ON THE HYDRO-BIOLOGICAL SURVEY OF SORSOGON BAY FOR THE PROPOSED FISH NUSERIES/RESERVATIONS

By

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INTRODUCTION

To conserve and develop the country's marine resources, President Ferdinand Marcos ordered the banning or restriction of commercial fishing operations in various parts of the country. Our shallow areas are over-exploited due to the operation of trawlers and other destructive fishing methods. These cause the depletion of our fishery resources greatly affecting fish production and the small fishermen. To remedy the situation, we must properly exploit our marine resources to conserve and develop these for future generations. We contribute materially to population increase, therefore we have a moral obligation to understand the food problems of the world and help alleviate the same in our small ways.

THE SURVEY AREA

Sorsogon Bay is a small shallow bay about one-fifth the size of Manila Bay. The mouth of the bay opens to a narrow channel leading to Ticao Pass. The depth ranges from three to 14 meters and has an average depth of 7.05 meters. Station 23 (12°52'12" N; 123°49'06" E) is the deepest part of the bay, while Station 2 (12° 56'06" N; 124°01'12" E) is the shallowest part. Water transparency ranges from two to six meters deep. The color of the sea varies from greenish-blue to yellowish-green.

The technical description of the area covered by the hydrobiological survey is as follows:

All waters enclosed by an imaginary line drawn starting from a point at Magallanes, Sorsogon, at longitude 123°49'45" East, latitude 12°49'45" North,

thence northwest approximately 3.3 nautical miles to a point at Salongbuaya, Castilla at longitude 123°47'25" East, latitude 12°51'55" North,
thence northeast along the coastline of Castilla,!
thence eastward to Sorsogon along its coastline,
thence south to Casiguran along its coastline,
thence westward along the coastline of Juban,
thence westward along the coastline to the starting point at Magallanes, Sorsogon, with an area of approximately 60 square nautical miles.

METHODS

A hydro-biological survey was conducted on board a hired baby trawler. A total of 24 stations were sampled and in each station (see Station Map, Figure 1), actual depth, air temperature and water temperature readings, water sampling for salinity and oxygen determination, water transparency and color determination, and plankton and benthos collections were made. Observations on the area were also recorded. Figure 2 shows the station numbers and the coordinates.

a. Water sampling and water temperature readings at certain depths were obtained with the use of the Nansen bottle with reversing thermometer. Oxygen determination was done through the modified Winkler method and salinity determination by titration method. Water color was determined with the use of Forel sea water color scale. A pure white Secchi disc was used to determine water transparency.

b. A Marutoku net was used for plankton collection and 30 vertical hauls were made. A flow meter which was attached to the mouth of the net registered the volume of water that passed through the net. The depth of the plankton station was from one to five meters from the surface. Plankton samples were preserved in a 4%-formalin solution. Plankton volume was determined by the volume displacement method. Total plankton counts from each station were by the aliquot portion method. Fish eggs and fish larvae from each station were sorted and preserved in small vials for identification. The ml/m³ of plankton volume and percentage of occurrence were computed from each station and plotted in tables and charts which are attached to this report. The whole plankton composition was re-grouped into four major groups.

c. Thirty benthic stations were occupied utilizing a 0.1-m² Van Veen grab. One grab sample was obtained from each sample site and contents were noted for texture and color and sieved through a 0.5 mm-square-mesh. The remains in the sieve were collected and sorted in 5-10% formalin. Organisms were sorted to major taxonomic groups, blotted dry and weighed to 0.1 mg accuracy. Net weights were converted to ash free dry weights (AFDW) using the conversion factors given by Lie (1969). The conversion factors for Polychaetes and miscellaneous organisms (Nemerteans, Nematodes, etc.) were 0.122, for crustaceans, 0.15; bivalves, 0.05; and echinoderms 0.03 to 0.12.

d. On the biological part, three experimental trawlings were conducted inside Sorsogon Bay. Catch composition, length and weight measurements, sex and maturity determination were the basic biological analyses made.

Fish landing survey was done only once due to the early start of the hydro-biological survey. The kind and quantity of fish landed and the type of gear used were determined.

RESULTS AND DISCUSSIONS

Hydro-biological survey

a. **Hydrography**

Surface

Water temperature on the southern part registered 26.9°C and going north it increased to 27.6°C. Water mass on the eastern part of the bay registered 27.4°C. A similar water mass from the northern part extending outside the bay was observed (Figure 3).

Salinity on the eastern part was 33°/oo, then, it decreased as it reached the middle portion of the bay to 31°/oo. As it extended outside the bay, the salinity gradually increased to 32.23°/oo (Figure 4).

Dissolved oxygen concentration of 4.5 ml/l was observed homogenously in the whole bay (Figure 5).

Bottom

Water temperature from the southern part registered 27.1°C and going up north it increased by 0.4°C, extended up to the eastern part. At station 5 (12°52'18" N, 123°59'42" E), it registered a temperature of 28.2°C, higher than that found at the mouth of the bay (Figure 6).

Salinity at the southern and eastern parts registered 33°/oo, while on the northern part it varied from 33°/oo. At the mouth of the bay, salinity registered was 32°/oo (Figure 7).

Dissolved oxygen concentration of 5.0 ml/l was observed on the eastern part of the bay and then decreased to 4.5 Ml/l as it went out (Figure 8).

b. Plankton

Twenty-four plankton samples were collected from an average depth of 7.1 meters. Station 12 which is about 1.7 nautical miles northwest of Magacnon Pt. and Station 18, approximately nine nautical miles northwest of Patubajao, exhibited the highest plankton volume (14 ml). Station 1, about 1.8 nautical miles southwest of Sorsogon proper, contained a minimal volume of less than 1 ml.

Quantitative analysis of plankton samples was performed following the determination of plankton volume. Plankton organisms were identified and were later grouped into zooplankton and phytoplankton. Phytoplankton constituted 18.78% of the plankton organisms. The diatoms *Thallasiothrix* and *Chaetocerus* were the most common species. Station 1 had the most abundant phytoplankton while Station 18 had the minimal amount. Members of the zooplankton were further classified into several major groups. Dinoflagellates represented mostly by the luminiscent *Noctiluca* and *Ceratium* composed the biggest percentage which was 67.20%. Highest concentrations of *Noctiluca* were found in Station 19 with 1,689 organisms which indicated *Noctiluca* bloom.

In Station 19 located one nautical mile southwest of Alimpayao Pt., copepods were widely distributed over the entire area. These minute crustaceans formed an important link between the phytoplankton and the fish. They formed the major diet of many small fishes which were, in turn, preyed on by larger fishes. Other important groups were the following: Chaetognath (*Sagitta*); Tunicate (*Oikopleura* and *Salpa*); mollusk (including mollusk eggs); crustaceans other than copepods (nauplius, megalop and mysis); coelenterates (medusae and *Diphyes*) which had the lowest percentage; annelids and minor organisms (Foraminiferan, Echinoderm and Radiolarians). Figure 9 shows four major groups: dinoflagellates, phytoplankton, copepods and miscellaneous (composed of the minor groups enumerated above) groups. Figures 10 to 12 enumerate the percentage of occurrence of plankton composition.

After the quantitative analysis of the plankton samples, sorting and counting of fish eggs and fish larvae were done. A very low concentration of fish larvae was observed, with 10 stations completely without them. The highest number of fish larvae was noted in Station 1 with six larvae sorted. A total of 35 larvae were sorted from the 24 stations covered by the survey. Fish eggs were scarse as only 84 were sorted. Highest number of fish eggs was recorded in Station 22. Five stations were completely without them (Figure 13). These counts were estimated. Fish eggs and larvae are still to be identified and classified.

c. Benthos

The initial sampling data indicates that Sorsogon Bay has a bivalve, polychaete, brachyuran dominant community structure. Table 1 enumerates the biomass, frequency and diversity data. Figure 14 shows the relation between the biomass and the frequency of occurrence.

Polychaetes occurred most frequently but had a small biomass compared to the bivalves and brachyuran. The frequency of occurrence of polychaetes suggests an important role in the community structure, being an important food source for demer-

Table 1 — Sorsogon Bay — Data on major taxonomic groups with a breakdown of commonly occuring species

Taxonomic Group	Wet Weight gr/.1m²	Total AFDW Grams	Average AFDW gr/.1m²	Percent Biomass AFDW (gr.) %	Percent Occurence %	No. of Individual N	No. of Species S	Diversity $\frac{S-1}{\log N}$	Importance % Species of major taxa
Polychaeta (Total)	0.1617	0.0734	0.0187	2.64	87.50	101	25	.15	
Aglaophamus sp.	0.0296	0.0363	0.0036		62.5	47			6.53
Other	0.1321	0.3365	0.0161		79.16	54			
Bivalvia (Total	9.1631	12.0352	0.5040	67.71	66.67	4.6		.10	50.00
Paphia undulata	8.2169	10.8463	0.4519		33.33	23	7		15.00
Solonidae	0.3641	0.4806	0.0200		29.17	7			
Others	0.0278	0.0367	0.0015		20.83	17			
Brachyura	1.4333	5.1599	0.2150	28.88	50.00	48	15	.23	
Ophiuroidea	0.0596	0.0429	0.0018	0.24	29.17	12	7	0	
Nemertea	0.0242	0.0708	0.0030	0.40	12.5	3	1	0	
Nematoda	0.0003	0.0008	0.0003	0.0004	4.17	1	1	0	
Stomatopoda	0.0063	0.0227	0.0009	0.12	4.17	1	1	0	
	10.3485	17.8657	0.7444						

sal fish. This aspect will be studied further in a complete community analysis of Sorsogon Bay which will include demersal fish stomach content analysis.

