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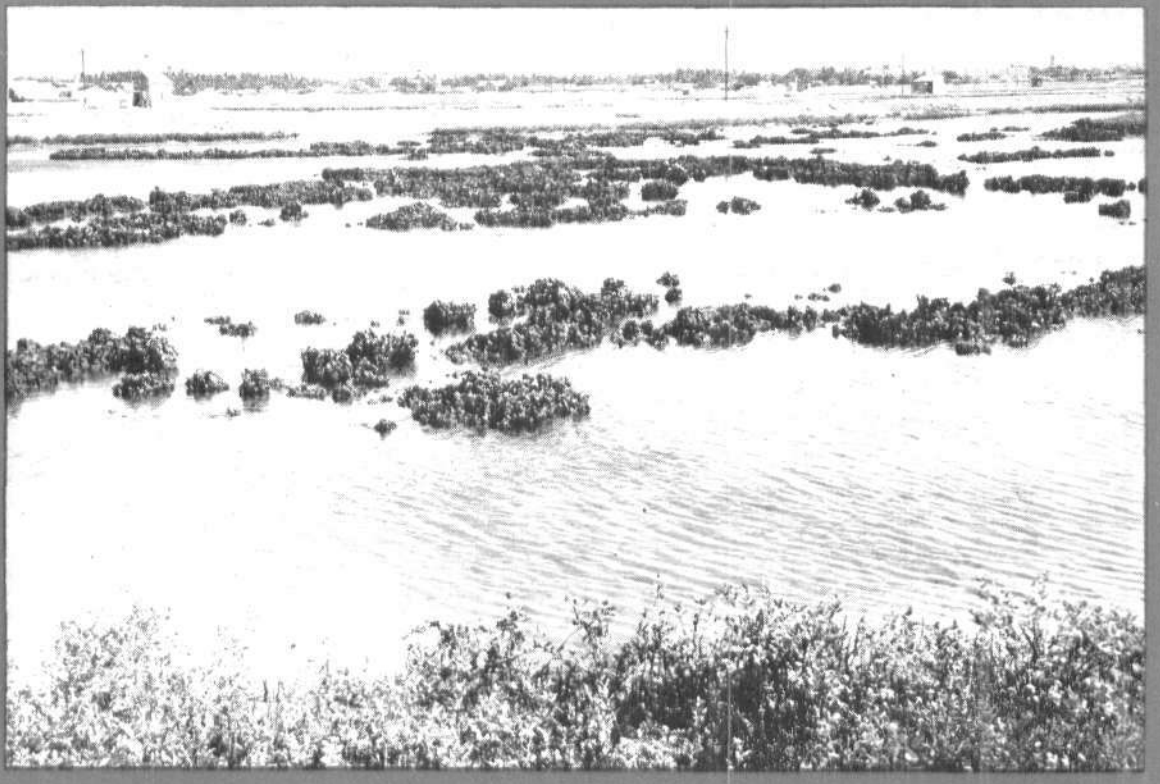

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (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.

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AN INSTANCE OF MASS MORTALITY IN THE MUTTUKADU FARM NEAR MADRAS DURING APRIL 1983*

Introduction

The Mariculture Centre at Muttukadu is situated in the Kovalam backwater and is about 36 km south of Madras City. The northern wing of backwater which ends abruptly near Karikattukuppam village has an area of 93 ha running parallel to the coast and is being converted into a fin fish and prawn culture farm (Fig.1). An earthern bund with steel sluice gates runs across

