# SIZE COMPOSITION, OCCURRENCE, DISTRIBUTION AND ABUNDANCE OF SCALLOPS IN THE VISAYAN SEA*

By

Ma. Ethel Gabral Llana**

## ABSTRACT

**This paper is concerned with the size composition, and occurrence, distribution and abundance of scallops (*Amusium pleuronectes*) obtained from the trawl catches of the R/V ALBACORE in the Visayan Sea from June 1976 to March 1977. The results showed that the sizes of 1,114 scallop individuals vary from 21 to 91 mm, with an average of about 66 mm shell height; the majority of the scallops, of the size group 61-70 mm, are taken from fishing track 12; scallops are found in the Visayan Sea throughout the year, but their abundance is seasonal with a peak in June through August; and scallops in this study are distributed along the coastal waters of eastern Panay and northeastern Negros, on soft (sandy-muddy to muddy) substratum in depths up to approximately 40 m.**

## INTRODUCTION

Scallops are important as food for man, as materials used in the shell-craft industry, and as a source of lime. Fisheries statistics show that for a period of five years (1974-78), the recorded scallop export (frozen/chilled) was over 525 thousand kg valued at almost ₱12 million. Based on these figures, it is estimated that the price of scallops (usually only the meat or adductor muscle) is about ₱23 per kg and that scallops contribute over ₱2 million annually to the Philippine economy. Although the supply of scallops comes only from wild stocks, unlike other bivalve molluscs which are being cultured (e.g., oysters and mussels), the scallops have contributed to the economy by earning dollars for the country. Yet, the scallop resource has not received as much attention as other minor fishery resources and the fish-

---

* *Part of a PCARR-funded thesis prepared in partial fulfillment of the requirements for the degree of Master of Science (Marine Biology), University of the Philippines, under the guidance of Dr. Virginia L. Aprieto, Professor of Marine Fisheries, U.P. College of Fisheries.*

** *Senior Fishery Biologist, Fisheries Research Division, Bureau of Fisheries and Aquatic Resources.*

ery has not been as popular and developed as the oyster and mussel fisheries. In other countries, however, several scallop fisheries have expanded to become economically important fisheries. In the U.S.A., for instance, the sea scallop ranks second in value among the bivalve mollusks – surpassed in total value only by the oyster and ranking slightly higher in value than the oyster per pound of meats (Merrill, 1971). In the Canadian Maritimes, the scallop fishery had undergone a dramatic expansion for a period of 10 years (1951-1961) and by 1962, landings totalled 13.6 million lb (shucked meats) valued at $4.5 million. In 1951 the sea scallop was third in landed value of all molluscan shellfish caught in the Maritimes, while in 1962 it was worth over 10 times the combined value of other species of shellfish and was fourth in landed value of all species of fish landed on the Canadian east coast (Bourne, 1964).

The scallops referred to in this paper are the Asian moon scallops or 'sun and moon' shells, *Amusium pleuronectes* (Linnaeus, 1758). They are the most common and abundant among the species of scallops found in the Philippine waters and the only species which supports a fishery. Except the study which I conducted in 1980 on scallop biology, no other study on Philippine scallops has yet been undertaken. Related scallop studies by foreign investigators, however, although not on *A. pleuronectes,* are numerous. Among the studies which have provided information on size composition are those by Broom (1976), Hennick (1970) and Squires (1962); on occurrence, distribution and abundance, one may mention the works of Roe *et al.* (1971), Dickie (1955), Ursin (1956), Choat (1960), Dickie and Chiasson (1955), Dow (1969), Bourne (1964), Dreyer and Castle (1941), and Marshall (1947).

This paper presents some of the results of the study conducted as part of PCARR Project No. 129 (Trawl Fishing Investigations of Traditional and Non-traditional Fishing Grounds in the Philippines), a research project being carried out by the U.P. College of Fisheries Institute of Fisheries Development and Research.

## MATERIALS AND METHODS

### *The Study Area*

The study was conducted in the Visayan Sea (Fig. 1), one of the country's rich fishing grounds, located at approximately longitude 123° to 124°E and latitude 11° to 12°N. The area is bounded on the north by Masbate Island, on the east by Leyte and portions of Masbate and Cebu, on the south by Cebu and Negros, and on the west by Panay Island. It connects to several bodies of water: Asid Gulf on the north, Samar Sea on the northeastern side, Camotes Sea on the southeast, Tañon Strait on the south, Guimaras Strait on the southwest, and Jintotolo Channel on the northwestern side.

Based on the methodology of the Institute of Fisheries Development and Research, the study area was divided into three-sections designated as A, B and C covering a total area of 2,085 square nautical miles. Twenty-one echo tracks were selected and drawn after a thorough study of areas with minimum seabed obstructions and of even soundings on the Philippine Coast and Geodetic Survey Navigational Chart No. 4405 which covers the Visayan Sea. Of these, 12 fishing tracks which were found to have level and smooth bottom profiles and 13 oceanographic stations were selected (Aprieto and Patolot, 1977; Aprieto, 1978). The positions of the fishing tracks and oceanographic stations are shown also in Fig. 1.



