ON THE SOCIO-ECONOMIC SURVEY AND HYDRO-BIOLOGICAL SURVEY OF MAQUEDA BAY, VILLAREAL BAY AND PART OF ZUMARRAGA CHANNEL FOR THE PROPOSED FISH NURSERIES/RESERVATION

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I. INTRODUCTION:

President Marcos escalated the government's effort to conserve and develop the country's marine resources through the closure or restrictions of commercial fishing in 13 more fishing grounds and sanctuary. One of these is Maqueda Bay, Villareal Bay and part of Zumarraga Channel.

Similar work as presented in this paper are being undertaken in the following areas: Manila Bay, Cavite side; Panguil Bay, Misamis Occidental and Lanao; Sorsogon Bay, Sorsogon; Pagapas Bay, Batangas; Tinagong Dagat Bay, Capiz; San Miguel Bay, Camarines Sur; Bantayan Islands, Cebu; Lingayen Gulf, Pangasinan; San Pedro Bay, Leyte; Acid Gulf, Masbate; Polillo Islands, Quezon; and Puerto Galera, Oriental Mindoro.

The concern over the economic consequence of excessive fishing in Maqueda Bay, Villareal Bay and part of Zumarraga Channel is jointly shared by both the Bureau of Fisheries and Aquatic Resources (BFAR) and the fishermen in the area. The lack of systematic fishery management may lead to uncontrolled exploitation and depletion of fishery resources which may ultimately result in economic difficulties for the fishermen in this region. To obviate this possibility, the BFAR has established fish nurseries and reservations in the area. The technical description of the project area is as follows:

All waters enclosed by an imaginary line drawn, starting from Cuyo Point at Catbalogan, Samar, at longitude 124° 53' 03" E, latitude 11° 45' 12" N.

Thence southward 4.4 nautical miles (approximately) to Tubigan Point, Buad Island, at longitude 124° 53' 24" E, latitude 11° 40' 48" N.

Thence southward along the coastline of Buad Island to its southern tip at longitude 124° 50' 00" E and latitude 11° 38' 00" N.

Thence southwest, 1.6 nautical miles (approximately) to Bagacay, Daram Island, at longitude 124° 49' 18" E, latitude 11° 36 30" N.

Thence southward along its coastline to a point near Lipundan Bay at longitude 124° 50' 18" E, latitude 11° 34' 24" N.

Thence southeast 2 nautical miles (approximately) to Mallorga, Samar, at longitude 124° 51' 27" E, latitude 11°32' 48" N.

Thence northeastward along the coastline of Samar thru the towns of Villareal, Pinabaodao, Calbiga, Binabangan and Wright.

Thence westward along the coastline of Samar to the starting point, with an approximate area of 87 sq. nautical miles.

II. MATERIALS AND METHODS

The socio-economic and hydro-biological surveys which were conducted during the period July 1-10, 1974 and September 24 — October 8, 1975, respectively, are discussed in this report.

A. Socio-economic Survey

The mayors, councilors, and fishermen of the municipalities included in the areas proposed as fish nurseries and fish reservations were interviewed. Opinions, suggestions, and recommendations regarding the proposal were taken. The importance of the proposal were also explained to the fishermen and government leaders in the affected area.

Data on population, names of important fishing villages, general income, income from fishing, fishing ports, ice plants, electricity, water supply, fish landings, fish

markets, fishing cooperatives, fishing grounds, fish prices and means of transportation were gathered.

The barrio captains of at least two important fishing barrios were interviewed. Data gathered were on barrio population, distance of the barrio from the provincial capital, land area, number of rivers connecting the area to the sea, number and kinds of fishing gears used, kinds of fishes caught by certain methods, the quantities of fish caught, number of fishing hours, fishing seasons and market, number and total areas of fishponds, annual fishpond production, number of ice plants and methods of preservation commonly used in the barrio.

Names of public officials were recorded for reference.

B. Hydro-biological survey:

A hydro-biological survey was conducted on board a hired baby trawler measuring 47 feet in length and powered by a 10 HP engine.

Thirty stations were sampled and at each station (see station map, Fig. 1) actual depth, air and water temperature reading, water sampling for salinity and oxygen determination, water transparency and color determination, plankton and benthos collection were made. Observations on the area were recorded.

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

b. A Marutoku net was used for plankton collection and 30 vertical and one horizontal hauls were made. The flow meter was attached to the mouth of the net to register the volume of the water that passed thru the net. The depth of the plankton station

is from one to five meters from the surface. Plankton samples were preserved in 4% formaldehyde. Plankton volume was determined by the volume displacement method. Total plankton count from each station was taken by the aliquot portion method. Then the fish eggs and larvae were sorted by station and preserved in small vials for further analysis.

The ml/m^3 of plankton volume were computed from each station. Percentages of occurrence of all the organisms in each station were also computed and plotted in tables and charts which are attached to this report. The whole plankton composition was re-grouped into 4 major groups.

c. Benthos samples were collected with a 0.1 m^2 Van Veen grab at 24 stations. One grab was taken at each and the contents were noted for color and texture and then sieved through a 1 mm square mesh. The animals were then collected and preserved in 5-10% formalin. The specimens were identified into major taxonomic groups, blotted and weighed up to 0.1 milligram accuracy. Conversion of wet weight to ash free dry weight (AFDW) was calculated according to the conversion factors given by Lie (1964). The mean conversion factors for Polychaetes and miscellaneous worms were 0.122, for crustaceans, 0.15, bivalves 0.05 and for Echinoderms, 0.03 to 0.12.

d. On the biological aspect, fish landing samples were collected to study the fishes and minor sea products landed. Length and weight measurements, sex and maturity determination were the basic biological analyses made.

Six (6) trawling experiments were conducted in Maqueda Bay, Villareal Bay and part of Zumarraga Channel, on board a commercial baby trawler with a 10 HP engine. The length of the boat is 47 feet, size of the board is 0.5 m x 12, weighing

four kilos each, length of towing warp is 75 m. The towing speed is 2-3 knots. Mesh size is 1 cm.

The fish landing survey was done only once due to the early start of the hydro-biological survey. Kinds and quantities of fish landed and types of gear were determined. Fish samples were bought for laboratory analysis.

III. RESULTS AND DISCUSSIONS:

A. Socio-Economic Survey

Of the eight (8) fishing barrios surveyed, 80% of residents in Barrio Gia-an in the town of Jiabong were fishermen. In Buray, Wright, fishermen comprise 30% of the total population, while in Lamingao, Villareal, 28% and in Guintarcan, Villareal, 20%. In Daram Island, the barrio of Sibungaan, the fishing population is 25%. The other inhabitants were engaged in farming and other kinds of economic endeavors. (Table No. 1)

The most common fishing gear used was the gill net, followed by the hook and line, and the baby trawl.

Barrio Silanga in Catbalogan has five commercial fishing boats. Lamingao, Villareal led the motorized banca category with 100 units followed by San Isidro, Zumarraga. The municipalities of Villareal and Zumarraga also had the most number of non-motorized bancas.

Motiong and Wright are the only municipalities using fish corral as one of the fishing gears.

Fishponds in Jiabong and Wright have no commercial value during the socio-economic survey because they are not fully-developed. (Table No. 2)

B. Hydro-biological Survey

a. Physico-chemical aspects — Figures 2 to 10 show the surface, middle and bottom distribution.

Surface

1. Temperature — Maqueda Bay near Pangdan registered 32°C and going inward decreased to 31°C, giving a

Table No. 1

Number of Fishing Gear Used by Fishermen in the Coastal Barrios of Zumarraga Channel, Villareal Bay and Maqueda Bay

Town	Barrio	Gen. Pop (approx.)	Fish. Pop. %	Hook & Line	Gill net	Fish corral	Trawl	Sapyao :panamban:	Troll	Push net	Bin- tol	Baby trawl
Catbalogan	Silanga	3,000	-	40	40	0	5	-	0	0	0	0
Jiabong	Gia-an	700	80	80	20	-	-	-	-	-	0	0
Motiong	Oyandic	266	6	10	4	4	0	0	0	0	0	0
Wright	Buray	779	30	-	7	4	0	0	0	0	-	0
Villareal	Guintarcan	2,000	20	20	30	9	0	0	0	0	0	6
	Lamingao	1,700	28	10	50	0	0	0	0	0	0	3
Zumarraga	San Isidro	1,500	20	15	20	0	0	0	0	0	0	10
Daram	Sibungaan	250	25	8	20	0	0	0	0	0	0	8
Total: 7		8	10,895		183	191	11	5	-	-	-	24

NOTE: - unknown numbers

Table No. 2

Fisheries Information Data Along Maqueda Bay, Villareal Bay and Zumarraga Channel Coastal Towns of Samar.

Towns	Barrios	No. Comm. fish boat	No. motor banca	No. non-motor banca	No. fish corral	No. rivers	No. fish ponds	Area	Production K/Year
Catbalogan	Silanga	5	20	40	0	0	0	0	0
Jiabong	Gia-an	0	6	* 80	-	1	1 B	No commercial value	
Motiong	Oyan-dic	0	0	20	4	0	0	0	0
	Bayog								
Wright	Buray	0	0	24	4	2	1 B	No commercial value	
Villareal	Guinatarcan	0	40	70	0	0	0	0	0
	Lamingao	0	100	100	0	0	0	0	0
Zumarraga	San Isidro	2	60	100	0	0	0	0	0
Daram	Sibungan	2	30	60	0	1	0	0	0
Total - 7	8	9	258	514	8	4	2	-	-

* B - Bangus
H - Hito

distinct difference in temperature. Villareal Bay gave a temperature reading of 29°C increasing eastward, while in Zumarraga Channel temperature was 30°C. (Fig. 2)

2. Salinity — Highest salinity was recorded at the opening of Maqueda Bay with a reading of 33 o/oo decreasing to 31 o/oo going inward. Salinity of Villareal Bay was 32 o/oo decreasing to 31 o/oo going east. In Zumarraga Channel, salinity reading was reversed from 31 o/oo it increased to 32 o/oo going east. (Fig. 3)

3. Oxygen — Inner Maqueda Bay gave a reading of 5.4 ml/1 — decreasing at the center to 5.0 ml/1 and increasing to 5.7 ml/1 as you go outward. Villareal Bay gave 5.0 ml/1 and increasing as you move to Zumarraga Channel.

Middle

1. Temperature — Maqueda Bay and Villareal Bay registered 31°C at the inner part and going outward decreased to 29°C. Zumarraga Channel showed the same pattern. (Fig. 5)

2. Salinity — Maqueda Bay and Villareal Bay showed lower salinity (31 o/oo) at the inner side and going outward increased to 35 o/oo while in Zumarraga Channel it gave a reading of 30 o/oo increasing as you go outward to 34 o/oo. (Fig. 6)

3. Oxygen — A part of Maqueda Bay and Villareal Bay showed a reading of 5.5 ml/1 decreasing to 5.0 ml/1 going outward. Same pattern was recorded for Zumarraga Channel. (Fig. 7)

Bottom

1. Temperature — Inner Maqueda Bay and Villareal Bay registered higher temperature, 31°C which decreased to 29°C going outward. Then from Majaba Island, it increased to 30°C and going outward increased to 32°C. (Fig. 8)

2. Salinity — Maqueda Bay, Villareal Bay and part of Zumarraga Channel showed lower salinity, 31 o/oo at the inner side increasing to 34 o/oo going sea ward. (Fig. 9)
3. Oxygen — Maqueda Bay showed high oxygen value, 4.9 ml/1 going inward. Upper Villareal Bay near Buad Island gave 4.5 ml/1 going up to Maqueda Bay increasing to 4.8 ml/1 and a portion of Zumarraga Channel gave 4.9 ml/1. (Fig. 10)

b. Plankton — The plankton composition in the area is shown in Table No. 3 and the plankton volume in Graph No. 1. Total count of fish eggs and fish larvae are in Graph No. 2 while their percentage occurrence of kind in the area is shown in Table No. 4.

