ON THE HYDRO-BIOLOGICAL AND SOCIO-ECONOMIC SURVEYS OF SAN MIGUEL BAY FOR THE PROPOSED FISH NURSERIES/ RESERVATIONS

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INTRODUCTION

The need for fishery management along San Miguel Bay stemmed from the government and the fishing industry's concern over the economic consequences of overfishing in the area. At present the Bureau of Fisheries and Aquatic Resources is undertaking a hydrobiological survey of 13 areas for the establishment of fish nurseries or fish reservations. One of these areas is San Miguel Bay.

The technical description of the boundaries of San Miguel Bay proposed as fish nursery or reservation are the following:

All waters enclosed by an imaginary line drawn starting from a point at Bito Siruma at Longitude 123°14'30" E, Latitude 13°58'05" N.

thence southward along the coastline of Camarines Sur thru the towns of Tinambac and Calabanga,

thence westward along the coastline to Cabusao,

thence northward to Magsatangi Point at Longitude 123°03' 45" F, Latitude 13°53'30" N,

thence southeast 4.4 nautical miles (approximate) at Longitude 123°10'00" E, Latitude 13°52'30" N,

thence northeast approximately 7.3 nautical miles to the starting point with an area of approximately 160 sq. nautical miles.

METHODS

The socio-economic and hydro-biological surveys which were conducted from April 20 — May 17, 1975 and from November 9-10, 1975, respectively, are the contents of this report.

A. Socio-economic Survey

During this survey, the mayors, councilors and fishermen of the municipalities included in the proposed area for fish nursery or reservation were interviewed. Opinions, suggestions and recommendations regarding the proposal were taken. The importance of the proposal was also cited and explained.

Data on fishing population, fishing ports, number of ice plants in the area, methods of preservation, fishery cooperatives, number of rivers, commercial fishing boats, motorized and non-motorized bancas were gathered.

Data on different fishing gears, fishing season and the common catch were likewise gathered.

B. Hydro-biological Survey

A hydro-biological survey was conducted on board a 3.5-ton baby trawler powered by a 9-hp Hercules engine.

A total of 30 stations were sampled and in each station (see Station Map. Figure 1), actual depth, air and water temperature readings, water sampling for salinity and oxygen determination, water transparency and color determination, plankton and benthos collections were made. Table I shows the stations, number and their coordinates.

a. Water sampling and water temperature readings at certain depths were obtained through the use of the Nansen bottle with reversing thermometer. Oxygen determination was done through the use of 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 was attached to the mouth of the net to register 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

Table 1. San Miguel Bay.

Station Number and the Coordinates

Station	Latitude	Longitude
1	13° 48' 15" N	123° 17' 33" E
2	13° 51' 00" N	123° 16' 43" E
3	13° 53' 30" N	123° 15' 43" E
4	13° 55' 15" N	123° 16' 45" E
5	13° 55' 50" N	123° 14' 25" E
6	13° 54' 50" N	123° 11' 30" E
7	13° 53' 00" N	123° 13' 30" E
8	13° 51' 00" N	123° 14' 35" E
9	13° 49' 00" N	123° 15' 30" E
10	13° 47' 00" N	123° 16' 00" E
11	13° 45' 20" N	123° 13' 20" E
12	13° 49' 30" N	123° 12' 35" E
13	13° 48' 45" N	123° 12' 30" E
14	13° 51' 00" N	123° 11' 50" E
15	13° 52' 55" N	123° 11' 00" E
16	13° 51' 40" N	123° 09' 30" E
17	13° 49' 40" N	123° 10' 20" E
18	13° 48' 10" N	123° 10' 50" E
19	13° 45' 25" N	123° 11' 00" E
20	13° 45' 55" N	123° 09' 15" E
21	13° 48' 15" N	123° 08' 25" E
22	13° 50' 25" N	123° 08' 00" E
23	13° 52' 05" N	123° 07' 00" E
24	13° 51' 20" N	123° 04' 40" E
25	13° 49' 00" N	123° 06' 15" E
26	13° 47' 40" N	123° 06' 50" E
27	13° 45' 30" N	123° 06' 50" E
28	13° 46' 55" N	123° 04' 30" E
29	13° 48' 20" N	123° 05' 00" E
30	13° 49' 28" N	123° 04' 05" E

were preserved in 4% formalin solution. Plankton volume was determined by the volume displacement method. Total plankton counts from each station were taken by the aliquot portion method. Then fish eggs and fish larvae were sorted from each station and preserved in small vials for identification. The ml/m^3 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 m^2 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, sorted and preserved in 5-10%-formalin. Organisms were sorted according to major taxonomic groups, blotted-dry and weighed to 0.1 mg accuracy. Wet 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 for echinoderms 0.03 to 0.12.

d. On the biological aspect, two experimental trawlings inside the proposed area for fish nursery and reservation were conducted. Catch composition, length and weight measurements, sex and maturity determination were the basic biological analyses made.

The 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 were determined.

RESULTS AND DISCUSSIONS

A. Socio-Economic Survey

During the socio-economic survey of San Miguel Bay, (April 20 — May 17, 1974) the following information were gathered:

Cabusao, Tinambac, Calabanga, Mercedes and Vinzons were the five towns surveyed. Seven fishing barrios from

the five towns were represented. In these barrios 50-100% of the population are fishermen. In other barrios like Manguisoc and Sabang, the fishing population is about 20-45%.

The fishing ports along the San Miguel Bay area are Mercedes, Sabang, Castillo and Barceloneta.

There are three ice plants along the area and they are located in Mercedes and Sabang. The most common methods of fish processing are drying, salting and smoking. There are two fishery cooperatives, one in Calabanga and the other in Mercedes.

There are 10 rivers connecting the sea within the surveyed areas. Along the mouth of the river were approximately 48 fish corrals.

There were 13 commercial fishing boats in San Miguel Bay, six of which were in Barrio Bagacay, Tinambac. There were 277 motor boats and 1,007 non-motorized bancas. Sabang, Calabanga, with 500 non-motorized bancas, seemed to be the center of the fishing business near Naga City. (See Table 2). There is a fish landing along the shore where the small fishermen sell their catch.

One of the most common methods of fishing is the hook and line. In some places like Sabang, Vinzons, the hook and line method was used from 5-6 hours daily from February to June while in some areas like Castillo, Calabanga, they were utilizing this fishing gear for 12 hours daily throughout the year. In most of the surveyed areas, the total catch per day from the hook and line ranged from 50-150 kilos. The most common catch were croakers, four-lined grunt, whiskered croakers, pomadasids, sea catfish and sharks.

Gill net (pante) are in operation throughout the year in most places, except in two barrios (Sabang, Vinzons and Sibobo, Calabanga) which used this fishing gear from November to June. The duration of operation varies from 4-12 hours daily. The average daily catch ranges from 5-50 kilos the most common species of which were croakers, cutlass fish, shrimps, pomadasids, sea catfish and mullets.

Table No. 2

Table 2. Fisheries Information Data — San Miguel Bay in the coastal towns of Camarines Sur and Camarines Norte.

Town	Barrio	No. of comm. fish boat	No. of motor banca	No. of non-motor banca	No. of fish corral	No. of river connecting the sea	No. of fish-pond	Area Ha.	Production kilo/year
Cabusao	Castillo	4	40	70	14	1	0	0	0
	Sta. Cruz	0	6	60	4	1	0	0	0
Tinambac	Bagacay	6	10	110	0	1	0	0	0
Calabanga	Babang	2	60	500	0	3	1	1	40
	Sibobo	0	25	75	18	1	0	0	0
Mercedes	Manguisoc	1	10	50	9	2	1	10	-
Vinzons	Sabang	0	126	142	3	2	0	0	0
Total -5	7	13	277	1,007	48	11	2	11	40

Table 3. Fish landing survey — San Miguel Bay Sabang, Calabanga November 18, 1975.

Baby trawl catch composition

kind	1		2		3		4		5	
	kg.	%	kg.	%	kg.	%	kg.	%	kg.	%
Anchovy	15	14.28	10	4.17						
Croaker	15	14.28	2	8.33	10	9.09	3	5.45		
Hairtail	7	6.67	20	8.33						
Caranx	8	7.62	10	4.17						
Trash fish	60	57.14	180	74.99						
Sardines					20	18.18				
Slipmouth					30	27.27				
Flatfish					10	9.09	2	3.64		
Sp. Mackerel - (Juvenile)					10	9.09				
Squids							30	54.54	15	55.55
Shrimp							2	3.64	7	25.92
Miscellaneous					30	27.27	15	27.27		
Eel							3	5.45		
Blue Crab									5	18.52
Clam										
Small Barracuda										
"Riring"										
Ray										
Pampano										
TOTAL	105	99.99	240	99.99	110	99.99	55	99.99	27	99.99

Table 3. Continued . . .

Kind	6 kg	6 %	7 kg	7 %	8 kg	8 %	9 kg	9 %	Total kg	Total %
Anchovy			10	3.85	6	2.90	15	8.01	56	4.60
Croaker	5	19.60	22	8.49	30	14.49	20	10.68	125	10.28
Hairtail			10	3.86	5	2.42	6	3.20	48	3.95
Caranx			2	0.77	6	2.90			26	2.14
Trash fish			60	23.16	90	43.47	90	48.06	480	39.50
Sardines			10	3.86	5	2.42	10	5.34	45	3.70
Slipmouth			30	11.58			5	2.67	65	5.35
Flatfish					5	2.42	3	1.60	20	1.65
Sp. Hackerel - (Juvenile)	1.5	5.88							11.5	0.95
Squias					15	7.25	5	2.67	65	5.35
Shrimp					5	2.42	10	5.34	24	1.98
Miscellaneous									45	3.70
Eel									3	0.24
Blue Crab	10	39.20	20	7.72	10	4.83	15	8.01	60	4.94
Clam	5	19.60			30	14.49	5	2.67	40	3.29
Small Barracuda	2	7.84							2	0.15
"Riring"	6.	2.84	5	1.93					7	0.58
Ray			90	34.74			2.5	1.34	92.5	7.60
Pampano							0.8	0.43	0.8	0.06
TOTAL	25.5	99.96	259	99.97	207	100.01	187.3	100.02	1,215.8	100.01

Fish corrals are set at several places along San Miguel Bay at different seasons. In barrio Castillo, the fish corrals are being established from March to August, while in Sibobo they are in operation from November to June. The common catch are sardines, anchovies, cutlass fish, shrimps and croakers.

In some places, several baby trawlers operate from September to December but in barrio Castillo, they are in operation throughout the year. The average daily catch is from 5-50 kilos in most areas and from 500 to 1,000 kilos in some places.

Another important fishing gear is the push net. They are in operation from November to April in some places, but in Bagacay they use them whole year. These are used for catching shrimps only. In Manguisoc they catch shrimps from 115 to 230 kilos daily for 12 hours of operation. Other fishing gears are also being employed, but they do not catch much.

B. Hydro-biological Survey

a. Hydrography

Surface

The southeastern part of the bay registered a warmer temperature of 31°C and going outward it decreased to 29°C. From the eastern part, the temperature was lower, 27.7°C and going to the inner portion it increased by 0.3°C. The temperature at the lower eastern part of the water going west was 28.4°C and going to the inner portion it decreased. A much lower temperature was observed in the water mass going inside the bay, 27.5°C, and in the inner most section it slightly increased by 0.5°C. The three masses of water met at the center of the bay so the colder water from outside became warmer as it approached the shore (See Figure 2).

The low salinity, 12°/oo, of the southeastern part of the bay was due to the river discharge coming from the Bicol River. Going out from the western part of the bay, the salinity increased to 26°/oo. A high salinity, 28°/oo was observed at the upper eastern side and this was due to the presence of a lagoon, causing the water of the area to be stagnant. Going out of the bay, a much higher salinity was observed, 29°/oo (Figure 3).