Bivalves had a high biomass and a high frequency of occurrence. *Paphia undulata,* a large bivalve with the average ash free dry weight of 0.4716 g, comprised approximately 89% of the total bivalve biomass. The species, by weight, was the most abundant but their importance to demersal fish stocks is still unknown. Again, further studies should reveal more about the relation of *Paphia undulata* and other bivalves to the demersal fishes.

The brachyurans had a highly diverse fauna although *Xenothalmus pennothuroides* composed majority of the number. This species is commonly found in many shallow water areas of the Philippines.

Ophiuroids also had a high diversity although their contribution to the biomass was small.

Natantians, gobies, and poriferans were also sampled but their contribution to the biomass was not added to the total biomass figure due to their epifaunal nature. Two echiurans were also sampled but their biomass were not added to the total biomass as its high biomass would have been out of proportion in relation to its frequency of occurrence.

One large specimen of *Acra binakayensis* and one *Placamen folicacea* were also sampled but these were also omitted from the biomass figure due to their frequency occurrence. The actual contribution of these epifaunal and uncommonly large specimens to the standing crop is questionable. Epifaunal species are not accurately sampled by the grab and large specimens may represent long-lived species whose contribution to the annual production may be out of proportion to their contribution to the standing crop when sampled unfrequently. Again, further studies will help to clear up some of these questions.

The standing crop of 0.74 gr/0.1m² is small. This figure can only be treated as a rough estimate and replicate sampling in further studies will help in obtaining a better estimate.

d. **Experimental trawling**

Three experimental trawlings were conducted inside Sorsogon Bay. The first trawling produced no catch after one-hour dragging. The second trawling caught 47.6 kg after two-hour dragging. The histogram on Figure 15 showed the percentage composition by weight (kg) of the catch. Slipmouths, (*sap-sap*), dominated the catch, followed by trash fish, cavalla, (mamsa), and others. The third trawling got a total catch of 40.2 k after one-hour dragging. The histogram on Figure 6 showed that almost 80% of the catch was slipmouths. The remaining percentage was composed of Spanish mackerel, squids, caesio, and blue crabs.

e. **Fish Biology**

Fishes caught during the experimental trawling in Sorsogon Bay were analyzed. Length and maturity were determined.

Leiognathus bindus (slipmouths) — the length ranged from 35 mm to 70 mm. All were in their immature stages (Figure 17).

Leiognathus ruconius (slipmouths) — length ranged from 45 mm to 60 mm, the gonads showed that 66.66% were immature while 33.33% were mature (Figure 18).

Leiognathus splendens (slipmouths) — length ranged from 75 mm to 115 mm. Gonads showed 62.5% mature and 37.5% immature (Figure 19).

Caranx kalla (cavalla) — size ranged from 110 mm to 195 mm, 75% were mature (Figure 20).

Apogon sp. (cardinal fish) — size ranged from 80 mm to 85 mm and all were mature (Figure 21).

Shrimp fish — length ranged from 95 to 160 mm and 85.68% were immature (Figure 22).

Spanish mackerel, leather jacket, flatfishes, horn fish and glassfish were all of immature stages.

f. **Fish landing survey**

Fish landing survey was conducted in Cambulaga, Sorsogon for one day only. The most common catch of the baby trawl was blue crabs, next were shrimps, flatfishes, octopus, croakers and mollusks. A total of 600 k of blue crabs and 20 k of shrimps were landed. Other species were in negligible amounts (Figure 23).

COMMENTS AND RECOMMENDATIONS

— The S.T. diagram (Figure 24) shows two distinct salinity values. One ranged from 31.2°/oo to 32.5°/oo with corresponding temperature ranging from 27.0°C to 27.8°C. The other ranged from 33.1°/oo to 34.2°/oo with temperature ranging from 27.5°C to 27.8°C. This shows that there were two distinct types of water in Sorsogon Bay during the survey (November 20-27, 1975).

— High plankton concentration was observed in Station 12 which was located in the middle of the southern part of the bay, with a value of 32.62 ml/m. Another high concentration was observed in Station 6 which was located on the northeastern part with a value of 28.0 ml/m.

— Fish eggs and larvae were scarce as shown by the poor collection of the samples. Only a total of 119 fish eggs and larvae were collected from 24 sampling stations.

— This initial pilot survey study indicates a small biomass with bivalves, brachyurans and polychaetes dominating. Each of the dominating groups showed a rich diversity with one species dominating (i.e. Bivalvia, *Pahia undulata;* brachyuran, *Xenothalmus pennothuroides;* polychaeta, *Aglaophamus sp.*

— A comparison of the trawling experiments shows that slipmouths predominated the catch and that the deeper waters can yield better quality of fish than the shallower one.

— Most of the fishes were immature which means that the period of the survey, November 1975, is not the spawning time for most of them. This may explain the poor collection of fish eggs and larvae.

— Suitability of this particular area for the establishment of fish nurseries/sanctuaries cannot yet be ascertained due to the synoptic nature of this study. Data gathered from this survey have yet to be substantiated by succeeding investigations.

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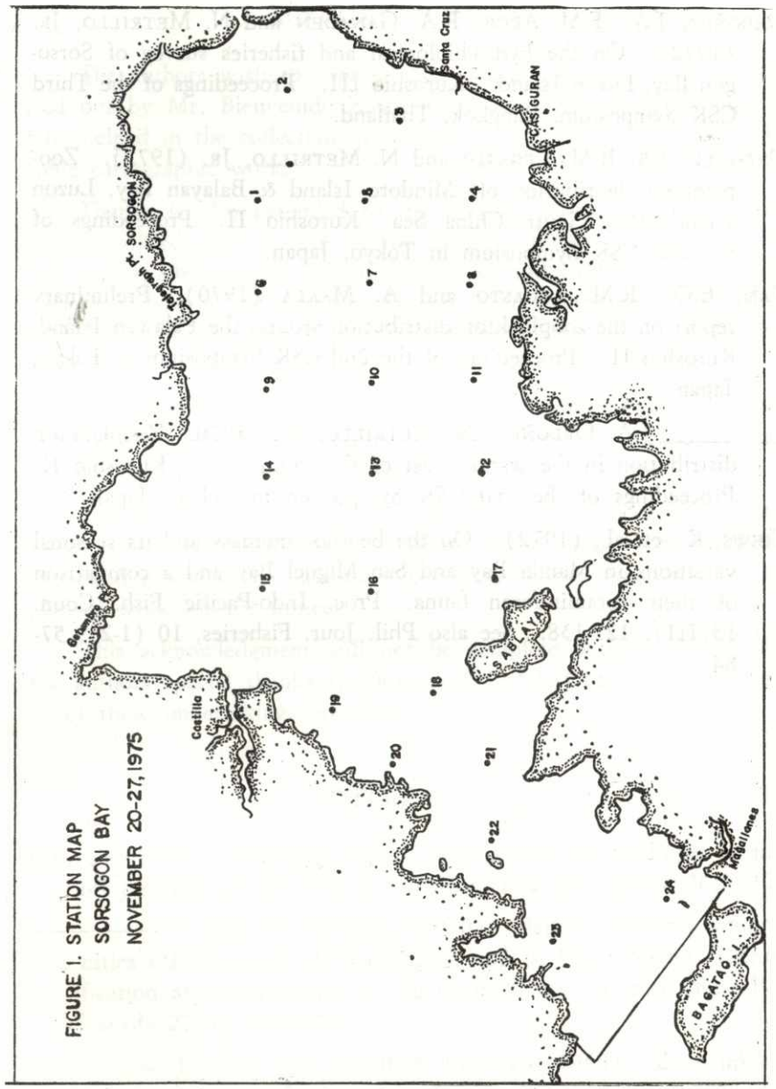


FIGURE 1. STATION MAP
SORSOGON BAY
NOVEMBER 20-27, 1975

Figure 2 - Station Number and the Coordinates

SORSOGON BAY

Sta. Number	Longitude	Latitude
1	123° 59' 42" E	12° 56' 30" N
2	124° 01' 12" E	12° 56' 06" N
3	124° 00' 54" E	12° 54' 18" N
4	123° 59' 42" E	12° 53' 18" N
5	123° 59' 42" E	12° 52' 18" N
6	123° 58' 30" E	12° 53' 30" N
7	123° 58' 30" E	12° 54' 54" N
8	123° 58' 18" E	12° 54' 54" N
9	123° 56' 54" E	12° 56' 18" N
10	123° 57' 00" E	12° 54' 48" N
11	123° 57' 12" E	12° 53' 24" N
12	123° 55' 48" E	12° 53' 18" N
13	123° 55' 42" E	12° 54' 48" N
14	123° 55' 42" E	12° 56' 18" N
15	123° 54' 06" E	12° 56' 18" N
16	123° 54' 06" E	12° 54' 48" N
17	123° 54' 12" E	12° 53' 00" N
18	123° 52' 42" E	12° 53' 54" N
19	123° 52' 18" E	12° 55' 18" N
20	123° 51' 42" E	12° 54' 30" N
21	123° 51' 42" E	12° 53' 06" N
22	123° 50' 42" E	12° 53' 06" N
23	123° 49' 06" E	12° 52' 12" N
24	123° 49' 02" E	12° 50' 42" N