The largest number of fish eggs was counted in Station 1 located in front of Pangdan with a total of 55 eggs. Station 15 located in Buad Channel has the biggest number of fish larvae with 51 species.

The maximum plankton volume was 34.44 ml/m³ recorded near Moroparo Island. Station 24 had the least plankton volume of 1.46 ml/m³, located in front of Gaang in Buad Island.

Phytoplankton were the most dominant plankton organism with 93.95% and was observed in Station 6. (Graph No. 3) Next to phytoplankton were the Dinoflagellates with 83.37% of occurrence and was observed in Station 21. Copepods were third with 13.52% (Graph No. 4) and Foraminiferans, fourth. (Graph No. 5)

Other plankton groups were also present in the samples but in negligible amounts. These are Coelenterates, Tunicates, Polychaetes, Chaetognaths, Annelids, Echinoderm and Mollusk, (Graph 6 and 7).

c. Benthos

The bottom characteristics of the surveyed area can be divided into four major bottom types according to the subjective in-situ observations of sediment characteristics (Figure 11). The muddy sand and shell bottom type was confined

Table No. 3
PLANKTON COMPOSITION (mean no./ml) MAQUEDA, VILLAREAL BAY & PART OF ZUMARRAGA CHANNEL

PHYTOPLANKTON	:	1,181.11
COPEPOD	:	221.78
CRUSTACEAN	:	52.90
MISCELLANEOUS	:	2,867.49
FISH LARVAE	:	.75
FISH EGG	:	.76

Table No. 4

AREA : SAMAR

SPECIES	PERCENTAGE OCCURRENCE											
	STA. 1	STA. 2	STA. 3	STA. 4	STA. 5	STA. 6	STA. 7	STA. 8	STA. 9	STA. 10	STA. 11	STA. 12
A. phytoplankton	7.70	71.40	19.9	85.26	93.39	93.95	83.30	57.18	24.40	7.70	26.14	21.90
B. zooplankton												
dinoflagellates	80.40	14.3	73.80	5.26	3.31	3.72	9.70	35.77	48.10	83.4	55.7	74
mollusk												
coelenterate, medusae, diphyes			0.3		0.83					3.0	11.81	2.25
copepods	7.7		4.5	4.21	2.48	2.33	3.3	3.98			2.95	0.50
crustacean other than copepod	2.1		0.6	3.16			3.1	1.84	18.3			
chaetognath	0.7		0.6				0.3	0.92	5.4	2.4	2.11	0.63
tunicate	0.7			1.58			0.6		3.0	3.5	0.42	0.36
fish egg and larva								0.8			0.42	
annelid			0.3	0.53				0.31				
polychaete	0.7										0.42	0.13
foramineferan		14.3										
echinoderm							0.3					
unknown												
	100	100	100	100	100.01	100.01	100	100	100	100	99.97	100.04

Table No. 4 (Continued)

SPECIES	PERCENTAGE OCCURRENCE								
	STA. 13	STA. 14	STA. 15	STA. 16	STA. 17	STA. 18	STA. 19	STA. 20	STA. 21
A. phytoplankton	11.76		21.60	3.59	12.21	25.50	35.8	23	12.1
B. zooplankton									
dinoflagellates	73.73		64	81.59	72.51	67.5	49.7	61.6	87.04
mollusk coelenterate, medusae, diphyes	63		1.0	0.89			0.8	0.2	0.22
copepods	9.4		8.2	4.95	5.34	5.2	6.6	11.2	2.2
crustacean other than copepod	1.28		1.4	0.90	.76	0.5	3.0	0.4	0.22
chaetognath	1.50		1.8	2.7	0.76	0.80	2.0	1.6	
tunicate	0.86			0.45	5.34				
fish egg and larva				0.45	1.53				
annelid	0.43		0.2	0.45		0.2	1.0	1.4	0.22
polychaete	0.43				0.78				
foramineferan									
echinoderm				0.45	0.76	0.3	0.1		
unknown				2.24					
% TOTAL	100.01		100.2	100.01	99.99	100	100.01	100	100

there were three gravid shrimps, fishes were immature, except for one goatfish. Another trawling for 30 minutes was done but there was no catch. (See Table No. 7).

Fish Landing Samples

We spent one day conducting the fish landing survey during which all fish landed were by six trawlers and one purse seiner. (See Table No. 8) Miscellaneous fishes dominated the catch which was composed of juveniles of nemipterid, cavalla, grouper, spanish mackerel, mullet, pampano rays and some mature goatfish, lizard fishes, slipmouth, sardines and grunts. Next to the miscellaneous fishes are the croakers, slipmouths, squids, cuttlefish which were one foot in length, big-eyed and mullets measuring six (6) inches in total body length. These mullets were in their juvenile stage. The catch from the purse seine was 300 kilos of garfishes with some flying fishes. Based on data gathered, both on the experimental trawling and the fish landing survey, the most common catch were slipmouths, glassfishes and croakers. Slipmouths, glassfishes and croakers were 50% mature and 50% immature, while tuna were all mature, cavalla, mackerel and sardines were mostly immature. Shrimps, crabs and sea mantis were of mature stage.

IV. REMARKS AND RECOMMENDATIONS:

— Maqueda Bay, Villareal Bay and part of Zumarraga Channel are of shallow waters with depth ranging from 1 to 11 meters.

— Experimental trawling showed small amounts of catch, sometimes none at all.

— Fish landing samples and samples taken from experimental trawling consisted mostly of immature fishes and some mature ones.

— Plankton samples showed plenty of fish eggs and fish larvae.

— Temperature, salinity and oxygen content were conducive to mussel culture.

— The benthos pilot study served to delineate four general sediment types in the survey area. This information will

Table No. 7

SAMAR

September 27, 1975

Trawling No. 1 - Maqueda Bay (Basiao Island)
50 minutes dragging

1 cm. - mesh size
2-3 knots = towing speed
3.187 kilos = total catch

Catch Composition

Squids	- 0.65 k
Shrimps	- 0.03 k
Blue crabs	- 0.02 k
Grunt	- 0.50 k
Dilis	- 0.02 k
Flatfishes	- 0.02 k
Big-eyed	- 0.05 k
Nemipterid	- 0.02 k
L. splendens	- 0.26 k
Slipmouth	- 0.04 k
Glassfish	- 1.56 k
Catfish	- 0.02 k
	3.19 k

size range of slipmouth	- 31 mm - 88 mm	
size range of glassfish	- 58 mm - 86 mm	
size range of sea catfishes	- 55 mm - 68 mm	(fry)
size range of flatfishes	- 60 mm - 63 mm	"
size range of slipmouths	- 81 mm -109 mm	
size range of grunts	-100 mm -125 mm	

September 29, 1975

Trawling No. II - Maqueda Bay (Inner)
52 minutes dragging

Catch Composition

1 big mullet	- 450 mm -	- 1.3 k
2 small mullets	- 140 mm -	- .6 k
Cavalla	- 110 mm - 250 mm	- .81 k
Sardines	- 80 mm - 170 mm	- .80 k
Goatfish	- 142 mm -	- .04 k
Pampano	- 132 mm -	- .04 k
Shrimp	- 135 mm -	- .01 k
Crabs	- 65 mm - 115 mm	- .11 k
Slipmouth	- 37 mm - 78 mm	-
Flatfishes	- 66 mm - 68 mm	-
Anchovies	- 66 mm - 82 mm	-
	Total Catch	- 3.31 kilos

September 30, 1975

Trawling No. III - Zumarraga Channel - one hour dragging

Catch Composition:

squids	1.30 k	- size range - 35 mm - 134 mm
croakers	1.40 k	- size range - 53 mm - 109 mm
unidentified fish	0.19 k	- size range - 79 mm - 126 mm
goatfish	1.00 k	- size range -
"papakol"	0.11 k	- size range -
anchovies	0.02 k	- size range - 80 mm - 83 mm
slipmouth	0.11 k	- size range - 70 mm - 98 mm
sea manthis	0.03 k	-
glassfish	2.09 k	
crabs	0.60 k	- size range - 40 mm - 74 mm
Total catch	5.75 kilos	

October 1, 1975

Trawling No. IV - Villareal Bay - one hour dragging

Catch Compositions:

goby	0.38 k	- size range - 105 mm - 126 mm
croakers	0.38 k	- size range - 45 mm - 74 mm
glassfish	0.15 k	- size range - 34 mm - 67 mm
crabs	0.03 k	-
shrimps	0.10 k	
sea manthis	0.02 k	
L. splendens (slipmouth)	0.11 k	- size range - 31 mm - 70 mm
flatfish	0.01 k	
L. spp. (slipmouth)	1.34 k	- size range - 61 mm - 48 mm
squids	0.50 k	
total catch	3.02 k	

October 2, 1975

Trawling No. V - Villareal Bay - one hour dragging, a total catch of 0.5 k

Catch composition:

1 big goatfish
1 small goatfish - immature
1 crab
3 big shrimps - mature
lizard fishes - immature
shrimps - immature - size range - 77 mm - 130 mm
slipmouth - immature
sea catfish - fry

October 2, 1975

Trawling No. VI - Villareal Bay - for 30 minutes dragging we did not catch anything

October 3, 1975 - FISH LANDING SAMPLES - TRAWL

total weight - 4 kilos

Catch composition		we (kg.)
Slipmouth	- Total no. of samples - 63 size range - 72 mm - 128 mm about 50% are of stage IV & V and 50% are of stage I - III	0.60
Tuna	- Total no. of samples - 6 size range - 212 mm - 342 mm about 83.3% are stage IV 16.3% are of stage V	2.40
Hasa-hasa	- Total no. of samples - 7 size range - 168 mm - 207 mm all 6 samples were of immature, only one at stage V.	0.50
Sardines	- Total no. of samples - 9 size range - 102 mm - 166 mm most are of stage I & II.	0.20
Salay-salay	- Total no. of samples - 8 size range - 105 mm - 128 mm most are mature.	0.10
Slipmouth	- Total no. of samples - 14 size range - 70 mm - 150 mm	-
Dilis	- Total no. of samples - 8 size range - 73 mm - 90 mm	0.40
		4.20k

Table No. 8

CATCH COMPOSITION — FISH LANDING SURVEY

September 30, 1975 - 1600H - 1700H

TRAWL	1		2		3		4		5		6		Total	
	kg.	%	kg.	%	kg.	%	kg.	%	kg.	%	kg.	%	kg.	%
Cuttlefish (1 ft.)	30	72.27											30	4.23
	0.5	1.20											.5	0.07
Flatfishes	0.5	1.20											.5	0.07
Lizard Fish	0.5	1.20											.5	0.07
Glass Fish	0.5	1.20												
	10.0	24.09	60	29.28	120	49.99	140	87.50	50	100	6.5	52.00	386.5	54.50
Miscellaneous													35	4.94
			35	17.08									110	15.51
Squids			110	53.6									120	16.92
					120	49.99								
Slipmouth							20	12.50					20	2.82
Croaker											5	40	5	0.71
Big-eye											1	8	1	0.41
Mullet (6")														
Sp. mackerel (1 ft.)														
TOTAL	41.5	99.96	205	100.4	240	99.98	160	100	50	100	12.5	100	709.0	99.98

	kg.	%
Purse seine		
Garfishes	300 k	98.34
Flying fishes	5 k	1.64
Total	305 k	99.98

Note: Mackerel schools consist mainly of juvenile forms of hemiptrid, cavalla, grouper sp.

enable the forthcoming survey to perform a random sampling survey based on the stratification of the sediment types, which will allow an accurate quantitative analysis of the community structure in the proposed sanctuary site.