### *Biological Investigations*

*Collections.* Specimens of *A. pleuronectes* were collected from the trawl catches of the R/V ALBACORE, the research and training vessel of the U.P. College of Fisheries, in the Visayan Sea from June 1976 to March 1977. After each catch was landed on deck all scallops were collected and counted. Dragging operations, using an otter trawl gear, were done once a month involving one drag on each fishing track. The mesh size of the cod end of the net used was 1.5 cm (stretched).

*Size composition.* Shell heights, *i.e.,* the straight-line distance from, at right angles to, the hinge to the edge of the shell, were measured with a Vernier caliper and recorded on board the vessel. Shell height, instead of shell length, was used to determine the sizes of the scallops following the dimension used by Bourne (1964), Squires (1962), Hennick (1970), and Dickie (1955).

*Occurrence, distribution and abundance.* These were determined by the number of individuals obtained and in relation to the following environmental factors: depth, substratum, temperature, salinity, dissolved oxygen, and hydrogen-ion concentration (pH). The term abundance was used to denote the quantity or amount of scallops, while relative abundance was used to refer to the quantity of scallops found in one fishing track in relation to those in other tracks. Relative abundance was determined by the number of scallops per fishing track following the use by Dickie (1955) and Dow (1969) of the seasonal catch per boat in thousands of pounds and catch per boat per day in pounds, and scallop landings in thousands of pounds, respectively, as rough measures of relative abundance.

### *Collection of Hydrographic Data*

The hydrographic data were collected, on board the R/V ALBACORE, from 13 oceanographic stations more or less evenly located within the study area.

The depth of each oceanographic station and fishing track was determined by means of an echo sounder. Samples of bottom materials were

Table 1. Size composition data for *A. pleuronectes* taken from the Visayan Sea, June 1976-March 1977.

| HEIGHT GROUP (mm) | 1976 | | | | | | | | | | | | | | 1977 | | | | | | | | JUNE to MARCH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JUNE | | JULY | | AUG. | | SEPT. | | OCT. | | NOV. | | DEC. | | JAN. | | FEB. | | MAR. | | | | | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | | | No. | % |
| 1-20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 21-30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1.15 | 1 | 0.85 | 0 | | 1 | 0.88 | 0 | 0 | | | 3 | 0.27 |
| 31-40 | 1 | 0.63 | 5 | 3.73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1.71 | 1 | 0.90 | 3 | 2.63 | 1 | 2.86 | | | 13 | 1.17 |
| 41-50 | 7 | 4.43 | 15 | 11.19 | 5 | 2.70 | 5 | 3.88 | 0 | 0 | 3 | 3.45 | 4 | 3.42 | 8 | 7.21 | 3 | 2.63 | 2 | 5.71 | | | 52 | 4.67 |
| 51-60 | 32 | 20.25 | 39 | 29.10 | 27 | 14.59 | 17 | 13.18 | 8 | 18.18 | 20 | 22.99 | 17 | 14.53 | 16 | 14.41 | 16 | 14.04 | 18 | 51.43 | | | 210 | 18.85 |
| 61-70 | 66 | 41.77 | 50 | 37.31 | 102 | 55.14 | 42 | 32.56 | 21 | 47.73 | 32 | 36.78 | 34 | 29.06 | 50 | 45.04 | 38 | 33.33 | 5 | 14.29 | | | 440 | 39.50 |
| 71-80 | 46 | 29.11 | 21 | 15.67 | 47 | 25.41 | 63 | 48.84 | 14 | 31.82 | 23 | 26.44 | 49 | 41.88 | 31 | 27.93 | 51 | 44.74 | 5 | 14.29 | | | 350 | 31.42 |
| 81-90 | 6 | 3.80 | 4 | 2.99 | 4 | 2.16 | 2 | 1.55 | 1 | 2.27 | 8 | 9.20 | 9 | 7.69 | 5 | 4.50 | 2 | 1.75 | 4 | 11.43 | | | 45 | 4.04 |
| 91-100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.85 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0.09 |
| TOTAL | 158 | 99.99 | 134 | 99.99 | 185 | 100.00 | 129 | 100.01 | 44 | 100.00 | 87 | 100.01 | 117 | 99.99 | 111 | 100.00 | 114 | 100.00 | 35 | 100.01 | | | | |



collected using a van Veen grab; these were taken to the laboratory of the Institute of Fisheries Development and Research and analyzed to determine the characteristic of the bottom. For collecting sea water samples and for taking the water temperature at different depths, Nansen bottles with reversing thermometers were lowered to various depths. Water samples were then analyzed by means of a refractometer to determine the salinity, by the modified Winkler method to determine the levels of dissolved oxygen and by using a Beckman pH meter to determine the hydrogen-ion concentration of the water.

Since scallops are bottom-dwelling animals, only those hydrographic data which pertained to the waters immediately above scallop beds were considered in the subsequent analysis.

## RESULTS AND DISCUSSION

### *Size Composition*

Table 1 shows the size composition data obtained from June 1976 to March 1977. In 10 months sampling, 1,114 live scallops of sizes ranging from 21 to 91 mm shell height were caught. No empty scallop shells were included in the monthly catch.

