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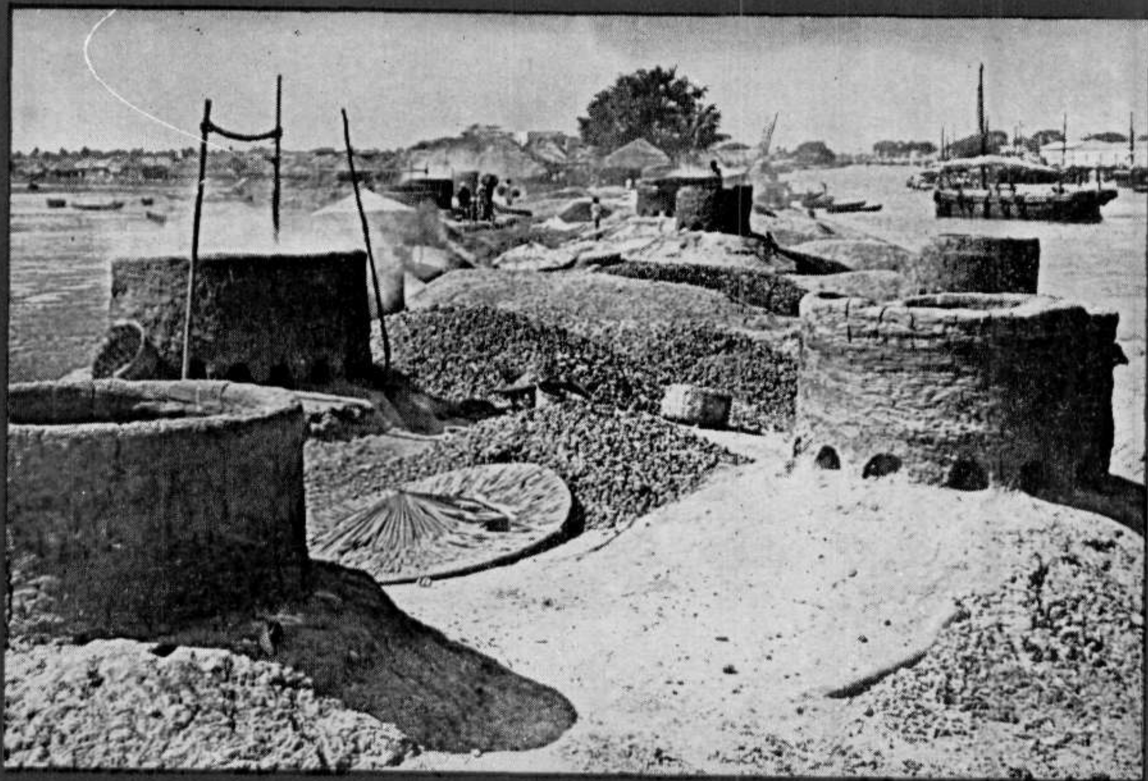

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation - *Mar. Fish. Infor. Ser. T & E Ser.*, No. 59: 1984

CONTENTS

Cover photo: Heaps of lime collected by fishermen and kilns in which the shells are processed for commercial purposes at Kakinada

THE MOLLUSCAN RESOURCES AND ECOLOGY OF KAKINADA BAY

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Introduction

In the Kakinada Bay several species of bivalves and gastropods are regularly fished and the annual production has been estimated to be about 6,000 t (Narasimham, 1973). Among them the windowpane oyster *Placenta placenta* (Linnaeus) and the blood-clam *Anadara granosa* (Linnaeus) are of particular interest. In India the latter forms a fishery only in Kakinada Bay while the former is fished also in Pindara Bay in the Gulf of Kutch and in Goa. The molluscs are mainly used as lime shell and the flesh is eaten locally to a limited extent. In general, the production during the last two decades has been static mainly due to low demand. However, in 1983 trial consignments of the frozen meat of the windowpane oyster and the blood-clam collected from the bay were exported to Japan by an entrepreneur and were received well. As the export market is being developed one would expect the picture to change rapidly. In the light of these developments it was felt that a quick survey of the bay to estimate the abundance of the constituent species would be useful to the industry. Further, such basic information is necessary to evolve, suitable managment policies. With these objectives a survey of the Kakinada Bay was conducted in March-April 1983. Also the results of a survey conducted in the last week of March 1979 of the Kakinada (Upputeru) canal have been incorporated in this report. Environmental data which may have bearing on the distribution and abundance of the molluscs were also collected.

Earlier works in the bay relevant to this study were mainly related to hydrography (Ramasarma and Ganapati, 1968), sediments and their organic carbon (Rao, 1967), bottom fauna (Radhakrishna and Ganapati, 1968) and molluscan resources (Narasimham, 1973 and Murthy *et al.*, 1979).

Physiography of the Bay

The bay lies between 16° 51′ N to 16° 59′ N and 82° 15′ E to 82° 22′ E and covers an area of 146 km². It opens into the Bay of Bengal in the north by a 5.6 km wide mouth, bordered on the west by mainland, on the south by extensive mangrove forests and on the east by a narrow sand bar called Hope Island (Fig. 1). It has a maximum length of 14.8 km and width of 13.0 km. The Kakinada (Upputeru) canal, Chollangi canal, Matlapalem canal, Coringa river, Gaderu river and Pillavarava creek, which

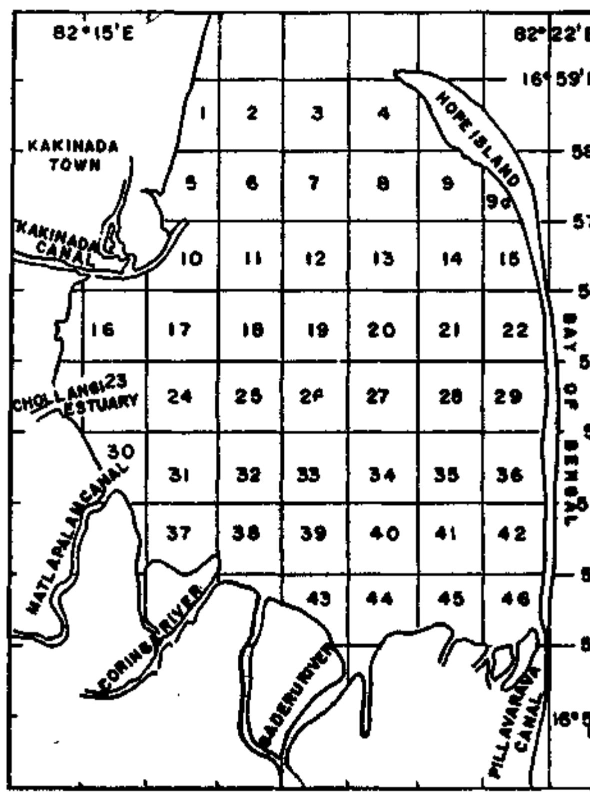


Fig. 1. Map of Kakinada Bay showing the squares.

are connected to the Gautami branch of the Godavari river, open into the Bay. It is shallow and large mud flats are exposed at low tide on the southern and western sides. The maximum depth is 6.8 m and only in the northern section, it is > 3 m. The tides are semidiurnal and the maximum amplitude during spring tides is 1.8 m.

Survey methods

Following Murthy *et al.* (1979), the Bay was divided into 47 squares, each measuring 1 sq. nautical mile or 3.43 km^2 excepting those bordering the land which are smaller (Fig, 1 and Table 1). A 4 m fibreglass dinghy fitted with 7.5 h.p. outboard motor was used in the survey conducted from 22-3-1983 to 28-4-1983. In each square the following equipments were used/ samples collected manually.

Table 1. *Square-wise extent and depth (at low tide) of the Kakinada Bay and the dates of the survey*

Square No.	Area (m^2)	depth (m)	Date of survey
1.	15,94,950	0.8	7-4-83
2.	34,29,904	2.4	27-4-83
3.	34,29,904	5.2	27-4-83
4.	33,18,525	6.8	27-4-83
5.	25,38,200	1.0	5-4-83
6.	34,29,904	2.2	6-4-83
7.	34,29,904	3.1	27-4-83
8.	34,29,904	4.6	23-4-83
9.	27,44,000	3.0	23-4-83
9a.	8,23,200	2.0	22-4-83
10.	20,83,725	0.4	22-3-83
11.	34,29,904	2.4	2-4-83
12.	34,29,904	2.6	4-4-83
13.	34,29,904	2.8	22-4-83
14.	34,29,904	2.0	22-4-83
15.	21,43,750	1.8	23-4-83
16.	34,29,904	0.0	25-4-83
17.	34,29,904	1.2	25-4-83
18.	34,29,904	1.5	25-3-83
19.	34,29,904	1.8	13-4-83
20.	34,29,904	1.8	13-4-83
21.	34,29,904	0.9	21-4-83
22.	28,72,625	0.9	23-4-83
23.	34,29,904	0.0	26-4-83
24.	34,29,904	0.3	26-4-83
25.	34,29,904	0.9	26-4-83
26.	34,29,904	1.0	11-4-83
27.	34,29,904	1.5	11-4-83
28.	34,29,904	0.9	11-4-83
29.	28,89,775	0.3	10-4-83
30.	25,21,050	0.0	26-4-83
31.	34,29,904	0.6	28-4-83
32.	34,29,904	0.6	21-4-83
33.	34,29,904	0.3	21-4-83
34.	34,29,904	0.6	21-4-83
35.	34,29,904	0.3	21-4-83
36.	28,12,600	0.6	12-4-83
37.	28,89,775	0.0	28-4-83
38.	34,29,904	0.6	20-4-83
39.	34,29,904	0.0	20-4-83
40.	34,29,904	0.1	20-4-83
41.	34,29,904	0.3	20-4-83
42.	29,58,375	0.1	12-4-83
43.	21,86,625	0.6	19-4-83
44.	32,07,050	0.3	19-4-83
45.	29,24,075	0 0	19-4-83
46.	26,32,525	0.1	12-4-83
Total	14,60,37,945		

1. A dredge of 0.5 m opening and with 15 mm synthetic yarn mesh (Pl. 1) was hauled 4-6 times, each haul covering 5m^2 area.

2. A clam seed sampler of 0.5 m opening and with 4 mm synthetic yarn mesh (Pl. 2) was hauled twice, each haul covering 1m^2. The samples obtained by these gears were sieved through 1 mm mesh, species identified, counted, weighed and specimens in the subsample measured for length in the anteroposterior direction.

3. Van Veen grab covering 10 cm x 10 cm was operated once and the material was sieved through 0.5 mm mesh.

4. Sediment collected by the grab was analysed for particle size by using test sieves. Wentworth's grade scale (Welch, 1948) was followed.

5. Organic carbon of the sediment collected by the grab was analysed by the chromic acid titration method (F.A.O. 1975).

6. 10-minute plankton hauls with plankton net of 50 cm ring diameter and 0.3 mm mesh size were made. Subsamples were made using Folssom plankton splitter (Wickstead, 1976), and studied. The organisms were counted and estimates were made for whole sample.

7. Surface water samples were collected and analysed for temperature, salinity (Mohr's titration method), dissolved oxygen (Winkler's method), inorganic phosphate, silicate, nitrite and nitrate (Calorimetric method using spectrophotometer). Wherever desired transparency was studied. The samples were collected during 0600 to 1200 hrs. The Kakinada canal concrete embankments were surveyed by fixing stations 200 m apart and collecting samples from 1 m^2 area at each station.

Hydrography

Transparency: The water was highly turbid with secchi-disc reading not exceeding 50 cm except on the northeastern side where it was clear with secchi-disc values upto 150 cm.

Temperature: Water temperature varied from 25.6° to 32.5°C with maximum in square 22 and minimum in squares 20 and 21 (Fig. 2).

Salinity: Salinity values ranged from 28.9‰ to 35.0‰ (Fig. 3) with maximum in square 20 and minimum at Kakinada canal confluence (square 5) and Coringa confluence (square 38).

Dissolved oxygen: The range in the dissolved oxygen values observed was from 2.0 ml/l in squares 20 and 21 to 7.0 ml/l in squares 14, 23 and 41 (Fig. 4). The distribution of the low values of dissolved oxygen indicated the formation of an eye in the circulation pattern around squares 20 and 21 which is associated with low temperature and high salinity profile.