Dissolved oxygen concentration of 5 ml/1 was observed near Bicol River and on the western part of the bay, the concentration was 4.6 to 4.7 ml/1. At the mouth of the lagoon, the value was 5 ml/1 and going up to San Miguel Is., and upward to Kagliliog Pt., it increased by 0.2 ml/1 (Figure 4).

Bottom

The temperature at the bottom has a very slight variation. The middle and the western part of the bay registered a temperature of 28.4°C while in the lower eastern part, it was observed to be 28.3°C which decreased to 28°C as it went deeper. The same is true at the upper eastern part of the bay (Figure 5).

A rather low salinity, 27°/oo, was observed at the western and southwestern part of the bay and this is attributed to the presence of the Bicol River. Going to the east, it increased to 30°/oo. Water going inside the bay registered a higher salinity of 31°/oo and in the inner portion it decreased to 28°/oo. The water from the lagoon registered a salinity of 30°/oo which extended to the middle of the bay to the western part going outward. At the mouth of the bay near San Miguel Is., a higher salinity value, 32°/oo, was observed (Figure 6).

A dissolved oxygen value of 4.5 ml/1 was observed at the southern part from the eastern part extending to the western part, the value was 5.0 ml/1. Water coming from outside the bay had a lower dissolved oxygen value of 4.0 ml/1, and it increased to 4.5 ml/1 towards the middle. At the mouth of the lagoon, the value was a little higher, 4.7 ml/1 (Figure 7).

b. Plankton

A total of 30 plankton sampling stations were observed. The maximum plankton volume 4.9 ml/m^3, was observed in Station 12 which is located at the southeastern part of the bay, (13°49'30" N; 123°12'35" E). Minimum volume was registered at .48 ml/m^3 in Station 20 located at 13°45'55" N; 123°09'15" E in the southern part of the bay near the mouth of the Bicol River.

It is very interesting to find that only two fish eggs were counted from all the 30 stations. They were found in stations 8 & 15. Station 8 is located in the eastern part of the bay near Tinambac while Station 15 is located at the middle of the bay (Figure 8).

Each organism was identified and analyzed quantitatively. It was observed that the most dominant plankton group was the phytoplankton. The highest percentage of occurrence of phytoplankton was 98.11 which was noted in Station 8. The minimal phytoplankton count was observed in Station 28 which is located at the western part of the bay (Figure 9).

In Station 6 which is on the eastern part of the bay near the mouth, a total count of the phytoplankton reached up to 118,944 cells, this being the highest in all the total cell counts from the 30 stations. These phytoplankton are the *Noctiluca, Thallasiothrix, Rhizosolenia, Skeletonema, Coscinodiscus,* and *Ceratium* (Figure 10).

The second dominant plankton group was the copepods, which was 88.17%. This was noted in Station 28. The minimal percentage of copepod occurrence was observed in Station 27 which was located in front of Bicol River (Figure 9).

The third dominant plankton group was the dinoflagellates. The highest percentage of occurrence was observed in Station 15 at 13.44%. Station 15 is located at the middle of the mouth of the bay (Figure 9).

Other plankton groups that were observed in some stations were the mollusks, chaetognaths, tunicates, crustaceans, and other plankton organisms with very minimal occurrences. (Figures 11 & 12).

The percentage composition of the major groups of zooplankton for the whole area was computed & shown in Figure 13.

c. Benthos

Sediment characteristics were not easily separable according to subjective observations with the exception of one shallow sand station at the mouth of the Bicol River. The remaining stations exhibited a mud bottom type with grey to grayish green color. The composition of organisms at the sand bottom type was distinctly different from the mud sediment type and was thus separated in analysis of biomass and diversity.

Biomass, frequency, diversity and important figures are shown in Table 4. The total ash free dry weight per 10 meter square estimates a sizeable standing crop for the mud type community. Major contributors to the standing crop of the mud bottom type were the gastropod *Turitella terebra* (41.18% of the standing crop), the bivalve *Chione* sp. (32.09% of the standing crop), and the brachyuran *Xenopthalmus pinnotheroids* (14.59% of the standing crop). In terms of frequency of occurrence per station, the polychaetes *Aglaophamus* sp. and *Lumbriconereis heteropoda* (34.48% and 27.59% respectively), the gastropod *Turritella terebra* (27.59%) the bivalves *Chione* sp. and *Silegua* sp. (24.14% and 20.64% respectively) were most important. The synoptic nature of this survey and tropical diversity made it difficult to delineate a community type based on conventional methods. Based on standing crop and frequency of occurrence, the community type can tentatively be named according to the above named species. Normal medium and high latitude benthic communities can usually be named according to two or four important species. The common occurrence and high biomass of six species found in San Miguel Bay made it difficult to exclude any of these species in the total community type description (benthos Figures 14 and 15). Further analysis based on replicate sampling procedures and sediment size analysis will allow a more complete structural analysis of the community.

Table 4. Benthos — San Miguel Bay

Infaunal Mud Sediments Taxonomic Group	Total Wet Wt. (gr)	Total AFDW (gr)	Average AFDW (gr/.1m²)	Percent Biomass AFDW(gr)%	Percent Occurrence %	Number of Individuals N	Number of species S	Diversity S-1/lnN	Importance % Species of Majortaxa
POLYCHAETA	0.5247	0.0640	0.0021	0.28	51.72	39	8	.1512	–
Lumbriconereis heteropoda	0.0652	0.0080	0.0003	0.0004	27.59	13	–	–	33.33
Aglaophamus sp.	0.1382	0.0169	0.0006	0.0007	34.48	16	–	–	41.03
BIVALVIA	144.8183	7.9650	0.332	34.86	37.93	693	5	.0024	–
Chione sp.	133.2992	7.3315	0.2528	32.09	24.167	672	–	–	96.97
Siliqua sp.	3.3205	0.1826	0.0063	0.8	20.64	18	–	–	2.60
Macoma incongrua	0.8794	0.0484	0.0017	0.21	6.90	2	–	–	.29
GASTROPODA	194.2625	10.6844	0.3684	46.76	37.93	28	6	.1696	–
Turritella terebra	171.0559	9.4081	0.3244	41.18	27.59	23	–	–	82.14
BRACHYURA	22.2247	3.3337	0.1149	14.59	10.34	16	–	0	–
Xenothalmus pinnetheroides	22.2247	3.3337	0.1149	14.59	10.34	16	–	–	100
STOMATOPODA	4.2258	0.6335	0.0218	2.77	6.90	2	2	3.3222	–
NEMATODA	0.0489	0.0059	0.0001	0.02	10.34	7	1	0	–
NEMERTEA	0.2217	0.0270	0.0009	0.11	10.34	3	3	2.3700	–
OPHIUROIDEA	3.2051	0.0961	0.0033	0.42	6.90	2	2	3.3222	–
HOLOTHUROIDEA	0.6386	0.0779	0.0027	0.34	13.45	1	1	0	
		22.8484	0.7079						

Infaunal Sand Sediments	Total Wet Wt. (gr)	Total AFDW (gr)	Average AFDW (gr/.1m²)	Percent Biomass AFDW(gr)%	Percent Occurrence %	Number of Individuals N	Number of species S	Diversity S-1/lnN	Importance % Species of Majortaxa
POLYCHAETA	0.9340	0.1164	0.1164		100.00	80	5	0.0337	
Errantia	0.1682	0.0205	0.0205	14.60	100.00	7	4	0.8103	
Sedentaria	0.7858	0.0959	0.0959	68.30	100.00	73	1	0	
OPHIUROIDEA									
Amphioplus micera	0.7955	0.0239	0.0239	17.62	100.00	13	1	0	
NEMERTEA	0.0032	0.0003	0.0003	0.01	100.00	1	1	0	
		0.1407	0.1407						

The numerically important species of the sandy bottom type were on sedentarian (as yet unidentified), the ophiuroid *Amphiopholis misera*, and one unidentified errantian. The extent of this community type can not be determined as only one station was occupied in waters as shallow as Station 27 (Figure 1).

Stations were divided into three groups according to arbitrary depth limits, and plotted against occurrence of taxa to estimate taxonomic affinities for specific depths (Table 5). The 3.0 to 6.9-meter-depth-group appeared to have the least occurrence of different taxonomic groups. Bivalves did not occur at all in these depth ranges and they seemed to have the highest affinity for the 7.0 to 8.9-meter-depth range. Effects due to run off could possibly contribute to the low diversity of the lower depth ranges.

d. Experimental Trawling

Two experimental trawlings were conducted in San Miguel Bay.

In the first trawling, the total catch for the two-hour dragging was 62.5 kilos of predominantly trash fishes. These are mostly slipmouth, croakers, shrimps and hairtails (Figure 16).

In the second trawling, the total catch was 15 kilos. Slipmouths predominated the catch together with anchovy, flatfishes, bisugo and goby (Figure 17).

Both the first and second trawls showed slipmouths as the common catch. Aside from the different fishes, starfishes, jellyfishes, holuthurians, mollusks and the seaweed *Sargassum* were also in the catch.

e. Fish Biology

Fishes caught during the experimental trawling were analyzed. Length measurements were recorded and sex and maturity were determined.

Table 5. Benthos — San Miguel Bay

	3.0 – 6.9 m depth Station #									7.0 – 8.9 m depth Station #													9.0 – 12 m depth Station #						
	1	10	11	12	20	24	26	28	29	2	3	4	7	8	9	13	17	18	19	21	25	30	5	6	14	15	16	22	23
Polychaeta		x			x			x	x		x				x	x	x		x		x		x	x	x		x		
Lumbriconereis heteropoda								x	x		x					x	x				x		x	x	x				
Aglaophamus sp.					x			x							x		x		x		x			x			x		
Bivalvia										x	x	x		x		x		x					x	x		x	x	x	x
Chione sp.										x	x	x		x		x							x	x			x		
Siliqua sp.										x				x		x											x	x	
Macoma incongrua																												x	x
Gastropoda	x				x		x			x	x			x	x						x		x	x	x				
Turritella terebra	x				x		x			x	x										x			x	x				
Brachyura								x							x				x										
Xenothalmus pinnetheroides								x							x				x										
Stomatopoda																						x					x		
Nematoda											x																x		
Nemertea												x		x					x										
Ophiuroidea																													
Holothuroidea		x																											
Gobioidea		x						x						x		x	x								x	x			
Natantia		x															x											x	

Leiognathus ruconius (Slipmouth) — sizes ranged from 20 mm to 57 mm. Examination of the gonads showed that they were all immature (Stages I to III) (Figure 18).

Leiognathus splendens (Slipmouth) — the length ranged from 30 mm to 82 mm. All were also in immature stages (Figure 19).

Leiognathus blochii (Slipmouth) — sizes ranged from 61 mm to 102 mm. All were in immature stages (Figure 20).

Nemipterus japonicus (Bisugo) — length ranged from 76 mm to 108 mm. All the gonads showed that they were all immature (Figure 21).

Thrissocles hamiltoni (Anchovy) — length ranged from 78 mm to 89. All were in their mature stages (Figure 22).

Apogon sp. (Cardinal fish) — sizes ranged from 35 mm to 87 mm and all fishes examined were immature (Figure 23).

Upenoides (Goatfish) — sizes ranged from 59 mm to 75 mm. Gonads showed that they were immature (Figure 24).

Herklotsichthys dispilonatus (Sardines) — sizes ranged from 75 mm to 95 mm. Seventy-five (75) percent were in their immature stages (Figure 25).