The monthly size-frequency distribution of the scallop samples is shown in Fig. 2 which demonstrates a unimodal distribution throughout the sampling period. From June through January, except in September and December, the majority of the scallops caught were of the size group 61-70 mm. Majority of the scallops caught in September, December and February were of the size group 71-80 mm; in March, 51-60 mm shell height. Fig. 3 shows the distribution of the monthly average size of scallops. In July and March, the scallops were quite small (with averages between 61 and 62 mm) compared to those in other months (between 66 and 70 mm). Considering the data as a whole irrespective of the date of collection, the average size of scallops which may be obtained from the Visayan Sea is about 66 mm shell height.

The size distributions of scallops obtained during the whole sampling period are illustrated in Fig. 4. Majority of the scallops were of the size group 61-70 mm and were taken from fishing track 12. Majority of the scallops taken from fishing track 11 were of the size group 71-80 mm; fishing track 10, 61-70 mm; and fishing track 9, 51-60 mm shell height.

### *Occurrence, Distribution and Abundance*

The monthly catch data recorded for each fishing track are shown in Table 2. In June, 158 scallops were caught; July, 134; August, 185; Septem-

Table 2. Catch data of scallops from the Visayan Sea, June 1976-March 1977.

| Fishing Track No. | Ave. Depth (m) | 1976 | | | | | | 1977 | | | Total No. of Ind./FT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | |
| 1-8 | 65-117 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 39.35 | 1 | 0 | 1 | 1 | 0 | 22 | 7 | 13 | 5 | 0 | 50 |
| 10 | 18.30 | 20 | 40 | 89 | 49 | 7 | 5 | 8 | 15 | 11 | 28 | 272 |
| 11 | 28.37 | 24 | 41 | 56 | 45 | 11 | 36 | 54 | 8 | 6 | 1 | 282 |
| 12 | 30.20 | 113 | 53 | 39 | 34 | 26 | 24 | 48 | 75 | 92 | 6 | 510 |
| Total No. of Ind./Mo. | | 158 | 134 | 185 | 129 | 44 | 87 | 117 | 111 | 114 | 35 | 1,114 |



ber, 129; October, 44; November, 87; December, 117; January, 111; February, 114; and March, 35. Fig. 5 summarizes these data and shows the monthly fluctuations in scallop abundance. Abundance (as measured by catch rates) varied from month to month; it was highest from June until September and considerably decreased in October, then went up again in November and declined in March. Such variation in the catch suggests that, although scallops occur throughout the year in the Visayan Sea, their abundance is seasonal with a peak in June through August.

As shown in Table 2, scallops occurred only in four out of 12 fishing tracks in depths of approximately 18 to 40 m, with greatest concentrations at about 30 m which is probably the optimum depth for this species in Philippine waters. The depth range at which scallop samples were obtained indicates that *A. pleuronectes* is a shallow-water species and its distribution is essentially coastal, occurring at a maximum depth of about 40 m. According to the Director of the Queensland Fisheries Service (personal communication), in Queensland, Australia *A. pleuronectes* is abundant in relatively shallow water (3-15 fm), or 5.4-27 m, between the Gulf of Carpentaria and Bowen. In the Visayan Sea scallops (particularly the young and/or larval stages) possibly occur in waters shallower than 18 m, but this cannot be ascertained at the moment since sampling was limited to deeper waters.

The general bottom topography of Visayan Sea and the distribution and relative abundance of scallops thereat are illustrated in Fig. 6. Based on the analysis of samples of bottom sediments obtained from the study area, by the Institute of Fisheries Development and Research, the bottom was classified into two types: soft (composed of silt, mud and/or sandy mud) and hard (composed of coralline sand, coral and/or rock). Scallops generally occur on soft bottom as evidenced by the presence of mud and/or sandy mud particles on the lower valve and in the mantle of the scallop samples. Information from the literature, however, show that other species of scallops generally live on hard bottom. The sea scallops (*Placopecten magellanicus*), for instance, generally live on firm sand or gravel bottom although they do occur on muddy bottom, and they are also found on rocky bottom (Bourne, 1964). Dow (1969) mentioned that sea scallops are gathered in commercial quantities from rocky bottoms that are impossible to drag with conventional scallop gear.

The relative abundance of scallops obtained from the Visayan Sea is described, based on the total number of samples obtained from each fishing track (see Table 2), as follows: present but scarce (± 50 scallops per fishing track), moderately abundant (± 277 scallops per fishing track), and present in considerable abundance (± 510 scallops per fishing track). The number representing moderately abundant, *i.e.*, ± 277, is the average of the numbers of scallop individuals obtained from fishing tracks 10 and 11 which were com-

**Table 3. Scallop abundance and monthly means of the bottom-water temperature, salinity, dissolved oxygen and pH of the area covering fishing tracks 12, 11, 10 and 9 from June 1976 to March 1977. (Means were derived from the data for oceanographic stations 8, 7, 12, 2 and 13 which are located near these fishing tracks.)**

| Month | Scallop Abundance | Temperature (°C) | Salinity (°/oo) | Oxygen (mgA/l) | pH |
|---|---|---|---|---|---|
| June 1976 | 158 | 27.77 | 31.90 | 5.58 | 8.42 |
| July | 134 | 28.18 | 33.92 | 6.52 | 8.43 |
| August | 185 | 28.35 | 33.20 | 6.72 | 8.33 |
| September | 129 | 28.35 | 33.00 | 6.56 | 8.56 |
| October | 44 | 28.16 | 33.00 | 5.55 | 8.43 |
| November | 87 | 28.43 | 33.60 | 6.27 | 8.49 |
| December | 117 | 28.03 | 33.61 | 6.21 | 8.46 |
| January 1977 | 111 | 27.25 | 32.90 | 6.53 | 8.33 |
| February | 114 | 25.64 | 33.05 | 6.42 | 8.24 |
| March | 35 | 26.57 | 32.95 | 5.94 | 8.41 |



bined because the difference in yield between these tracks was negligible.