Inorganic phosphates: Phosphate values ranged between 1.00 and 3.00 μ g at/l (Fig. 5). The tidal flats on the western side had maximum phosphate content (2.7–3.0 μ g at/l) which may be due to land drain by the Kakinada, Chollangi and Matlapalem canals. Similarly the Pillavarava confluence on the southeastern side was relatively rich in phosphates (1.82–2.2 μ g at/l). While the Gaderu and the Coringa confluences had moderate phosphate content (1.2–1.85 μ g at/l) lowest values were obtained on the northeastern side of the bay in squares 8, 9 and 20.

Silicate: The values varied from 11.0 to 67.0 μ g at/l with maximum around Coringa confluence (squares 32 and 38) and minimum in square 8 (Fig. 6). The distribution showed low values (11–22 μ g at/l) on the northern side of the bay. However, a patch of high silicate values was recorded in squares 15 and 22, close to the bay opening into the sea.

Nitrite: The range in the nitrite values fluctuated between 0.36 and 1.45 μ g at/l with maximum in square 21 and minimum in square 8 (Fig. 7), where the silicate was also low. Similarly Coringa confluence had high nitrite content (1.21–1.33 μ g at/l) as is the case with silicate.

Nitrate: The values ranged from 1.1 to 4.0 μ g at/l with maxima in squares 1, 2, 4, 21, 22 and 23 (Fig. 8) and minimum at Pillavarava confluence. In general in the southern and western parts the nitrate was present in moderate concentrations.

Zooplankton: The foraminifera was represented by *Globigerina* sp. *Obilia* spp., *Liriope tetraphylla, Eutima mira, Aequorea* spp., *Aurelia* spp., *Bougainvillia* spp. and *Phialidium* spp. were the representative hydromedusae. On an average they formed 0.5% in zooplankton and were abundant in squares 41, 46 and 29. Siphonophores formed about 0.3% and were represented by *Lensia* spp., *Muggiaea* spp, *Dimophyes* spp. and *Eudoxides* spp. Ctenophores formed on an average 0.3% and were represented by *Beroe* spp. and *Pleurobrachia* spp. The chaetognaths contributed about 0.6% and the common species were *Sagitta inflata* and *S. robusta.* Cladocera and ostracoda accounted for 0.3% and were commonly represented by *Evadne* sp. and *Cypridina* spp.

At different stations the copepods contributed from 0.2 to 91.0% in total zooplankton (average 11.6%). Calanoid genera were common and were represented by *Calanus, Rhincalanus, Eucalanus, Calocalanus, Paracalanus, Pseudocalanus, Microcalanus Eucaheta, Temora, Centropages, Labidocera, Parapontella* and *Acartia.* Other genera in the samples were *Oithona, Corycaeus, Euterpina* and *Microstella.* Parasitic forms *Lernaea* spp. and *Caligus* spp. were encountered in squares 4, 10, 13, 19, 24–26, 32, 33, 43 and 44.

The amphipods formed less than 0.2%; *Hyperia* spp. and *Corphium* spp. being the common. The appendicularians constituted less than 0.2%. Adult decapods were represented by *Acetes indicus* and *Lucifer* spp. and they contributed from 0.02 to 84.4% in different squares with an average of 13.6%.

The decapod larvae contributed from 0.03 to 65.6% in different squares with an average of 10.5% of which the crab larvae belonging to Porcellanidae, Paguridae, Pinnotheridae, *Portunus* spp. and *Carcinus* spp. formed 9.4%. Others were phyllosoma larva, alima larva and various larval stages of penaeid prawns namely *Penaeus indicus, Metapenaeus brevicornis, M. affinis, M. dobsoni* and *M. monoceros.*

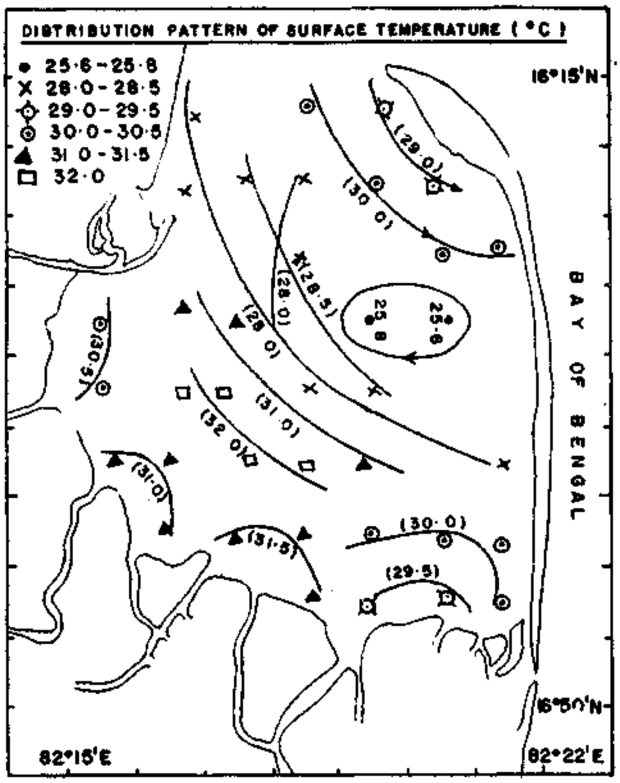


Fig. 2. Surface temperature (°C) of the water in the bay.

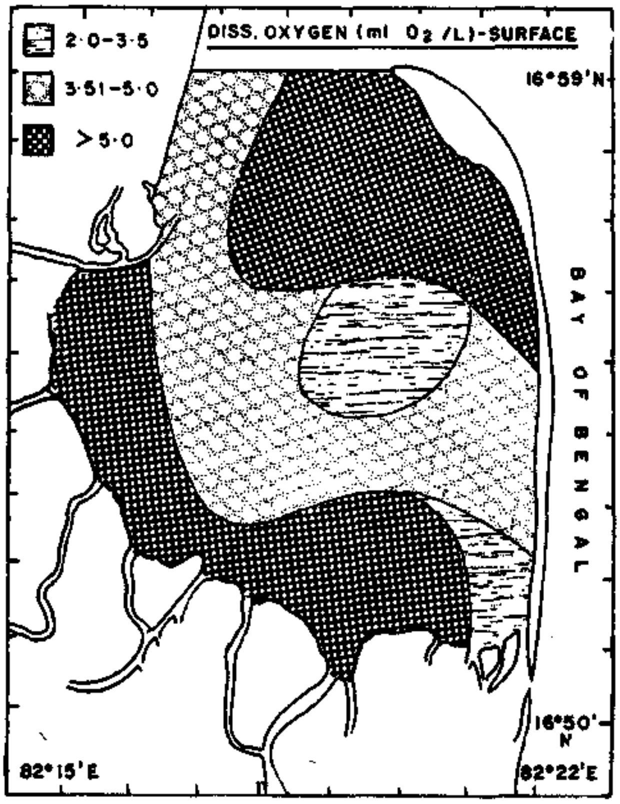


Fig. 4. Distribution pattern of dissolved oxygen (ml/l) in the bay.

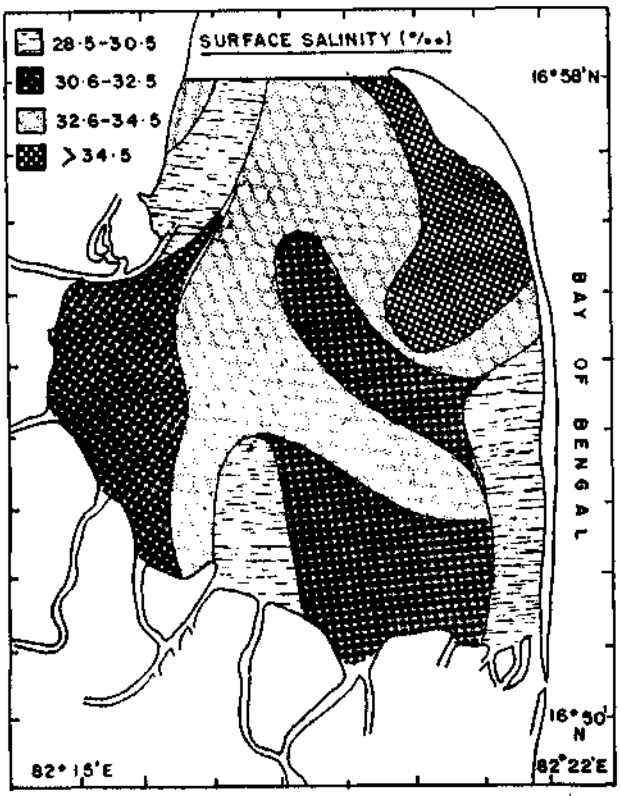


Fig. 3. Distribution pattern of salinity (‰) in the bay.

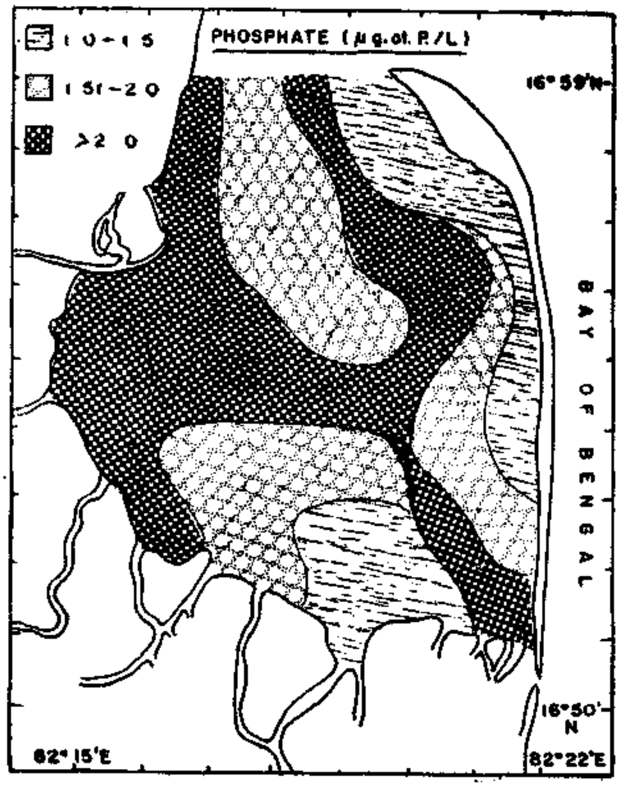


Fig. 5. Distribution of inorganic phosphates (µg at/l) in the bay.

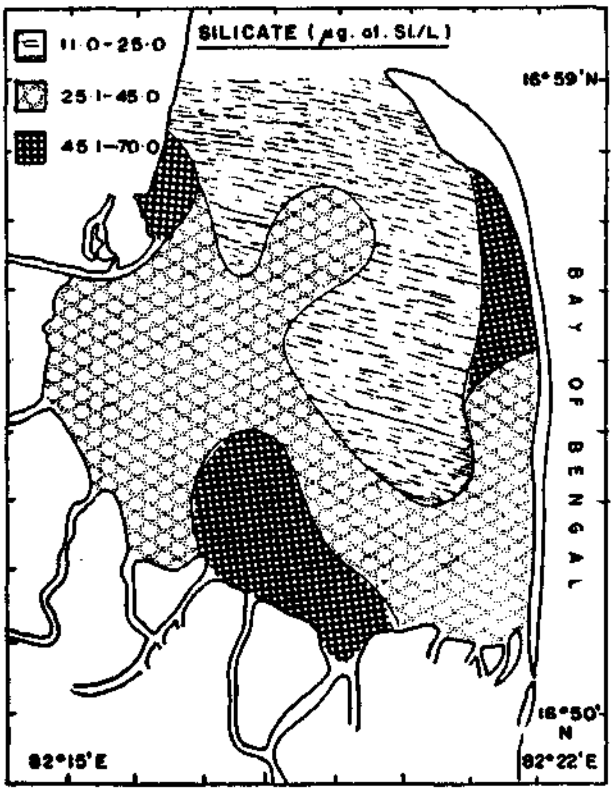


Fig. 6. Distribution of silicate (µg at/l) in the bay.