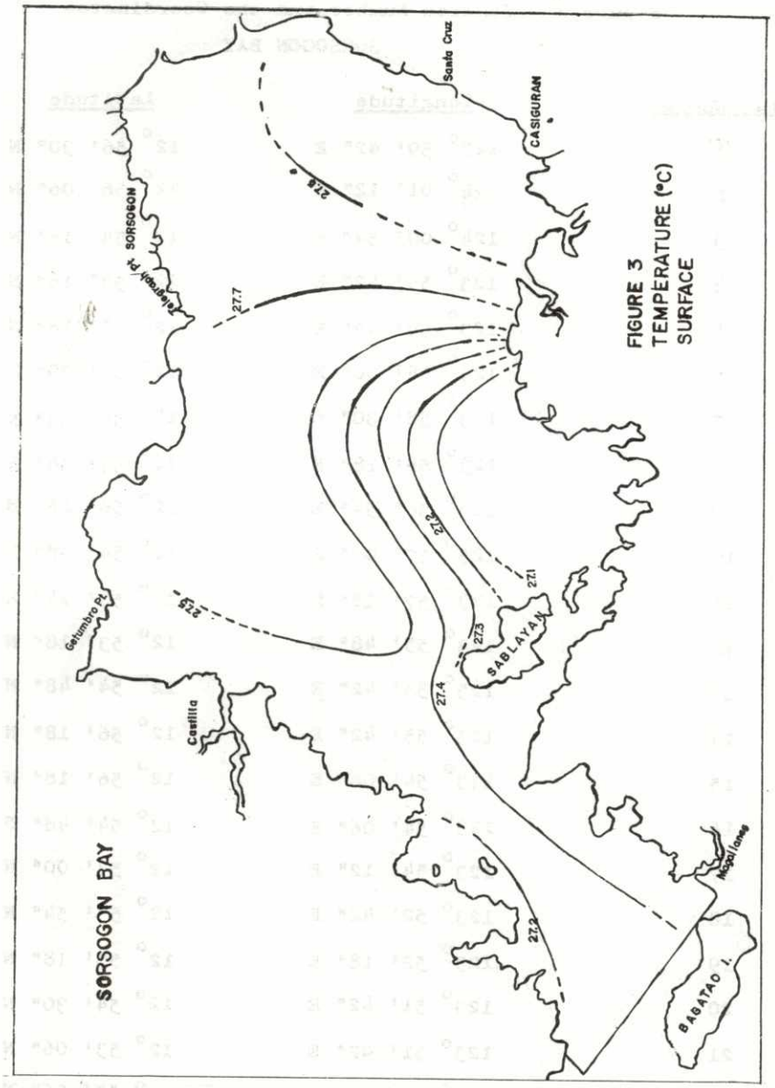


FIGURE 3
TEMPERATURE (°C)
SURFACE

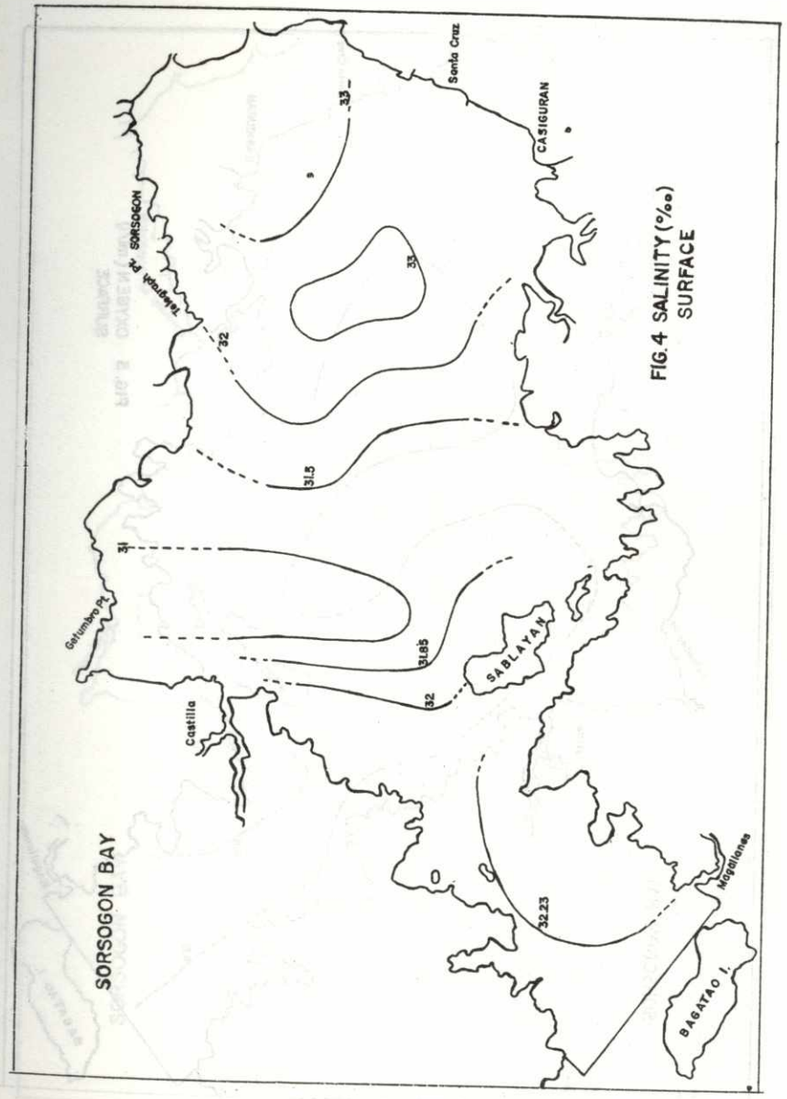


FIG. 4 SALINITY (‰)
SURFACE

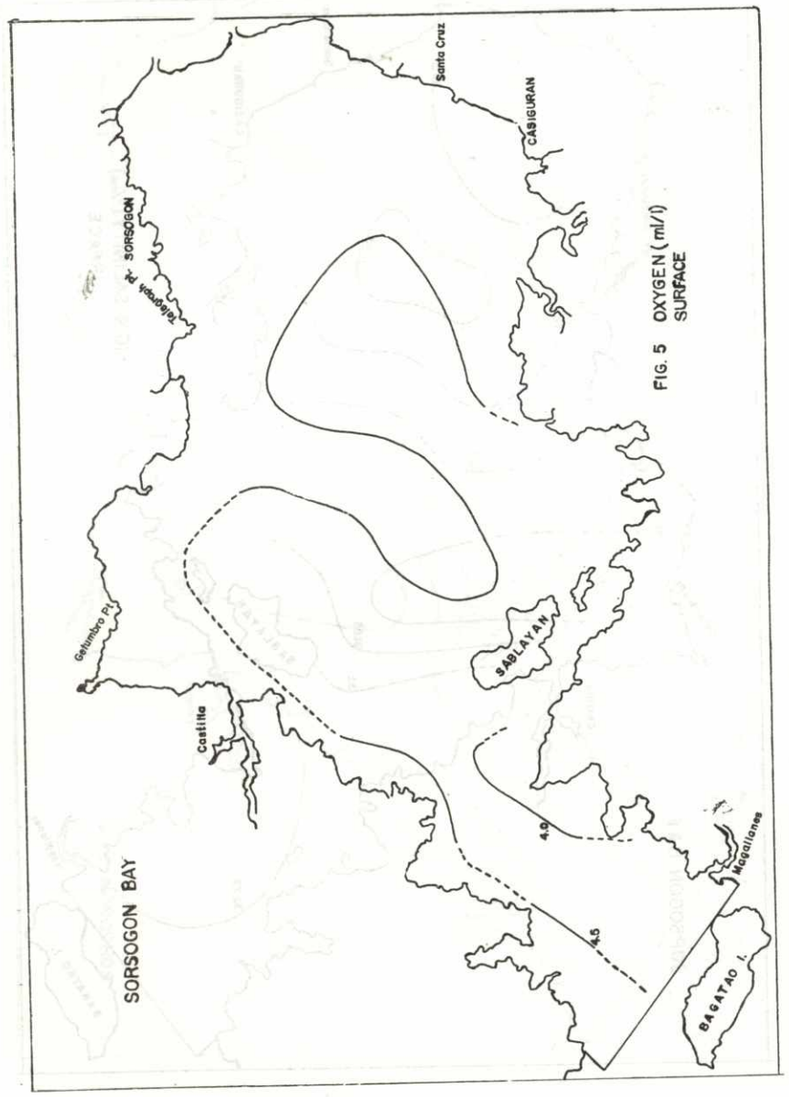


FIG. 5 OXYGEN (ml/l) SURFACE

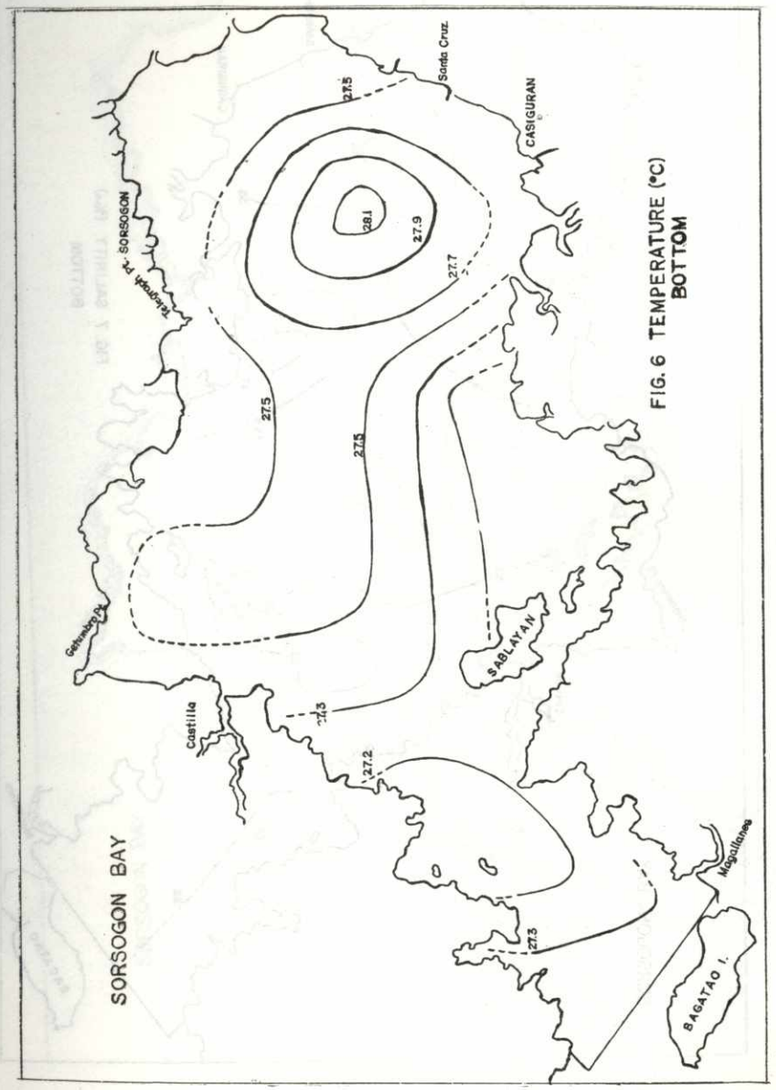


FIG. 6 TEMPERATURE (°C) BOTTOM

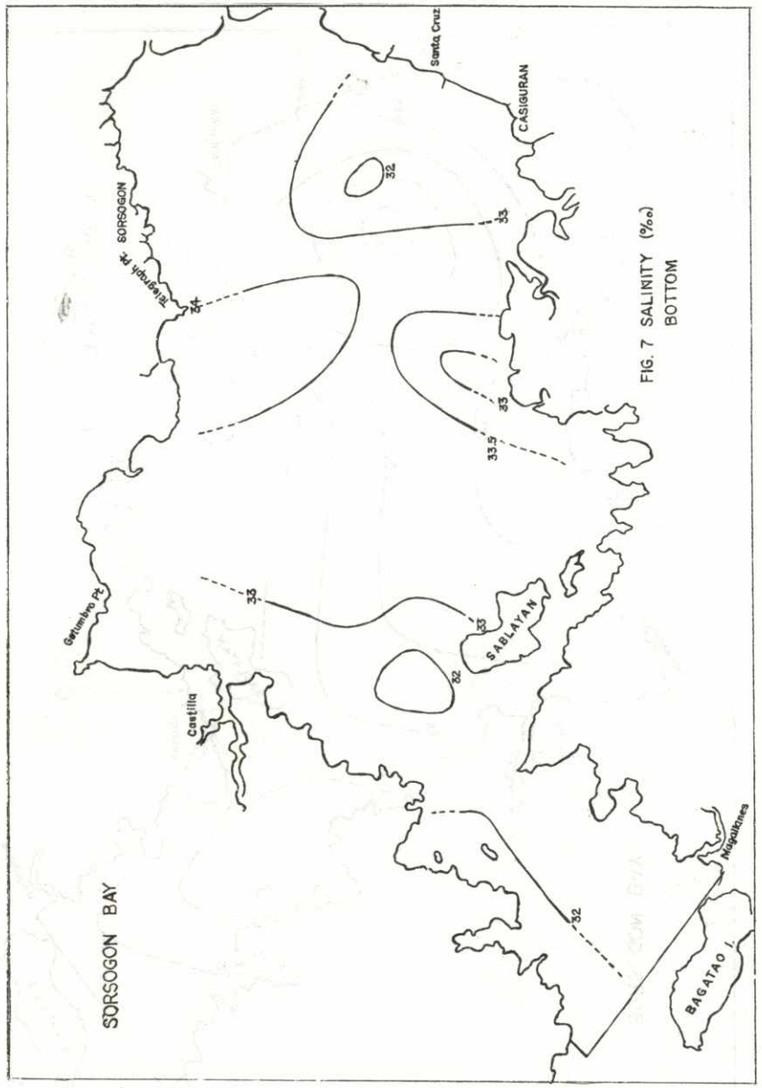


