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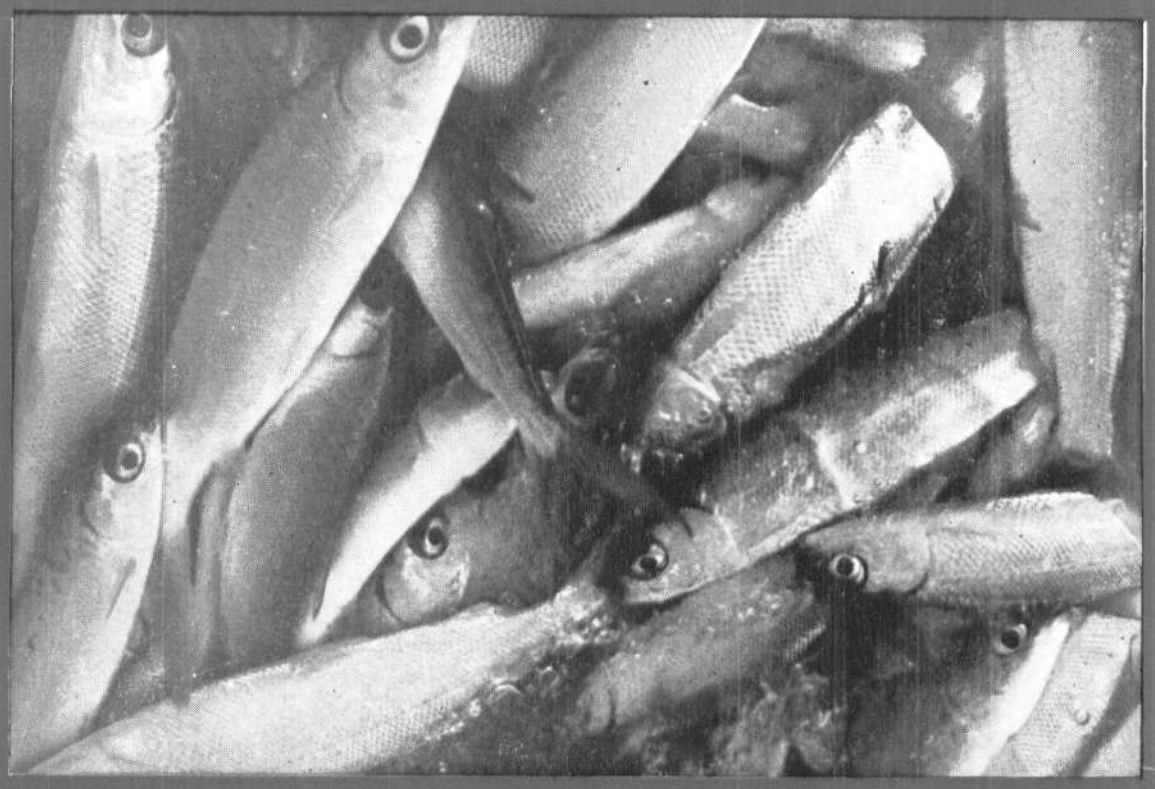

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions 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. Serv. T & E Ser.*, No. 48: 1983..

CONTENTS

Cover Photo: Milk fish harvested from the pond at Mandapam

FISH CULTURE IN MARINE FARM AT MANDAPAM

G. Mohanraj, A. Raju, V. Gandhi and V.S. Rengaswamy

Introduction

It is well known that large-scale monoculture and polyculture of the milkfish, *Chanos chanos* (Forskal) (Fig.1) are undertaken both in brackishwater and seawater farms in many Southeast Asian countries, particularly in Indonesia, Philippines and Taiwan. In polyculture, milkfish is cultured either with another fin fish (mullet) or with the shellfish (prawn and crab). Milkfish culture in India was initiated by the Madras Fisheries Department. Culture experiments conducted by Tampi *(Ind. J.Fish.*7 (1): 137-46, 1960) at Mandapam indicated the potentiality of milkfish culture even in an apparently low productive coastal pond of Mandapam area with a moderate biological niche. Further confirmatory culture experiments in this region were hampered because of the total devastation of the farm by the cyclone in 1964. After renovation and remodelling of the ponds at Mandapam, monoculture and polyculture experiments on milkfish were possible only during 1980-82. The present report highlights some interesting and encouraging results obtained during the experiments conducted in 1981-82 and provides further useful information to the culturist on the feasibility of undertaking marine fish culture along the coastal areas of Ramanathapuram District.

Monoculture of milkfish

Pond preparation

The culture experiment was planned in a 0.25 ha pond. Earlier, the water in the pond was completely drained eradicating undesirable fishes and other competitor organisms. It was allowed to dry for a few days before pumping seawater to a depth of 45 cm. This depth was maintained throughout the period of experiment by resorting to daily pumping of seawater.

Stocking

1000 milkfish fingerlings, collected from tidal pools at Pamban and Pillaimadam lagoon were stocked in September 1981 at a stocking rate of 4000/ha. The average length and weight of fingerlings at the time of stocking were 129 mm and 13 g respectively. Supplementary feeding with doughs of rice bran, groundnut oil cake, tapioca powder and fishmeal mixed in equal proportion was done at the rate of 5-10% of body weight. Fish samples were taken once in 30 days from the pond and the length and weight of about 10% of the total stock in the pond were recorded to ascertain the growth rate. Environmental parameters were periodically recorded (Fig.2) for the ten month duration of the experiment.

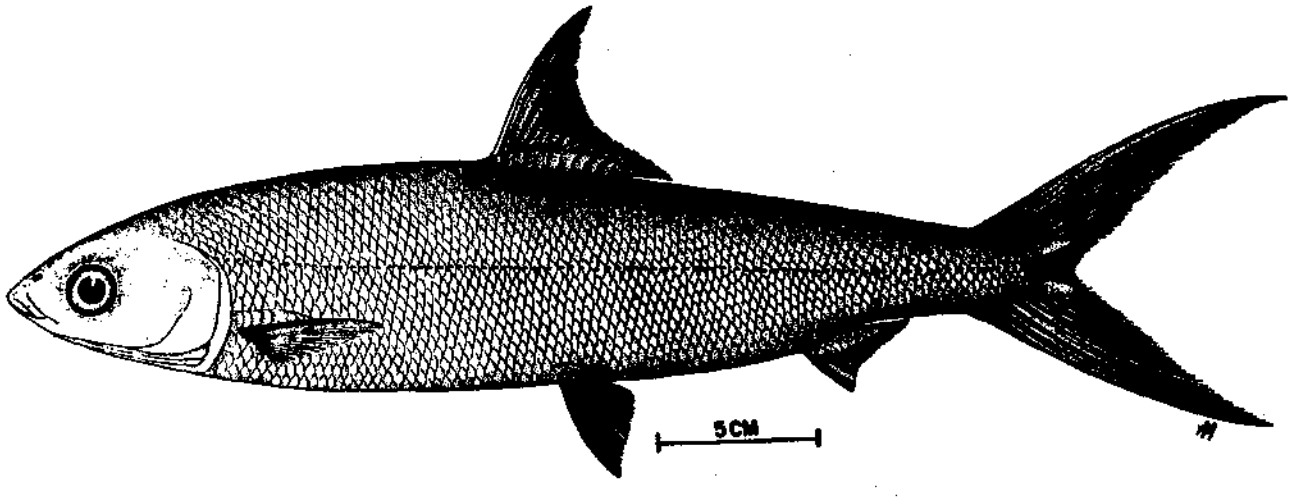

Fig. 1. The milkfish, *Chanos chanos* (Forskal).