Shrimps and blue crabs were all gravid, while sea mantis were immature.

f. Fish Landing

Fish landing survey showed that trash fishes dominated and was about 40% of the catch composed mainly of small slipmouths, croakers, crabs and sea mantis. It was followed by croakers, slipmouths, squids, blue crabs, and anchovies. Shrimps constituted only 1.98% of the total catch in one day (Table 3).

REMARKS AND RECOMMENDATIONS

— Boundaries covered for the proposed fish nursery and fish reservation in San Miguel are shallow areas with depth ranging from 2-11.5 m.

— Phytoplankton, dominated the plankton samples.

— Results of the trawling experiments conducted showed that the catch was composed mostly of immature fishes.

— Fish landing samples showed that trash fish dominated the almost 40% of the total catch composed mainly of immature slipmouths, crabs, sea mantis, croakers and flatfishes.

— The most dominant species in the experimental trawling and fish landing survey were the slipmouths which were mostly immature.

— Succeeding surveys will determine the amount of the total benthos biomass actually available to the fish as a food source.

— Complete benthic community structure analysis by replicate sampling and sediment size analysis will help delineate the specific contributions of taxa in the community structure and a more accurate standing crop measurement.

— This survey serves to lay the groundwork for more extensive benthic community analysis while organisms collected will serve as a reference collection for stomach contents analysis of fish caught at the time of succeeding surveys.

— There is a need for a biologist to identify the fish eggs and fish larvae of the plankton samples.

— It is suggested that the closing of the area be done during the months of May up to September. During this season, very few fishing activities are being undertaken in the bay because of the southwest monsoon. However, boundaries of the area will not be changed.

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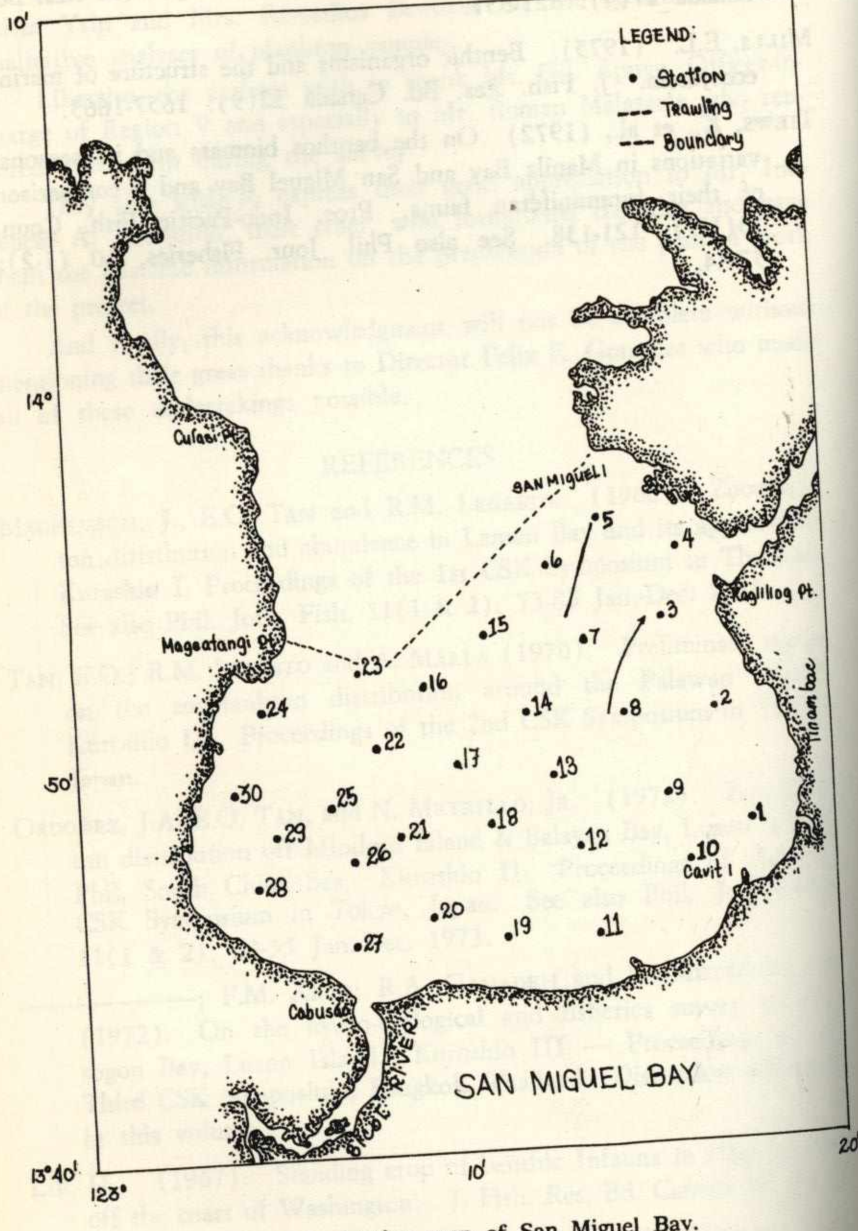

Figure 1. Station map of San Miguel Bay.

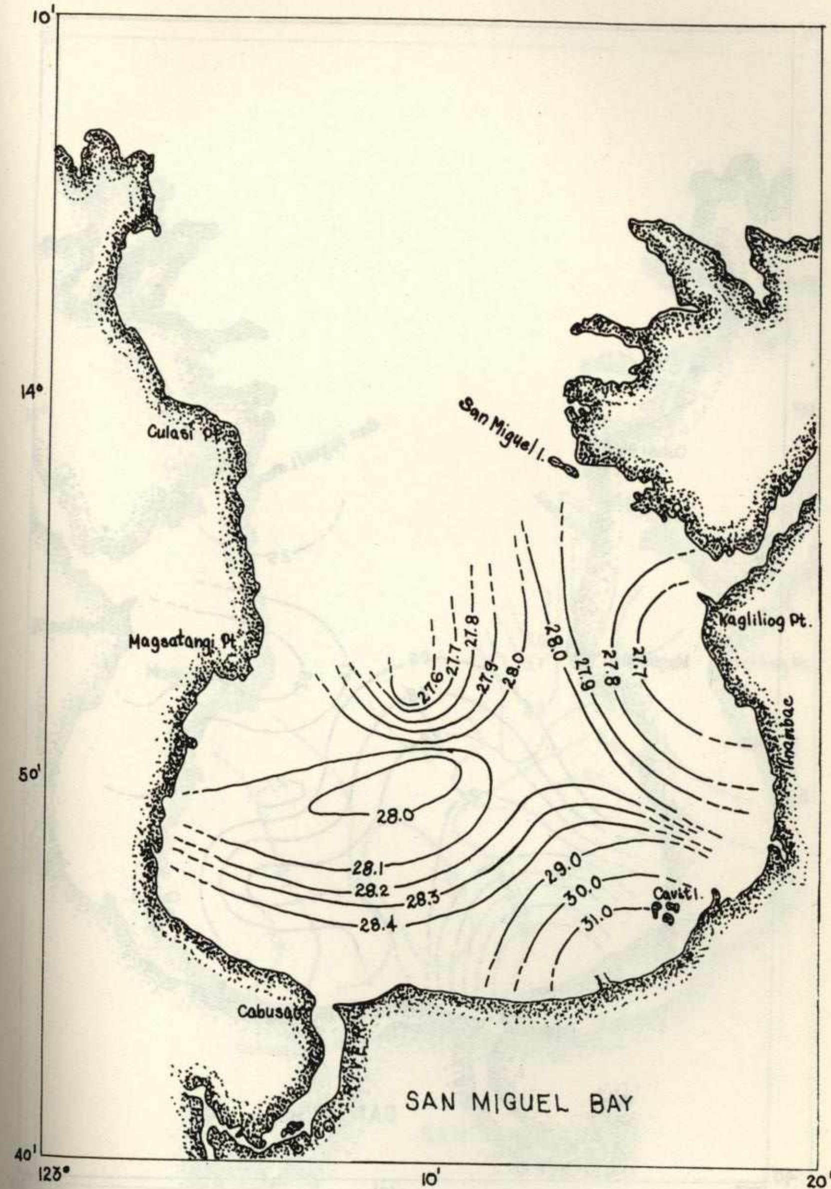

Figure 2. Surface temperature of San Miguel Bay.

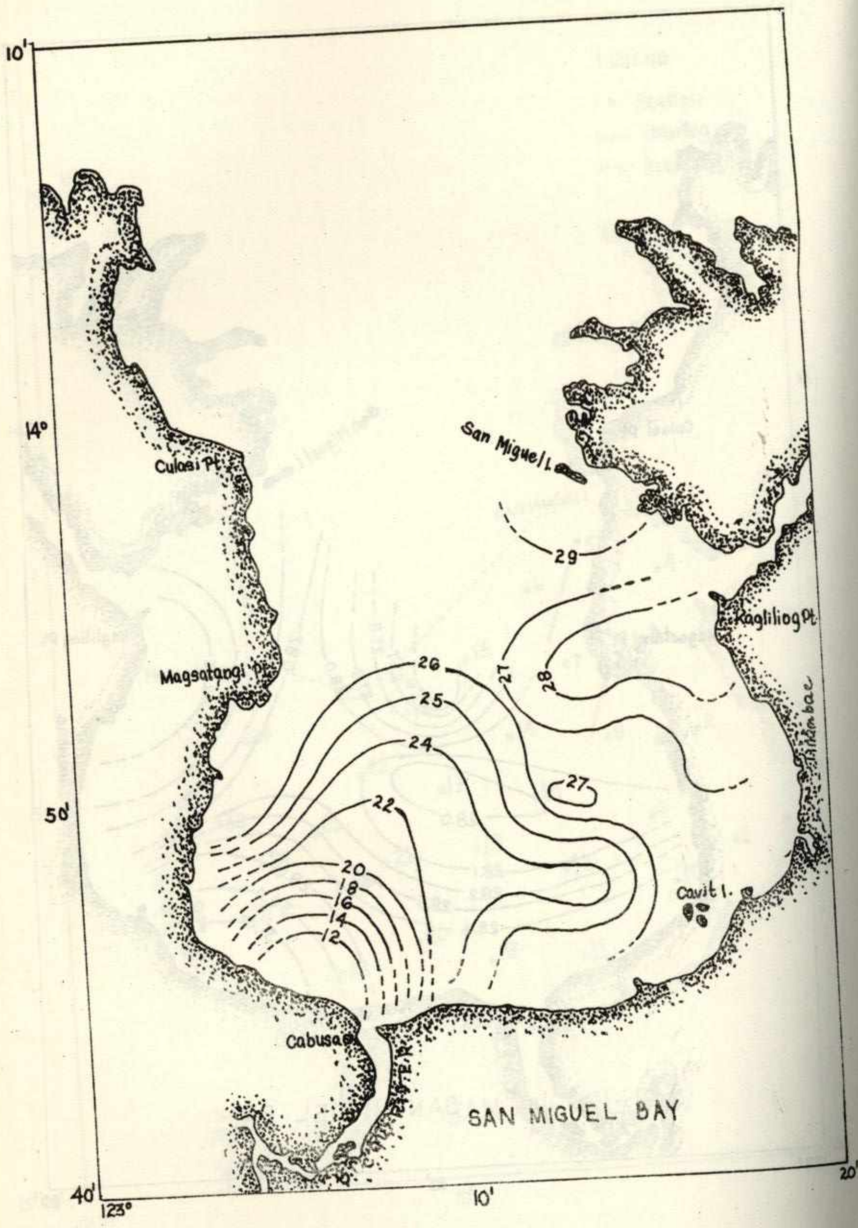

Figure 3. Surface salinity of San Miguel Bay.

