

## FISH SPECIES AND FISHERY PRODUCTION OF YEN-LIAO BAY IN NORTHEASTERN TAIWAN

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One hundred and thirty-nine species in 56 families are found during the study period (November 1980-September 1981) from landings of commercial catch operated around Yen-Liao Bay. Most of them are commercially important species which include pelagic, coral reef and demersal fishes. Annual fishery production in the bay is estimated about 1,500-2,500 tons. The majority of fishery production is contributed by hand-line fishery before 1972, which is substituted by purse-seine and pole and dip net fisheries after 1973. Fishing objects of those types of fishery are mainly pelagic fishes caught in spring and autumn from outer part of the bay. Miscellaneous-fish long-lining is the second important fishery in the bay. It operates all year round from coral reef area, with rather high species diversity. Sandy bottom of the bay is the important fishing ground of larval fishes during spring and summer. Seaweed, small abalone, spiny lobster are caught along the rocky shore of the bay. The elvers are caught from the estuary in winter.

**Key words:** Fishes, Fisheries, Yen-Liao Bay, Taiwan

Yen-Liao Bay is an open type of bay, located in the northeastern coast of Taiwan (Fig.1). The outer part of the bay faces the Kuroshio current some 100 Km away from the shore. Inner part of the bay has received mass influx of freshwater discharged from Shuang-chi River. Substratum of the bottom in outer part of the bay is mostly rocky while that in the inner part is sandy and that on offshore ground is muddy. Therefore, it is expectable that fish fauna in the bay will be more complicated and diversified.

At present, a proposed nuclear power station is underplanned with the site near village Yen-Liao. The problem on whether thermal effluents from the power station will influence the fishery resources of the

surrounding waters are deeply concerned by biologists and local fishermen. Unfortunately, there was no up-to-date base line data on fish community and fishery production on the bay. Under the current financial support of National Scientific Committee on Problem of the Environment, Academia Sinica, Environmental and ecological studies on Yen-Liao coastal area has been conducted since 1980 (Su et al., 1981). Under the overall research heading, a series of subdivided studies entitled fish assemblages, early life history of fishes and fishery production have been investigated by the present authors. The work on the bottom fish assemblages (Tzeng, 1982) and larval fishes (Huang et al., 1985) have been completed.

The present paper deals mainly with fishery production and species composition of the commercial catch in the bay based on the specimen collections and commercial catch statistics from local fish markets.

## MATERIALS AND METHODS

In order to understand the exploited status of the fishery resources in Yen-Liao Bay and the adjacent waters. The catch data for the past decade (1972-1981) recorded by Aoti Regional Fishermen's Association were used. Accordingly, CPUE (catch per unit effort) was computed and seasonal variations on the fishery production were analyzed.

Because the catch data kept in the Fishermen's Association were recorded in species groups with local names. The appropriate scientific names of the species of the catch are not truly understood. In order to verify the existing catch data, fish specimens were then collected monthly from the landings of each type of fishery during the period from November 1980 through September 1981. The available specimens were identified to species level according to Abe (1978), Chen (1969), Masuda et al. (1984) and Shen et al. (1993).

## RESULTS

### Species composition

From November 1980 to September 1981, fishes of 139 species in 56 families (Table 1) were collected from the landings of the boats at Aoti, Fulong and Yenliao (Fig. 1). Most of them were commercially important species.

Regarding the number of species in the

family, Carangidae was the highest with twenty species making up 14.39% of the total number of species and followed in the order of Muraenidae with 9 species (6.47%), Serranidae with 7 species (5.04%) Scombridae with 6 species (4.32%), Scorpaenidae, Lutjanidae and Mullidae each with 5 species (3.60%), Clupeidae, Lethrinidae, Mugilidae, Sphyrænidae and Acanthuridae each with 4 species (2.88%). Each of the remaining 44 families had 1-3 species.

Considering the number of species caught in relation to the types of fishing gears, the catch of the gill-net was the most numerous with 76 species and followed in the order of long-line (58 species), hand-line (15 species), purse-seine (11 species), pole and dip net (5 species). The number of species caught by other fishing gears was very low, sharing a total of only 5 species.