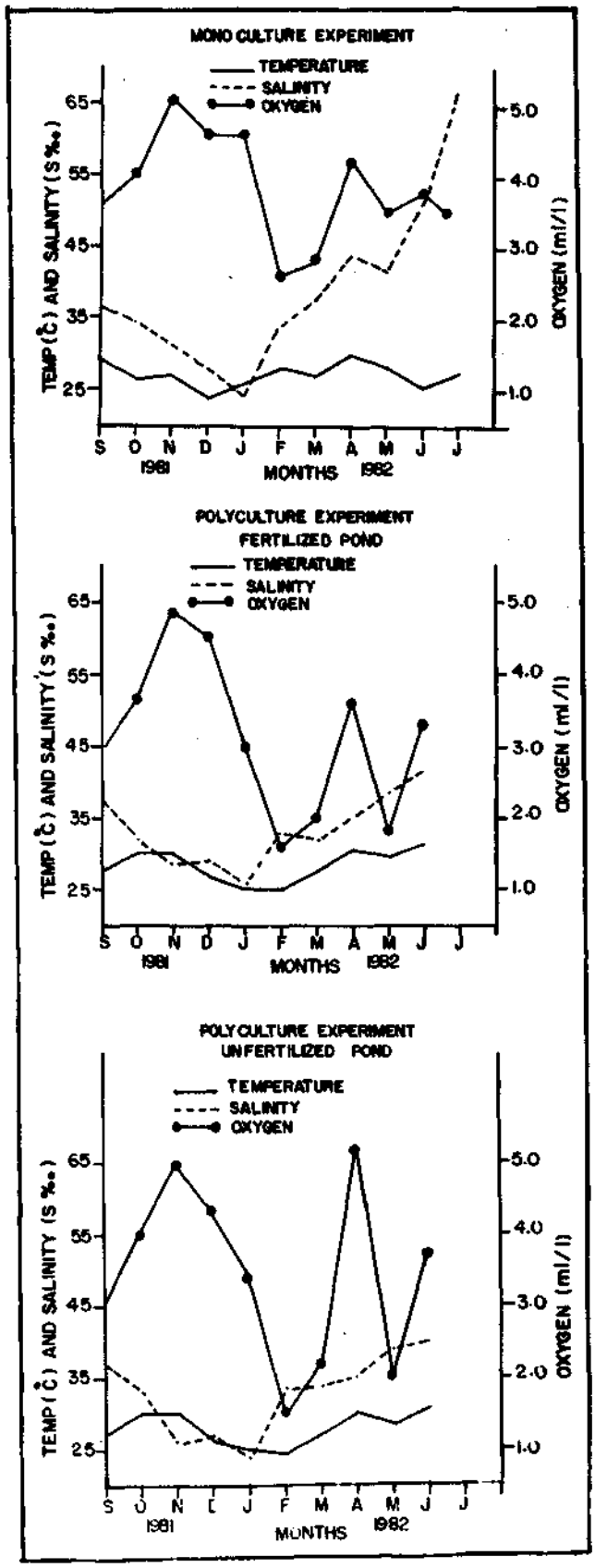

Fig. 2. The environmental parameters of the pond water showing the monthly average of temperature, salinity and oxygen in the monoculture and polyculture of milkfish.

Results

i) Growth

The average length and weight of milkfish recorded in different months are given in Fig.3. The average size of the fish increased from 129 mm (13 g) in September '81 to 250 mm (133.9 g) in three months, 293.7 mm (195.3 g) in six months and 368.7 mm (325.4 g) at harvest (at the end of ten months). The monthly increment in length varied between 1.58 mm and 72.35 mm and the weight between 0.39 g and 88.64 g, with an average of 23.97 mm in length and 31.24 g in weight. Faster grwoth was observed during the first, third and seventh months of the rearing period. During these ten months, the fish gained a net increase of 239.7 mm in length and 312.39 g in weight indicating 0.8 mm length increase and 1.04 g of weight increment per day.

ii) Yield

The different size groups in length and weight at harvest are shown in figures 4 and 5 respectively. The milkfish at harvest ranged from 240 mm to 494 mm in length and 80 g to 780 g in weight. About 53.5% of the total harvested fish had grown above average size. The harvest yielded 213 kg. denoting a calculated production rate of 852 kg/ha. The survival rate was 63%. A total of 1990 kg of artificial feed was supplied to the fish to achieve a net weight increase of 200 kg. The gross conversion ratio for the feed was 9.95 : 1.

Remarks on the results of 1980-81 experiments:

In the culture experiments conducted earlier in 1980-81, 1000 fingerlings of milkfish were stocked in the same pond in September '80, at a stocking rate of 4000/ha. The average size at stocking was 59.2 mm (1.9 g). Supplementary feeding was not attempted. However, in order to promote algal growth, the pond was manured with 250 kg of organic manure (chicken droppings) before stocking. Subsequent to stocking, 5 kg of inorganic fertilizer NPK (12:24:12), was supplied fortnightly. The size of the milkfish showed an increase from 59.2 mm (1.9 g) to 159.1 mm (32.7 mm in three months, 188.5 mm (54.8 g) in six months and 211.9 mm (60.2 g) at harvest (at the end of ten months). The average monthly growth recorded was 15.27 mm in length and 5.83 g in weight. The yield was 54 kg of milkfish (216 kg/ha) with a survival rate of 89.7%. The minimum and maximum size of milkfish at harvest were 184 mm (44 g) and 248 mm (78 g) respectively. 41% of the harvested fish were found to have grown above the average size.

Polyculture of milkfish with mullet

Pond preparation

During 1981-82, milkfish was cultured along with mullet in two ponds, each of 450 sq.m. Seawater sup-