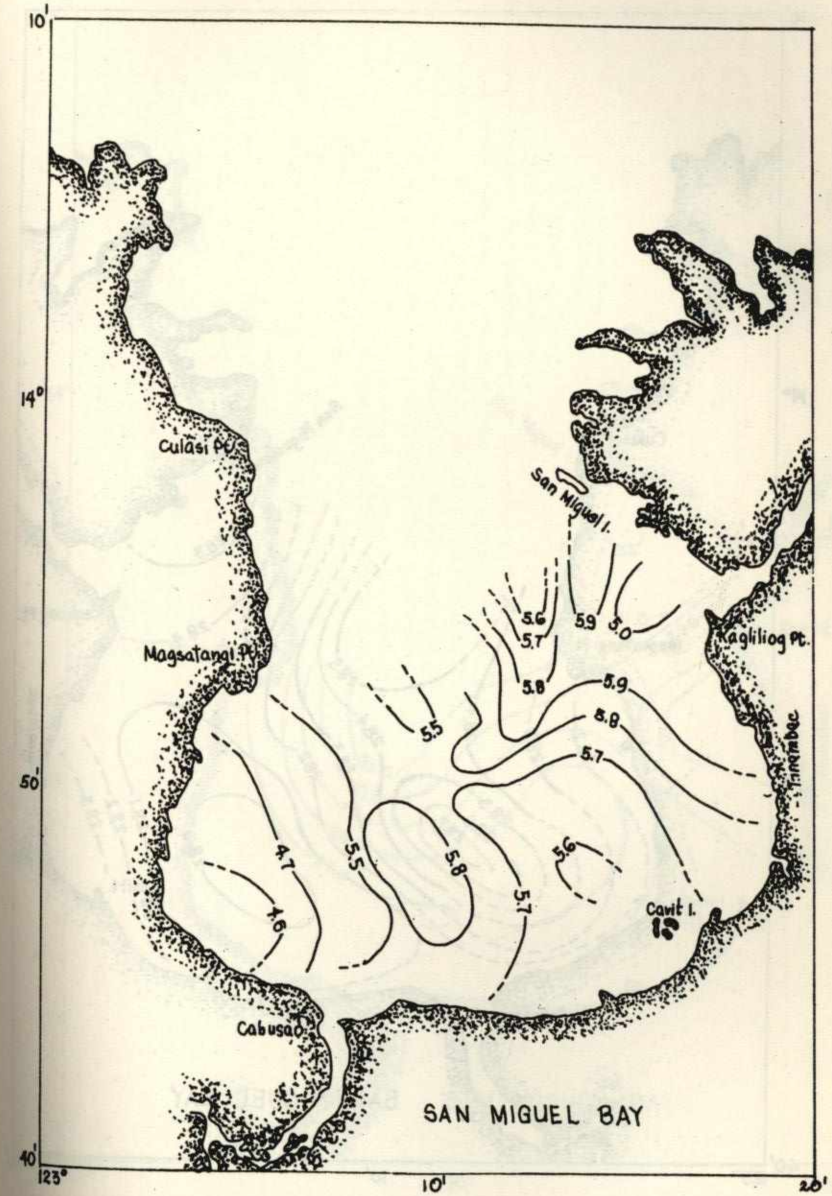

Figure 4. Oxygen content of surface waters of San Miguel Bay.

Figure 5. Temperature of bottom waters of San Miguel Bay.

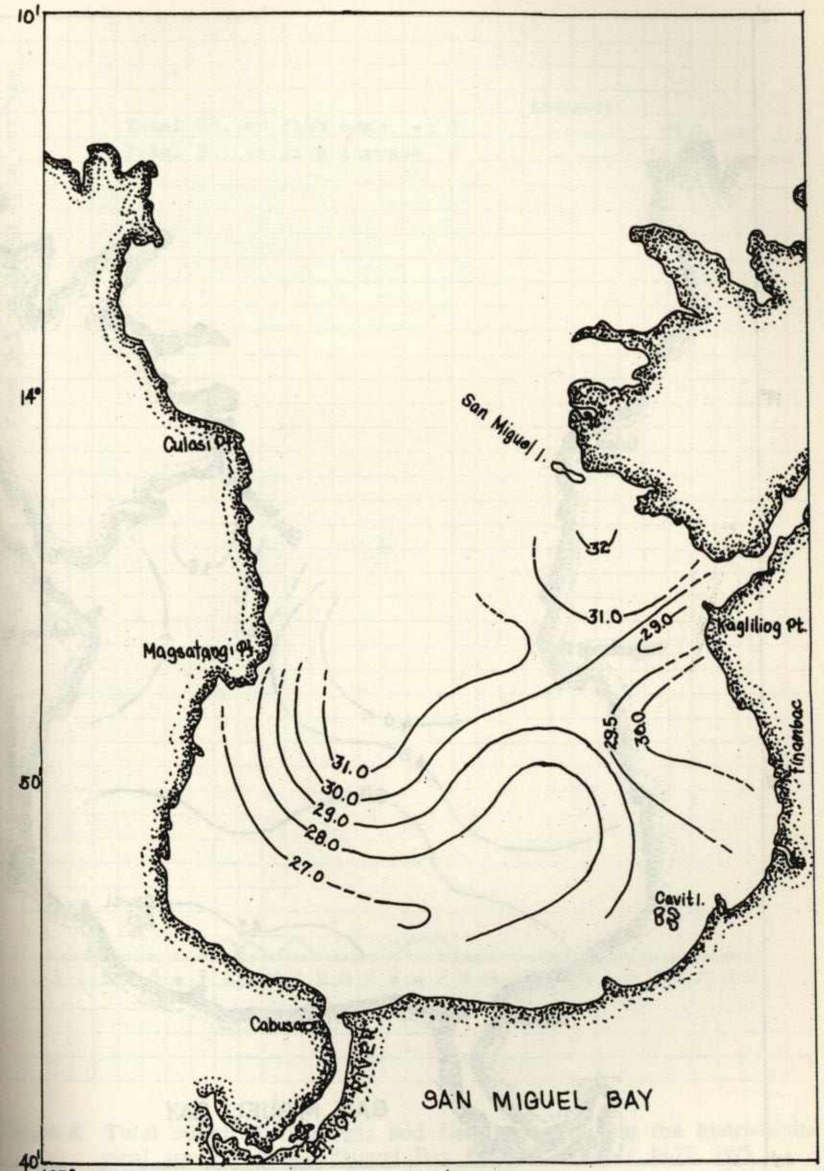

Figure 6. Salinity of bottom waters of San Miguel Bay.

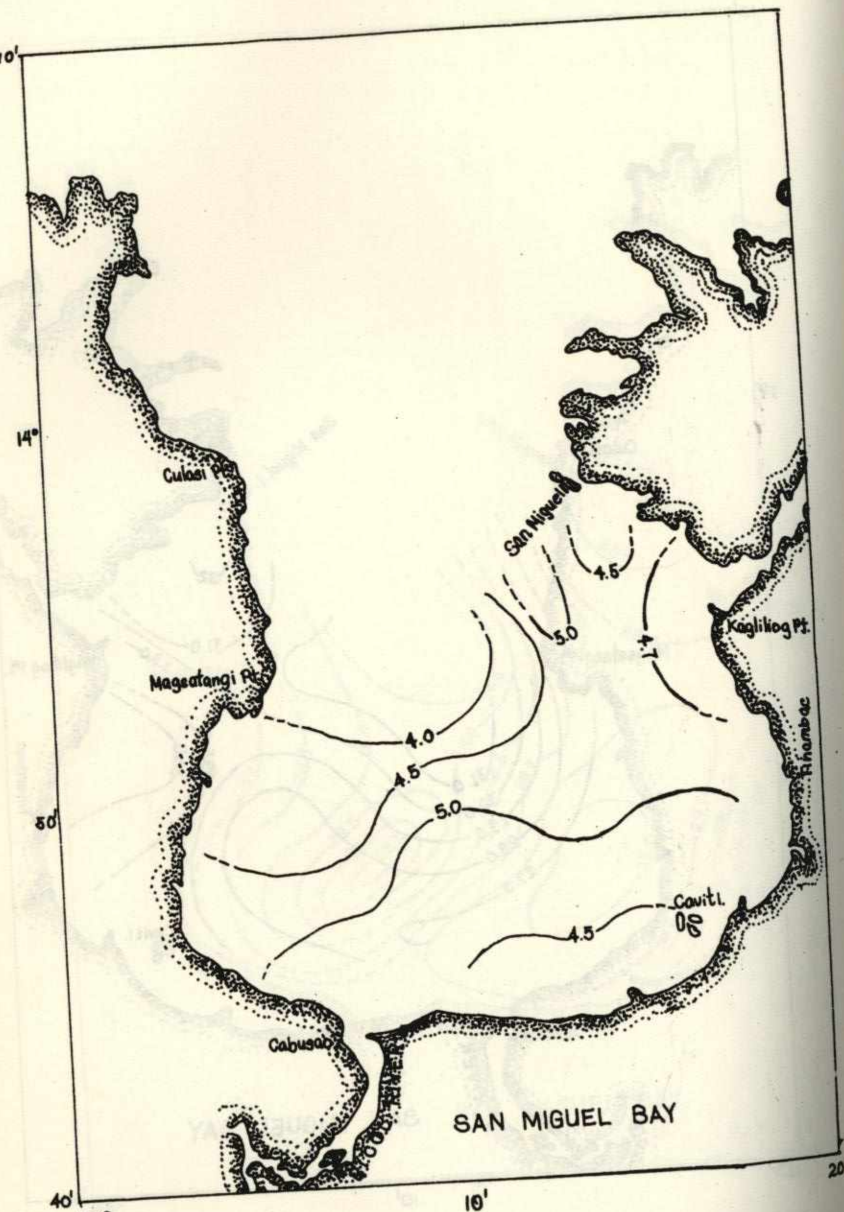

Figure 7. Oxygen content of bottom waters of San Miguel Bay.

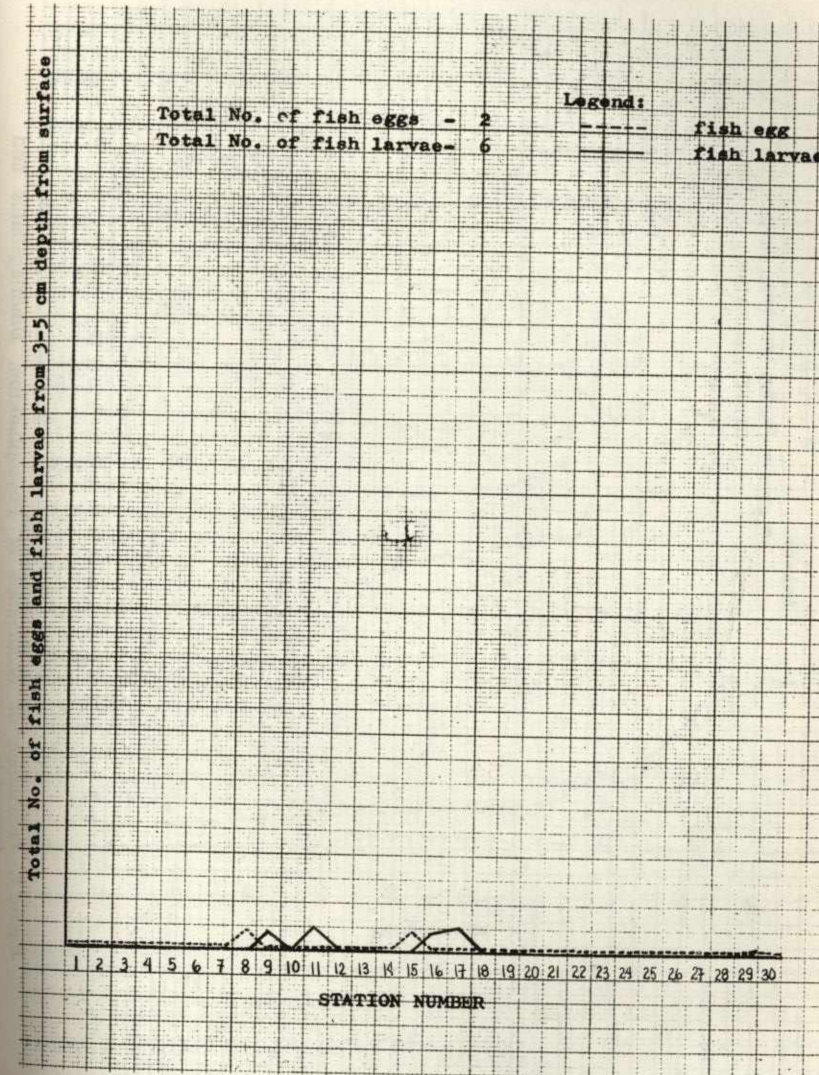

Figure 8. Total count of fish eggs and fish larvae during the hydro-biological survey of San Miguel Bay from November 19-29, 1975.