As the habitats of fishes concerned, the migratory pelagic fishes including families Carangidae, Scombridae, Clupeidae, Exocoetidae, Mugilidae and Sphyrænidae from the coastal waters of the bay were caught mainly by purse-seine, pole and dip net, gill-net and driving-in net. Fishes from rocky bottom and coral reef including families Muraenidae, Scorpaenidae, Serranidae, Labridae, Balistidae, Tetraodontidae, Holocentridae, Kyphosidae, Pomacentridae, Apogonidae, Kuhliidae, Lutjanidae, Mugiloididae, Scaridae and Acanthuridae were mainly fishing objects of long-line and hand-line fishery. Sand and muddy bottom fishes including families Synodontidae, Bothidae, Soleidae, Cynoglossidae, Zeidae, Mullidae, Sciaenidae, Gerridae, Haemulidae, Tetraodontidae, Uranoscopidae, Trichiuridae, Rhinobatidae and Dasyatidae were the main fishing objects of gill-net, long-line

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Table 1. Species of fishes collected from Yen-liao Bay, during November 1980 through September 1981.

Species	No. of specimens	Body length (cm)	Fishing methods*
SCARIDAE			
<i>Scarus ghobban</i>	1	33.1	LL
URANOSCOPIDAE			
<i>Ichthyoscopus lebeck</i>	1	25.3	GN
<i>Uranoscopus bicinctus</i>	1	34.6	GN
<i>U. japonicus</i>	3	17.8-20.8	GN
MUGILOIDIDAE			
<i>Parapercis kamoharai</i>	5	16.7-21.7	LL,MF
<i>P. multifasciata</i>	12	14.3-17.2	LL,MF
ACANTHURIDAE			
<i>Acanthurus bleekeri</i>	1	29.5	GN
<i>A. dussumieri</i>	1	17	GN
<i>A. mata</i>	1	22.3	LL
<i>Prionurus scalprus</i>	1	37.9	GN
TRICHIURIDAE			
<i>Trichiurus lepturus</i>	8	61.8-82.2	GN
SCOMBRIDAE			
<i>Auxis rochei</i>	10	25.2-30.5	GN,HL,PS
<i>A. thazard</i>	3	27.5-28	GN
<i>Rastrelliger kanagurta</i>	1	14.5	GN
<i>Sarda orientalis</i>	108	43.7-61.0	TL
<i>Scomber japonicus</i>	76	15.0-34.0	GN,HL,PS
<i>S. australasicus</i>	22	27.0-37.5	GN,HL,PS
BOTHIDAE			
<i>Arnoglossus japonicus</i>	2	21.3-22.9	GN
CYNOGLOSSIDAE			
<i>Paraplagusia bilineata</i>	2	20.4-21.0	GN
<i>P. japonica</i>	10	18.5-23.3	GN
SOLEIDAE			
<i>Synaptura orientalis</i>	1	14.8	GN
<i>Zebrias zebra</i>	2	15.4-18.1	GN
BALISTIDAE			
<i>Aluterus monoceros</i>	1	30.6	GN
<i>Sufflamen fraenatus</i>	3	21.0-30.4	LL,MF
TETRACDONTIDAE			
<i>Lagocephalus gloveri</i>	12	21.1-27.1	LL
<i>L. Sceleratus</i>	16	22.9-47.4	LL

\* DI : Driving-in net

GN : Gill net

HL : Hand lining

LL : Long lining

MF : Miscellaneous fish long lining

PD : Pole and dip net

PS : Purse seine

TL : Troll lining

Table 1. Species of fishes collected from Yen-liao Bay, during November 1980 through September 1981. (Cont.1)

