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A STUDY OF THE TRASH FISH CAUGHT BY OTTER TRAWL IN THE VISAYAN SEA*

by

Jose A. Ordonez**

ABSTRACT

A 9-month study on the distribution, abundance and ecology of trash fish in the Visayan Sea is presented. It is based on the data obtained from the trawling experiments and oceanographic observations conducted on board the research and training vessel, M/V "Albacore" of the U.P. College of Fisheries.

A total of 1,789.2 kilograms of trash fish was caught in 213 hours, giving a mean catch rate of 8.4 kilograms per hour for the entire 9-month period. Results show differences in real distribution, seasonal (monthly) abundance, depth and time distribution.

Of the 59 families, 51 genera and 46 species identified, the predominant "commercial " groups were those belonging to the Families Platycephalidae (flatheads), Leiognathidae (slipmouths), Synodontidae (lizardfishes) and Bothidae (flatfishes); Families Tetraodontidae (pufferfishes), Apogonidae (cardinalfishes), Triglidae (gurnards), Torpedinidae (electric rays) and Pomacentridae (damselfishes) were among the top ranking "non-commercial" fish groups in the trash fish component of the trawl catch.

Temperature, salinity, dissolved oxygen and pH conditions made no significant influence on the distribution of *Spheroides lunaris, Lepidotrigla sp.* **and** *Daya jerdoni.*

INTRODUCTION

Trash fish is that portion of the bottom trawl catch, mainly composed of the young or juveniles of commercially important fish species, as well as both the young and adults of lesser known food fish species. These are sorted out and referred to as "dyako" in the local dialect. "Dyako" belong to the lowest category in the commercial classification of trawl-caught fish; hence, they have the least market value. In other countries , trash fish is also called "scrap fish", "waste fish" or "industrial fish" when processed into products for human consumption and other industrial uses.

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In the early days of trawling, sizeable amounts of trash fish were shoveled overboard to give more space in the fish holds of trawlers and/or fish carriers for much more valuable or highly priced commercial fish species which were subsequently caught during fishing operations.

Trash fish occupy space and consume ice. Proceeds from their sale is not commensurate with the consumption of ice, plus the time and energy expended in its transport and handling, especially over distances between trawling grounds and fishing ports and fish landings.

In recent times, however, because of the apparent decline in the trawl catches of commercially important food fish, the trash fish had attracted greater attention as raw material for processed fishery products like *bagoong* (fish sauce), dried fish and fish meal. Their utilization has increasingly gained importance among small fishermen and even big processing establishments.

The economic implications of trash fish as they relate to the trawl fishing industry and conservation aspects of the trawl fishery have been given serious management considerations by fisheries administrators in other countries like Denmark and the United States (Blegvad, 1946; Sayles, 1951). In the light of the recent knowledge on the state of the demersal fish stocks in the southeast Asian region, especially that of the Sunda Shelf and the Malacca Strait, concern over the large numbers of small fish being caught has increased. In this connection possible control measures are adopted and aimed at preventing the loss of potential value of such small fishes being discarded as trash fish (Anon 1978). Studies of the status of the demersal fisheries of the Gulf of Thailand show that sustained trawl fishing tends to increase the percentage of trash fish in the catch (Ritragsa, 1976). In the Philippines, more focus on the study of trash fish would shed more light on their role in fisheries production, management and conservation especially in connection with the problem of overfishing traditional fishing grounds.

The Visayan Sea has been significantly contributing to the total fish production of the Philippines. In 1976, 8.6 percent (or 120,255 metric tons of trawl-caught fish) was the share of the Visayan Sea from the total Philippine fish production of 1,393,483 metric tons.

This report presents the results of a study on the ecology of the trash fish component of the trawl catch in the Visayan Sea, specifically three species, namely, *Spheroides lunaris* (Bloch and Schneider), *Lepidotrigla sp.* and *Daya jerdoni* (Day). Data include those on catch composition, relative abundance, depth and areal distribution and [illegible] of their capture.

REVIEW OF LITERATURE

As far as the Philippine waters (particularly the Visayan Sea area) are concerned, no distributional and ecological study has been made on trash fish caught by any fishing gear, whether in the commercial or municipal fishery.[1] Even the fisheries statistics compiled by the Bureau of Fisheries and Aquatic Resources do not reflect data or information on trash fish.

Warfel and Manacop (1951), in their study of possible trawling grounds in the Philippines, described "jaco" (their term for trash fish) as a mixture of juveniles of commercially important fish species. In his description of the marine fisheries of central Visayas, Rasalan (1957) did not give any information on trash fish in the area.

In northern Europe, Blegvad (1946) discussed the composition of the "waste fish" (which he described as unfit for human consumption) in the Belt Sea in Denmark. He also discussed the economic and management aspects of the "waste fish" fishery in the area of the Belt Sea, especially on the mesh size regulation preventing the young of commercial species from being caught.

In America, conservation implications of the trash fish fishery in southern New England were analyzed by Sayles (1951). The increased landings of trash fish in New England ports caused concern over the possibility that these landings included large numbers of the young of commercial species. Haskell (1961) studied the Gulf of Mexico trawl fishery for "industrial species", their composition and their utilization in the pet food industry of the north Gulf; while Fahy (1966) concentrated on studying the species composition of the North Carolina "industrial fish" fishery.

In the southeast Asian region, observations on trash fish were conducted by the Marine Fisheries Research Department of the Southeast Asian Fisheries Development Center in Singapore (Anon. 1975). Initial survey work included the study on the composition, abundance and landing statistics of trash fish. Chilvers (1974), in his observation on the trawl catch in the trawling grounds off Hong Kong, included the trash fish aside from the "commercial" and the "potentially commercial" fish in the classification of the trawl catch. Latiff *et al.* (1976) classified trash fish as to include those commercial species which had not attained marketable size in his classification of the composition of the trawl catch in the coasts of Sarawak, Brunei and Sabah. Off the Khmer (Cambodia) coast, Saroeung (1976) estimated the demersal fish stocks and came out with the result that trash fish

[1]In commercial fishery, fishing vessels over three tons gross are used. In municipal fishery, fishing vessels three tons gross and below are used. (Anon. 1976).

consisted of more than 60 percent of the catch. This has been attributed to intensive exploitation of the country's coastal resources. In the Gulf of Thailand trawl fishery, Ritragsa (1976) referred to "scrap fish" as that portion of the catch not considered commercially important and demonstrated that increased catch in "scrap fish" is accompanied by a decline in the average annual catch.

In his studies of the demersal fisheries of the South China Sea, Jones (1976) noted the increase in trash fish percentages in the commercial trawl landings in Hong Kong and some southeast Asian countries.

PURPOSE OF THE INVESTIGATION

The purpose of this study is to gather information on the ecology and relative abundance of trash fish caught by otter trawl in the Visayan Sea.

The specific objectives are: to determine the catch composition, seasonal (monthly) abundance and areal distribution of trash fish and to determine distributional and correlation patterns of common, lesser known and non-commercial fish species comprising the trash fish catch with depth, trawling time, temperature, salinity, dissolved oxygen and pH values.

MATERIALS AND METHODS

Description of the Study Area

The area is somewhat elongated, running in a more or less northeast-southwest direction and covers approximately 5,184 square kilometers (2,085 square nautical meters).

Figure 1 shows the depth contours of the Visayan Sea. The south-west portion is situated in the area bounded by the Gigantes Islands to the north, Bantayan Island to the east, northeastern Negros to the south and northeastern Panay to the west. This is the shallow portion of the study area whose depth ranges from 20- to 40-meters.

The northeast portion is situated in the area bounded by Asid Gulf to the north, Manocmanoc and Carnasa Islands to the east, Bantayan and Guintacan Islands to the south and the Gigantes Islands to the west. This is the deep portion which ranges from 41- to 180-meters.

Equipment Used and Sampling Procedure

The Research Vessel and Sampling. Field observations and sampling work were done on board the M/V "Albacore", a 190-gross ton [illegible]

of Fisheries (Plate 1). The vessel is designed and equipped for conducting oceanographic survey work, stern trawling, purse seining and tuna longlining. Vessel particulars are in Appendix A.

Trawl fishing operations were conducted on 12 suitable fishing tracks previously determined by the Furuno echo sounder/fishfinder on board the vessel. The fishing tracks are shown in Figure 2 and their respective positions are listed on Table 1.

Trawl fishing was conducted for two hours each month in each fishing track for nine months from July 1976 to March 1977.

The fishing gear used in this study is a two-seam high opening otter trawl net with a codend mesh size of 15 millimeters. Figure 3 shows the diagram of the net. The otter trawl net is a gear designed to catch demersal fishes or those that are caught on or near the sea bed.

Catch (abundance) *data.* After each haul, the weight of the catch was taken. The larger sized commercial fish species were sorted into generic groups and weighed. The remaining trash fish component was also weighed and then sorted out and classified up to species whenever possible.

When the trash fish portion of the catch was large in any particular haul, aliquot sampling was done. This was resorted to so as not to be overtaken by the next haul, because sorting and weighing were time consuming. Weights of sorted trash fish were recorded in grams but were converted to kilograms since the catch per haul was calculated in kilogram per hour.

For the purpose of this thesis, kilogram per hour is the unit of measure used in presenting variations in abundance relative to time (months and hours), area and depth. Kilogram per hour is a generally applied unit of measure in determining relative abundance in capture fisheries (Anon. 1974).

Physico-chemical parameters. Monthly oceanographic observations and samplings for nine months were made in 13 pre-determined stations (Figure 2) from July 1976 to March 1977. Table 2 shows the positions and depths in meters of the oceanographic stations.

Serial temperature readings at standard depths (0-, 10-, 20-, 30-, 50-, 75-, 100-, etc. meters) were obtained through the use of the protected reversing thermometers. They were enclosed in protective frames which were in turn attached to the Nansen reversing water bottles (Plate 2). The readings were corrected through the use of the calibration tables corresponding to the particular thermometers used.

Water samples were collected to determine salinity, dissolved oxygen content and pH. Salinity values were determined through the use of the refractory salinometer. Dissolved oxygen content determinations were made by applying the modified Winkler method. pH values were determined by using the pH meter.

For this study, only the bottom values of each station were used.

Nature of bottom sediments. Grab samples were taken from predetermined stations in the survey area to determine the distribution of the various sediment types. A Van Veen type of grab was used in sampling the bottom sediments.

OBSERVATIONS AND RESULTS

Relative Abundance and Distribution of Trash Fish in the Visayan Sea

A total of 1,789.2 kilograms of trash fish was caught during the 9-month survey period and this is about 21.6 percent of the total trawl catch during that period.

Table 3 shows the mean monthly catch in kilogram per hour of trash fish and its corresponding percentages from the commercial fish portion of the trawl catches in the Visayan Sea. The whole Visayan Sea showed a mean of 8.4 kilograms per hour catch for the entire 9-month period. This is 24.2 percent of the entire mean catch rate.

Comparing the two major areas of the Visayan Sea, the shallow portion has a mean value of 7.3 kilograms per hour catch rate which was 30.0 percent of the commercial catch while the deep portion had a mean catch of 9.0 kilograms per hour which was 20.7 percent of the commercial catch.

Monthly variations for the whole area showed that December had the highest rate of 13.2 kilograms per hour which was 34.6 percent of the commercial catch. The lowest rate was 6.8 kilograms per hour in September and whose corresponding percentage was 13.0. Figure 4.1 shows a clear presentation of the monthly variations.

Monthly variations in the shallow area showed that August had the highest rate of 13.2 kilograms per hour, while February had the least catch rate of 4.1 kilograms per hour. This can be seen on Table 3 and in Figure 4.2.

Monthly catch rate variations in the deep area showed December as having the highest value at 15.9 kilograms per hour while the lowest was 5.2 kilograms per hour in August as shown on Table 3 and in Figure 4.3.

There were 59 families, 51 genera and 46 species which were identified from among the trash fish of the otter trawl catch (Table 4). They were grouped into two. One group of 27 families which are considered "commercial" fish were early juveniles of food fish that had not reached marketable size. The other group of 32 families consisted of adults and juveniles of non-food fish categorized as trash fish. They are shown on Tables 5 and 6, listed in the order of abundance in kilogram per hour.

Physico-chemical Conditions

In describing the physico-chemical conditions of the Visayan Sea, emphasis is given to bottom temperature, salinity, dissolved oxygen and pH conditions as the fishes under study were those belonging mostly to the demersal group which is most associated with the bottom and near bottom environmental conditions. These bottom oceanographic observations were obtained from within the 5-meter distance from the sea floor.

The mean monthly bottom temperature values showed that the lowest at 25.14°C was observed in February, while the highest at 28.08°C was observed in July.

The monthly bottom isotherm plots of the Visayan Sea area from July 1976 to March 1977 (Figure 5) show that there were at least three distinct bottom interplaying water masses which are 1) the cold water (24.00°C to 25.75°C) which can be referred to as the Masbate water coming from the southern tip of Masbate and whose origin is the deep area between Masbate and Biliran, 2) the warm water (28.30°C to 28.40°C) which can be referred to as the Jintotolo water coming from Jintotolo Channel between northeastern Panay and western Masbate, 3) the warm water (28.30°C to 28.70°C) coming from Guimaras Strait between Panay and northeastern Negros. A fourth water mass (25.00°C to 26.00°C) of intermediate temperature may be present or coming from the area between Bantayan Island and northern Cebu.

On salinity, a general mean of 33.25°/oo was observed for the entire 9-month period. For the mean monthly bottom salinity values the lowest at 32.89°/oo was observed in January, while the highest at 33.80°/oo was noted in July. These values can be seen on Table 7.

The highest mean monthly bottom dissolved oxygen content was observed in August with a value of 6.60 milligrams per liter, while the lowest was 5.83 milligrams per liter in October. The highest individual reading was 7.74 milligrams per liter at Station 8 north of Negros in September while the lowest individual reading was 4.25 milligrams per liter at Station 5 near the southeastern tip of Masbate. These values

The mean monthly bottom pH values showed that February had the lowest at 8.25 while July had the highest at 8.50. The lowest individual reading was obtained at Station 3 with a value of 8.13 in March, while the highest individual reading was obtained at Station 10 with a value of 8.60 in July. These values can be seen on Table 7.

Nature of the Bottom within the Study Area

Figure 6 shows the general bottom characteristics of the study area. The thatched portion shows the soft bottom type whose sediment nature ranges from silt and mud to sandy mud, which was observed in both the shallow and the deep portions.

Starting from the northeastern side of Panay, off Pan de Azucar, Calagnaan and Sicogon Islands, the soft bottom sediment type extends northeastward towards the eastern side of the Gigantes Islands and eastward towards Tanguingi Island in tongue-like extensions. A broad stretch of the area extends southeastward towards the northeastern side of northern Negros towards Tanon Strait.

In the deep portion, with Tanguingi Island as the reference point, the soft bottom sediment type extends from 12 to 13 nautical miles to the north and northeast directions and about 17 nautical miles to the east. The soft bottom extends in a south-southeastward direction about five nautical miles in width towards the area between Bantayan and Guintacan Islands. It farther extends toward the east of Guintacan Island. The southern extension joins the area north of Tanon Strait.

Isolated areas of soft bottom sediment were observed in the northern and central portion of the Visayan Sea. This portion is characterized by hard bottom which ranges from coralline sand to corals and rocks.

Extensive areas of hard bottom are in the southern central portion of the Visayan Sea around Bantayan Island but much more were observed on the northwestern, western and southern sides where trawling could be done.

The northern side of Negros shows hard bottom, extending to the northeast of Igbon and Malagaban Islands, and west-northwestward towards Tagubanhan Island.

DISCUSSION

Abundance and Distribution of Trash Fish

Catch and size composition. Fishes of the Family Platycephalidae or *sunog* ranked first in abundance among the "commercial"

period (Table 5). This value represented 29.2 percent of the grouping. These flatheads belong to *Platycephalus spp.* with sizes ranging from 11 to 15 centimeters.

The slipmouths or *sapsap* (Family Leiognathidae) ranked second with a 5.3 kilograms per hour catch rate which represented 20.7 percent of the catch. These fishes belong to *Leiognathus spp.* with a size range of three to five centimeters.

Ranking third were the lizardfishes (Family Synodontidae) which showed a 4.4 kilograms per hour catch rate. They were composed of *Saurida spp.* (2.2 kilograms per hour), *Saurida tumbil* (20.0 kilograms per hour) and *Trachynocephalus myops* (0.2 kilogram per hour). Their size range was from six to 11 centimeters.

The fishes of the Family Bothidae ranked fourth and this group showed a 2.7 kilograms per hour catch rate. Most of them were included in the trash fish component. Some, however, were big enough to be included in the commercial catch category. Those included as the trash fish were within the nine to 15-centimeters range.

After the Family Bothidae, catch rates from 1.1 kilograms to 0.1 kilogram per hour in descending order included the families Priacanthidae, Nemipteridae, Mullidae, Gerridae, Lutjanidae, Carangidae, Cynoglossidae, Soleidae, Gobiidae, Pleuronectidae, Dasyatidae and Stromateidae.

Families which had catch rates of less than 0.1 kilogram per hour were Pomadasyidae, Serranidae, Trichiuridae, Clupeidae, Psettodidae, Engraulidae, Muraenesocidae, Lethrinidae, Sillaginidae, Ephippidae and Theraponidae.

The conger eel, locally known as *igat* (*Muraenesox cinereus*) had the highest length range (20 to 25 centimeters), followed by the cutlass fishes (*Trichiurus haumela*) with an 18 to 24 centimeters length range. Third was the Family Dasyatidae. It was represented by the sting ray (*Dasyatis kuhlii*) which has a 14 to 21 centimeters length range.

The species which had the smallest length ranges were the slipmouth (three to five centimeters), followed by the red bullseye (three to seven centimeters), by the mojarras (four to seven centimeters), the anchovies (four to eight centimeters), the threadfins (four to nine centimeters), the theraponids (five to eight centimeters), *Alectis indica* (five to eight centimeters), the glassfishes (five to nine centimeters) and *Platax orbicularis* (five to nine centimeters).

The other species, whose juvenile forms were common, were the

Of the "non-commercial" fish groups (Table 6) and ranking first in abundance, the pufferfishes of the Family Tetraodontidae, particularly *Spheroides lunaris*, predominated the catch. A rate of 14.4 kilograms per hour for the Family Tetraodontidae had been observed during the 9-month period. This represented about 31.5 percent of the whole catch.

Present in a significant amount and ranking second in abundance was the Family Apogonidae (the cardinal fishes). A catch rate of 9.2 kilograms per hour was noted and represented about 20.1 percent of the catch. *Apogonicthys ellioti* was the most common among the members of the Family Apogonidae with a 4.0 kilograms per hour catch rate and representing about 8.8 percent of the catch.

The third ranking group consisted of the members of the Family Triglidae (the gurnards). This group was represented by *Lepidotrigla spp.* which had a catch rate of 5.0 kilograms per hour, representing about 10.9 percent of the catch.

The electric rays (Family Torpedinidae) represented by *Narcine timlei*, ranked fourth with a 2.8 kilograms per hour catch rate which was about 6.1 percent of the catch.

Damselfish, *Daya jerdoni*, of the Family Pomacentridae, was fifth in rank with a 2.7 kilograms per hour rate which was about 5.9 percent of the catch.

The *Ambassis* of the Family Centropomidae ranked sixth with a 2.4 kilograms per hour rate. This was about 5.9 percent of the catch.

From scorpionfishes (Family Scorpaenidae), which had a rate of 2.0 kilograms per hour, there was a gradual decrease of the catch rate down to 0.1 kilogram per hour among flying gurnards (Family Dactylopteridae), stargazers (Family Uranoscopidae), batfishes (Family Ogcocephalidae), triggerfishes (Family Balistidae), trumpetfishes (Family Fistularidae), ophidiids, mugiloidids, triacanthids, stonefishes (Family Synancejidae), parrotfishes (Family Scaridae), catfishes (Family Plotossidae), bregmacerotids, porcupinefishes (Family Diodontidae), anglerfishes (Family Lophiidae) and shrimpfishes (Family Centriscidae).

The other groups which had catch rates of less than 0.1 kilogram per hour included boxfishes (Family Ostraciontidae), sergeantfishes (Family Rachycentridae), frogfishes (Family Antenariidae) percophids (Family Percophidae), pegasids (Family Pegasidae), pipefishes (Family Syngnathidae), soldierfishes (Family Holocentridae), trypauchenids (Family Trypauchenidae), pineconefishes (Family

The anglerfishes, sergeantfishes, trumpetfishes, electric rays and triggerfishes were among the groups of fishes which had the biggest size ranges of 20 to 45 centimeters, 25 to 32 centimeters, 15 to 40 centimeters, 15 to 30 centimeters and 15 to 30 centimeters, respectively.

The small-sized groups were principally represented by the cardinal fishes (four to eight centimeters), *Daya jerdoni* (three to ten centimeters), the bregmacerotids (four to eight centimeters), some tetraodontids (four to nine centimeters) and the butterflyfishes (five to eight centimeters).

Monthly Catch Rates and Percentage Composition. While the flatheads (Family Platycephalidae) dominated the overall 9-month period catch rate, the other major families took turns percentagewise in dominating the monthly catch composition (Figure 7.1).