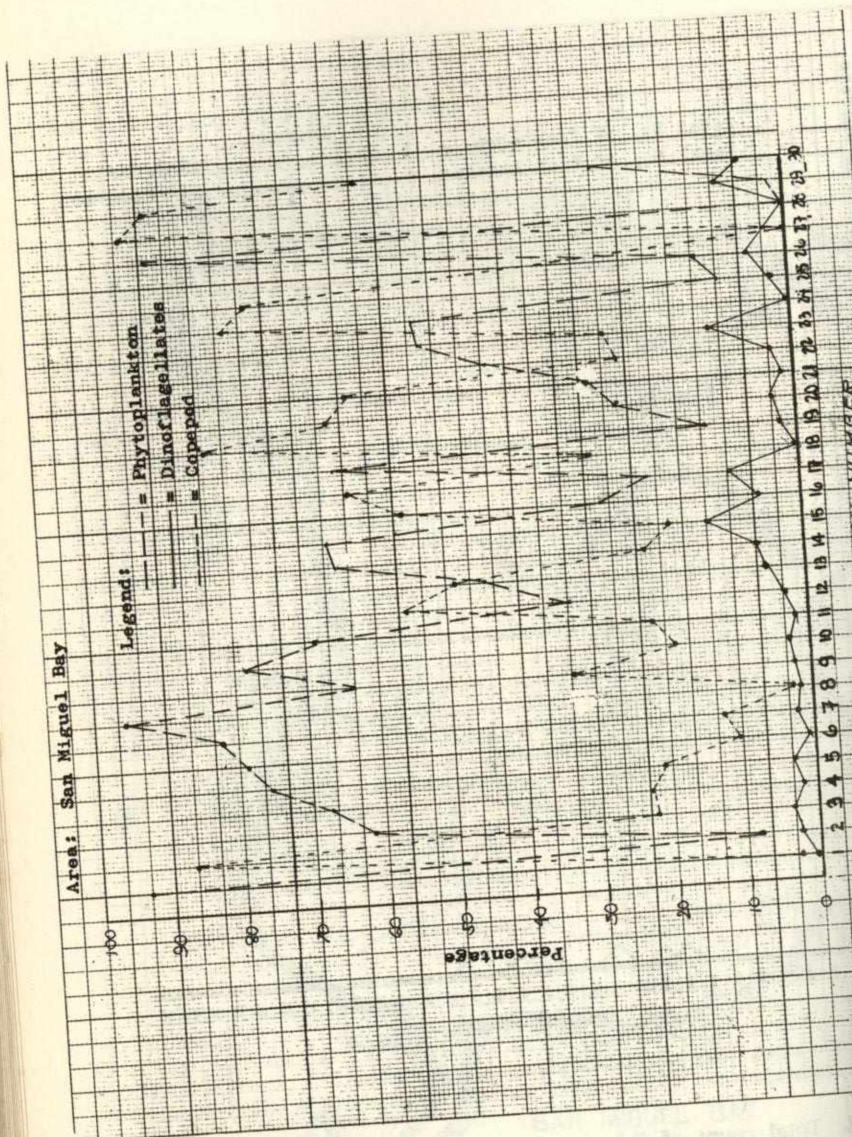

Figure 9. Percentage of occurrence of Phytoplankton, Dinoflagellates and Copepods.

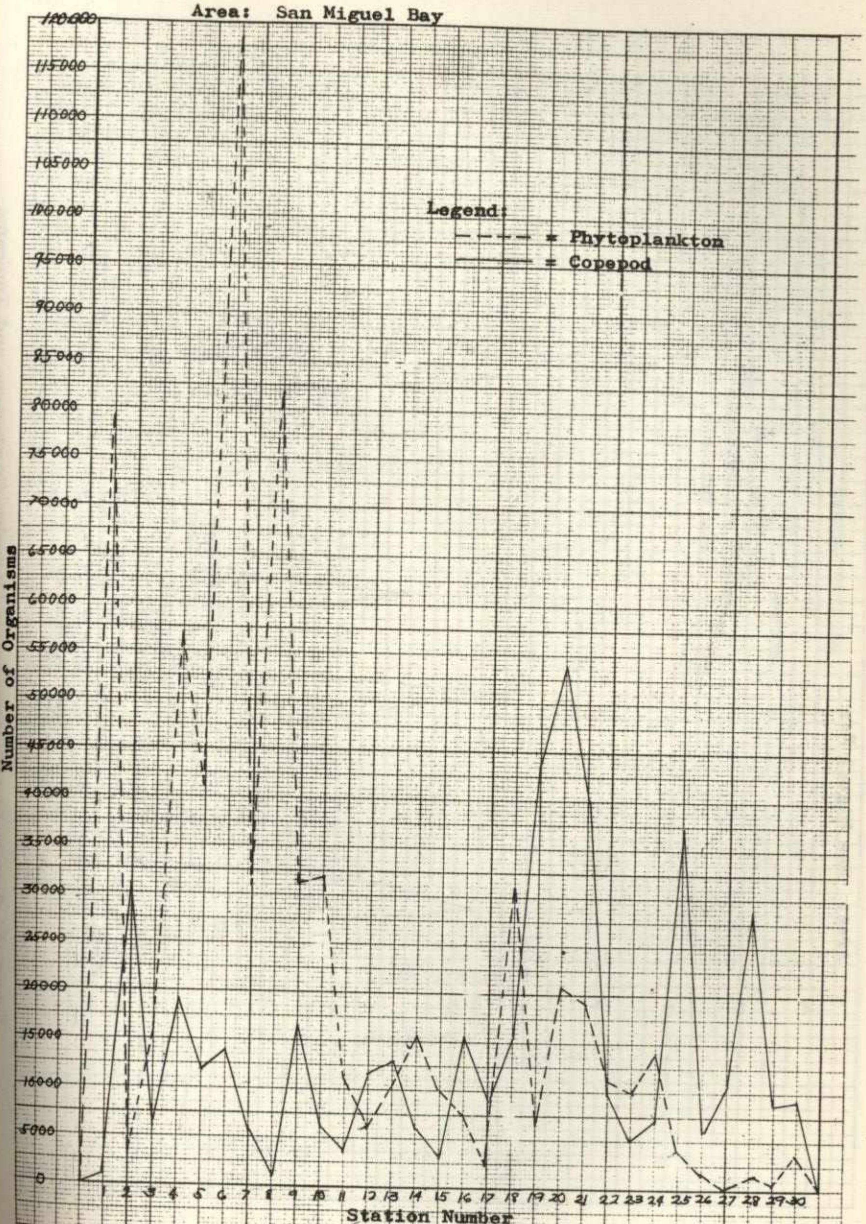

Figure 10. Total number of Phytoplankton and Copepods.

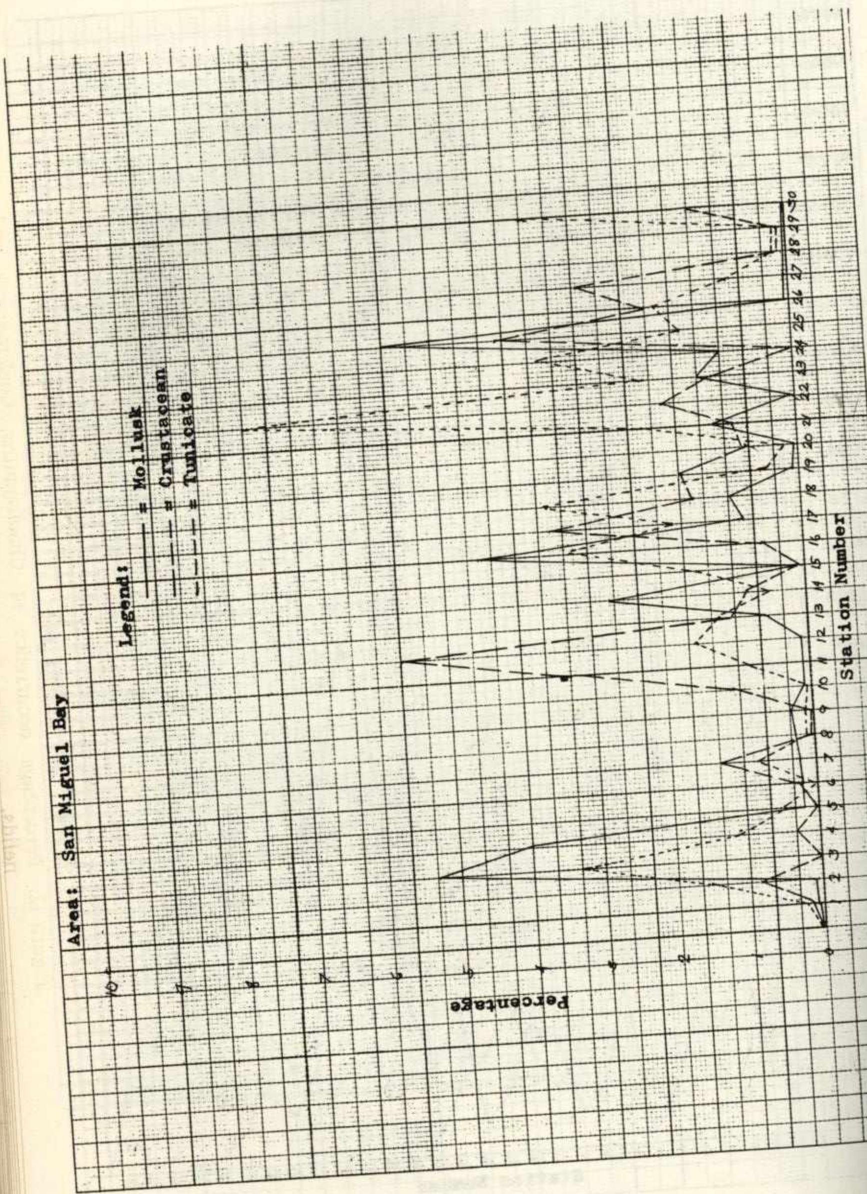

Figure 11. Percentage of occurrence of Mollusks, Crustaceans and Tunicates.