Species	No. of specimens	Body length (cm)	Fishing methods*
SCYLIORHINIDAE			
<i>Galeus eastmani</i>	6	36.4-42.7	MF
RHINOBATIDAE			
<i>Rhinobatos schlegelii</i>	1	-	LL
DASYARIDAE			
<i>Dasyatis akajei</i>	1	-	LL
MEGALOPIDAE			
<i>Megalops cyprinoides</i>	6	29.4-32.9	GN
MURAENIDAE			
<i>Echidna nebulosa</i>	3	38.9-62.5	LL
<i>Enchelycore pardalis</i>	1	58.9	MF
<i>Gymnothorax eurostus</i>	16	36.9-62.5	LL
<i>G. chilospilus</i>	21	31.3-48	LL
<i>G. chlamydatus</i>	2	39.3-51.4	LL
<i>G. fimbriatus</i>	1	81.8	LL
<i>G. kidako</i>	3	43.1-74.8	LL
<i>G. meleagris</i>	3	38.9-51.1	LL
<i>Siderea chilospilus</i>	6	44.7-56.8	LL
CLUPEIDAE			
<i>Etrumeus teres</i>	61	9-17	GN,PD
<i>Sardinella zunasi</i>	1	11.3	GN,PD
<i>S. gibbosa</i>	24	9.4-13.2	GN,PD
<i>S. lemura</i>	1	16.5	GN,PD
ENGRAULIDAE			
<i>Engraulis japonicus</i>	71	2.0-13.0	GN,PD
CHANIDAE			
<i>Chanos chanos</i>	5	26.4-31.8	GN
AULOPIDAE			
<i>Aulopus japonicus</i>	5	15.6-21.7	LL,MF
SYNODONTIDAE			
<i>Saurida undosguamis</i>	9	18.2-38.1	GN
<i>Trachinocephalus myops</i>	14	13.6-31.7	LL,GN
EXOCOETIDAE			
<i>Cypselurus agoo</i>	3	19.8-27.5	DI
<i>C. cyanopterus</i>	6	28.3-34.1	DI
<i>C. poecilopterus</i>	6	18.6-22.8	DI
BELONIDAE			
<i>Ablennes hians</i>	2	690-101.0	GN
HOLOCENTRIDAE			
<i>Sartogocentron rubrum</i>	1	17.4	MF

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Table 1. Species of fishes collected from Yen-liao Bay, during November 1980 through September 1981. (cont.2)

Species	No. of specimens	Body length (cm)	Fishing methods*
<b>ZEIDAE</b>			
<i>Zeus faber</i>	1	34.3	MF
<b>CAPROIDAE</b>			
<i>Antigonia capros</i>	4	17.7-18.5	MF
<b>SCORPAENIDAE</b>			
<i>Sebastiscus albofasciatus</i>	7	11.4-24.7	MF
<i>S. marmoratus</i>	85	13.8-27.9	MF,LL
<i>Sebastapistes albobrunea</i>	2	12.0-18.3	MF,LL
<i>Surpaena ornaria</i>	1	22.7	MF
<i>Scorpaenopsis cirrhosa</i>	5	14.0-20.2	MF,LL
<b>TRIGLIDAE</b>			
<i>Pterygotrigla hemisticta</i>	2	21.2-21.7	MF
<b>SERRANIDAE</b>			
<i>Cephalopholis boenack</i>	33	13.3-24.8	LL,MF
<i>Doderleinia berycoides</i>	1	23	LL
<i>Epinephelus fasciatomaculatus</i>	2	23.6-27.4	LL
<i>E. fasciatus</i>	1	31.3	MF
<i>Holanthias chrysostictus</i>	3	11.2-12.8	MF
<i>Liopropoma japonicum</i>	1	18.4	LL
<i>Plectranthias kelloggi</i>	2	13.8-13.9	LL
<b>TERAPONIDAE</b>			
<i>Terapon jarbua</i>	43	11.8-20.0	GN,HL
<b>KUHLIDAE</b>			
<i>Kuhlia marginata</i>	3	15.8-16.9	GN
<b>PRIACANTHIDAE</b>			
<i>Priacanthus cruentatus</i>	1	11.3	GN
<i>P. blochii</i>	1	12.1	GN
<i>P. hamrur</i>	2	20.0-21.1	GN
<b>APOGONIDAE</b>			
<i>Apogon aureus</i>	30	10.0-13.3	GN,HL,LL
<i>A. doederleini</i>	2	10.0-12.1	GN,MF
<b>MALACANTHIDAE</b>			
<i>Branchiostegus japonicus</i>	4	28.3-33.7	MF
<i>Malacanthus Brevirostris</i>	1	24.6	LL
<b>RACHYCENTRIDAE</b>			
<i>Rachycentron canadum</i>	2	36.1-38.3	GN
<b>CARANGIDAE</b>			
<i>Alectis ciliaris</i>	1	7.7	GN
<i>Caranx papuensis</i>	3	14.0-16.8	GN
<i>C. sexfasciatus</i>	3	15.5-16.0	GN