With a catch rate of 3.66 kilograms per hour in July, the slipmouths (Family Leiognathidae) were the most abundant, being almost one-half (47.26 percent) of the total catch. They were immediately followed by the flatheads (Family Platycephalidae) which represented 13.38 percent. The lizardfishes (Family Synodontidae), crevalles (Family Carangidae), goatfishes (Family Mullidae) and mojarras (Family Gerridae) followed in abundance with 12.56 percent, 12.02 percent, 3.82 percent and 3.55 percent, respectively. The other families with percentage composition of less than 3.00 percent were lumped together under "others" which represented 7.30 percent.

In August, the lizardfishes were the dominant group in the catch (1.87 kilograms per hour), representing 29.41 percent. The flatheads ranked second with a 22.45 percent value, followed by the red bullseye with 17.11 percent. The slipmouths were still a major component of the catch in August with a 14.43 percent value. The goatfishes, glassfishes, mojarras and "others" had 3.74 percent, 3.20 percent and 9.62 percent values, respectively.

As in July, the slipmouths dominated the catch in September. The catch rate for the month was 3.33 kilograms per hour. The slipmouths represented 44.74 percent of the whole catch and almost similarly followed by the flatheads with a 17.41 percent value. Third ranking were the lizardfishes which represented 17.11 percent of the catch.

The glassfishes, mojarras, bothids, red bullseye, threadfins and "others" were 5.70 percent, 3.60 percent, 3.30 percent, 3.00 percent and 5.10 percent, respectively, of the catch.

The dominance of the flatheads started in October which had a represented 26.71 percent of the catch. The lizardfishes ranked third with an 18.41 percent value. The bothids and the threadfins and "others" had 11.55 percent, 6.13 percent and 9.02 percent values, respectively.

A gradual increase in the dominance of the flatheads was observed in November. They represented 32.91 percent of the catch, the rate of which was 3.22 kilograms per hour. The presence of the bothids was markedly noticed when they ranked second in November. They comprised 21.73 percent of the catch. The lizardfishes continued to be a major component during this time by being third with a 17.39 percent value.

The slipmouths took a minor role by being fourth ranking with a mere 8.69 percent value. The cynoglossids, the pleuronectids and "others" had 5.59 percent, 3.41 percent and 10.00 percent values, respectively.

The peak of the flatheads' abundance was observed in December. From a 5.46 kilograms per hour catch rate for the month, the flatheads represented 41.75 percent of the catch.

Dropping to 13.73 percent were the lizardfishes which ranked second. A gradual percentage decrease of the other families was represented by the bothids (7.50 percent), the snappers (7.14 percent), the slipmouths (5.49 percent), the goatfishes (4.94 percent), the threadfins (4.39 percent), the soles (3.66 percent) and "others" (11.35 percent).

The flatheads' preponderance (35.31 percent) was still noticeable in January. The January catch rate was 3.20 kilograms per hour. Just like in November the bothids (22.81 percent) ranked second. For the second time the red bullseye ranked third (13.43 percent), a little less than when they were also third in August. The slipmouths ranked fourth (9.37 percent). Fifth ranking (7.18 percent) were the lizardfishes. The other families with less than 3.00 percent each were included in "others", totalling 11.87 percent of the catch for the month.

The catch in February (1.35 kilograms per hour) was dominated by the lizardfishes which represented about 28.88 percent. The flatheads followed closely (26.91 percent). Ranking third (15.55 percent) were the bothids. The threadfins (5.92 percent) and the goatfishes (2.96 percent) ranked fourth and fifth, respectively. The other families represented 20.00 percent of the catch.

Until March the lizardfishes were dominant group (25.98 percent), followed by the flatheads (22.03 percent). The catch rate for March was 1.77 kilograms per hour. The threadfins ranked third (16.38

percent), the highest percentage they had attained from previous months. Others made up 7.34 percent.

In the order of descending abundance, the other groups in the March catch were the bothids (15.25 percent), the pomfrets (7.34 percent) and the slipmouths (5.64 percent). Others was 7.34 percent.

Among the "non-commercial" groups, the pufferfishes dominated the trash fish catch for six months during the 9-month survey period (Figure 7.2).

The pufferfishes were most abundant (30.02 percent) in the July catch. Second were the electric rays which were 20.36 percent of the catch. Following in descending order were the cardinal fishes, gurnards, catfishes and scorpionfishes with values of 16.18 percent, 8.09 percent, 5.48 percent and 3.65 percent, respectively. The other species formed 16.18 percent of the catch.

More than one-half of the August catch was made up of the pufferfishes (62.90 percent). The catch rate for the month was 6.26 kilograms per hour. The next single group was composed of the cardinal fishes which comprised 12.61 percent of the catch. The gurnards and the trumpetfishes followed with 3.67 percent and 3.19 percent, respectively. Others made up 17.57 percent.

In September, the cardinal fishes dominated the catch (23.01 percent) with the rate of 3.52 kilograms per hour. The pufferfishes were not far behind at 19.60 percent. Third ranking were the gurnards (13.35 percent), followed by the other families a gradual decrease in percentage.

The month of October with a catch rate of 5.51 kilograms per hour, saw the dominance of the pufferfishes (20.81 percent). The cardinal fishes (19.06 percent) followed closely behind as the second dominant group in the catch. Not far behind were the gurnards (16.33 percent) which ranked third in dominance. A substantial portion of the catch was made up of the damselfishes (11.25 percent).

The other groups of fishes comprising the October catch were the scorpion fishes (5.63 percent), the batfishes (4.35 percent), the electric rays (3.62 percent), the triggerfishes (3.62 percent), the flying gurnards (3.09 percent) and others (12.15 percent).

The dominance of the pufferfishes in November had slightly changed from that of the previous month, their percentage in the catch being a little higher at 21.51 percent at the rate of 6.23 kilograms per hour. This time the gurnards ranked second (15.57 percent). A gradual decrease in percentage was observed from the cardinal fishes (10.27 percent) down to the triggerfishes (3.21 percent).

Members of the Family Apogonidae dominated the catch with 19.92 percent and 13.32 percent in December and January, respectively.

The pufferfishes were back in dominance in February and March with 37.90 percent and 40.67 percent, respectively. This group of fishes was predominant in the catches during this time of the year.

A big portion (23.71 percent) of the catch in February was composed of the centropomids with the cardinal fishes (12.19 percent), the gurnards (7.90 percent) and the electric rays (4.63 percent) and others comprising the rest of the catch.

A very significant part of the catch in March consisted of the cardinal fishes (33.03 percent) which ranked second. The other groups were the gurnards (6.57 percent), the stargazers (4.62 percent) and others (15.09 percent) making up the rest of the catch.

Depth Distribution. On depth distribution, the shallow area is within the 20- to 40-meter and 41- to 60-meter levels; the intermediate depth is within the 61- to 80-meter and 81- to 100-meter levels; the deep area is within the 101- to 120-meter and 121- to 140-meter depth levels.

Trash fish was most abundant in the deep area as clearly seen on Table 8 and in Figure 8. Markedly higher kilogram per hour catch rates in the 101- to 120- and the 121- to 140-meter-depth levels with mean catch rates of 10.5 kilograms per hour and 13.6 kilograms per hour, respectively, were observed during the 9-month period.

The lowest mean catch rate of 6.0 kilograms per hour was observed in the intermediate depths particularly in the 61- to 80-meter depth levels.

Peaks of abundance in the intermediate depths, particularly in the 61- 81- to 100-, 101- to 120-, 121- to 140-meter depth levels going higher the deeper they go, — from 14.0 to 22.6 kilograms per hour and then to 26.3 kilograms per hour catch rates, respectively.

Peaks of abundance in the shallow area were observed during the warmer and rainy months. In July, a mean of 21.9 kilograms per hour catch was observed in the 41- to 60-meter depth level. At the 20- to 40-meter depth level, August and September had their peak catch rates at 20.1 and 14.5 kilograms per hour, respectively.

Ecology of Three Trash Fish Species

Three species of "non-commercial" trash fish species were selected for specific ecological investigations. They are *Spheroides lunaris*, *Lepidotrigla sp.* and *Daya jerdoni* which belong to the major groups

S. lunaris, the common pufferfish or *botete*, belonging to the Family Tetraodontidae, is best known for its poisonous nature. It is the cause of many deaths of people who try to eat it. Because of its abundance, it can be the source of raw material for possible industrial uses.

Lepidotrigla sp. is a gurnard belonging to the Family Triglidae whose abundance can also be a source of material for fish meal processing. Information on their availability relative to distribution and seasonality may be useful for people who may wish to utilize the members of this group.

D. jerdoni is a damselfish belonging to the Family Pomacentridae. (Pomacentrids are more commonly known to occur in reef areas.) Its presence in the muddy to sandy-muddy trawling grounds of the Visayan Sea evokes special interest for studies on its distribution, aside from being also a possible raw material for some utilization industries.

Areal Distribution. Figure 9 shows the relative areal distribution of *S. lunaris* from July 1976 to March 1977.

July showed a distribution where high concentrations (3.1 to 4.0 kilograms per hour) were observed in the vicinity south and east of Calagnaan and Sicogon Islands (Figure 9.1). The southern portion of the shallow area had very low concentrations (less than 1.0 kilogram per hour) east of Pan de Azucar (FT 11) and north of Negros (FT 12).

The concentrations in the deep area ranged from very low to low with a catch rate of 1.0 to 2.0 kilograms per hour.

August showed a similar distribution pattern to that of July except that in August there was a tendency for some schools to form Island (FT 10) had become very high with values greater than 4.0 kilograms per hour. Similarly in the deep portion, formation of moderate concentrations (2.1 to 3.0 kilograms per hour) was observed towards the southern and eastern sides of the area. The adjacent areas remained in very low concentrations.

There was a sudden decrease in concentrations in the shallow area for the month of September (Figure 9.3). However, there was no marked change in the concentration in the deep area, a situation which is more or less similar to that of July.

From very low concentrations in September, the month of October had shown some increased concentration to moderate and low concentrations in the shallow area (Figure 9.4). The deep area had not

In November, a contrast in concentration was surprisingly presented (Figure 9.5). All of the concentrations were very low (less than 1.0 kilogram per hour), while the easternmost side of the deep area particularly at FT 8 had a very high concentration (greater than 4.0 kilograms per hour). The very low concentrations in the shallow area were observed at FT's 10 and 11, with total absence of *S. lunaris* from FT's 9 and 12. In the deep area *S. lunaris* was not observed at FT 3.

Distribution in December showed movement of concentrations to be towards the southern portion of both areas, going to low from very low concentrations in the shallow area and going to low and moderate concentrations in the deep area (Figure 9.6). Absence of *S. lunaris* at FT 9 was observed.

In January (Figure 9.7), very low concentrations were observed in the shallow area while the situation in the deep area was similar to that of December except for the total absence of *S. lunaris* at FT 3 and the interchange of low and very low concentrations between FT's 5 and 6.

While the shallow area had remained in very low concentrations in February, the deep area had concentrations soaring to very high values, especially at FT's 5, 6 and 7 (Figure 9.8). FT 8 had moderate concentration.

The situation in March (Figure 9.9) had not departed much from the February condition. In the shallow area, the very low concentration at FT 9 had increased to low concentration; while in the deep area, movement of concentrations had been towards the north and northeast.

The monthly areal distribution of *Lepidotrigla sp.* is shown in Figure 10.

The months of July and August showed very low concentrations at all fishing tracks (Figures 10.1 and 10.2). The absence of *Lepidotrigla sp.* was observed at FT 10 in July and at FT's 10, 11 and 3 in August.

The September situation showed the start of the movement towards deeper waters and noticeable increase in concentration as shown in Figure 10.3. At FT 3 the concentrtion had become moderate.

Total absence of *Lepidotrigla sp.* from the shallow area was observed in October as shown in Figure 10.4. A sudden increase to very high concentration was observed at FT 7 and to moderate at FT 8 in the deep area.

The October situation was observed to be carried towards

Figure 10.5. In December, total absence of *Lepidotrigla sp.* in the shallow area was still presented in Figure 10.6. Concentrations were confined in the deep area ranging from very low, low, moderate and high concentrations.

January still showed the total absence from the shallow area of *Lepidotrigla sp.* and the high, the moderate and the low concentrations had been reduced to very low, low, moderate concentrations in the deep area (Figure 10.7).

The months of February and March showed the return of *Lepidotrigla sp.* to the shallow area in very low concentrations and the increase to low and moderate concentrations in the deep area (Figures 10.8 and 10.9).

Figure 11 shows the relative areal distribution of *D. jerdoni* in the Visayan Sea.

The months of July, August and September showed very low concentrations for both the shallow and the deep areas of the Visayan Sea (Figures 11.1 to 11.3). *S. jerdoni* appeared in two fishing tracks in July, five in August and seven in September.

A change in the situation was observed during the month of October (Figure 11.4) when moderate concentration was noted in the southern part of the shallow area north of Negros, while a high concentration was formed in the deep area of the Visayan Sea.

There was virtual disappearance of *D. jerdoni* in the shallow area in November (Figure 11.5) when very low concentration was observed only at FT 9 east of Sicogon Island. Low and moderate concentrations were observed at three fishing tracks in the northern side of the deep area.

December showed the reappearance of *D. jerdoni* of very low and low concentrations at FT's 11 and 12 in the shallow area (Figure 11.6). Very low concentration was observed in the southern side of the deep area at FT , and at the same time the disappearance of two low concentrations at FT's 1 and 4.

The noticeable change in January was the appearance of high concentration at FT 1 in the deep area (Figure 11.7). The moderate concentration at FT 4 was reduced to very low concentration. In the shallow area the disappearance of the very low concentration at FT 11 was observed.

Just like in July, August and September, the months of February and March had very low concentrations in both areas of the Visayan Sea (Figures 11.8 and 11.9).

Distribution in Relation with Depth. Table 9 and Figure 12 show the distribution of *S. lunaris* in the different depth levels in the Visayan Sea.

It was observed that this species was found in all depth levels sampled. The monthly distribution shows that in July, it occurred most in the 41- to 60-meter level with a 2.8 kilograms per hour catch rate. Its occurrence was least in the 121- to 140-meter level which had less than 0.5 kilogram per hour catch rate.

The occurrence during the 9-month period was highest at 10.4 kilograms per hour in August in the 20- to 40-meter level. Much lesser rates in the lower depths during the same month were observed.

In September, the highest occurrence at 1.0 kilogram per hour was observed in the 81- to 100-meter level. Occurrences in the 20- to 40-, 41- to 60- and 61- to 80-meter levels were 0.5, 0.7 and 0.6 kilogram per hour, respectively. No occurrence was observed in the 101- to 120-meter level. At the 121- to 140-meter level, occurrence was less than 0.5 kilogram per hour.

In October, the highest occurrence was observed in the 41- to 60-meter level with a catch rate of 2.0 kilograms per hour. The second highest was observed in the 81- to 100-meter level with a 1.6 kilograms per hour catch rate. Third was 1.4 kilograms per hour in the 20- to 40-meter level. Less than 0.5 kilogram per hour occurrences were observed in the 61- to 80- and 101- to 120-meter levels. No occurrence was observed in the 121- to 140-meter level.

The second highest occurrence during the 9-month period was in November with a 9.8 kilograms per hour catch rate in the deepest (121- to 140-meter) level. The upper levels had much lesser occurrences, ranging from less than 0.5 kilogram per hour to 0.9 kilogram per hour catch rates.

December had its highest occurrence in the 101- to 120-meter level with a 2.8 kilograms per hour catch rate.

Like December, January had its highest occurrence in the 101- to 120-meter level with a 2.7 kilograms per hour value. The second highest occurrence of 0.5 kilogram per hour was observed in the 61- to 80-meter level. Less than 0.5 kilogram per hour values were observed in the 20- to 40-, 81- to 100- and the 121- to 140-meter levels. No occurrence was observed in the 41- to 60-meter level.

February had the third highest occurrence with a 7.3 kilograms per hour rate during the 9-month period. This was observed in the

the intermediate and deep levels. Less than 0.5 kilogram per hour catch rate was observed in the 20- to 40-meter level. Occurrences in March in the different depth levels did not show wide ranging differences, but higher values were observed in the lower levels. It was only in the 20- to 40-meter level where the occurrence was less than 0.5 kilogram per hour. The highest occurrence in March was seen in the deepest level (121- to 140-meter) with a 3.7 kilograms per hour catch rate.

The distribution of *S. lunaris* from the shallow waters to the deepest levels sampled was shown by its presence in the majority of the trawl hauls made.

Figure 12 shows *S. lunaris* in a characteristic pattern in vertical distribution. During the warm, rainy months of July and August, the concentration of their distribution was in the upper levels. This was just about during the height of the southwest monsoon. Towards the inter-monsoon period they started moving towards the deeper waters and remained there until the onset and during the height of the northeast monsoon period. This concentration, however, started moving up during the inter-monsoon period from northeast to southwest monsoons.

The depth distribution of *Lepidotrigla sp.* can be seen on Table 10 and in Figure 13.

The higher occurrences were observed in the intermediate and deep levels, but mainly from the 81- to 100-meter level down to the 121- to 140-meter level, although the highest values were observed in the 101- to 120-meter level with the months of October and November having catch rates of 5.8 and 6.2 kilograms per hour, respectively.

Most of the occurrences of *Lepidotrigla* sp. in the upper levels were less than 0.5 kilogram per hour. There were no occurrences from October to February in the 20- to 40-meter level and from October to January in the 41- to 60-meter level. In the 61- to 80-meter level, the other months had less than 0.5 kilogram per hour mean monthly values, except for a 0.6 kilogram per hour value in January.

The highest in the 81- to 100-meter levelwas 2.2 kilograms per hour in November, followed decreasingly by December and September with 1.5 and 1.4 kilograms per hour values, respectively.

In the 121- to 140-meter level, the highest catch rate was 3.1 kilograms per hour in December, followed by 2.4 kilograms per hour in October. The months of July, August, September and November had values that were within the 0.7 to 0.9 kilogram per hour range. January and February had a less than 0.5 kilogram per hour

Lepidotrigla sp. is more of a deep fish species. Its concentration in the deeper waters is defined although it was also found in small numbers in the shallow waters during certain times of the year. Figure 12 shows the highest concentration in the 101- to 120-meter level in October and in November or during the inter-monsoon period, from the southwest monsoon to the northeast monsoon.

On the depth distribution of *D. jerdoni*, it can be gleaned from Table 11 and Figure 14 that it occurred only in the shallow and intermediate levels or not deeper than the 81- to 100-meter level.

In the months of July, August, September and February the occurrences of *D. jerdoni* were all less than 0.5 kilogram per hour.

The highest occurrence observed was 1.8 kilograms per hour in the 61- to 80-meter level in November. The second highest was 1.7 kilograms per hour in December, also in the 61- to 80-meter level. Third was 1.6 kilograms per hour in October, and fourth was 1.2 kilograms per hour in January both also in the 61- to 80-meter level.

In the 20- to 40-meter level, high occurrences (greater than 0.5 kilogram per hour) were noted in the months of October, December and January at about the same time that the higher values were observed in the 61- to 80-meter level.

The highest value in its deepest level of occurrence was observed in March at 0.5 kilogram per hour.

D. jerdoni is more of a shallow-water fish species. It had not been observed to occur in areas deeper than 100 meters. Its distribution is more confined in the southwestern portion of the Visayan Sea where it is shallow. The plotted areal distribution shows *D. jerdoni* to be distributed also in the northeastern side, which is in the deep area, but does not occur in areas deeper than 100-meters.

Its vertical distribution as shown in Figure 15 seems to suggest that there could be two major population stocks which are entirely separate from each other. One population stock is confined to the shallow area and the other stock to the intermediate depth level.

Distribution in Relation with Time. *S. lunaris*, *Lepidotrigla sp.* and *D. jerdoni* exhibited catch rate variations according to time of trawling and frequency of occurrence (Table 12).

S. lunaris was observed to be most abundant in the afternoon (1200-1800 hours) with a rate of 2.5 kilograms per hour, occurring 89.5 percent of the 19 drags made. Its next abundance was in the evening (between 6 p.m. and 12 midnight (1800-2400 hours), at the catch rate of 1.3 kilograms per hour, with a 75.0 percent occurrence from out of

occurred 90.0 percent of 31 drags made with a 1.2 kilograms per hour rate. Between midnight and 6 a.m. (0000-0600 hours) only one drag was made and the rate was about 0.1 kilogram per hour.

Lepidotrigla sp. was most abundant in the evening (1800-2400 hours) with a catch rate of 1.4 kilograms per hour, occurring 60.0 percent of 20 trawl drags made. A slightly lower catch rate of 1.2 kilograms per hour was observed in the afternoon (1200-1800 hours) with a slightly lower frequency of occurrence of 57.9 percent from 19 drags. In the morning (0600-1200 hours), the catch rate was 0.7 kilogram per hour with a 56.3 percent frequency of occurrence from 31 drags. An identical catch of 0.1 kilograms per hour with *S. lunaris* was observed in the early morning (0000-0600 hours) from one drag.

While *S. lunaris* was most abundant in the afternoon, *Lepidotrigla sp.* in the evening, *D. jerdoni* was most abundant in the early morning with a catch rate of 0.8 kilogram per hour. Its occurrence was 59.4 percent from the 31 trawl drags made.

Its next abundance was in the afternoon at a catch rate of 0.5 kilogram per hour with a frequency of occurrence of 52.6 percent from a total of 19 drags.

A 0.3 kilogram per hour rate was noted in the evening and the occurrence of 35.0 percent from 20 drags was observed of *D. jerdoni*.