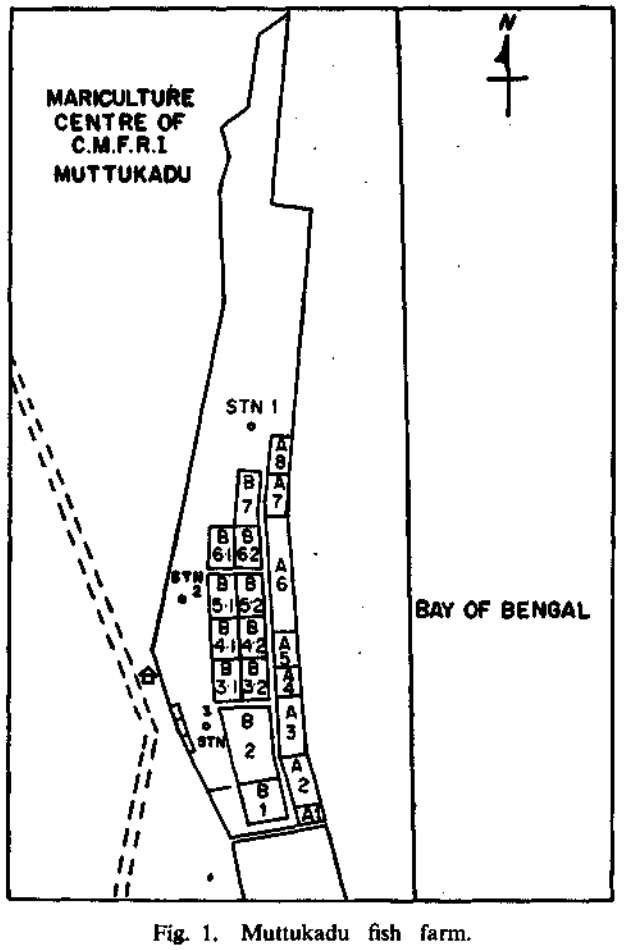

Fig. 1. Muttukadu fish farm.

the backwater separating the farm area from the main body of backwater.

The Kovalam backwater is connected to the sea only during part of the year, the bar mouth usually remains open in October/November. Free water exchange is thus rather limited. This is particularly true of the farm area; as such it is a separate wing of the backwater and the sluice gates further limit water exchange. This pattern of periods of no exchange alternating with periods of limited exchange is repeated every year. Over the past one year due to drought conditions even this limited water movement has been considerably curtailed. There had been very little rain during the monsoon of 1982, it not having rained after November, 1982. The bar mouth closed, by early January, 1983, much earlier than normal. Thus a closed system with no water exchange has been existing in the farm area.

During the period after July, 1981, construction of ponds and their deepening have been carried out on a large scale. A sizeable quantity of water was drained from the farm area for deepening and constructing new ponds in June, 1982 and January, 1983. The total body of water in the farm thus decreased considerably. Mariculture activities in the farm have been intensified particularly after October, 1982. All these activities have been changing the environmental conditions in the farm and adjacent waters. Regular environmental monitoring of these waters has been going on since July, 1981.

While carrying out routine environmental monitoring of the farm site, an unusual mortality of fishes and other organisms was observed in the open site surrounding the farm at Mariculture Centre of CMFRI, Muttukadu between 10-4-'83 to 22-4-'83 (Figs 2-4). The phenomenon was particularly extensive on 19-4-'83. The following is a brief account of this unfortunate incident, giving an analysis of the relevant parameters and discussing the probable causes.

Fish mortality

A few eels of the species *Thyrsoidea macrura*, cat fishes *Tachysurus jella* and *Plotossus anguilaris* were found dead and washed ashore in the early morning

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Fig. 2. Dead fishes strewn over the farm edges — a general view.

Fig. 3. The dead fishes included several varieties.

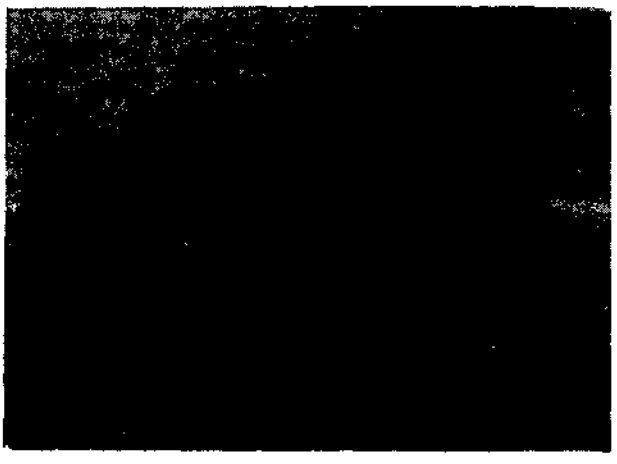

Fig. 4. Another view of the dead fishes.

hours at the northern sector of the farm area on 10 and 11–4–'83 and again from 14 to 18–4–'83. On the 18th and 19th the mortality was particularly heavy and along the western side of the farm area dead cat fishes, eels, *Etroplus surratensis, E. maculatus, Scatophagus argus, Pomodasys* sp. were noticed near the edge of the water. On 20th also heavy mortality of nearly 200 eels and other fishes was noticed. On the same day in the morning *Chanos* and mullets were observed coming to surface gasping for breath in B2 pond. The details of dead fishes together with size range are given in Table 1.