Table 1. Species of fishes collected from Yen-liao Bay during November 1980 through September 1981. (cont.3)

Species	No. of specimens	Body length (cm)	Fishing methods*
<i>Carangoides armatus</i>	2	13.9-15.0	GN
<i>C. equula</i>	2	20.1-21.0	GN
<i>C. hedlandensis</i>	6	10.7-13.4	GN
<i>Carangichthys dinema</i>	2	5.8-5.9	GN
<i>Decapterus kurroides</i>	395	18.0-31.0	GN,HL,PS
<i>D. macrosoma</i>	207	6.0-29.5	GN,PS
<i>D. maruadsi</i>	153	6.0-22.6	GN,PS
<i>D. macarellus</i>	2	24.4-25.6	GN
<i>D. tabl</i>	1	12.8	GN
<i>Elagatis bipinnulata</i>	1	37	GN
<i>Megalaspis cordyla</i>	34	27.0-32.0	PS
<i>Parastromateus niger</i>	6	20.8-26.4	PS
<i>Pseudocaranx dentex</i>	3	18.5-23.0	GN
<i>Scomberoides tol</i>	3	27.0-31.7	GN
<i>Sela crumenophthalmus</i>	66	7.0-20.8	GN,PS
<i>Seriola dumerili</i>	2	15.8-18.8	GN,PS
<i>Trachurus japonicus</i>	118	8.0-26.0	GN,HL,PS
CORYPHAENIDAE			
<i>Coryphaena hippurus</i>	1	5.9	MF
LEIOGNATHIDAE			
<i>Leiognathus</i> sp.	1	2.7	GN
LUTJANIDAE			
<i>Lutjanus kasmira</i>	2	15.4-16.8	LL
<i>L. lutjanus</i>	2	17.0-17.1	GN
<i>L. quinquelineatus</i>	1	15.4	GN
<i>L. vitta</i>	7	14.8-24.9	GN,LL
<i>Paracaesio caeruleus</i>	4	21.1-24.8	LL
CAESIONIDAE			
<i>Pterocaesio diagramma</i>	15	7.5-15.5	GN
GERRIDAE			
<i>Gerres filamentosus</i>	31	12.0-15.5	GN
HAEMULIDAE			
<i>Parapristipoma trilineatum</i>	2	13.7-23.2	GN,HL
<i>Plectorhynchus cinctus</i>	1	15.1	GN
<i>Pomadasys argenteus</i>	2	18.8-20.4	GN
SPARIDAE			
<i>Dentex tumifrons</i>	7	13.4-16.2	MF
<i>Pagrus major</i>	1	23.1	LL

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Table 1. Species of fishes collected from Yen-liao Bay, during November 1980 through September 1981. (cont.4)

Species	No. of specimens	Body length (cm)	Fishing methods*
<b>LETHRINIDAE</b>			
<i>Gymnocranius griseus</i>	1	28.5	LL
<i>Lethrinus hematopterus</i>	1	28	LL
<i>L. mahsena</i>	1	14	LL
<i>L. nebulosus</i>	1	21.1	GN
<b>NEMIPTERIDAE</b>			
<i>Scolopsis vosmeri</i>	4	14.0-17.2	HL,LL
<b>SCIAENIDAE</b>			
<i>Argyrosomus japonicus</i>	4	13.6-22.9	GN
<b>MULLIDAE</b>			
<i>Parupeneus chrysopleuron</i>	1	20	LL
<i>P. indicus</i>	1	31.5	LL
<i>P. heptacanthus</i>	3	22.8-24.8	LL
<i>P. ciliatus</i>	1	20.2	HL
<i>P. multifasciata</i>	5	17.5-21.6	LL
<b>PEMPHERIDAE</b>			
<i>Parapriacanthus ransonneti</i>	2	4.1-4.6	GN
<b>KYPHOSIDAE</b>			
<i>Girella melanichthys</i>	1	34.1	HL
<i>Kyphosus lembus</i>	1	19.5	GN
<b>EPHIPPIDAE</b>			
<i>Drepane punctata</i>	1	14.2	GN
<b>OMACENTRIDAE</b>			
<i>Abudefduf saxatilis</i>	12	10.6-12.0	HL
<b>APLODACTYLIDAE</b>			
<i>Goniistius zonatus</i>	1	31.7	LL
<b>MUGILIDAE</b>			
<i>Liza macrolepis</i>	1	18.2	GN
<i>Mugil cephalus</i>	10	15.9-30.5	GN,HL
<i>Valamugil cunnesius</i>	3	14.4-16.1	GN
<i>V. formosae</i>	2	23.7-24.2	GN
<b>SPHYRAENIDAE</b>			
<i>Sphyraena forsteri</i>	1	15.2	GN
<i>S. japonica</i>	6	15.1-31.5	GN
<i>S. jello</i>	9	15.8-23.5	GN
<i>S. picuda</i>	1	13.2	GN
<b>POLYNEMIDAE</b>			
<i>Polydactylus plebeius</i>	1	24	GN
<b>LABRIDAE</b>			
<i>Choerodon azurio</i>	15	17.2-33.5	HL,LL
<i>Pseudolabrus japonicus</i>	18	15.5-20.5	HL,LL