D. jerdoni had a 0.1 kilogram per hour catch in the early morning from one trawl drag as did *S. lunaris* and *Lepidotrigla sp.*

Relation between Catch and the Hydrographic Conditions. Figures 15 to 17 show the relation between the mean monthly catch of *S. lunaris*, *Lepidotrigla sp.* and *D. jerdoni* and the corresponding mean monthly bottom temperature, salinity, dissolved oxygen and pH values. The summary of correlation analysis is shown on Table 13.

For *S. lunaris* (Figures 15.1 to 15.4) there were three peaks of abundance during the 9-month period. The highest was in August, followed by the February-March peak and the third was in November. The curves seem to show some kind of pattern of positive and negative relations between the catch and the hydrographic conditions. Of the four conditions, dissolved oxygen content of the water and pH show the highest but insignificant degrees of association. Positive relation with dissolved oxygen ($r = 0.339$) and negative relation with pH ($r = -0.408$) was observed.

Temperature and salinity showed no relation at all with abundance as the value r was *-0.098* for temperature and *0.075* for salinity.

Of the four hydrographic conditions (Figures 16.1 to 16.4), dissolved and negative correlation, $r = 0.375$ for pH and $r = -0.420$ for dissolved oxygen. The values, however, are not significant. The coefficient of correlation between abundance and salinity was *0.040*, which shows almost total absence of association between the two. Between temperature and abundance, the value of r was *0.129*, which indicates a very low and insignificant degree of association.

For *D. jerdoni*, Figures 17.1 to 17.4 show that the highest degree of association is exhibited between catch and dissolved oxygen content, where the coefficient of correlation r, is *-0.376*.

The next highest degree of association is shown between catch and salinity, with r being *-0.184*.

pH and catch showed the third highest degree of association with a *0.150* value, while temperature and catch showed the least value of *0.087*.

Considering the various degrees of association exhibited between the catch and the hydrographic conditions, the variations in abundance of the three trash fish species were not due to the existing physico-chemical changes during the 9-month period.

Trawl Trash Fish Catch and Management Implication

Trash fish is categorized into two groupings. One grouping referred to as "commercial" or temporary members of the trash fish component, is composed entirely of juveniles or early adult stages of commercially important species. The other grouping is referred to as "non-commercial" or permanent component of the trash fish catch because it is made up of both the young and adult sizes of lesser known species.

The multi-species nature of the trawl fishery of the Visayan Sea, just like the trawl fishery in other fishing grounds of the Philippines and other tropical trawl fisheries of the world, poses difficulties related to management measures. Lower trawl catch of poor quality fish has been the common observation among trawlers, brought about by over-fishing mainly through the use of fine-meshed nets.

The continued use of fine-meshed trawl nets could eventually lead to depletion of the demersal fishery. Trends in some trawl fisheries have shown this situation as in the Gulf of Thailand (Ritragsa, 1976), where the proportion of the "commercial" trash fish from the total catch had been increasing with the corresponding decrease of the commercial catch from the total catch (Table 14).

The trawl catch, being composed of fishes having different sizes, shapes and stages of sexual maturity characteristics, makes the

thus allowing the small ones to grow, leaves the other species which are naturally small fishes at maturity as an unutilized resource. To allow the use of smaller meshed nets to catch the small and mature fish would result in the catching of the immature sizes of the commercially important fish species.

In this situation, it would be necessary to determine the relative economic value of various sizes of fish caught in the same fishing gear and operation and the role of the various species in the entire ecosystem to know the course of resource management.

The availability of trash fish is important for the continued operation of certain fish utilization industries. But the continued dependence on the temporary trash fish species would seriously affect the stability of the various commercial fish stocks.

However, the development of a permanent trash fish fishery could be encouraged as results of some deep-sea trawl explorations show promise of availability of trash fish in waters deeper than the traditional trawling depths.

In experimental trawlings conducted by Magnusson (1972) in the Samar Sea on different depth levels showed that there was increasing catch with increasing depth. Philippine trawlers have not been commonly operating in waters deeper than 50-meters, but areas deeper than 50-meters showed that there was higher catch. To illustrate from Magnusson's data, the catch at the 26- to 50-meter level was 120 kilograms per hour; at the 51- to 70-meter level, the catch was 166 kilograms per hour, and at 75-meters the catch was 200 kilograms per hour. It is believed that this could be also true for some other areas in the Philippines needing to be explored farther. Depending on what are catchable fish species, a specific fishery may be developed, e.g. elephantfish (Chimaera) or rattail fishery for industrial purposes. Hussain *et al* (1972) in their exploratory fishing in the coast off west Pakistan had also found that increasing depths yield greater catches of demersal fishes.

With the production trend existing in known demersal fisheries, like the baby trawl and medium trawl fisheries in Manila Bay (Personal communication, Ganaden 1980), the actual serious problem now is to reduce the catch of the young of the more important fish groups, e.g. grouper or *lapu-lapu*. Catching them in coastal and shallow areas should be properly regulated.

There are existing regulatory measures to prevent the catching of juveniles of demersal fish species. One is Presidential Decree (P.D.) No. 1915, which provides that no person shall operate trawls in waters seven fathoms deep or less. It also provides that the President may

The regulation on mesh size (Fisheries Administrative Order No. 40-4) prohibits the use of fine-meshed nets, which shall include all nets used in fishing with mesh size less than two centimeters stretched. The exception is the use of fine-meshed nets for the catching *ipon* (small goby), *padas* (rabbitfish fry), bangus fry, etc. and such species which by their very nature are small but already mature such as *tabios*, *sinarapan*, *dilis*, etc.

Studies on mesh size selectivity are therefore necessary upon whose results shall be based more appropriate regulatory measures that could be enforced without increasing the dangers of affecting the stability of certain demersal fish fishery.

SUMMARY

Trash fish make up that portion of the bottom trawl catch locally referred to as "dyako" and having the least market value. These used to be discarded while still at the fishing grounds, but is now brought ashore and sold as raw material for processed fishery products like *bagoong*, fish meal, etc.

Trash fish have gained significance because of their economic and management implications in relation to fishery development. Studies in foreign countries aim to assess this resource as it affects the demersal fish stocks.

In the Philippines, practically no studies on trash fish have been made. This study was aimed at collecting information on the relative abundance and ecology of trash fish in the Visayan Sea.

A 9-month exploratory trawl fishing and oceanographic observation was made on board the research and training vessel M/V "Albacore" of the U. P. College of Fisheries.

A total of 1,789.2 kilograms of trash fish was caught in 213 hours, giving a mean catch rate of 8.4 kilograms per hour of trash fish. This catch was about 21.6 percent of the total trawl catch during that period.

The deep area of the Visayan Sea yielded a higher catch rate of 9.0 kilograms per hour, representing 20.7 percent of the catch, than that of the shallow area which yielded a catch rate of 7.3 kilograms per hour or about 30.0 percent of the catch.

On the hydrographic conditions of the Visayan Sea, at least three distinct bottom water masses interplay in the area, namely: 1) the cold Masbate water (24.00°C to 25.75°C) coming from the deep area between Masbate and Biliran, 2) the warm Jintotolo water (28.30°C to 28.40°C) coming from Jintotolo Channel, and 3) the warm Guimaras water

The trawlable grounds of the Visayan Sea are characterized by soft bottom sediments, generally ranging from silt and mud to sandy mud and sand. The hard or untrawlable areas are characterized by irregular bottom topography.

A total of 59 families, 51 genera and 46 species were identified. The predominant "commercial" groups were those belonging to Families Platycephalidae (flatheads), Leiognathidae (slipmouths), Synodontidae (lizardfishes) and Bothidae (flatfishes); while Families Tetraodontidae (pufferfishes), Apogonidae (cardinalfishes), Triglidae (gurnards), Torpedinidae (electric rays) and Pomacentridae (damselfishes) were among the most abundant "non-commercial" fish groups in the trash fish component of the trawl catch.

Trash fish was most abundant in the deep area, -10.5 kilogram per hour in the 101- to 120-meter level and 13.6 kilograms per hour in the 121- to 140-kilograms per hour in the 121- to 140-meter level. The lowest mean catch rate of 6.0 kilograms per hour was observed in the intermediate depths (61- to 80- and 81- to 100-meter level).

Three trash fish species, namely *Spheroides lunaris* (pufferfish), *Lepidotrigla sp.* (a gurnard) and *Daya jerdoni* (a damselfish) were selected for ecological investigations for being among the most abundant specific groups and because of their possible economic importance and special interest.

On areal distribution, *S. lunaris* showed high (3.1 to 4.0 kilograms per hour) to very high (greater than 4.0 kilograms per hour) concentrations in the shallow area during the southwest monsoon period (particularly in July and August) and in the deep area during the northeast monsoon period (particularly in February and March).

Lepidotrigla sp. showed high to very high concentrations in the deep area during the inter-monsoon and during the onset of the northeast monsoon period (October-November-December).

D. jerdoni occurred in both the shallow and the deep areas of the Visayan Sea, but occurred most abundantly in high to very high concentrations in October and in January.

Vertical distribution showed that *S. lunaris* was observed in all depth levels sampled. However, during the warm-rainy months the concentration was in the upper levels. This was observed especially in July when there was a catch rate of 2.8 kilograms per hour in the 41- to 60-meter level and in August when there was a 10.4 kilograms per hour catch rate in the 20- to 40-meter level.

Distribution in relation with time of trawling showed that *S. lunaris* was most abundant in the afternoon (1200-1800 hours) with a 2.8 kilograms per hour catch rate, *Lepidotrigla sp.* in the evening (1800-2400 hours) with a 1.4 kilograms per hour catch rate and *D. jerdoni* in the morning (0600-1200 hours) with a catch rate of 8.0 kilograms per hour.

Temperature, salinity, dissolved oxygen and pH conditions did not show any significant effect on the seasonal (monthly) variations of *S. lunaris*, (*Lepidotrigla sp.*) and *D. jerdoni* in the Visayan Sea.

The multi-species nature of the trawl fishery of the Visayan Sea poses difficulties related to management measures. The imposition of mesh size regulations is quite difficult because of the different characteristics as regards to size, shape and stage of sexual maturity of the fishes comprising the trawl catch.

The development of a permanent trash fish fishery to answer the needs of fish utilization industries can be brought about by farther exploratory bottom trawling in deeper waters of the Philippines which showed promise as discovered through preliminary surveys and through results of investigations in other countries.

Mesh size selectivity studies are necessary in the formulation of more appropriate control measures to safeguard the stability of certain demersal fish fishery.

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Table 1
Fishing track list

Track No.	POSITION		Approx. Distance (naut. miles)
	Start	End	
01	Lat. 11°44.3'N Lo. 123°30.5'E	Lat. 11°34.0'N Lo. 123°47.4'E	20
02	Lat. 11°42.0'N Lo. 123°40.0'E	Lat. 11°41.7'N Lo. 123°52.0'E	12
03	Lat. 11°39.0'N Lo. 123°35.4'E	Lat. 11°34.0'N Lo. 123°43.8'E	10
04	Lat. 11°39.8'N Lo. 123°43.4'E	Lat. 11°30.0'N Lo. 123°56.3'E	15
05	Lat. 11°39.2'N Lo. 123°45.5'E	Lat. 11°33.7'N Lo. 123°56.0'E	12
06	Lat. 11°21.8'N Lo. 123°34.9'E	Lat. 11°33.9'N Lo. 123°34.9'E	14
07	Lat. 11°30.2'N Lo. 123°56.0'E	Lat. 11°30.2'N Lo. 123°44.3'E	15
08	Lat. 11°31.5'N Lo. 123°47.3'E	Lat. 11°21.9'N Lo. 123°47.6'E	10
09	Lat. 11°20.5'N Lo. 123°51.2'E	Lat. 11°32.3'N Lo. 123°50.9'E	12
10	Lat. 11°36.9'N Lo. 123°53.5'E	Lat. 11°21.9'N Lo. 123°54.8'E	14
11	Lat. 11°23.6'N Lo. 123°57.8'E	Lat. 11°39.3'N Lo. 123°57.8'E	16
12	Lat. 11°31.8'N Lo. 123°04.0'E	Lat. 11°21.2'N Lo. 123°04.0'E	10

Table 2
Oceanographic stations list

Station No.	Position	Depth (m)
1	11°42.4'N 123°24'E	23
2	11°22.6'N 123°23.3'E	45
3	11°26.8'N 123°41.1'E	29
4	11°42.3'N 123°41.9'E	25
5	11°42.3'N 124°01.1'E	128
6	11°22.5'N 124°01.7'E	29
7	11°11.2'N 123°13.7'E	27
8	11°04.0'N 123°23.5'E	27
9	11°14.0'N 123°30.3'E	38
10	11°32.2'N 123°30.3'E	40
11	11°34.2'N 123°50.6'E	91
12	11°23.0'N 123°11.4'E	22
13	11°31.1'N 123°16.5'E	27

Table 3
Mean monthly catch in kg/hr of trash fish and its percentage from the commercial catch in the Visayan Sea

ea	Month	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	
llow	Mean	11.5	13.2	5.2	6.8	7.1	7.7	4.3	4.1	5.7	X = 7.3
	Percentage	40.0	43.5	14.6	32.5	46.2	42.5	11.1	24.0	15.7	X% = 30.0
p	Mean	5.4	5.2	7.7	9.0	10.5	15.9	10.5	8.5	8.5	X = 9.0
	Percentage	8.6	10.2	11.1	31.9	26.4	27.4			18.5	X% = 20.7
ole	Mean	7.5	8.1	6.8	8.2	9.4	13.2	8.3	7.1	7.4	X = 8.4
	Percentage	16.3	18.1	13.0	33.2	34.1	34.6	19.5	31.5	17.9	X% = 24.2

Table 4
Listing of fishes observed in the trash fish caught by Otter Trawl (M/V "Albacore") in the Visayan Sea[1]

CLASS ELASMOBRANCHII
Subclass Selachii
Order Batoiei

1. Family Torpedinidae
   Narcine timlei (Bloch and Schneider)

2. Family Dasyatidae
   Dasyatis kuhlii (Muller and Henle)

CLASS TELEOSTII
Superorder Elopomorpha
Order Anguilliformes
Suborder Anguilloidea

3. Family Muraenesocidae
   Muraenesox cinereus (Forskal)

Superorder Clupeomorpha
Order Clupeiformes
Suborder Clupeoidei

4. Family Clupeidae
   Sardinella sirm (Walbaum)
   Sardinella fimbriata (Cuvier and Valencienes)

5. Family Engraulidae
   Stolephorus spp.

Superorder Protocanthopterygii
Order Salmoniformes
Suborder Myctophoidei

6. Family Synodontidae
   Saurida tumbil (Bloch)
   Saurida undosquamis (Richardson)
   Trachynocephalus myops (Forster)

Superoder Ostariophysii
Order Siluriformes

7. Family Plotosidae
   Plotosus anguillaris (Bloch)

Superorder Paracanthopterygii
Order Lophiiformes
Suborder Lophioidei

8. Family Lophiidae
Lophiomus setigerus (Vahl)

Suborder Antennarioidei

9. Family Antennariidae
Antennarius sp.

10. Family Ogcocephalidae
Halieutea stellata (Vahl)

Order Gadiformes
Suborder Gadoidei

11. Family Bregmacerotidae
Bregmaceros sp.

Suborder Ophidioidei

12. Family Ophidiidae (including Brotulidae)
Brotula sp.

Order Beryciformes
Suborder Berycoidei

13. Family Monocentridae
Monocentris sp.

Superorder Acanthopterygii

14. Family Holocentridae

Suborder Aulostomoidei

15. Family Fistularidae
Fistularia petimba (Lacepede)

16. Family Centriscidae
Centriscus scutatus (Linnaeus)

Suborder Syngnathoidei

17. Family Syngnathidae
Hippocampus sp.

Order Scorpaeniformes
Suborder Scorpaenidei

18. Family Scorpaenidae (including Tetrarogidae)

19. Family Triglidae

Suborder Platycephalidei

21. Family Platycephalidae
Platycephalus spp.

Order Dactylopteriformes

22. Family Dactylopteridae (Cephalacanthidae)
Dactylopterus sp.

Order Pegasiformes

23. Family Pegasidae
Pegasus sp.

Order Perciformes
Suborder Percoidei

24. Family Centropomidae (including Ambassidae)

25. Family Serranidae
Epinephelus spp.

26. Family Theraponidae
Therapon spp.

27. Family Priacanthidae
Priacanthus hamrur

28. Family Apogonidae
Apogon spp.

29. Family Sillaginidae
Sillago sihama

30. Family Rachycentridae
Rachycentrom canadus

31. Family Carangidae
Alectis indica
Caranx spp.
Decapterus macrosoma

32. Family Menidae
Mene maculata

33. Family Leiognathidae
Leiognathus spp.
L. bindus, L. lineolatus, L. leuciscus
L. ruconius, L. splendens, L. elongatus

34. Family Lutjanidae (including Caesiodidae)

35. Family Nemipteridae (including Scolopsidae)
    Nemipterus spp.
    Scolopsis spp.

36. Family Gerridae
    Pentaprion longimanus
    Gerres spp.

37. Family Pomadasyidae (including Gaterinidae/ Plectorynchidae)
    Pomadasys sp.
    Gaterin sp.

38. Family Sciaenidae

39. Family Mullidae
    Mulloidicthyes auriflamma (Forskal)
    Parapeneus lutus (Cuvier and Valenciennes)
    Upeneus mollucensis (Bleeker)
    Upeneus sulphureus (Cuvier and Valenciennes)

40. Family Ephippidae (including Platacidae)
    Platax orbicularis

41. Family Chaetodontidae
    Chaetodon sp.

42. Family Pomacentridae (including Abudefdufidae)
    Daya jerdoni (Day)

Suborder Mugiloidei

43. Family Mugilidae
    Mugil sp.

Suborder Labroidei

44. Family Scaridae (including Callyodontidae)

Suborder Trachinoidei

45. Family Mugiloididae (including Parapercidae)
    Parapercis sp.

46. Family Uranoscopidae

Suborder Gobioidei

47. Family Gobiidae (including Eleotridae, Periophthalmidae)

48. Family Trypauchenidae

1976		December 1976				January 1977			
O_2 mg/L	pH	Temp °C	Sal. °/oo	O_2 mg/L	pH	Temp. °C	Sal. °/oo	O_2 mg/L	P
6.33	8.44	27.60	33.50	6.52	8.50	27.26	33.00	6.23	8.
5.32	8.46	26.94	33.75	5.73	8.45	26.33	33.00	6.82	8.
6.09	8.49	27.71	33.75	5.83	8.45	25.23	33.50	7.39	8.
6.29	8.15	27.60	33.25	6.56	8.43	26.73	33.00	6.19	8.
4.46	8.38	24.02	34.00	4.66	8.38	23.46	32.75	4.32	8.
6.23	8.27	27.04	33.00	5.84	8.50	26.35	32.50	6.47	8.
6.26	8.48	28.70	33.75	6.42	8.50	27.47	33.00	6.44	8.
6.29	8.52	27.92	33.80	6.42	8.39	27.81	33.50	6.45	8.
6.48	8.51	27.76	33.35	5.91	8.40	27.38	33.50	6.02	8.
6.09	8.40	27.00	33.50	5.99	8.49	26.65	32.30	5.87	8.
6.72	8.49	25.10	33.75	5.02	8.40	24.51	32.50	5.25	8.
6.95	8.50	28.49	33.25	6.02	8.46	27.71	32.50	6.55	8.
6.54	8.51	28.08	33.50	6.46	8.50	26.91	32.50	6.41	8.
6.16	8.46	27.23	33.55	5.95	8.45	26.45	32.89	6.19	8.

