Bull. Inst. Zool., Academia Sinica **18**(1): 29-37 (1979)

SPECIES COMPOSITION AND DISTRIBUTION OF THE TAIWAN RIBBONFISHES

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(Received March 23, 1979)

Sin-Che Lee (1979) Species composition and distribution of the Taiwan ribbonfishes. *Bull. Inst. Zool., Academia Sinica* **18**(1): 29-37. This report was based on the surveys carried out during February 1976 and December 1978. It revealed that *Trichiurus* from Taiwan inshore water as a whole constituted 61.36% of *T. japonicus* and 38.64% of *T. lepturus*, while those from offshore Taiwan Strait were almost 100% of *T. japonicus*. *Tentoriceps cristatus* was found occasionally in certain grounds associated with *T. japonicus*. *T. lepturus* was concentrated within 60 m of depth and sometimes was found as deep as 200 m. The commercial fishing grounds of *T. lepturus* were mainly located along the southeast coast and southwest coast of Taiwan, it was rarer in deeper part of the east coast. *T. japonicus* distributed widely from shallower inshore water to a deeper ground of over 300 m. It significantly outnumbered in shallower Taiwan Strait especially the middle part as well as the deeper east coast where large adults of *T. japonicus* were frequently found. In general, both species from shallower inshore water were smaller than those from deeper ground. Seasonal abundance of the ribbonfishes in the inshore waters was evidently associated with their spawning migration and abundance of their forage anchovies.

The ribbonfish is an economically important demersal fish occurring on the muddy-sand bottoms of the continental shelf. In Japan, the commercial fishing grounds of the ribbonfish were mainly in the East China Sea and the Yellow Sea where the amount of total catches reached 50,000-56,000 metric tons during 1967 and 1969[6]. In Taiwan, according to the official fishery report of Taiwan Fisheries Bureau[7], annual landings in 1977 alone reached 19,714 metric tons, of which 60% were contributed by Keelung trawlers operated from the northern part of Taiwan Strait to the East China Sea.

The author used the samples taken from Taiwan Strait and the inshore waters around Taiwan to study the species composition of ribbonfishes as well as their variations with locations, seasons and water depths of habitat.

Three species of ribbonfishes, namely *Trichiurus japonicus*, *T. lepturus* and *Tentoriceps cristatus*, occurred around the waters of Taiwan[1]. Among them, *T. japonicus* was the most abundant species which ranged from shallower inshore water to adjacent deeper ground and extended to the entire Taiwan Strait. *T. lepturus* was less abundant and was restricted to a narrower inshore areas. *Tentoriceps cristatus* was very rare and had the same distribution as that of *T. japonicus*.

METHODS

30-50 specimens for each species were collected monthly from Wanli (Keelung), Hualien, Chengkong, Tungkang and Kaohsiung areas during February 1976 and December 1978. Fishes collected from the above mentioned fishery ports were either from the adjacent inshore waters or trawling grounds in Taiwan Strait. *Trichiurus*

Paper No. 203 of the Journal Series of the Institute of Zoology, Academia Sinica.

was identified down to the species level and their species compositions were determined from:

$$\frac{\text{Individuals of a particular species}}{\text{Individuals of total fish species}} \times 100$$

The stock density of *T. japonicus* in Taiwan Strait was calculated from the catch records supplied by 8 fishing boats operated during February 1973 and May 1975 and it was expressed as catches (kg) per unit of haul. Catch records of ribbonfishes and anchovies in the southeast and southwest coasts of Taiwan were available from local fishermen's associations. Vertical distribution for each species was determined from catches in shallower water by gill-net, swing bell net or dragnet and catches in deeper water by using longliners. All samples were pooled to determine the overall vertical distribution of two *Trichiurus* species. *Tentoriceps cristatus* was not recorded because of its rare occurrence.