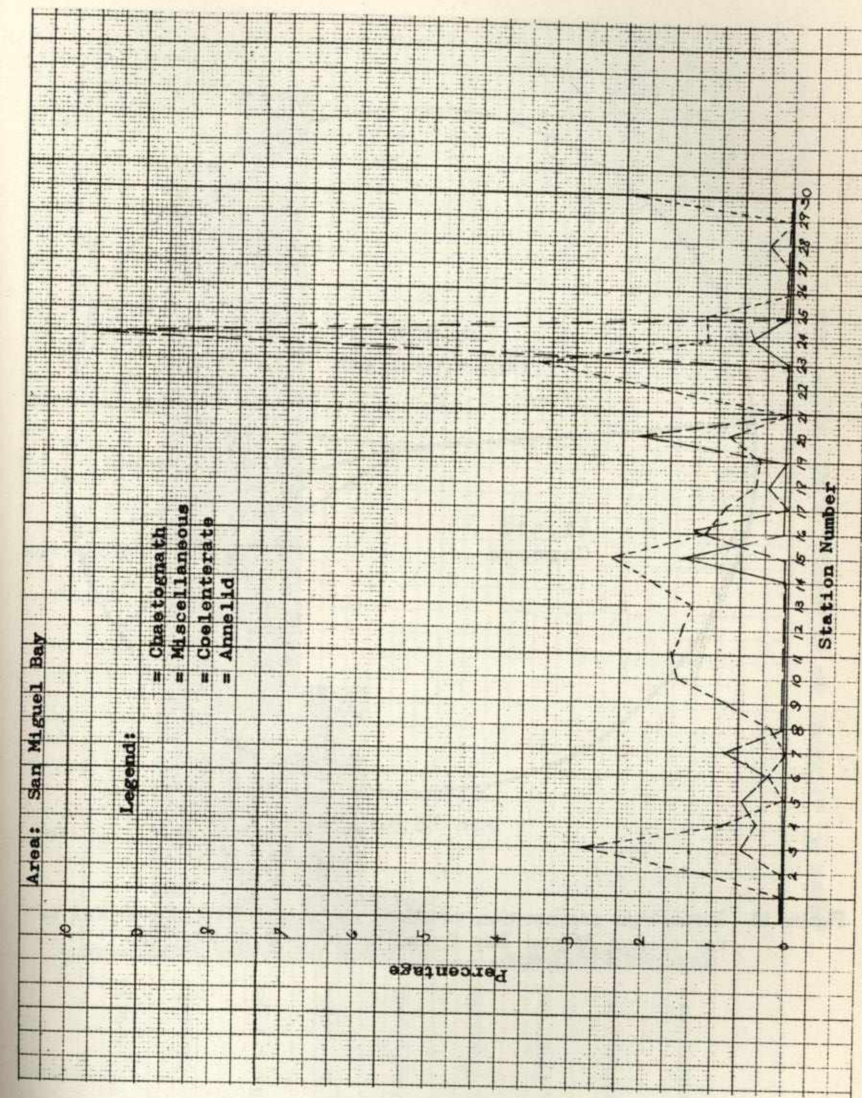

Figure 12. Percentage occurrence of Chaetognaths, Coelenterates and Annelids.

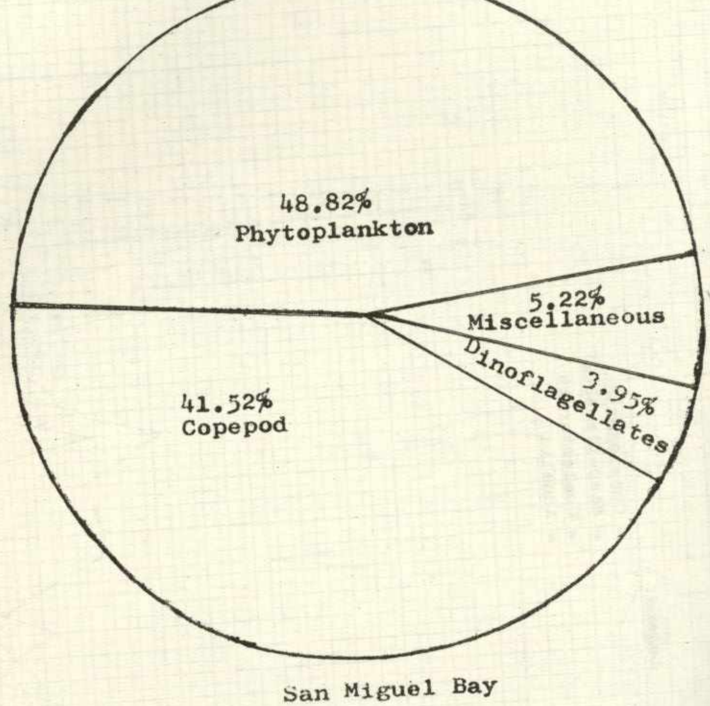

Figure 13. Percentage composition of Plankton in the Hydro-biological survey of San Miguel Bay from November 9 to 19, 1975.

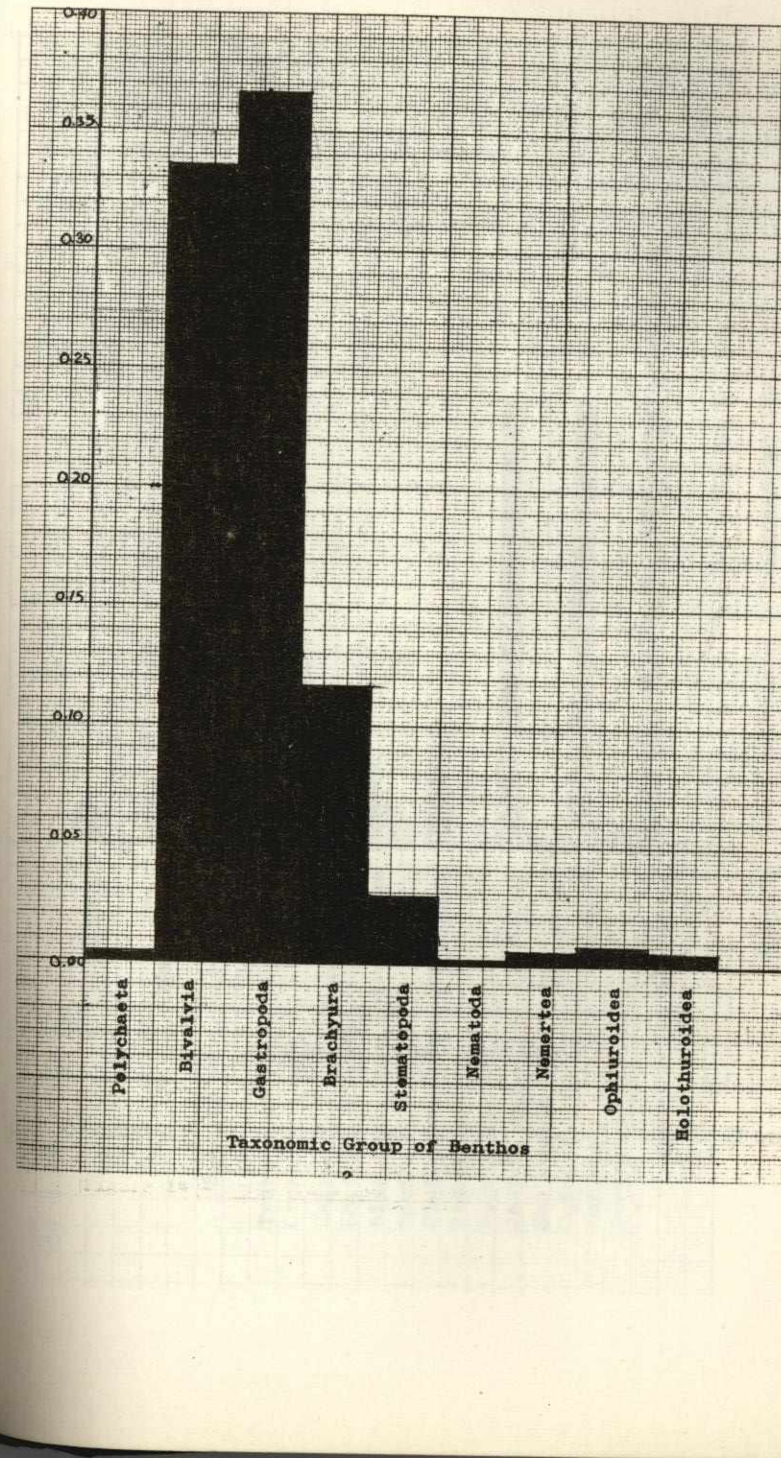

Figure 14. AFDW/0.1 m² of Benthos in San Miguel Bay.

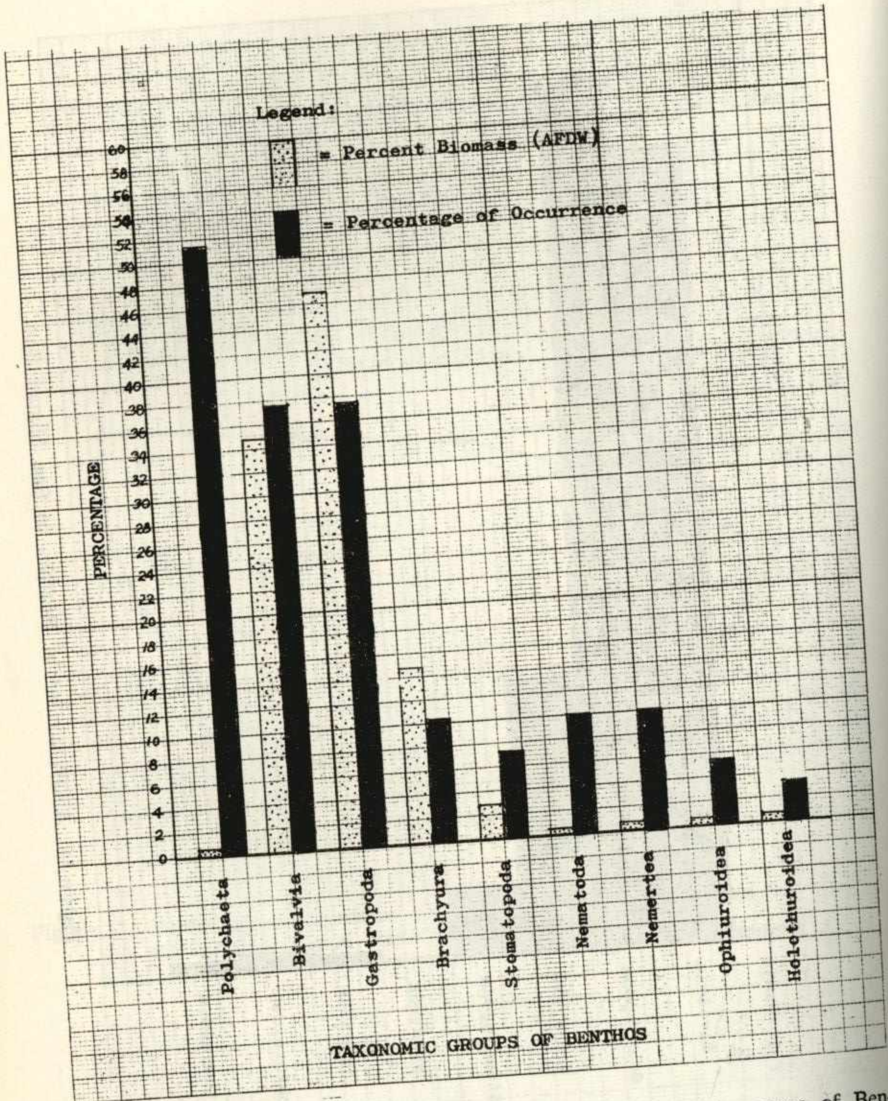

Figure 15. Percent Biomass (AFDW) and percentage of occurrence of Benthos in San Miguel Bay.

