Scrutinizing on the subdivision of Indian Ocean for the betterment of adjusted Albacore CPUE trend, dating from 1980 to 2010 of Taiwanese longline fisheries dataset

by

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Abstracts

It has been notified for quite a long time that the factor of "subarea" in GLM analyses always played the major and significant role in explanatory of total variability. Although,numerically speaking, the contrasts in mean square obtained from two different subarea setups might not big enough to be statistically significant, it is still worthwhile to scrutinize the true facts behind those subdivision reasonings.

In addition to conventional area subdivision mainly based on its posterior catch composition, the authors bring in the element of number of hooks per basket information, which is generally available since 1995 because of new log book format. It is noticed by this analyses that (1) within the range of number of hooks (5 to 21+) per basket, two distinct groups were identified: using 5-12 hooks per basket and that of 13-21+ group; (2) catch of 5-12 hooks group appeared targeting on albacore, whereas 13-21+ hooks group appeared more on bigeye, all types of hooks seems workable for yellowfin without any preference; and (3) area distribution of 5-12 hooks appeared more concentrated within the 30-40 degree S zonation, while the 13-21+ hooks more concentrated in 10 degree N to 15 degree S zonation.

Clustering technique by using within-block overall mean catch composition as its character vector were also applied and resulted in a tree structure of 4 groups of fishing block. Comparing these 4 group with aforementioned area distribution of hooks group and major species caught, it is noticed that cluster group 2 corresponding to bigeye and cluster group 3 corresponding to albacore. Although cluster group 1 and 4 seemed to be closely nearby, it is determined that cluster group1 corresponding to yellowfin and cluster group 4 appeared to be a independent group based on its species composition is different from others.

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Introduction

Taiwanese longline fleets have been one the major fishing fleets fished in the Indian Ocean. It was not until late 1980s, when the deep freezer vessel were widely available, the major tuna fished in the Indian Ocean were albacore. As one of the major fleets utilizing the Indian albacore resource, it is equally responsible for providing albacore catch and effort statistics for stock assessment.

It has been very unfortunate, however, the log book reporting format was established in those years of not able to purview how quick the commercial longline can be changed. The number of hooks per basket changed from conventional 5-12 hooks per basket, which is majority of conventional albacore longline vessels deploying, became greater than 13 hooks per basket and still not alble to predict how far it can go. A new version of log book, which includes denoting the number of hooks per basket became a necessity, was launched since mid 1990s. This new information was thus scrutinized in this paper for providing better grounding to standardize the albacore CPUE trend.

It has been notified for quite a long time that the factor of "subarea" in GLM analyses always played the major and significant role in explanatory of total variability. Although,numerically speaking, the contrasts in mean square obtained from two different subarea setups might not big enough to be statistically significant, it is still worthwhile to scrutinize the true facts behind those subdivision reasonings. In addition to conventional area subdivision mainly based on its posterior catch composition, the authors bring in the element of number of hooks per basket information, which is generally available since 1995 because of new log book format.

Material and Method

All Taiwanese 1980-2010 longline fisheries dataset were mainly provided by the Overseas Fisheries Development Council, which should be identical with those deposit and provided by IOTC.

By 5 degree square block condensation of Taiwanese longline catch

composition was performed by averaging all vessel-time fishing observations weighed by its fishing effort. Cluster analyses was performed by using SAS statistical package (version 9.13).

Results

Figure 1 shows the total catch in number of all tunas and only albacore in the Indian Ocean by Taiwanese longline fleet from 1980 to 2010.

Figure 2 indicates the total fishing efforts in total number of hooks deployed in the Indian Ocean by Taiwanese longline fleets from 1980 to 2010.

Figure 3 showed the nominal CPUE in number of all tunas and only albacore species in the Indian Ocean by Taiwanese longline fleets from 1980 to 2010. These three Figures as well as Figure 4 provide basic information related to Taiwanese longline fleets fished in Indian Ocean from 1980 to 2010.

