WP 1

TAIWAN'S TUNA LONGLINE FISHERIES OPERATING IN SOUTH PACIFIC OCEAN

by

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1. INTRODUCTION

Roughly speaking, the exploitation of tunalike fishes are divided into two parts, i.e. inshore fishery and far seas fishery, This classification is traditionally according to the gross tonnage of the fishing boats which are whether or not over 50 gross tonnage.

Inshore ~~fishery~~ fisheries include purse seine, gill net, miscellaneous fish longline, troll line and tuna longline. Among them, tuna longline is the most important fishery in exploitation of tunalike fishes. On the other hand, far seas ~~fishery~~ fisheries contain three types only, i.e. large purse seine, large mesh gill net and tuna longline. Among them, only tuna longliners are on target of tunas.

Catch compositions of these two tuna longlines are roughly classified into tunas, billfish and others. According to the catch statistics of Taiwan Fisheries Bureau (1985), ~~tunas~~ tunalikes occupied 80 percent of total catch of inshore tuna longliners, and in far seas, over 95 percent are of tunalikes.

Here, tunalikes include tunas, billfishes and other miscellaneous fishes. Tunas include albacore, yellowfin, bigeye, bluefin and other small tunas.

This paper is a review of recent decade of Taiwan's tuna longline fisheries operating in Pacific Ocean, especially in South Pacific ocean.

2. INSHORE TUNA LONGLINE FISHERY

During the recent decade (1975 - 1984), annual productions of tunas of all inshore fisheries are over twenty thousands MT. As shown in Fig. 1, about 90 percent of the total catch of tunas in inshore fisheries are exploited by inshore tuna longliners.

Table 1 shows the annual productions and catch compositions of inshore tuna longliners. In 1975, total catch of tuna longliners has been over sixty thousands MT. It shows a significant decrease in this

decade. In 1984, total catch is just over thirty thousands MT. This decrease may be due to the variations of miscellaneous fishes, especially for sharks. Annual production of sharks was over 25000 MT in 1975. But, in 1984, it is 3420 MT only. Comparatively, the variations of tunas and billfishes are rather stable (Fig.2).

As shown in Fig. 3, yellowfin is the most important species in tunas. Albacore occupies lower than 3 percent only.

Table 2 shows the yearly variations of Taiwan's inshore tuna longline fishing boats. The number of boats below 20 gross tonnage varies in 1100 boats level up and down. But, those over 20 gross tonnage shows a remarkable increase in recent years. It is 782 boats in 1984. And, in 1975, there is 267 boats only. This implies a rapid extension of inshore tuna longline fishing grounds. Regretly, no long series of detail information about the variations of inshore longline fishing grounds are available.

A survey of inshore tuna longline fishing grounds was carried out in 1980 (Yang et al, 1982). As shown in Fig. 4, tuna longliners operate in South China Sea during January to May. Then, they move to south-western Pacific Ocean gradually. It also shows a seasonal movement from north to south. In September and October, longliners concentrate on the lower latitude area. Then, they go through Banda Sea, Celebes Sea, Sulu Sea, and returned to South China Sea.

As pointed out by Wang (1986a), since the target species is yellowfin, variations of inshore tuna longline fishing grounds may be dependent on the movement of yellowfin population.

As shown in Fig. 5, it shows a significant negative linear

relationship between CPUE and fishing efforts of total catch. This is the similar type of variation of yellowfin (Fig. 6).

Compared to yellowfin, albacore shows a very differnet type of fluctuation (Fig. 7). Before 1980, it reveals a decreasing tendency. but from 1980 to 1984, it shows a steeply increasing. For this phenomenon, two reasons are considered. Firstly, albacore is not the target species of inshore longliners. Only a few of information are available from tuna longliners. This fluctuation may be due to the catch of albacore by chance only. Secondly, as shown in Table 2, increase of larger fishing boats implied a rapid extension of fishing grounds. Before 1980, only a few of boats are larger than 20 gross tonnage, hence, fishing grounds may be mainly limited in North Pacific Ocean. This means they may ~~be on target of~~ catch the North Pacific albacore only. After 1980, traditional north Pacific fishing grounds adjacent to Taiwan area become crowded and sharply contested due to the steep increaseing of larger boats. Hence, they try to cruise farther toward southern hemisphere. And, they may be near or evenly cross over equator to exploit the south Pacific albacore population. Exploitation on different populations implies different types of fluctuation.

3. FAR SEAS TUNA LONGLINE FISHERY

Fig. 8 shows the variations of annual productions of Taiwan's far seas tuna longliners operating in South Pacific Ocean. A remarkable decreasing tendency may be found in this figure except 1980. In 1984, total catch is near fifteen thonsands MT. The percentage of which exploited in South Pacific Ocean with respect to the total catch of all of the world also reveals a similar tendency. This means a steady decrease of the importance of the Pacific fishing grounds. In 1984,

only 15 percent of catch of far seas longliners are exploited from Pacific Ocean.

In 1980, hooks used in Pacific Ocean also shows a significant increase (Fig. 9). Relatively, there is a considerable decreasing in Atlantic Ocean in this year. Hence, increase of Pacific Ocean may be due to the decrease of hooks used in Atlantic Ocean. Japan's far seas longliners operating in South Pacific Ocean varied in a similar type in 1980. This may be due to the higher hooking rates in Pacific Ocean in preceding years. And, in order to lighten the oil shock, they shifted to South Pacific Ocean.

Catch compositions of South Pacific Ocean are shown in Fig. 10. High percentage of albacore is remarkable. Over 80 percent of total catch in number are of albacore. This is clearly very different from the inshore tuna longliners for which a rather high percentage are of yellowfin.

As shown in Table 3, a prosperous development of Pacific tuna longliners can be found during 1976 to 1980. In this period, over one hundred and fifty tuna longline boats are operating in Pacific Ocean. Almost all of them belong to 100 - 200 tonnage class. After 1981, the number of boats decreased gradually and there is 61 boats in 1984 only. On the other hand, operation by Taiwan (Kaohsiung)-based port increase rapidly in recent years. There is 295 boats in 1984. This is near 5 times of which based on abroad.

Fig. 11 shows the relationship of CPUE in hooking rates and efforts in hooks used for albacore during the recent decade. It varies in a rather stable level. The regression coefficient is $r = 0.0658^{ns}$ with d.f. = 8 for 5 % significance level. It implies that the results are not so suitable for surplus production analysis.

Yearly variations of fishing grounds are shown in Fig. 12. This is a distribution of hooks used expressed by 5°-square and by year. Only a few number of longliners operated in North Pacific Ocean. Main fishing grounds concentrate on South Pacific Ocean, especially between 20°S and 40°S in latitude.

4. FUTURE RESEARCH

Because of that not so much biological data are accumulated and the coverage of catch statistics of Taiwan's far seas tuna longliners are rather low in early years, we haven't assessed south Pacific albacore stock. On the other hand, since yellowfin is the most important target species of Taiwan's inshore tuna longliners, we made more studies about the yellowfin population (Yang et al, 1970a; 1970b; Wang et al, 1970; Chi et al, 1971; Yang, 1971; Huang et al, 1972; Chen et al, 1973; Huang et al, 1974; Sun et al, 1983; Wang 1986a).

We prepare to study South Pacific albacore by following procedures:

(1). To estimate the effective fishing efforts.

We have finished the estimation of effective fishing efforts of Indian albacore in this year (Huang et al, 1986). We shall use the same method to analyze the south Pacific albacore from July, 1986.

(2). Length frequency analysis.

We began to collect length composition data from 1979. As shown in Table 4, over one million individuals of fork length were measured by commercial fishing boats during 1979 to 1984. These data need a rather long time to check the reliability. If we have enough time and manpower, and if these data are rather ~~believable~~ reliable, we will try to use the method proposed by Wang (1985) to decompose length compostion data into catch-at-age data. Based on these data we shall estimate the natural mortality and catchability and hence, fishing mortality and population density will be estimated by ACC-method (Wang, 1984; 1986b).

(3) Stock assessment of South Pacific Ocean albacore.

MCA-method (Wang, 1985) will be applied to the stock assessment of South Pacific Ocean albacore population. Recruitment and reproduction curve will be discussed based on the results of MCA-method too.

In order to obtain more reliable assessment of South Pacific Ocean albacore, classical mehtod, like as surplus production model, Beverton and Holt method also be used to recheck the results of those methods described above.