The range of scallop distribution, as far as the area surveyed is concerned, is approximately at longitude 123°11' to 123°26'E and latitude 11°03' to 11°32'N, along the shallow waters of eastern Panay and northeastern Negros. They are present but scarce in the waters south of Antonia Island on the north, moderately abundant in the coastal waters of eastern Panay (from south of Sicogon to east of Igbon Island), and present in considerable abundance in the shallow waters of the northeastern part of Negros (near Maca Reef and Panal Reef) on the south (see Fig. 6).

In an attempt to relate the abundance of scallops to environmental conditions, the monthly means of the bottom hydrographic data gathered from oceanographic stations near the fishing tracks with scallop yields were computed. Table 3 shows the number of scallop individuals collected per month and the mean values for the bottom temperature, salinity, dissolved oxygen and pH. For temperature, the mean values ranged from 25.64°C in February to 28.43°C in November; salinity, 31.90°/°o in June to 33.61°/oo in November; dissolved oxygen, 5.55 mg A/1 in October to 6.72 mg A/1 in August; and pH, 8.24 in February to 8.56 in September. Fig. 7 attempts to relate scallop abundance to temperature, salinity, dissolved oxygen and pH, and suggests that the abundance of scallops in the study area was not related to any of the ecological parameters measured, except dissolved oxygen. In August, the number of scallops increased with increased oxygen level; in March, it declined when the amount of dissolved oxygen in the water decreased; and in December through February, it went up again with increased dissolved oxygen level. Statistical treatment, however, showed that scallop abundance was not also related to the dissolved oxygen concentration of the water. The result of the computation of the correlation coefficient between these two variables showed a value of 0.49 which is not statistically significant; the significant level is 0.62 (Pauly, personal communication).

## SUMMARY AND CONCLUSIONS

1. The sizes of 1,114 scallop individuals obtained from the Visayan Sea ranged from 21 to 91 mm, with an average of about 66 mm shell height. The size-frequency distribution was unimodal from June 1976 to March 1977. Majority of the scallops caught throughout the sampling period belong to the size group 61-70 mm and were taken from fishing track 12.

2. The total number of scallop individuals obtained from the study area was broken down by month as follows: June, 158; July, 134; August, 185; September, 129; October, 44; November, 87; December, 117; January, 111; February, 114; and March, 35. The monthly catch data suggested that scallops are found in the Visayan Sea throughout the year, but their abundance is sea-

sonal with a peak in June through August.

3. *A. pleuronectes* is a shallow-water species which generally lives on soft bottom (sandy mud to mud). The depth at which the scallops in this study were taken ranges from approximately 18 to 40 m, with greatest concentrations at about 30 m.

4. As far as the area surveyed is concerned, the range of scallop distribution is approximately at longitude 123°11' to 123°26'E and latitude 11°03' to 11°32'N, along the shallow waters of eastern Panay and northeastern Negros. Scallops are present but scarce in the waters south of Antonia Island, moderately abundant in the coastal waters of eastern Panay, and present in considerable abundance in the shallow waters of the northeastern part of Negros (near Maca Reef and Panal Reef).

5. The ranges of the mean values obtained for bottom temperature, salinity, dissolved oxygen and pH are as follows: 25.64-28.43°C, 31.90-33.61°/oo, 5.55-6.72 mg A/1 and 8.24-8.56, respectively. Based on the data obtained, scallop abundance is not related to any of the ecological parameters measured.

## RECOMMENDATIONS

Inasmuch as sampling was limited to depths of 18 m and above, future studies on scallops should include sampling in shallower areas (<18 m) to be able to get better data on size composition. If possible, sampling in these areas should be done by SCUBA divers in order to have a clearer picture of the distribution and natural habitat of the species.

Similar studies should be undertaken in other fishing areas to determine whether or not variations in distribution, abundance and ecological relationship occur from area to area.

A better statistical data collection which would include a separate statistics for each species, particularly on scallops and other commercially important invertebrates, is recommended. This may be helpful in the assessment of the scallop resource and other important invertebrate resources of the country.

## ACKNOWLEDGMENTS

I am indebted to the Philippine Council for Agriculture and Resources Research for funding my research study, and the U.P. College of Fisheries, Institute of Fisheries Development and Research for making my study a part of its project on trawl investigations.

I am grateful to Dr. Virginia L. Aprieto, thesis adviser; Dr. Edgardo D. Gomez, thesis critic; Mr. Arthur C. Simpson, Dr. Daniel Pauly, and Mr. Jaime J. Cabrera for their invaluable assistance.