— The apparent high productivity of the area as evidenced by the plankton blooms and high oxygen content can support a large bivalve population but it may serve as a selective advantage to bivalve competitors as well. The mussel farm in the area could be useful in conducting comparative studies of competitive factors affecting harvest capabilities.

— Observations made during the survey present only the existing conditions at that particular time.

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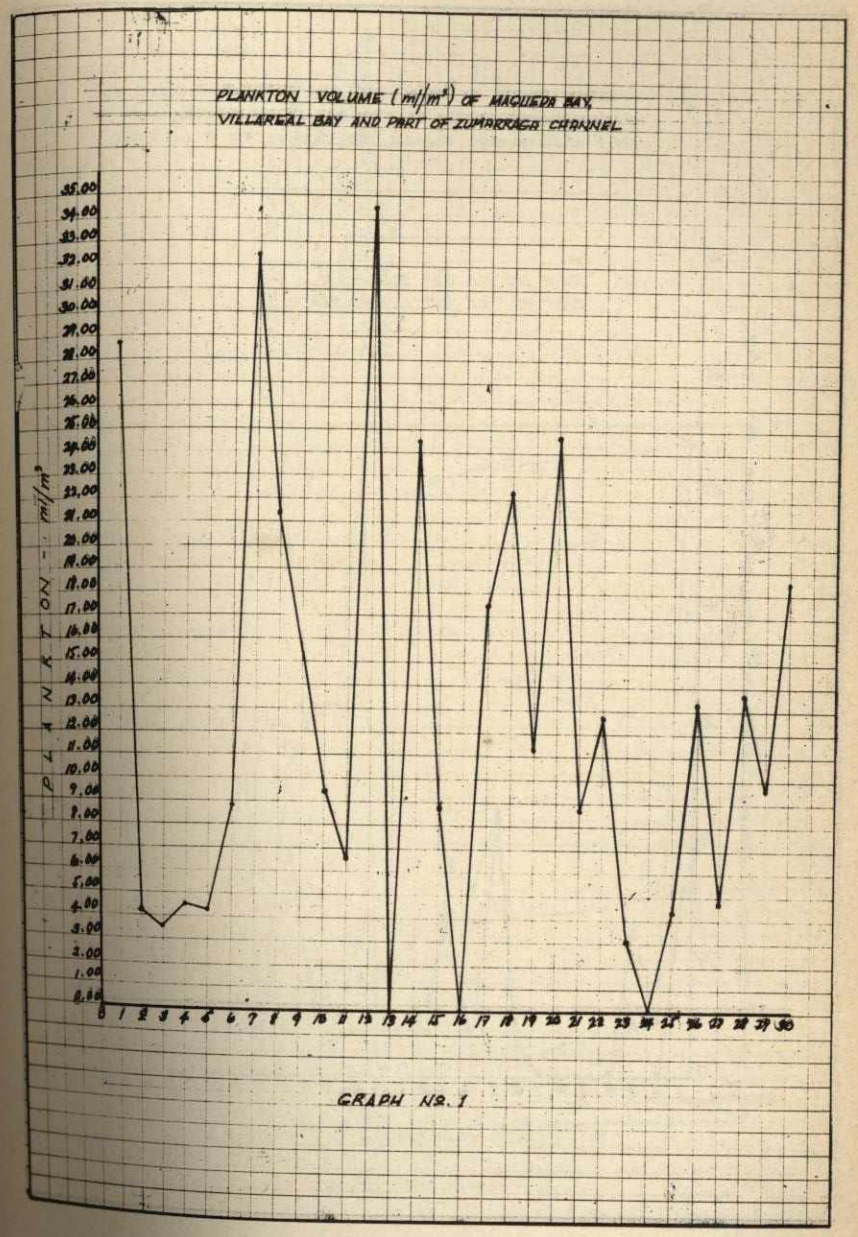
LITERATURE CITED

LIE, ULF. (1969). Standing Crop of Benthic Infauna in Puget Sound off the coast of Washington, J. Fish. Res. Bd. Canada 26:55-62.

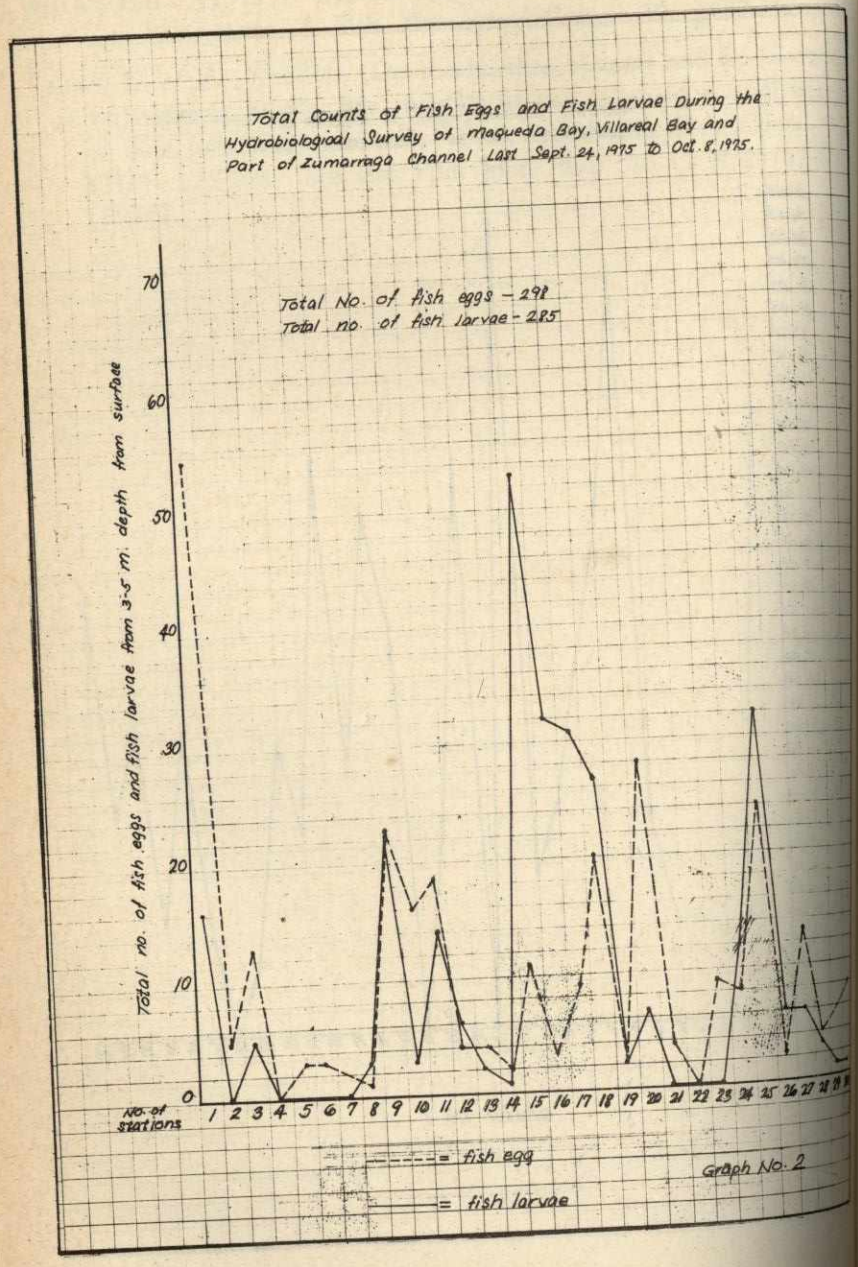
LIE, U. and J.C. KELLYA. (1970). Benthic infauna communities of the coast of Washington and in Puget Sound: Identification and distribution of the communities. J. Fish. Res. Bd. Canada 27: 621-651.

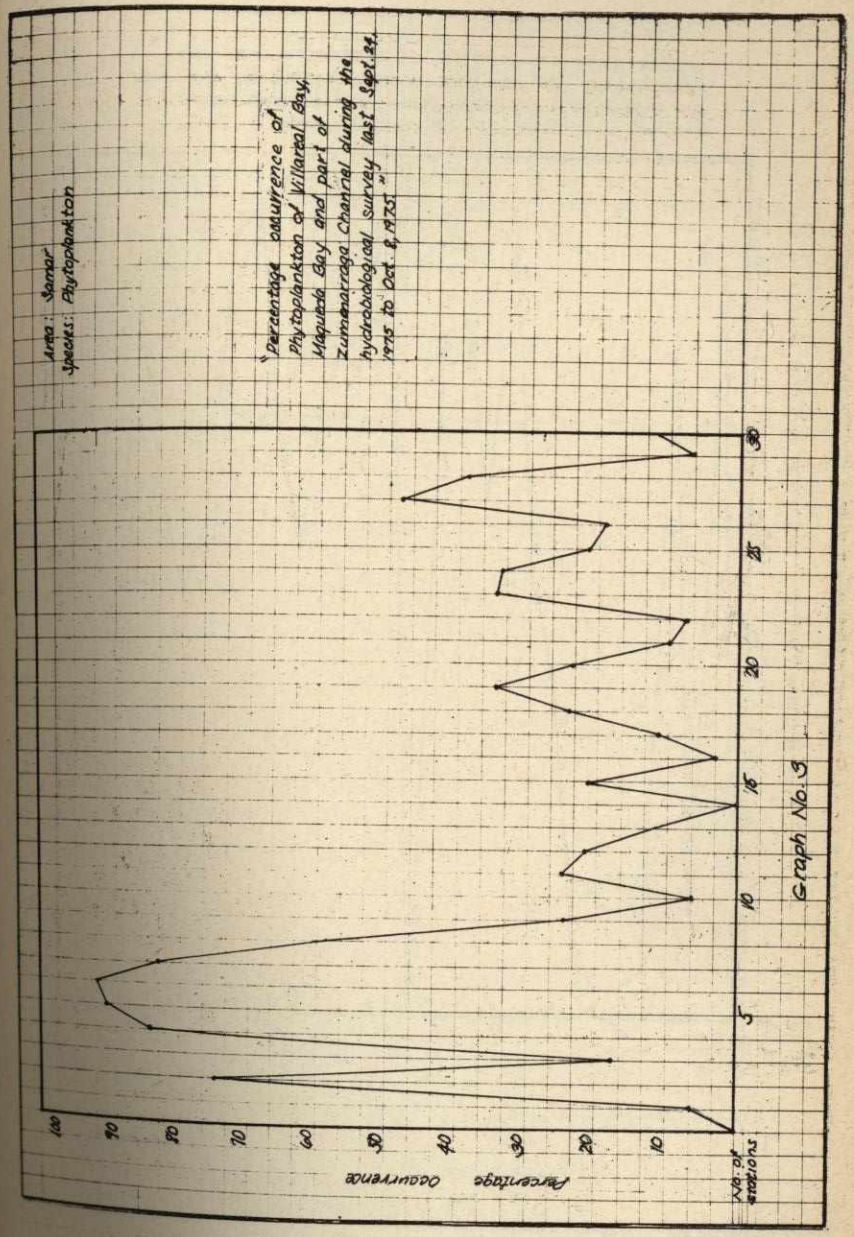
MILLS, E.L. (1975). Benthos Organisms and the Structure of Marine Eco-systems. J. Fish. Res. Board Canada 32: 1657-1663.