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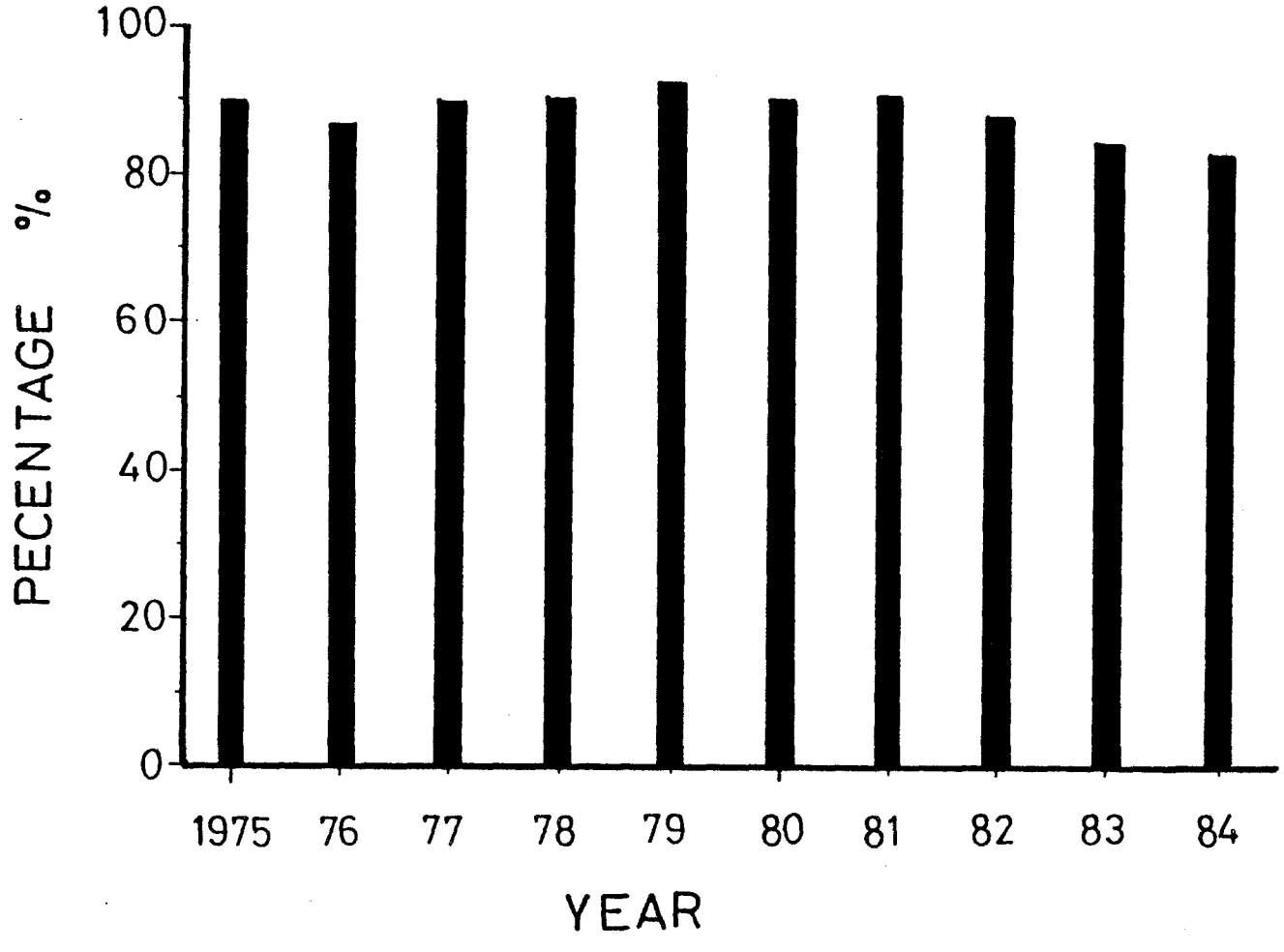


Fig. 1. Percentage variations of catch in tunas of tuna longliners with respect (those of) to the total inshore fisheries.

Table 1. Yearly variations of the inshore tuna longline productions and catch compositions.

unit of catch : MT

Year	Total	Tunas	Billfish	Sharks	Albacore	Bigeye	Yellowfin	Bluefin	Little tuna
1975	60720	19617	7353	25423	254	3787	13539	5	2032
in %		32.31	12.11	41.87	1.29	19.30	69.02	0.03	10.36
1976	57183	18853	4155	22431	565	1628	12425	9	4226
in %		32.97	7.27	39.23	3.00	8.64	65.90	0.05	22.42
1977	49811	21002	5243	13205	301	1169	16471	122	2938
in %		42.16	10.53	26.51	1.43	5.57	78.43	0.58	13.99
1978	43010	22397	6101	9283	278	1780	19165	60	1114
in %		52.07	14.19	21.58	1.24	7.95	85.57	0.27	4.97
1979	42222	26004	5191	4413	106	2099	22629	47	1123
in %		61.59	12.29	10.45	0.41	8.07	87.02	0.18	4.32
1980	39047	19960	4387	1892	39	871	18265	38	747
in %		51.12	11.24	4.85	0.20	4.36	91.51	0.19	3.74
1981	32116	19782	5369	2935	163	1150	17778	0	691
in %		61.60	16.72	9.14	0.82	5.81	89.87	0.00	3.49
1982	34093	19149	5574	4761	521	777	16508	201	1142
in %		56.17	16.35	13.96	2.72	4.06	86.21	1.05	5.96
1983	34153	18879	5924	4751	512	876	16260	173	1058
in %		55.28	17.35	13.91	2.71	4.64	86.13	0.92	5.60
1984	32436	19316	4893	3420	471	1034	16107	379	1325
in %		59.55	15.09	10.54	2.44	5.35	83.39	1.96	6.86