RESULTS

Species composition

Resulting from a three-year's data obtained during February 1976 and December 1978 for the ribbonfishes from inshore waters. *T. japonicus* constituted 61.36% and *T. lepturus* 38.64% while those from offshore grounds in Taiwan Strait were almost 100% for *T. japonicus*. *Tentoriceps cristatus* was rather rare and was found only occasionally from the East China Sea and middle Taiwan Strait near Pescadore Islands.

Both species of *Trichiurus* occurred along the coasts of Taiwan year around. However, the species composition may vary due to (1) locations, (2) seasons and (3) types of fishing gears. In Hualien where the fish caught by longliners were consistently predominated by *T. japonicus* except in December and January. *T. lepturus* reached 64% and 40.7% during the sampling in December and January, respectively. In Chengkong, there were no special indication of seasonal changes in the species composition, however, more *T. lepturus* was caught by gill net than by the longliners. In the southeast coast near Tawu, the fish caught by gill net from the beach were almost entirely *T. lepturus* throughout the year except in March and April. This was due to the inshore movement of *T. japonicus* from nearby deeper ground. In Tungkang, *T. lepturus* had higher proportion than *T. japonicus* during October and November and the period between February and May. During these period the most Tungkang based longliners operated in the nearby fishing grounds where *T. lepturus* was in great abundance. *T. japonicus* were more abundant in the rest of year coinciding with the most trawlers operated in offshore Taiwan Strait where *T. japonicus* was the most abundant. *T. lepturus* caught by gill net from the coast of Kaohsiung were generally smaller and predominant except in both March and October, 1977, when *T. japonicus* were usually higher in numbers.

Geographical distribution

As shown in Fig. 1, *T. lepturus* showed a

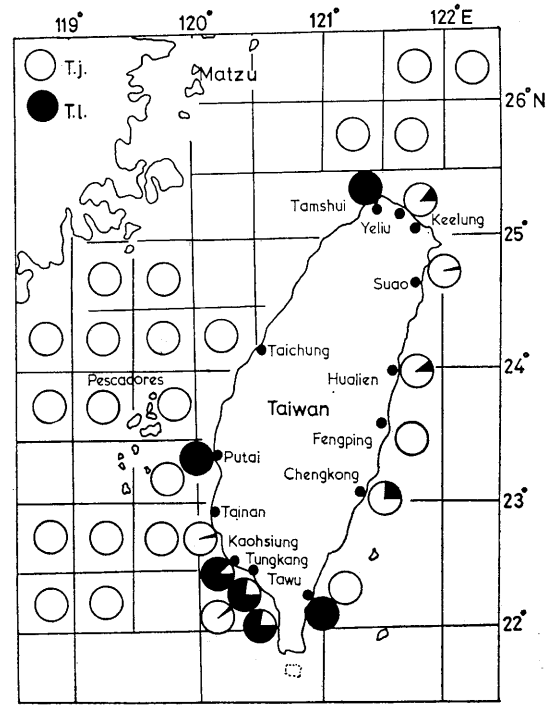

Fig. 1. Species composition and geographical distribution of Taiwan *Trichiurus* ribbonfishes (white circle: *Trichiurus japonicus*; solid circle: *T. lepturus*).

tendency of increasing proportion from the east toward the west. Its major fishing grounds concentrated mostly in the southwest coast of Taiwan.

Trichiurus japonicus was generally predominant in deeper water along the east coast of Taiwan. Regarding its distribution in Taiwan Strait alone, it was more densely populated in middle Taiwan Strait near Pescadore Islands and an area close to the south of Kinmen (Fig. 2). *T. japonicus* in Taiwan Strait and the coast of Kaohsiung were smaller than those from the deeper east coast of Hualien and Chengkong (Fig. 3). *T. lepturus* caught by longliners between Tungkang and Fengkang were larger than those from the shallower water along Kaohsiung (Fig. 4). *Tentoriceps cristatus* was only found occasionally in middle Taiwan Strait and the East China Sea.