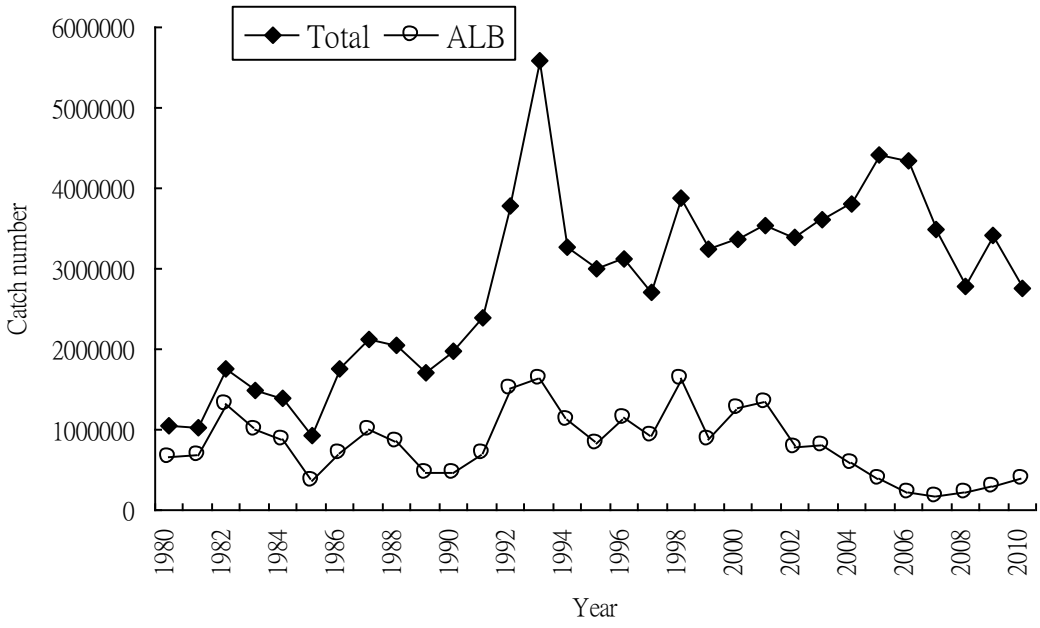

Fig. 1 Fluctuations of total catch and albacore catch made by Taiwanese longline fisheries in Indian Ocean, 1980-2010.

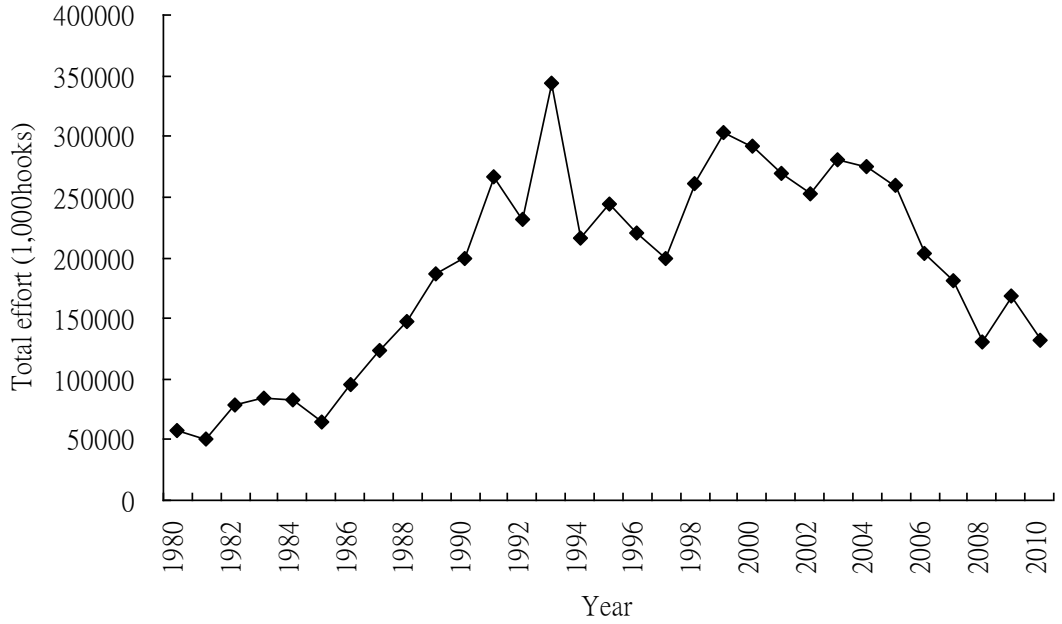

Fig. 2 Fluctuation in the fishing effort of Taiwanese longline fisheries operated in Indian Ocean,
1980-2010.