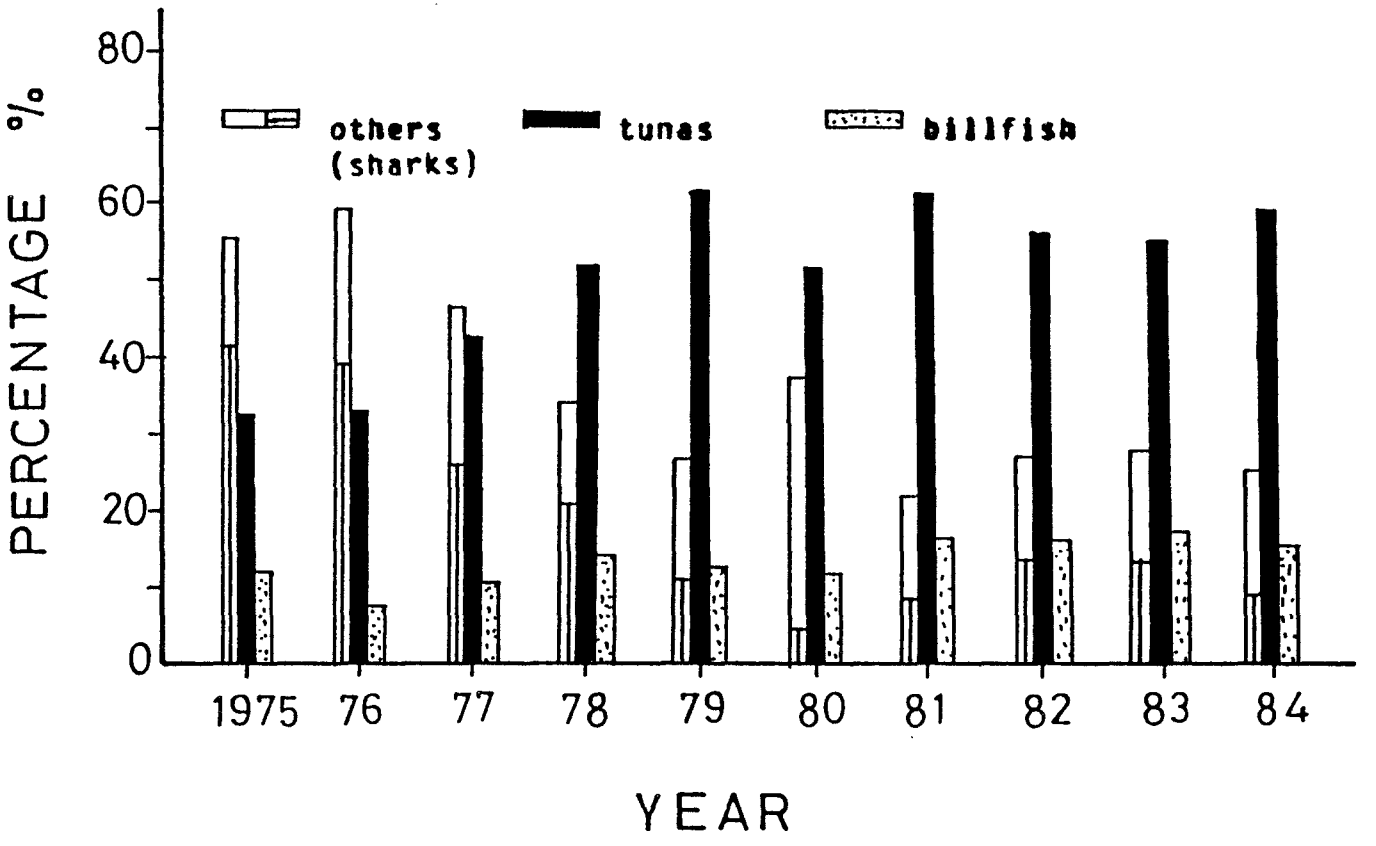


Fig. 2. Percentage variations of catch compositions of inshore tuna longliners during the recent decade (1975-1984).

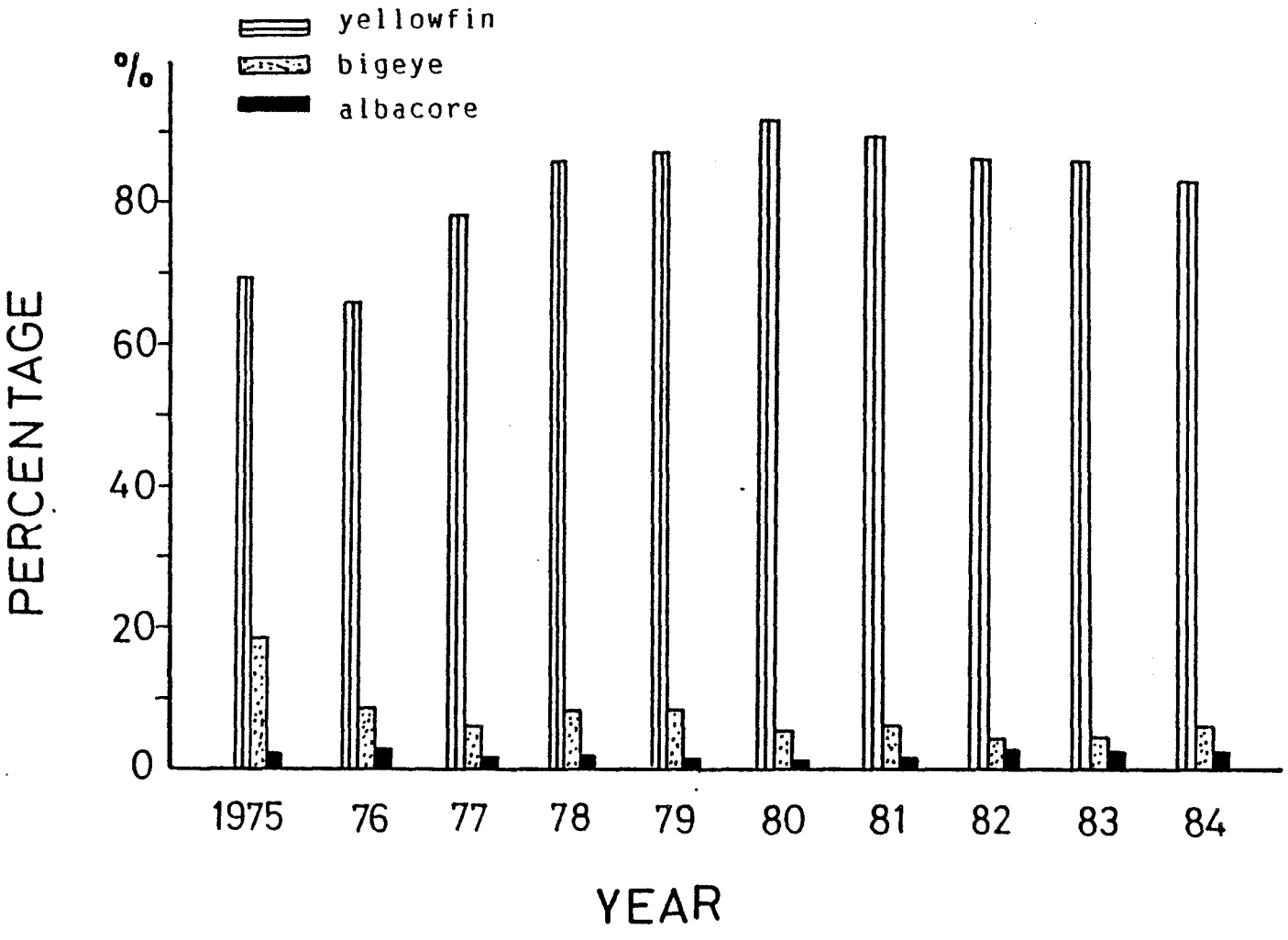


Fig. 3. Percentage variations of three main species of tunas in inshore tuna longliners (1975-1984).

Table 2. Yearly variations of tonnage class of Taiwan's inshore tuna longline fishing boats. (1975 - 1984)

Year	Total	Below 5T	5 - 10T	10 - 20T	20 - 50T	Tonnage	Average
1975	1411	78	462	604	267	23339	16.54
1976	1331	82	392	604	253	23374	17.56
1977	1382	67	380	635	300	24773	17.93
1978	1670	71	378	664	557	33259	19.92
1979	1840	75	300	695	770	41500	22.55
1980	1900	251	213	627	809	41893	22.05
1981	1846	251	213	583	799	42360	22.95
1982	1831	251	207	605	768	41457	22.64
1983	1872	251	208	669	744	41896	22.38
1984	1944	251	216	695	782	43553	22.40