Vertical distribution

Fishes of *Trichiurus* stayed inactive on the bottom surface during the day and started upward movement at dusk simply for pursuing food[2]. Owing to the diurnal vertical movement of such demersal fishes, vertical distribu-

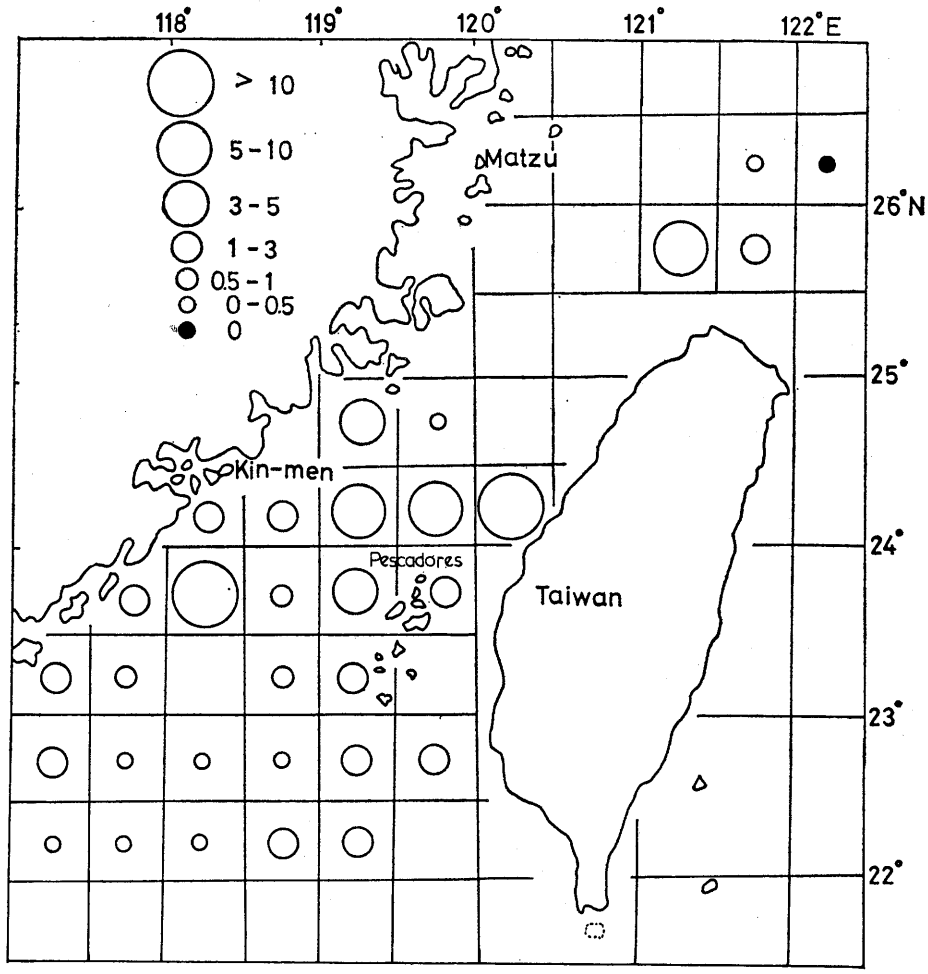

Fig. 2. Density of *Trichiurus japonicus* in Taiwan Strait and southern East China Sea, expressed as catches (kg) per haul.