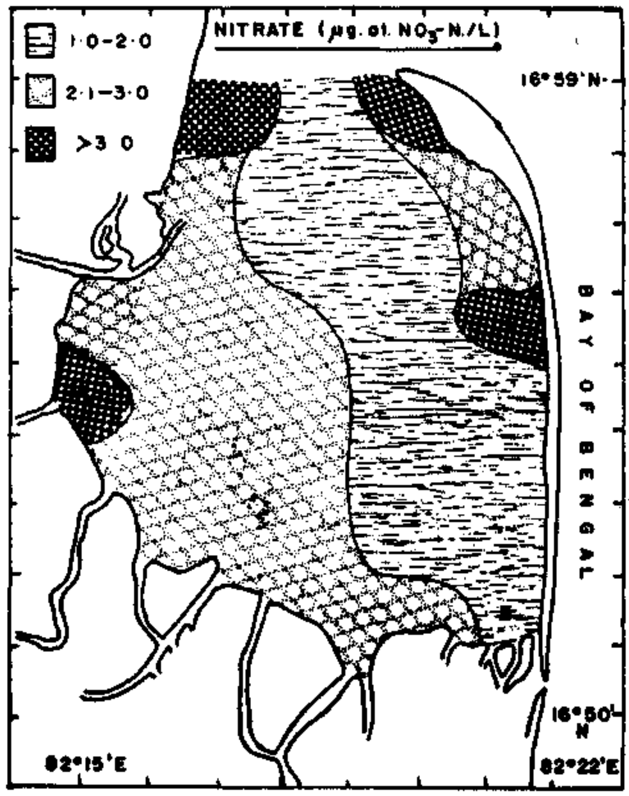


Fig. 8. Distribution of nitrate (µg at/l) in the bay.

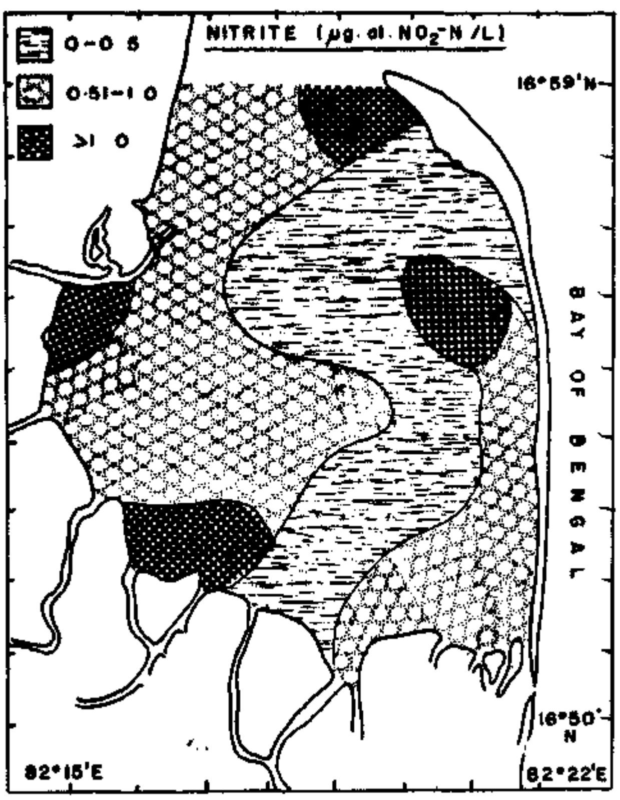


Fig. 7. Distribution of nitrite (µg at/l) in the bay.

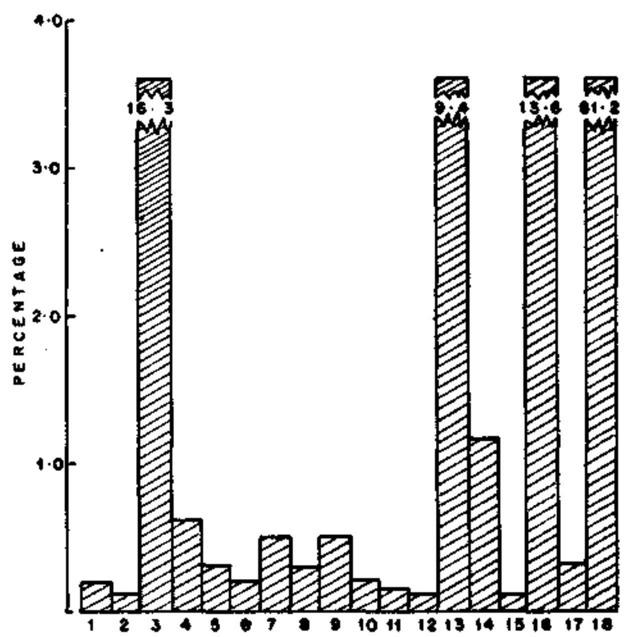


Fig. 9. Average zooplankton biomass in the bay. 1. Alima larvae 2. Amphipods 3. Copepods 4. Chaetognaths 5. Ctenophores 6. Cladocerans 7. Medusae 8. Mysids 9. Molluscan larvae 10. Oikopleura 11. Parasitic copepods and Isopods 12. Phyllosoma larvae 13. Crab larvae 14. Prawn larvae 15. Polychaete larvae 16. *Lucifer* 17. Siphonophores and 18. Fish eggs and larvae.

Polychaete larvae nepthyid and phyllodocid were encountered and the polychaete larvae contributed on an average of 0.03%. Bivalve veligers, young gastropods and pteropds formed about 0.6% in zooplankton. Bivalve larvae were common in squares 3-5, 7, 10, 13, 18-20 30, 33-36, 38, 40-44 and 46. The percentage composition of fish eggs and larvae varied from nil to 99.6 with an average of 61.2% in zooplankton (Fig. 9). The common forms were the eggs and larvae of clupeidae, Mullidae, Gobidae, Pleuronectidae and Belonidae.

As the survey was conducted in the summer months the hydrographical conditions as well as the composition of plankton in the bay were typically marine. Generally the plankton was rich in the variety of species. While the collections made between 6 and 8 hrs. were dominated by fish eggs and larvae, pelagic tunicates, crustacean larvae, *Lucifer* sp. and copepods, those made around noon comprised mostly of coelenterates and chaetognaths.

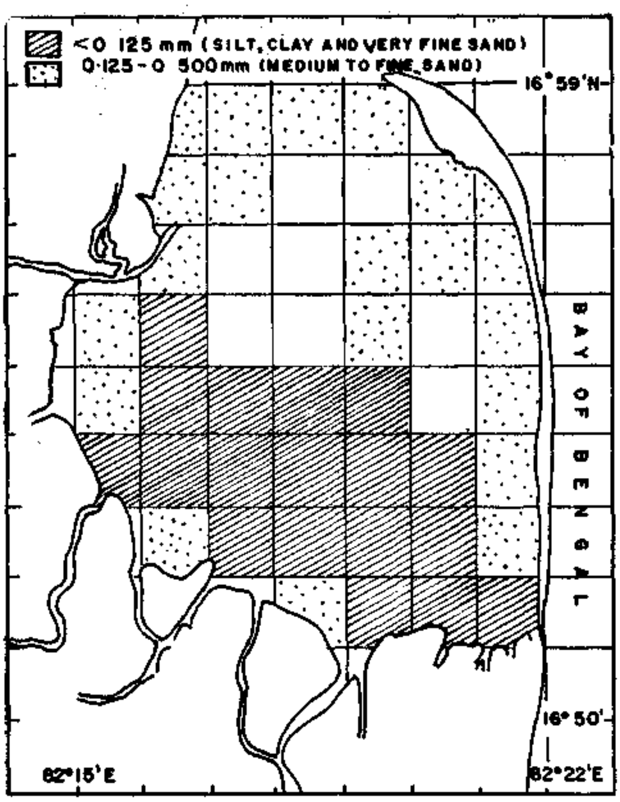


Fig. 10. Particle size of the sediments in the bay. Each category indicates the predominant type (over 50%)

Sediments

Particle size: The results of the particle size analysis by weight are shown in Table 2. In the southern and southwestern part of the bay the sediment is predominantly composed of clay, silt, and very fine sand (particle size < 0.125 mm) (Fig. 10). The rivers and irrigation canals bring in considerable quantities of these fine particles resulting in soft bottom in these areas. On the other hand, the sediments of the eastern and northern parts of the bay are predominantly made up by fine to medium sand (particle size between 0.125 to 0.500 mm) due to the influence of the strong tidal currents from the sea. The Hope island Itself is a sand bar.

Organic carbon: Organic carbon content in the sediments (Fig. 11) was highest along the southwestern tidal flats (0.9–11%) and lowest along the northeastern side close to the sand bar. Another diagonal belt of high values ranging from 0.87 to 1.02% was recorded in the central portion of the Bay in southeast to northwest direction. Coringa and Gaderu confluences had lower values (0.3–0.6%) while the northern side close to the mouth of the bay had median values (0.6 - 0.8%). The present study indicates that regions of fine sediments are generally rich in organic carbon.

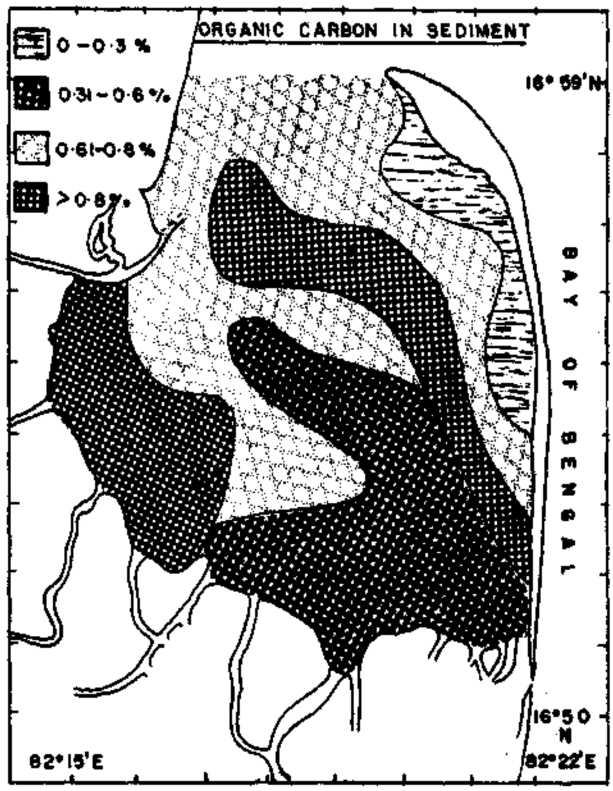


Fig. 11. Organic carbon (1%) in the sediments of the bay.

Molluscan resources

Based on the dredge collections the square-wise estimates of live molluscs and holothurians by weight and numbers are given in Table 3.