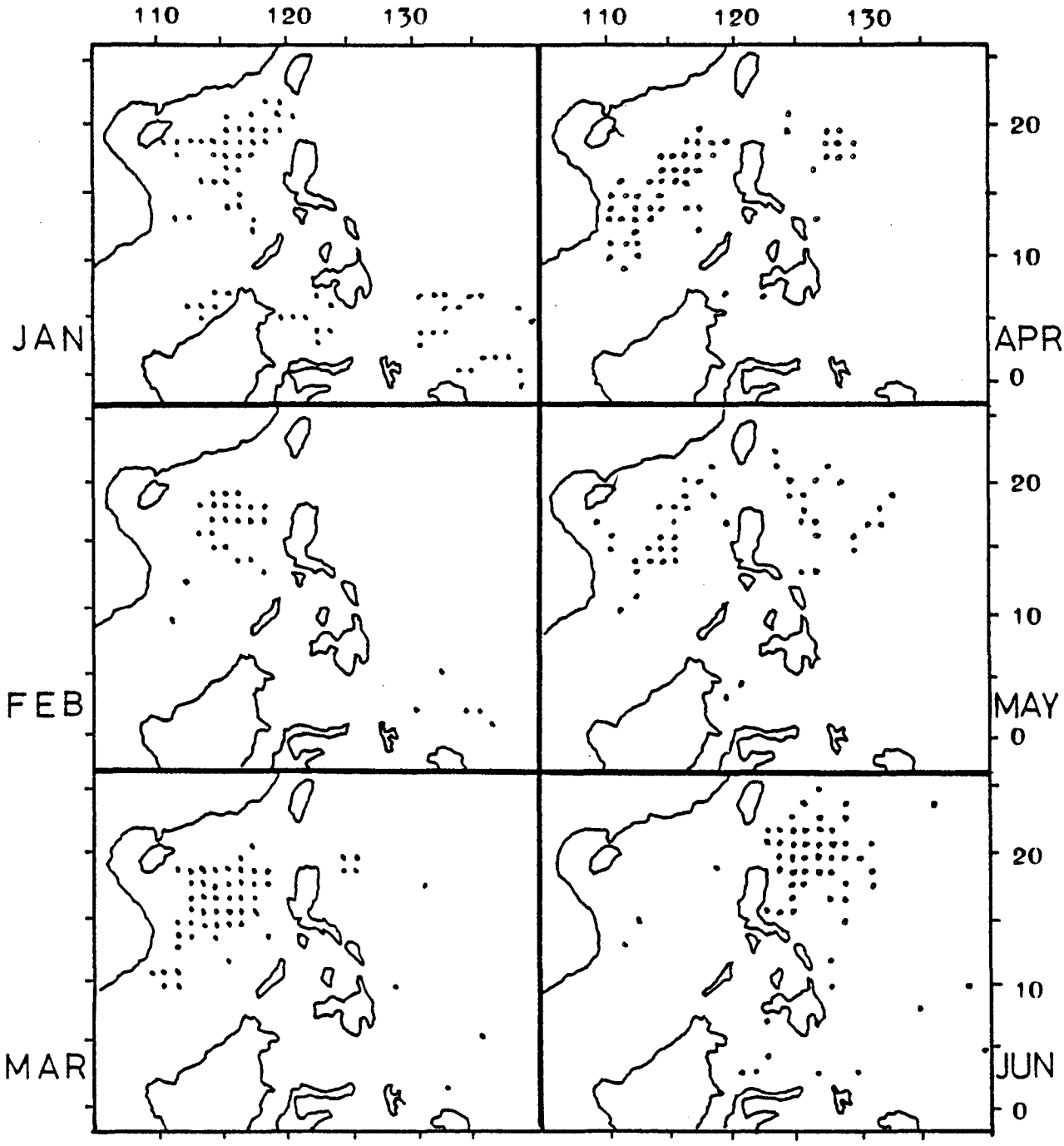
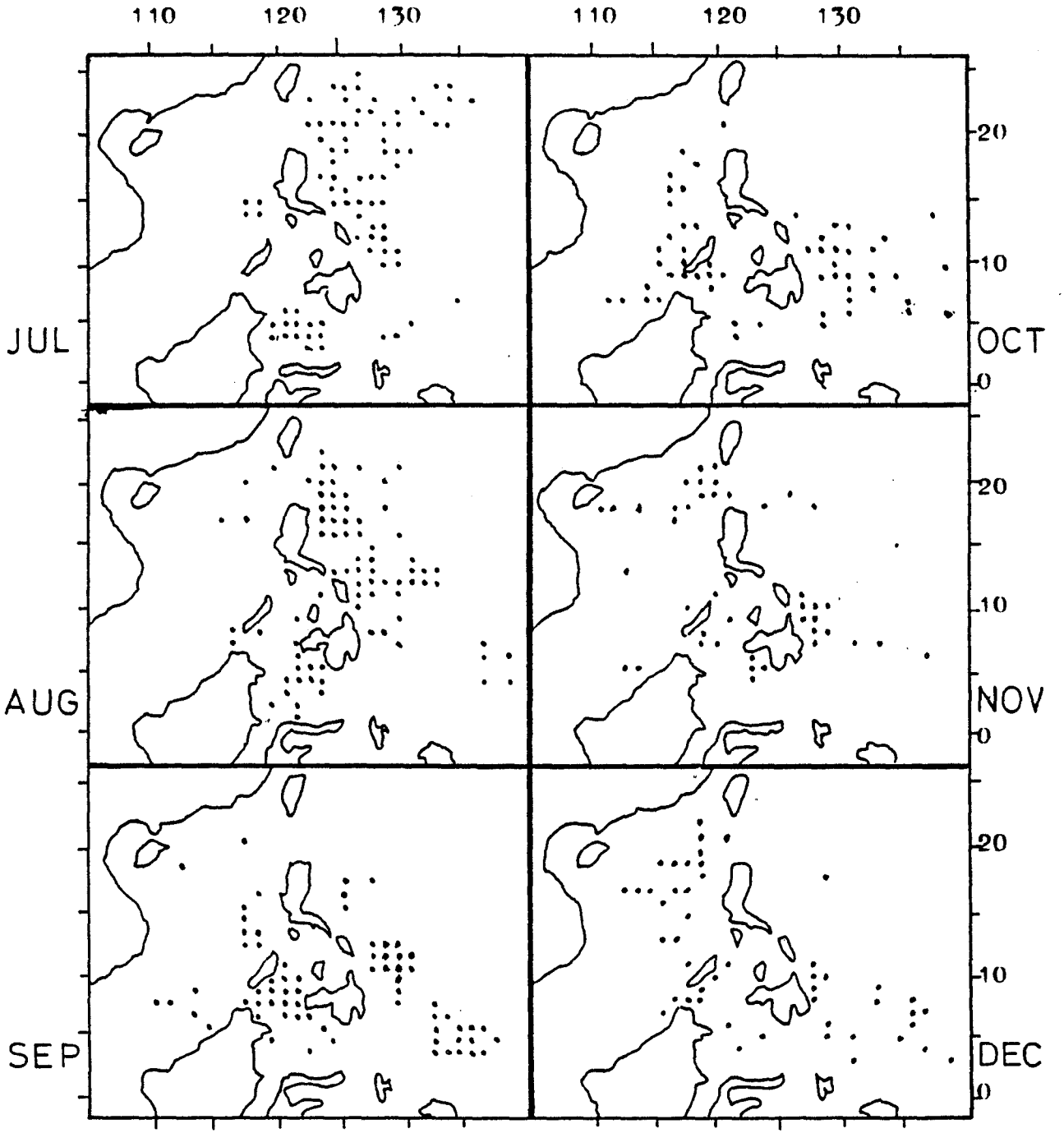


Fig. 4. Seasonal variations of inshore tuna longline fishing grounds. (adopted from Yang et al, 1982, Fig. 1)



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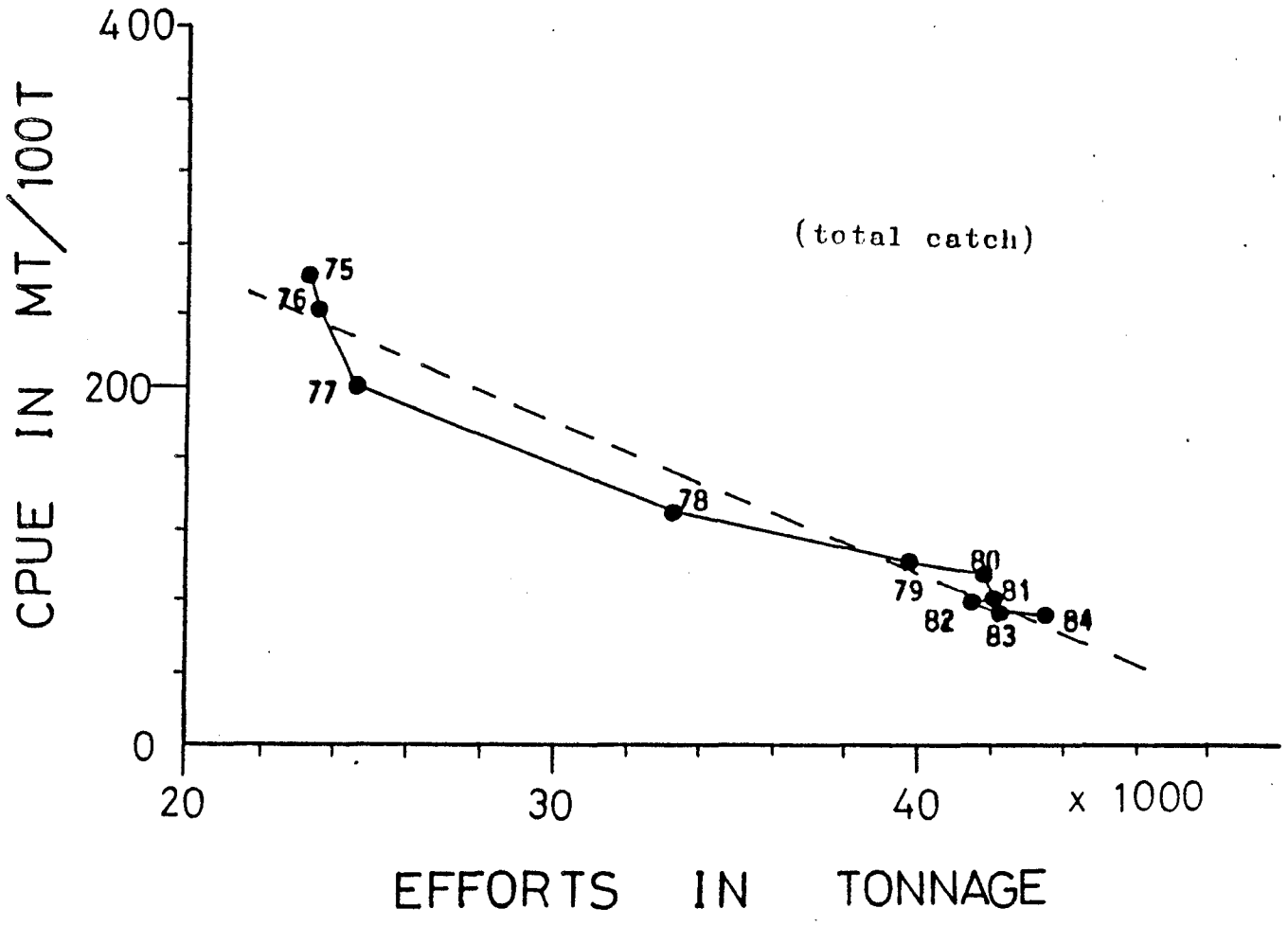

Fig. 5. Relationship of CPUE and fishing efforts of inshore longliners.