Table 5
Catch rates in kg/hr of trash fish from the highest to the lowest of the various "commercial" fish families/genera/species, their corresponding percentages, their common names and size ranges, from July 1976 to March 1977 in the Visayan Sea

Families	Catch Rates	Percentage	Common Names		Size Range (Length in cm)
			English	Local	
1. Platycephalidae	7.5	29.2	Flatheads	Sunog	11-15
Platycephalus sp.					
2. Leiognathidae	5.3	20.7	Slipmouths	Sapsap	3-5
Leiognathus spp.					
3. Synodontidae	4.4	17.1	Lizard fishes	Kalaso	6-11
Saurida sp.	2.2	8.5			
Saurida tumbil	2.0	7.8			
Trachynocephalus myops	0.2	0.7			
4. Bothidae	2.7	10.5	Flounders	Dapa	9-15
Bothid spp.					
5. Priacanthidae	1.1	4.2	Red bullseye	Dilat	3-7
Priacanthus hamrur					
6. Nemipteridae	1.1	4.2	Threadfins	Bisugo	4-9
Nemipterus spp.	0.8	3.1			
Scolopsis sp.	0.3	1.1			
7. Mullidae	0.8	3.1	Goatfishes	Saramulyete	5-10
Mulloidicthyes auriflamma	0.1	0.4			
Parapeneus sp.	0.1	0.4			
Upeneus sp.	0.6	2.3			
8. Gerridae	0.6	2.3			
Pentaprion longimanus	0.4	1.5	Glassfishes	Hubad	5-9
Gerres sp	0.2	0.8	Mojarras	Malakapas	4-7
9. Lutjanidae	0.5	1.9			
Lutjanus	0.4	1.5	Snappers	Maya-maya	6-11
Caesio	0.1	0.4		Dalagang bukid	7-9
10. Carangidae	0.5	1.9			
Alectis indica	<0.1	<0.4			5-8
Caranx	0.4	1.5	Crevalles	Salaysalay	7-10
Decapterus	<0.1	<0.4	Roundscads	Galunggong	6-8
11. Cynoglassidae	0.3	1.3	Flatheads	Chinelas	9-16
Cynoglossid spp.					
12. Soleidae	0.3	1.3	Soles	Dapa	8-15
Soleid spp.					
13. Gobiidae	0.2	0.8			10-14
Gobiid spp.					
14. Pleuronectidae	0.1	0.4	Flatheads	Dapa	10-15
Pleuronectid spp.					
15. Dasyatidae	0.1	0.4	Sting rays	Pagi	14-21
Dasyatis kuhlii					
16. Stromateidae	0.1	0.4	Pomfrets	Duhay	7-10
Apolectis niger					
17. Pomadasijadae	<0.1	<0.4	Grunts	Agoot	9-10
Pomadasys spp.					
Gaterin spp.					
18. Serranidae	<0.1	<0.4	Groupers	Lapu-lapu	8-12
Epinephelus sp.					
19. Trichiuridae	<0.1	<0.4	Cutlass fishes	Espada	18-24
Trichiurus haumela					
20. Clupeidae	<0.1	<0.4	Sardines	Tunsoy	7-10
Sardinella spp.					
21. Psettodidae	<0.1	<0.4	Flatfishes	Dapa	10-15
Psettodes erumei					

myops	0.2	0.7			
4. Bothidae Bothid spp.	2.7	10.5	Flounders	Dapa	9-15
5. Priacanthidae *Priacanthus hamrur*	1.1	4.2	Red bullseye	Dilat	3-7
6. Nemipteridae	1.1	4.2	Threadfins	Bisugo	4-9
Nemipterus spp.	0.8	3.1			
Scolopsis sp.	0.3	1.1			
7. Mullidae	0.8	3.1	Goatfishes	Saramulyete	5-10
Mulloidicthyes auriflamma	0.1	0.4			
Parapeneus sp.	0.1	0.4			
Upeneus sp.	0.6	2.3			
8. Gerridae	0.6	2.3			
Pentaprion longimanus	0.4	1.5	Glassfishes	Hubad	5-9
Gerres sp	0.2	0.8	Mojarras	Malakapas	4-7
9. Lutjanidae	0.5	1.9			
Lutjanus	0.4	1.5	Snappers	Maya-maya	6-11
Caesio	0.1	0.4		Dalagang bukid	7-9
10. Carangidae	0.5	1.9			
Alectis indica	<0.1	<0.4			5-8
Caranx	0.4	1.5	Crevalles	Salaysalay	7-10
Decapterus	<0.1	<0.4	Roundscads	Galunggong	6-8
11. Cynoglassidae Cynoglossid spp.	0.3	1.3	Flatheads	Chinelas	9-16
12. Soleidae *Soleid* spp.	0.3	1.3	Soles	Dapa	8-15
13. Gobiidae Gobiid spp.	0.2	0.8			10-14
14. Pleuronectidae Pleuronectid spp.	0.1	0.4	Flatheads	Dapa	10-15
15. Dasyatidae *Dasyatis kuhlii*	0.1	0.4	Sting rays	Pagi	14-21
16. Stromateidae *Apolectis niger*	0.1	0.4	Pomfrets	Duhay	7-10
17. Pomadasijadae *Pomadasys* spp. *Gaterin* spp.	<0.1	<0.4	Grunts	Agoot	9-10
18. Serranidae *Epinephelus* sp.	<0.1	<0.4	Groupers	Lapu-lapu	8-12
19. Trichiuridae *Trichiurus haumela*	<0.1	<0.4	Cutlass fishes	Espada	18-24
20. Clupeidae *Sardinella* spp.	<0.1	<0.4	Sardines	Tunsoy	7-10
21. Psettodidae *Psettodes erumei*	<0.1	<0.4	Flatfishes	Dapa	10-15
22. Engraulidae *Stolephorus* spp.	<0.1	<0.4	Anchovies	Dilis	4-8
23. Muraenesocidae *Muraenesox cinereus*	<0.1	<0.4	Conger eels	Egat	20-25
24. Lethrinidae *Lethrinus* sp.	<0.1	<0.4			8-9
25. Sillaginidae *Sillago sihama*	<0.1	<0.4	Whitings	Asohos	8-10
26. Ephippidae *Platax orbicularis*	<0.1	<0.4			5-9
27. Theraponidae *Therapon* spp.	<0.1	<0.4			5-8

Table 6
Catch rates in kg/hr of trash fish from the highest to the lowest of the various "non-commercial" fish families/genera/species, their corresponding percentages, their common names and size ranges, from July 1976 to March 1977 in the Visayan Sea

Families/genera/species	Catch Rates	Percentage	Common Names: English	Common Names: Local	Size Range (Length in cm)
1. Tetraodontidae	14.4	31.5	Puffer fishes	Butete	
Tetraodontid spp.	1.0	2.2			4–9
Spheroides lunaris	13.4	29.3			5–18
2. Apogonidae	9.2	20.1	Cardinal fishes	Isdang pusa	
Apogonid spp.	2.3	5.0			4–8
Apogon	2.9	6.3			4–8
Apogonicthys ellioti	4.0	8.8			5–10
3. Triglidae	5.0	10.9	Gurnards		10–20
Lepidotrigla sp.					
4. Torpedinidae	2.8	6.1	Electric rays		15–30
Narcine timlei					
5. Pomacentridae	2.7	5.9	Damsel fishes		3–10
Daya jerdoni					
6. Centropomidae	2.4	5.2			5–8
Ambassis sp.					
7. Scorpaenidae	2.0	4.3	Scorpion fishes		
Scorpaenid spp.	1.4	3.0			6–10
Pterois sp.	0.6	1.3			8–12
8. Dactylopteridae	1.6	3.5	Flying gurnards		16–25
Dactylopterus sp.					
9. Uranoscopidae	1.5	3.2	Stargazers		17–30
Uranoscopus					
10. Ogcocephalidae	1.4	3.0	Batfishes		20–30
Halieutea stellatus					
11. Balistidae	1.1	2.4	Triggerfishes	Papakol	15–30
Balistes spp.					
12. Fistularidae	1.0	2.1	Trumpetfishes		15–40
Fistularia petimba					
13. Ophidiidae	0.7	1.5			12–19
Brotula sp.					
14. Mugiloididae	0.6	1.3			9–14
Parapercis sp.					
15. Triacanthidae	0.6	1.3			11–16
Triacanthus sp					
16. Synancejidae	0.4	0.8	Stonefishes		18–25
Synancejid spp.					
17. Scaridae	0.4	0.8	Parrotfishes	Loro	8–12
Callyodontes spp.					
18. Plotossidae	0.3	0.6	Catfishes		8–10
Plotossus anguillaris					
		0.4			4–8

Centropomidae Ambassis sp.	2.4	5.2			5-8
Scorpaenidae	2.0	4.3	Scorpion fishes		
Scorpaenid spp.	1.4	3.0			6-10
Pterois sp.	0.6	1.3			8-12
Dactylopteridae Dactylopterus sp.	1.6	3.5	Flying gurnards		16-25
Uranoscopidae Uranoscopus	1.5	3.2	Stargazers		17-30
Ogcocephalidae Halieutea stellatus	1.4	3.0	Batfishes		20-30
Balistidae Balistes spp.	1.1	2.4	Triggerfishes	Papakol	15-30
Fistularidae Fistularia petimba	1.0	2.1	Trumpetfishes		15-40
Ophidiidae Brotula sp.	0.7	1.5			12-19
Mugiloididae Parapercis sp.	0.6	1.3			9-14
Triacanthidae Triacanthus sp	0.6	1.3			11-16
Synancejidae Synancejid spp.	0.4	0.8	Stonefishes		18-25
Scaridae Callyodontes spp.	0.4	0.8	Parrotfishes	Loro	8-12
Plotossidae Plotossus anguillaris	0.3	0.6	Catfishes		8-10
Bregmacerotidae Bregmaceros	0.2	0.4			4-8
Diodontidae Diodon	0.2	0.4	Porcupine fishes		10-20
Lophiidae Lophiomus setigerus	0.1	0.2	Angler fishes		20-45
Centriscidae Centriscus Scutatus	0.1	0.2	Shrimpfishes		13-17
Ostraciontidae Ostraciontid spp.	<0.1	<0.2	Boxfishes		10-20
Rachycentridae Rachycentron canadus	<0.1	<0.2	Sergeant fishes		25-32
Antenariidae Antenarius sp.	<0.1	<0.2	Frog fishes		6-9
Percophidae Bembrops sp.	<0.1	<0.2			7-12
Pegasidae Pegasus sp.	<0.1	<0.2			6-10
Syngnathidae Hippocampus	<0.1	<0.2			11-21
Holocentridae Holocentrus sp.	<0.1	0.2	Soldier fishes		11-15
Trypauchenidae Trypauchen vagina	<0.1	<0.2			
Monocentridae Monocentris sp.	<0.1	<0.2	Pinecone fishes		7-10
Chaetodontidae Chaetodon spp.	<0.1	<0.2	Butterfly fishes		5-8

H	February 1977 Temp. °C	Sal. °/oo	O_2 mg/L	pH	March 1977 Temp. °C	Sal. °/oo	O_2 mg/L	pH
26	25.37	33.00	7.18	8.34	26.11	33.50	6.64	8.36
30	25.30	33.50	6.00	8.20	25.58	32.75	4.72	8.42
30	25.06	33.50	6.32	8.23	25.28	33.00	5.54	8.13
24	24.61	33.50	5.78	8.30	25.44	33.00	6.15	8.14
29	23.47	33.00	4.96	8.15	24.00	33.80	4.97	8.40
38	25.19	33.00	7.03	8.30	25.45	32.50	6.21	8.40
30	25.70	33.00	6.39	8.31	26.93	33.00	6.33	8.35
42	25.98	32.75	6.38	8.24	26.83	33.00	6.13	8.50
29	25.56	33.75	6.60	8.20	26.20	33.25	5.72	8.38
29	24.47	33.50	5.56	8.31	25.34	33.00	5.26	8.40
29	24.96	33.00	5.11	8.20	26.24	33.75	6.33	8.35
40	25.64	33.00	6.42	8.20	27.27	33.00	6.37	8.39
22	25.57	33.00	6.93	8.24	26.22	33.00	6.17	8.38
31	25.14	33.19	6.20	8.25	25.91	33.12	5.89	8.37

Table 7
Monthly bottom temperature, salinity, dissolved oxygen and pH values taken from the oceanographic stations in the Visayan Sea

Table 8
Distribution of trash fish in the different depth levels in kg/hr-catch by month from July 1976 to March 1977 in the Visayan Sea

July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Mean
4.2	20.1	14.5	5.0	7.5	6.1	7.3	3.7	4.7	8.1
21.9	6.9	3.8	6.6	8.6	4.9	6.4	2.1	3.3	7.1
3.7	7.3	5.0	5.6	6.9	5.2	12.8	3.1	4.6	6.0
3.8	2.1	12.8	5.2	7.6	14.0	9.0	6.6	4.4	7.2
3.7	4.4	2.3	14.6	12.5	22.6	12.0	13.8	8.9	10.5
7.6	7.8	14.5	12.1	20.7	26.3	2.2	13.3	18.3	13.6

Table 9
Distribution of *Spheroides lunaris* in the different depth levels in mean kg/hr-catch by month from July 1976 to March 1977 in the Visayan Sea

Depth (m)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March
20-40	1.0	10.4	0.5	1.4	0.3	0.7	0.4	0.3	0.1
41-60	2.8	1.5	0.7	2.0	—	—	—	—	—
61-80	0.8	0.2	0.6	0.4	0.5	0.4	0.5	1.3	2.4
81-100	0.8	0.4	1.0	1.6	0.1	1.4	0.1	2.9	2.4
101-120	0.7	0.2	—	0.3	0.9	2.8	2.7	7.3	2.7
121-140	0.1	2.1	0.3	—	9.8	0.3	0.1	2.0	3.7

Table 10
Distribution of *Lepidotrigla* sp. in the different depth levels in mean kg/hr-catch by month from July 1976 to March 1977 in the Visayan Sea

Depth (m)	July	Augt	Sept	Oct	Nov	Dec	Jan	Feb	March
20-40	0.02	0.02	0.1	—	—	—	—	0.1	
41-60	0.1	0.1	0.02	—	—	—	—	0.04	0.1
61-80	0.1	0.2	0.1	0.1	0.4	0.3	0.6	0.1	0.4
81-100	0.6	0.2	1.4	0.5	1.1	1.5	0.4	0.7	0.1
101-120	0.1	0.1	0.3	5.8	6.2	2.8	0.6	2.4	2.1
121-140	0.9	0.7	0.8 2.4	0.8	3.1	0.02	0.1	—	

Table 11
Distribution of *Daya jerdoni* (Day) in the different depth levels in mean kg/hr-catch by month from July 1976 to March 1977 in the Visayan Sea

Depth (m)	July	Augt	Sept	Oct	Nov	Dec	Jan	Feb	March
20-40	0.01	0.4	1.3	0.4	—	0.6	1.0	0.1	0.2
41-60	—	0.02	0.01	0.02	0.1	0.004	0.1	—	—
61-80	0.1	0.1	0.3	1.6	1.8	1.7	1.2	0.1	0.1
81-100	—	—	0.02	0.2	—	—	—	—	0.5
101-120	—	—	—	—	—	—	—	—	—
121-140	—	—	—	—	—	—	—	—	—

Table 12
Catch rate variations according to time of trawling and frequency of occurrance (F.O.)

Time	0000-0600 Hours (1 drag)		0600-1200 Hours (31 drags)		1200-1800 Hours (19 drags)		1800-2400 Hours (20 drags)	
Fish Species	kg/hr	% F.O.	kg/hr	% F.O	kg/hr	% F.O.	kg/hr	% F.O
Spheroides lunaris	0.10	100	1.2	90.6	2.5	89.5	1.3	75.0
Lepidotrigla sp.	0.10	100	0.7	56.3	1.2	57.9	1.4	60.0
Daya jerdoni	0.10	100	0.8	59.4	0.5	52.6	0.3	35.0

Table 13
Summary of table of correlation analysis between catch and some hydrographic conditions from July 1976 to March 1977 in the Visayan Sea

Month / Parameters	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Value of *r*		
										Spheroides lunaris	*Lepidotrigla* sp.	*Daya jerdoni*
Temperature °C	28.08	27.83	27.56	27.06	27.55	27.23	26.45	25.14	25.91	-0.098	0.129	0.987
Salinity°/oo	33.80	33.38	33.08	33.00	33.28	33.55	32.89	33.19	33.12	0.075	0.042	-0.184
Dissolved oxygen												
mg/l	6.28	6.60	6.37	5.87	6.16	5.95	6.19	6.20	5.89	0.339	-0.420	-0.376
pH	8.50	8.32	8.45	8.42	8.46	8.45	8.31	8.25	8.37	-0.408	0.375	0.150
kg/hr/catch												
S. lunaris	1.039	3.774	0.613	0.993	1.230	0.901	0.594	2.074	2.183	—	—	—
Lepidotrigla sp.	0.319	0.235	0.473	0.900	0.977	1.037	0.282	0.467	0.379	—	—	—
D. jerdoni	0.015	0.128	0.203	0.622	0.567	0.470	0.506	0.077	0.156	—	—	—

Table 14
Average annual catches in kg/hr of trawling made by M/V "Pramong 2" in area I-IX, 1968-1972 in the Gulf of Thailand (After Ritragsa, 1976)

Year	1963	1966	1967	1968	1969	1970	1971	1972
Good Fish	220.0	11171.0	102.67	92.19	88.85	82.85	53.99	50.29
Scrap Fish	28.9	19.06	12.37	13.73	14.68	14.59	12.31	12.85
Percent of scrap from Good Fish	13.13%	17.06%	12.05%	14.73%	16.67%	17.61%	22.80%	25.55%

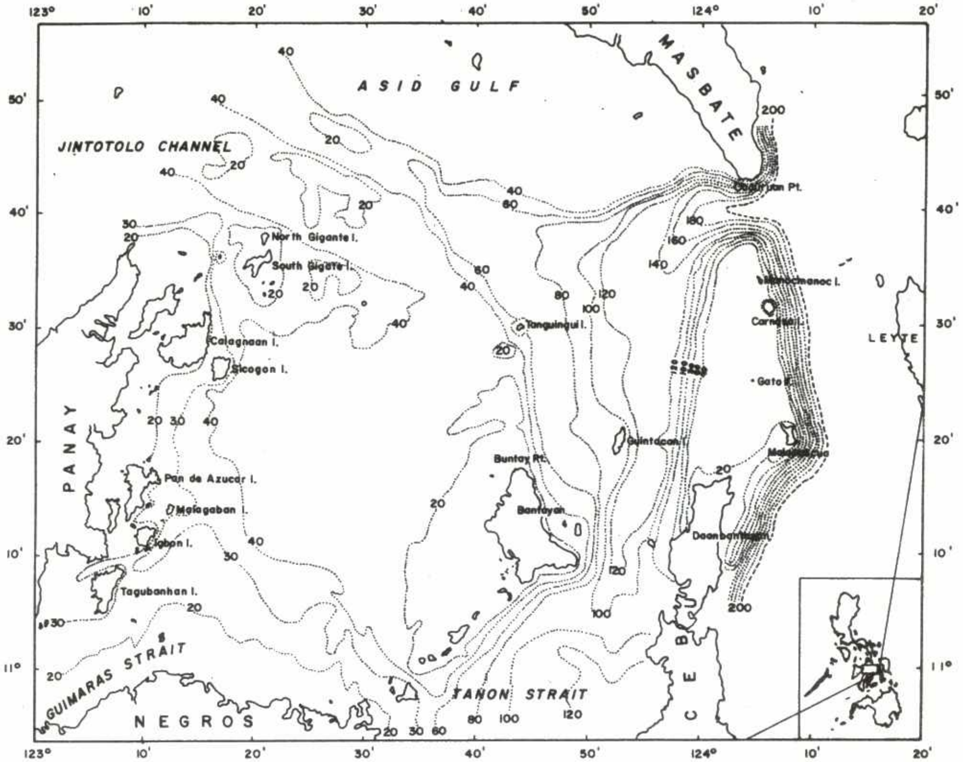


Figure 1 — Visayan Sea survey area showing the depth contours in meters.

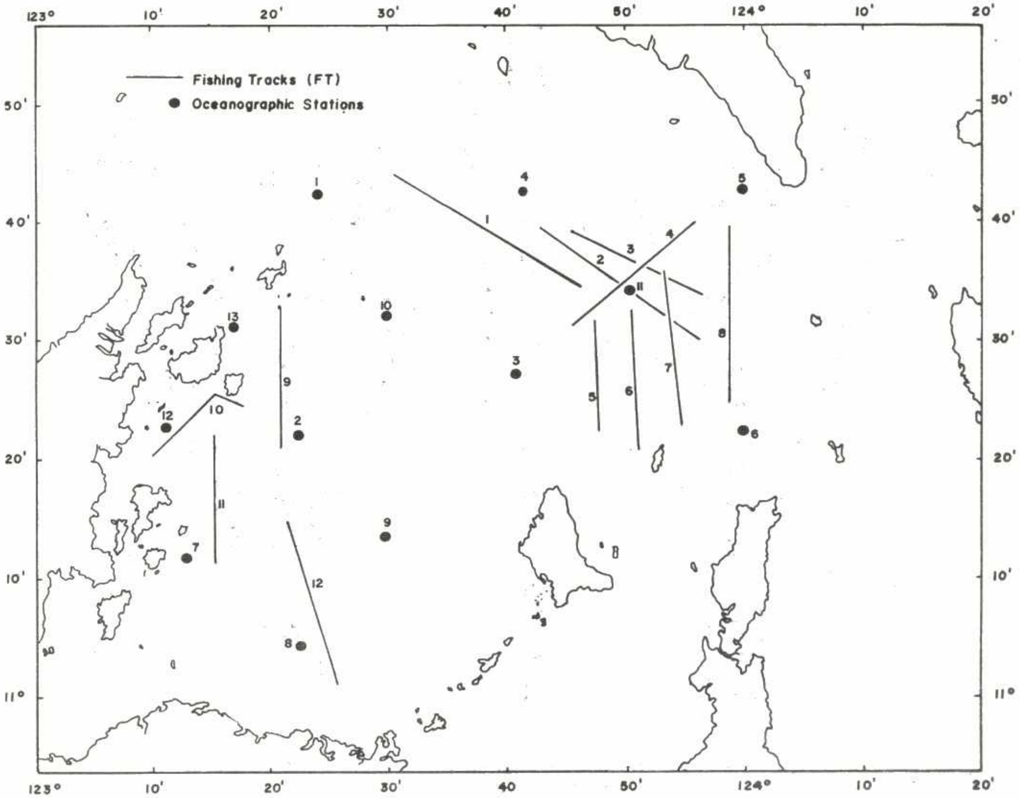


Figure 2 — Fishing tracks and oceanographic stations in the Visayan Sea.