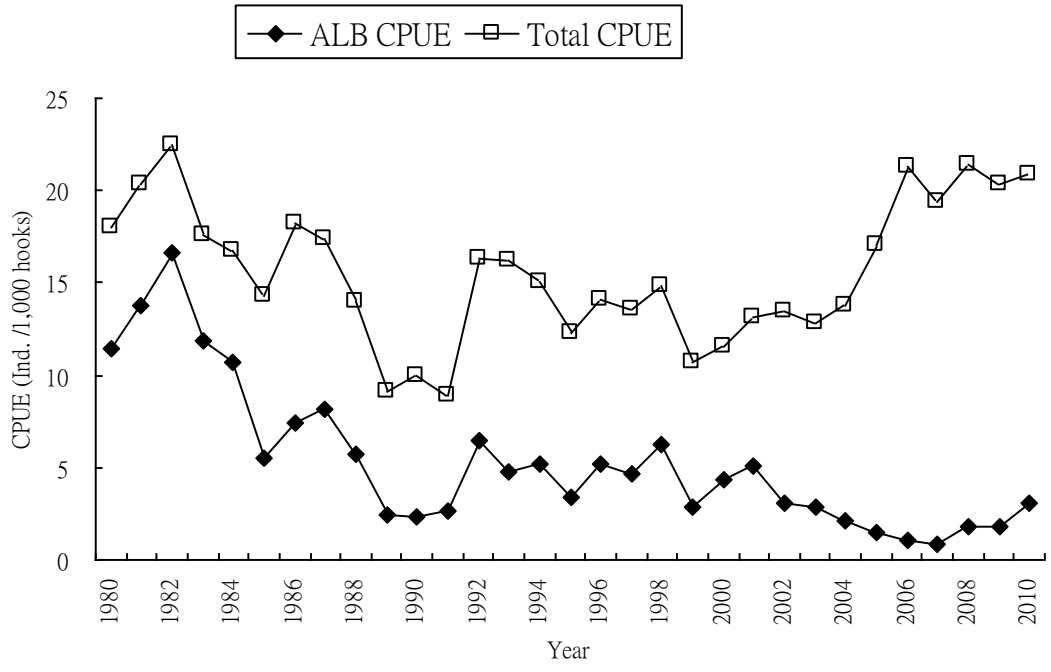

Fig. 3 Fluctuations in the nominal CPUE of total catch and albacore catch made by Taiwanese longline fisheries in Indian Ocean, 1980-2010.

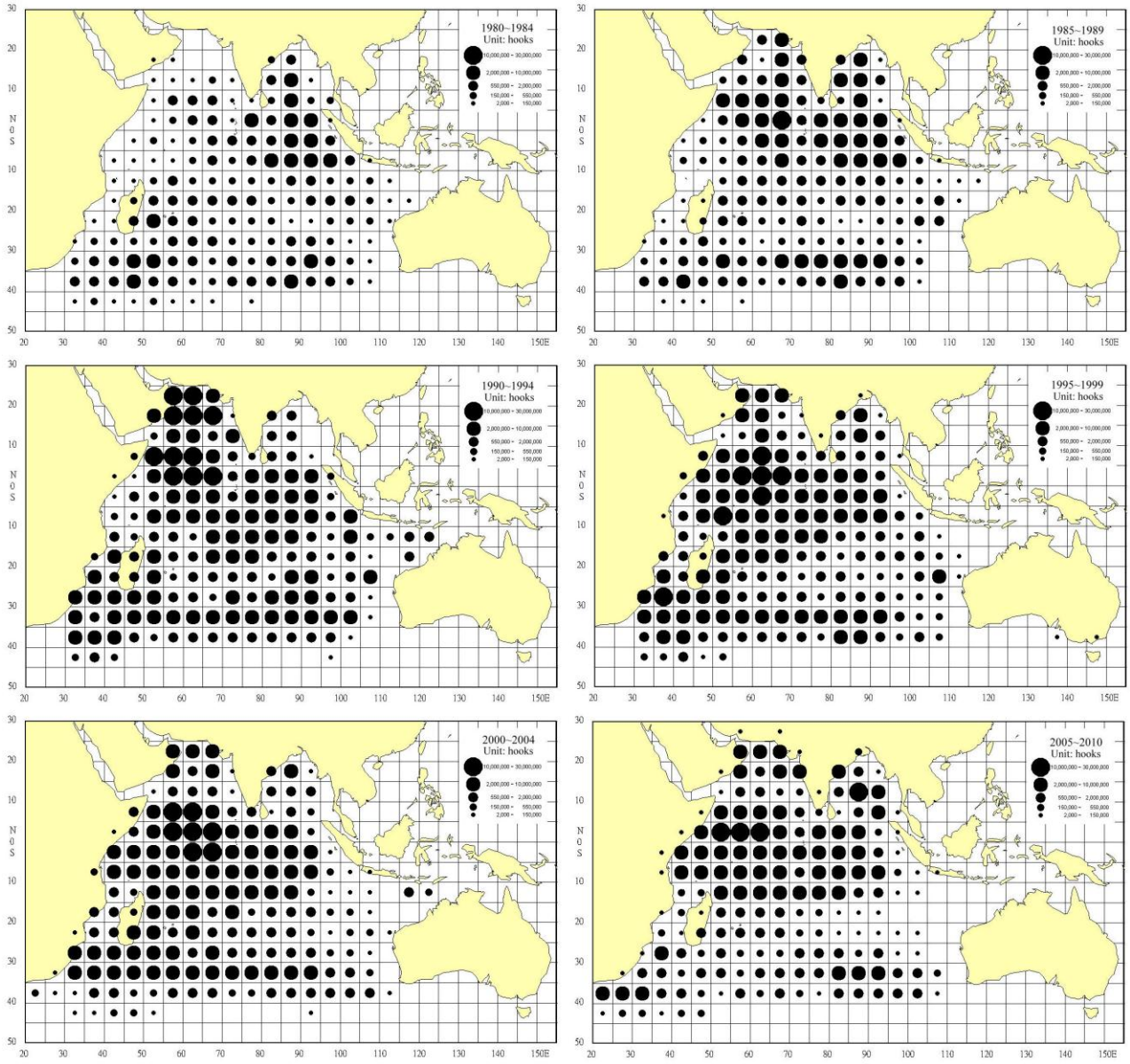

Fig.4 Distributions of Taiwanese longline fishing effort in Indian Ocean, 1980-2010.