FIG. 7 SALINITY (‰)
BOTTOM

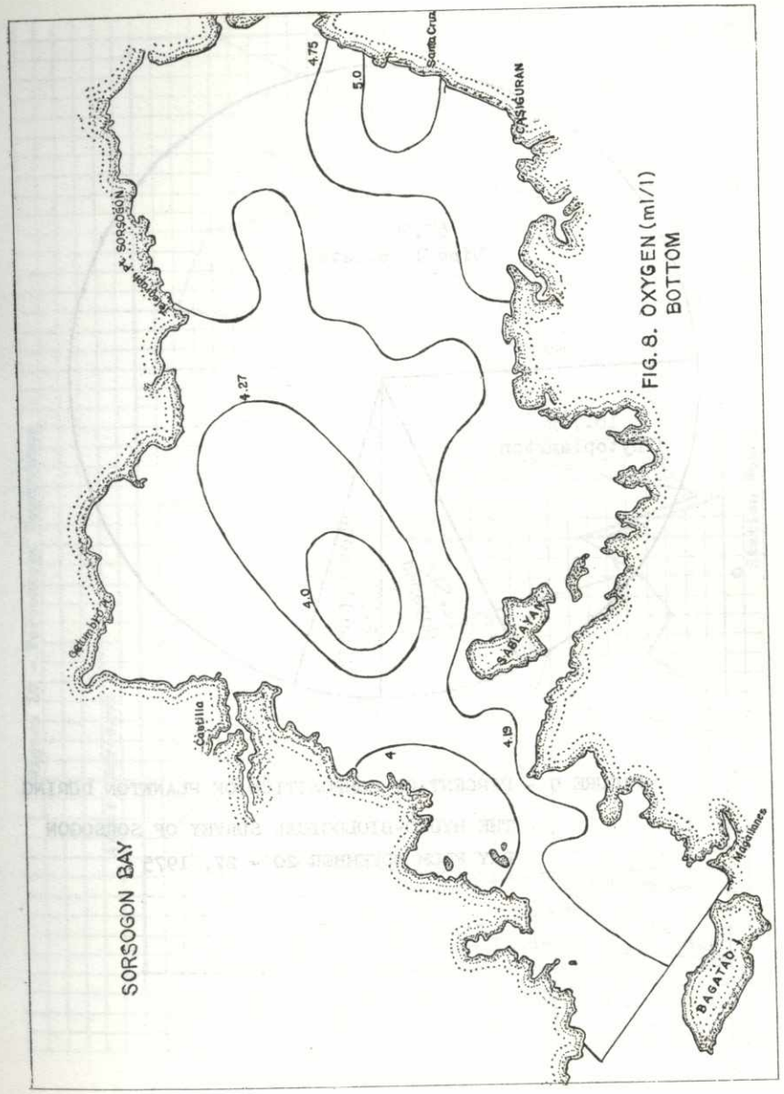


FIG. 8. OXYGEN (ml/l)
BOTTOM

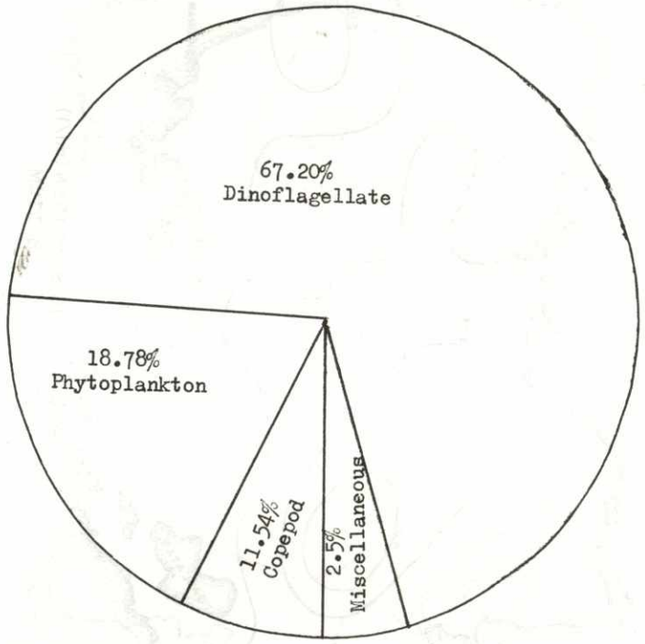
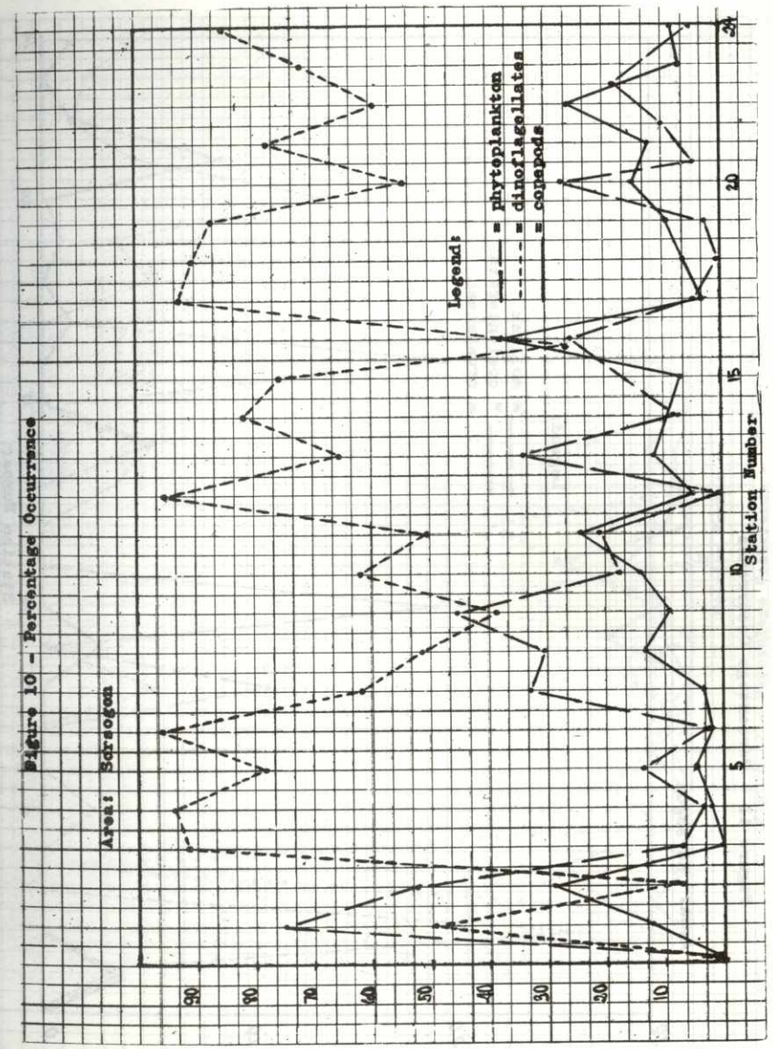
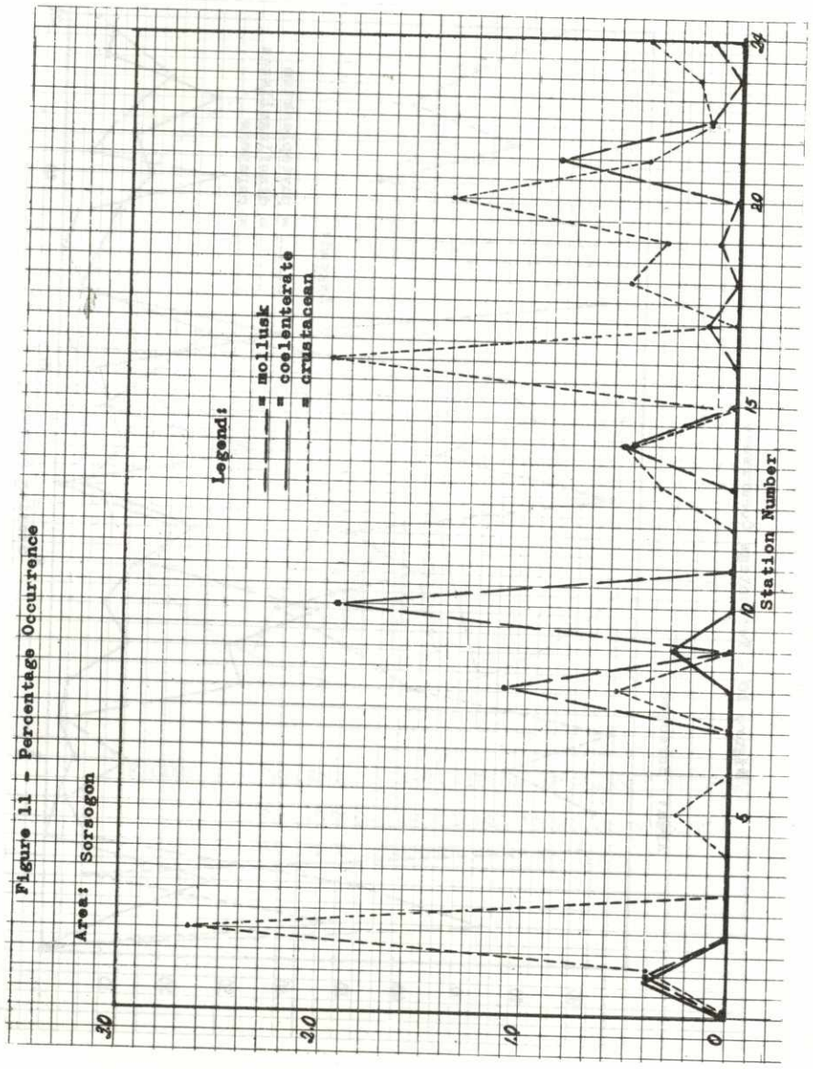


FIGURE 9 - PERCENTAGE COMPOSITION OF PLANKTON DURING THE HYDRO-BIOLOGICAL