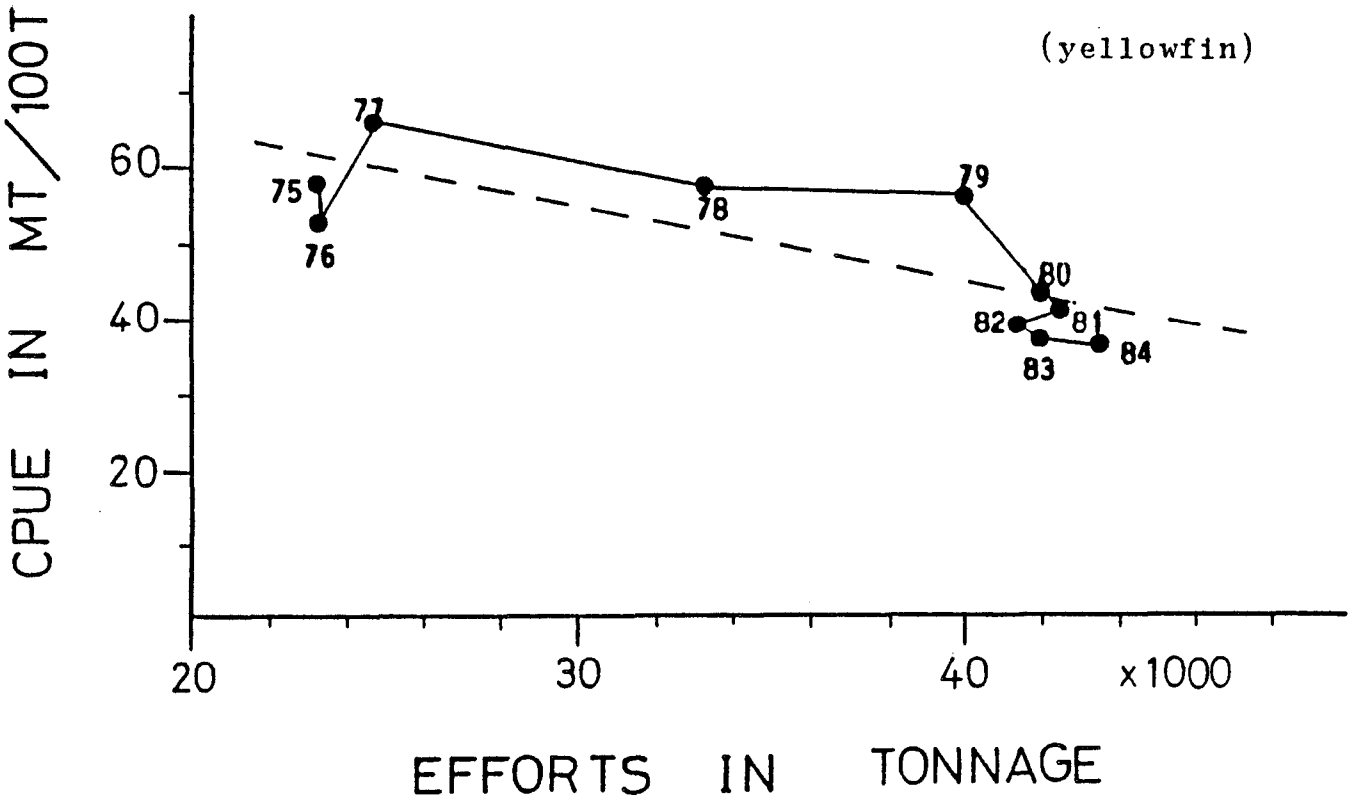

Fig. 6. Relationship of CPUE and fishing efforts of inshore longliners.

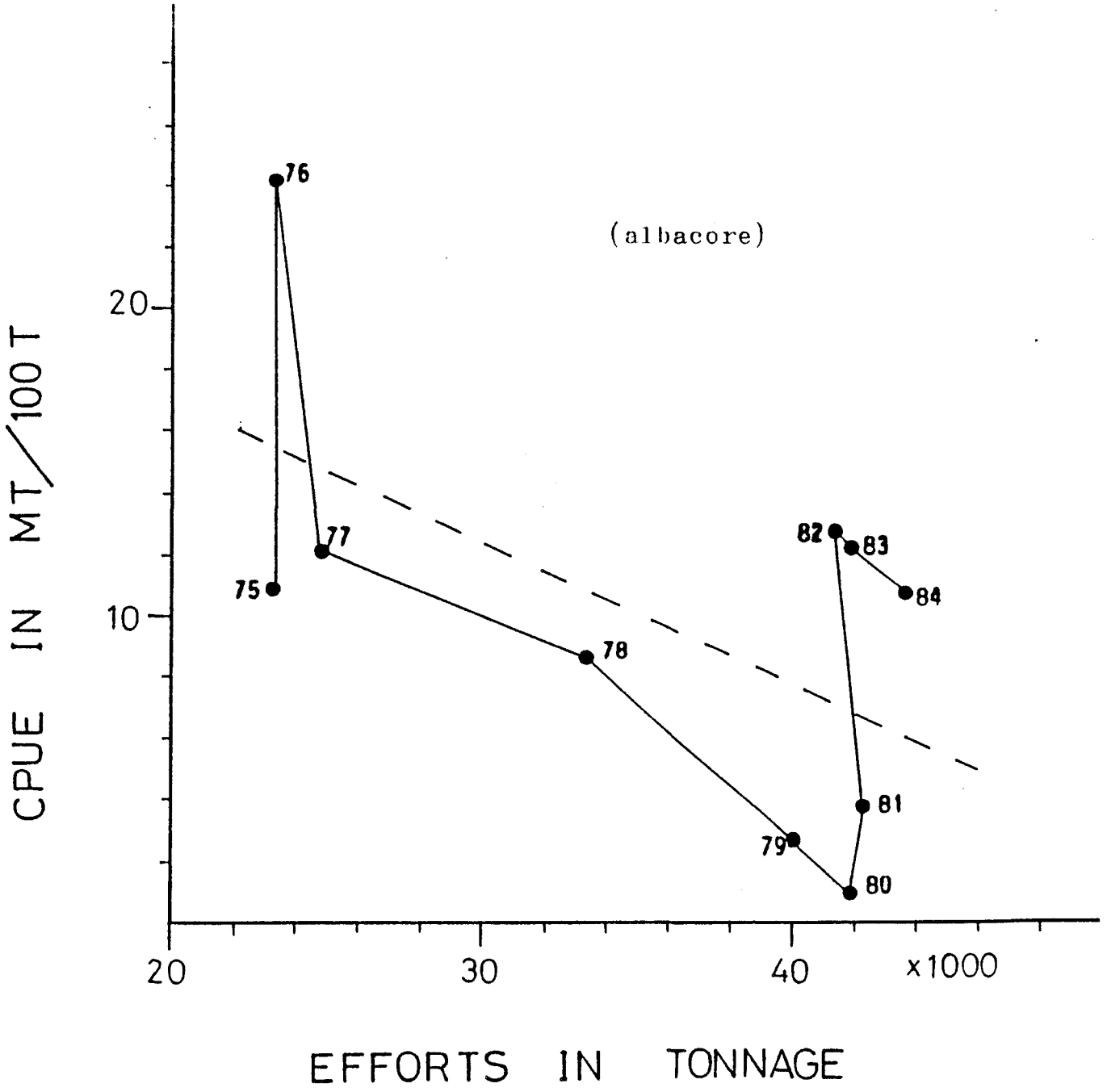

Fig. 7. Relationship of CPUE and fishing efforts of inshore longliners.