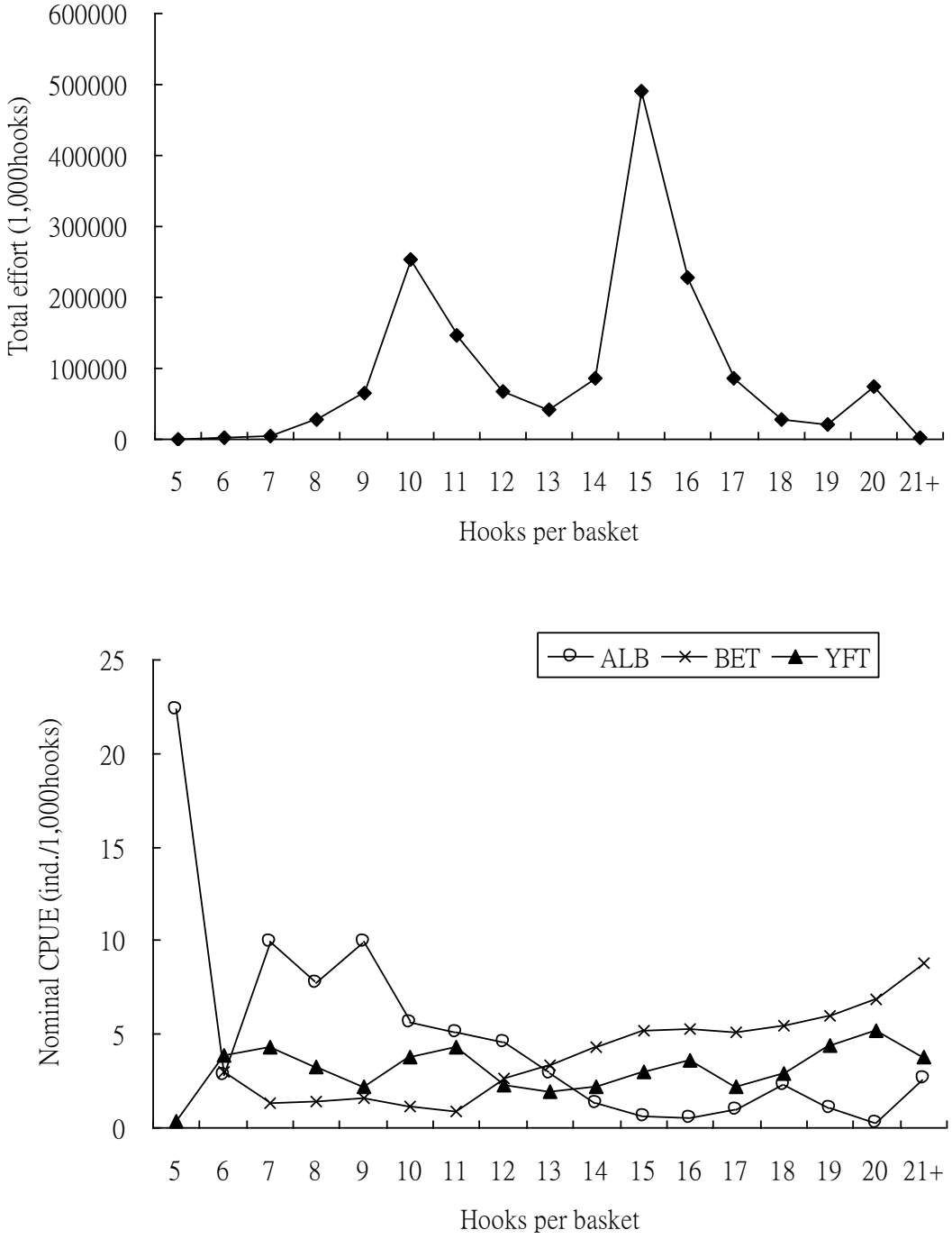

Fig. 5 Distribution of fishing effort (top plot) and nominal CPUE of main species (bottom plot), corresponding to the numbers of hook per basket applied in the daily operation, of Taiwanese longline fisheries, 1995-2010.