SURVEY OF SORSOGON BAY FROM NOVEMBER 20 - 27, 1975





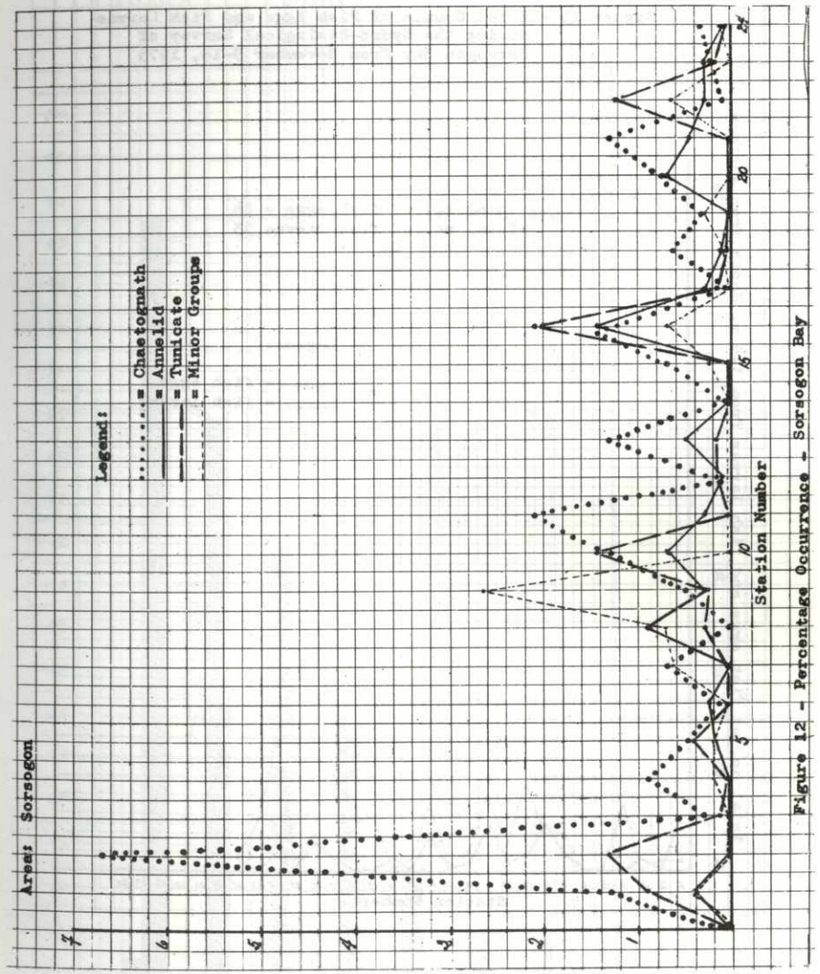


Figure 12 - Percentage Occurrence - Sorsogon Bay

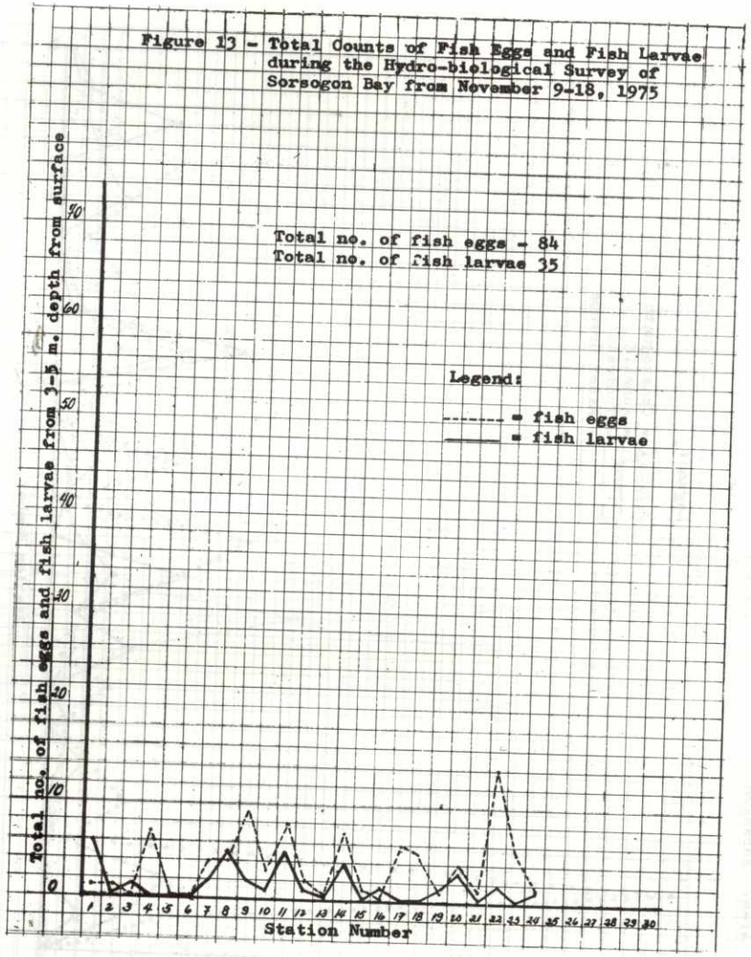


Figure 13 - Total Counts of Fish Eggs and Fish Larvae during the Hydro-biological Survey of Sorsogon Bay from November 9-18, 1975