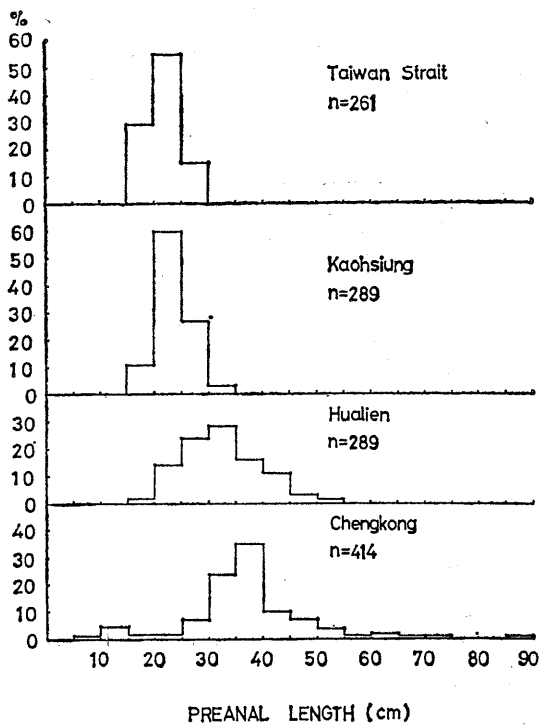

Fig. 3. Body length composition of *Trichiurus japonicus* from different areas.

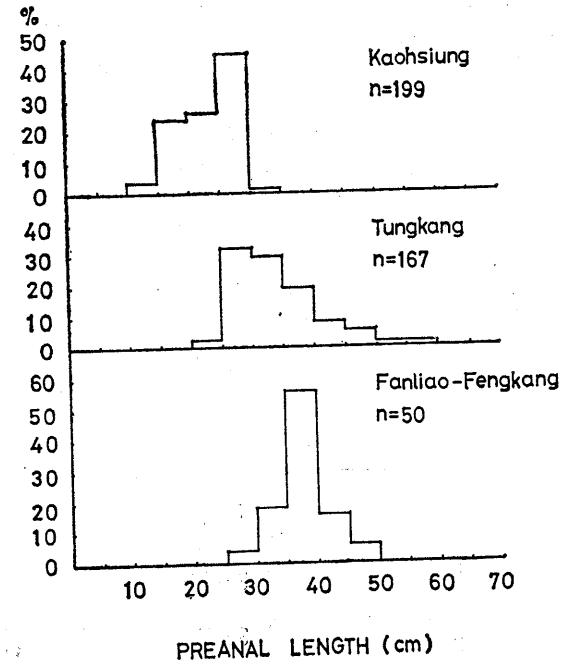

Fig. 4. Body length composition of *Trichiurus lepturus* from different areas.

tion of the 2 *Trichiurus* species must take in account the actual depths of the habitat instead of the depths at which the fish was captured. For detail consideration on this matter, data from 6 selected locations: Wanli, Hualien, Chengkong, Tawu, Tungkang and Kaohsiung (Fig. 5A-F) were used to interprete.

In Wanli (Fig. 5A), the inner part of bay with 10-20 m in depth had 73.77% of *T. lepturus* and 26.23% of *T. japonicus* while the outer part of bay with 40-60 m in depth had 100% of *T. japonicus*.

In Hualien (Fig. 5B), the ground in the farther northeast of the river mouth with 40-70 m in depth had 27.78% of *T. lepturus* and 72.22% of *T. japonicus* while that in the southeast of river mouth with 50-90 m in depth had 12.93% of *T. lepturus* and 87.07% of *T. japonicus*.

In Chengkong (Fig. 5C), the inner part of bay of the north of Sanhsientai with 20-40 m in depth had 64.41% of *T. lepturus* and 35.59% of *T. japonicus* while that in outer part of bay with 200-400 m in depth had 100% of *T. japonicus*. Another ground near the village Tuli with 120-370 m in depth had 18.67% of *T. lepturus* and 87.33% of *T. japonicus*.

In the southeast coast of Taiwan, the ground near Taimali (Fig. 5D) with 200-400 m in depth had 100% of *T. japonicus*. The inner ground off Tawu (Fig. 5D) with 20-170 m in depth had 100% of *T. lepturus* while in outer ground with about 500 m in depth had only *T. japonicus*.