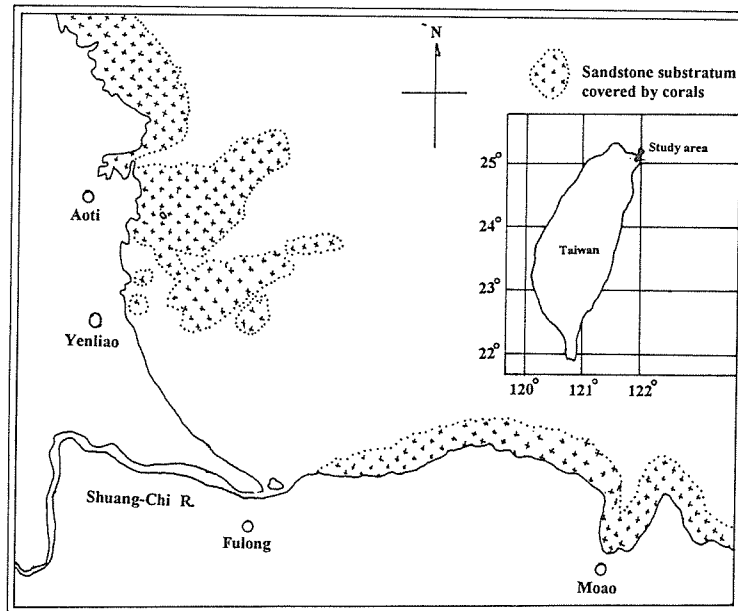


Figure 1. The Yen-Liao Bay in the northeastern Taiwan. The substratum of the bay off the Shuang-chi River estuary is dominated by sandy bottom, the others by coral reef.

and hand-line. In addition, sparids including *Dentex tumifrons* and *Pagrus major* and the tilefish *Branchiostegus japonicus* from offshore muddy bottom were important fishing objects of miscellaneous-fish long-line.

#### Analysis of fishery production

Annual catch of fishery production from Yen-Liao Bay was calculated on the basis of the records kept in the Aoti Fishermen's Association during 1972 and 1981 inclusive. The total annual catch ranged from 1,000 to 2,500 tons with a periodic change of every 5 year intervals. The peak catch appeared in 1972 and 1977 while the poor catch was in 1974 and 1979 (Fig. 2).

By types of fishery, the annual catch hand-line fishery was highest in 1972, replaced by purse-seine and pole and dip-

net fishery a year later. All these types of fishery exploited same fishing objects such as mackerels and bonitos, with a clearly inverse relationship between hand-line fishery products and others. Except the highest annual catch of gill-net in 1976, the annual catch of other types of fishery was relatively low with little fluctuation.

Monthly change of CPUE varied with types of fishing gears (Fig. 3). Fishing season of the peak catch for purse-seine and hand-line fisheries occurred both in spring (May-June) and autumn (September-October), while that of pole and dip net in November, gill-net in January and May, miscellaneous-fish long-lining in June, long-lining in January troll-lining in July and spear-fishing in October. All such differences in fishing season are probably the result of the migration of fishes in the bay.

Catch composition of each type of



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fishery in the bay differs year by year. The main object fishes for the purse-seine were red scad (*Decapterus kurroides*), lajang scad (*D. macrosoma*), bonitos (*Auxis* spp.), mackerels (*Scomber* spp.), black promfret (*Parastromateus macrosoma*) and clupeids in 1980, however, the importance of the first two groups was replaced by horse mackerels (*Trachurus japonicus*) in 1981.