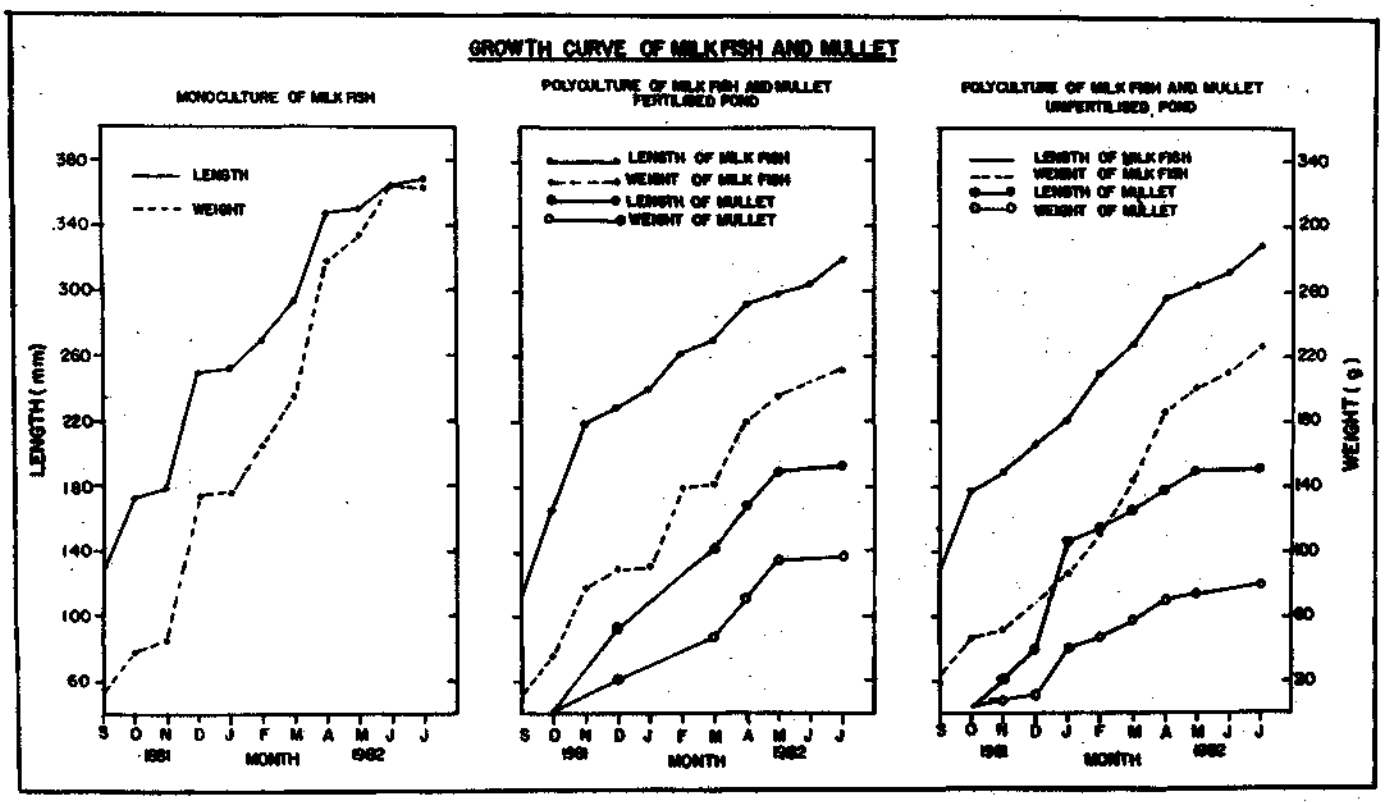

Fig. 3. Growth curve of milkfish and mullet in monoculture and polyculture experiments.

ply to the ponds was maintained by direct pumping. Of the two ponds, one was fertilized with organic manure at the rate of 1000 kg/ha initial application and thereafter once in three months at a rate of 500 kg/ha. The other pond was not fertilized.

Stocking

The milkfish seed were collected from tidal pools and streams at Manoli Island and Pillaimadam lagoon whereas the mullet seed were collected from Thonithurai area along the Palk Bay side of Mandapam. These were reared indoor in 12′ dia pools for one month prior to stocking in ponds. In both ponds, 375 fingerlings of milkfish *(Chanos chanos)* were stocked in September, '81 and after one month 350 fingerlings of mullet *(Valamugil seheli)* were stocked at an overall stocking rate of 16000/ha. The stock in both ponds were given (daily once) supplementary feed, of rice bran and groundnut oil cake mixed in equal proportion, in the form of dough, at a rate of 5-10% of the body weight. The environmental conditions of these ponds were regularly monitored (Fig.2). Harvesting was done in July '82. The results obtained from fertilized and unfertilized ponds were treated separately.

Results

Fertilized pond

i) Growth

The growth pattern of milkfish and mullet are given in Fig.3. The milkfish grew to a size of 229.2 mm (88.6 g) in three months, 271.5 mm (143.4 g) in six months and 322.7 mm (213.0 g) at harvest (at the end of ten months) from the initial average size of 109.9 mm (12.8 g). The monthly length increment was from 6.0 mm to 57.0 mm and the weight from 7.0 g to 47.2 g. The average monthly increase worked out to 21.3 mm and 20.0 g in length and weight respectively. Growth was noticed to be better in the first, second, fifth and seventh months.

The mullet attained a size of 88.8 mm (11.7 g) in two months, 170.6 mm (73.4 g) in six months and 195.0 mm (97.6 g) at harvest at the end of nine months from the initial average size of 42.5 mm (2.5 g). The growth per month ranged between 2.7 mm and 27.8 mm in length and 0.8 g and 25.4 g in weight with a monthly average of 16.9 mm and 10.6 g in respect of length and weight.

ii) Yield

Harvest done in July '82 yielded a total of 58 kg of milkfish and 4 kg of mullet which works out to a calculated production rate of 1289 kg/ha for milkfish and 89 kg/ha for mullet. The survival rate of milkfish and mul-

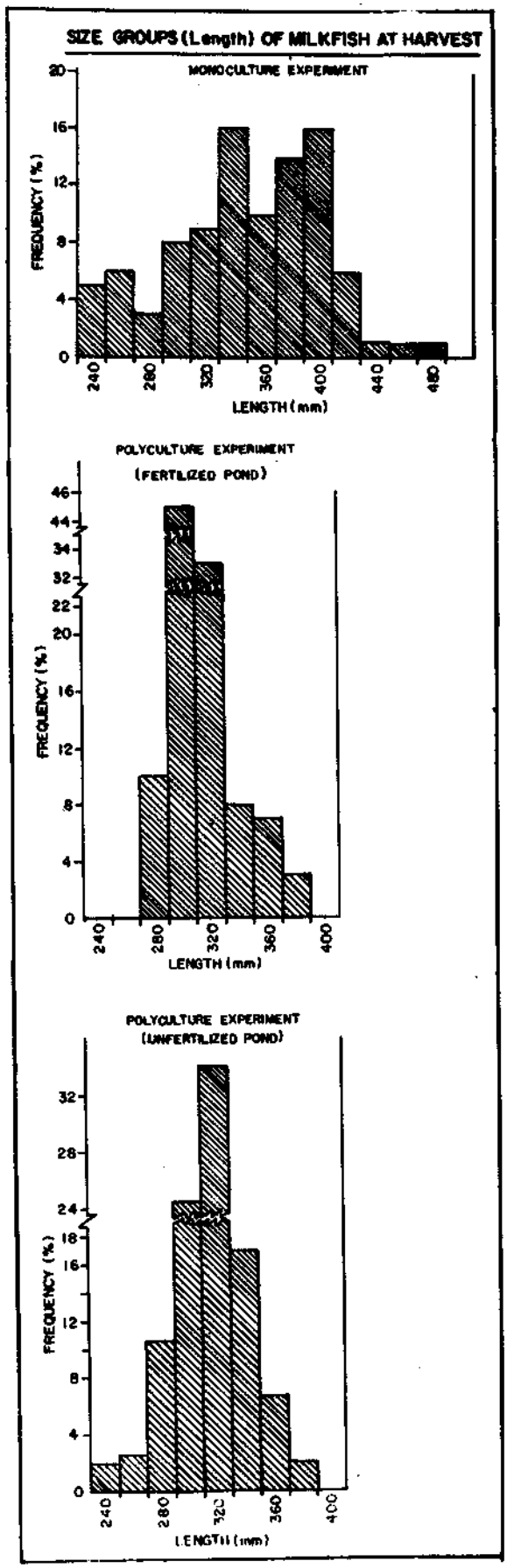

Fig. 4. The length groups of milkfish in the monoculture and polyculture at harvest.