Table 1. *List of dead fishes observed during the mortality*

Species	Size range (mm)
Liza macrolepis	150–342
Mugil parsia	299–315
Valamugil seheli	301–399
Chanos chanos	238–392
Etroplus maculatus	42–62
	(9 fish per m^2)
Etroplus suratensis	144–178
Plotosus angularis	241–771
Tachysurus jella	100–484
Scatophagus argus	170–244
Therapon jarbua	38–148
Pomadasys sp.	306–394
Gobius sp.	39–52
	(467 fish per m^2)
Cynolgossus cynolgossus	90–210
Thyrsoidea macrura	350–1840
Epinephelus aereolatus	160–630

Mortality of prawns

On 19th afternoon, while examining the pen in which a brood stock of *P. monodon* (200 mm) was being maintained, it was found that all the prawns were dead. From the condition of dead specimens, they appeared to have died during the early hours of 19–4–'83. A total of 73 numbers were found dead in the brood-stock pen.

Observation on the bloom

High density of phytoplankton was noticed in the first week of April '84 which later developed into a dense bloom of *Peridinium* sp. and *Ceratium furca.*

The bloom, colouring the water yellow-brown, extended throughout the farm in the open area as well as in the pond B2. Ponds A2 and A3 were predominated by *Oscillatoria.* The densities are indicated by Chlorophyll 'a' value (Table 3). The phytoplankton of the Kovalam backwater area analysed at the same time also contained the Dinophytes but in much smaller density. Continuous bright sunshine, high salinity and low level of nutrients favoured the growth of Dinophytes. Coinciding with the mass mortality of fishes on 19–4–'83 the bloom died out in the area around station 2 continuous with Pond B2. Plankton on that day contained no live *Peridinium,* very few *Ceratium* some *Navicula* and *Nitzschia* sp. and resting spores of *Peridinium.* A similar condition prevailed in Pond B2, the bloom, however, continued near Station 1 and in the canal between A & B Pond series. Thus there was a heterogeneity in the plankton composition and distribution.

The degeneration of phytoplankton extended throughout the farm area by the 23rd. On 24th the water was deep brown in colour and on examination proved to contain a bloom of *Thalassiosira* and *Synechocystis.* Subsequent detailed examination on 26–4–'83 again revealed a difference between the northern body of the farm area and the southern part. The former was found to contain mostly *Ceratium* with a few *Navicula* and *Nitzschia.* The southern part (Station 2) contained dense populations of *Chaetoceros* with numerous *Ceratium* too. Thus it appears that the bloom of *Peridinium* died successively, first in the area near the ponds, then in the ponds and then in the northern end. The bulk of the *Peridinium* appears to have formed resting spores which may again germinate and develop into bloom.

Zooplankton collections made on 12 and 19–4–'83 (night collection) and 26–4–'83 did not reveal any appreciable zooplankton populations. Only amphipods were noticed in the collections. Huge dead masses of amphipods were washed ashore on 19th morning to the extent that they formed thick beds at the water edge on the western side.

Environmental parameters

Chlorophyll: Chlorophyll 'a' values reflected the phytoplankton populations, being very high in the first fortnight, falling during the period of mass mortality and rising again in the reviving period; plankton population consisted mainly of diatoms (Tables 3& 4).

Gross productivity: From an average gross productivity of 200.11 mg C/m³/day in January, the productivity rose to 2210.46 mg C/m³/day in March and remained high during April (Tables 3 and 4).

Nutrients: During the peak of the bloom on 12–4–'83, of the nutrients studied only phosphate-P and nitrite-N were detected in low concentrations both in the open areas and in the ponds. One week later, at the time of mass mortality, phosphate-P showed a slight increase while nitrite-N remained at the same level. Ammonia-N concentration, however, increased tremendously, from nil to 28/ug-at/l (Table 3). These altered conditions led to bloom predominated by daitoms and the nutrients levels dropped significantly.

Temperature: General level of temperature was high, varying between 31.1 to 34.0 °C in the open area. In the ponds temperature varied from 31.5 to 36.0°C.

Salinity: The prevailing high temperature and lack of rain fall since December 1982 led to hypersaline conditions. This ranged from 45.1 to 48.8 ppt in the open area and 48.8 to 54.0 ppt in the ponds.