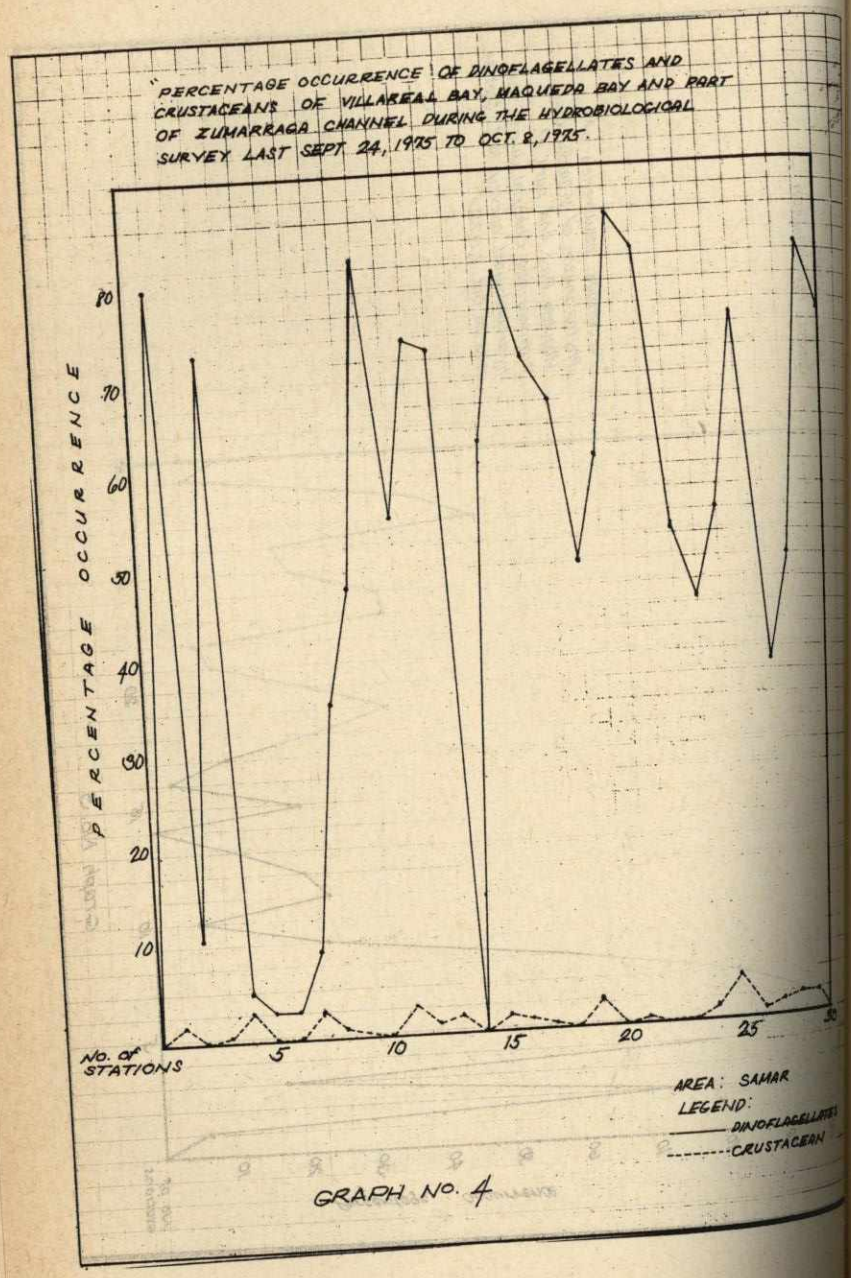
TIEWS, K. *et al.* (1959). On the benthos biomass and its seasonal variations in Manila Bay and San Miguel Bay and a comparison of their foraminiferans fauna. Proc. Indo-Pacific Fish. Coun., 13 (III): 121-138. See also Phil. Jour. Fish. 10 (1 & 2) 57-84, (1972).



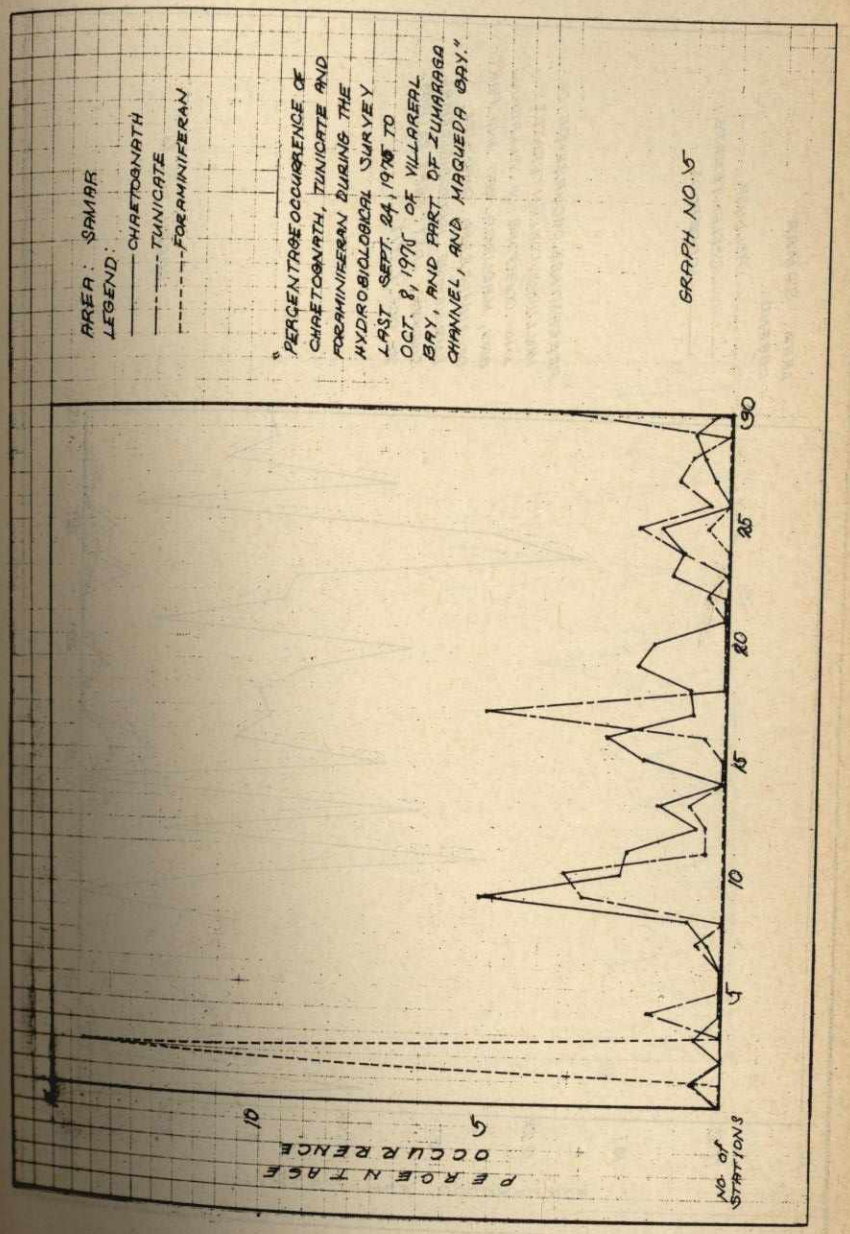
GRAPH NO. 1

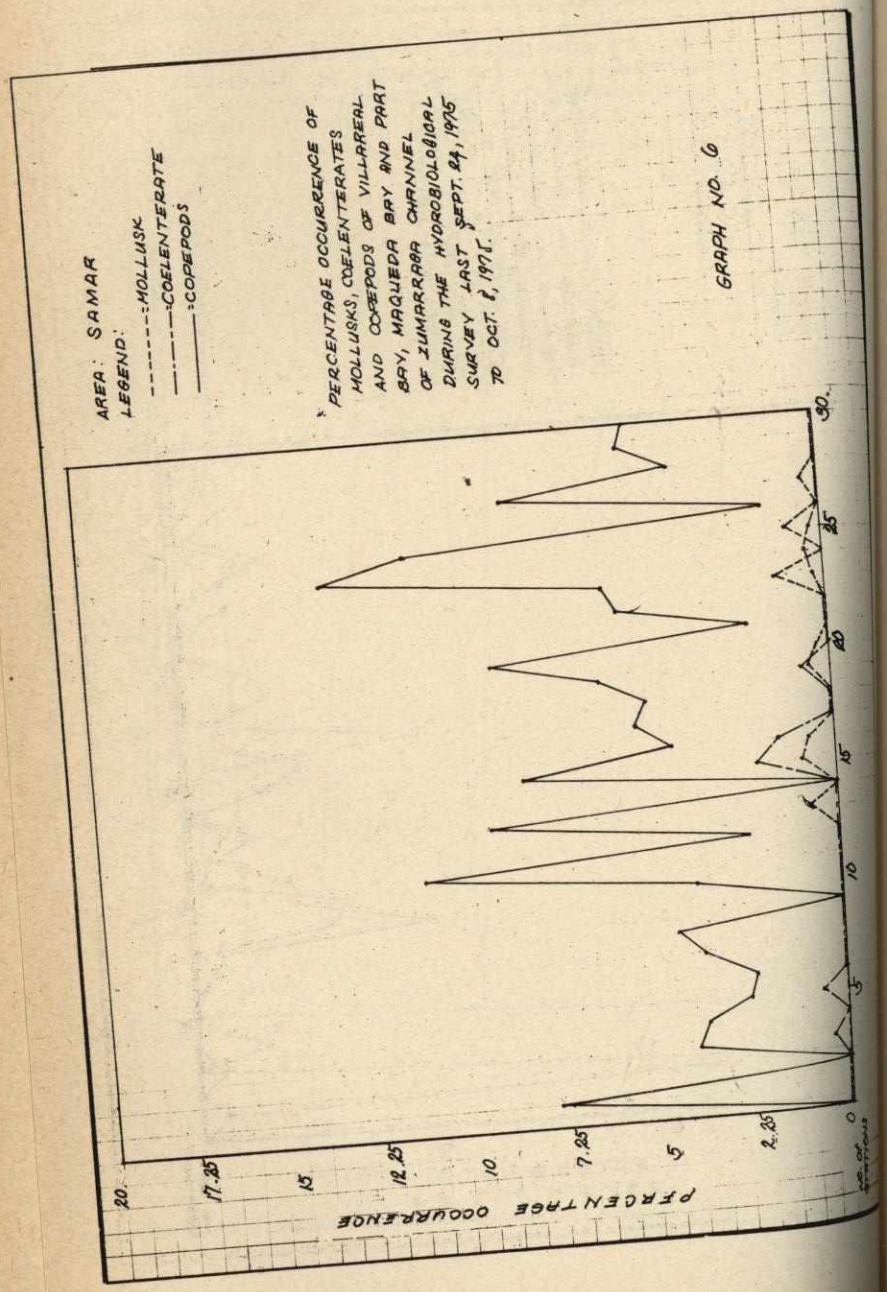

Total Counts of Fish Eggs and Fish Larvae During the Hydrobiological Survey of Maqueda Bay, Villareal Bay and Part of Zumarraga Channel Last Sept. 24, 1975 to Oct. 8, 1975.
Total No. of fish eggs - 298
Total no. of fish larvae - 285
Total no. of fish eggs and fish larvae from 3-5 m. depth from surface
No. of stations
= fish egg
= fish larvae
Graph No. 2