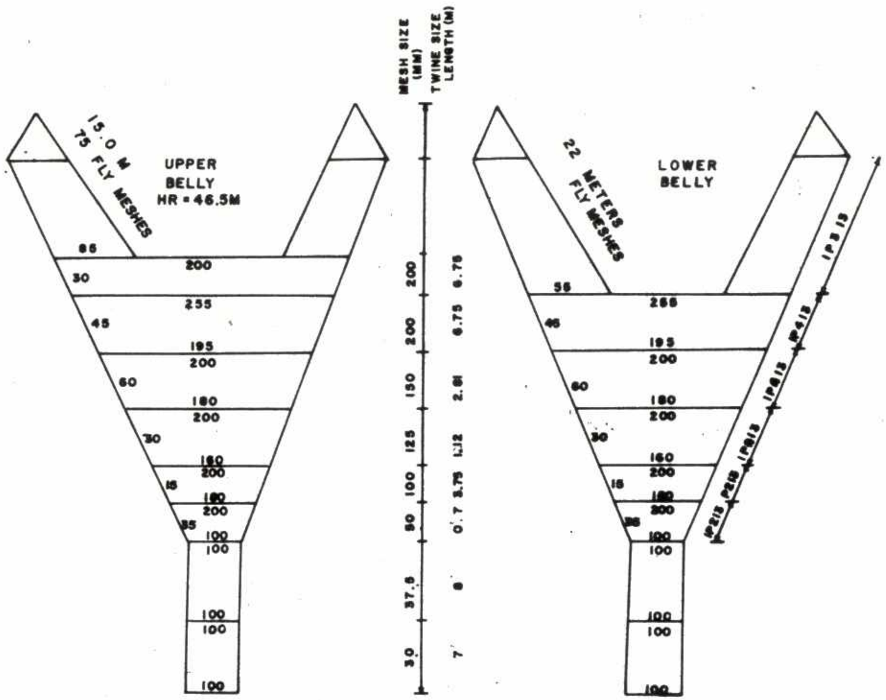


Figure 3 — Plan of two-seam high opening bottom trawl net used by M/V "Albacore".

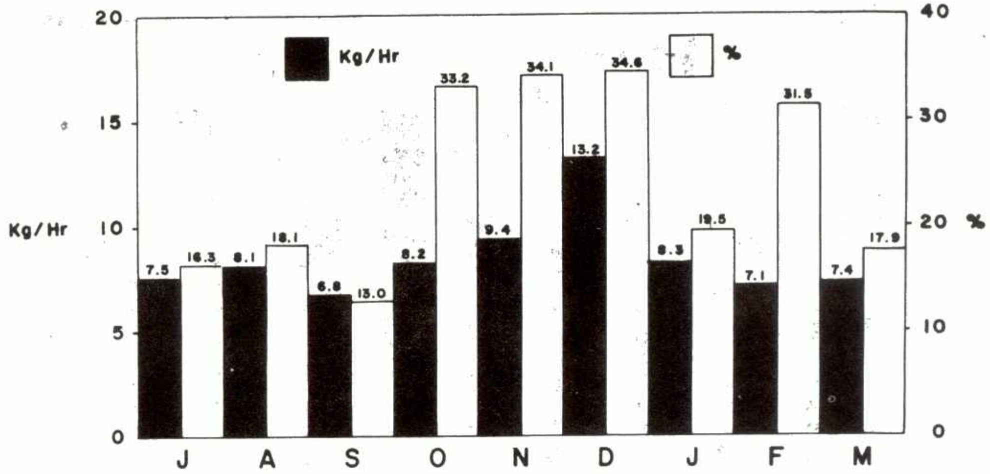


Figure 4.1 — Mean monthly kg/hr-catch of trash fish and its corresponding percentage from the commercial catch in the whole Visayan Sea.

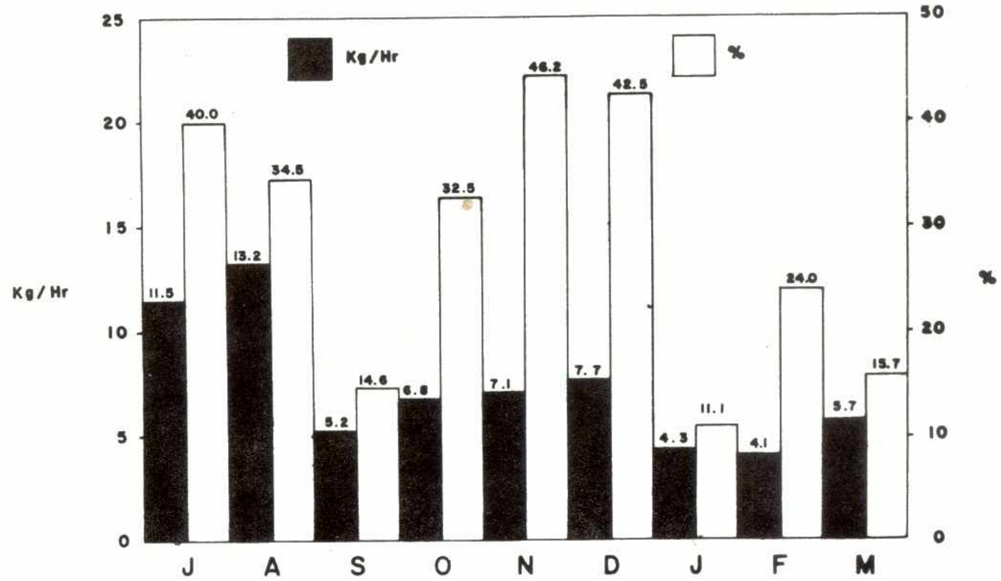


Figure 4.2 — Mean monthly kg/hr-catch of trash fish and its corresponding percentage from the commercial catch fish in the shallow area of the Visayan Sea.

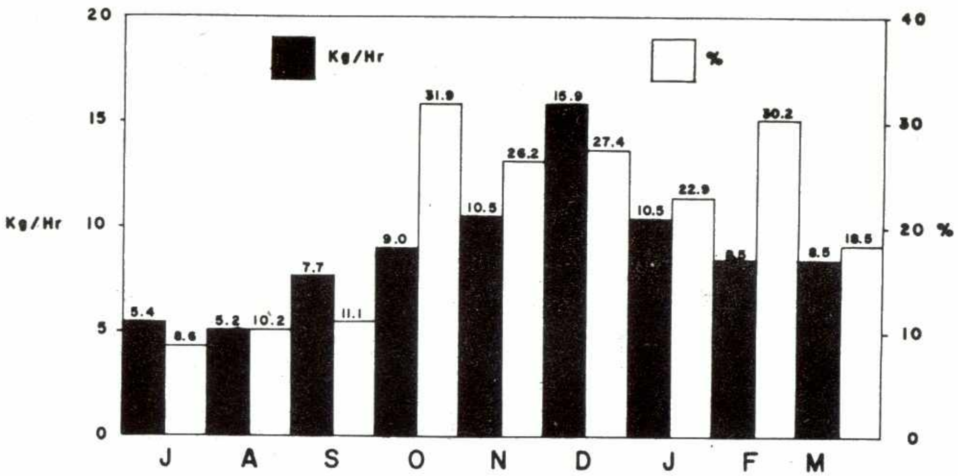
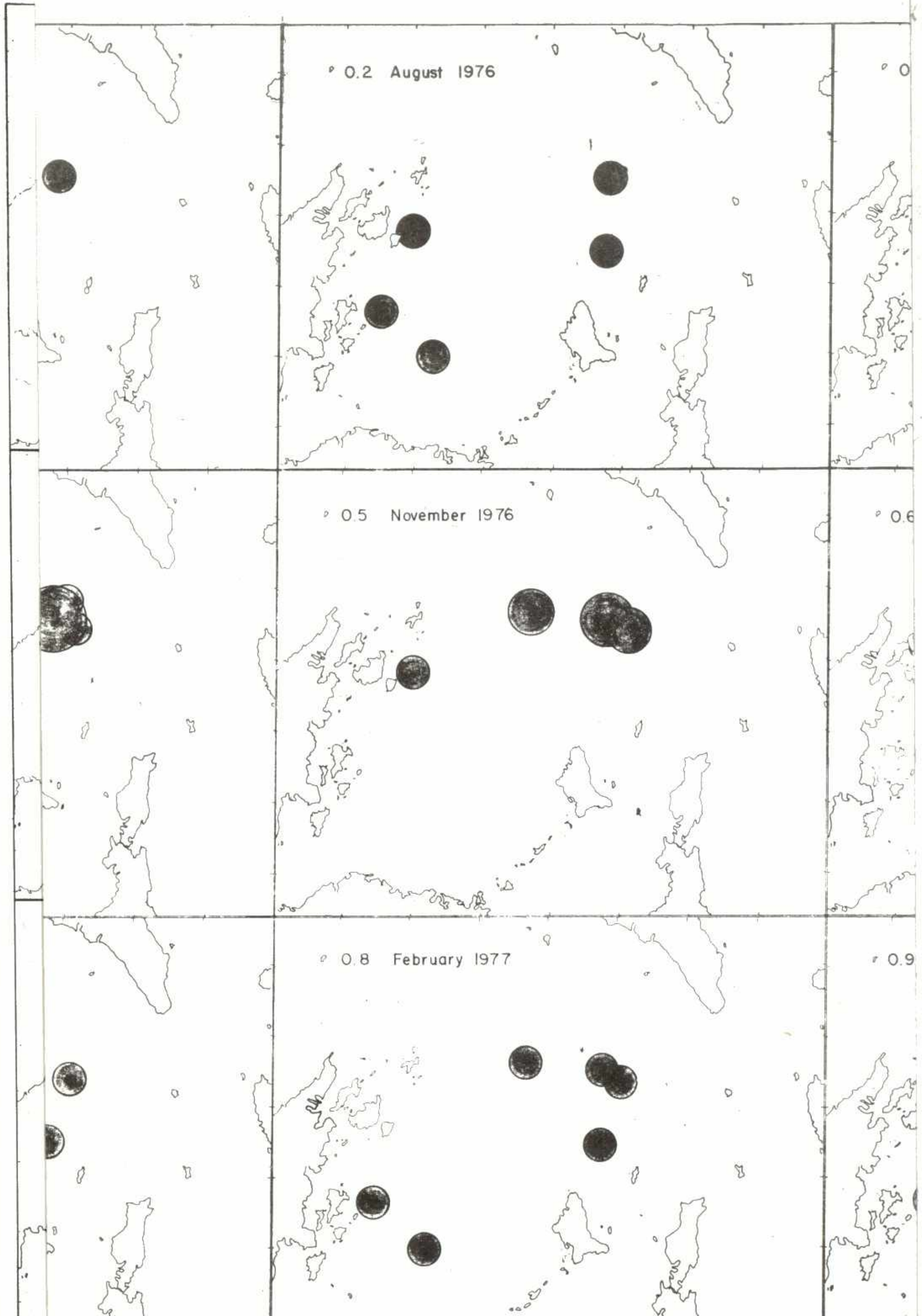
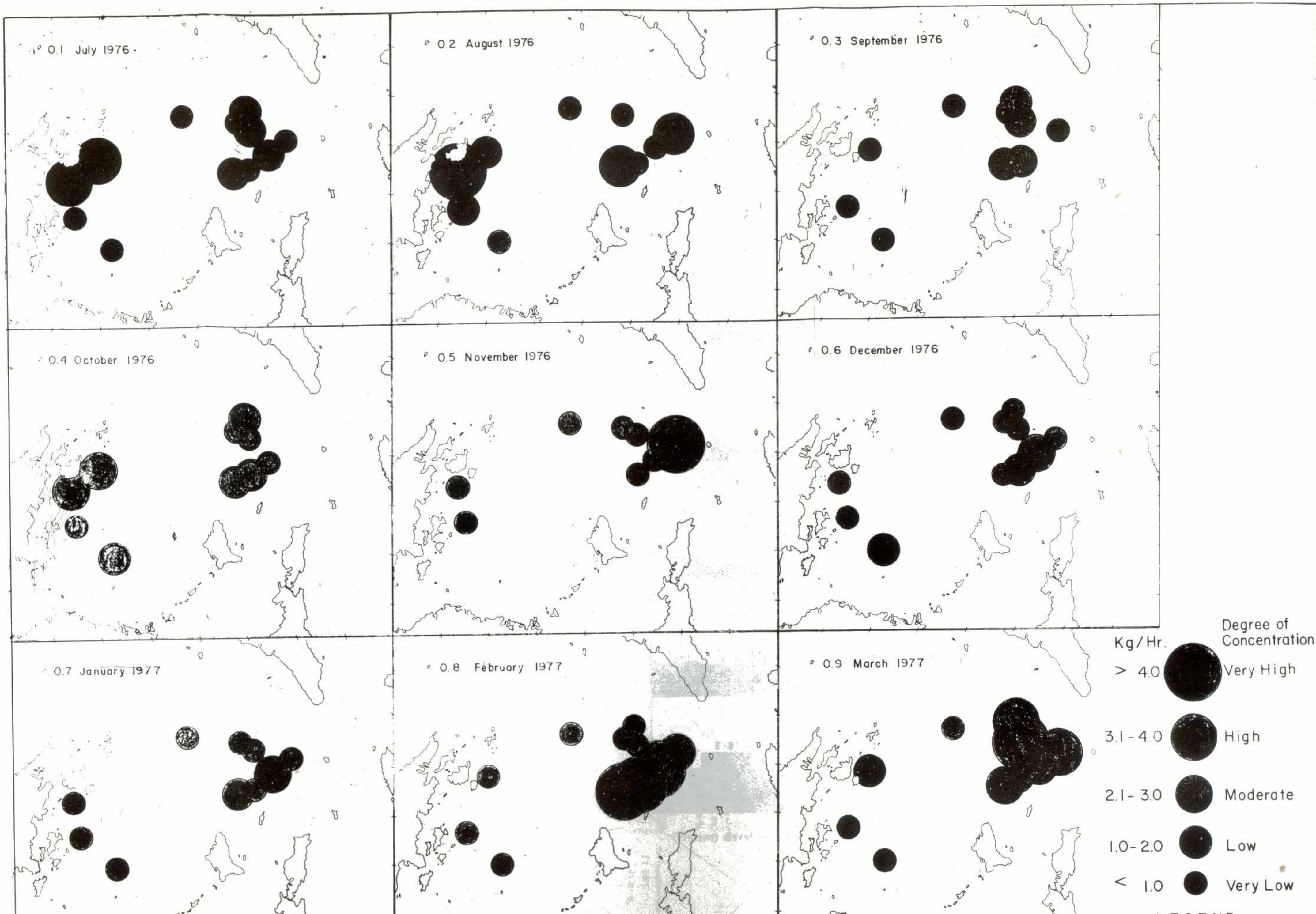


Figure 4.3 — Mean monthly kg/hr-catch of trash fish and its corresponding percentage from the commercial catch in the deep area of the Visayan Sea.




0.1 July 1976
0.2 August 1976
0.3 September 1976
0.4 October 1976
0.5 November 1976
0.6 December 1976
0.7 January 1977
0.8 February 1977
0.9 March 1977
Kg/Hr.
Degree of Concentration
> 4.0 Very High
3.1 - 4.0 High
2.1 - 3.0 Moderate
1.0 - 2.0 Low
< 1.0 Very Low


0.1 July 1976
27.80
28.0
28.00
28.10
28.20
28.20
0.2 August 1976
28.40
27.50
26.50
28.30
28.20
28.00
28.00
28.20
28.40
28.50
28.60
0.3 September 1976
28.50
28.30
23.00
25.00
26.00
27.00
28.00
27.80
27.60
27.80
28.40
29.00
0.4 October 1976
23.00
25.00
27.00
27.50
28.50
29.00
0.5 November 1976
24.50
25.50
26.50
27.30
29.00
28.00
27.50
0.6 December 1976
24.50
25.50
27.00
27.00
27.50
28.25
0.7 January 1977
24.00
25.50
26.50
27.00
27.50
0.8 February 1977
23.75
24.25
24.75
24.75
25.00
25.00
25.50
25.75
0.9 March 1977
24.25
24.75
26.00
25.10
25.50
27.00
26.00
26.50

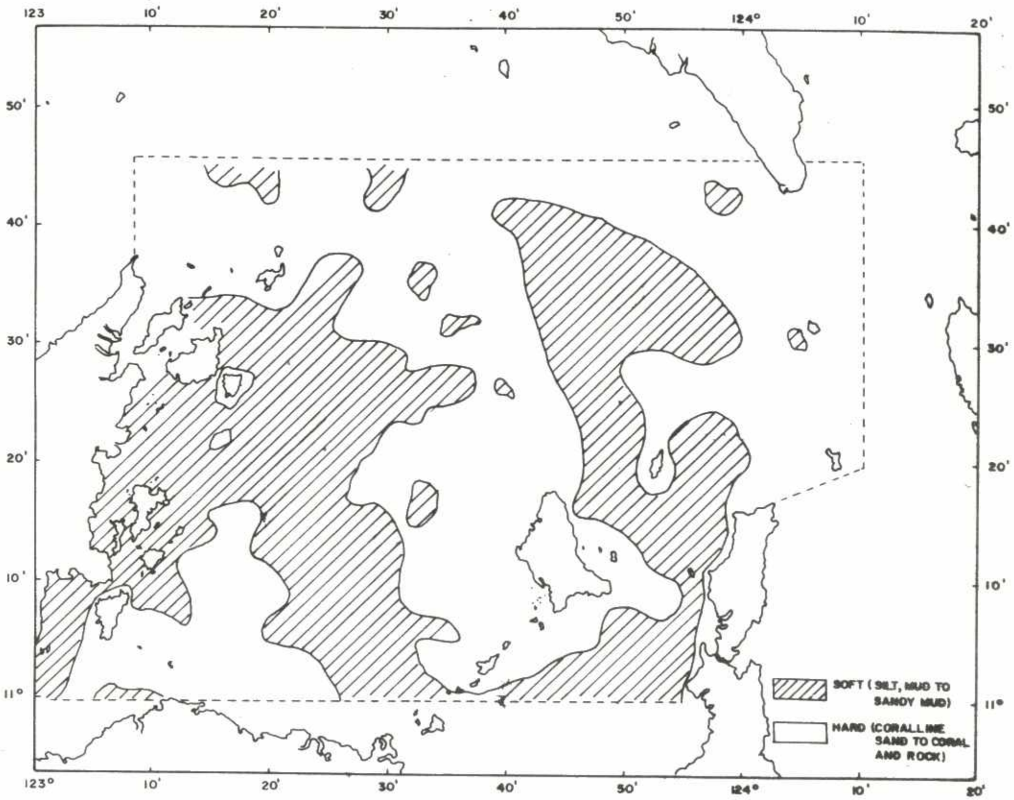


Figure 6 — Chart showing the general bottom characteristics of Visayan Sea.

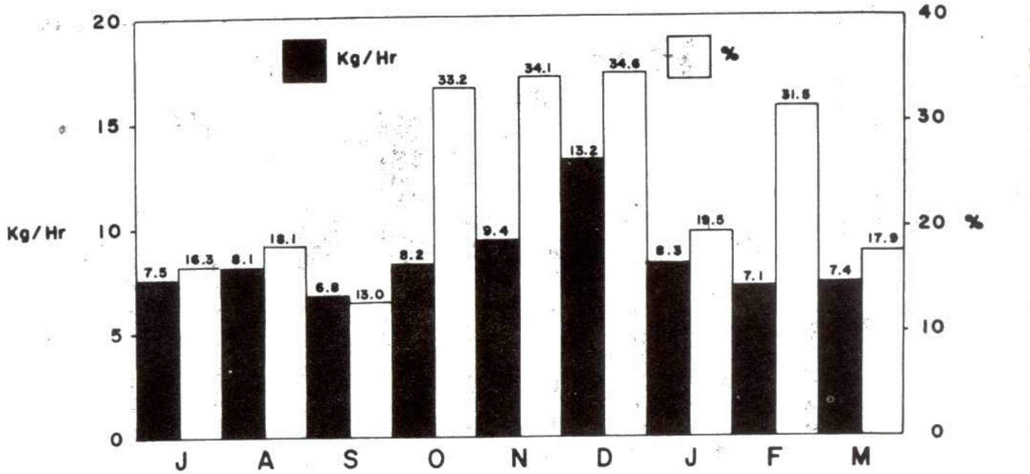


Figure 4.1 — Mean monthly kg/hr-catch of trash fish and its corresponding percentage from the commercial catch in the whole Visayan Sea.

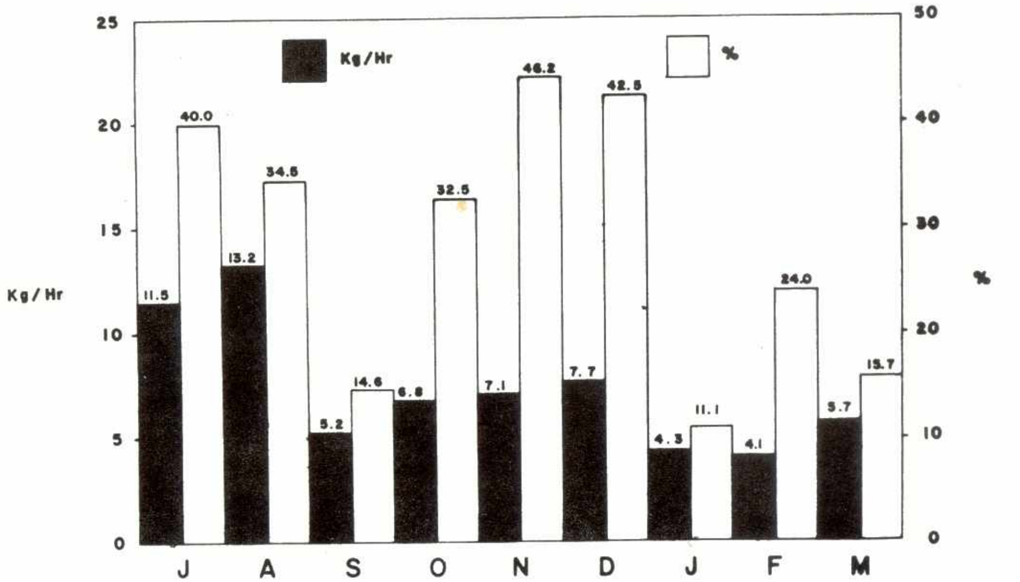


Figure 4.2 — Mean monthly kg/hr-catch of trash fish and its corresponding percentage from the commercial catch fish in the shallow area of the Visayan Sea.