In the Tunkang area (Fig. 5E), the fish on the west bank of the river mouth with 8-10 m in depth had 100% of *T. lepturus* while in the south of the river mouth with 40-70 m in depth had 86.77% of *T. lepturus* and 12.23% of *T. japonicus*. The ground between Tungkang and Liuchiuyü with 40-100 m in depth had 67.05% of *T. lepturus* and 32.95% of *T. japonicus*. An outermost ground in Taiwan Strait with 50-60 m in depth had 4% of *T. lepturus* and 96%

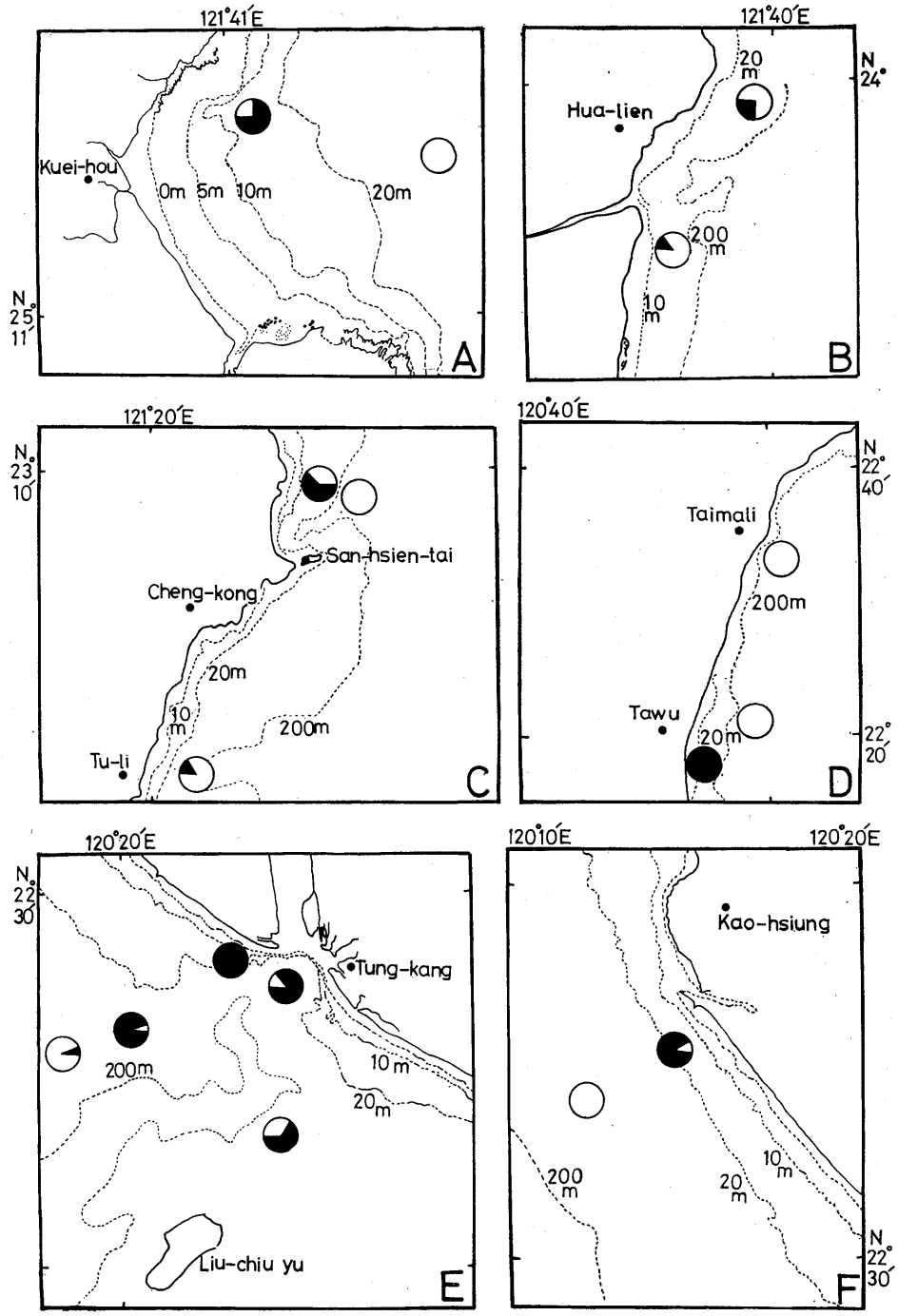

Fig. 5. Species composition and vertical distribution in the areas of Wanli (A), Hualien (B), Chengkong (C), Tawu (D), Tungkang (E) and Kaohsiung (F). White circle: *Trichiurus japonicus*; solid circle: *T. lepturus*.

of *T. japonicus* while its immediately adjacent inner ground with 26–30 m in depth had 97.52% of *T. lepturus* and 2.48% of *T. japonicus*.

In Kaohsiung (Fig. 5F), the inner ground with about 20 m in depth had 91% of *T. lepturus* and 9% of *T. japonicus* while that in its neighbouring outer Taiwan Strait with 50 m in depth had only *T. japonicus*. In Putai (Fig. 1), the inner part of the shore with depth of less than 10 m had 100% of *T. lepturus* while that in the nearby Taiwan Strait with about 30 m in depth had 100% of *T. japonicus*.

Summarising from the above findings, *T. lepturus* appeared with higher proportion in shallower inshore waters while *T. japonicus* appeared with higher proportion in farther offshore deeper ground. The vertical distribution of *Trichiurus* is shown in Fig. 6A-B. *T. lepturus* was found mostly in water depths of less than 60 m in the east coast (Fig. 6A-B). Occasionally they were found in deeper ground but never exceeding 200 m in depth (Fig. 6B). *T. japonicus* on the other hand, ranged widely from shallower inshore waters toward the farther deeper offshore ground of more 300 m in depth where they were almost entirely large adult fishes.

DISCUSSION

water depth limit and topography of undersea appear to govern the distribution of ribbonfish. Since ribbonfishes are restricted on mud or muddy sand bottoms in habitats, area of soft grounds affect their distributional patterns. In the east coast of Taiwan where the bottoms are deeper and predominantly rocks with very limited patches of muddy sand sediments immediately outside the mouth of rivers and their adjacent waters. It is then expected that fishing for *Trichiurus* is rather limited. In the east coast, *i. e.*, Hualien and Chengkong where the soft patches extend somewhat as deep as 300 m or even more immediately adjourning the narrow shallower inshore bays, it had a higher propor-