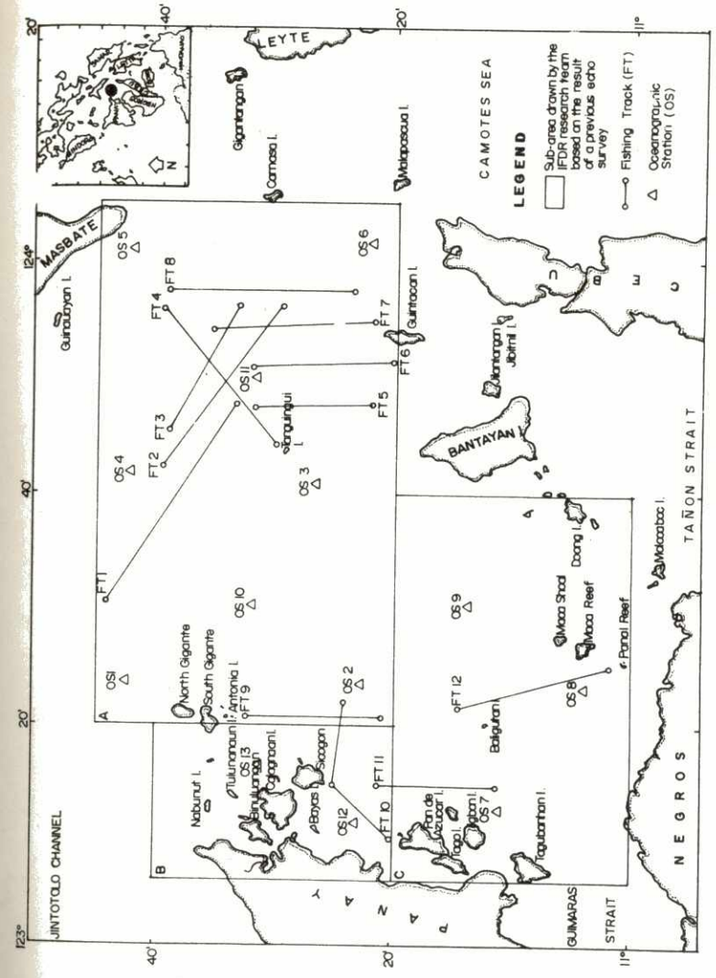


**Fig. 1 Map of the Visayan Sea showing the positions of the fishing tracks and oceanographic stations.**

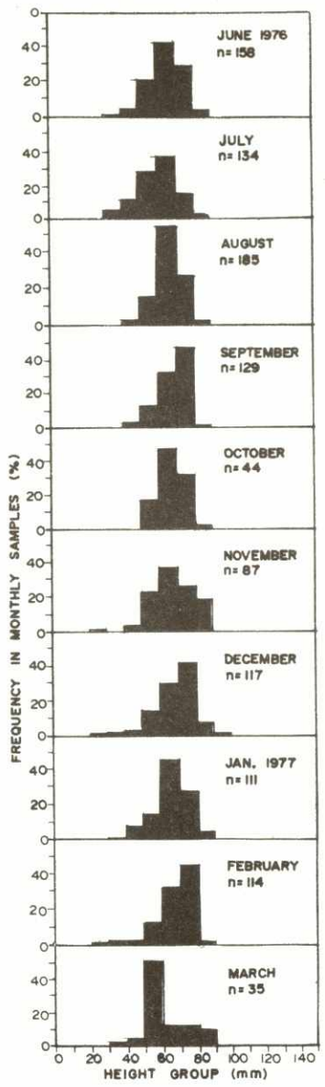


**Fig. 2. Monthly size-frequency distribution of samples of *A. pleuronectes* taken from the Visayan Sea, June 1976-March 1977.**