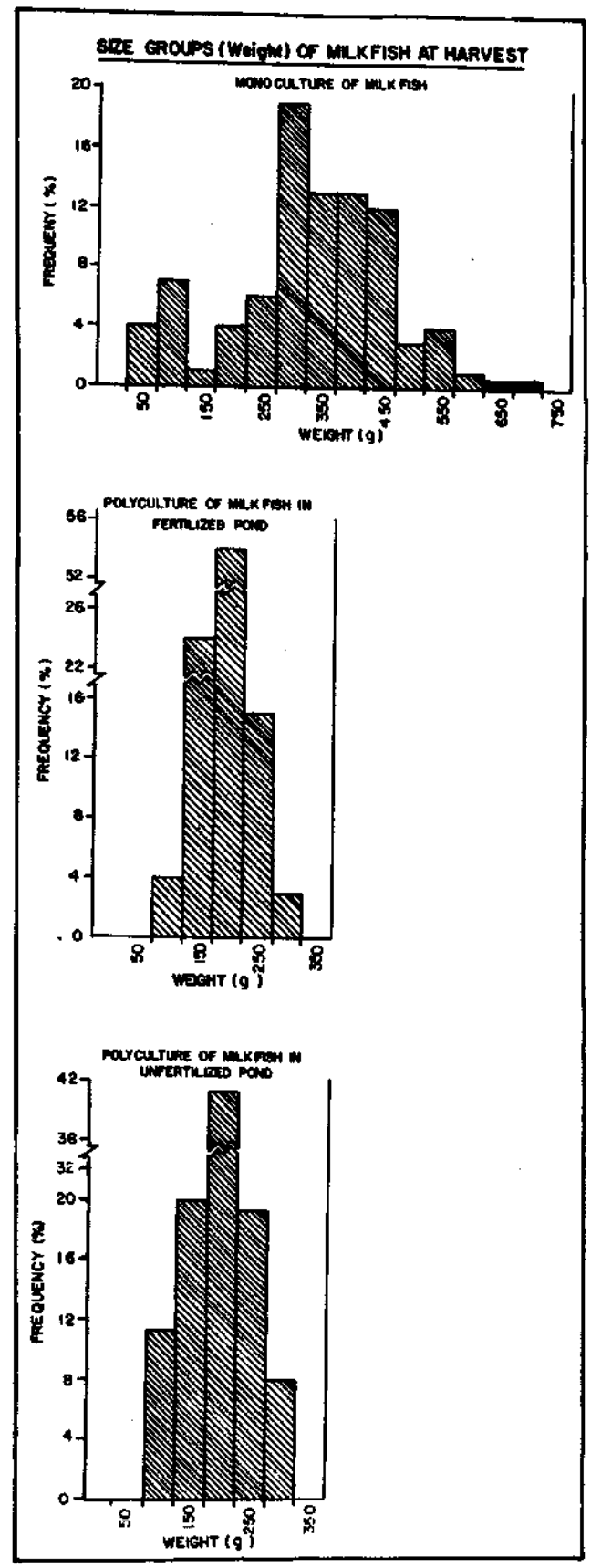

Fig. 5. The size groups (weight) of milkfish in the monoculture and polyculture at harvest

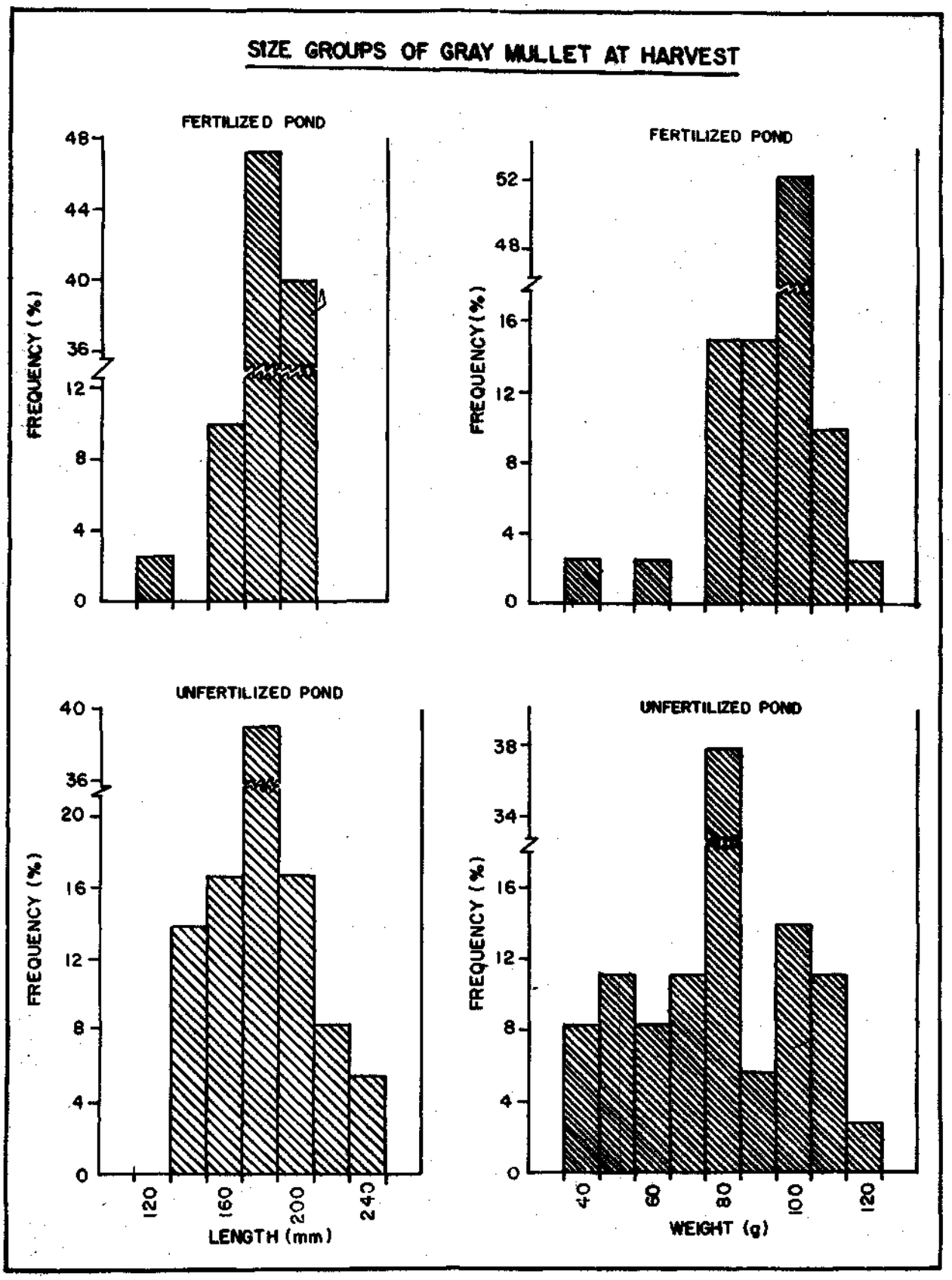

Fig. 6. The size groups (length and weight) of grey mullet in the polyculture at harvest.

let was 81.2 and 11.4% respectively. The size of milkfish at harvest ranged from 283 mm (120 g) to 397 mm (300 g). About 39% of the harvested milkfish had grown above the average size. The size groups of milkfish at harvest both lengthwise (Fig.4) and weightwise (Fig.5) are indicated. The size range of mullet at harvest was from 120 mm to 218 mm in length and 40 g to 120 g in body weight with about 57% of fish grown above the average size (Fig.6).