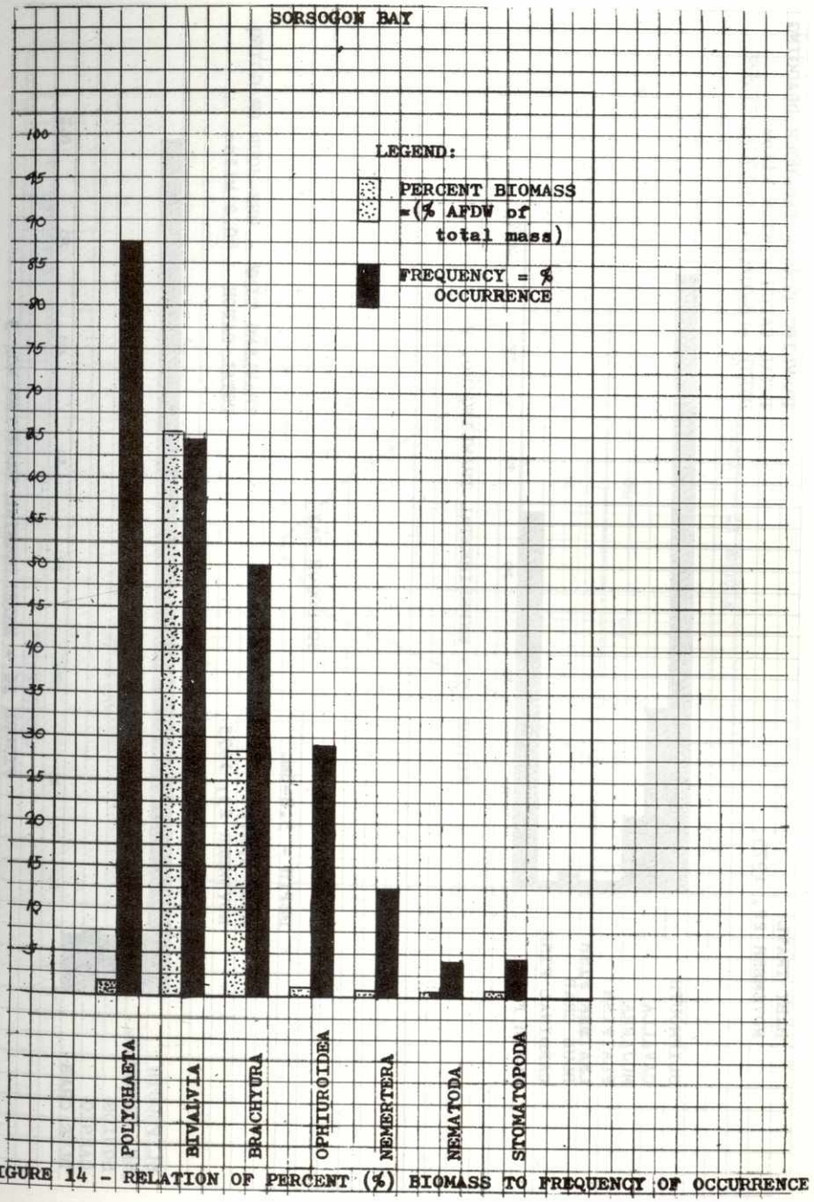


FIGURE 14 - RELATION OF PERCENT (%) BIOMASS TO FREQUENCY OF OCCURRENCE

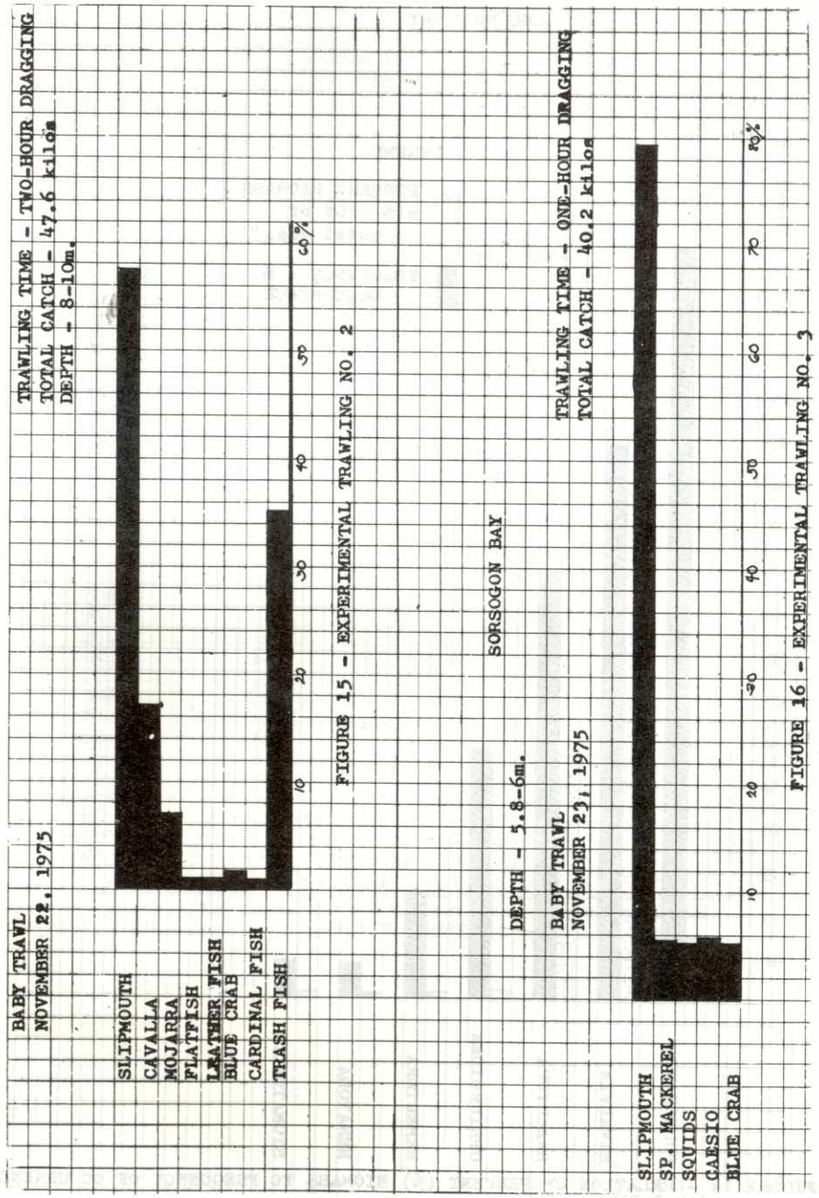


FIGURE 15 - EXPERIMENTAL TRAWLING NO. 2

FIGURE 16 - EXPERIMENTAL TRAWLING NO. 3

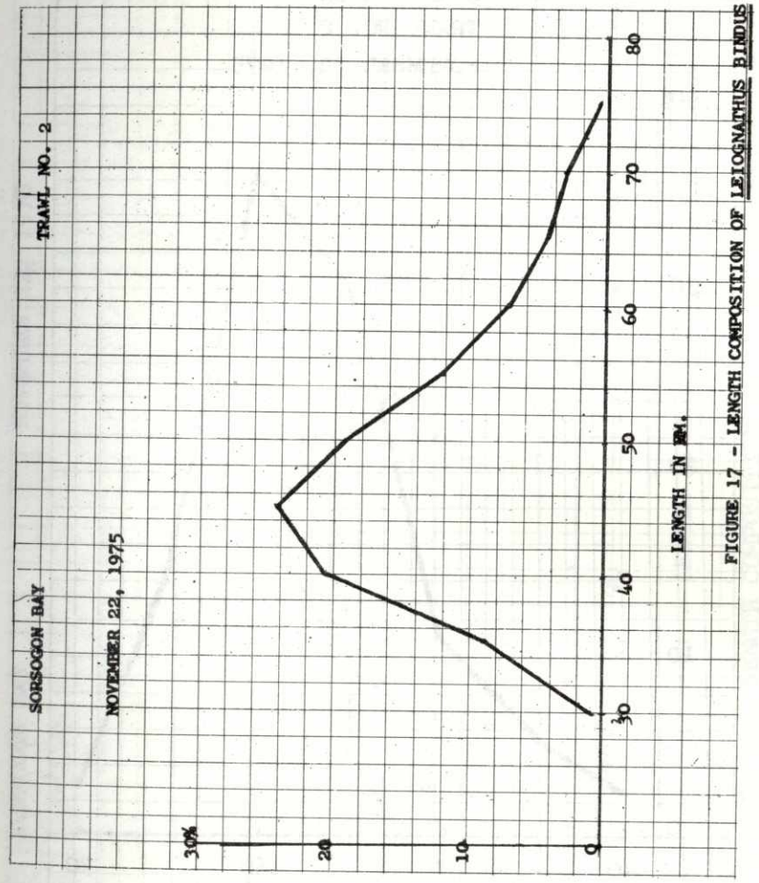


FIGURE 17 - LENGTH COMPOSITION OF LEIOGNATHUS BINDUS