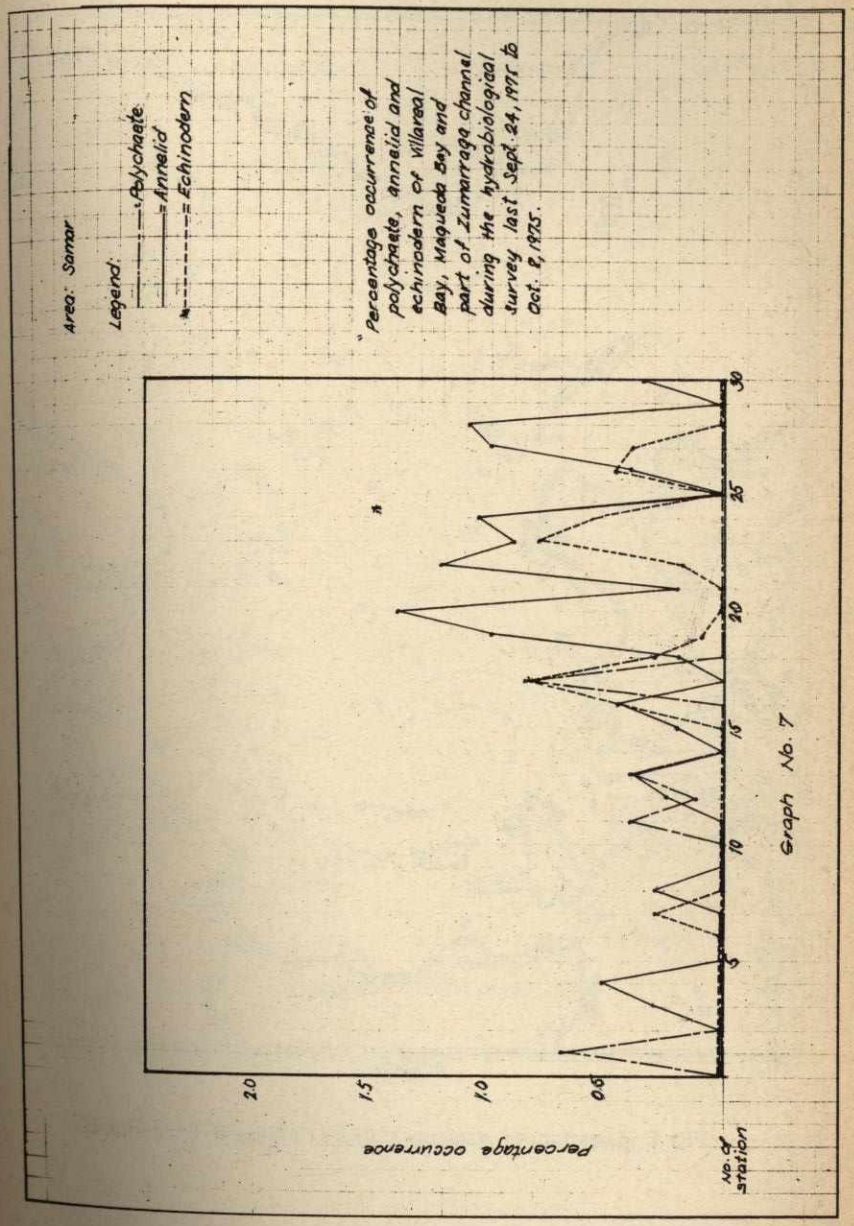

Area: Samar
Species: Phytoplankton
"Percentage occurrence of Phytoplankton of Villareal Bay, Maqueda Bay and part of Zumarraga Channel during the hydrobiological survey last Sept. 24, 1975 to Oct. 8, 1975."
Percentage occurrence
No. of stations
Graph No. 3


"PERCENTAGE OCCURRENCE OF DINOFLAGELLATES AND CRUSTACEANS OF VILLAREAL BAY, MAQUEDA BAY AND PART OF ZUMARRAGA CHANNEL DURING THE HYDROBIOLOGICAL SURVEY LAST SEPT 24, 1975 TO OCT. 8, 1975.
PERCENTAGE OCCURRENCE
80
70
60
50
40
30
20
10
5
10
15
20
25
30
NO. of STATIONS
AREA: SAMAR
LEGEND:
DINOFLAGELLATES
CRUSTACEAN

GRAPH NO. 4


AREA: SAMAR
LEGEND:
CHAETOGNATH
TUNICATE
FORAMINIFERAN
"PERCENTAGE OCCURRENCE OF CHAETOGNATH, TUNICATE AND FORAMINIFERAN DURING THE HYDROBIOLOGICAL SURVEY LAST SEPT. 24, 1975 TO OCT. 8, 1975 OF VILLAREAL BAY, AND PART OF ZUMARRAGA CHANNEL, AND MAQUEDA BAY."
GRAPH NO. 5
PERCENTAGE OCCURRENCE
5
10
15
20
25
30
NO. of STATIONS


AREA: SAMAR
LEGEND:
MOLLUSK
COELENTERATE
COPEPODS
PERCENTAGE OCCURRENCE OF MOLLUSKS, COELENTERATES AND COPEPODS OF VILLAREAL BAY AND PART OF ZUMARRAGA CHANNEL DURING THE HYDROBIOLOGICAL SURVEY LAST SEPT. 24, 1935 TO OCT. 8, 1935.
GRAPH NO. 6
PERCENTAGE OCCURRENCE
20.
17.25
15
12.25
10
7.25
5
2.25
0
5
10
15
20
25
30
No. of Stations


Area: Samar
Legend:
Polychaete
Annelid
Echinoderm
Percentage occurrence of polychaete, annelid and echinoderm of Villareal Bay, Maqueda Bay and part of Zumarraga channel during the hydrobiological survey last Sept. 24, 1935 to Oct. 8, 1935.
Percentage occurrence
2.0
1.5
1.0
0.5
5
10
15
20
25
30
No. of station
Graph No. 7

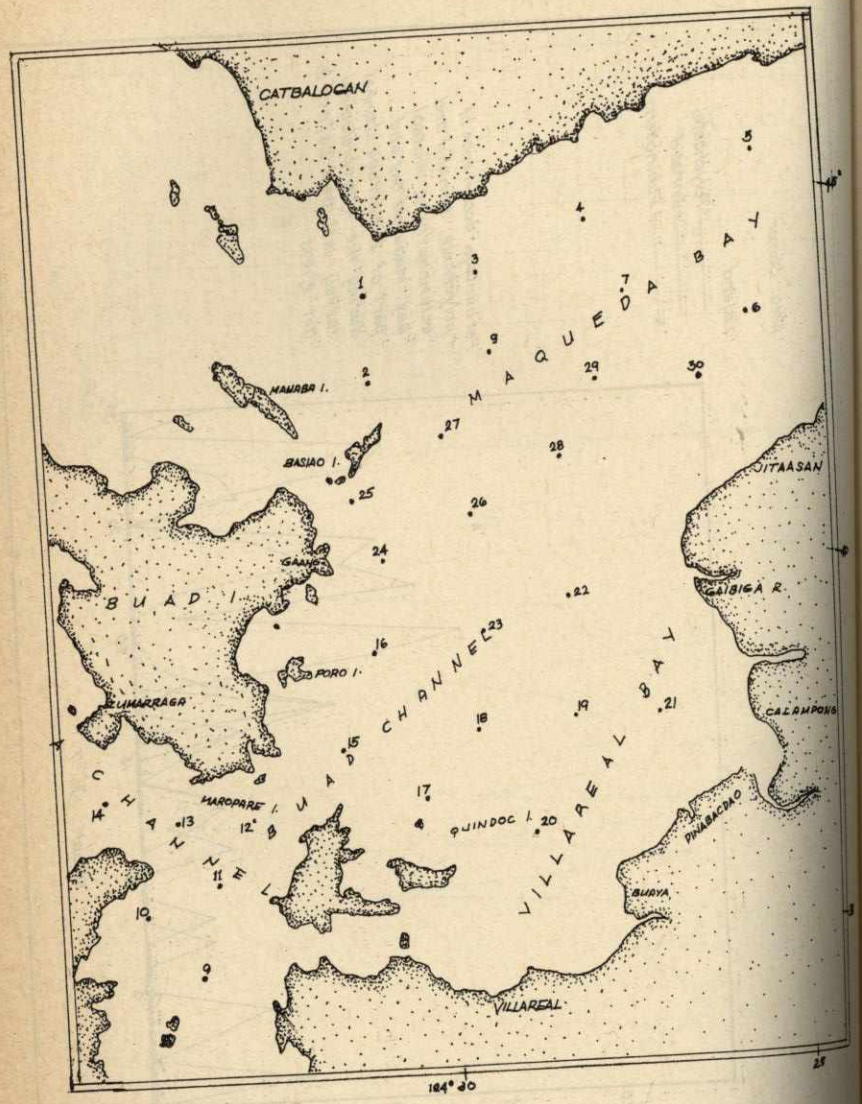


Fig. 1. Location of various stations indicated by numbers.

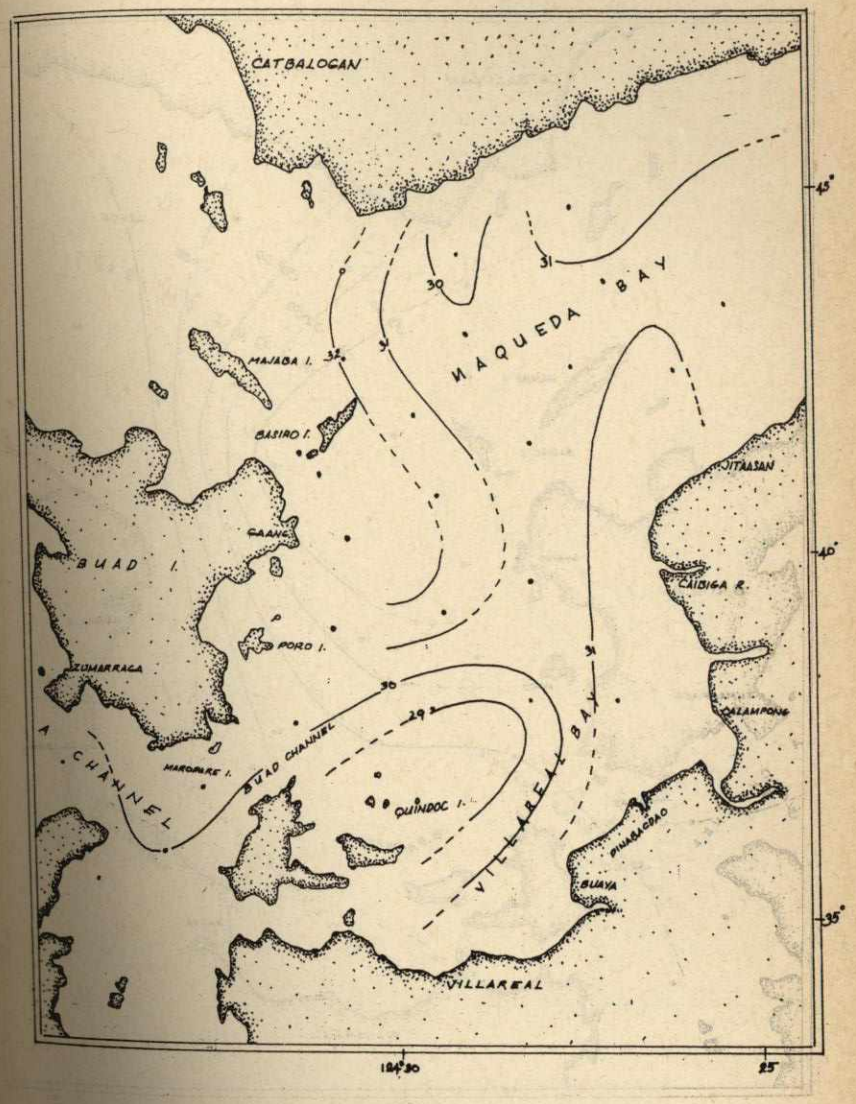


Fig. 2. Temperature of surface waters.