Remarks on the results of 1980-81 experiment

Similar experiment in the same pond with indentical stocking density was conducted during September- June of the preceeding year (1980-81) also. The average size of milkfish and mullet fingerlings at the time of stocking was 91.6 mm (10.6 g) and 50.6 mm (2.0 g) respectively. At harvest, the milkfish had grown to an average size of 360.0 mm (270.0 g) and the mullet to 190.1 mm (75.0 g). The monthly growth rate ranged between 3.4 mm (1.3 g) and 48.8 mm (60.7 g) with an overall monthly average of 26.5 mm (25.9 g) for milkfish and for the mullet between 7.8 mm (1.0 g) and 21.0 mm (15.8 g) with an overall monthly average of 15.5 mm (8.1 g). Th actual yield at harvest was 57 kg (calculated yield 1267 kg/ha) of milkfish and 15 kg (calculated yield 333 kg/ha) of mullet with a survival rate of 60.8% and 57% respectively. The percentage of milkfish and mullet which had grown above the average sizes was 49% and 62% respectively.

Unfertilized pond

i) Growth

Milkfish fingerlings increased from the average stocking size of 121.9 mm (21.2 g) to 206.5 mm (68.3 g) in the first three months, 267.2 mm (143.2 g) at the end of six months and 329.1 mm (227.2 g) at the end of ten months, at harvest (Fig.3). The range in monthly increase was from 4.9 mm to 54.9 m in length and 6.2 g to 44.9 g in weight with an overall monthly average of 20.7 mm and 20.6 g respectively. The growth of milkfish was better in 1st, 5th and 7th month of the rearing period.

ii) Yield

As in the case of the fertilized pond, harvest was done in July, '82. 63.25 kg of milkfish and 2.9 kg of mullets were harvested which worked out to a calculated production rate of 1405 kg/ha for milkfish and 64 kg/ha for mullet with a respective survival rate of 86.7% and 10.3%. The harvested milkfish ranged in size from 245 m (100 g) to 398 mm (340 g) with about 44.7% of total fish grown above the average size. The size groups in length (Fig.4) and in weight (Fig.5) at harvest are indicated. The mullet which ranged from 150 mm (40 g) to 250 mm (120 g) at harvest showed a percentage of 53% above the average size (Fig.6).

Remarks on the results of 1980-81 experiment

During the preceding year (1980-81) identical experiment was conducted in the same pond. The average size of milkfish and mullet fingerlings at stocking were 65.9 mm (2.5 g) and 57.0 mm (3.0 g) respectively. The milkfish grew to an average size of 343.3 mm (249.0 g) at harvest at the end of 10 months and the mullet to 190.9 mm (65.0 g) at harvest at the end of 9 months. The monthly growth rate ranged from 7.6 mm (0.8 g) to 69.6 mm (80.0 g) for the milkfish and 7.3 mm (1.0 g) to 33.6 mm (23.3 g) for the mullet, with an average growth increase of 27.7 mm (24.6 g) and 14.9 mm (6.9 g) respectively. The total quantity of fish harvested was 54.25 kg of milkfish (1205 kg/ha)and 9.75 kg of mullet (217 kg/ha) with a recovery rate of 65% for the former and 42.9% for the latter, 49% and 57% in respect of total harvested milkfish and mullet recorded above the average size.

General Remarks

From the foregoing results it is apparent that in the monoculture of milkfish the average size of the fish as well as the production rate could be substantially stepped up by resorting to supplementary feeding. It is interesting to note that the average growth rate of 24 mm and 31 g per month obtained in 1981-82 experiments is higher when compared with the results obtained by Thampi (1960) in the same area. With regard to polyculture of milkfish, the average growth rate was found to be more or less similar in both the fertilized and unfertilized ponds. However, the survival and production rates were higher in unfertilized pond when compared with those of the fertilized pond. The salient features of the culture operations are presented in Table 1.

The milkfish production in the present experiment is found to be much better than in Thailand, where on an average 560 kg/ha/yr was produced (Arporna-Sribhaibhadh, Fishing News (Books) Ltd: 74-83, 1970). The yield of milkfish under monoculture in the present study is comparable to that of Ceylon, where selective harvesting followed by replenishment gave a production of 799 to 1159 kg/ha/annum. A production rate of 1405 kg/ha/10 months obtained in the present experimental polyculture of milkfish is similar to the yield of 1338 kg/ha realised at the reclaimed tidal land of Taiwan (Jium-Kuo Liang and Chin-Yun Huang, Fishing News (Books) Ltd: 417-28, 1970). Although more confirmatory data are needed to findout the actuals, the experiments conducted by CMFRI at Mandapam have helped to demonstrate the feasibility of culturing milk-

a

b

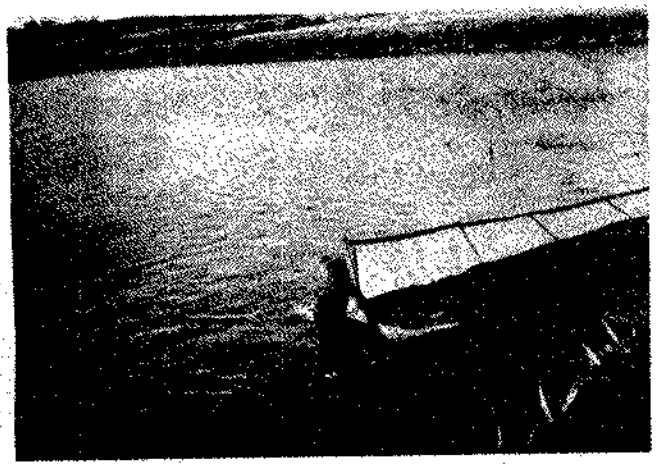

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Plate 1. (a-f) showing the sequence of operation of the net and the catch of milkfish at harvest.

Table 1. *Culture of milkfish and mullet during the period 1981-'82 at Mandapam*

Sl. No.	Particulars	Monoculture (Un-Fertilized) Pond	Polyculture (Fertilized) Pond		Polyculture (Un-Fertilized) Pond	
1.	Size of the pond	0.25 ha	0.045 ha		0.045 ha	
2.	Name of the Species	Milkfish	Milkfish	Mullet	Milkfish	Mullet
3.	No of seed stocked	1000	375	350	375	350
4.	Stocking rate per hectare	4000	8333	7777	8333	7777
5.	Date of stocking	20.9.81	14.9.81	14.10.81	14.9.81	14.10.81
6.	Size at stocking					
	a) Average length (mm)	129.0	109.9	42.5	121.9	42.5
	b) Average weight (g)	13.0	12.8	2.5	21.2	2.5
7.	Date of harvest	21.7.82	19.7.82	19.7.82	18.7.82	18.7.82
8.	Culture period (Days)	303	303	274	303	274
9.	Size at harvest					
	a) Average length (mm)	368.7	322.7	195.0	329.1	190.0
	b) Average weight (g)	325.9	213.0	97.6	227.2	80.0
10.	Growth rate (Monthly average) a) length (mm)	24.0	21.3	16.9	20.7	16.4
	b) Weight (g)	31.2	20.0	10.6	20.6	8.6
11.	Total quantity harvested (Kg)	213.0	58.0	4.0	63.250	2.9
12.	Production rate (Kg/ha)	852.0	1289.0	89.0	1405.0	64.0
13	Survival rate (%)	63.0	81.2	11.4	86.7	10.3

fish in coastal seawater ponds, which are considered biologically less productive.