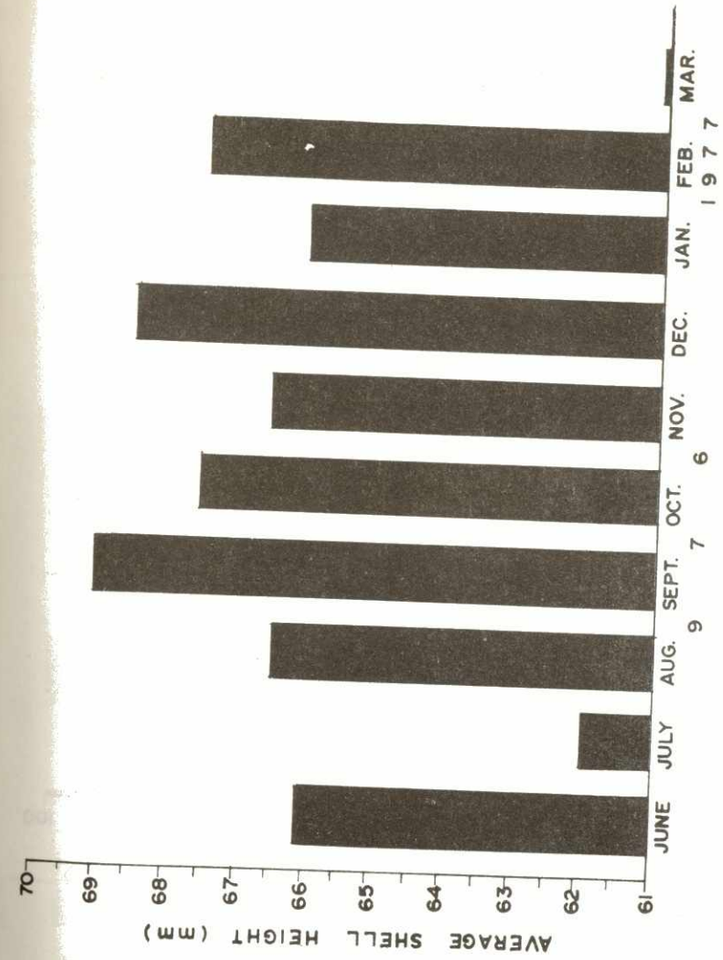


**Fig. 3. Monthly average size of scallops obtained from the Visayan Sea, June 1976-March 1977.**

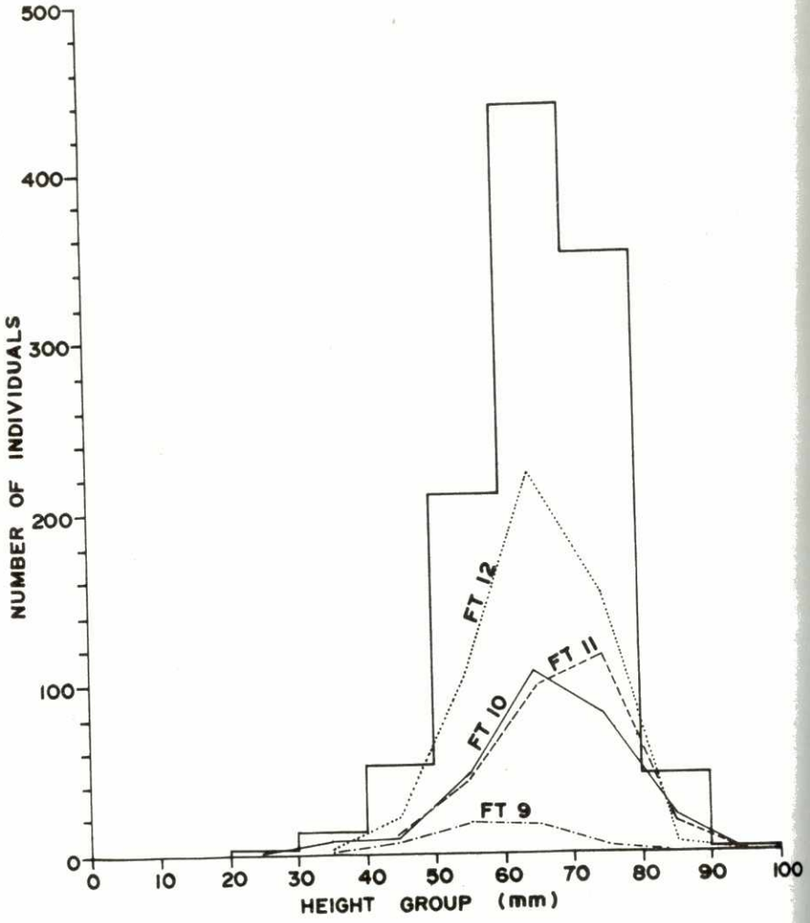


Fig. 4. Size distributions of samples of *A. pleuronectes* taken from the Visayan Sea, June 1976-March 1977. (Histograms show the distribution of all samples irrespective of the fishing tracks from where taken; polygons show the distribution according to fishing track.)