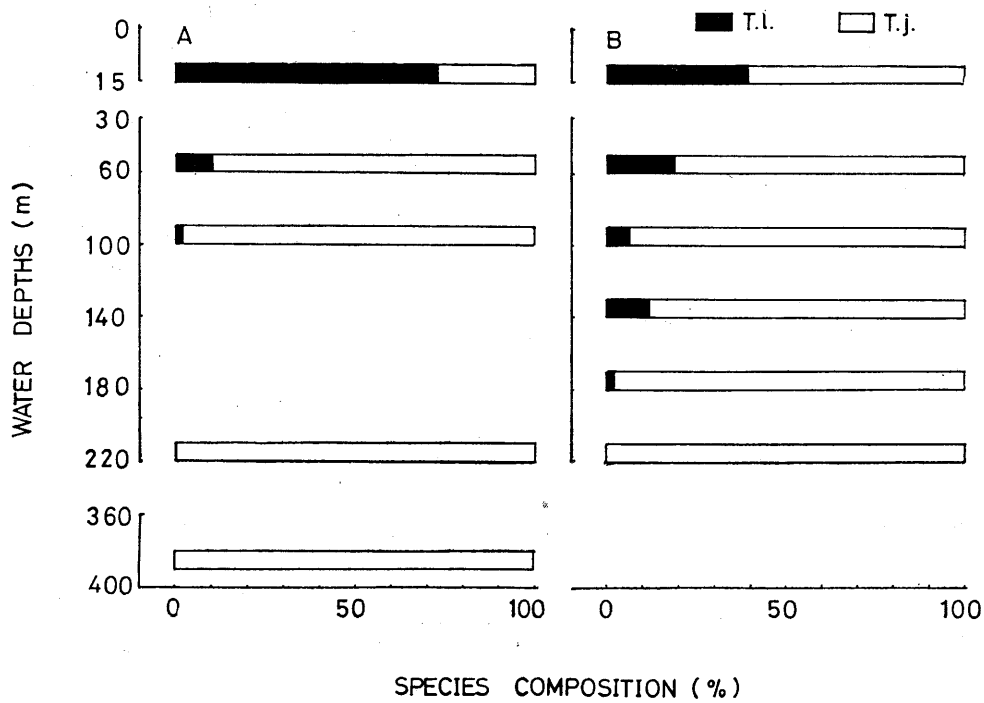

Fig. 6. Species composition of *Trichiurus* at the different depths in Hualien (A) and Chengkong (B). *T. j.*= *Trichiurus japonicus*; *T. l.*= *T. lepturus*.

tion of *T. japonicus*. In the waters off western Taiwan and Taiwan Strait are exclusively the soft bottoms. Thus the habitat area of the ribbonfishes in the west is more extensive than that of the east.

Distribution of *Trichiurus* in Taiwan may also be associated with seasonal changes in abundance of the fishes due to migration for wintering and spawning[5]. Fish of the East China Sea have involved with a southward migration from the area at farther north of Penchiayü Island (Block Nos. 2164 and 2184) toward middle Taiwan Strait (Block Nos. 3027 and 3037) starting in September[3]. The ribbonfish population in Taiwan Strait may be somewhat linked with that in the East China Sea. The ribbonfish (possibly almost *T. japonicus*) in middle Taiwan Strait appears with higher density in January, March and May[4] in response to the decreasing density after March in the east coast. The density of the fish in the east coast appears to be higher during November and February when it is otherwise lower in Taiwan Strait. According to the information from the fishermen, the shoals of *T. japonicus* originated from the coast of the mainland China have moved toward the water between Tainan and Kaohsiung and have made a further southward movement to the water near Fengkang during winter and perhaps they have advanced toward the east coast. Most of ribbonfishes return to their original ground in the end of spring. Thus, it is suggested that there is somewhat a migration between Taiwan Strait (perhaps including mainland China coast) and the east coast of Taiwan although the author has not done tagging experiments during the period of study.

Seasonal changes in the abundance of the ribbonfish may be due to the spawning of the ribbonfish and the seasonal occurrence of anchovies in areas. Since mature female ribbonfishes

