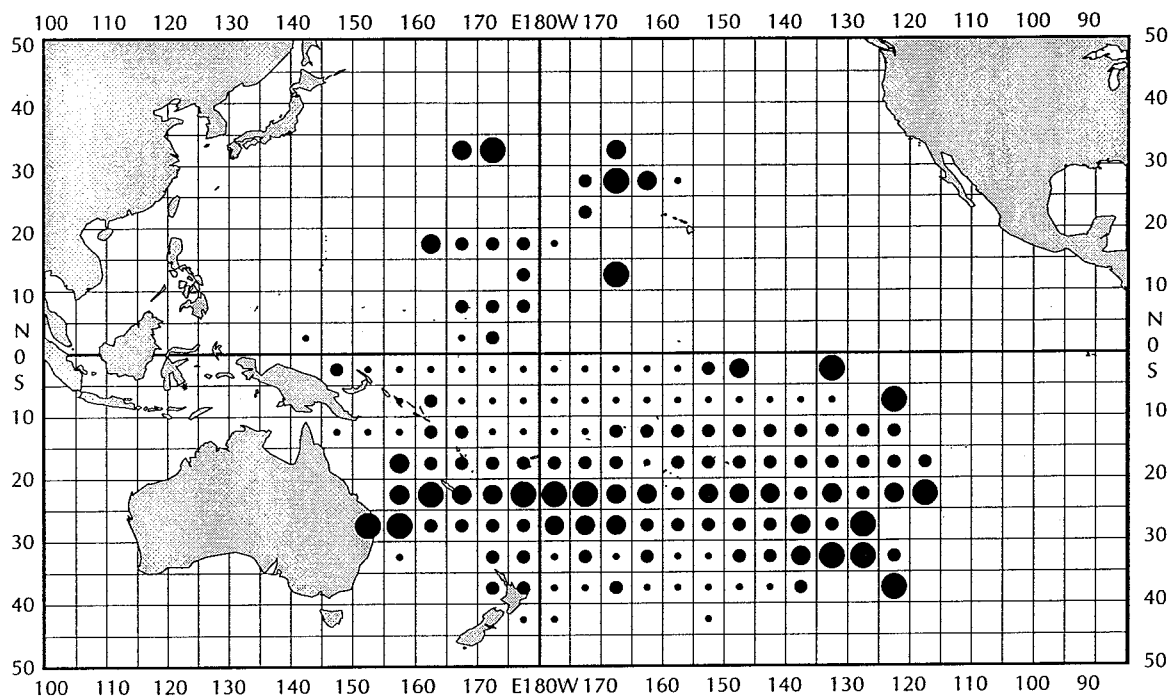


Fig. 4. Pacific bigeye and yellowfin CPUE distribution of Taiwan distant-water longline fishery (solid circle) and offshore longline fishery (empty circle) of 1975-1997. (The bigeye CPUE of distant water longline fishery may have included some data from offshore longline fishery targeting on bigeye.)

1964-1978



1979-1997

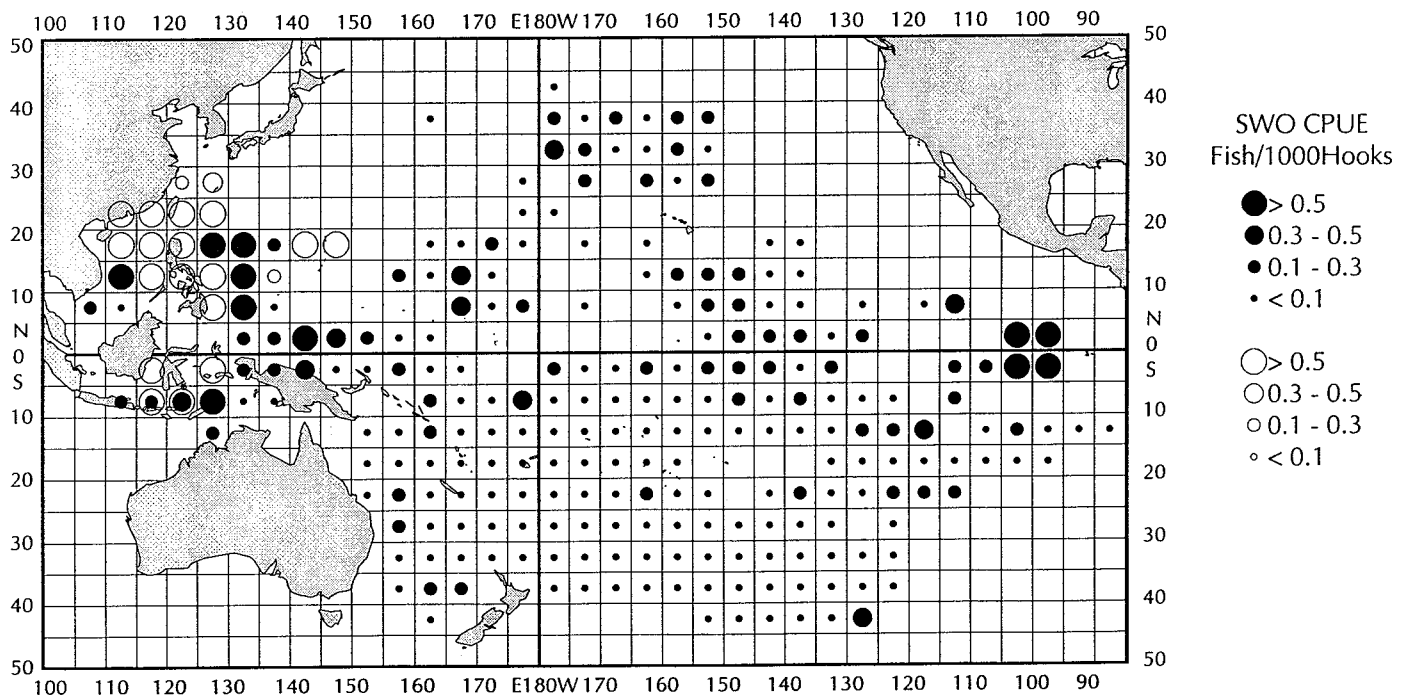


Fig. 5. Pacific swordfish CPUE distribution of Taiwan distant-water longline fishery (solid circle) and offshore longline fishery (empty circle) of 1964-1978 and 1979-1997.