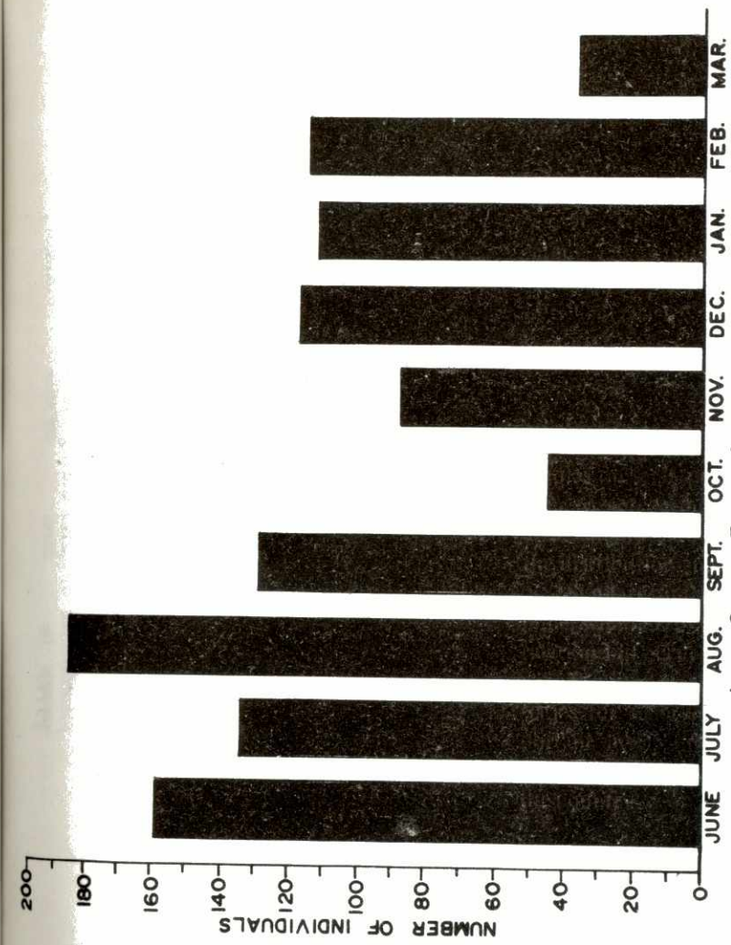


Fig. 5. Monthly abundance distribution of scallops taken from the Visayan Sea, June 1976-March 1977.

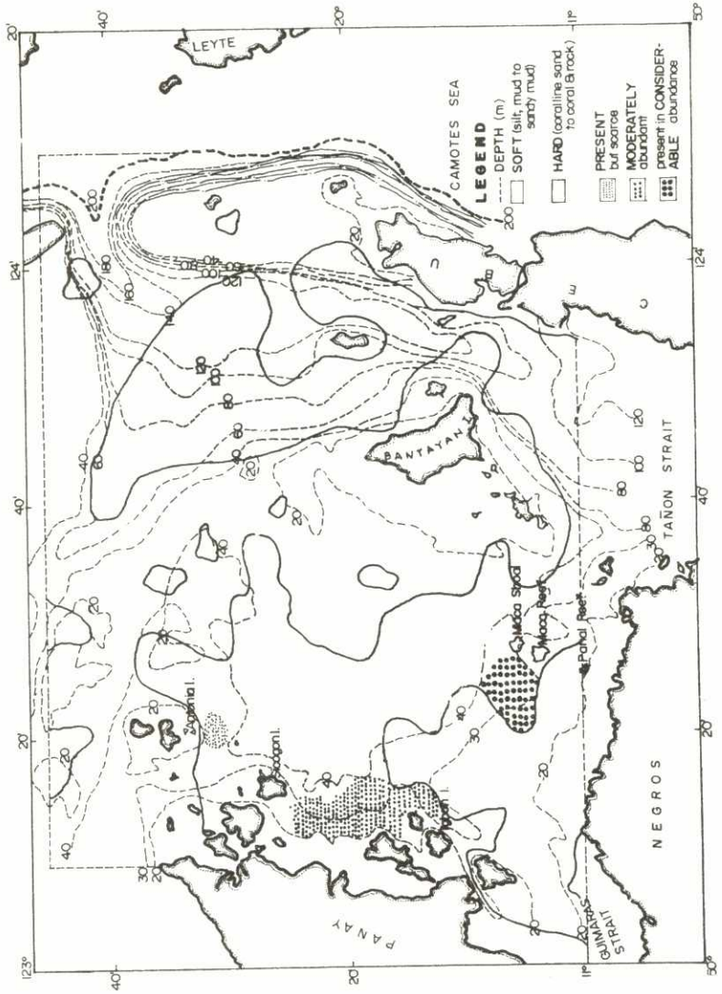


**Fig. 6. The general bottom topography of Visayan Sea and the areal distribution and relative abundance of a population of *A. pleuronectes* obtained during the period June 1976 to March 1977.**



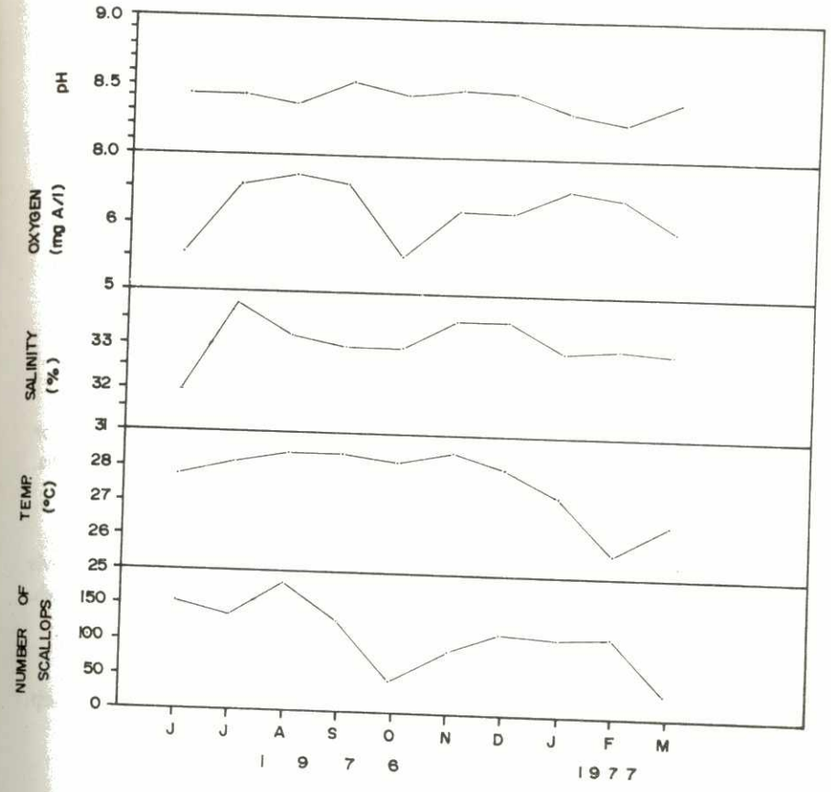


**Fig. 7. Monthly catch of scallops and means of bottom temperature, salinity, dissolved oxygen content and pH in the Visayan Sea, June 1976-March 1977.**