The major fishing object by pole and dip-net fishery was lajang scad in 1980, becoming Formosan squid in 1981. The catch composition for the miscellaneous-fish long-line fishery appeared no great differences between 1980 and 1981. Troll-line fishery mainly caught bonitos in both years while catch of gill-net fishery was bonitos in 1980, shifting to horse mackerel, shark and flying fish in 1981. The catch composition of other types of fishery also varied with years, with comparatively simple in composition. Besides the above men-

tioned fishery products, some other economically important coastal products other than fishes including seaweed, small abalone and spiny lobster along the rocky coast and anguillid elvers in the estuary were also substantial (Tzeng, 1976; Tzeng, 1985).

## DISCUSSION

This is the first time to investigate the fish species and fishery production of Yen-Liao Bay. It reveals a significantly year-to-year fluctuation in total catch which is mainly caught by purse-seine, pole and dip-net and hand-line fisheries. Catch composition of all these types of fishery mainly consist of pelagic fishes which are almost certainly recruited from the offshore. In general, the population size of pelagic fishes change greatly year by year, its rate of availability may be influenced

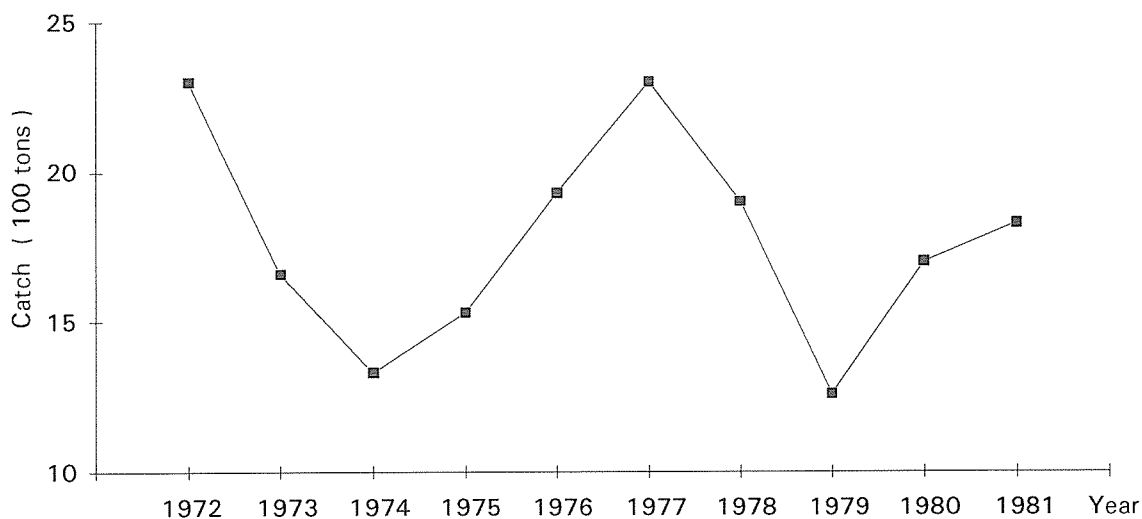


Figure 2. Annual fishery production landed in Aoti fish market during 1972 through 1981.