Table 2. *Particle size and organic carbon in the sediments*

Square No.	Particle size of sediments in % (by weight)							Organic carbon (%)
	>2000 Microns	1000–2000	500–1000	250–500	125–250	63–125	<63	
1.	—	—	13.7	22.8	28.0	34.8	0.7	0.74
2.	—	—	14.4	20.2	39.6	21.6	4.2	0.62
3.	—	—	10.3	9.2	48.7	28.3	3.5	0.60
4.	—	—	5.6	19.3	45.9	26.9	2.3	0.65
5.	—	—	—	47.2	49.3	3.1	0.4	0.71
6.	—	—	—	17.8	56.5	25.1	0.6	0.96
7.	3.0	—	13.8	19.1	22.2	40.7	1.2	0.77
8.	—	—	2.8	3.9	45.8	41.9	5.6	0.21
9.	0.2	—	1.8	3.2	50.4	42.8	1.6	0.21
9A	3.0	0.1	—	2.5	62.8	31.2	0.4	0.13
10.	0.6	—	—	11.5	41.4	43.7	2.8	0.71
11.	—	—	25.2	21.3	15.7	37.1	0.7	0.87
12.	8.5	—	30.1	20.1	21.8	9.9	9.6	0.97
13.	0.9	0.1	—	25.6	36.5	33.2	3.7	0.90
14.	1.0	—	—	18.2	44.8	34.2	1.8	0.66
15.	0.2	—	2.1	4.1	48.1	37.5	8.0	0.62
16.	0.2	—	7.7	12.7	52.9	23.7	2.8	0.99
17.	2.6	—	2.5	4.2	24.1	64.6	2.0	0.65
18.	0.5	—	18.6	17.6	20.0	23.4	19.9	0.50
19.	—	—	17.8	23.6	22.6	24.2	11.8	0.74
20.	0.5	0.1	—	—	57.3	40.6	1.5	0.71
21.	0.8	—	22.4	19.9	24.1	22.7	10.1	1.02
22.	—	—	—	7.3	80.0	12.7	—	0.06
23.	1.1	—	—	37.1	27.3	21.8	12.7	1.10
24.	—	—	—	10.5	28.5	59.4	1.6	0.71
25.	—	—	—	16.8	25.5	51.8	5.9	0.91
26.	0.8	—	2.5	5.0	33.0	56.2	2.5	0.40
27.	1.0	—	4.0	5.5	32.9	46.9	9.7	0.37
28.	—	—	9.0	10.9	35.9	42.4	1.8	0.87
29.	0.9	—	16.7	21.0	31.7	28.5	1.2	0.13
30.	—	—	4.4	0.6	7.0	69.4	18.6	0.87
31.	0.2	—	7.2	7.2	17.5	53.3	14.6	0.87
32.	0.8	—	—	32.4	12.6	47.5	6.7	0.71
33.	0.7	—	13.2	15.4	20.2	48.1	2.4	0.77
34.	—	—	4.6	7.6	21.1	63.7	3.0	0.71
35.	1.2	—	3.9	7.6	34.0	49.5	3.8	0.59
36.	—	—	—	18.8	35.8	40.3	5.1	0.75
37.	—	—	—	18.7	42.8	38.1	0.4	0.99
38.	—	—	—	9.9	30.9	57.2	2.0	0.59
39.	—	—	10.0	9.8	27.7	48.1	4.4	0.59
40.	—	—	—	7.2	22.8	57.8	12.2	0.47
41.	—	—	2.9	6.9	28.8	56.0	5.4	0.44
42.	1.4	—	—	25.9	29.9	41.8	1.0	0.90
43.	0.4	—	—	8.8	44.9	44.3	1.6	0.34
44.	—	—	3.5	5.2	8.7	75.8	6.8	0.31
45.	—	—	—	12.1	24.6	54.6	8.7	0.56
46.	1.6	—	6.4	3.7	20.9	51.8	15.6	0.50

Table 3. *Molluscan and holothurian resources of the Kakinada Bay* (t: *in tonnes* & Nos.: *in lakhs*)

Square No.	*Placenta placenta*		*Anadara granosa*		*Paphia textille*		*Tellina* sp		*Pinctada chemnitzi*		*Meretrix meretrix*		*Hemifusus pugilinus*		*Cerithidea fluviatilis*		*Acaudina molpadioides*	Others
	t	Nos.	t	Nos.	t	Nos.	t	Nos.	t	Nos.	t	Nos.	t	Nos.	t	Nos.	Nos.	t
1.	—	—	22.3	7.97	2.6	10.10	—	—	—	—	—	—	—	—	—	—	—	—
2.	21.2	8.00	35.7	20.6	18.4	21.72	3.0	16.07	—	—	—	—	—	—	5.9	4.6	4.57	2.1
3.			—	—	20.6	80.95	4.4	19.21	—	—	—	—	—	—	—	362.2	160.52	15.0
4.	—	—	—	—	—	—	—	—	—	—	—	—	56.4	8.29	—	—	—	—
5.	—	—	129.5	47.38	12.4	42.30	—	—	—	—	—	—	14.3	5.92	—	—	—	11.3
6.	—	—	—	—	23.0	117.76	—	—	—	—	—	—	—	—	—	—	—	4.0
7.	—	—	137.5	53.51	17.8	89.18	2.7	24.70	—	—	—	—	20.6	2.74	—	42.5	39.79	—
8.	—	—	—	—	—	—	3.8	44.59	—	—	—	—	8.6	1.71	—	25.7	10.30	—
9.	—	—	—	—	—	—	—	—	105.4	27.44	—	—	5.5	2.20	—	—	—	—
9a.	—	—	—	—	5.1	19.76	—	—	—	—	—	—	—	—	—	—	—	—
10.	300.1	83.35	118.4	42.51	—	—	—	—	—	—	—	—	4.2	1.67	—	—	—	1.7
11.	452.9	139.94	186.6	82.32	1.4	9.60	—	—	—	—	—	—	6.9	2.74	—	—	—	5.5
12.	111.7	28.58	20.0	10.29	144.7	176.07	—	—	—	—	—	—	22.0	2.29	—	—	—	5.8
13.	—	—	—	—	49.7	178.35	—	—	—	—	—	—	17.2	3.43	—	—	—	—
14.	—	—	—	—	25.0	13.2	—	—	—	—	—	—	22.6	3.43	—	—	—	—
15.	—	—	7.1	2.86	4.7	18.58	1.1	22.87	—	—	—	—	—	—	—	2.9	2.86	—
16.	347.1	85.06	137.2	150.92	1.4	10.98	—	—	—	—	—	—	—	—	—	308.7	31.55	—
17.	381.4	94.66	561.8	271.65	20.9	174.24	—	—	—	—	—	—	13.7	4.12	—	238.7	15.09	—
18.	835.8	217.23	296.3	107.47	—	—	—	—	—	—	—	—	6.9	1.14	21.7	24.1	20.58	11.7
19.	—	—	402.0	145.43	27.6	97.41	—	—	—	—	—	—	—	—	—	—	—	—
20.	—	—	—	—	21.3	83.69	1.5	6.86	—	—	—	—	—	—	—	4.8	4.12	3.3
21.	—	—	7.2	5.14	64.3	260.67	—	—	—	—	—	—	—	—	—	—	—	14.1
22.	—	—	—	—	—	—	—	—	196.2	32.83	124.8	52.53	1.3	1.64	—	—	—	—
23.	115.9	38.41	381.4	163.26	—	—	2.1	12.35	—	—	—	—	—	—	46.0	—	—	2.1
24.	219.3	48.02	772.4	305.95	2.1	5.49	14.5	185.21	—	—	—	—	14.4	2.74	54.9	105.6	10.98	—
25.	236.0	48.02	541.9	262.04	2.7	5.49	23.3	96.03	—	—	—	—	—	—	—	82.3	8.23	—
26.	702.4	193.45	164.6	57.62	7.4	38.41	—	—	—	—	—	—	12.3	1.37	—	24.7	15.09	—
27.	1,483.4	349.80	—	—	18.0	65.16	—	—	—	—	—	—	17.2	3.43	—	1.7	1.71	—
28.	94.3	29.15	50.4	30.87	39.3	133.37	6.0	44.59	—	—	—	—	—	—	—	—	—	1.7
29.	—	—	26.0	8.67	11.1	57.80	—	—	5.8	1.44	281.8	59.24	7.5	2.89	—	—	—	—
30.	12.6	4.03	373.1	186.56	—	—	5.0	61.51	—	—	—	—	—	—	83.7	—	—	5.0
31.	531.6	158.92	716.8	302.97	26.6	42.30	13.6	75.46	—	—	—	—	—	—	8.0	2.3	2.29	2.1
32.	1,004.3	197.56	496.0	235.98	—	—	—	—	—	—	—	—	—	—	—	119.4	13.72	2.9
33.	2,503.8	515.86	75.5	45.27	3.7	13.72	—	—	—	—	—	—	—	—	—	233.2	28.81	9.6
34.	1,443.3	318.29	41.0	19.21	—	—	—	—	6.9	1.37	—	—	11.0	2.74	—	8.2	5.49	—
35.	71.3	20.60	13.0	13.72	63.78	71.34	—	—	—	—	—	—	4.1	1.37	—	30.9	8.23	5.5
36.	168.8	24.75	14.1	12.38	8.7	52.88	—	—	—	—	355.5	69.75	6.8	2.25	—	38.3	48.37	12.7
37.	143.2	29.58	538.4	150.29	—	—	3.2	14.20	—	—	—	—	—	—	13.0	—	—	3.6
38.	192.8	86.43	278.5	113.87	—	—	—	—	—	—	—	—	—	—	42.5	—	—	7.5
39.	212.7	61.74	163.9	107.01	—	—	0.3	4.12	—	—	—	—	—	—	—	43.2	15.09	2.3
40.	305.3	85.06	31.0	12.35	5.4	15.09	14.0	135.82	—	—	—	—	—	—	—	315.6	12.35	9.5
41.	78.9	9.60	6.9	5.49	2.1	38.41	6.7	71.3	—	—	—	—	—	—	—	157.8	32.93	71.6
42.	1.2	17.75	1.8	1.18	3.9	13.02	4.6	40.23	—	—	319.5	66.27	2.4	1.18	—	16.6	44.97	14.2
43.	105.8	14.87	15.2	7.87	1.0	3.50	2.1	26.24	—	—	—	—	—	—	11.4	—	—	24.8
44.	112.2	25.66	39.3	16.04	—	—	—	—	—	—	—	—	1.6	1.60	—	—	—	26.5
45.	54.6	7.80	23.2	17.54	4.1	19.50	2.0	40.22	—	—	—	—	2.9	0.97	1.7	21.4	3.90	10.9
46.	174.8	49.49	69.3	44.23	3.9	24.22	1.3	16.85	—	—	—	—	—	—	—	51.6	31.59	2.1
Total	12,418.7	2991.66	6895.3	3,068.4	664.7	2,004.66	115.2	948.43	314.3	63.08	1081.6	247.79	280.4	61.86	288.8	2,270.0	573.13	289.1

Placenta placenta (Linnaeus): This species (Pl. 3) ranked first with an estimated 12,420 t (approximately 300 million). Good beds of the windowpane oyster were observed in squares 33, 27, 34, 32, 18, and 26 in their order of abundance (Fig. 12). The highest density of 15.04/m² or 730g/m² was obtained in square 33 while at square 26 the density was 5.64/m² or 206 g/m². These 5 squares covering an area of about 17.1 km² sustained a population of 7,973 t or 64.2% of the total. In squares 31, 11, 17, 16, 40, 10 and 38 the oysters were less abundent; the density varied from 4.60/m² (155/gm²) to 2.48/m² (56 g/m²). These squares comprise an area of 22.7 km² and account for 2,511.2 t or 20.2% of the population. In other areas the windowpane oyster was either absent or it occurred in small numbers (< 2/m²). The spat was scarce. Young oysters measuring 17–42 mm were collected in squares 8, 16, 24 and 30. The overall length frequency (Fig. 13a) showed that the oyster measured 17 to 151 mm with dominant length groups in the range 87 to 118 mm.

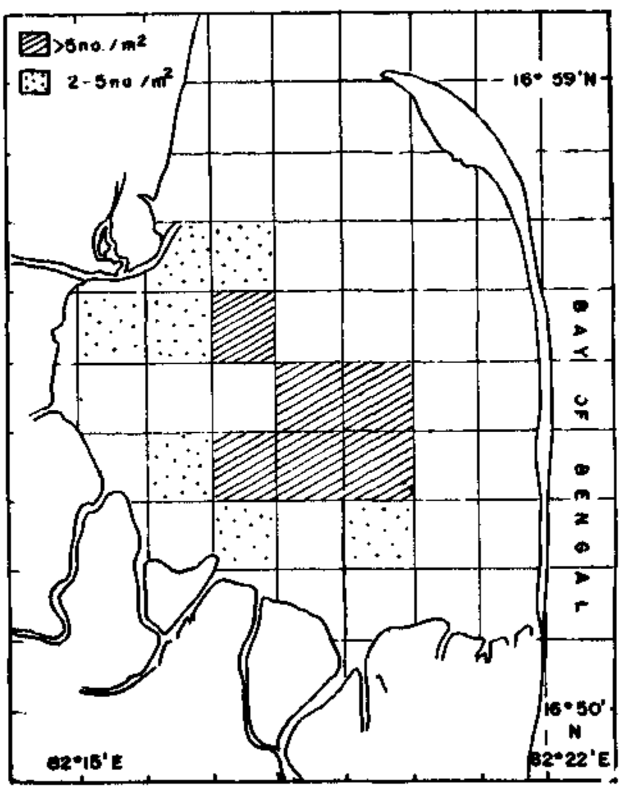


Fig. 12. *P. placenta* distribution in the bay.