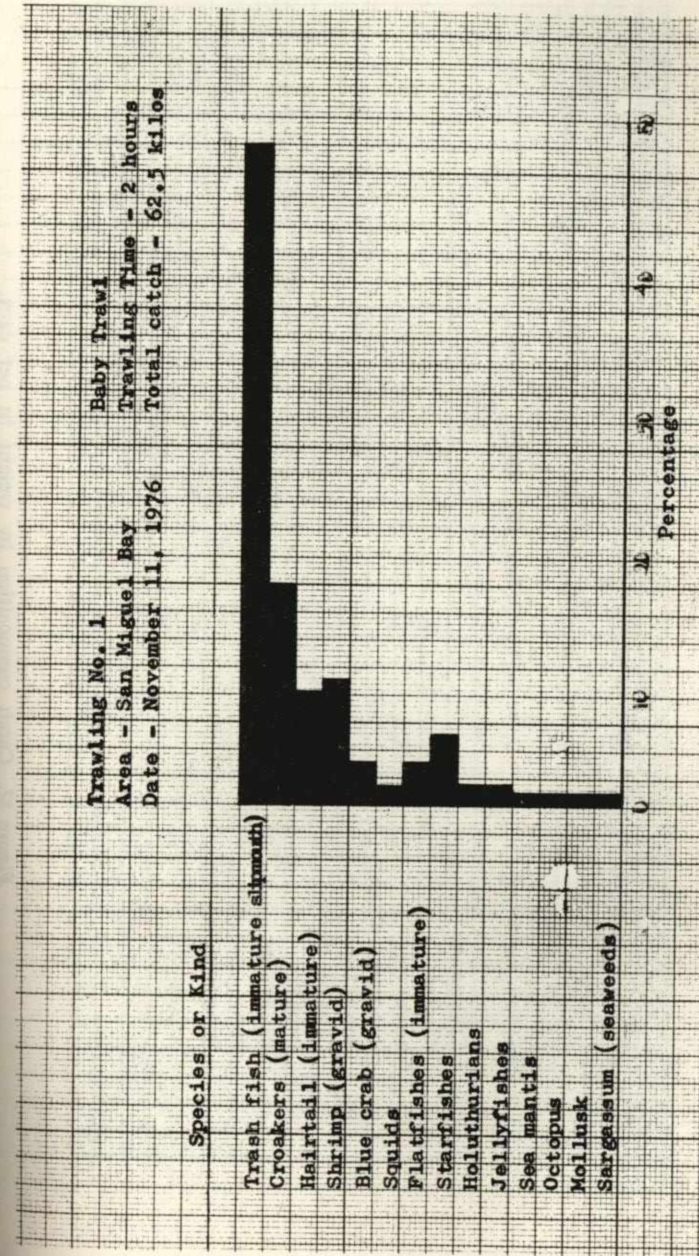

Figure 16. Catch composition by weight in per cent.

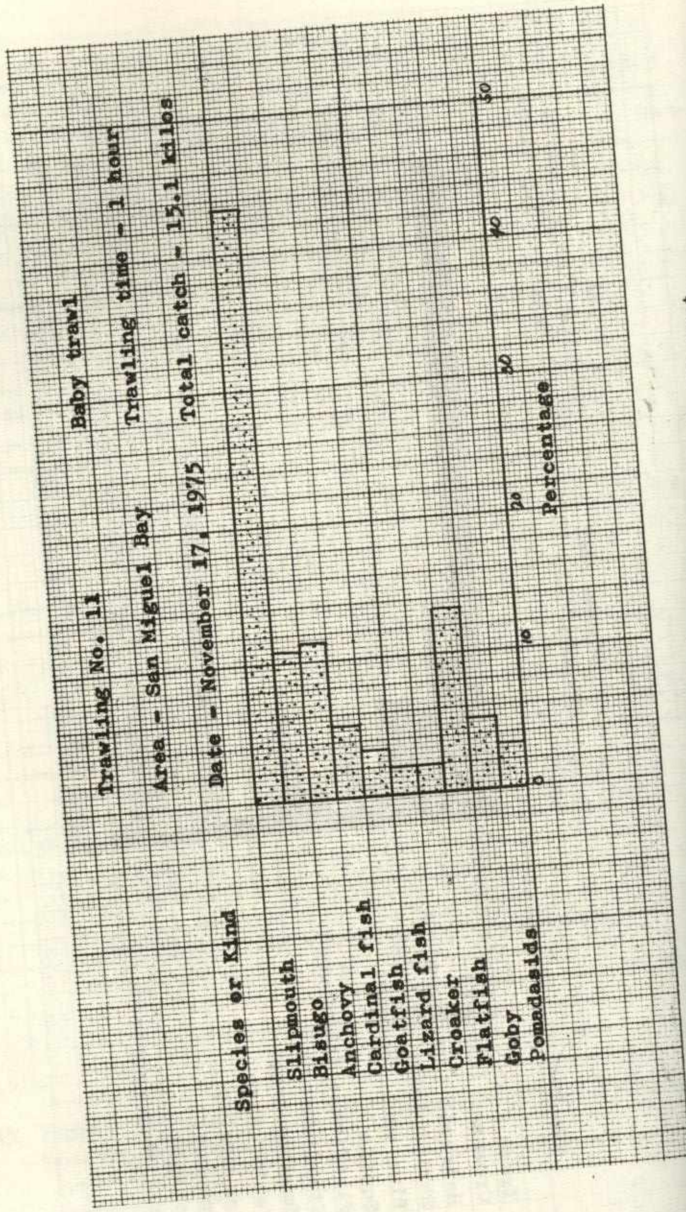

Figure 17. Catch composition by weight in per cent.

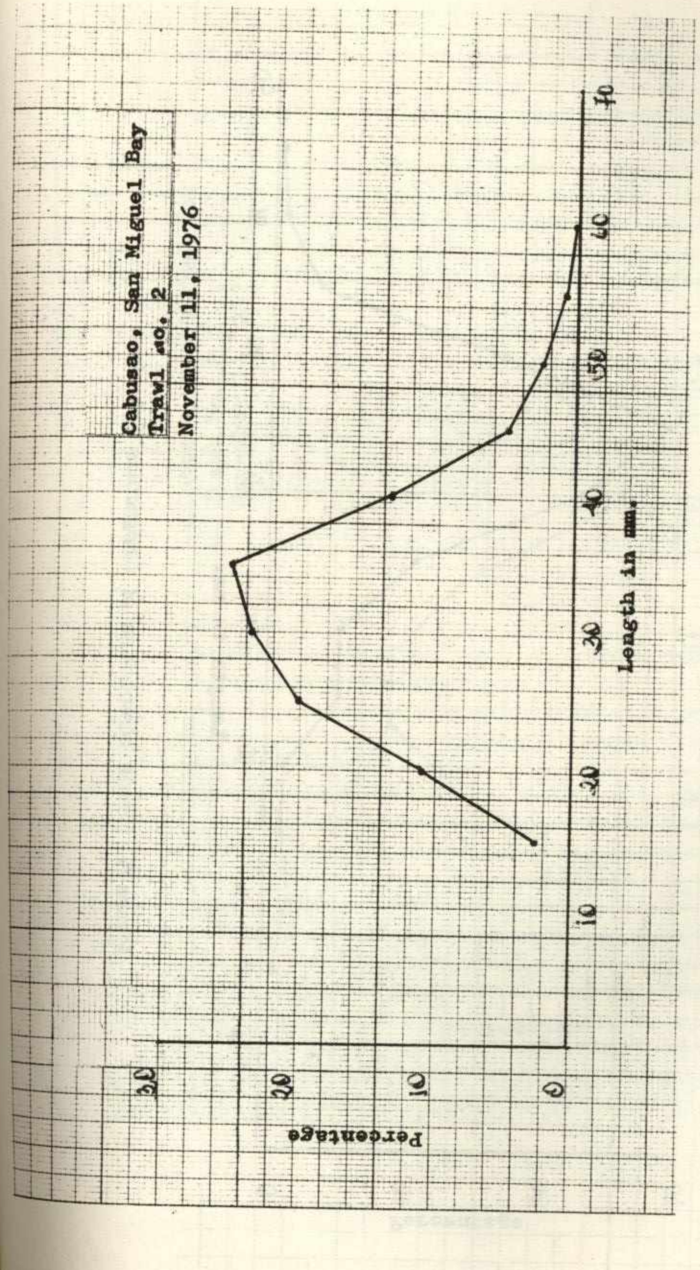

Figure 18. Length composition of *Leiognathus Ruconius*.