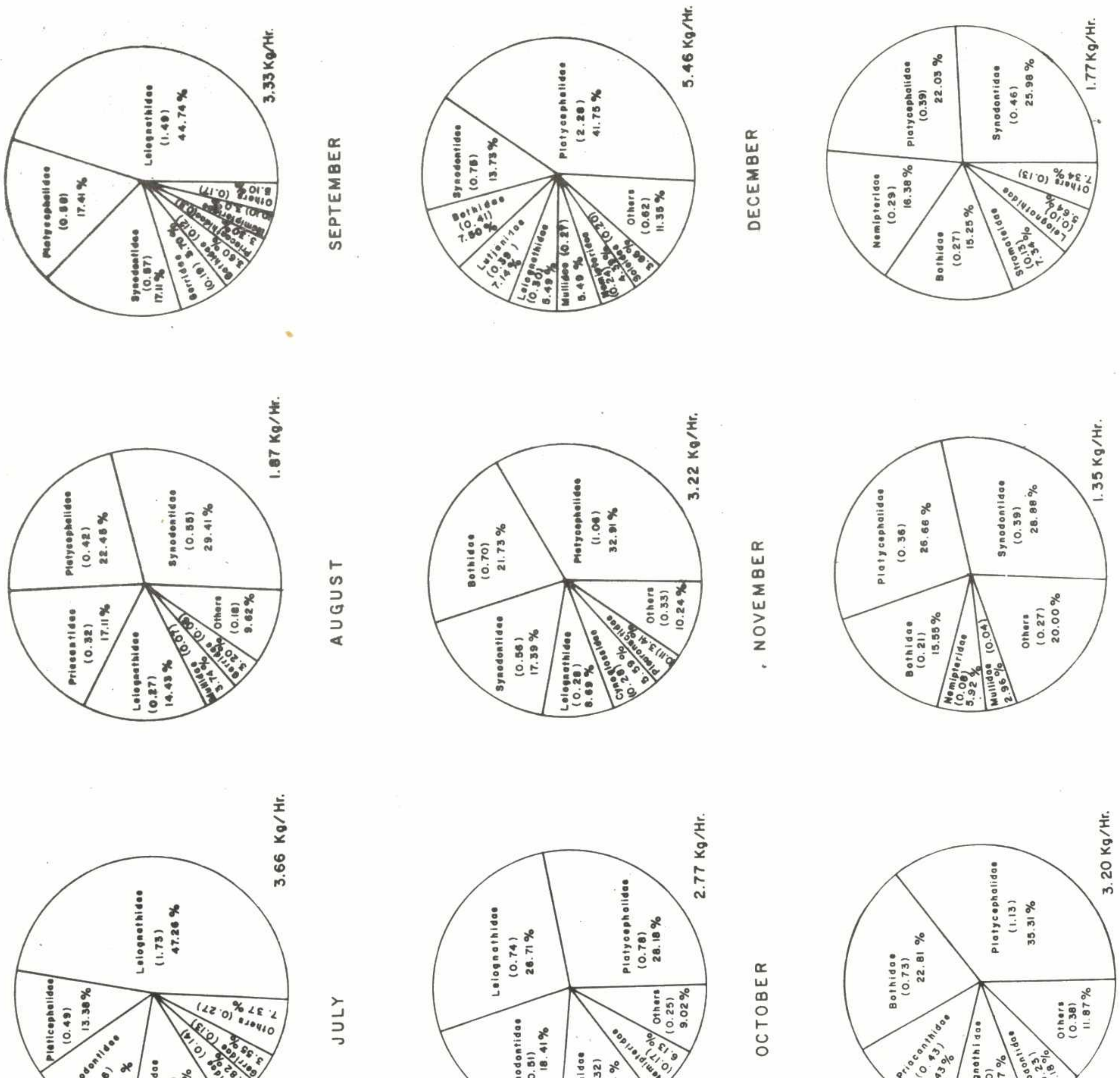


Figure 7.1 — Monthly catch rate in kg/hr and percentage composition of the "commercial" trash fish families from July 1976 to March 1977 in the Visayan Sea.

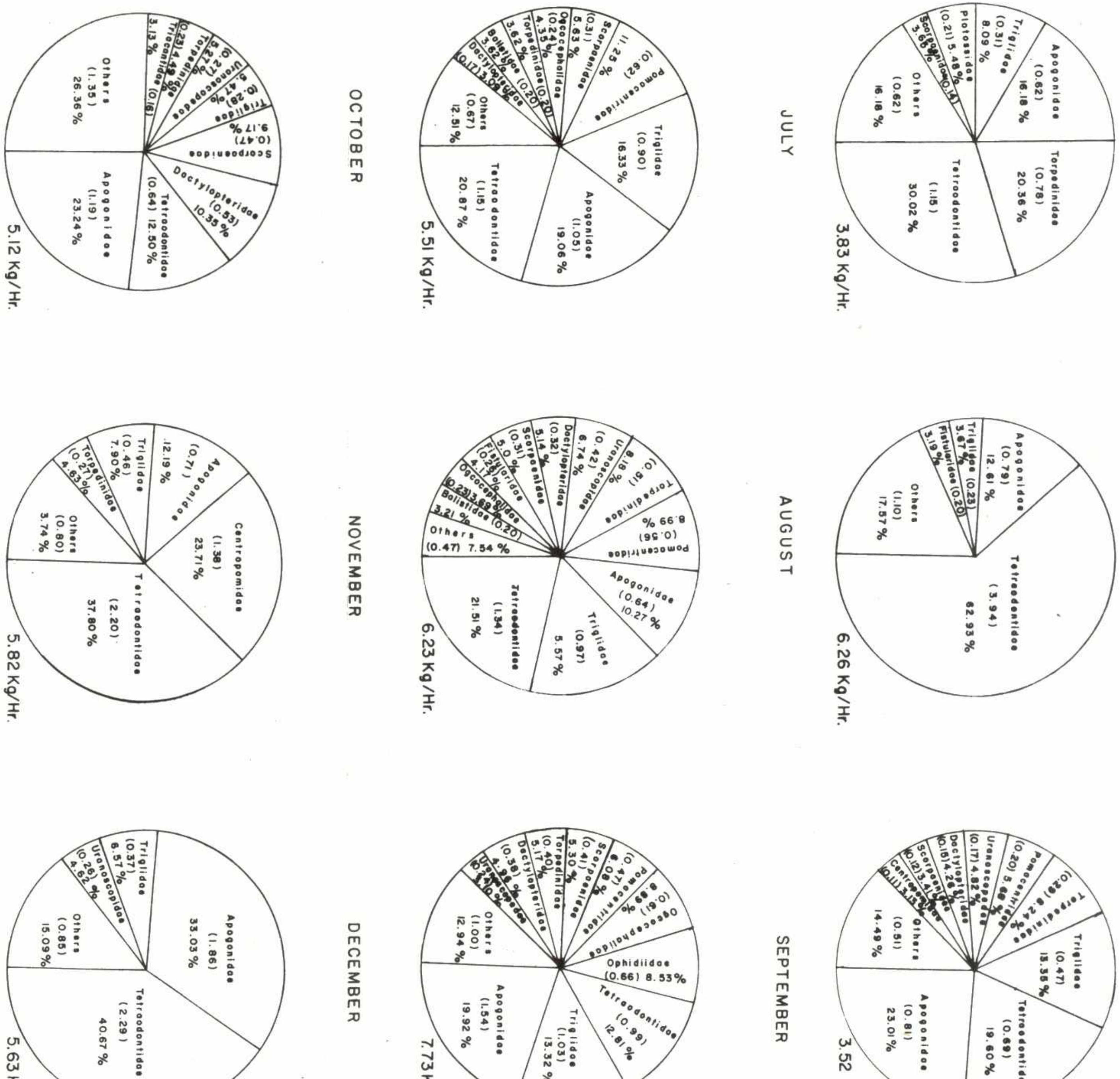
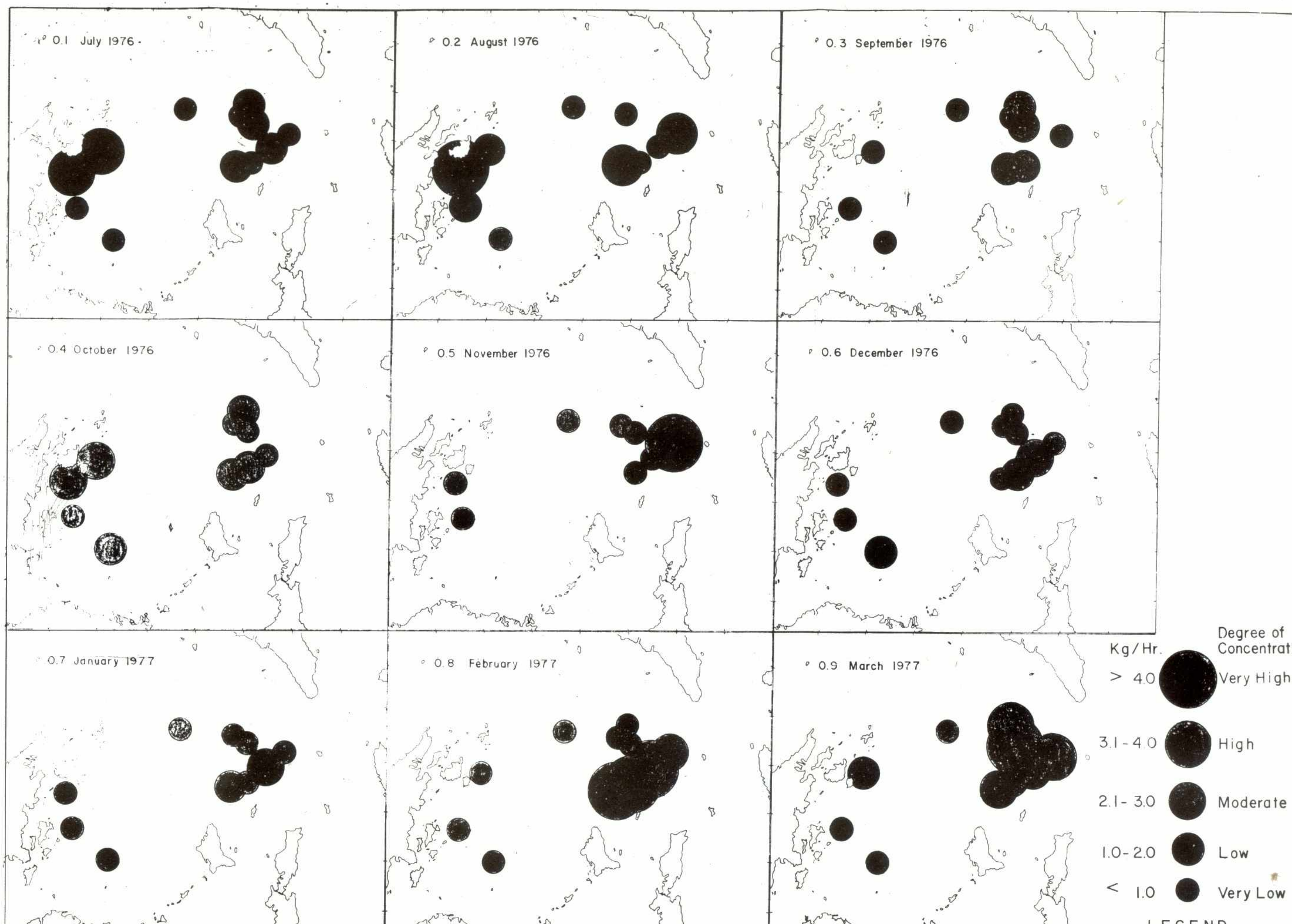


Figure 7.2 — Monthly catch rate in kg/hr and percentage composition of the "non-commercial" trash fish families from July 1976 to March 1977 in the Visayan Sea.


0.1 July 1976
0.2 August 1976
0.3 September 1976
0.4 October 1976
0.5 November 1976
0.6 December 1976
0.7 January 1977
0.8 February 1977
0.9 March 1977
Kg/Hr.
Degree of Concentrat
> 4.0
Very High
3.1 - 4.0
High
2.1 - 3.0
Moderate
1.0 - 2.0
Low
< 1.0
Very Low

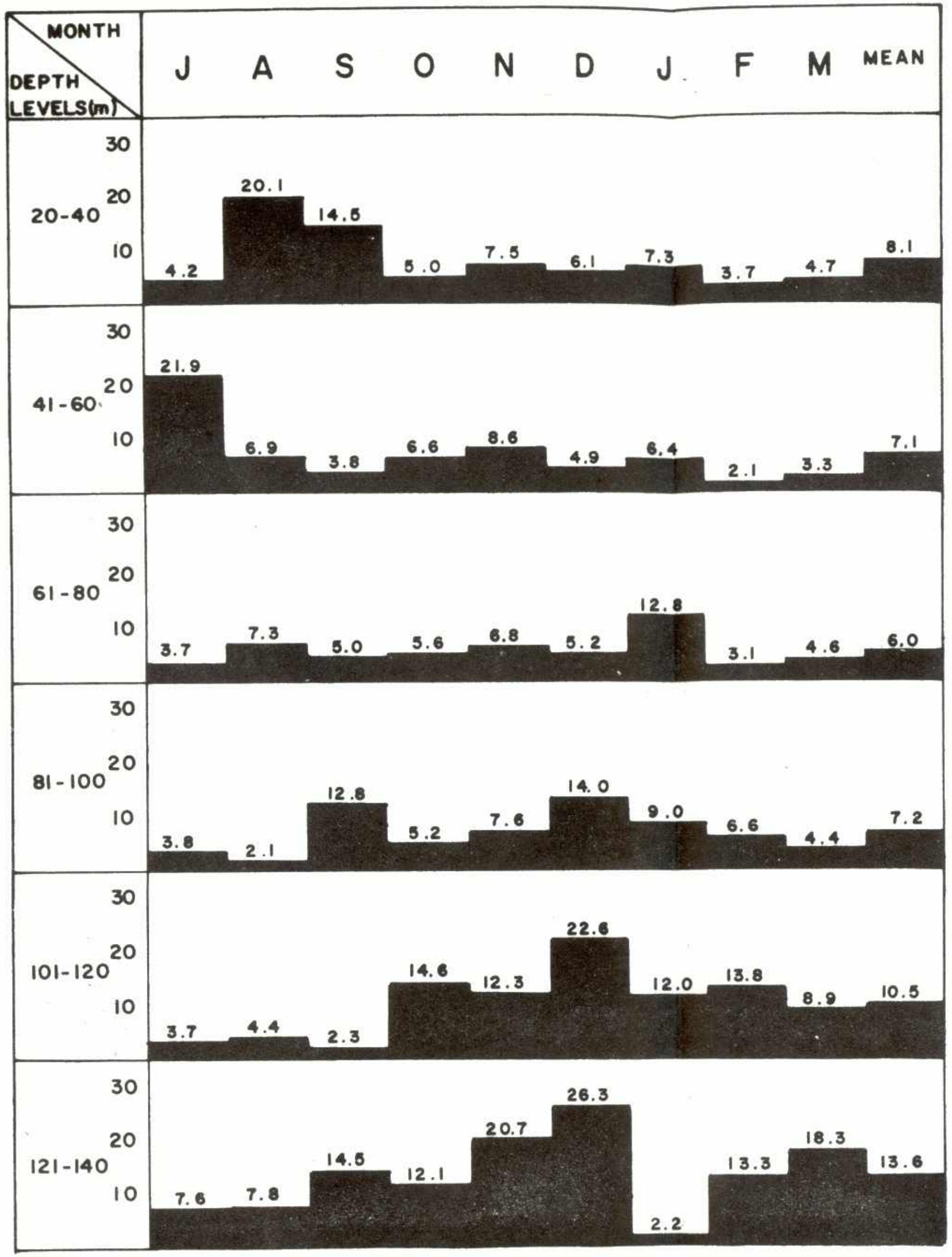
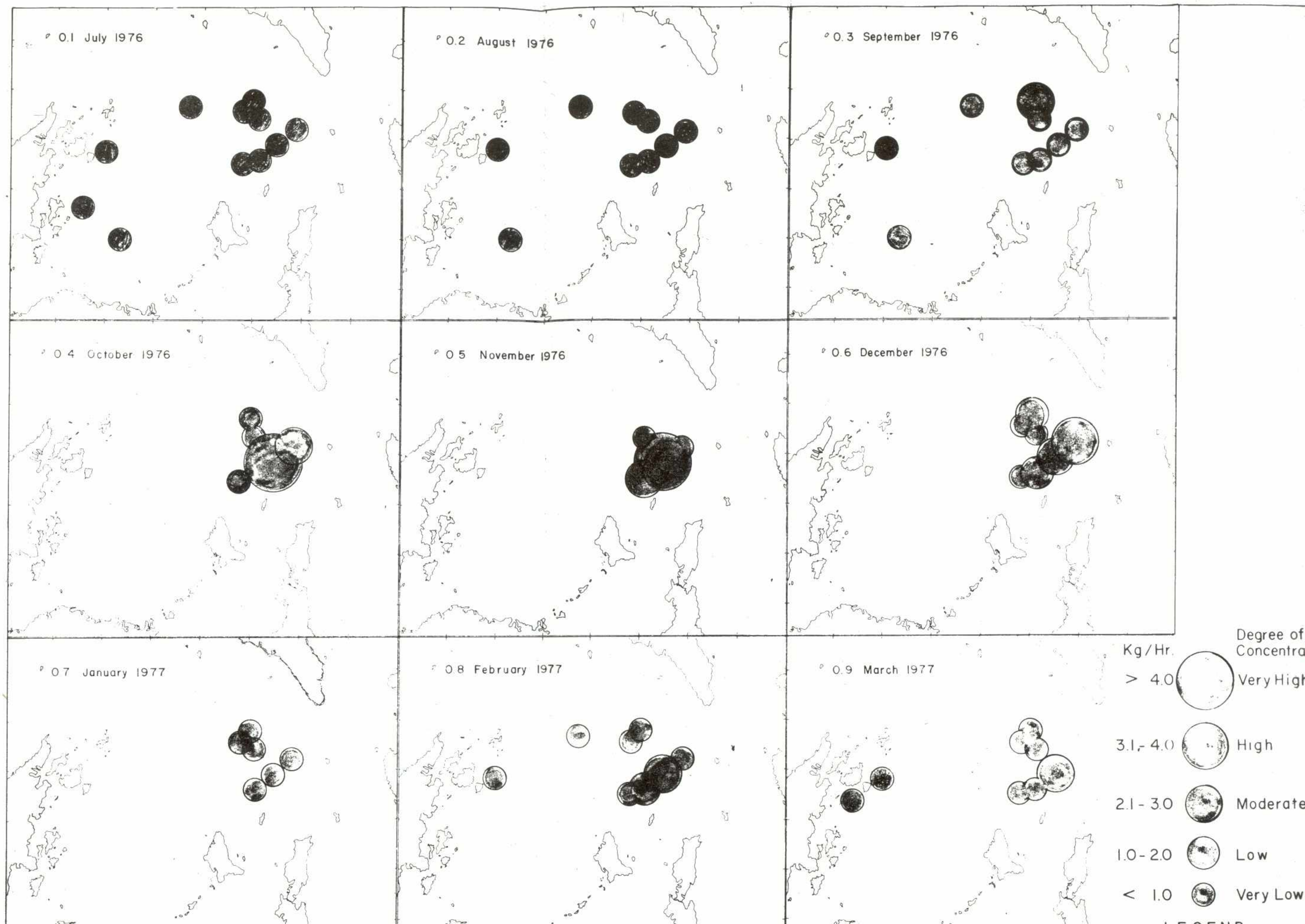
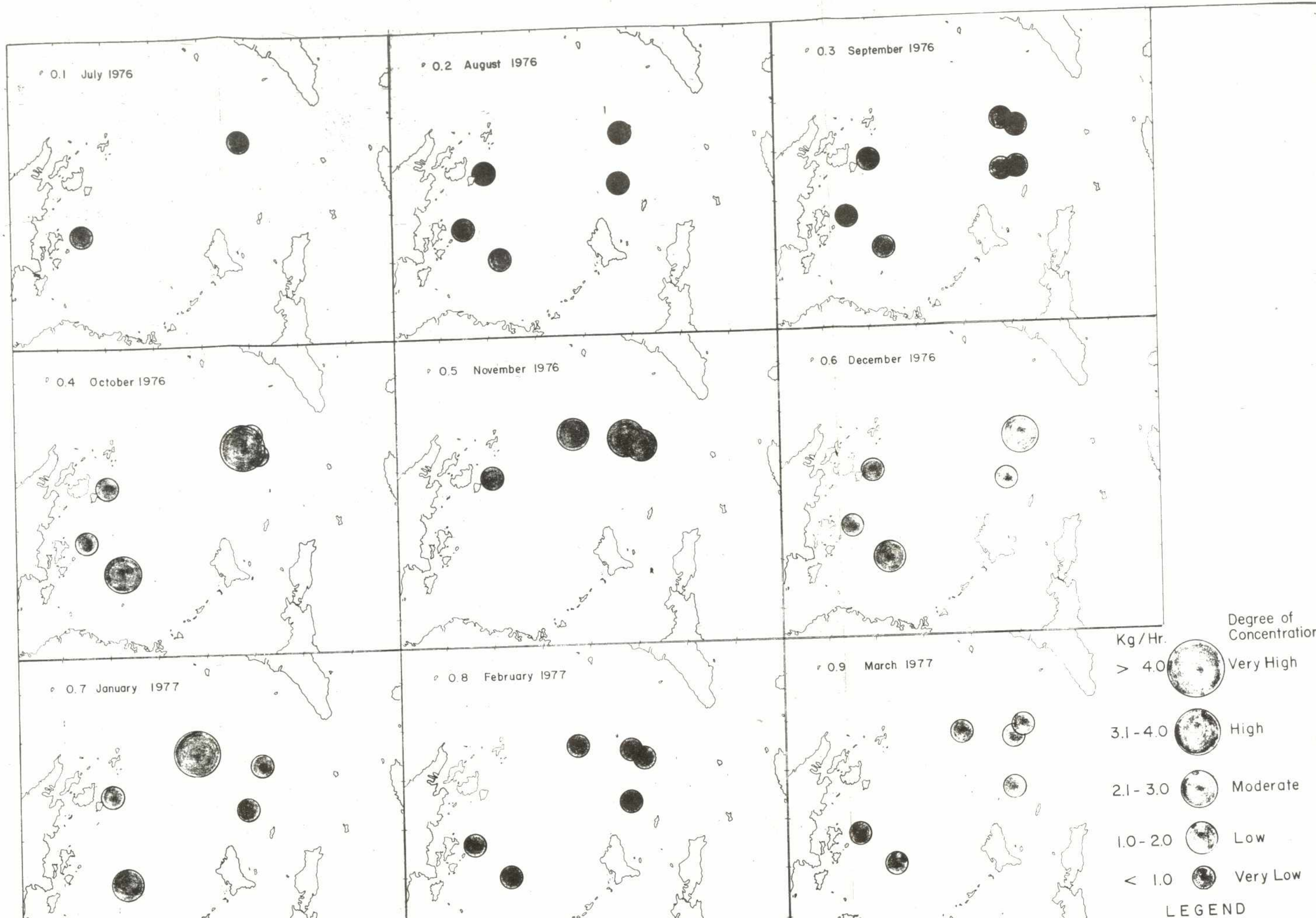


Figure 8 — Mean monthly kg/hr-catch rate of trash fish in the different depth levels (meters) in the Visayan Sea.