Anadara granosa (Linnaeus): This species ranked second with 6,895 t and in numbers 307 million (Pl. 4). It was abundant along the western side of the bay (Fig. 14) in squares 24, 31, 17, 25, 37, 32 and 30 in their order of abundance. These 7 squares covering 22.6 km2 area accounted for 4,000 t or 58.0% of the blood-clam population. Their density varied from 9/m² (225 g/m²) in squares 24 to 5/m² (186 g/m2) in square 37. Considerable quantities of the clam were available in squares 19, 23, 18, 38, 11, 39 and 16 which covered an area of 24.0 km². These squares supported a population of 1,846 t which formed 26.8% of the total clam population. The density in these squares varied from 4.76/m² (111 g/m²) in square 23 to 2.40 /m² (54 g/m²) in square 11. In other squares either there were no clams or their population was below 2/m². Their length varied from 15 mm to 63 mm (Fig. 13d) with dominant size groups at 25–45 mm.

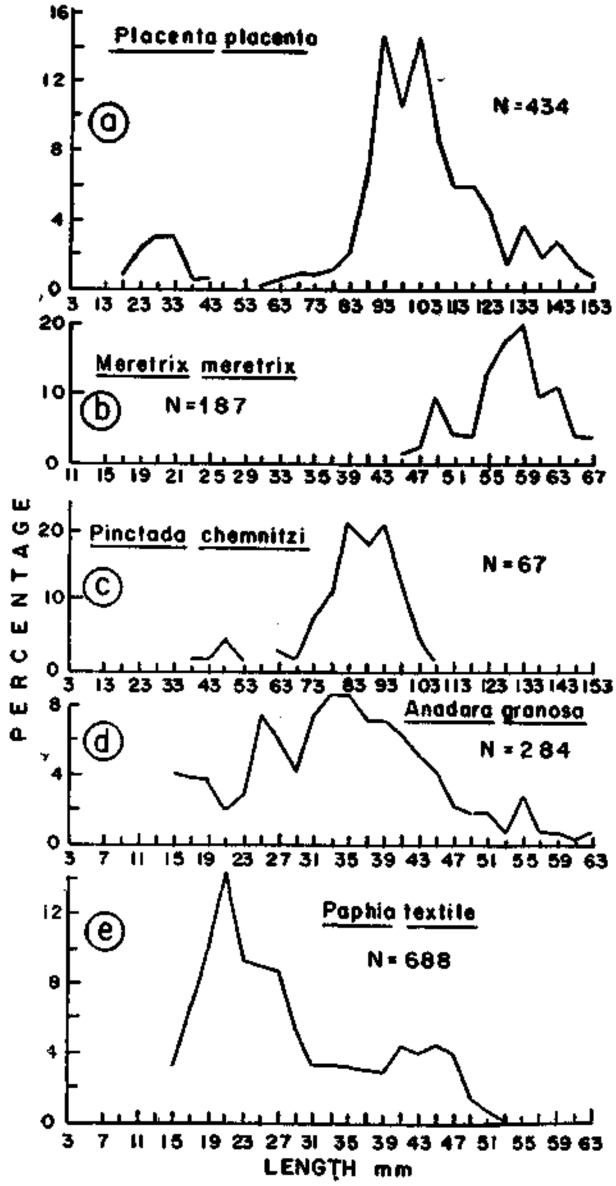


Fig. 13. Length frequency distribution of some bivalves collected by the dredge in the bay.

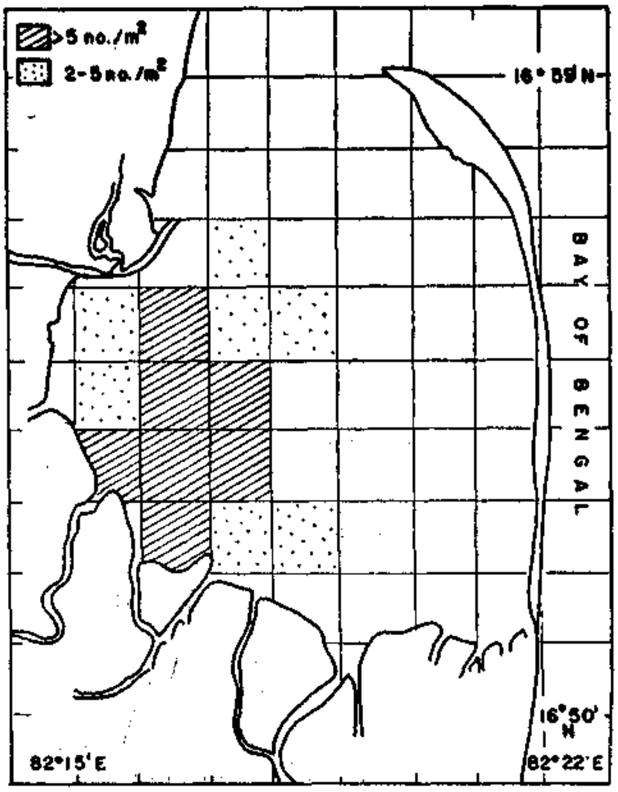


Fig. 14. A. *granosa* distribution in the bay.

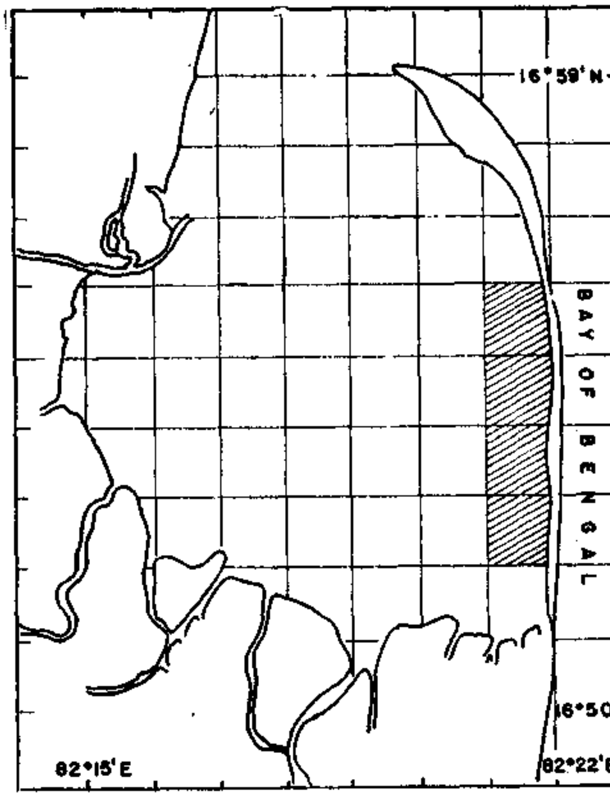


Fig. 16. *M. meretrix* distribution in the bay Stripes indicate the squares where this species is available.

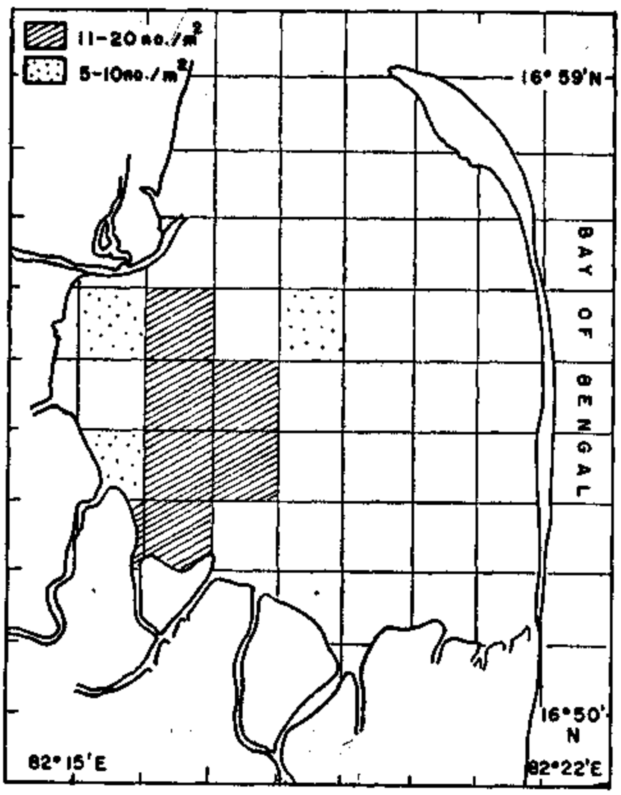


Fig. 15. A. *granosa* seed availability in the bay.

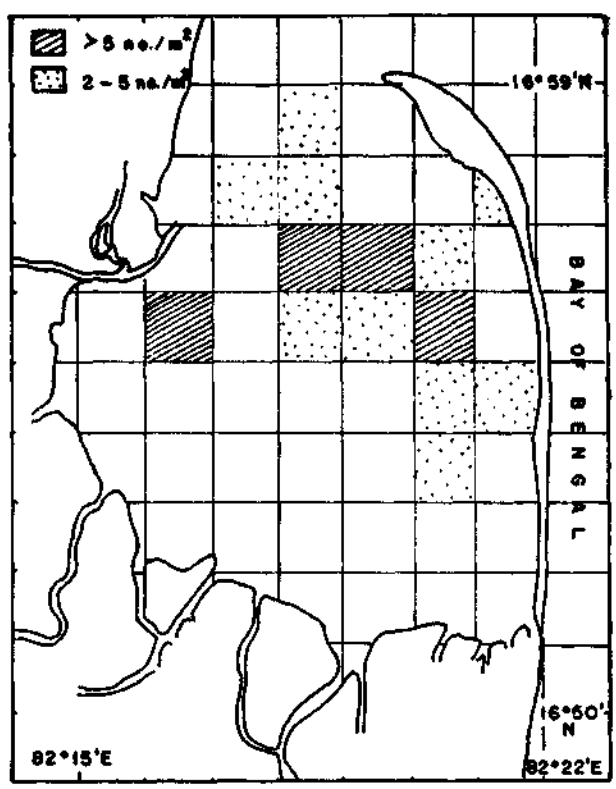


Fig. 17. *P. textile* distribution in the bay.

Seed resources of A. *granosa*: All the clams collected by the clam seed sampler were included here. Their length varied from 4 to 59 mm. However, vast majority of them (71%) were < 25 mm which is the size used in experimental culture (Narasimham, 1980). The distribution of the seed is limited to the western side of the Bay (Fig. 15) and is within the area where the adult population occurs. The density was high in squares 31, 24, 17, 37, 253 2and 16. It varied from $19/m^2$ in square 31 to $11/m^2$ in square 16. The Van Veen grab genrally gave a lower density of the bloodclams and this is probably due to the fact that very small area was sampled by the grab.

Meretrix meretrix (Linnaeus): This species (Pl. 5) ranked third among the molluscs and occurred at 4 squares *viz.* 36, 42, 29 and 22 along the eastern side of the bay (Fig. 16). The population was estimated at 1,082 t. The density was low and varied from $3/m^2$ ($126\ g/m^2$) in square 36 to $2\ /m^2$ ($43\ g/m^2$) in square 22. The size ranged from 45 to 67 mm with 55–63 mm group dominating (Fig. 13b).

Paphia textile (Gmelin): This species (Pl. 6) was distributed in major part of the northern section of the Bay. The population was estimated at 665 t (200 million) and it was abundant in squares 21, 13, 12 and 17 (Fig. 17). These squares covered an area of 13.7 km^2 and accounted for 42.0% of the population. Their density varied from $8\ /m^2$ in squares 21 to $5/m^2$ in square 17. In squares 28, 14, 6, 19, 7, 20, 9a, 3, 35 and 29 the density was low and varied from $2/m^2$ (in square 29) to $4/m^2$ (in square 28). These 10 squares covered an area of 31.2 km^2 and accounted for 38.3% of the population. Their length varied from 14 to 52 mm and 17–29 mm clams were dominant (Fig. 13e).