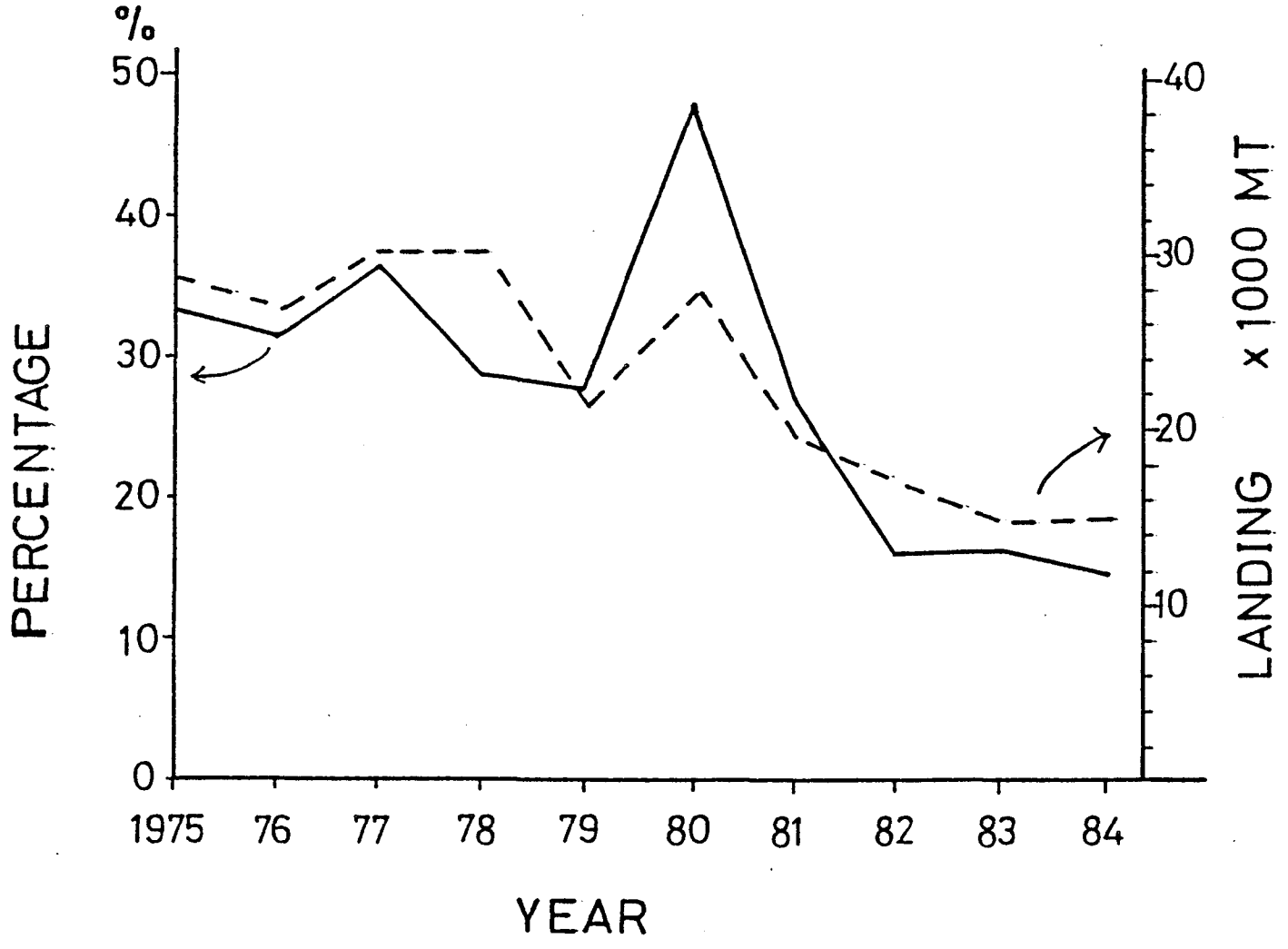

Fig. 8. Yearly variations of total catch expressed in percentage and in weight exploited by Pacific tuna longliners. (1975 - 1984)

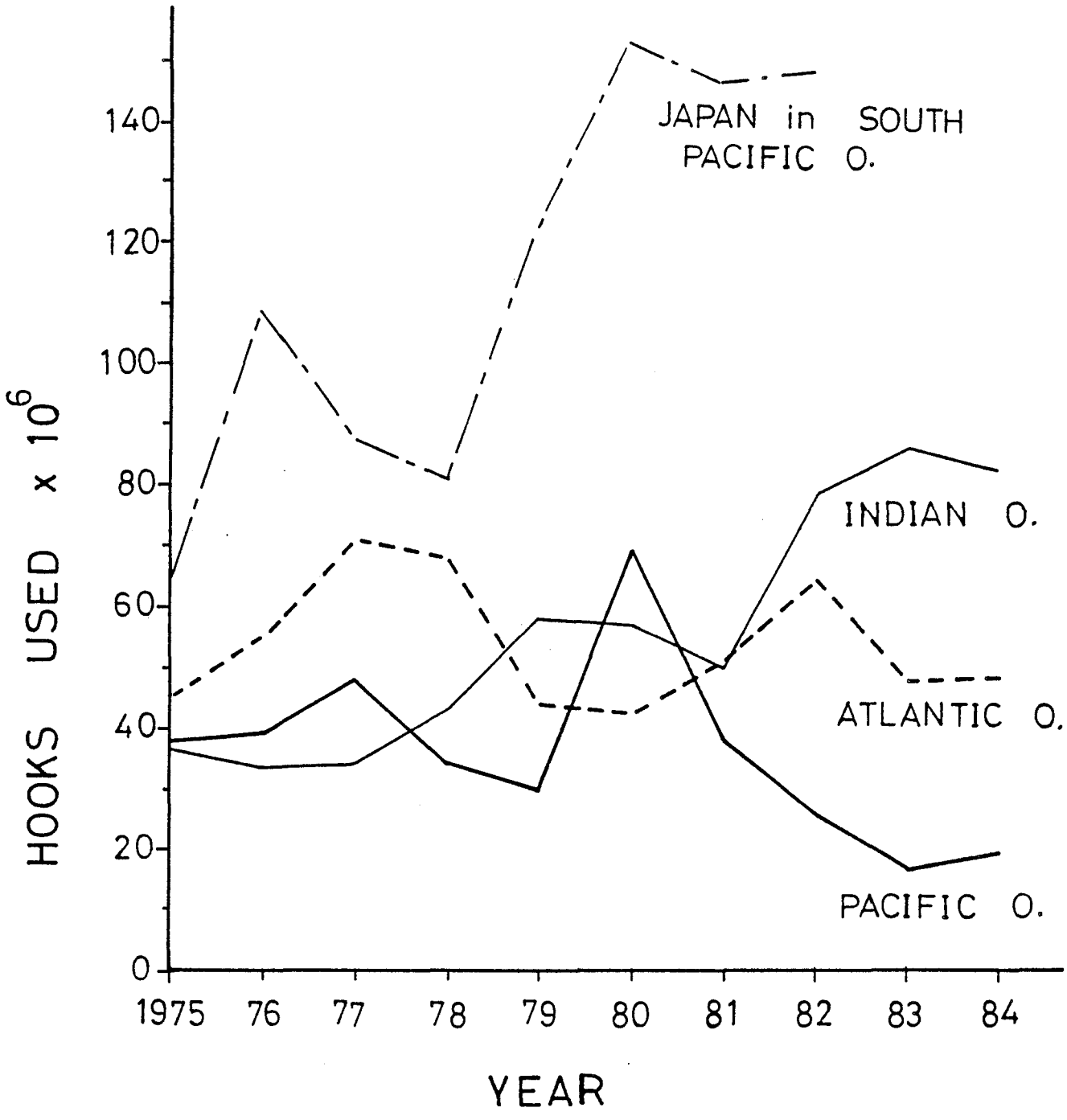

Fig. 9. Yearly variations of hooks used of far seas tuna longliners. (1975 - 1984)