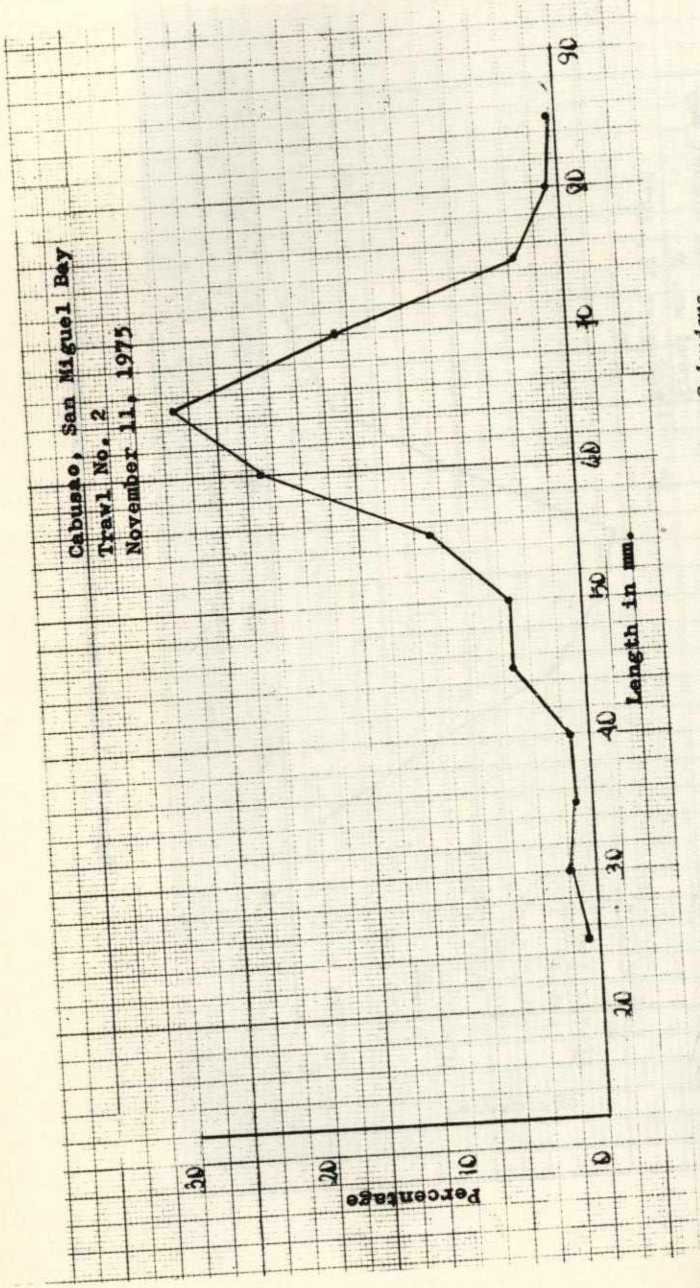

Figure 19. Length composition of *Leiognathus Splendens.*

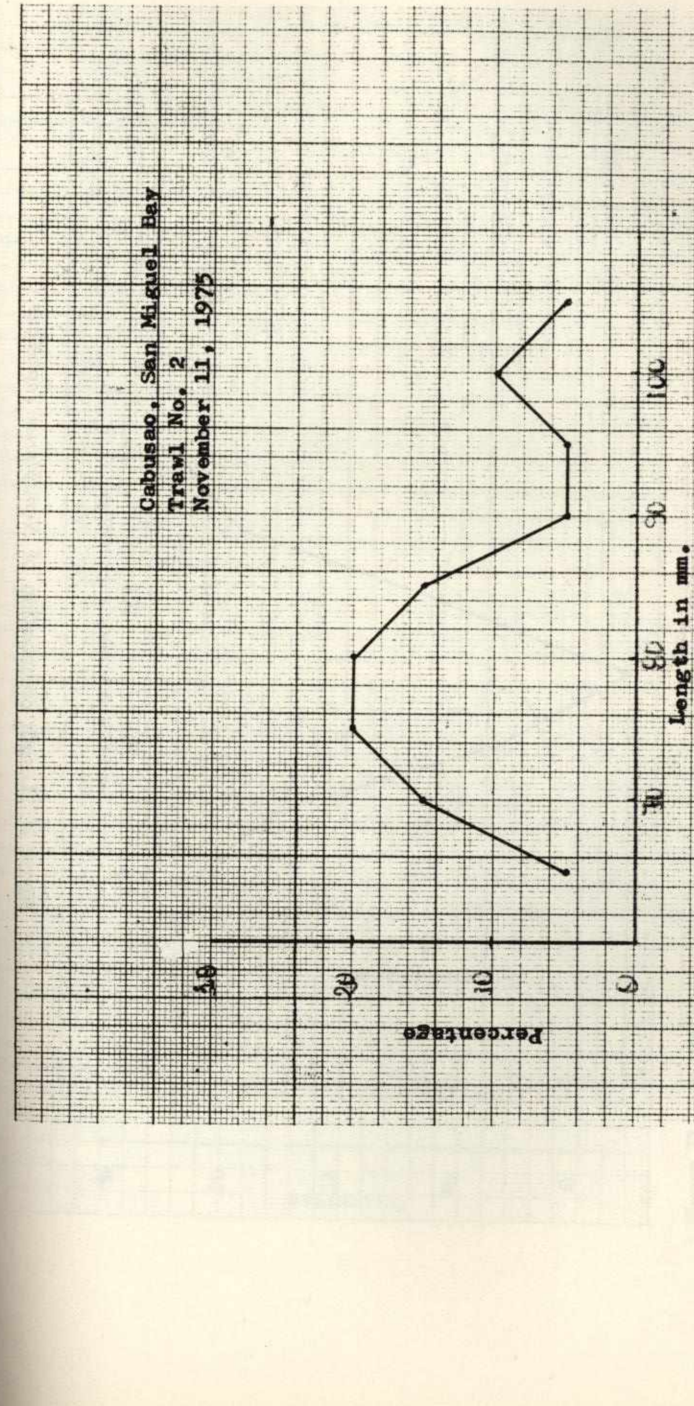

Figure 20. Length composition of *Leiognathus Blochii.*

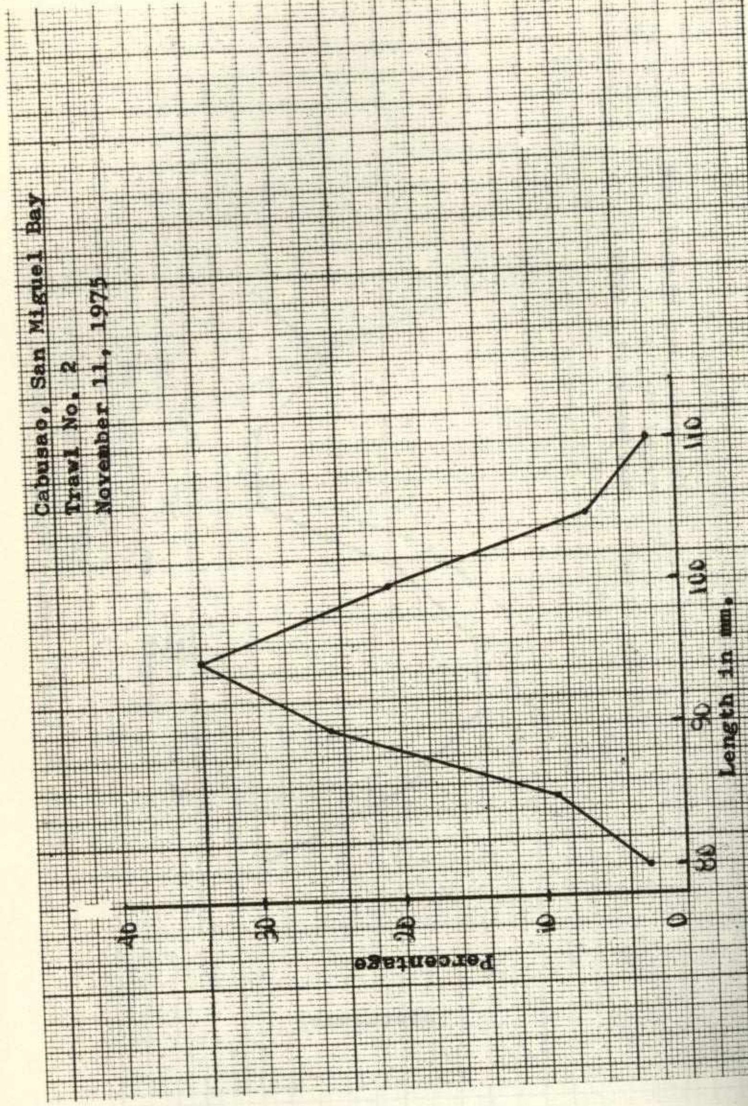

Figure 21. Length composition of *Nemipterus Japonicus.*

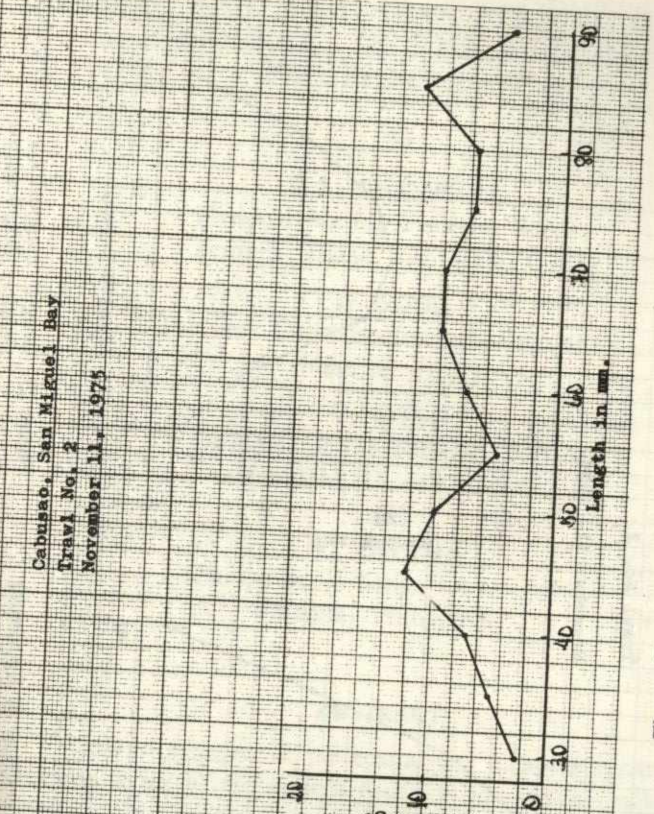

Figure 23. Length composition of *Apogon Sp.*

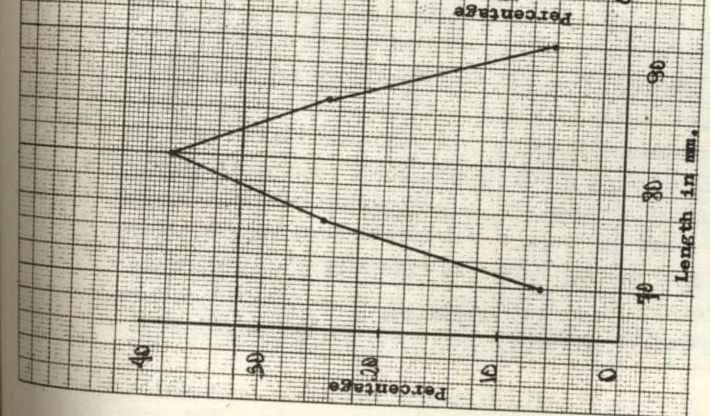

Figure 22. Length composition of *Thrissocles Hamiltoni.*

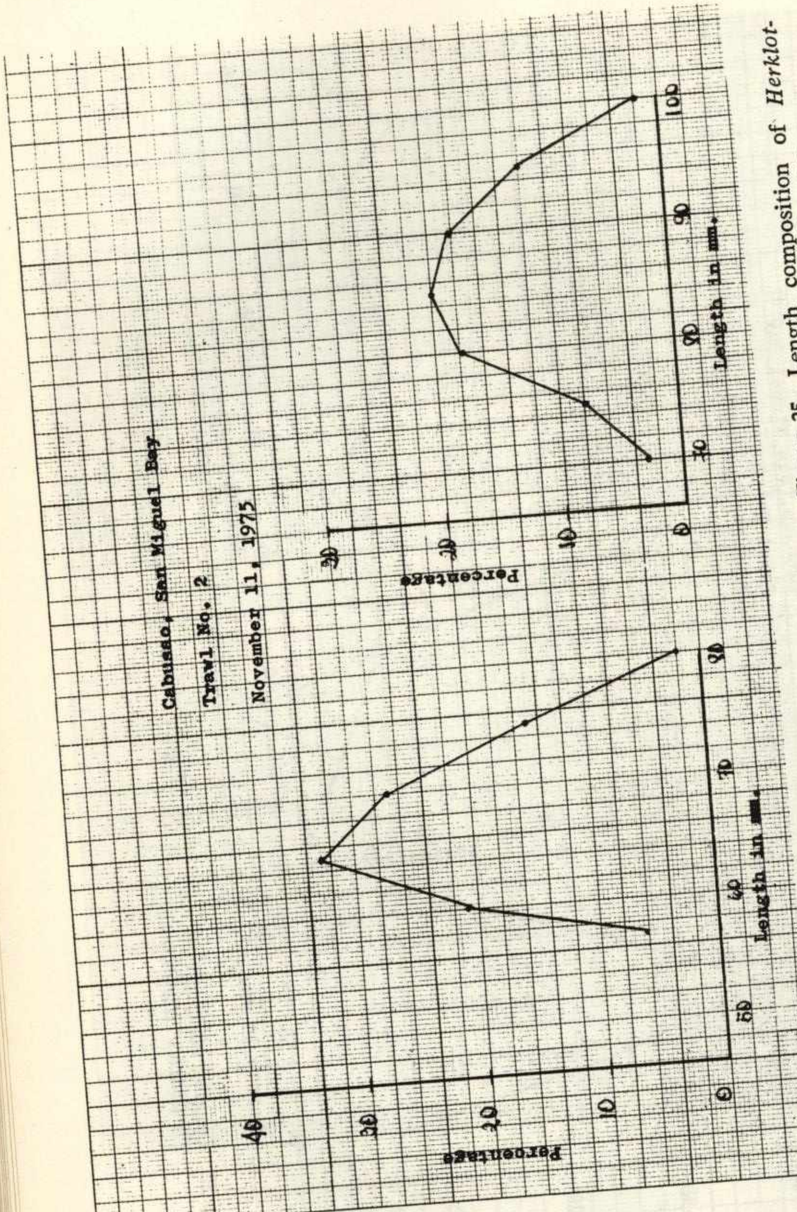

Figure 24. Length composition of *Upenoides Sp.*

Figure 25. Length composition of *Herklotsichthys Dispilonatus.*