Seasonal abundance of the milkfish seed in the nearby areas of Mandapam confers specific advantage in undertaking milkfish culture here. In addition to Chinnapalam creek and Pillaimadam lagoon which are well known potential grounds for milkfish seed, recent attempts made by this team brought to light the existence of more extensive areas near Mandapam for attempting large-scale collection of fry and fingerlings of milkfish and mullet.

The authors wish to express their very sincere gratitude to Dr.E.G.Silas, Director, Central Marine Fisheries Research Institute, Cochin for his constant encouragement throughout the period of this study. They are thankful to Dr. P.S.B.R.James, then Joint Director and Project leader for the guidance. They are also thankful to Shri S.Mahadevan, Officer-in-Charge for critically going through the manuscript and for the suggestions for improvement and Shri K. Dorairaj for the help in the preparation of this account.

FLUCTUATIONS IN THE MACKEREL CATCHES AT COCHIN*

On 21st and 28th September 1982, heavy catches of mackerel were landed by purse seiners at the Fisheries Harbour, Cochin, the estimated landings being 293.529 and 108.999 tonnes respectively. Since such heavy landings are quite unprecedented in the recent past, observations made on the biology of the fish and its fishery are presented.

The particulars of number of units, catch and catch per unit at Cochin during September 1982 are presented in Table 1. On 21st September, 56 purse seiners and 110 carrier boats landed 293.529 tonnes of mackerel at 5241.589 kg per unit. In the morning of the day when the purse seiners and carrier boats started arriving with catches, the auction price ranged from Rs.4550/- to Rs.4900/- per tonne of mackerel (Figs. 1 & 2). As the boats continued to bring in heavy catches, the price declined to Rs.1500/- per tonne of fish later in the day. On the following day, the mackerel catch came down to 16.059 tonnes at a catch rate of 297.389 kg per unit. On 28th instant, mackerel landings were good aggregating 108.999 tonnes at 2018.500 kg per unit. But, the fish merchants were not prepared to buy the catches as there was poor demand for fish in the market (being Bakrid). The catches of 28th continued to come till the early hours of 29th instant. On 29th morning, the catches were found strewn all over the Fisheries Harbour. The price came down to Rs.700/- per carrier boat of 1.8 to 2.0 tonnes of mackerel. Most of the mackerel landed was spoiled and some of the lots were transported as manure. This glut of mackerel in the harbour affected the auction sale of drift net catches. The price of cat fishes, pomfrets, horse mackerel, seer fishes, etc., declined drastically resulting in a fall in the average income per drift net boat from Rs.500/--525/- in the previous week to about Rs.240/- in the week under reference. The total estimated landings of mackerel in September 1982 aggregated 1026.222 tonnes which, incidentally, is the highest montly catch recorded at Cochin since March 1981 (catch: 1055.407 tonnes).

The size-ranges and dominant modal sizes of mackerel in the purse seine catches at Cochin in September 1982 (observation day-wise) are given in Table 2. The overall size-range of the fish during the month was 153-276 mm and the modal sizes varied between 180 and 250 mm suggesting that the fishery was supported mainly by 1-year and 2-years-old individuals. A majority of fish (58%) were in spent condition followed by immature, spent-recovering and developing individuals. The bulk (92%) of the bumper catch of 21st September comprised spent fish followed by spent-recovering individuals. These were 2-years-old.

The mackerel catches in Kerala State, constituting on an average about 30% of the landings in India, have been showing a declining trend from 1978 through 1982, the catches in the concerned years being 25917, 18585, 18474, 16200 and 10717** tonnes respectively. At Manassery,, Cochin, the mackerel fishery by indigenous boats operating Thangu vala (boat seine) and Ayila vala (gill net) has been sporadic and poor in 1978 and 1979, the landings being 521.449 and 387.325 tonnes respectively. With the introduction of purse seining on a commercial scale in 1979, the fishery improved considerably. The month-wise mackerel landings and catch per unit effort by purse seiners at Cochin during August 1979 - December 1982 are delineated in Table 3. The total landings of mackerel by purse seines, drift nets and trawl nets at the Fisheries Harbour, Cochin during 1979, 1980, 1981 and 1982 aggregated 248.989, 4359.363, 3948.141 and 2158.698 tonnes respectively of which purse seines contributed 19.32%, 96.83%, 98.78% and 97.20% in the concerned years. In 1980, the purse seine fishery was better during post-monsoon months with high yields and yield rates particularly in October (1495.203 tonnes and 662.180 kg per unit) and December (1127.243 tonnes and 679.881 kg per unit). This trend of high yields and yield rates continued through the pre-monsoon season of 1981 when the returns registered high values (e.g., 1335.692 tonnes and 1649.002 kg per unit in February and 1055.407 tonnes and 1552.069 kg per unit in March). The fishery was moderately good through the 1981 post-monsoon and 1982 pre-monsoon seasons. But for the high yield recorded in September, during October through December 1982 the fishery exhibited almost the same trend as in the post-monsoon season of 1981. As compared to the landings during 1980 and 1981, those in 1982 were considerably less. The fall in the effort expended during these years was rather marginal (9580, 8870 and 8779 purse seine units in the respective years).

The month-wise delineation of the catch data, however, does not give a true picture of the sporadic nature and magnitude of fluctuations in the mackerel fishery at Cochin. On an average, the number of days expended for fishing by purse seiners is 25 or 26 in a

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**Provisional

Table 1. *Particulars of the purse seine mackerel fishery at the fisheries Harbour, Cochin in September 1982.*

Date of observation	Number of units operated		Mackerel	
	Purse seiners	Carriers	Catch (kg)	Catch per purse seiner (kg)
4.9.1982	33	28	71409	2163.909
17—	52	35	63499	1221.135
21—	56	110	293529	5241.589
22—	54	46	16059	297.389
24—	54	40	47932	887.630
28—	54	52	108999	2018.500

Table 2. *Size ranges and dominant modal sizes of mackerel in the purse seine catches at the Fisheries Harbour, Cochin in September 1982.*

Date of observation	Size-range (mm)	Dominant modal size + (mm)
4-9-82	170—240	190, 200
17—	225—272	240
21—	228—275	230, 245
22—	215—276	235, 250
24—	153—222	180, 190
28—	220—270	235

+ Mid-points of size-groups.

month. An examination of the catch statistics of the Fishery Resources Assessment Division of the CMFRI suggests that on a majority of fishing days in a month the mackerel catch of purse seiners is highly negligible or even nil, the total landings of the month being made up of the good catches of certain days only. It is possible that mackerel shoals do not occur in sufficient concentration in the present fishing belt, even after extension of the fishing area by purse seiners. In Table 4 are presented the maximum mackerel catches and catch per unit effort recorded on certain days by purse seiners at Cochin during August 1979–December 1982. If Tables 3 and 4 are read in conjunction

Fig.1. A purse seine carrier boat with mackerel at the Fisheries Harbour, Cochin.

with each other, the reasoning that the total landings of a month are constituted by the good catches of certain days only becomes obvious.