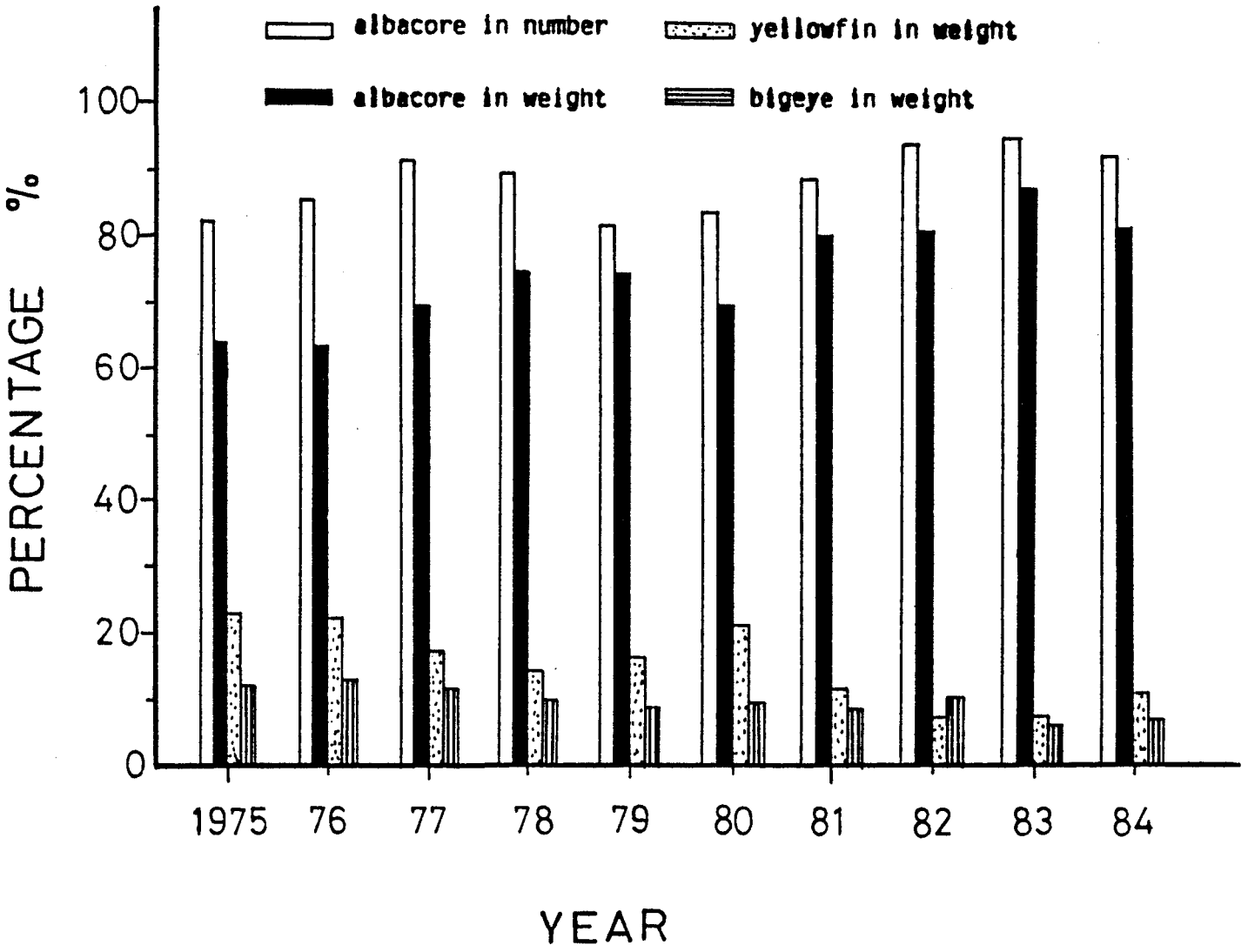

Fig. 10. Yearly variations of three main species of tunas exploited by Pacific tuna longliners. (1975 - 1984)

Table 3. Yearly variations of tonnage class of Taiwan's far seas tuna longline fishing boats operating in the Pacific Ocean. (1975 - 1984)

Year	Total	50 - 100T	100 - 200T	200 - 500T	over 500	Tonnage average	Kaonsiung*
1975	92	6	68	18	0	15745 171.15	-
1976	194	11	148	35	0	33108 170.66	-
1977	176	11	141	24	0	29079 165.22	137
1978	168	11	133	23	1	27689 164.81	134
1979	157	7	121	28	1	27369 174.32	185
1980	182	5	140	36	1	32791 180.17	189
1981	140	2	114	24	0	24898 177.84	194
1982	115	1	92	22	0	20216 175.79	173
1983	65	0	55	10	0	10989 169.06	253
1984	61	0	51	10	0	10816 177.32	295

* Including the boats which return from Indian and Atlantic Oceans, and most of them may be shifted to other fisheries or laid off in Kaohsiung.

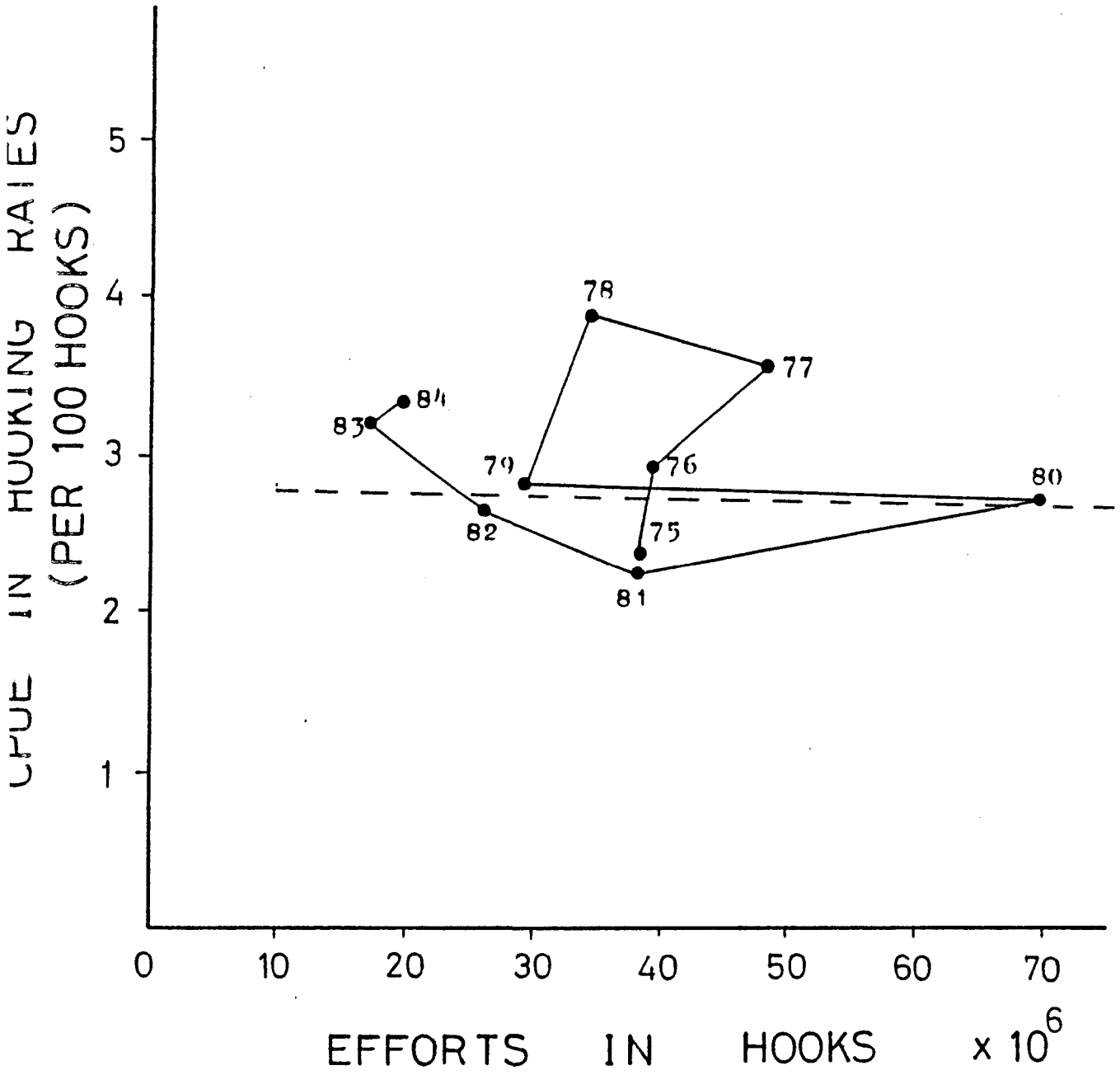

Fig. 11. Relationship of CPUE and fishing efforts of albacore exploited by Taiwan's far seas tuna longliners operating in Pacific Ocean. (1975 - 1984)