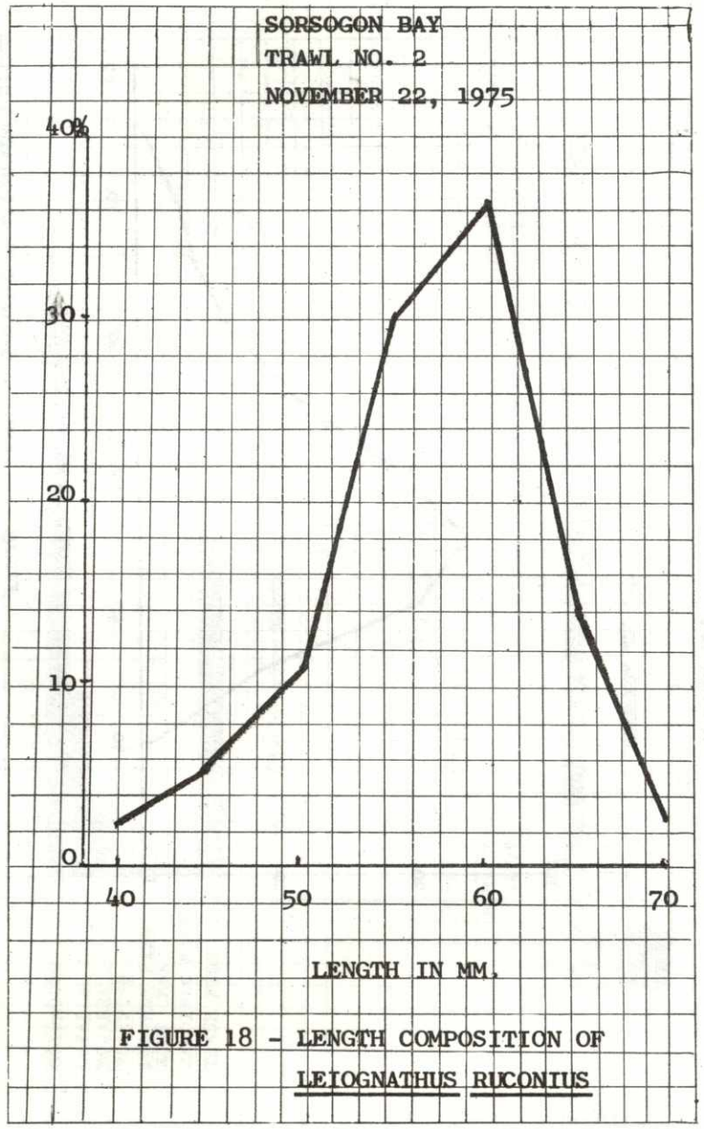


FIGURE 18 - LENGTH COMPOSITION OF LEIOGNATHUS RUCONIUS

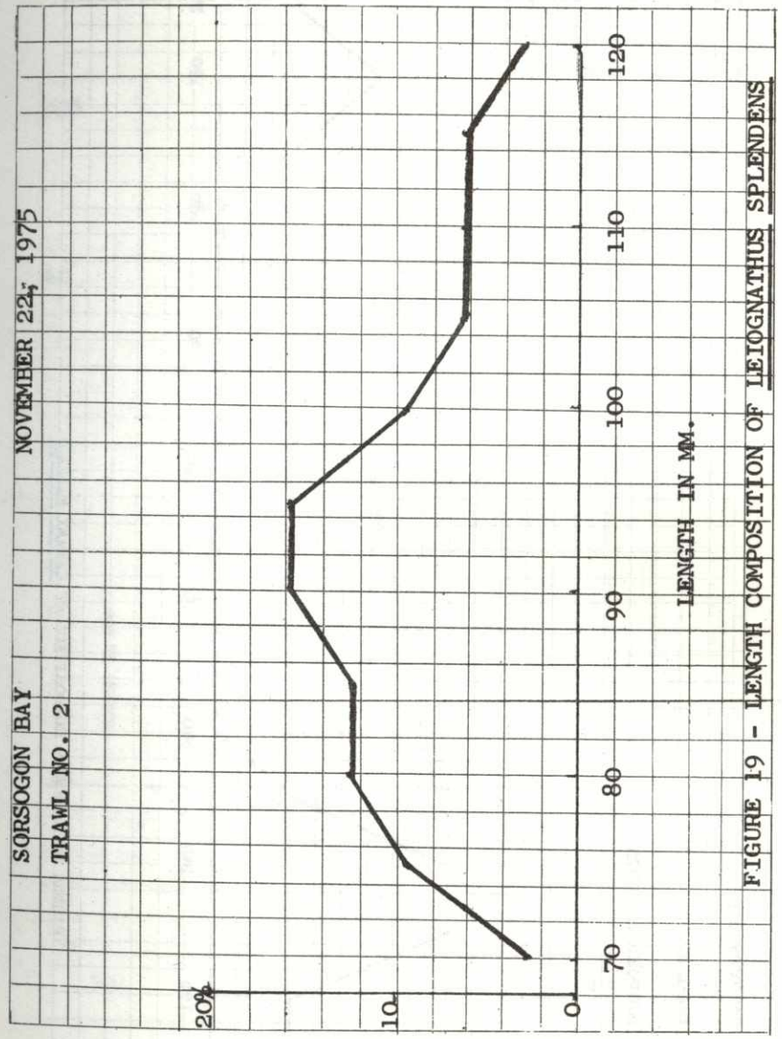


FIGURE 19 - LENGTH COMPOSITION OF LEIOGNATHUS SPLENDENS

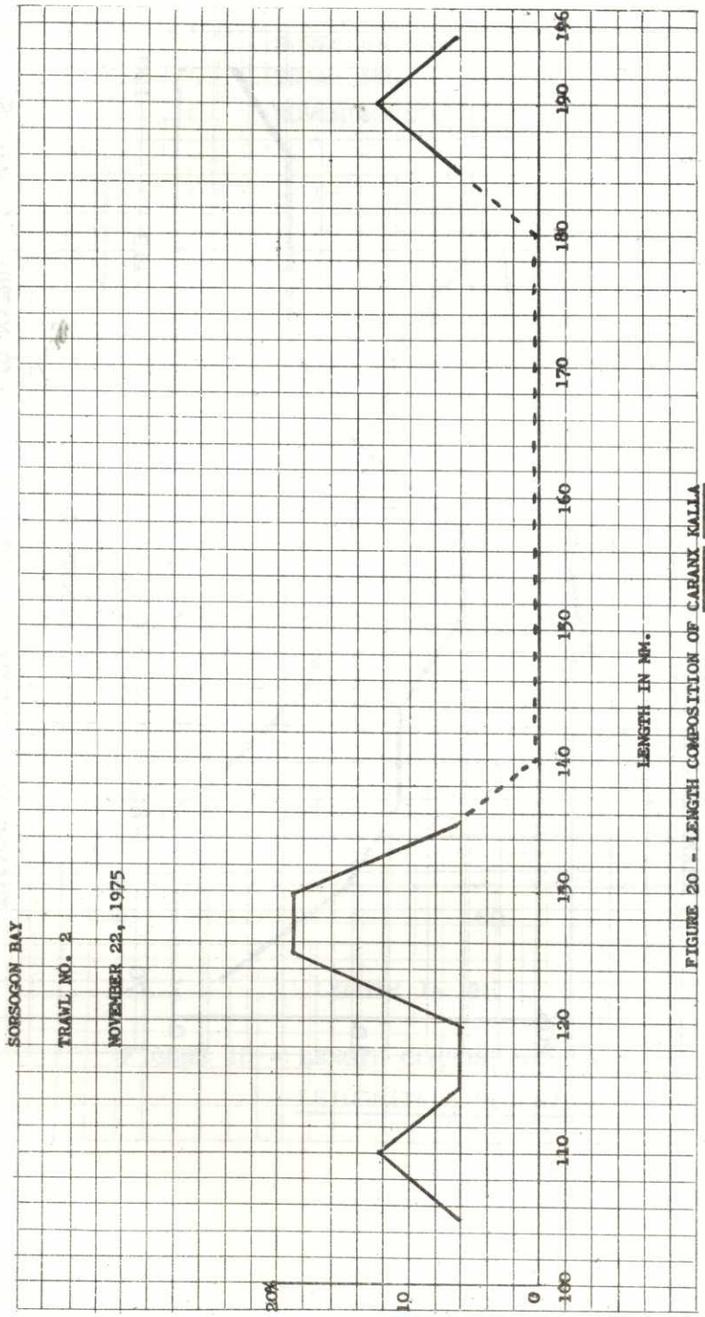


FIGURE 20 - LENGTH COMPOSITION OF CARANX KALLA

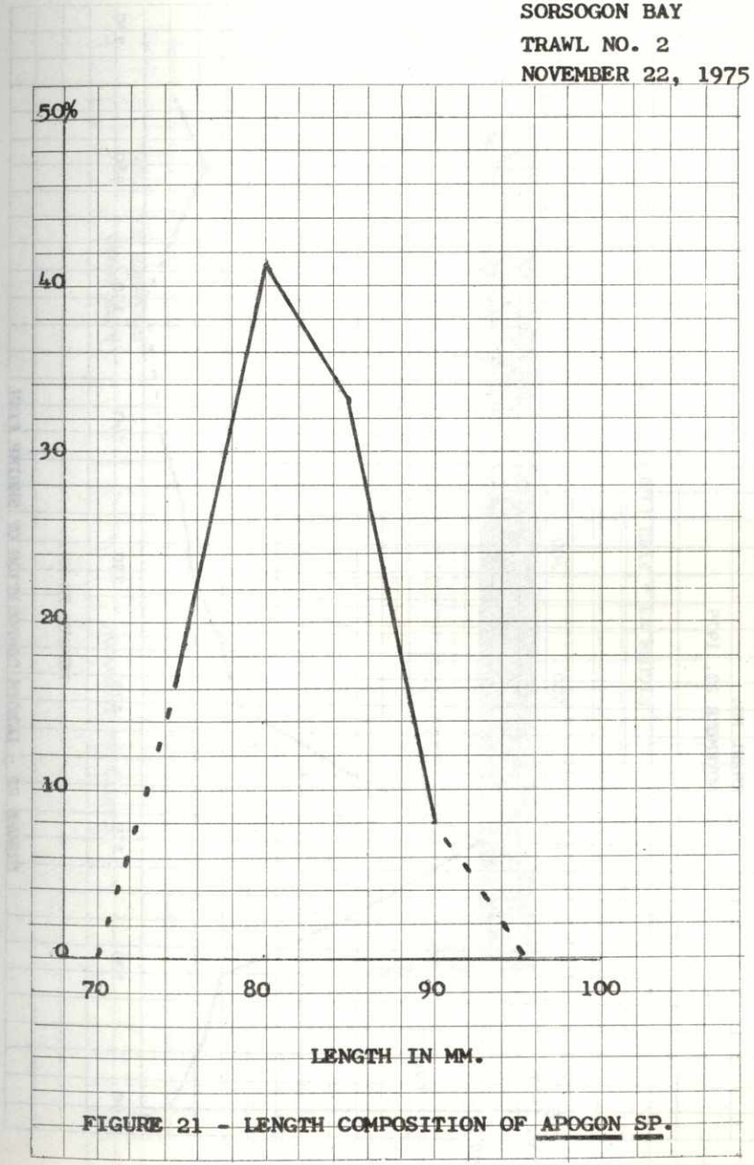


FIGURE 21 - LENGTH COMPOSITION OF APOGON SP.