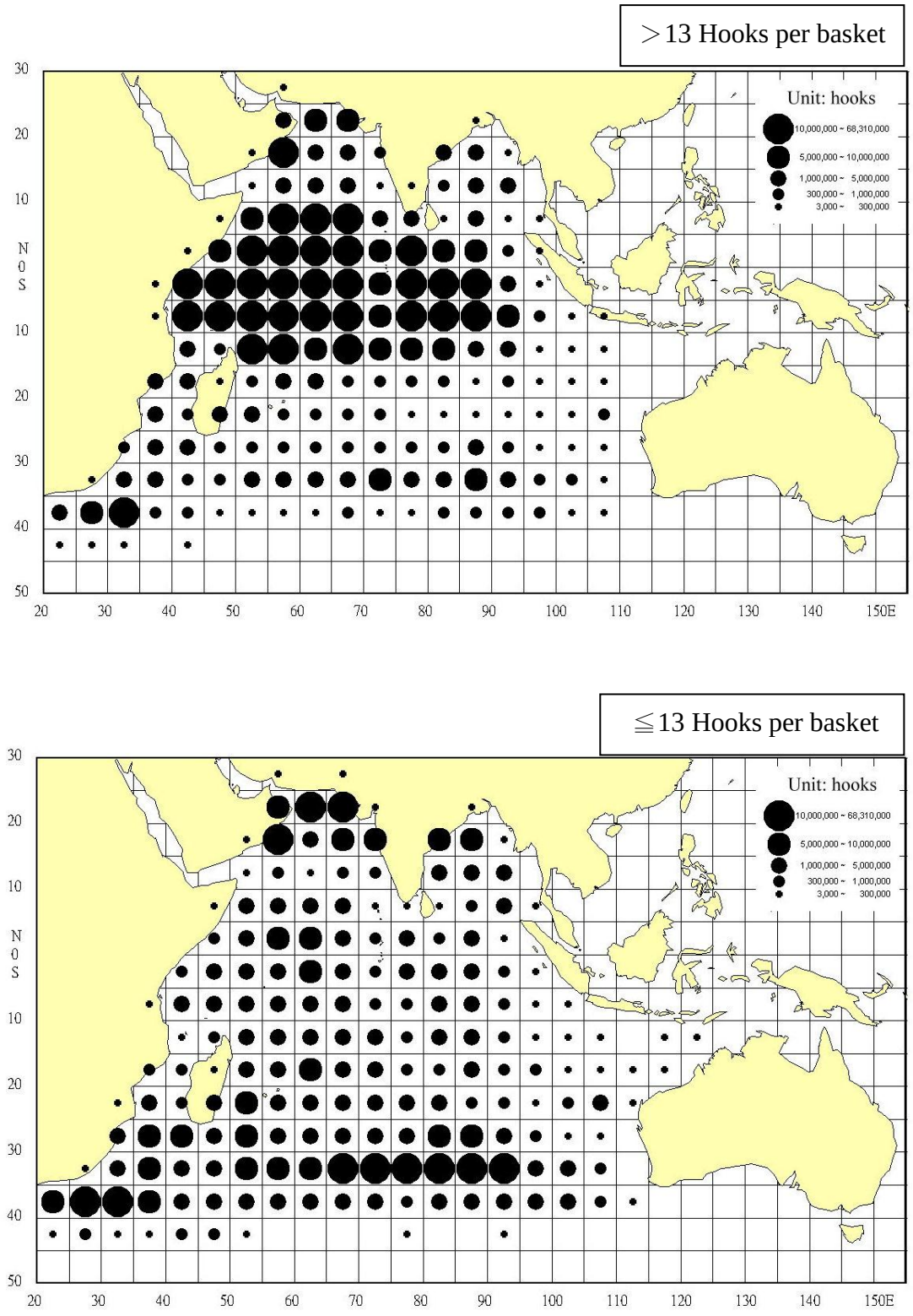

Fig. 6 Distributions of Taiwanese longline fishing effort operated with ＞13 hooks per basket (top) and with ≦13 hooks per basket (bottom), 1995-2010.