Seed resources of P. textile: The clams collected by the seed sampler varied in length from 3 to 48 mm and majority of them (66.2%) were < 20 mm in length. The seed occurred in the northern and eastern parts of the bay. Very high densities of $80/m^2$ in square 12, $39/m^2$ in square 35 and $31/m^2$ in square 42 were obtained (Fig. 18). In squares 3, 11, 8, 1, 36 and 28 moderate densities which varied from $16/m^2$ (square 3) to $11/m^2$ (square 28) were recorded. Seed occurrence was low in squares 21, 17, 34, 33, 2, 6, 5, 13, 26, 27, 9, 41,14, 15 and 22 which varied from $10/m^2$ (square 21) to $5/m^2$ (square 22). Generally seed was available in much larger area when compared to the distribution of adult population.

Pinctada chemnitzii (Philippi): The population was estimated at 314 t (6.3 million) and was limited in distribution to squares 22, 9, 34 and 29. They were found attached among them and to dead windowpane oyster shells (Pl. 7), in groups of 3 to 16 forming a lump. Within the square their distribution was patchy. They measured 37 to 106 mm (antero-posterior axis) and 73–98 mm oysters were dominant (Fig. 13 c).

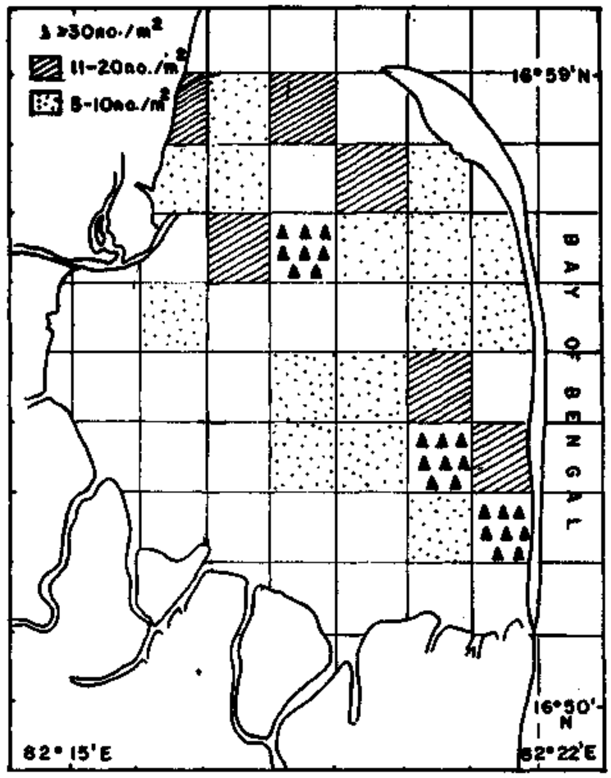
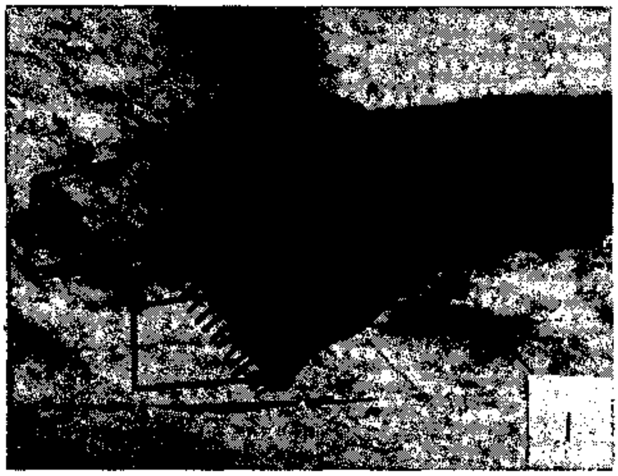


Fig. 18. *P. textile* seed availability in the bay.

Tellina spp: The resource was meagre at 115 t and was available in squares 25, 24 and 31. The size varied from 14 to 28 mm and because of the brittle shell and small size, the species does not have a fishery potential.

Hemifusus pugilinus (Born): This gastropod resource was small at 280 t and was mainly encountered in squares 4, 14, 13 and 7. It measured (apex to lower opercle edge) 28 to 98 mm in length. The opercle of this species finds use in the Unani system of medicine and is priced at 30 paise a piece locally while the shell is used in lime preparation.

Crithidea fluviatilis (Potiez and Michaud): An estimated 289 t was available in the bay. Their distribution was mainly confined to squares 30, 24, 23 and 18. This species measured (apex to lower opercle edge) 17 to 24 mm in length.



Pl. 1. The 0.5 m dredge

Other species: Fairly rich beds of *Modiolus* sp. were present in squares 10, 23, 38, 41 and 44. Polychaetes were abundant in squares 13, 14, 21, 25 and 32 and they often clogged the dredge. Large concentration of *Umbonium gestiarium* (Linnaeus) was encountered is square 9a. Mostly they passed through the dredge (Length 4–12 mm) but were collected by the seed sampler. Other species caught in stray numbers were *Katelysia opima* (Gmelin), *Donax* spp, *Telescopium* (Linnaeus) and *Paphia malabarica* (Chemnitz).

Pl. 2. The 0.5 m clam seed sampler

Holothurian resources

Acaudina molpadioides (Semper): The resource was estimated at 2,270 t and was abundant in squares 3, 40, 16, 17 and 33. It measured 20–160 mm.

Shell resources

The shells of molluscs remaining on the bed or superficially covered (upto 10 cm depth) by the sediment after death are dealt here under shell resources as distinct from subfossil shell deposits which may extend upto a few meters depth. The total shell resources were estimated at 21,097 t (Table 4).

Placenta placenta: The shells of this oyster were estimated at 8,200 t and they occurred in all the squares except 3, 4, 13 and 15. The shell was available in considerable quantities in squares 27, 31, 29, 16, 36, 18 and 34. The distribution is similar to the live population except for its presence in squares 29 and 36.

Anadara granosa: An estimated 1,817 t of shell was present. Major areas of abundance were squares 16, 24, 18, 32 and 25 which agrees with the distribution of live clams.

Other shells: Excepting the shells of the window-pane oyster and the blood-clam, the shells of other species dealt under the live resources were estimated at 1,1062 t. They were abundant in squares 4, 6, 13, 35, 12, 18, 11, 7, and 5. Their concentration in the northern section of the bay, which is generally poor in live populations, except for *P. textile*, suggests that the shells are probably carried by the currents.

Molluscan resources of the Kakinada canal

This irrigation cum navigation canal, originating from the Godavari river, opens into the bay at Kakinada. The banks are made by concrete structures and estuarine conditions prevails upstream upto 5 km length of the canal from the mouth. The concrete banks extend into the bay and harbour rocky fauna both on the inner canal side and outer bay side. The extent of its concrete banks and the estimated oyster population are given in Table 5.

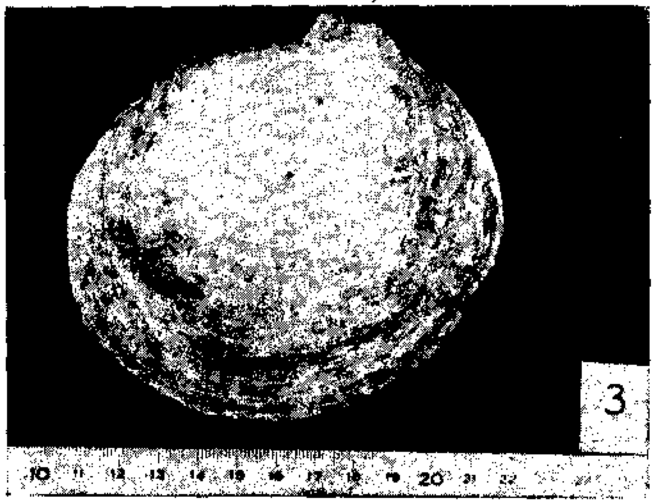
Oyster resources: The average width of the banks inhabited by the oysters is 3 m and except the bay side of the left bank the oyster bed extended upto a distance of 2.3 km upstream. However, the density of the oysters was high close to the mouth of the canal. The total spread of the oyster bed is 2.25 ha and the estimated weight of the population is 90 t (11.7 million) which gave a density of about 40 t/ha. At many sampling stations there was a thick mat of oysters and a maximum of 1,882/m^2 were counted. The rock oyster *Saccostrea cucullata* (Born) formed a negligible proportion (nil to 5.5%) while *Crassostrea madrasensis*

Table 4. *Abundance of shells in the Kakinada Bay (in tonnes)*

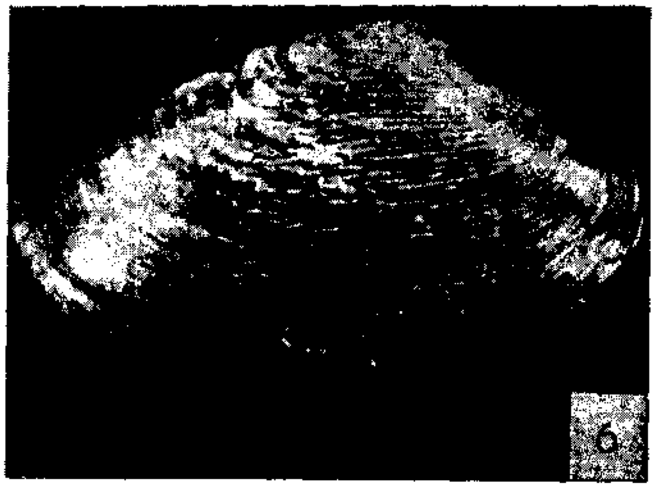
Square No.	*Placenta placenta*	*Anadara granosa*	Others	Square No.	*Placenta placenta*	*Anadara granosa*	Others
1.	12.2	18.6	156.4	24	178.4	356.7	157.8
2.	20.0	11.4	24.0	25	205.8	117.3	260.7
3.	—	—	10.3	26	196.5	17.2	94.7
4.	—	—	1,431.9	27	737.4	8.5	47.2
5.	30.5	34.7	405.3	28	214.4	11.1	61.2
6.	15.4	15.4	903.2	29	578.0	3.6	218.6
7.	102.9	—	419.1	30	26.5	14.1	222.9
8.	20.6	—	119.2	31	679.1	33.2	14.9
9.	286.5	—	107.6	32	149.5	134.3	159.8
9a.	26.3	—	16.1	33	133.1	12.5	144.1
10.	205.0	38.8	231.3	34	347.8	—	331.3
11.	219.5	27.4	592.0	35	46.6	—	702.4
12.	354.4	8.0	662.7	36	436.5	6.0	186.2
13.	—	—	788.9	37	26.0	—	156.2
14.	21.4	—	320.7	38	98.9	19.3	34.3
15.	—	—	13.0	39	105.0	37.0	71.3
16.	493.9	473.3	75.5	40	226.4	3.8	51.8
17.	37.0	34.3	150.9	41	188.1	35.0	128.6
18.	380.7	174.9	646.5	42	75.7	35.5	127.8
19.	225.3	38.4	119.1	43	95.1	3.0	6.0
20.	221.6	1.4	35.7	44	166.8	20.8	77.0
21.	169.8	6.3	262.4	45	21.2	8.1	11.7
22.	262.6	—	26.4	46	121.7	5.8	34.7
23.	57.6	51.4	242.8				
Total:					8,217.7	18,17.1	1,10,62.2