When Thangu vala was the principal gear employed in the mackerel fishery in the inshore belt of 4–10 km from Cochin, the fishery which was of small magnitude exhibited two phases, one of occurrence of juveniles during May–August and another of commercial sizes during October–April, with negligible or nil catches in September. With the extension of the area of fishing by purse seiners in 1979, the fishery exhibited a different picture since then–of large catches and very good catch rates of mainly adults in the pre-monsoon months of certain years and of predominantly juveniles in the post-monsoon period of certain other years (vide Table 3). It is interesting to note that on

Table 3. *Mackerel landings (kg) and catch per unit effort (kg) (in parenthesis) by purse seiners at the Fisheries Harbour, Cochin during August 1979—December 1982.*

Year	Jan.	Feb.	Mar.	Apr.	May	Jun. Jul. Aug.	Sep.	Oct.	Nov.	Dec.	Total
1979	—	—	—	—	—	— — ++	++	17565 (87.388)	28545 (102.312)	2000 (7.143)	48110 (58.386)
1980	15985 (53.822)	40247 (105.359)	116767 (197.242)	112289 (111.287)	287150 (354.506)	No operation	329183 (322.728)	1495203 (662.180)	696961 (448.495)	1127243 (679.881)	4221028 (440.608)
1981	59195 (65.699)	1335692 (1649.002)	1055407 (1552.069)	476030 (587.691)	239073 (283.262)	" "	319951 (325.484)	392323 (313.107)	15507 (12.998)	6688 (4.791)	3899866 (439.669)
1982	11110 (8.341)	314094 (283.478)	68631 (109.810)	154243 (119.476)	151366 (132.197)	" "	1026222 (846.718)	355158 (309.102)	5047 (12.875)	12352 (23.528)	2098223 (239.005)

++No mackerel in the purse seine catches.

Table 4. *Maximum mackerel catches (kg) and catch per unit effort (kg) (in parenthesis) on certain days by purse seiners at the Fisheries Harbour, Cochin during August 1979—December 1982.*

Year	Jan.	Feb.	Mar.	Apr.	May	Jun. Jul. Aug.	Sep.	Oct.	Nov.	Dec.
1979	—	—	—	—	—	—	—	18th 7660 (957.500)	15th 7500 (277.778)	27th 1000 (62.500)
1980	18th 3250 (406.250)	26th 8238 (374.455)	10th 30546 (872.743)	26th 33274 (627.811)	2nd 39092 (1699.652)	No operation	26th 127987 (1777.597)	13th 262471 (2322.752)	13th 66933 (1365.980)	24th 226420 (2902.821)
1981	3rd 12500 (367.647)	20th 186575 (4664.375)	2nd 92380 (3849.167)	18th 89320 (1488.667)	28th 103390 (2067.800)	" "	5th 66120 (1889.143)	6th 122090 (2219.818)	23rd 3033 (58.327)	8th 2040 (53.684)
1982	30th 1942 (37.346)	11th 62980 (1049.667)	18th 20825 (833.000)	12th 35453 (644.600)	17th 13707 (274.140)	" "	21st 293529 (5241.589)	5th 55500 (1067.308)	19th 1350 (54.000)	17th 3720 (97.895)

Fig.2. Bumper catch being packed for the market.

some days in September (vide Table 1) high catches and catch rates were obtained which indicates that the mackerel shoals available in the inshore waters were not adequately exploited before the introduction of purse seiners in the area (vide Table 3). Several hypotheses have been put forward for the shore-ward coastal migration of mackerel and the resultant wide fluctuation in the fishery. The significance of temperature and salinity in the availability of mackerel has been established by comparing the monthly mackerel landings and values of temperature and salinity at different centres by various authors. Certain optimal levels of temperature and salinity have been found to be good for the mackerel fishery.

PRELIMINARY OBSERVATIONS ON FISH PEN CULTURE IN A LAGOON AT MANDAPAM*

Introduction

Fish pens of various designs are in operation in countries like Philippines, Taiwan, Hongkong and Indonesia. Small fish enclosures were tried experimentally in Pulicat lake, Killai backwaters, Tuticorin Bay and Palk Bay. In the present study large fish pens of area 0.25 ha (50 × 50 m), 0.5 ha (100 × 50 m) and 1 ha (100 × 100 m) respectively were fabricated in the Pillaimadam lagoon near Mandapam Camp adjacent to the Palk Bay for culturing fishes. (Fig.1).

Location of culture area

The Pillaimadam lagoon is situated along the Mandapam coast (09° 17'N and 79° 06'E) adjacent to the Palk Bay. The maximum water spread of the lagoon during November-December is about 400 ha extending for about 5.2 km in length and 500 to 800 m in width. The lagoon was earlier reported to have two bar mouths opening into the Palk Bay. But now the opening at the western end has got closed and that has affected the topographical and the Physiochemical characteristics of the lagoon to a great extent. Though water is found throughout the year in the deeper parts of the lagoon, it dries up exposing the major part during September-October when the south west wind is strong. During the north east monsoon from November-December, the lagoon receives rain water mainly through the Pillaimadam creek, the main fresh water inlet of the lagoon

Based on the topography of the lagoon, it can be divided into 3 zones, the shallow eastern zone upto the bar mouth with 5-15 cm of mud, the middle zone between the bar mouth and the fresh water inlet with 10-40 cm of mud and the western shallow part beyond the fresh water inlet with 5-20 cm of mud. The deeper parts are restricted to the middle zone where the water is locked up through out the year (Fig.1). This area is suitable for culture of fishes through out the year in net enclosures or fish pens. Other areas can be utilised for culture for only about 6-8 months when there is water.

The bottom sediment consists of 48% of fine sand, (300-600 micron), 35% of coarse sand (600-1200 micron) and 11% of very fine sand (150-300 micron) and 2% silt (75-150 micron) in this middle zone. The mud contains 48 ppm/100 g nitrogen, 33 to 44 ppm/100 g phosphorus (P) and 253-385 ppm/100g Potassium (K). The pH of the mud ranges between 8.5 and 9.0 indicating alkaline condition and the electric conductivity from 7.0 to 7.2 mhos/cm.

The hydrological condition of the lagoon varies greatly. The salinity ranges between 22 and 180 ppm. The high saline condition is observed during September to October when the bar mouth is closed and the evaporation at the maximum. The dissolved oxygen of