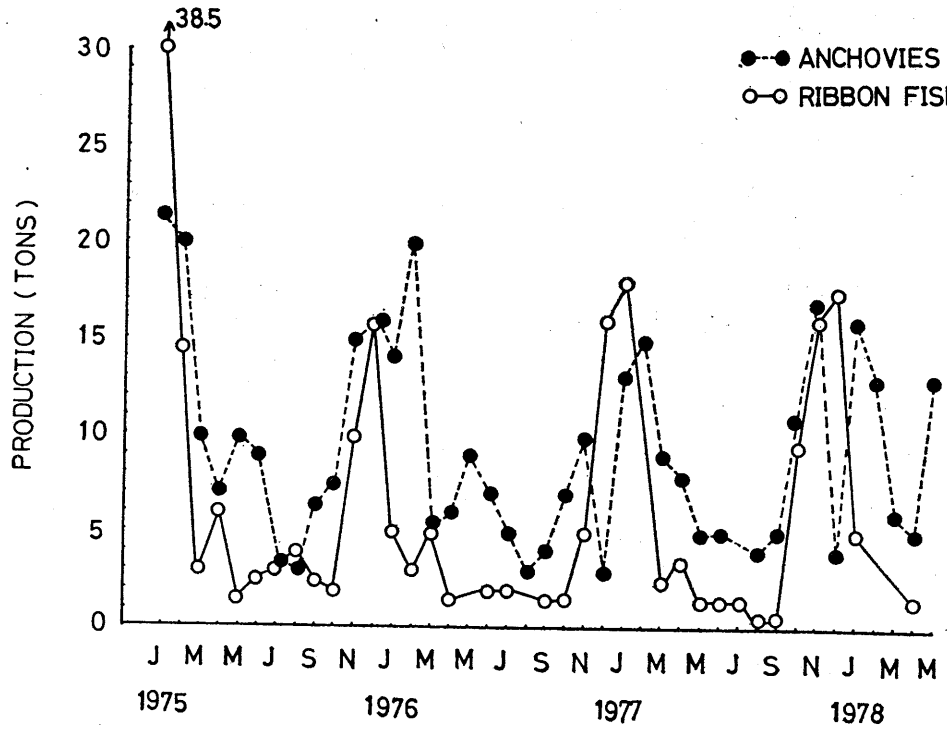

Fig. 7. Seasonal abundance of anchovies (solid circles) and ribbon fishes (white circles) from the east coast of Taiwan.

and their larvae have been found everywhere in the shallower inshore bays, spawning of the fish may be confirmed at the ground in the vincinity of Taiwan. *Trichiurus lepturus* in the Tungkang area spawns during March and August (peak in June) corresponding with higher density of the fish during February and May. *T. japonicus* of the east coast spawns during October and June (peak in March) corresponding with higher density of the fish during November and February. The anchovy is an important food of median sized ribbonfishes and other fishes, e. g., Priacanthidae and Sphyraenidae etc. A significant increase in the anchovy during winter in the east coast (Fig. 7) and both autumn and spring in Tungkang area[8] correspond quite well with higher production of the ribbonfish during spawning period. In other words, the intensive aggregation of ribbonfishes during the particular seasons are linked with feeding and spawning.

Acknowledgements: This research was supported by a grant 76-A31-0-907 from the Joint Commission on Rural Reconstruction. The author would like to thank Dr. K. H. Chang for his encouragement and Mr. K. S. Yeh of the Taitung Branch Station of Taiwan Fisheries Research Institute for help in sampling. Many thanks are also due to Mr. H. C. Yang of the Kaohsiung Branch Station of Taiwan Fisheries Research Institute for supplying catch records of the ribbonfish in Taiwan Strait and to Mr. W. L. Wu for his assistance during this study.

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臺灣產白帶魚之魚種組成及分佈

李 信 徽

本報告係根據1976年2月～1978年12月間在全省各地漁市場取樣調查之結果。臺灣海域之白帶魚共有瘦帶魚 (*Trichiurus japonicus*)、肥帶魚 (*T. lepturus*) 及隆頭帶魚 (*Tentoriceps cristatus*) 等三種。綜觀離岸不遠之臺灣沿岸二種 *Trichiurus* 屬白帶魚中，瘦帶魚佔 61.36%，肥帶魚佔 38.64%。近海區之臺灣海峽離岸較遠處幾全爲瘦帶魚（約 100%）。隆頭帶魚則極爲罕見，僅偶而發現於中部臺灣海峽及東中國海南方之瘦帶漁場，故未予合併計算於魚種組成中。肥帶魚之棲息水深主要在 60 公尺以內，偶而發現於 200 公尺之範圍內，其主要漁場在臺灣西南及東南沿岸，臺灣海峽及臺灣東岸深水處則極少。瘦帶魚則廣汎分佈自極淺之沿岸以迄深達 300 公尺或更深處，主要密集於臺灣海峽中部及東岸深水處。上述二種白帶魚之棲息於淺水處之體型概小於深水處者。臺灣沿岸二種白帶魚量之季節性變動似與產卵洄游及餌料魚（鯊）之豐度之變動有若干關連。