0.1 July 1976
0.2 August 1976
0.3 September 1976
0.4 October 1976
0.5 November 1976
0.6 December 1976
0.7 January 1977
0.8 February 1977
0.9 March 1977
Kg/Hr.
Degree of Concentra
> 4.0
Very High
3.1,- 4.0
High
2.1 - 3.0
Moderate
1.0 - 2.0
Low
< 1.0
Very Low


0.1 July 1976
0.2 August 1976
0.3 September 1976
0.4 October 1976
0.5 November 1976
0.6 December 1976
0.7 January 1977
0.8 February 1977
0.9 March 1977
Kg/Hr.
Degree of Concentration
> 4.0 Very High
3.1 - 4.0 High
2.1 - 3.0 Moderate
1.0 - 2.0 Low
< 1.0 Very Low
LEGEND

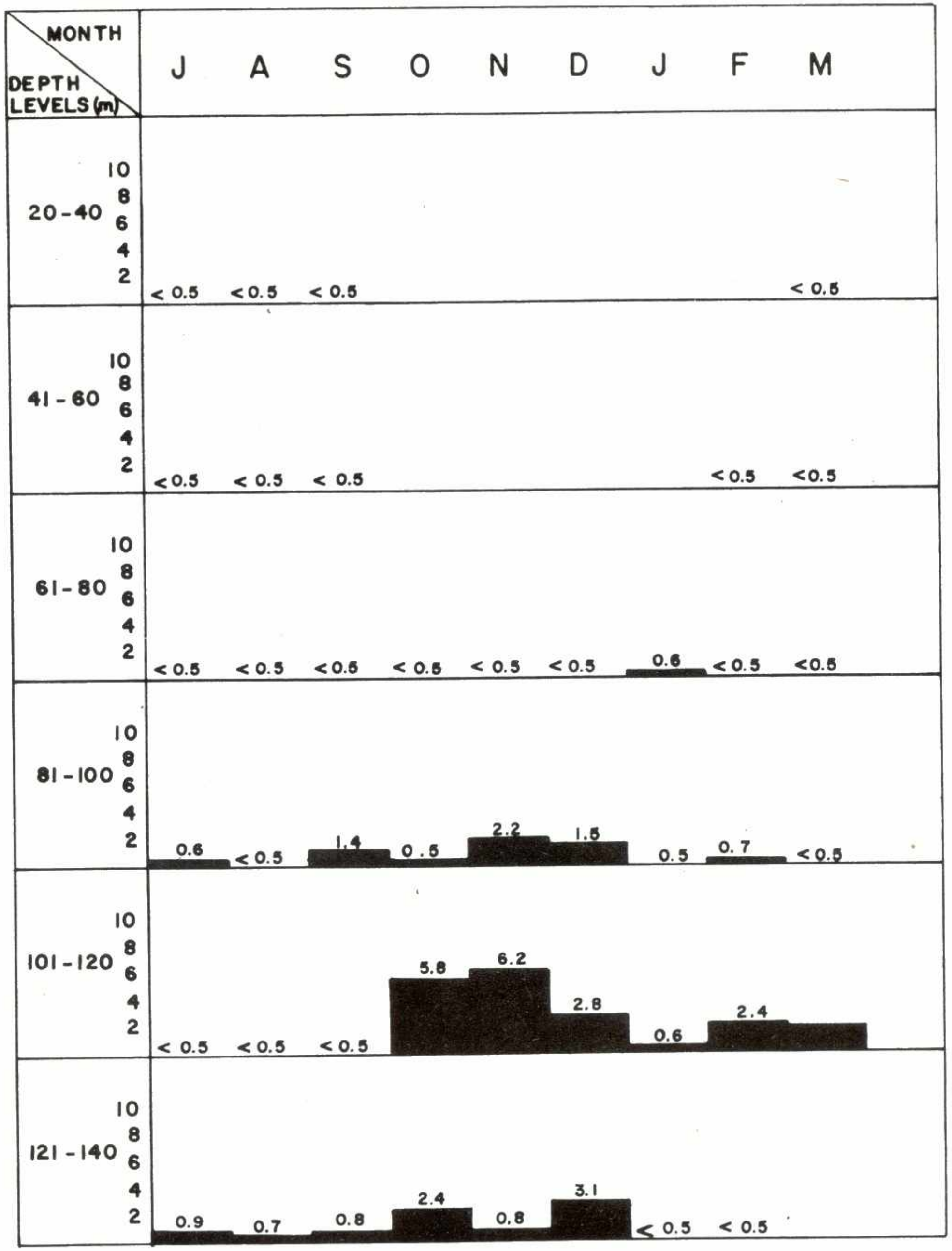


Figure 13 — Mean monthly kg/hr-catch of *Lepidotrigla sp.* in the different depth levels (meters)

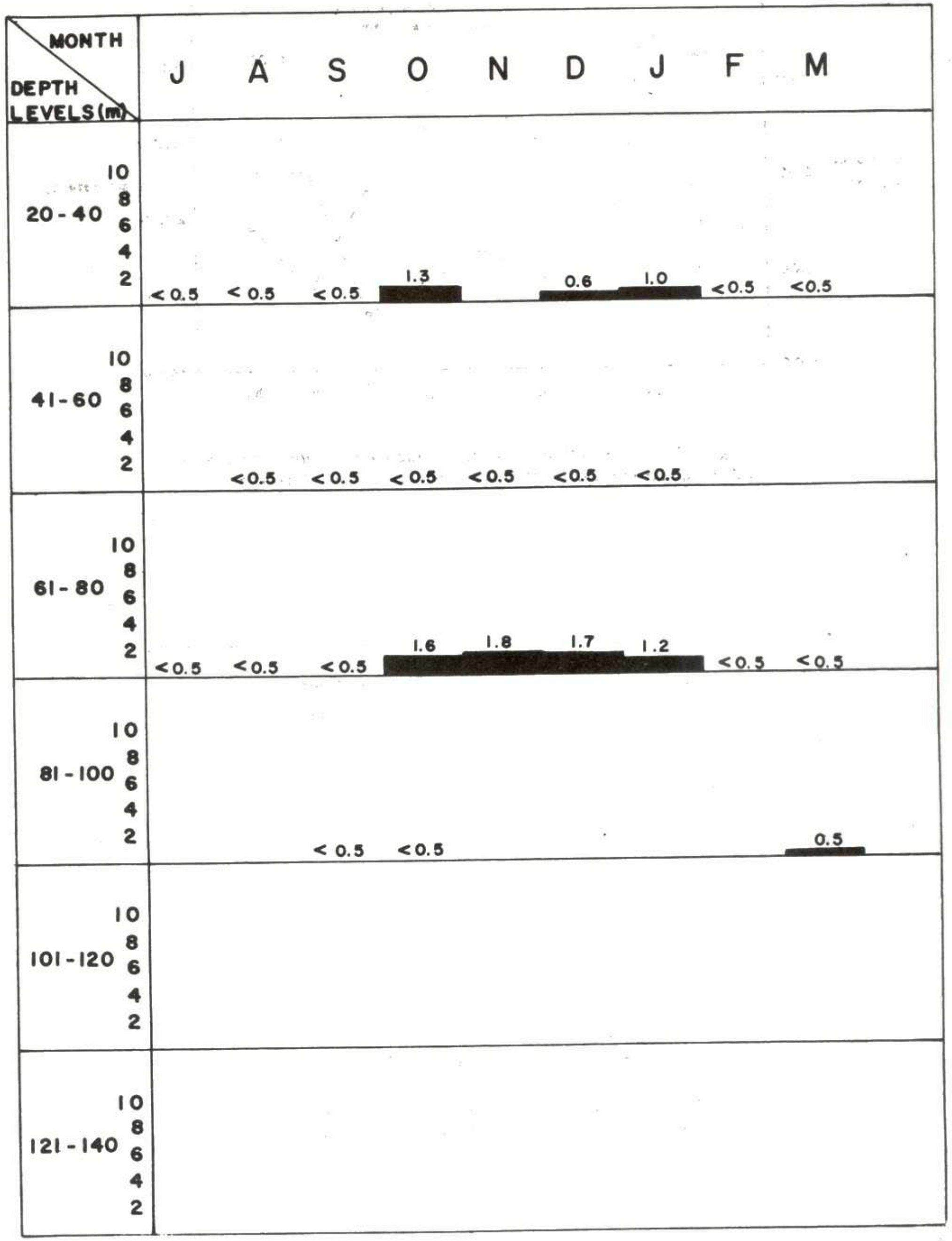


Figure 14 — Mean monthly kg/hr-catch of *Dava jerdoni* in the different depth levels (meters)

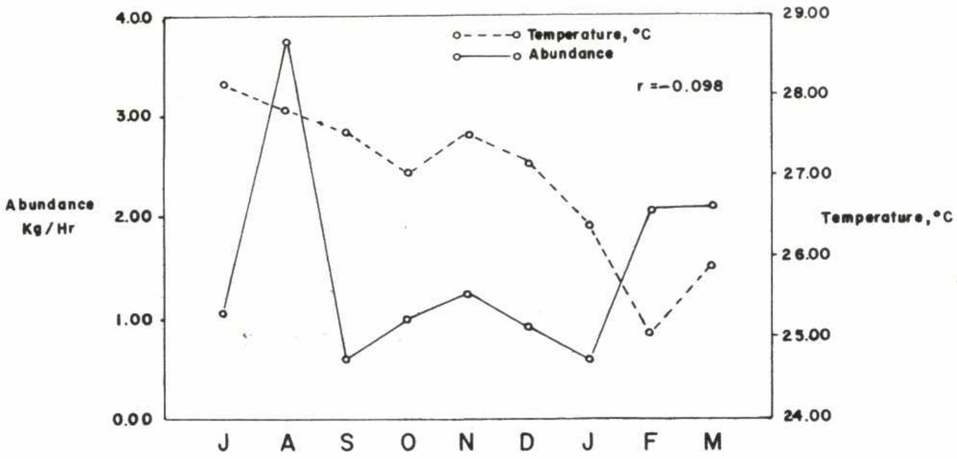


Figure 15.1 — Relation between abundance of *Spheroides lunaris* and the mean monthly bottom temperature in the Visayan Sea.

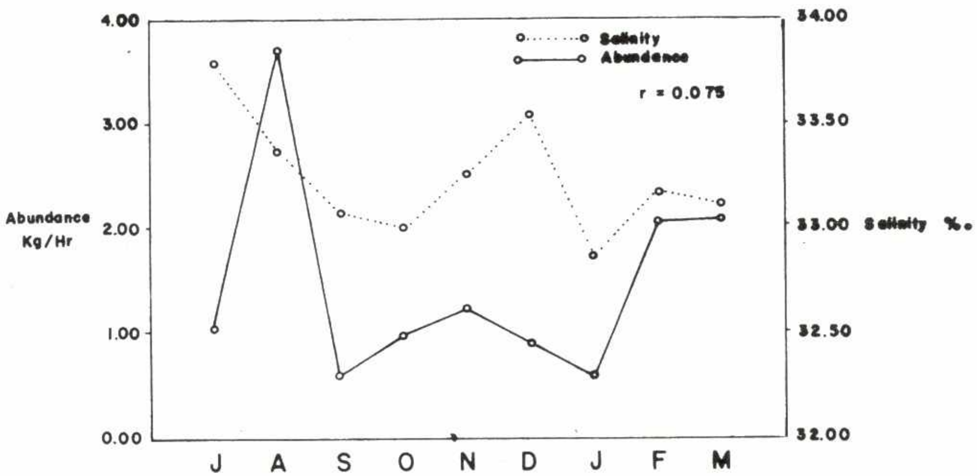


Figure 15.2 — Relation between abundance of *Spheroides lunaris* and the mean monthly bottom salinity in the Visayan Sea.

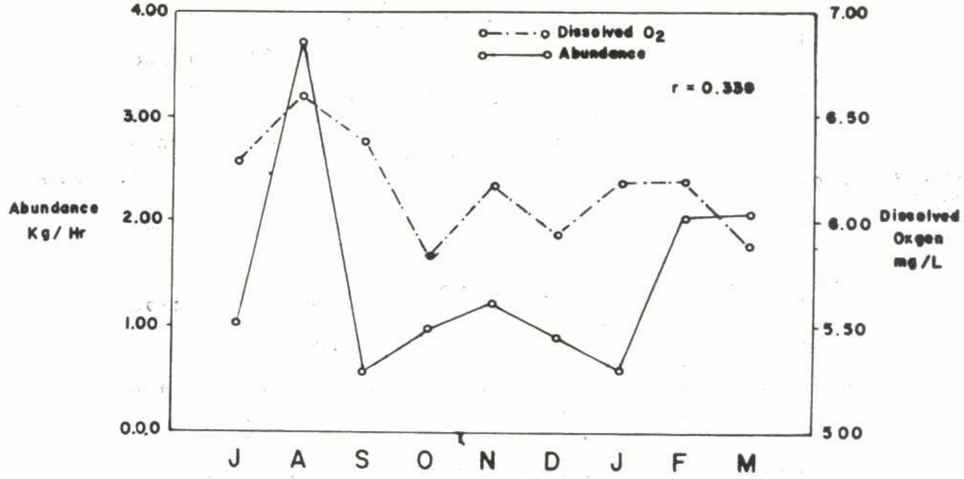


Figure 15.3 — Relation between abundance of *Spheroides lunaris* and the mean monthly botton dissolved oxygen in the Visayan Sea.

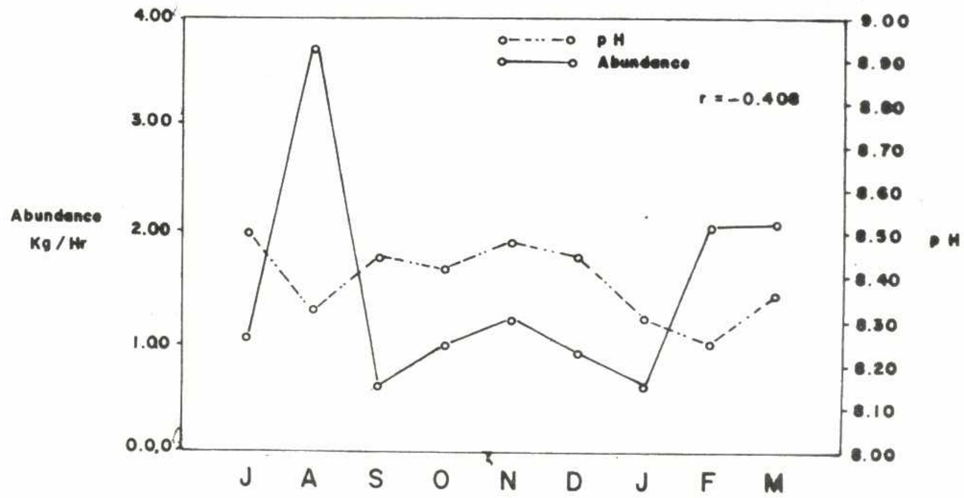


Figure 15.4 — Relation between abundance of *Spheroides lunaris* and the mean monthly bottom pH in the Visayan Sea.

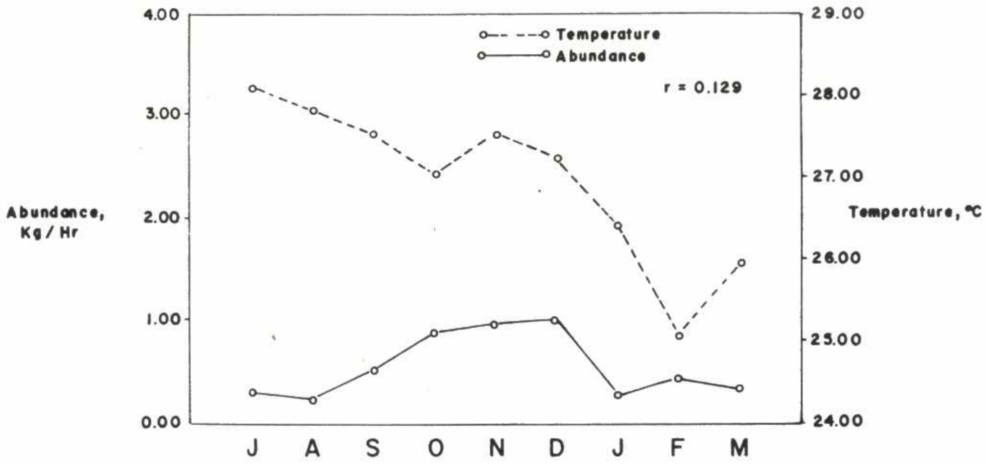


Figure 16.1 — Relation between abundance of *Lepidotrigla sp.* and the mean monthly bottom temperature in the Visayan Sea.

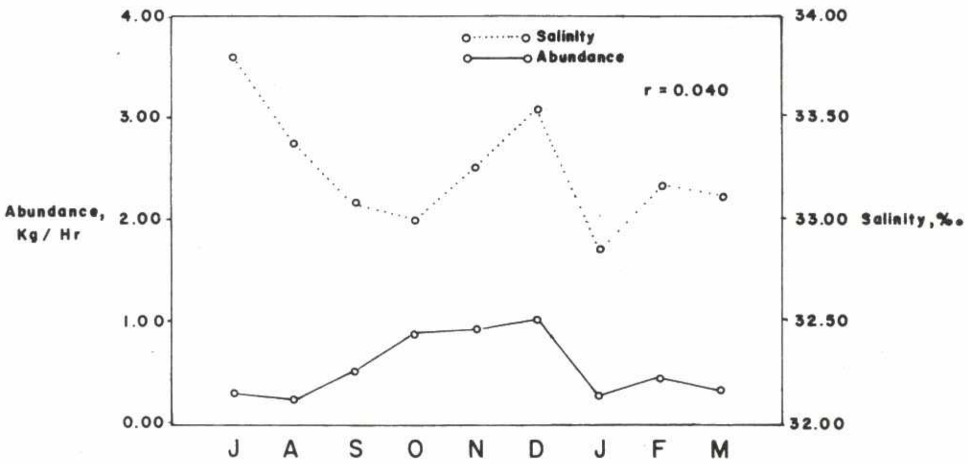


Figure 16.2 — Relation between abundance of *Lepidotrigla sp.* and the mean monthly bottom salinity in the Visayan Sea.