Table 5. *Edible oyster resources of the Kakinada canal*

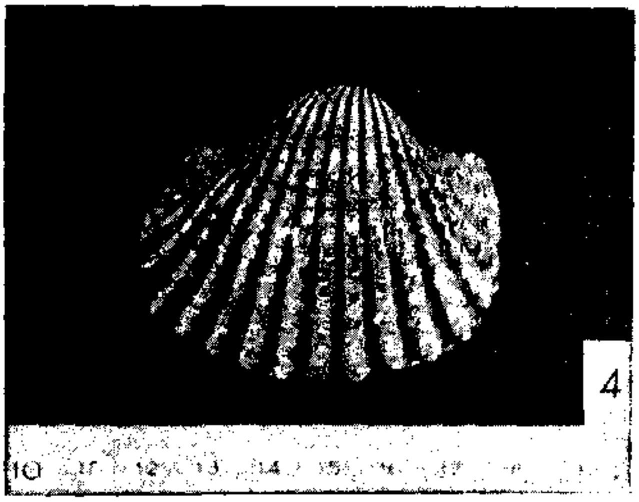
Sl. No.	Extent of bed	Range in nos/m² (Average)	Range in weight kg/m² (Average)	Estimated number for the bed	Estimated wt. kg for the bed	Species composition by numbers
1.	Left bank, bay side 1,800 m²	818–1,860 (1,510)	2.90–7.40 (5.82)	27,18,000	10,476	*S. cucullata* 3.9% *C. madrasensis* 96.1%
2.	Left Bank, canal side 6,900 m²	100–1882 (858)	1.20–7.50 (3.63)	59,20,200	25,047	*S. cucullata* 5.5% *C. madrasensis* 94.5%
3.	Right bank, canal side 6,900 m²	154–228 (200)	3.14–4.80 (4.18)	13,80,000	28,842	*S. cucullata* 0.8% *C. madrasensis* 99.2%
4.	Right bank, bay side 6,900 m²	112–384	2.6–4.4	16,56,000	25,530	*C. madrasensis* 100%
Total:	2.25 ha	—	—	1,16,74,200	89,895	



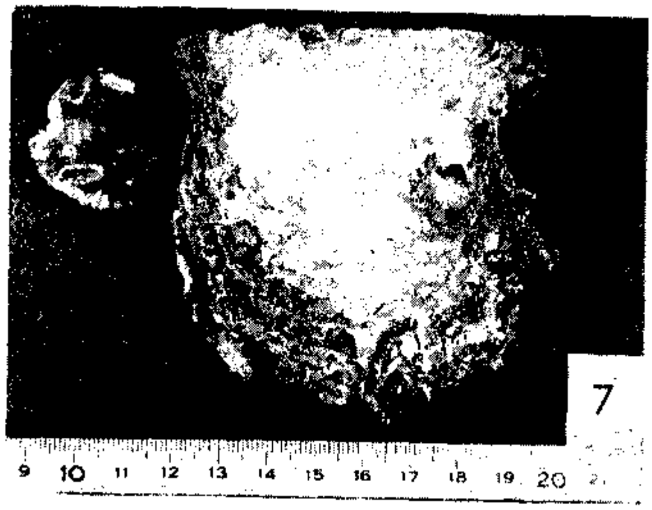
Pl. 3. *Placenta placenta*



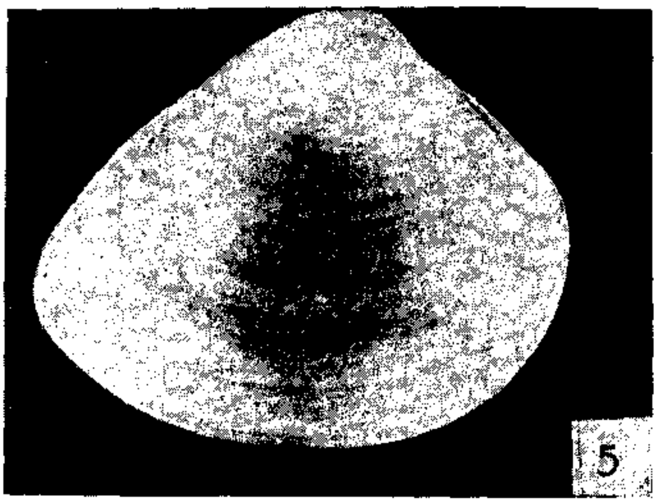
Pl. 6. *Paphia textile* (48 mm)



Pl. 4. *Anadara granosa*



Pl. 7. *Pinctada chemnitzi*



Pl. 5. *Meritrix meretrix* (66 mm)

Pl. 8. Oysters in the market.

(Preston) was dominant (94.5 to 100%). It varied in length (dorso-ventral axis) from 7 mm to 142 mm and majority measured below 30 mm in length.

Perna viridis (Linnaeus): This species occurred in patches along with the oysters closer to the low water mark. The total area inhabited by the mussel is 0.75 ha. Density varied from nil to 12/m2 with an average of $1/m^2$. A total of 586 kg of mussles (7,650) were estimated to be present. They varied in length from 68 to 137 mm.

Discussion

The studies by Rao (1967) indicate that more than 60% sand occurs opposite the Gaderu confluence, a small patch south of the Kakinada canal and along the western side of Hope Island. The present observations agree with the above but show that the northern section of the bay is also predominantly sandy. Sediment analysis of the natural beds of *A. granosa* in Malaysia (Pathansali, 1964) showed, barring one exception, that more than 95% of the particles were less than 0.124 mm; particles < 0.031 mm constituted 63 to 87%. The results obtained by him on culture beds were comparable to the natural beds but the particles < 0.031 mm were generally much less (25–79%). In the present study *A. granosa* and *P. placenta* were generally abundant in areas where more than 50% of the sediment particles were < 0.125 mm. It is well known that the pediveliger larvae of bivalves delay metamorphosis until the conditions are suitable for settlement (Wilson, 1958). The availability of substratum with finer particles which is rich in organic carbon seems to be an important factor limiting the distribution of these two species. On the other hand *P. textile* and *M. meretrix* occurred in considerable numbers in areas where the particle size of the sediment was coarse (>0.125 mm).

Rao (1967) observed that the organic carbon in the sediments was the highest (> 1%) in the tidal flats along the western side of the bay and lowest (< 0.4%) in the sands of the Gaderu confluence. He noted that the organic carbon was high in sediments of finer particle size than in coarser sediments. The results obtained in the present study are generally in agreement with the observations of Rao (1967).

Radhakrishna and Ganapati (1967) observed that *A. granosa* and *P. placenta* were restricted in distribution along the western and southern side of the Bay. The present study indicates considerably wider area and also overlapping in the distribution of these two species than what their figure 2 indicated.

Narasımham (1973) estimated the annual landings of *A. granosa* at 1,000 t and *P. placenta* at 4,000 t out of a total catch of 6,000 t of molluscs from the Bay. Recently Silas *et al.* (1982) gave the annual production of *A. granosa* in the bay as 2000 t. The present estimate of 6900 t of blood-clam in the Bay suggests that the resource is extremely limited. Since the blood-clam is a sedentary organism it becomes easily vulunerable to over fishing when the demand for its meat increases due to an export potential. Further its distribution is limited to shallower region, not exceeding 2.2 m depth. Techniques for the culture of *A. granosa* in the Bay were developed (Narasimham, 1980) which gave very encouraging results with regard to growth, survival and production. However, the seed resources in the Bay are not abundant (density below $20/m^2$) and cannot be depended upon for large scale clam culture. The only alternative is to go in for hatchery production of seed. Realising this the Central Marine Fisheries Research Institute is working on a project at Kakinada for the controlled production of the seed of *A. granosa.*

Murthy *et al.* (1979) estimated the live population of *P. placenta* in the Bay at about 9,000 t and dead oyster shell at about 43,000t. The present study indicated the live windowpane oyster resource at about 12,500 t and the gap between the present catch and the potential is narrow.

In the case of *M. meretrix* also the gap between the present catch of 400 t and the estimated resource at 1,080 t is narrow. *P. textile* is not exploited at present as it is distributed in the northern section of the Bay, in slightly deeper waters and is beyond the reach of the fishermen who collect the molluscs in the Bay at low tides by hand picking without any diving aids. It needs to be investigated whether the holothurian *A. molpadioides* has any economic importance.

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References

Chandramohan, P. and T. S. Satyanarayana Rao, 1972. Tidal cycle studies in relation to zooplankton distribution in the Godavari estuary. *Proc. Indian Acad. Sci.*, **75** (1B): 23-31.

F. A. O. 1975. Manual of methods in aquatic environment research. Technical paper No. 137, Part 1: 201-202.

Murthy, V. S., K. A. Narasimham and W. Venugopalam. 1979. Survey of windowpane oyster *(Placenta placenta)* resources in the Kakinada Bay. *Indian J. Fish.* **26**, (1 & 2): 125-132.

Narasimham, K. A. 1973. On the molluscan fisheries of the Kakinada Bay. *Indian J. Fish.* **20** (1): 209-214.

Narasimham, K. A. 1980. Culture of blood clam at Kakinada. *Mar. Fish. Infor. Serv. T & Ser.*, **20**: 7-9.

Pathansali, D. 1964. Notes on the biology of the cockle, *Anadara granosa* (L). *Proc. Indo-Pacific Fish. Coun.*, **8**: (11): 84-98.

Radhakrishna, Y. and P. N. Ganapati. 1968. Fauna of the Kakinada Bay. *Bull. Nat. Inst. Sci. India*, **39**: 689-699.

Ramasarma, D. V. and P. N. Ganapati. 1968. Hydrography of the Kakinada Bay. *Bull. Nat. Inst. Sci. India*, **38**: 49-79.

Rao, M. S. 1967. Studies on the Kakinada Bay on the east coast of India. *Quart. Jour. Geol. Min. Met. Soc. India.*, **39** (2): 75-91.

Silas, E.G., K. Alagarswami, K.A. Narasimham, K.K. Appukuttan and P. Muthiah. 1982. Country Reports: India. In: *Bivalve culture in Asia and the Pacific* (F. B. Davy and M. Graham, Eds), International development centre, Ottawa, pp 34-43.

Welch, P. S. 1948. *Limnological methods.* Mc Graw-Hill Book Company, Inc. New York. 371 pp.

Wickstead, J. H. 1976. *Studies in Biology. No.* 62, *Marine Zooplankton.* Edward Arnold Ltd. London. 60 pp.

Wilson, D. P. 1958. Some problems in larval ecology related to the localised distribution of bottom animals. *Perspec. in Mar. Biol.*, Part **1**; 87-103.

BUMBER CATCHES OF PRAWNS, POMFRETS, LITTLE TUNNIES, BLACK SHARKS AND OTHER FISHES AT KARWAR*

Purse seine catches

In 1982, at Karwar, the purse seine boats commenced fishing from 1st of September. A new pattern of fishing was evident from the beginning of the season. Because of lack of oil sardine and mackerel shoals the seiners were forced to scan deeper waters which resulted in exceptionally heavy catches of *Thrissa*, barred longtom *(Ablennis hians)*, seer fishes, little tunny *(Euthynnus affinis)* leather skin *(Chorynemus sanctipetri)* and black pomfret hitherto not known for such quantities in this part of coastline. Besides, bumper catches of prawns *Metapenaeus dobsoni* amounting to about 39 t were hauled up. It is said that such quantities of prawns were never recorded in the past by the purse seiners at Karwar eventhough the seiners were in operation here for more than half a decade. The catch details on weekly basis for September and October are given in Table 1.

The catch of *Thrissa* amounted to 75.4 t whereas barred longtom was about 8 t. Bumper catches of little tunny in mature condition mostly caught in northwest region of Karwar in depth of 40–75 m (Cancona area) were landed between 26th September and 23rd October. As high as 42.6 t of this species was landed on 8th October alone. Weight of each fish ranged from 1 to 3.15 kg.

The estimated catch of *Scomberomorous commersoni* and *S. guttatus* amounted to 21.8 t of which 20 t alone were landed on 21st and 22nd September. The former species accounted for more than 75% of the catches.

Unprecedented catches of black pomfret *(Parastromateus niger)* were made between 22nd and 31st October, mostly from the region between Karwar and Belekeri in the south, in the depth range of 40–60 m. On 29th October, the catch of this fish amounted to as high as 109.5 t an all time record in the annals of Karwar. Similarly dolphin fish weighing 28.5 t were landed on 26th October; of course, a rare sight by itself.