Table 2. *Environmental parameters: Estimated values as observed during the period of mortality*

	Atmosphere Temp (°C)			Water			Water transparency (cm)			pH			Salinity (ppt)			Dissolved oxygen (ml/l)		
Date	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4
Stn. 1	29.5	28.8	29.2	31.1	33.8	32.4	56	54	78	8.1	7.8	8.4	45.1	48.8	43.9	4.08	0.65	3.76
Stn. 2	29.8	29.0	29.2	32.0	34.0	32.6	32	28	28	8.2	8.0	8.7	46.0	45.0	44.5	4.45	0.40	6.36
Pond A2	29.8	28.0	29.4	32.5	36.0	32.5	15	14	23	8.3	8.0	8.3	48.8	49.2	51.1	5.29	3.76	4.55
Pond B2	30.0	30.2	29.4	31.5	35.2	33.0	22	28	26	8.2	8.0	7.9	51.3	54.0	55.0	3.48	2.16	3.16

Dissolved oxygen: From the normal levels (3.58 to 5.29 ml/1) during the first fortnight, the dissolved oxygen concentration fell drastically (0.40 to 3.76 ml/l) on 19–4–'83 (Table 2). This may be the result of accumulated effect of oxygen depletion during, the early hours of the morning, during the first fortnight. This is evident from the occasional mortality of fishes observed during the early hours of that fortnight. This is strengthened by diurnal monitoring done on 19th and 20th (Table 4). Two areas were monitored, on 12–4–'84; Station 2 which was already depleted in oxygen and in which the bloom had died, and Canal A/B which had higher level of oxygen and contained bloom of similar composition as obtained in Station 2. Table 4 reveals the extent of depletion, upto 0.41 ml/l at 0200 hrs in the canal containing the bloom. The diurnal monitoring of environmental parameters including dissolved oxygen carried out on 19/20–4–'84 substantiated this phenomenon (Table 4). It can be confidently inferred from this, that similar oxygen depletion had occurrred in Station 2 during the fortnight prior to mass mortality.

The continuous low oxygen levels observed during the day time on 19th April may be due to decomposition of the dead fish in the water. The deterioration in water quality also led to the death and decay of marcophytes especially *Halophilla ovalis*. This would have further added to oxygen depletion of the water.

Thus when under normal circumstances the oxygen depletion in the early hours would be made up by photosynthesis during the day, recovery was not possible here due to reduction in bloom and death and decay of different organisms (Table 4).

Table 3. *Environmental parameters: Estimated values as observed during the period of mortality*

	Gross productivity (mg C/m³/day)			Chlorophyll *a* (mg/m³)			Phosphate (µg-at/l)			Nitrite (µg-at/l)			Nitrate (µg-at/l)			Ammonia (µg-at/l)		
Date	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4	13/4	19/4	26/4
Stn. 1	111.4	—	896.2	24.1	35.5	32.4	0.52	—	N.D.	0.25	—	N.D.	N.D.	—	0.74	N.D.	—	N.D.
Stn. 2	—	—	1569.4	43.9	8.6	—	0.52	1.56	N.D.	0.6	0.62	0.07	N.D.	N.D.	1.4	N.D.	29.4	N.D.
Pond A2	1710.9	—	2701.4	55.2	23.9	19.6	N.D.	—	N.D.	1.0	—	0.2	N.D.	—	N.D.	N.D.	—	N.D.
Pond B2	1312.1	—	—	18.9	14.1	28.6	Tr.	—	1.3	0.65	—	0.07	N.D.	—	Tr.	N.D.	—	5.22

Table 4. *Diurnal variation in Dissolved Oxygen (Period of observation* 19–4–'83 *(1400 hrs) to* 20–4–'83 *(1100 hrs)*

Time	Station 2			Canal between A and B series		
	Temperature (°C)		Dissolved	Temperature (°C)		Dissolved
	Atmos.	Water	oxygen (ml/l)	Atmos.	Water	oxygen (ml/l)
1400	31.6	33.8	0.38	—	—	—
1700	27.6	34.0	0.78	27.6	35.1	4.45
2000	26.8	32.8	0.79	26.8	32.6	3.90
2300	26.8	31.7	0.57	26.8	31.0	2.39
0200	27.2	32.2	0.19	27.0	29.8	1.52
0500	25.8	30.8	0.19	25.6	28.8	0.41
0800	26.8	31.0	0.09	26.8	29.2	1.50
1100	27.8	33.2	1.50	27.8	33.4	3.62

Conclusion

During this season the prevailing high temperature and salinity and the enclosed nature of the water body, all resulted in an intense bloom of dinophytes. This led to oxygen depletion of the waters and then, very likely, of the mud. The environment of the closed system must have been strained to a fine degree of balance.

Another reason may be that large groups of fishermen belonging to Kovalam and Karikattukuppam villages, in view of poor fishing in the sea, started unauthorised fishing in the farm area at Muttukadu. The regular operation of drag nets and gill nets has stirred up the mud and created large scale disturbance which, combined with the oxygen depletion, must have precipitated the crisis and led to the mortality of prawns and fishes.