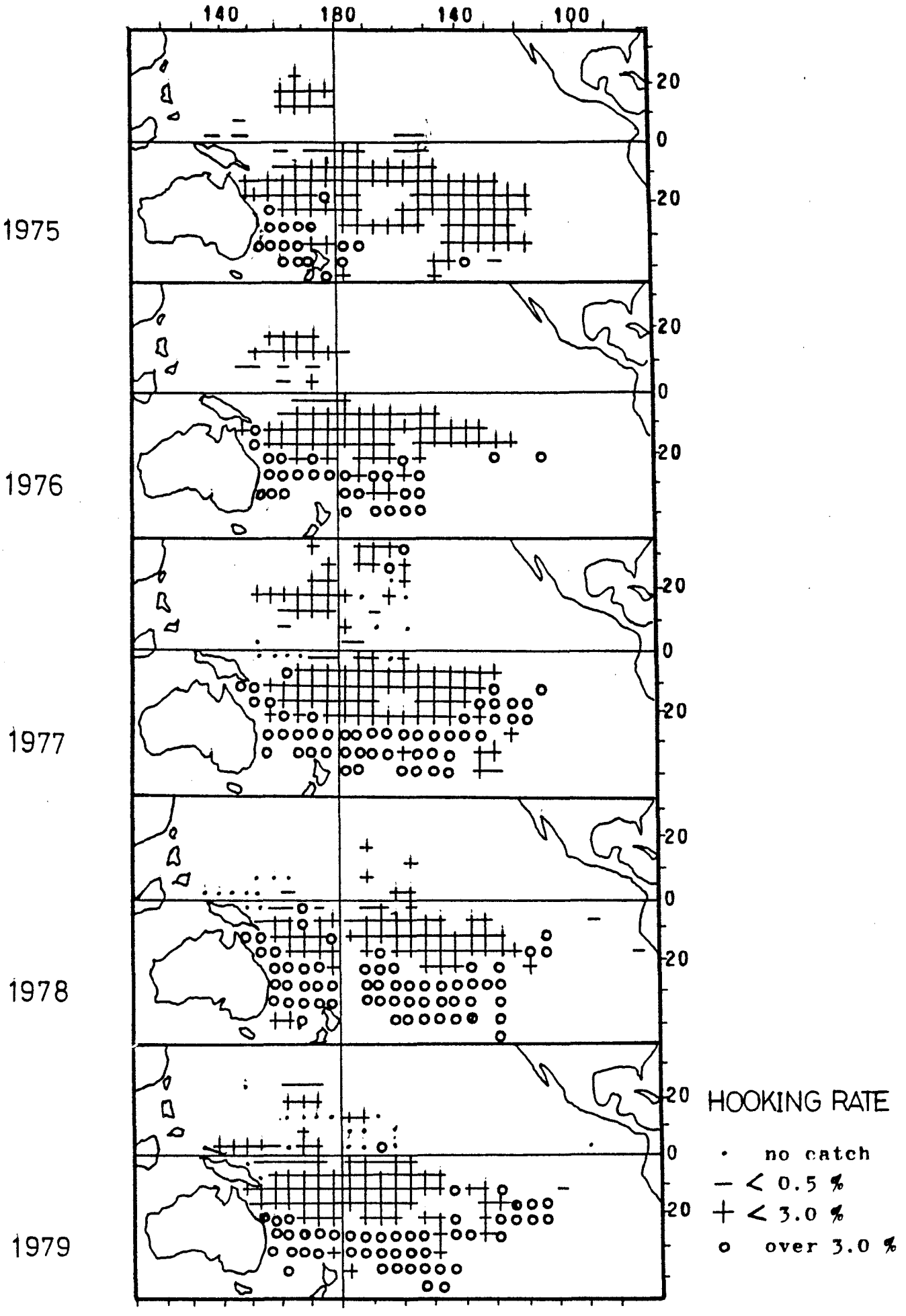

Fig. 12. Yearly variations of Taiwan's far seas tuna longline fishing grounds operating in Pacific Ocean. (1975-1984)

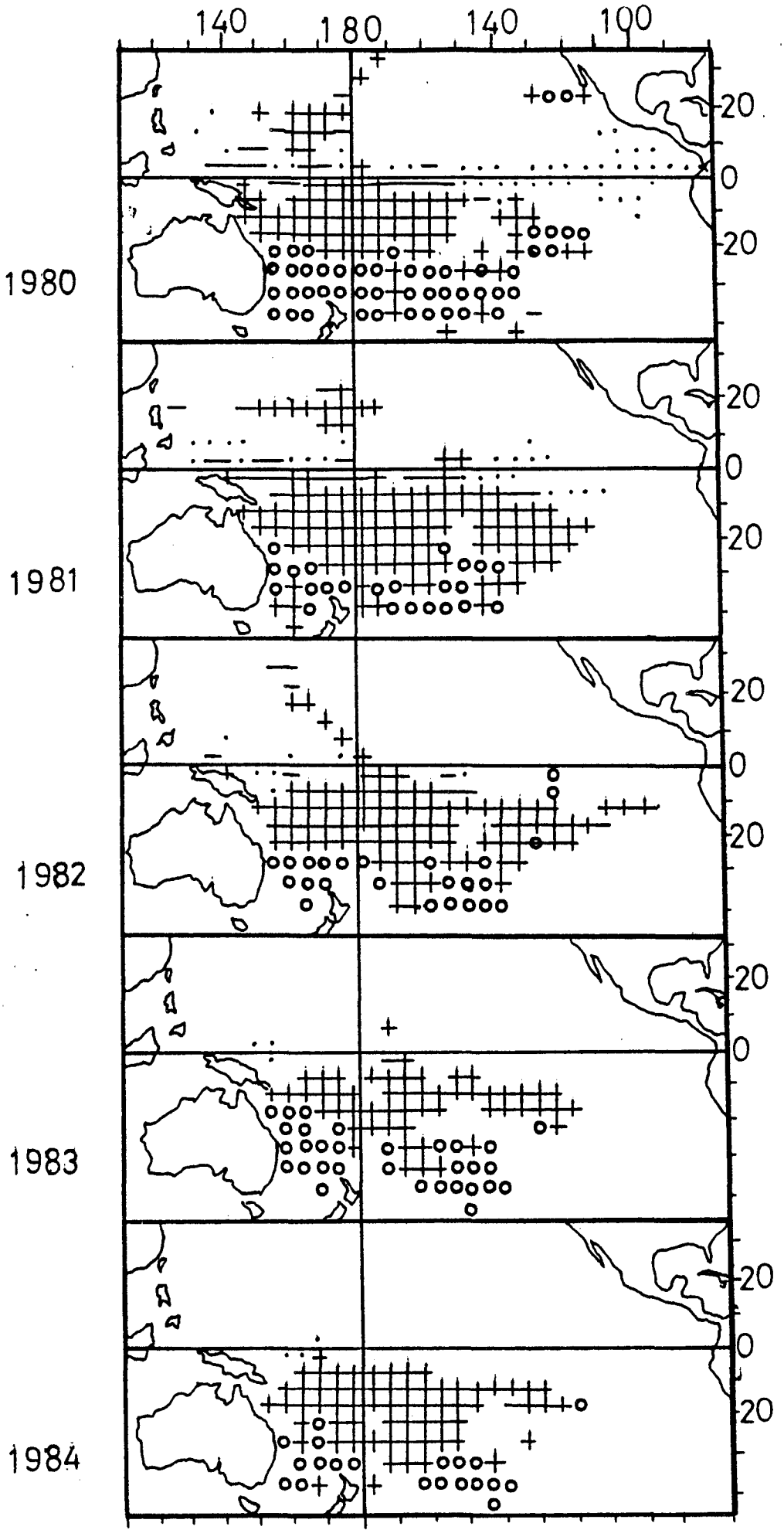

Fig. 12. ... continued.

Table 4. Sample size of fork length of Albacore measured in South Pacific Ocean.

year	number
1979	27650
1980	172233
1981	272891
1982	232087
1983	163419
1984	155954
1985	in proceeding
sum of 79-84	1024234