The local as well as neighbouring markets could not consume all these huge catches which naturally caused glut conditions on most of these days. Nevertheless, the distress sales were avoided because of heavy demand from the southern regions. The Karnataka Fisheries Development Corporation purchased most of the catches of seer fishes and black pomfret which in fact rescued fishermen from financial loss.

* Prepared by M. H. Dhulkhed, G. G. Annigeri, G. Nandakumar and D. Y. Naik

Important purse-seine catches

Metapenaeus dobsoni

Barred longtom (*Ablennis hians*)

Black pomfrets (*Parastromateus niger*)

Black shark (*Carcharinus melanopterus*)

Little tunny (*Euthynnus affinis*)

Dolphin fish

Table 1. *Catch details of prawns, pomfrets, little tunnies and others (in kg) in purse seiners at Karwar*

Date	Prawns (M.d.)	*Thrissa*	*Ablennis hians*	Tunny	Seer fishes	Black pomfret	*Chorinemus*	*Coryphaena*
1st–4th Sept.	8,400							
5th–11th „	20,225	14,060						
12th–18th „	10,185	44,100						
19th–25th „	22	15,500	1,000		20,030			
26th–30th „		35	375	12,000			15,020	
1st–2nd Oct.				12,900				
3rd– 9th „			6,600	1,11,950	170	300	490	
10th–16th „		700		24,700	1,600	1,230	420	
17th–23rd „		1,000		90		48,500		33,600
24th–31st „						4,00,660		
Total	38,832	75,395	7,975	1,61,640	21,800	4,50,690	15,930	33,600
R	71–125	110–169	825–1,272	400–680	400–610 (S.g.) 410–770 (S.c.)	100–450	220–370	210–460
M	93, 103	120, 150	—	410, 490, 510, 640 & 680	460, 510 (S.g.) 720 (S.c.)	110, 200 240 & 290	320, 340	330, 380 & 430
Price	Rs. 13/kg	Rs. 20–30/ 40 kg	Rs. 200– 300/100 Nos.	Rs. 0.50– 5/fish	Rs. 3/kg	Rs. 1.25– 6/kg	Rs. 150– 200/100 Nos.	Rs. 250/ 100 Nos.

R: Range in mm, M: Mode in mm, S. g.: *Scomberomorus guttatus, S. c.: Scomberomorus commersoni,* M.d.: *Metapenaeus dobsoni.*

As there is practically no market for tuna, they were packed in ice and transported to different parts of Kerala. Even then some catches could not be disposed off. For the first time at Karwar little tunny were to be diverted for salt curing.

Leather skin and dolphin fish were purchased by merchants to be taken to southern states where they command better prices.

Hooks and lines catches

The few fishermen who practiced hooks and line fishing in the Karwar area had to leave this profession with the advent of purse seines. Dug-out canoes fitted with inboard/outboard engines which operate drift nets added to their agony still more. However, a few enterprising fishermen have started going for hooks and lines fishing in the mechanised boats (10 m) from September onwards. On 25th of September three units landed five tonnes of black sharks *(Carcharinus melanopterus)*. Never before such a quantity of sharks was landed at Karwar. Their size ranged from 60 to 250 cm. Majority of them were males. The fishermen realised Rs. 6,500/-. The sharks were taken to Mangalore for extraction of oil and curing.

Due to inclement weather these units did not go out for fishing subsequently. Nevertheless, it appears that in coming months the hooks and lines fishing may revive in this area.

EARNING BY LEARNING AND DOING*

Prawn farming is no longer a myth to the poor landless harijan farm labourers of the coastal villages of Ernakulam and adjoining Districts. Traditionally, prawn farming has been a monopoly of the rich, and the poor landless farm labourers are engaged by them for farm labour. Taking a prawn farm on lease for prawn farming needs high investment in terms of lease value of the field which an ordinary farm labourer cannot afford. CMFRI has been able to implement a much simple method of Scientific prawn farming which could be done even in small canal systems in coconut groves.

Mr. Satyan, a harijan youth belonging to Kuzhuppilli, a remote village in Vypeen island lying at the coastal belt of Ernakulam District is one among the many landless labourers who are beneficiaries of the newly developed technology.

Satyan hailing from a family of 8 members is aged 23. He has studied up to eighth standard. The annual income of the family is around Rs. 1,800/-. Fishing and farm labour are the major sources of income. Satyan underwent the short-term training course on prawn farming conducted by the Krishni Vigyan Kendra of CMFRI at Narakkal in April 1980. Really this marked a turning point in his life. He was very much impressed by the feasibility of growing commercially important species of prawns in the canal systems. In the vicinity of his house his land lord is having a coconut grove of 1.5 acres with a canal system of about 52.5

Pl. 1. The prawn farm that provides livilihood for Mr. Satyan. All but some water logged canals in a coconut groove.

cents (2,100 m^2). This highly potential water area was left unutilized till Satyan, the enthusiastic youth stepped into it. During his training period itself he had made up his mind to try the new technique in this canal system. Meanwhile he approached the landlord and explained his ambition. Satyan, so trustworthy a youth had no difficulty in winning the confidence of his landlord and generously enough the landlord Mr. Moideen Haji released the water area to Satyan free of cost for growing prawns. Thus even before completing the training course he got the water area at his disposal. The staff of KVK visited the site and ascertained the suitability of the canal system for the purpose.

Soon after completing the training he embarked upon the ambitious programme. He got the fullfledged support of his father and two brothers who joined hands with him in accomplishing the culture operations.

Deepening and shaping of the canals were done by his own family members. Predatory organisms present in the water were fished out using cast net, drag net and bag net (*vattavala*). By the end of November the canals were ready for stocking. Juveniles of the

Pl. 2. "The gate way of prosperity" Mr. Satyan at work at the sluice gate of his prawn farm.

fast growing Indian white prawn *Penaeus indicus* were collected from shallow brackishwater canals at Chathanadu, Pallippuram and other nearby places. Prawn seeds were transported to the culture site by country canoes. Plastic buckets and earthern pots were used as containers. Stocking was over by mid-December. A total of 9,500 juveniles ranging in size 30–60 mm were stocked. Growth studies were done regularly by sampling method. The staff of KVK paid frequent visits to his farm and monitored the culture work. By the end of March the prawns attained marketable size and harvesting was advised. Harvesting was done in presence of the KVK staff. It was also witnessed by a large gathering of local farmers and landless farm labourers. To the surprise of the crowd waiting, Satyan

* Prepared by: K. Asokakumaran Unnithan, P. K. Martin Thompson and P. Radhakrishnan

and his associates netted out 68 kg of *naran (P. indicus)* fetching an amount of Rupees 2,100/-.

Encouraged by his first venture he followed the same operation during the following year, 1981. During this period two crops were taken, mid-November to mid-February and early March to early June. During the year 1983 another technique of farming was tried. This method involved intermittent stocking and harvesting. Here, a partial harvesting was done after 2 months of first stocking, taking out only the marketable sized ones. Followed by the partial harvesting, juveniles at the rate of double the number of prawns harvested were stocked again. Thenceforth every month there was a partial harvesting and stocking as above. This practice was continued till the onset of monsoon.

Satyan feels that this method of intermittent stocking and intermittent harvesting is superior to single stocking and single harvesting method. The former would provide opportunities of realising income at frequent intervals whereas in the latter method one would have to wait for 3 months to get the return. Another advantage of this method he explained is that the commercially most important species of prawn *Penacus monodon*, which needs relatively longer period of culture could also be stocked along with *P. indicus* since this method allows a prolonged duration of culture. *P. monodon* could be retained in the canals even during the monsoon period since it has more tolerance to low salinities.

During the last prawn culture season November '82 to April '83 he successfully tried this type of culture. A total of 5,000 numbers of *P.monodon* and 7,000 numbers of *P. indicus* were stocked at different intervals during November '82—March '83 period. Harvesting was done intermittently from February to April '83. He got 35.75 kgs of *P. monodon* and 53.5 kg of *P. indicus* fetching a total of Rs. 2,685.40.

During this culture operation his prawn stock suffered substantial mortality due to "softness". As soon as he noticed this phenomenon he conveyed the matter to KVK. Soon Scientists and Technicians of the Institute visited his farm and advised immediate harvesting. But for this heavy loss his income would have been much better, Satyan concluded.

Meanwhile his landlord had also become very much convinced by this low cost technology of prawn farming. Impressed by the immense potentiality of his canal system he expressed his desire to have a share of the income. Satyan was only happy to part with a part of his profit. Since last year he has been paying an amount to his landlord towards the lease value of the water area.

Now Satyan is fully confident. He would be able to get some return from the venture at any time of the year. He has taken up prawn farming as a full time occupation which provides a steady and satisfactory livelihood. Encouraged by the feasibility of the technique he is planning to take a larger field on lease for scientific prawn farming, next year.

Establishing a peeling shed was a long cherished dream of Satyan. Thanks to the Department of Harijan welfare—Satyan is getting a loan of Rs. 8,000/- for this purpose. The continuous association he had with prawn farming has helped him a lot in convincing the financing agency. One of the main constraints that he confronts is the inadequacy of natural prawn seed resources. Due to the objection raised by local fishermen he finds it difficult to collect juveniles from brackishwater canals. Prawn seeds available from hatcheries are of the postlarval stage, usually, which require prestocking care in nursery confinements. Since Satyan does not have this facility he is not able to rely on hatchery supply.

NEWS–INDIA AND OVERSEAS

Welfare fund for fishermen proposed

The Ministry of Agriculture, Government of India plans to set up a National Welfare Fund for Fishermen and a National Fisheries Development Corporation during the financial year 1984–85. The fund will provide civic amenities like drinking water, medical and family welfare facilities, education and housing. There will be provision for educating children as well as active adults and for lean season relief and old age pension to fishermen after the age of 60. The NFDC will evaluate the viability of tuna fishing and will train Indian crew in the operation of sophisticated vessels and run the Minicoy Tuna Canning Factory at its full capacity.

Seafood News Letter 63 (5), 1984.

Record fish production in 1983 in Japan

Japan's 1983 fisheries harvest totalled 11.9 million tonnes which was an increase of almost 5 per cent over the 1982 catch. Of the total catch the contribution from the marine side was 11.7 million tonnes. Japan has successfully maintained its fisheries catch above 10 million tonnes since 1979 and continues to land the world's largest catch.

Marine Fisheries Review 46 (3) 1984.

The echosounder that sorts out fish

A new echosounder evolved by the SIMRAD can analyse echo returns and indicate the proportion of fish of various sizes in the form of bar-diagrams. The ES 380 colour sensitivity is said to be such that in some cases even species may be identified.

World Fishing, June, 1984.

Algae clean fish ponds

The U. S. Department of Agriculture working with Haifa Technion, has developed a method of using particular algae to clean fish culture ponds. It has been found that commercially raised fish grow faster and give higher yields in clear water. Electron microscopic studies revealed that certain unicellular algae used in the experiments, and normally found in the ponds, are encased in a gelatinous material. This enables the muddy particles to stick to the algae and to accrete in numbers until the whole conglomeration sinks. As a result, transparency of the ponds increased from about 2 cm to more than 30 cm in four weeks after treatment. It has been found that 4.5 to 9 kg of nitrogen and phosphorous fertilizer per acre encouraged growth of the algae.

World Fishing, March, 1984.

Krill harvest by Japan

Japan harvested 32,000 tonnes of Antarctic krill during the year 1983/84 season. Ten large trawlers engaged in this fishery landed 23,000 tonnes of raw frozen krill, 8,000 tonnes of boiled frozen krill and 1,000 tonnes of meal and other products. Another two trawlers engaged in the Japan–Chile joint venture caught 3,500 tonnes. The use of krill in food is increasing and 70 per cent of last year catch went for direct consumption.

Fishing News International, 24 (6), 1984.

Yacht paint toxins damage shell fish

Shell fish in estuary waters around Britain are under threat from the underside of yachts. Anti-fouling paints traditionally used on the hull of yachts are found to cause the death or deformity of significant numbers of shell fish. The paint which slowly releases toxins into the water inhibiting marine growth, contains tin based compounds which can in turn be deadly to many kinds of marine life and their larvae.

Marine Pollution Bulletin, May, 1984.

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