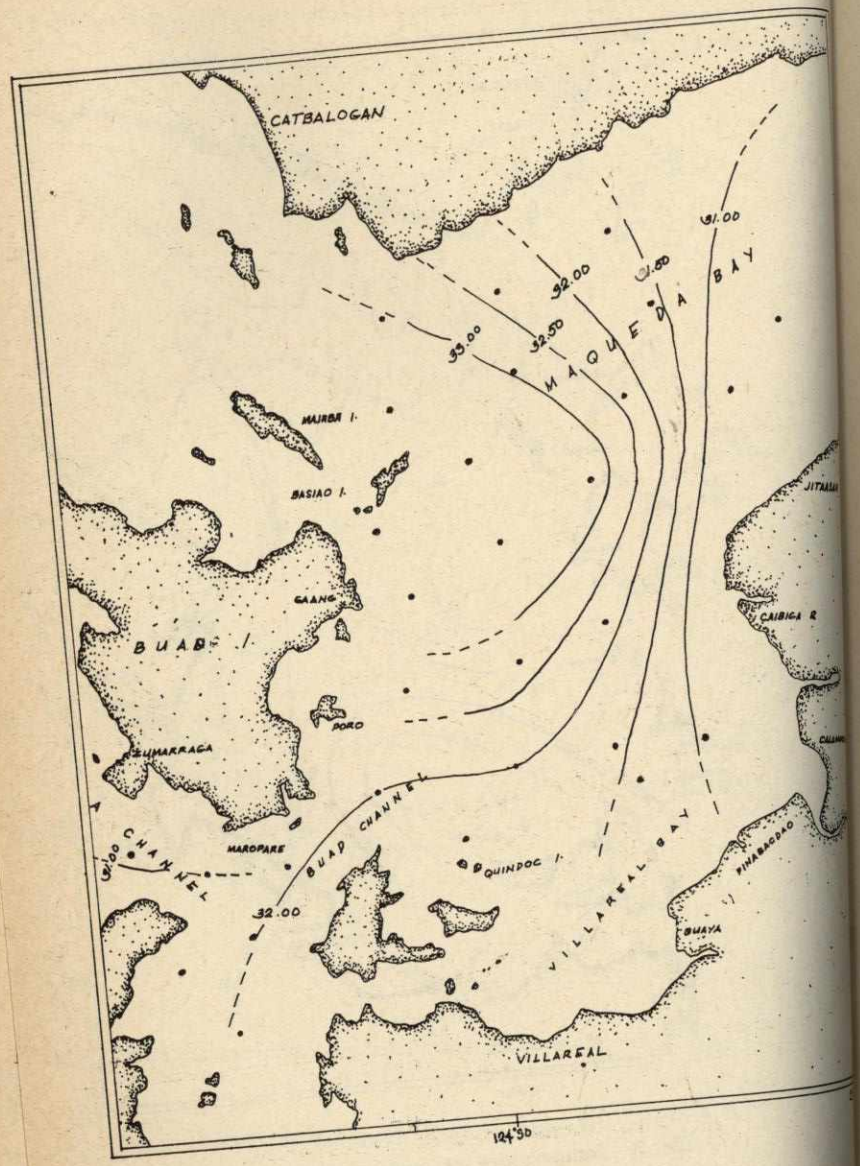


Fig. 3. Salinity of water surface.

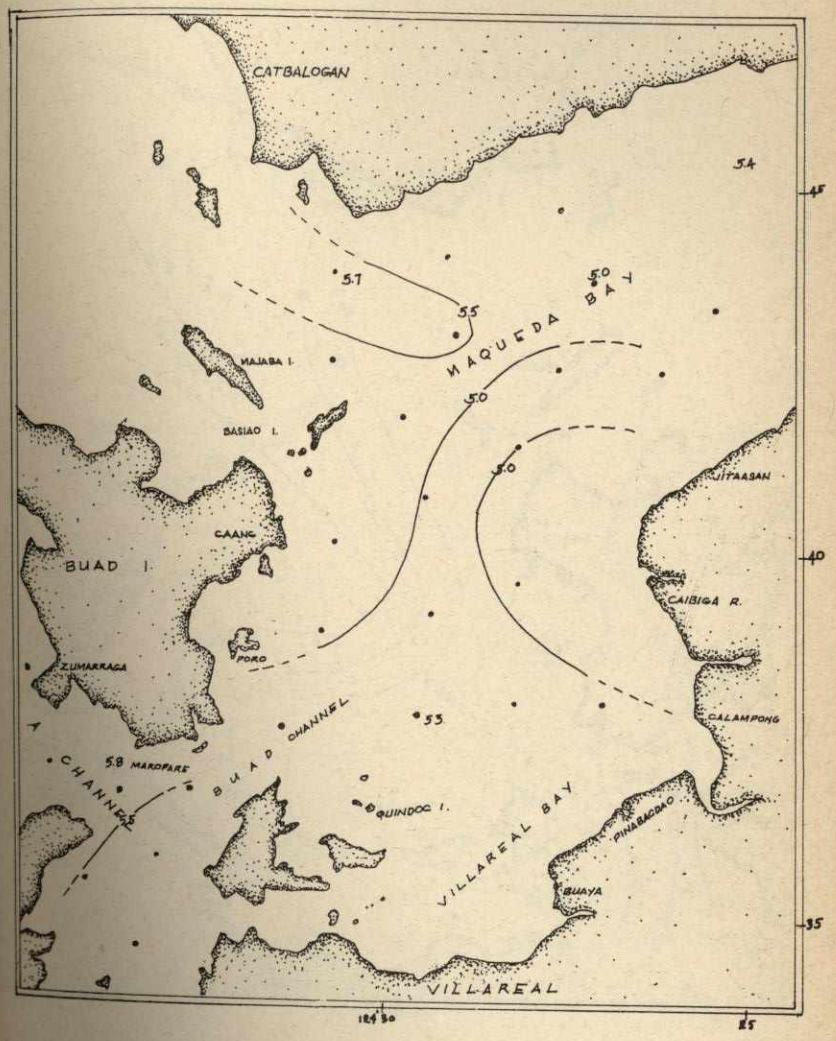


Fig. 4. Oxygen content of surface waters.

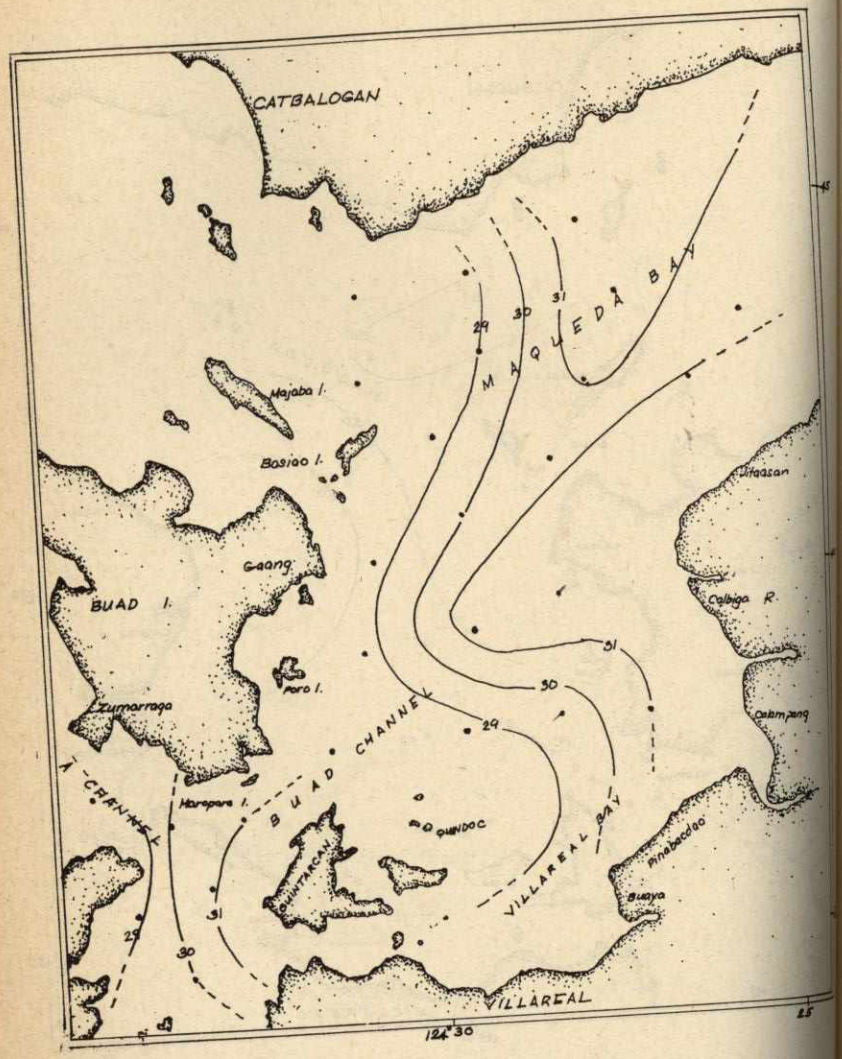


Fig. 5. Temperature of water at the middle.

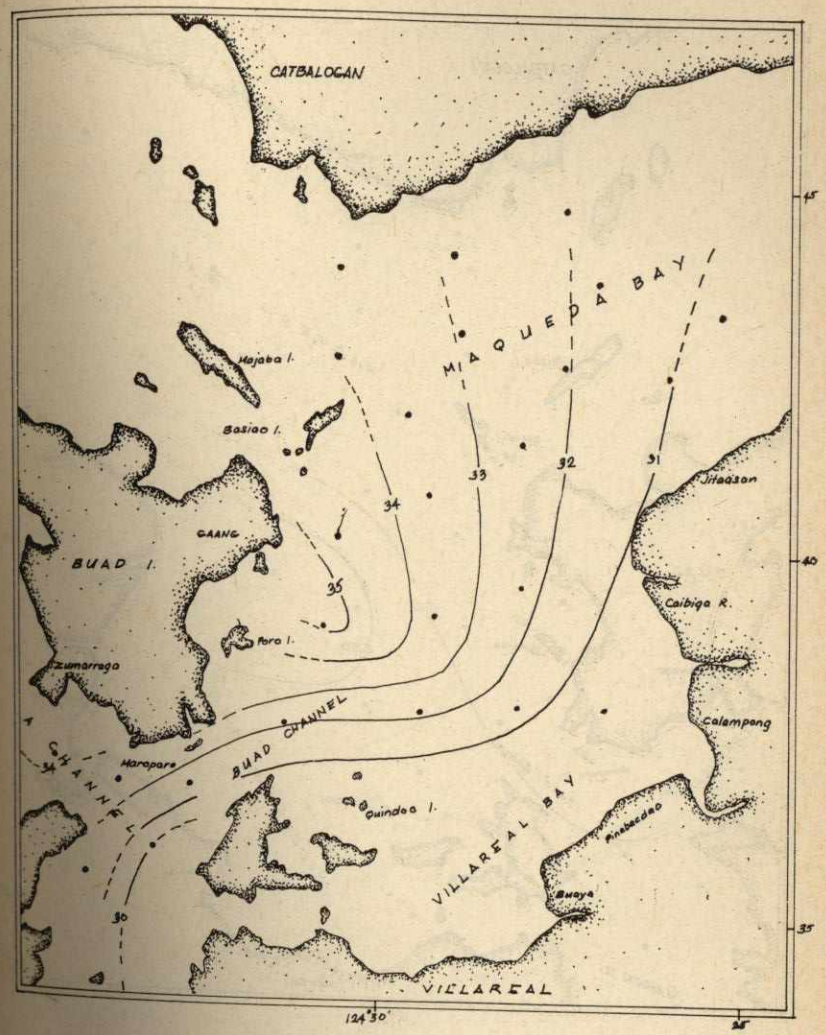


Fig. 6. Salinity of water at the middle.