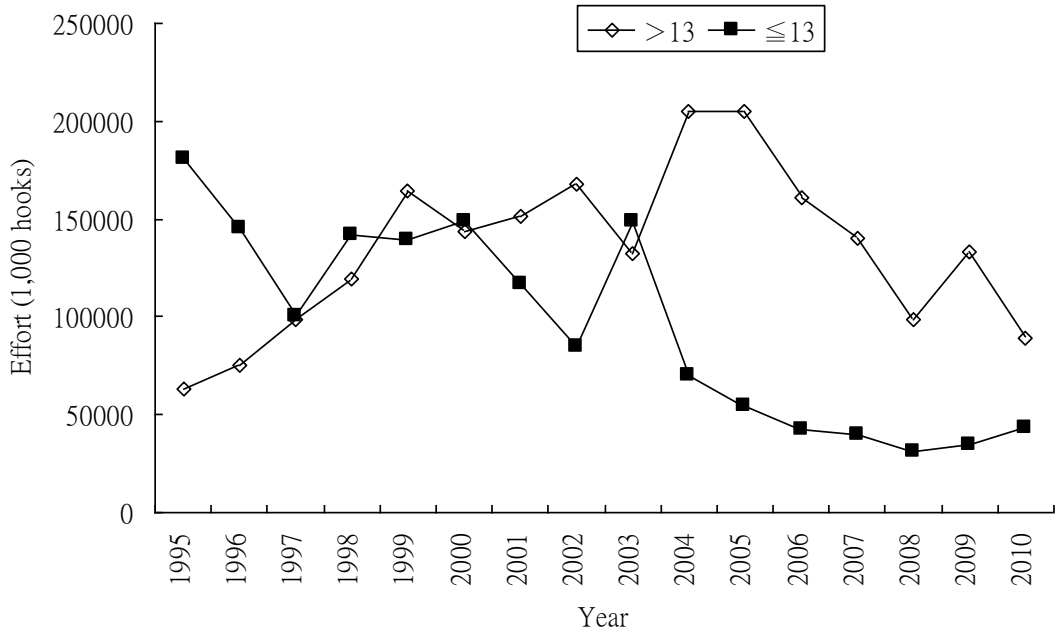

Fig. 7 Yearly fluctuations of Taiwanese longline fishing effort operated with >13 hooks per basket and with ≦13 hooks per basket, 1995-2010.

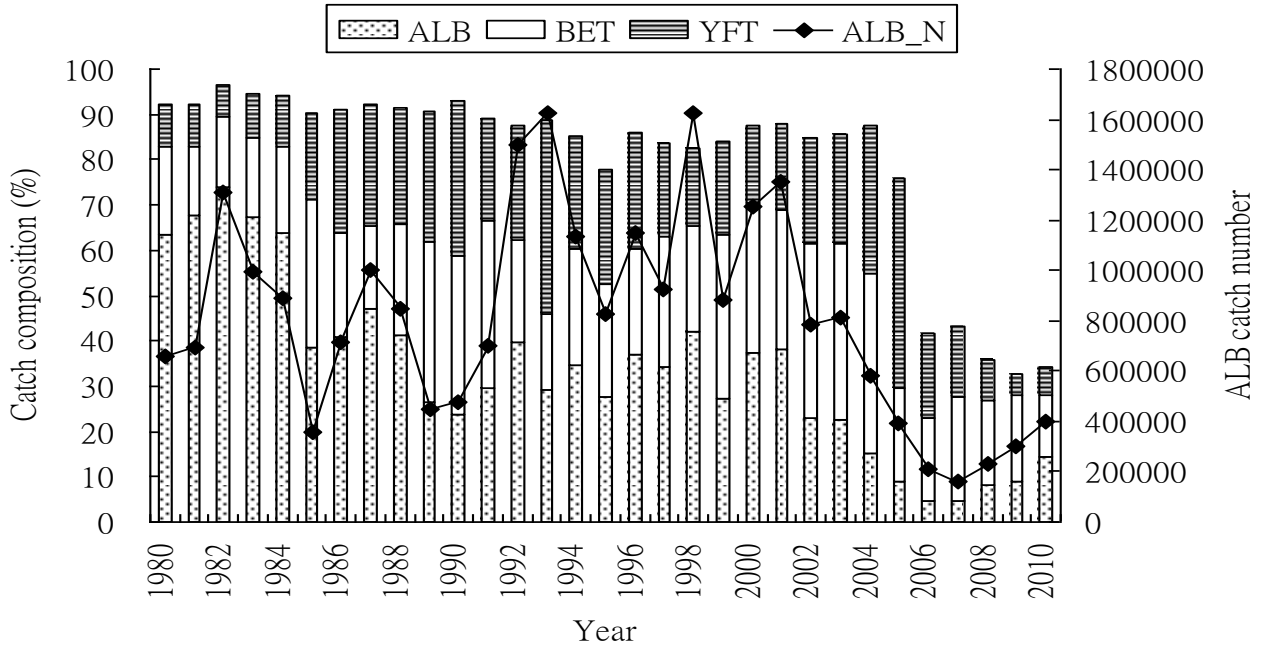

Fig. 8 Yearly fluctuations of albacore catch and catch composition of main species made by Taiwanese longline fisheries, 1980-2010.