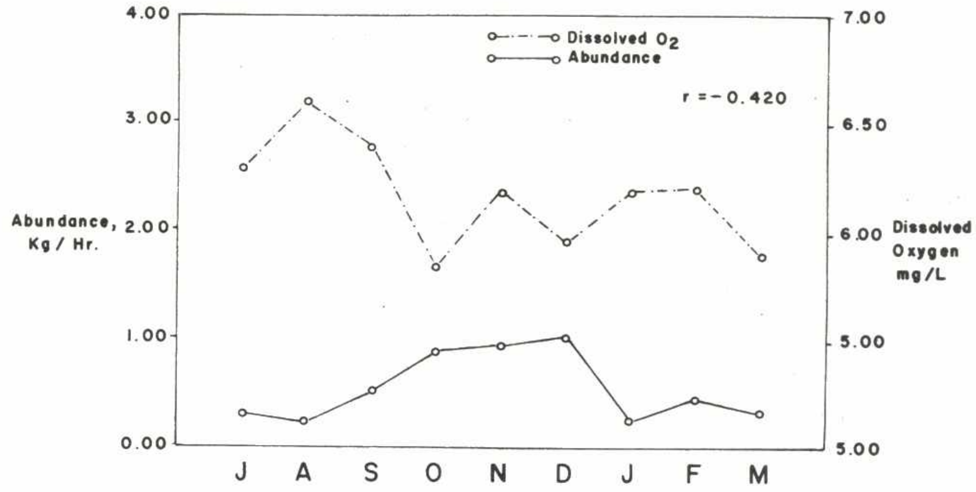


Figure 16.3 — Relation between abundance of *Lepidotrigla sp.* and the mean monthly bottom dissolved oxygen in the Visayan Sea.

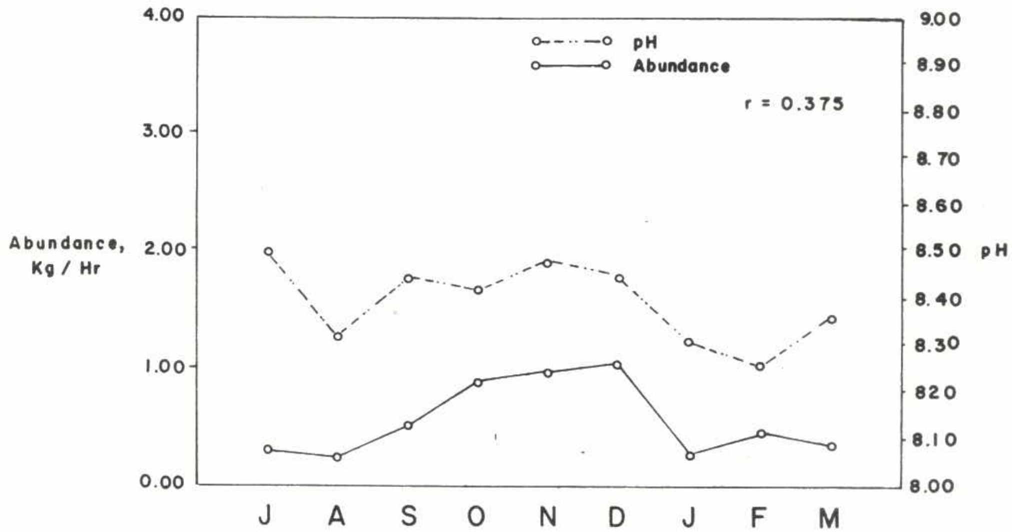


Figure 16.4 — Relation between abundance of *Lepidotrigla sp.* and the mean monthly bottom pH in the Visayan Sea.

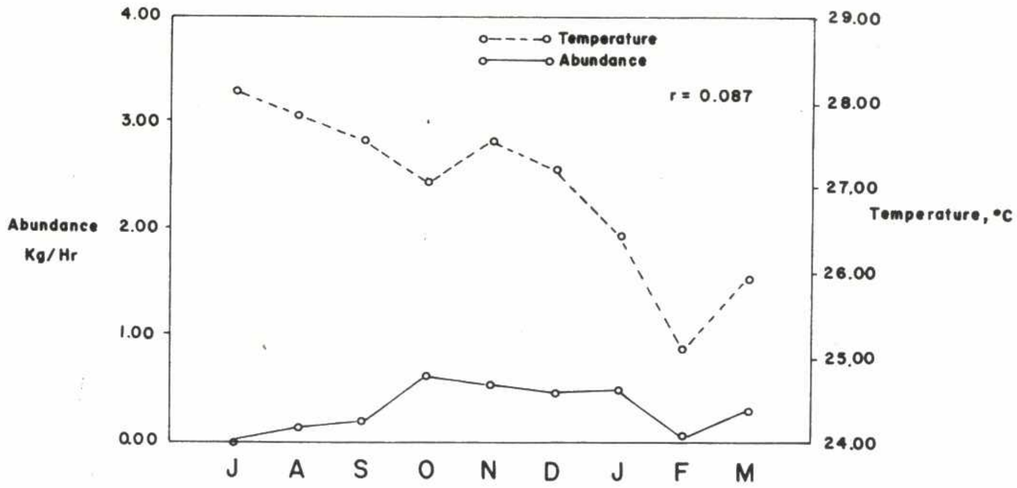


Figure 17.1 — Relation between abundance of *Daya jerdoni* and the mean monthly bottom temperature in the Visayan Sea.

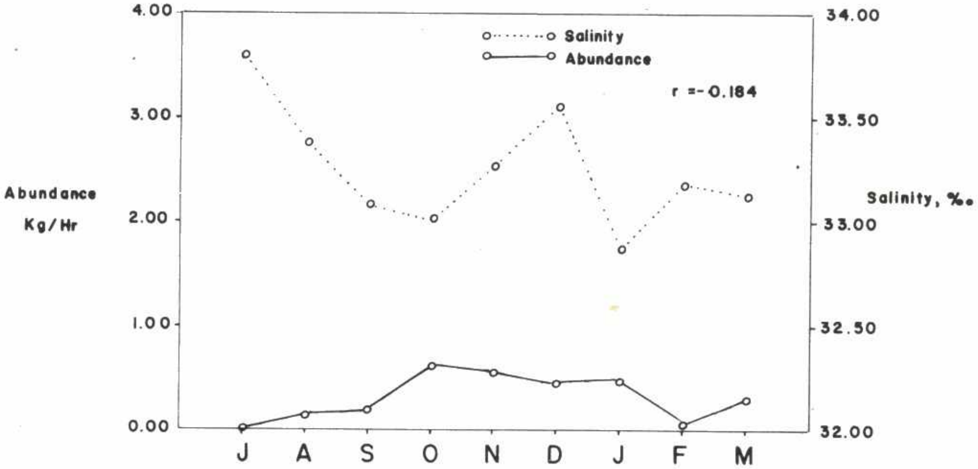


Figure 17.2 — Relation between abundance of *Daya jerdoni* and the mean monthly bottom salinity in the Visayan Sea.

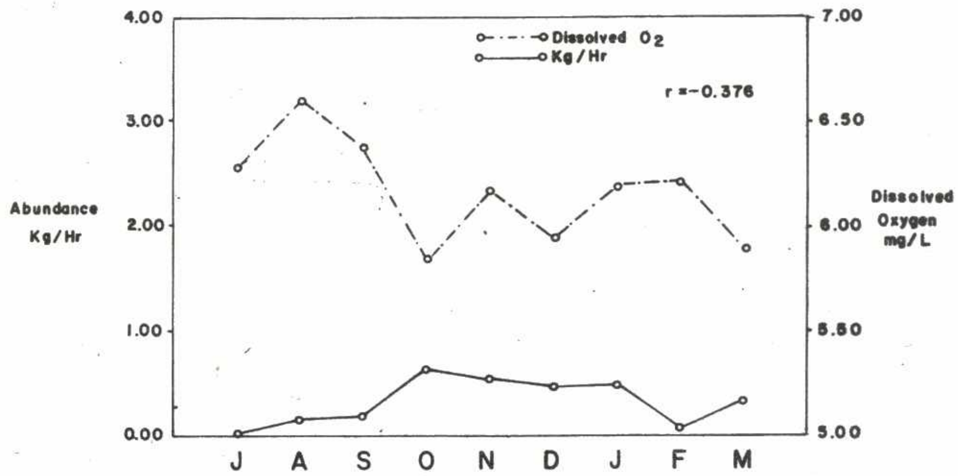


Figure 17.3 — Relation between abundance of *Daya jerdoni* and the mean monthly bottom dissolved oxygen in the Visayan Sea.

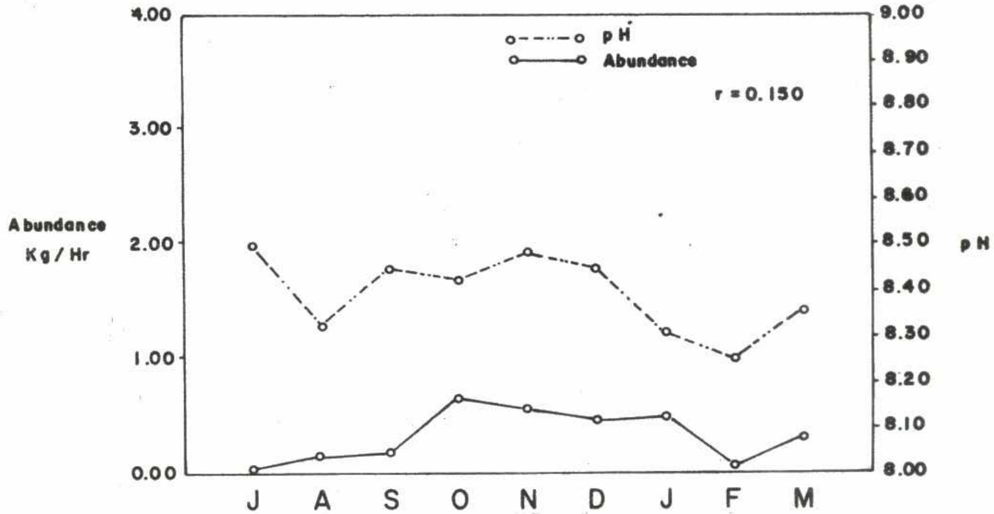


Figure 17.4 — Relation between abundance of *Daya jerdoni* and the mean monthly bottom pH in the Visayan Sea.

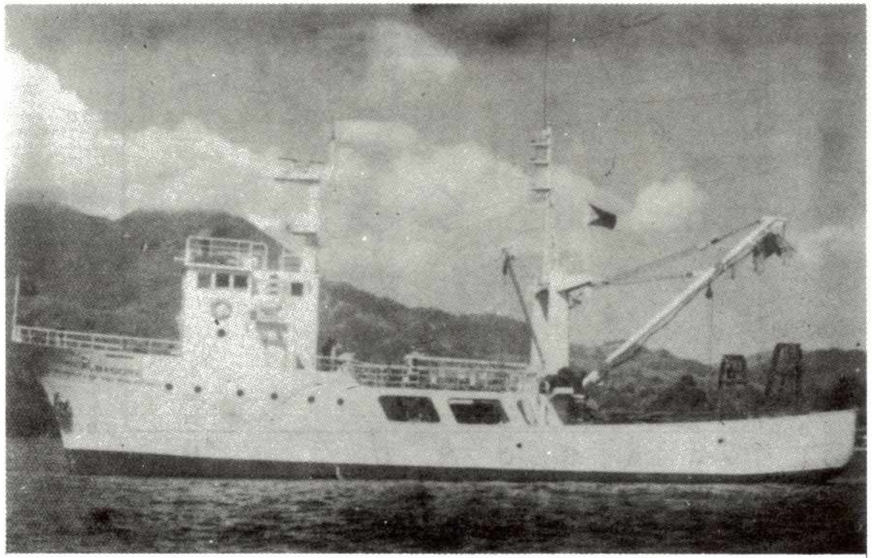


Plate 1 — M/V "Albacore", the research vessel used in the investigation.

Plate 2 — Nansen bottles used in sampling seawater.

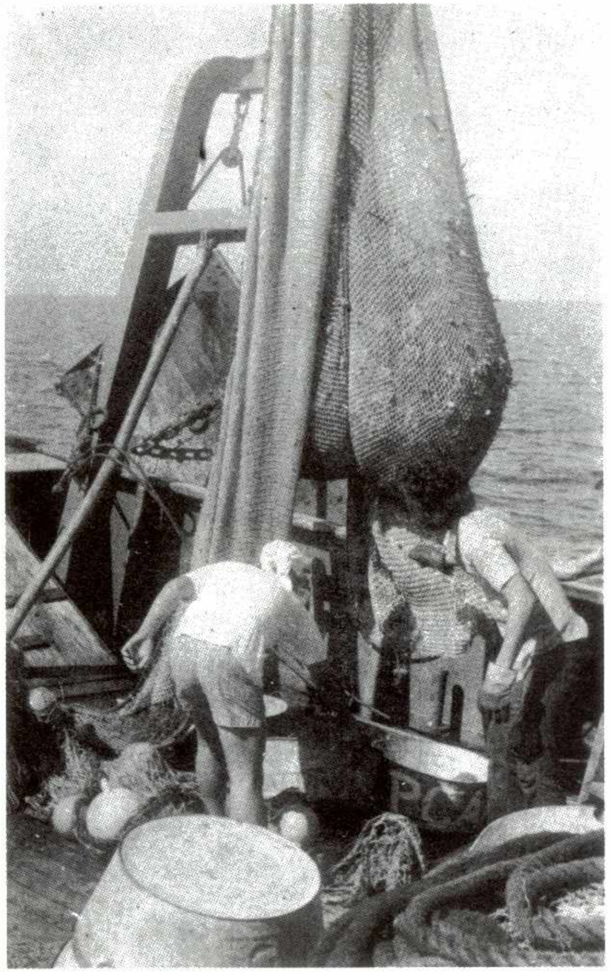
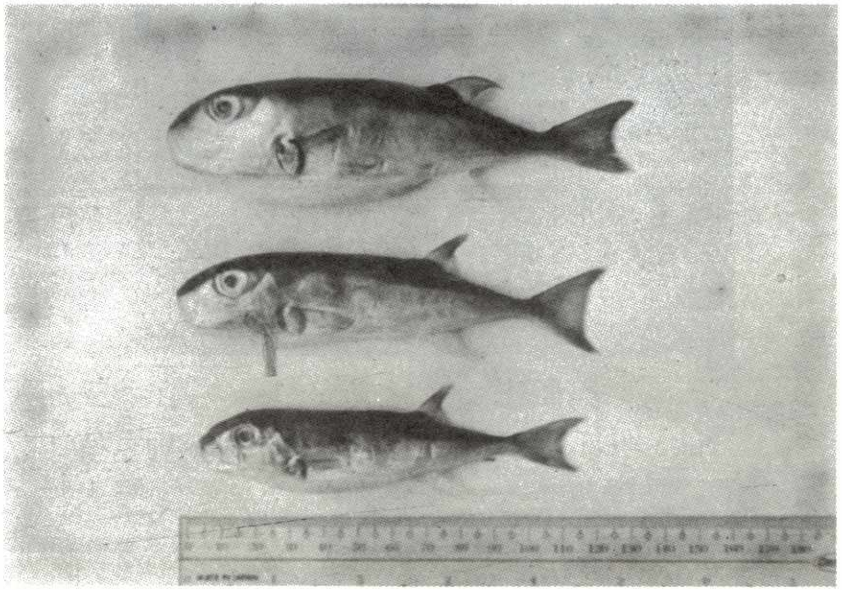


Plate 3 — Cod-end of the otter trawl being hauled up aboard M/V "Albacore".

Plate 4 — **View of trawl catch** prior to sorting.



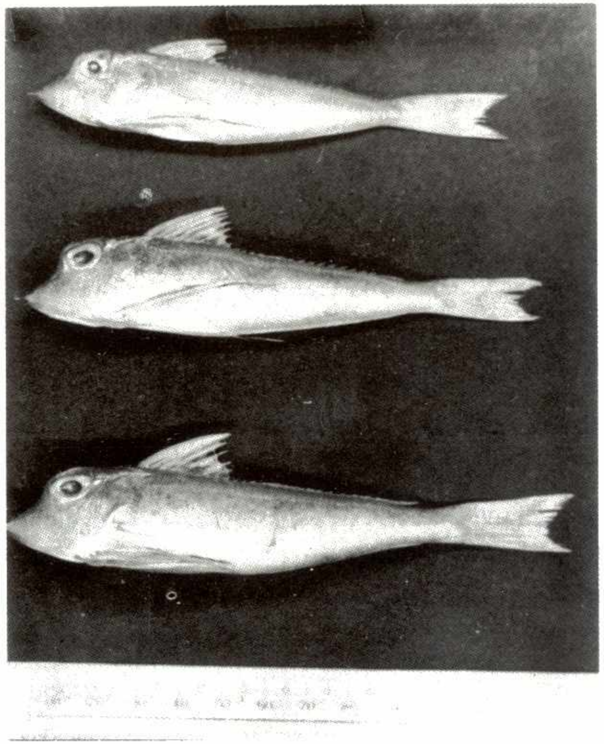
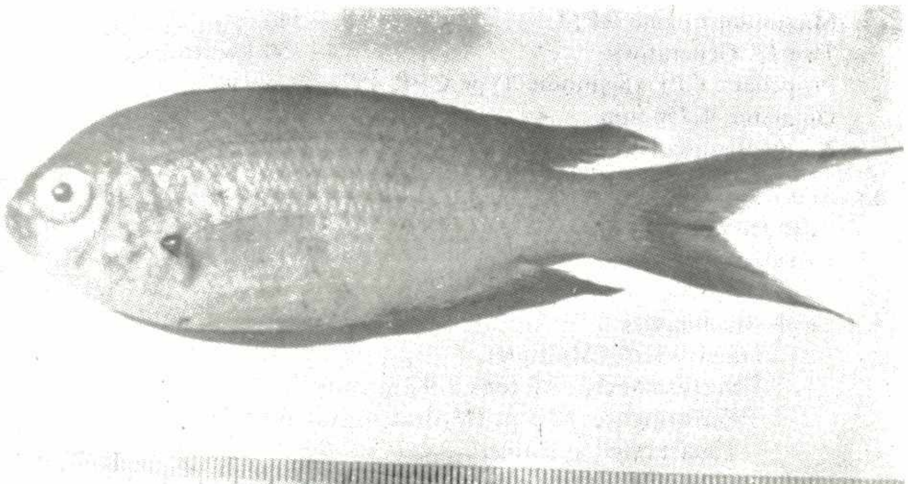


Plate 6 — *Lepidotrigla sp.*



APPENDIX A

Particulars of the M/V "Albacore" (After Aprieto and Patolot, 1976).

1. Principal Dimensions:
   - LOA (Length Overall) — 31.6 meters
   - Breadth (Moulded) — 7.0 meters
   - Depth (Moulded) — 3.2 meters
   - Draft — 2.5 meters

2. Tonnage and Capacity:
   - Gross Tonnage — 190.4 tons
   - Net Tonnage — 78.19 tons
   - Fish Hold Capacity — 40.0 cubic meters
   - Fresh Water Tank — 30.0 cubic meters
   - Fuel Oil Tank (100%) — 63.56 cubic meters
   - Lub Oil Tank (100%) — 2.22 cubic meters
   - Dry and Wet Food Storage

3. Engine Room Machineries:
   - Main Engine — Niigata Diesel Engine Model MG 20 AX, Single Acting 4 Cycle, Niigata-Napier, C-405 or SA-605 with air cooler
   - Maximum Continuous Shaft Horsepower — (BHP) 600 ps
   - Maximum Engine RPM — 840
   - Two (2) Generators — 50 kw (ea.)
   - Propellers: CPP (Kamome Type CPR-452)
   - Diamater: 1,750 mm
   - No. of Blades: Three (3) and a half

4. Speed:
   - Trial (Maximum) — 10.7 knots
   - Cruising — 11.393 knots

5. Deck Machineries:
   - Trawl Winch (Multiple)
     - Performance: 3.5 tons x 90 m/min
     - Performance: 82.5 ps (Hydraulic system) High Pressure
   - Tuna Longline Hauler
     - Type: Electric, Izui Iron Works Ltd.

   - Hydrographic Winch:
     - Type: Tsurumi — Seiki TS-2
     - Type: Electric Motor Driven with 3 mm dia
     - Type: Stainless Wire (steel)
     - Type: 1800 m with Folding "A" Type Frame
     - Type: Meter Wheel

6. Refrigeration (Fish Hold):
   - Refrigerant — Freon 22
   - Room Temperature — (-) 15°C
   - Compressor Capacity — 11 kw, 500 rpm, 11,900 k cal/hr

7. Compass:
   - One (1) Magnetic Standard Compass
   - One (1) Gyro Compass and Repeaters

8. Fishing Gear:
   - Otter Trawl
   - Purse Seine
   - Longline
   - Squid Line
   - Drift Nets

9. Electronic Equipment:
   - Radar, Loran, Radio Direction Finder, Transceiver, SSB, Echo Sounder

10. Complement:
    - Officers and Crew — 19
    - Professors — 2
    - Cadets — 15
    - Total 36

11. Builders: — Towa Zozen Kubushiki Kaisha
    - Place: — Shimonoseki, Japan
    - Keel Laid: — August 1972
    - Lauched: — November 1972
    - Christened: — November 1972
    - Accepted: — December 1972
    - Commissioned: — January 9, 1973

12. Classification Character:

APPENDIX B

Abbreviations/Symbols Used

sq naut mi	—	square nautical mile
sq km	—	square kilometer
m	—	meter
%	—	percentage
mm	—	millimeter
kg/hr	—	kilogram per hour
°C	—	degree Celsius
°/oo	—	parts per thousand
mg/l	—	milligram per liter
r	—	coefficient of correlation
FT	—	fishing track/echotrack