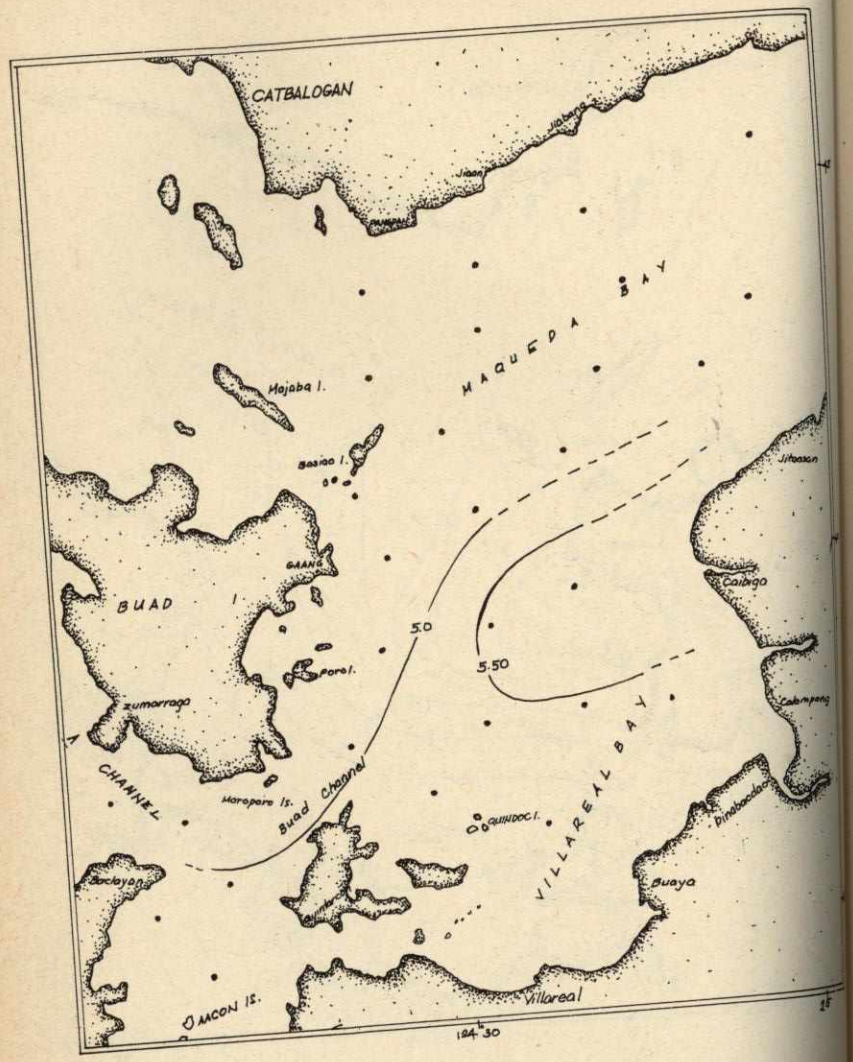


Fig. 7. Oxygen content of water at the middle.

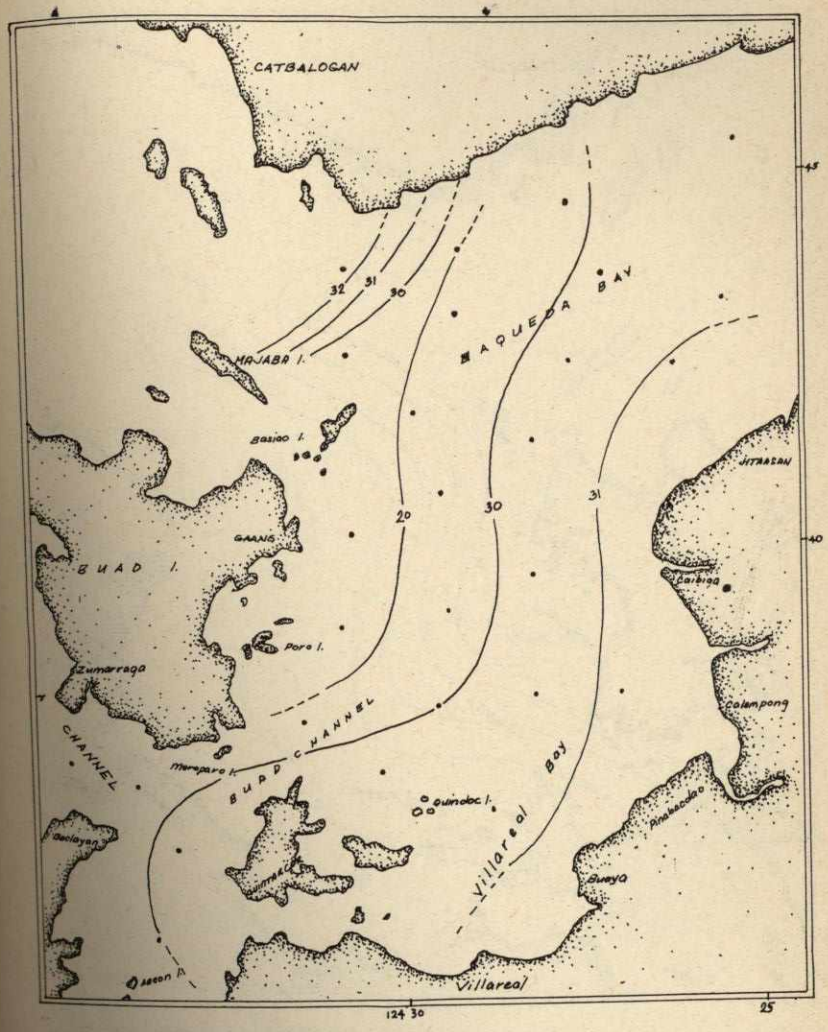


Fig. 8. Temperature of bottom waters.

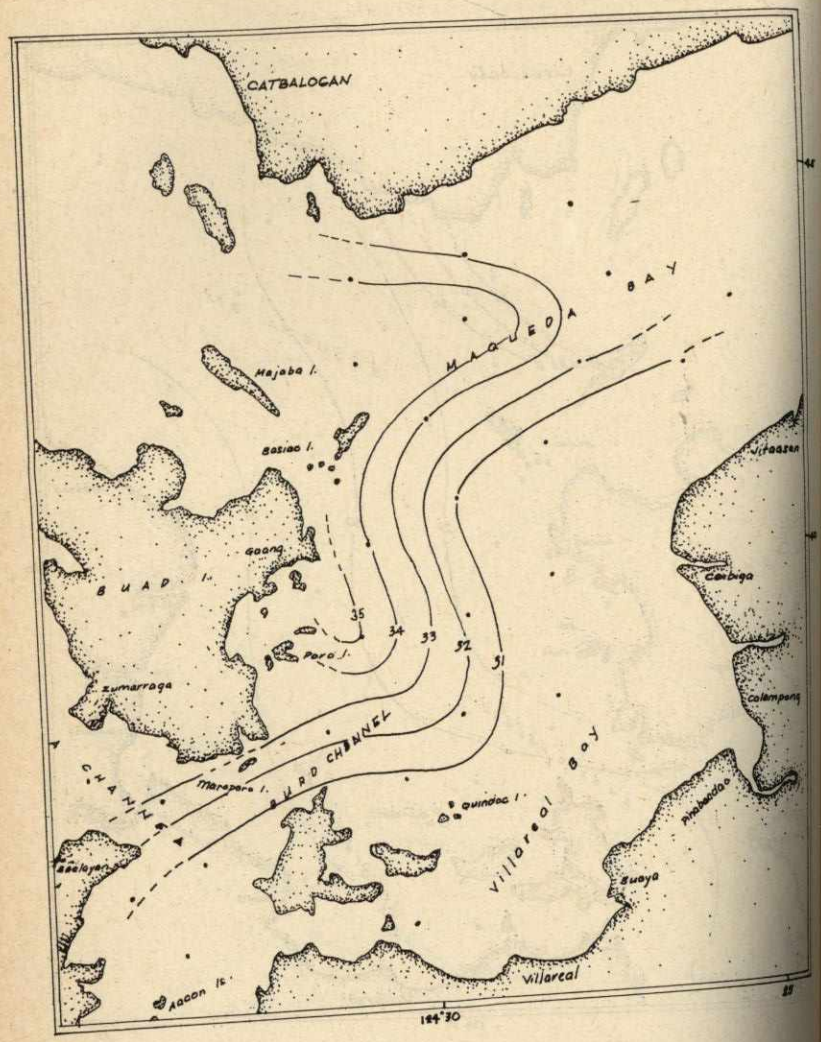


Fig. 9. Salinity of bottom waters.

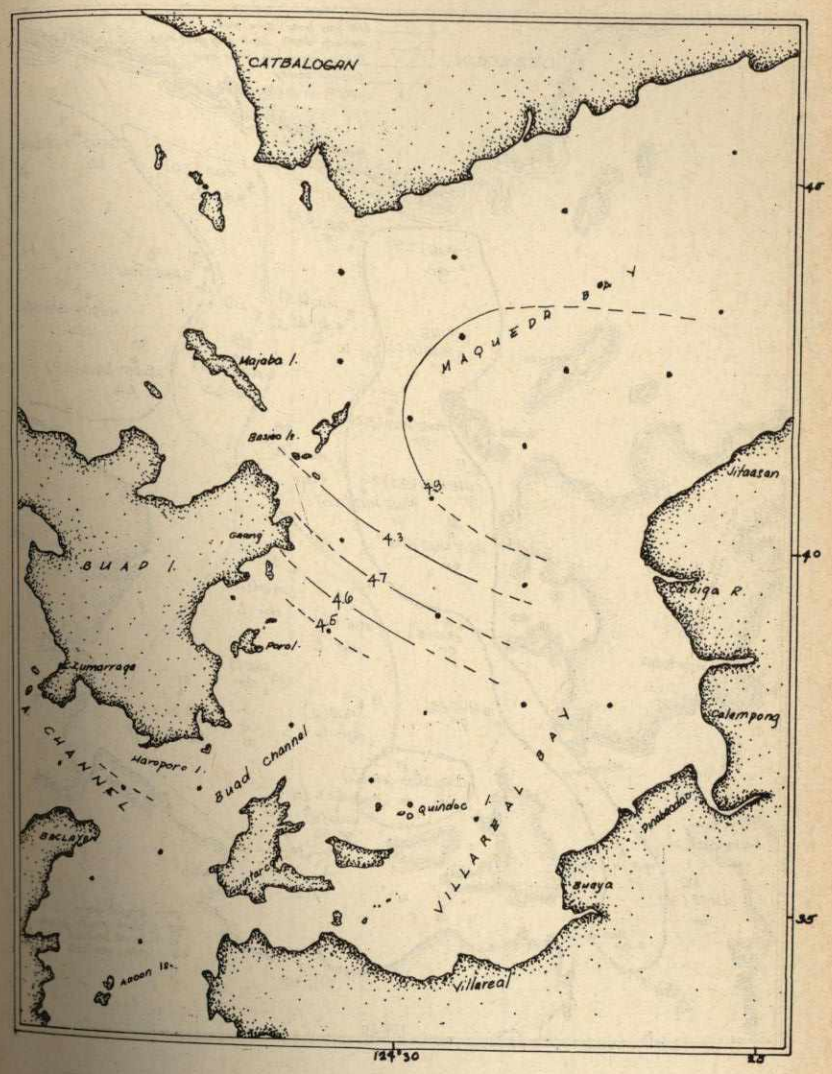


Fig. 10. Oxygen content of bottom waters.