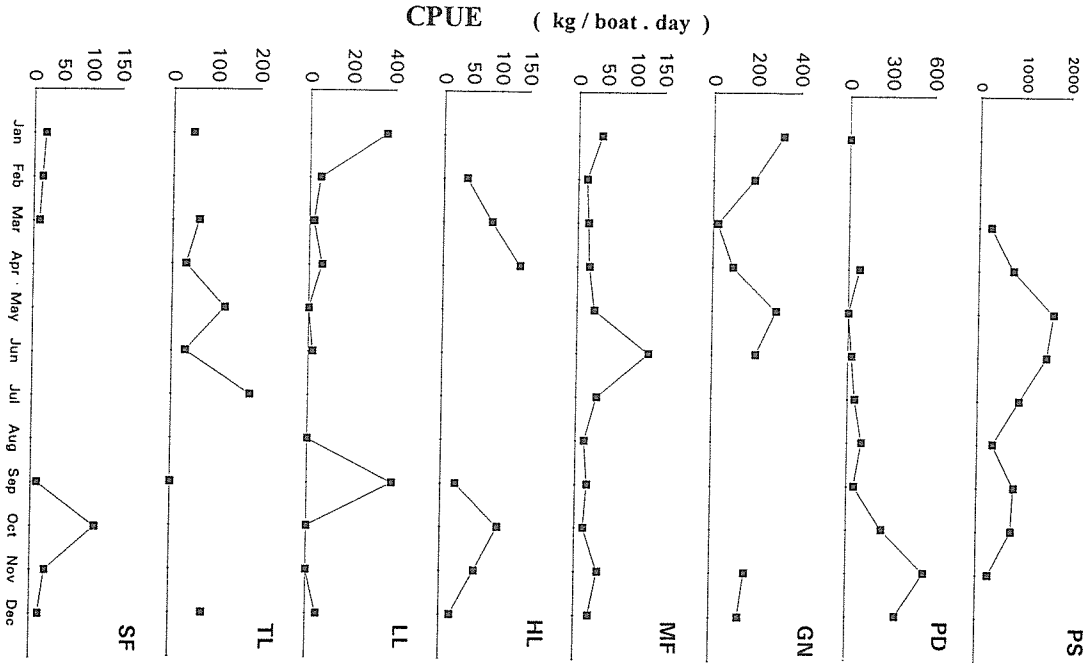


Figure 3. Changes in monthly mean CPUE ( kg/boat.day) of the commercially important fishreies in Yen-Liao Bay and its adjacent waters. The catch statistics were collected from Aoti fish market during July 1976 through September 1981. Abbreviations for the types of fisheries, PS, PD, GN, MF, HL, LL and TL, refer to Table 1; SF=Spear fishing.

by oceanographic condition (Tzeng and Hirano, 1979). To understand the mechanism of fluctuation in catches, further long term surveys on fishery productions and oceanographic factors are needed.

Because the landings of fishes at Aoti fish market are recorded and grouped into several arbitrary categories, such grouping is far too rough to understand what exact fish species involved in this survey. Only twenty categories of fish groups from catch statistics are far below the result of actual specimen collection during the investigation (139 commercial species) of landings from the boats. Number of species obtained differs by fishing gears, for instance, the fishes caught by gill-net and long-line are recorded not more than four

categories which is far below those shown in Table 1. Therefore, it is impossible to elucidate the species composition from the available catch statistics obtained from fish market. In order to clarify the real fish assemblages in the bay, it is necessary to investigate all the specimens caught by every kinds of fishing gears.

In general, species diversity and abundance of fish community vary with the latitude of the sites investigated and some oceanographic factors such as type of coastal line, actions of waves and currents, supply of nutrients from rivers and so on, are also responsible for them. Yen-Liao Bay is located in subtropical waters with a benefit from Kuroshio current on the offshore area and the discharge of upstream

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nutrients from river Shuang-chi may enhance this possibility. Meanwhile, its complicated nature of substratum eg., rocky outer part of the bay, sandy inner part of the bay and muddy offshore deeper ground may contribute a rather complicated environmental conditions, subsequently, a highly diversified fish community in the bay is expected. However, number of species is not limited to those listed in this report, it may be increased to a certain extent when sampling techniques and fishing ground are further expanded.

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# 臺灣東北部鹽寮灣的魚類相及 漁業生產特性

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本研究的目的，在瞭解鹽寮灣的魚類相，以及漁業生產的變動特性。自1980年11月至1981年9月，由鹽寮灣捕獲的漁獲物中，共發現魚類56科139種。大多數為經濟魚類，包括表層性洄游魚類，珊瑚礁魚類及底棲魚類。該灣的年漁獲量估計在1,500-2,500噸。大部分的漁獲，在1972年前主要來自手釣漁業；1973年後，以巾著網及棒受網漁業為主，主要漁獲對象為春、秋兩季洄游至鹽寮灣外緣的表層洄游性魚類。該灣的次重要漁業為雜魚延繩釣，全年可在岩礁區捕獲，漁獲種類歧異度相當大。春夏之交，灣內的砂質區域為仔魚的主要漁場。灣內的岩礁性沿岸盛產九孔、龍蝦。河口域在冬季盛產鰻線。