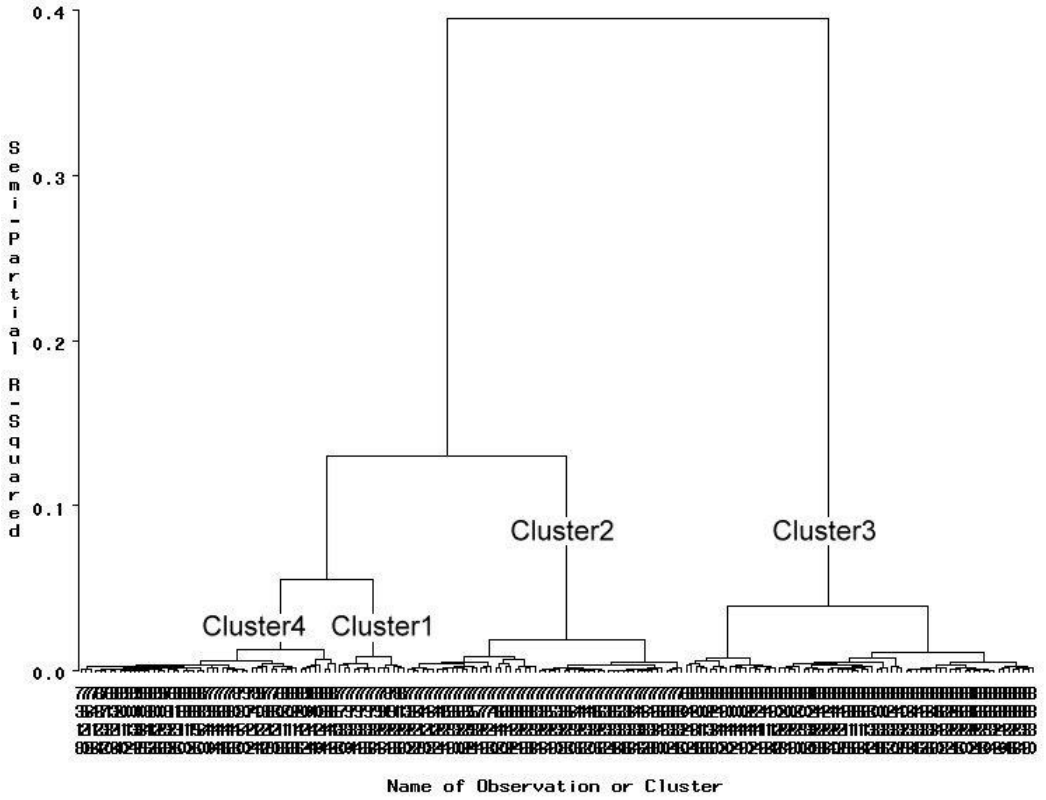

Fig. 9 Hierarchical structure of cluster analysis based on the catch composition of Taiwanese longline fisheries, 1980-2010.

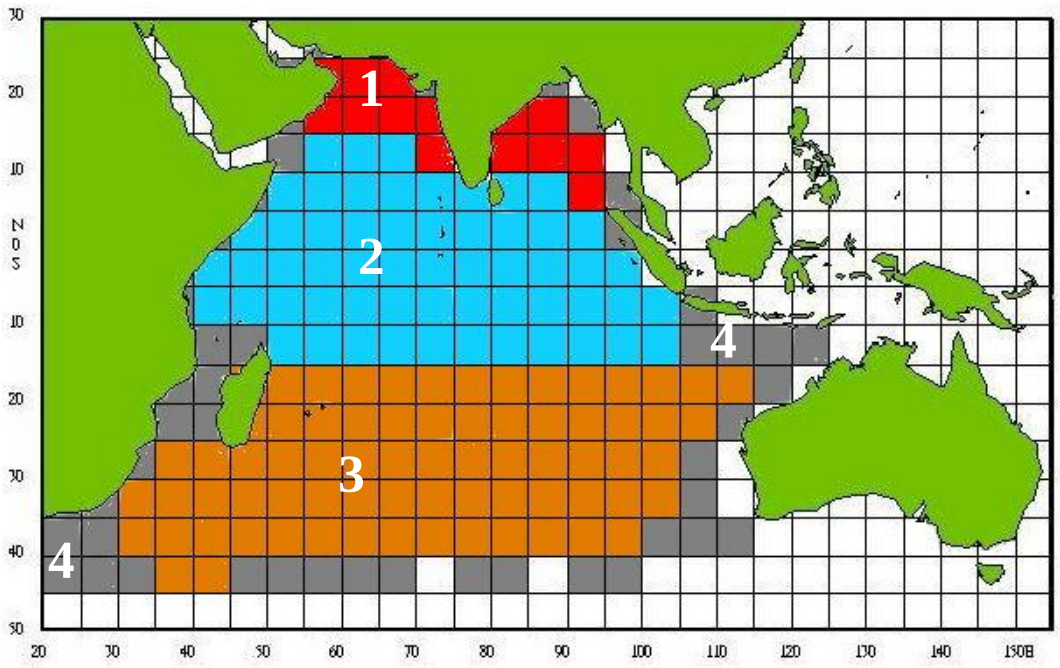

Fig. 10 Map showing the 4 subareas of Indian Ocean, based on the results of cluster analysis on Taiwanese longline catch statistics, 1980-2010.