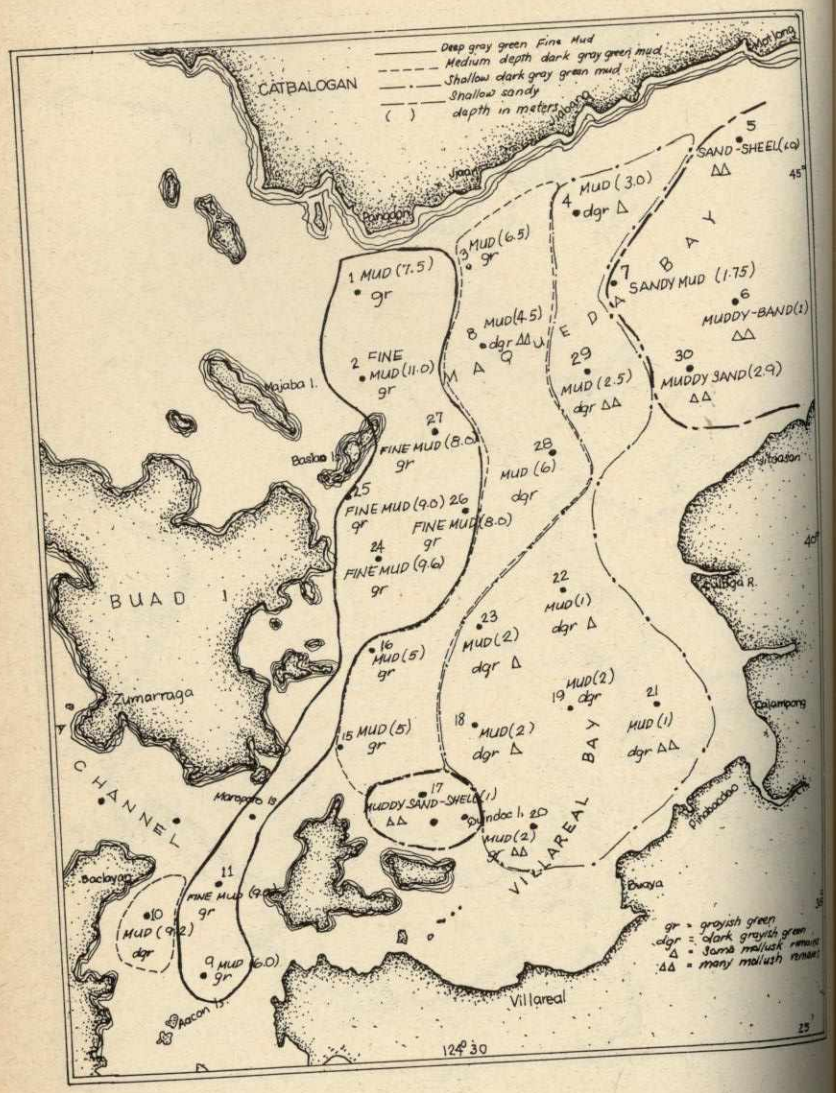


Fig. 11. Nature of Sea bottom.

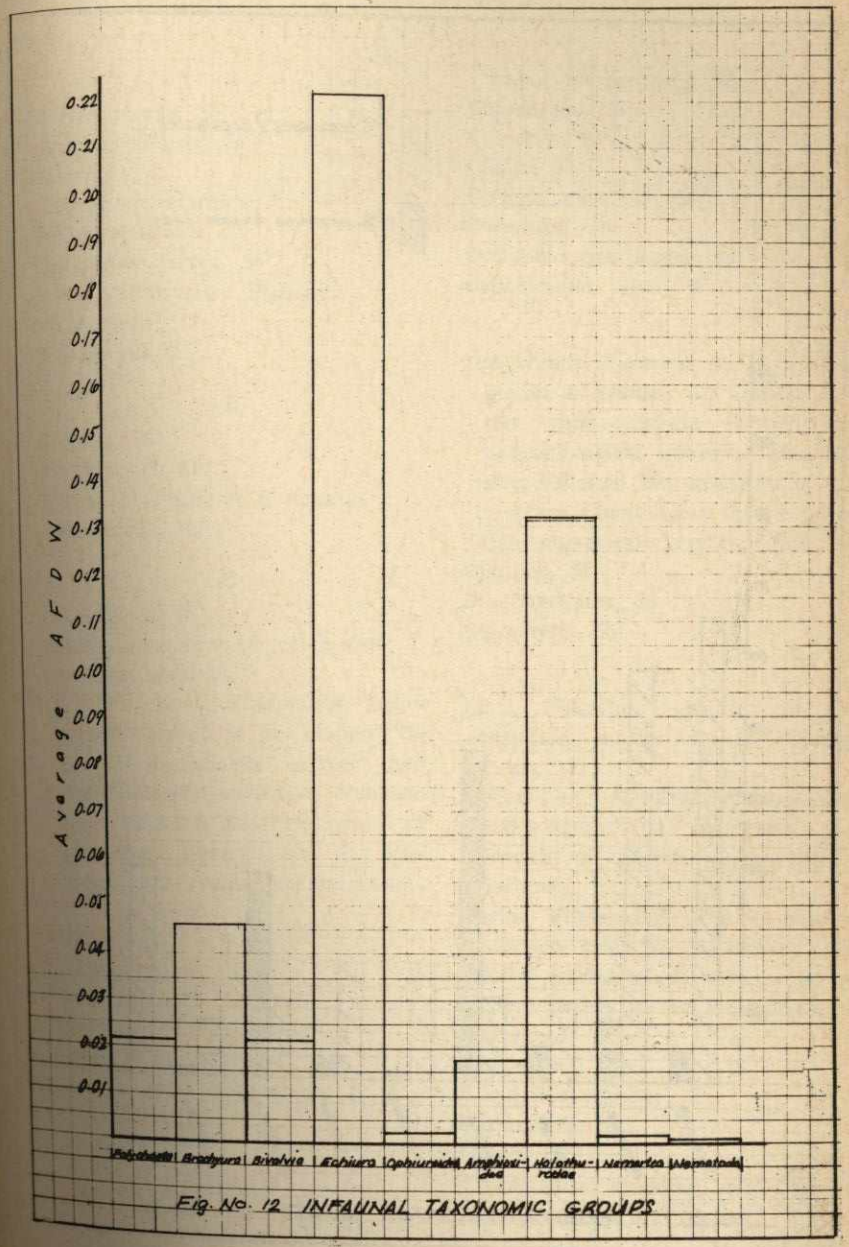


Fig. No. 12 INFAUNAL TAXONOMIC GROUPS

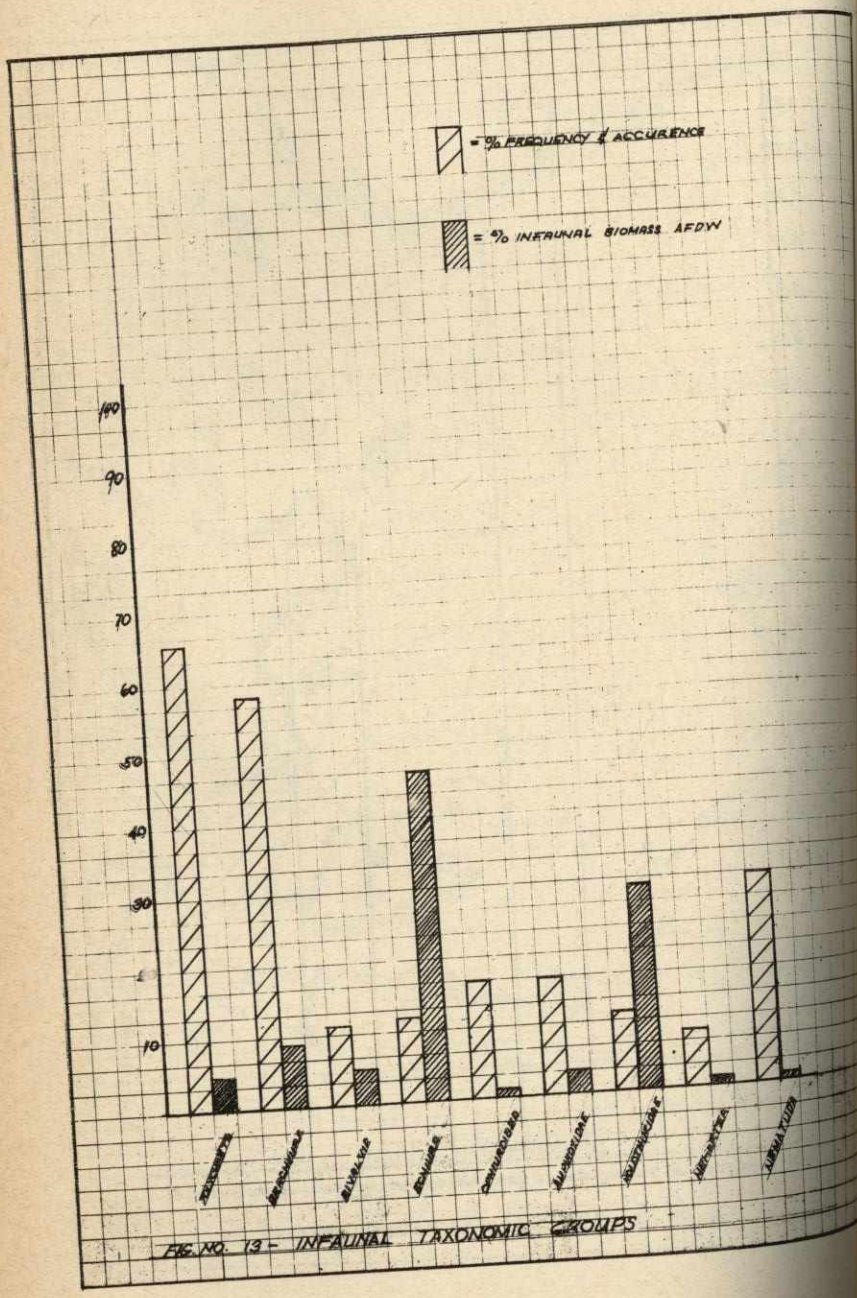


FIG. NO. 13 - INFAUNAL TAXONOMIC GROUPS