## REFERENCES

APRIETO, VIRGINIA L.
1978 Hydrobiological studies of the Visayan Sea demersal fisheries. A report on trawl fishing investigations of traditional and non-traditional fishing grounds in the Philippines 218 p. (Mimeo.)

_____ and J. N. PATOLOT
1977 Echo survey of the Visayan Sea. Fish. Res. J. Philipp. 2(1): 70-82.

BOURNE, N.
1964 Scallops and the offshore fishery of the Maritimes. Fish. Res. Bd. Canada Bull. (145): 60 p.

BROOM, M.J.
1976 Synopsis of biological data on scallops (*Chlamys Aequipecten) opercularis (Linnaeus), Argopecten irradians (Lamarck), Argopecten gibbus (Linnaeus).* FAO Fish. Synop. (114): 44.p.

BUTLER, A.J. and F.J. BREWSTER
1979 Size distribution and growth of the fan-shell *Pinna bicolor* Gmelin (Mollusca: Eulamellibranchia) in South Australia. Aust. J. Mar. Freshwat. Res. 30(1): 25-39.

CADDY, J.F.
1973 Underwater observations on the tracks of dredges and trawls and some effects of dredging on a scallop ground. J. Fish. Res. Bd. Canada 30 (2): 173-180.

CHOAT, J.H.
1960 Scallop investigation, Tasman Bay 1959-60. Fish. Tech. Rep. (N.Z.) (2): 51 p.

DICKIE, L.M.
1955 Fluctuations in abundance of the giant scallop, *Placopecten magellanicus* (Gmelin) in the Digby area of the Bay of Fundy. J. Fish. Res. Bd. Canada 12 (6): 797-857.

_____ and C. P. CHIASSON
1955 Offshore and Newfoundland scallop explorations. Fish. Res. Bd. Canada, Atl. Biol. Stn. Gen. Ser. Circ. (25): 4 p.



DOW, ROBERT L.
1969 Sea scallop fishery. In the Encyclopedia of Marine Resources, edited by Frank E. Firth. New York: Van Nostrand Reinhold Co: 616-623.

DREYER, WILLIAM A., and WILLIAM A. CASTLE
1941 Occurence of the bay scallop, *Pecten irradians.* Ecology 22(4): 425-427.

HARRISON, A.J.
1965 Tasmania scallop fishery and its future. Aust. Fish. News. 24 (6): 9, 11, 13.

HENNICK, DANIEL P.
1970 Reproductive cycle, size of maturity, and sexual composition of commercially harvested weathervane scallops (*Patino pecten caurinus)* in Alaska. J. Fish Res. Bd. Canada 27 (11): 2112-2119.

LLANA, MA ETHEL G.
1980 A contribution to the biology of the Asian Moon Scallop, *Amusium pleuronectes* (Linnaeus, 1758). MS Thesis, Univ. of the Phil., Diliman, Quezon City. 61 p.

MARRIAGE, L.D.
1958 The bay clams of Oregon – their identification, relative abundance, and general distribution, Educ. Bull. (Fish. Comm, Oregon) 2 : 29 p.

MARSHALL, N.
1947 An abundance of bay scallops in the absence of eelgrass. Ecology 28 (3): 321-322.

MERRIL, ARTHUR S.
1971 The sea scallop. Reprinted from Annual Reports for 1970 Amer. Malacol. Union : 24-27.

PHILIPPINES (Republic). Bureau of Fisheries and Aquatic Resources
1975 Fisheries statistics of the Philippines. 115 p. (Mimeo.)

_____
1976 *Ibid.* 258 p. (Mimeo.)

1977 *Ibid.* 417 p. (Mimeo.)

1978 *Ibid.* 373 p. (Mimeo.)

POORE, G.C.B., and S. RAINER

1974 Distribution and abundance of soft-bottom molluscs in Port Philip Bay, Victoria, Australia. Aust. J. Mar. Freshwat. Res. 25 (3): 371-411.

ROE, RICHARD B., R. CUMMINS JR., and H. R. BULLIS JR.

1971 Calico scallop distribution, abundance, and yield off eastern Florida, 1967-68. Fish. Bull. NOAA/NMFS 69 (2): 399-409.

SQUIRES, H.J.

1962 Giant scallops in New Foundland coastal waters. Fish. Res. Bd. Canada Bull. (135): 29 p.

URSIN, ERIK

1956 Distribution and growth of the queen, *Chlamys opercularis* (Lamellibranchiata), in Danish and Farose waters. Medd. Dan. Fish. – Havunders. (Ny Ser.) 1 (13): 1-32.