Table 1 Catch compositions, by subarea, of Taiwanese longline fisheries, 1980-2010.

species	Subarea1		Subarea2		Subarea3		Subarea4	
	CPUE (ind./10^3hooks)	Catch ratio (%)	CPUE (ind./10^3hooks)	Catch ratio (%)	CPUE (ind./10^3hooks)	Catch ratio (%)	CPUE (ind./10^3hooks)	Catch ratio (%)
ALB	0.01	0.06	0.38	3.65	14.51	67.41	3.17	7.56
BET	0.35	2.09	5.42	52.11	1.48	6.86	1.79	4.26
YFT	14.62	86.29	2.89	27.76	0.76	3.53	2.03	4.85
BFT	0.00	0.00	0.00	0.01	0.03	0.14	0.01	0.02
SBT	0.00	0.00	0.00	0.00	0.29	1.35	0.12	0.29
TUN	0.00	0.02	0.00	0.04	0.04	0.18	0.00	0.01
SWO	0.47	2.79	0.62	6.00	0.69	3.21	0.90	2.14
MLS	0.40	2.36	0.17	1.61	0.06	0.30	0.14	0.34
BLZ	0.14	0.84	0.18	1.73	0.04	0.18	0.05	0.13
BLM	0.06	0.37	0.03	0.25	0.01	0.05	0.05	0.11
BIL	0.24	1.43	0.06	0.61	0.04	0.19	0.06	0.15
SKJ	0.02	0.11	0.03	0.29	0.04	0.19	0.02	0.06
SKX	0.31	1.83	0.21	2.02	0.19	0.90	2.53	6.04
OTH	0.31	1.81	0.41	3.92	3.34	15.53	31.02	74.03
Total	16.94	100.00	10.40	100.00	21.53	100.00	41.90	100.00

ALB：Albacore, BET：Bigeye tuna, YFT：Yellowfin tuna, BFT：Bluefin tuna, SBT：Southern bluefin tuna, TUN：Other tunas, SWO：Broadbill swordfish, MLS：Striped marlin, BLZ：Indo-Pacific blue marlin, BLM：Black marlin, BIL：Other marlins, SKJ：Skipjack, SKX：Sharks, OTH：Other fishes.

Figure 5 shows the numbers of hook per basket applied by the Taiwanese longliners, and their correspondent catch compositions, 1995-2010. It is clear that fishing efforts are mainly contributed by two groups, i.e., 9-12 hooks and 14-17 hooks per basket, respectively. Most of albacore catch were made by those less than or equal to 13 hooks per basket, and by contrast, bigeye tuna were mainly caught by those greater

than 13 hooks per basket. However, the CPUE of yellowfin tuna largely fluctuated within 2-5 individuals/1000 hooks throughout all varied numbers of hook per basket. It is also found that most of the fishing efforts ＞13 hooks per basket concentrated in the tropical waters while those ≦13 hooks per basket were mainly operated in the waters north of 15◦N and south of 30◦S, respectively (Fig. 6). Moreover, the fishing efforts of the former are significantly higher than the latter in recent years (Fig. 7), and possibly explain the decline of albacore catch in this time period (Fig. 8).

The changes of Taiwanese longline fisheries in terms of fishing area and fishing strategies (number of hooks per basket applied) may be explained by the shift of targeting species of the fisheries and may also reflect the natures of habitat preference by these main tuna species, such as albacore, bigeye and yellowfin tunas, etc. These changes would also result in the changes in their catch compositions. The results of clustering analyses based on the catch compositions of each 5◦X5◦ square, 1980-2010, show a clear separation of 4 clusters (Fig. 9). These 4 clusters are located in totally different area of Indian Ocean, namely subarea 1-4 respectively (Fig. 10). Taiwanese longline fisheries operated in these 4 subareas also showed apparently different catch composition, i.e., yellowfin tuna (subarea 1), bigeye and yellowfin tunas (subarea 2), albacore tuna (subarea 3) and other species (subarea 4). It is therefore strongly recommended to take into account of the subarea factor in further population dynamic studies.

Conclusion and Suggestion

In addition to conventional area subdivision mainly based on its posterior catch composition, the authors bring in the element of number of hooks per basket information, which is generally available since 1995 because of new log book format. It is noticed by this analyses that (1) within the range of number of hooks (5 to 21+) per basket, two distinct groups were identified: using 5-12 hooks per basket and that of 13-21+ group; (2) catch of 5-12 hooks group appeared targeting on albacore, whereas 13-21+ hooks group appeared more on bigeye, all types of hooks seems workable for yellowfin without any preference; and (3) area distribution of 5-12 hooks appeared more concentrated within the 30-40 degree S zonation, while the 13-21+ hooks more concentrated in 10 degree N to 15 degree S zonation.

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