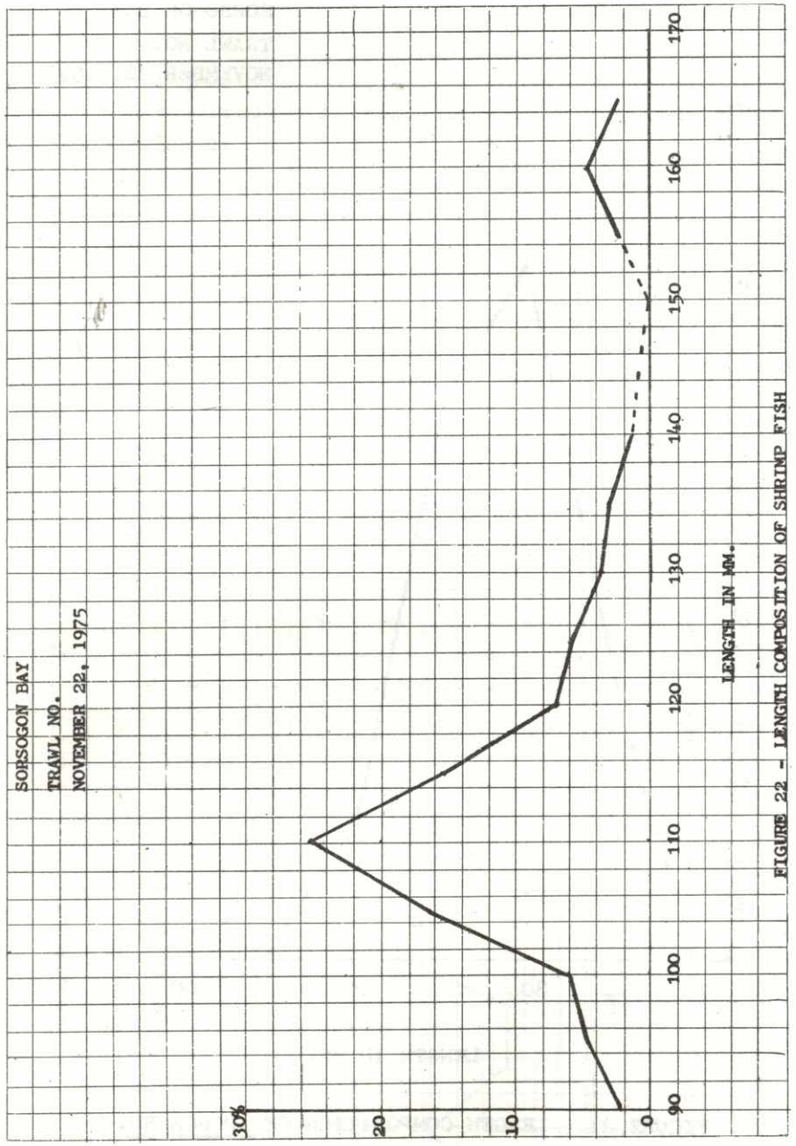


FIGURE 22 - LENGTH COMPOSITION OF SHRIMP FISH

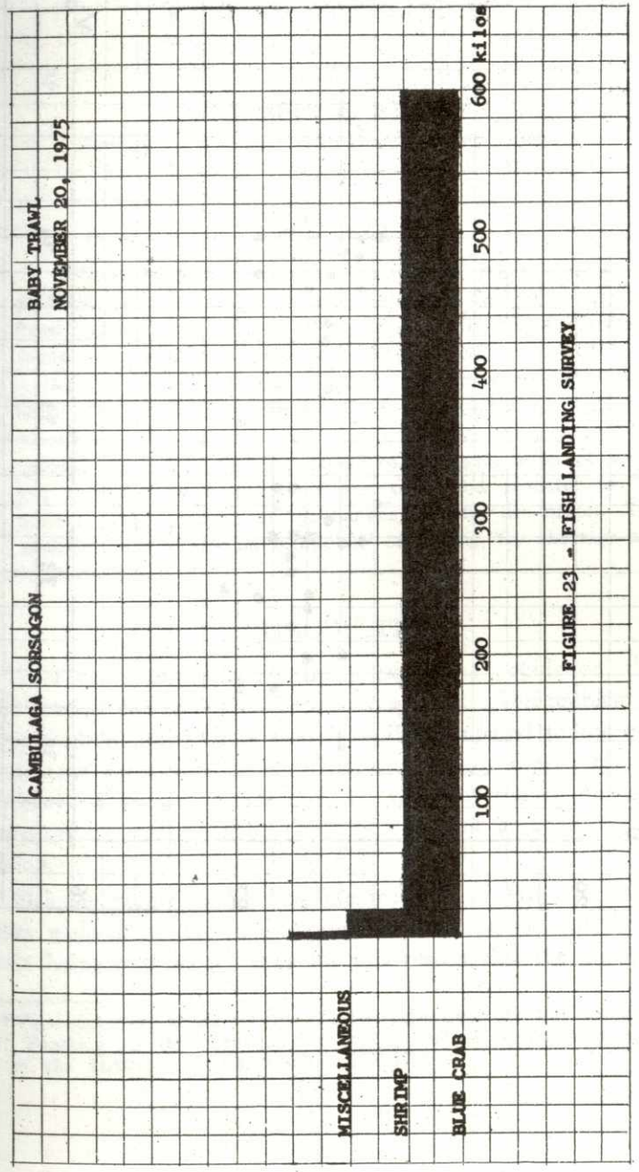


FIGURE 23 - FISH LANDING SURVEY

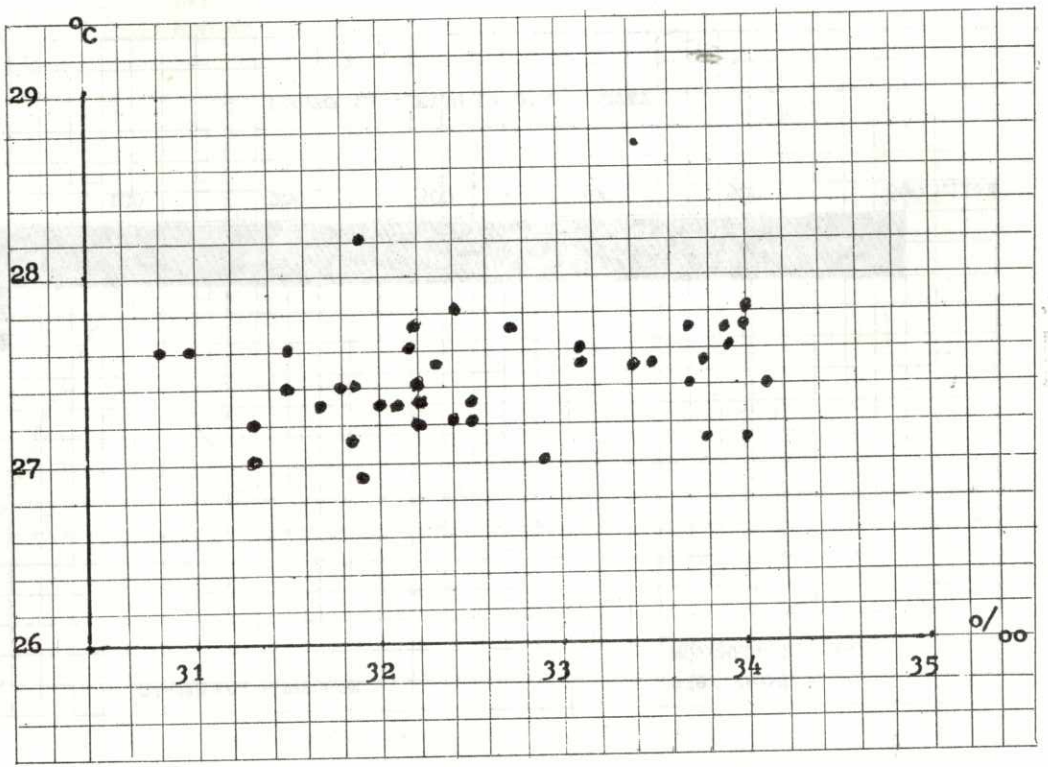


FIGURE 24 - SALINITY-TEMPERATURE DIAGRAM