*Prepared by R.S. Lal Mohan

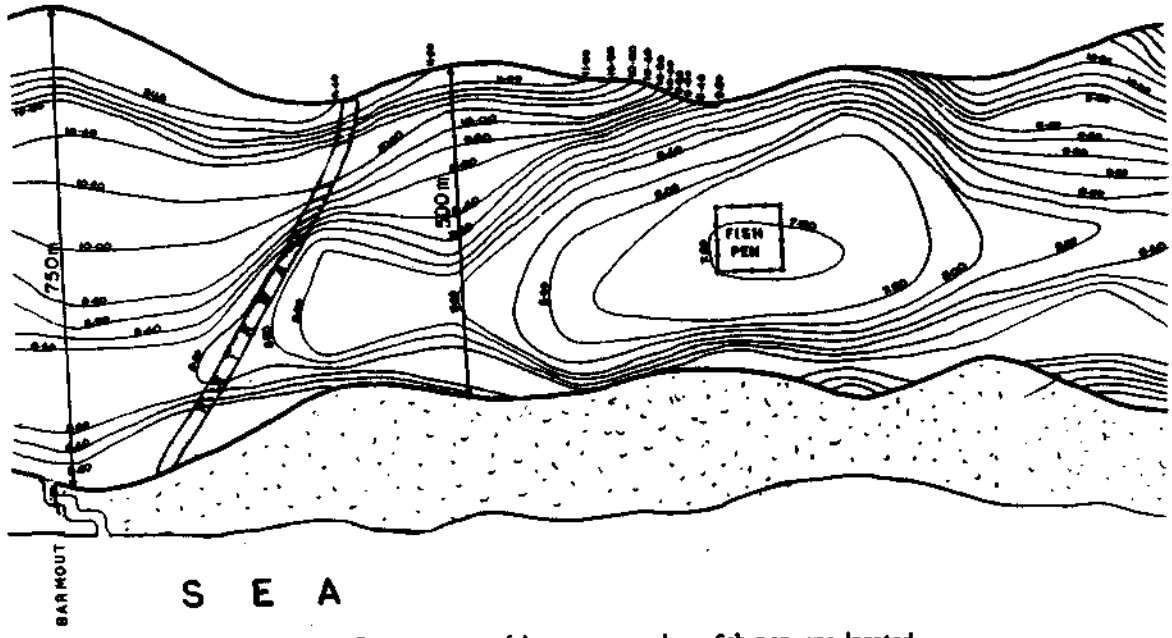


Fig.1. Contour map of lagoon area where fish pen was located

the lagoon varies between 2.1 and 6.0 ml/l and water temperature between 26° to 34°C. The productivity is almost nil during October when the salinity is very high (106.5 ppm), but increases to 951.9 mg C/m2/day as the salinity decreases (44.5 ppm) in January.

Potentiality of large scale fish culture in the Pillaimadam lagoon has been stressed by earlier workers. One of the advantages of the area is the availability of large number of milk fish seed in the lagoon during April-May.

Fish pens

Large fish pens covering an area of 0.25 ha (3 numbers), 0.5 ha and 1 ha were designed and fabricated (Fig.2, 3) in the lagoon taking into consideration various topographical features of the lagoon such as depth and soil condition. The fish pens were made of Palmyra poles and nylon webbing. The palmyra poles, 3.5 m long, 10 cm wide and 5 cm thick were used. The poles were planted 75 cm deep at an interval of 1.5 m with the help of a crow bar. An iron nail at the top of each pole served for attaching the head rope, a 3 mm nylon rope inserted through the upper meshes of the webbing. The webbing was made of 0.75 mm nylon twine with 20 mm mesh. The width of the webbing used was 3.5 m. The foot rope was inserted through alternate meshes of bottom free end. Laterite stones of about 500 g tied to the foot rope at an interval of 1.5 m served as sinkers. The webbing was securely placed on the nails at the top of the poles with the aid of the head rope. After allowing enough slackness tc the webbing i.e. 1 m slackness to 10 m of webbing, the sinkers were buried at a depth of 50 cm in between the poles. The lower end of the webbing was buried at a depth of 50 cm. The webbing was tied to the poles at an interval of about 1 m so that it was held tightly to the poles. An opening was provided at one of the corners. It could be closed by tying the free ends of the net to the poles after overlapping the webbing. A table made of palmyra poles measuring 2 × 1.5 × 1.5 m was provided near the gate for field observations (Fig.2, 3).

A scare line was provided inside the enclosure. The tender palmyra leaves of length 50 cm was tied to a nylon rope of 3 mm tickness at an interval of 1 m. The bright yellow colour of the palmyra leaves would

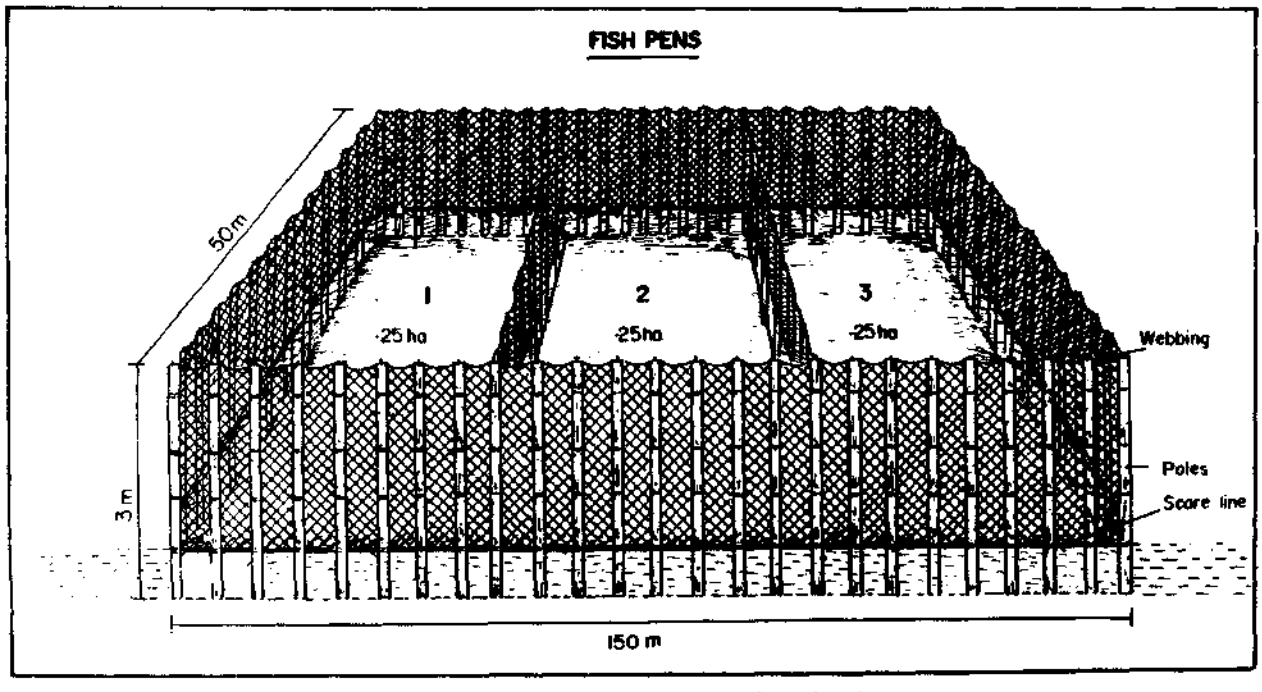


Fig.2. Three fish pens constructed in Pillaimadam lagoon

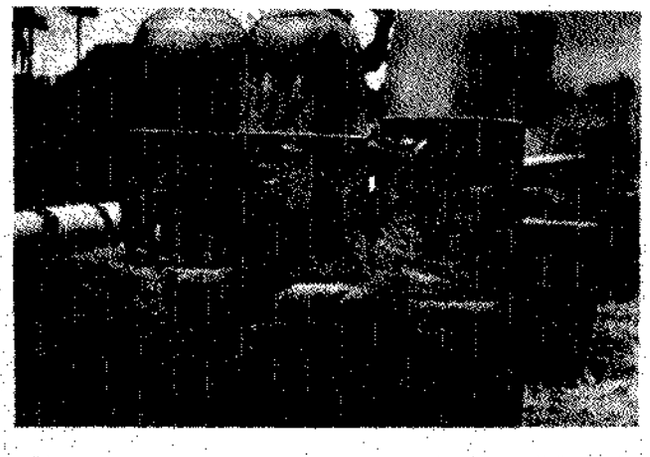
a

b

c

d

e



f

Figs. (a-f) Views of lagoon at Pillaimadam and preparations for pen culture in the lagoon.

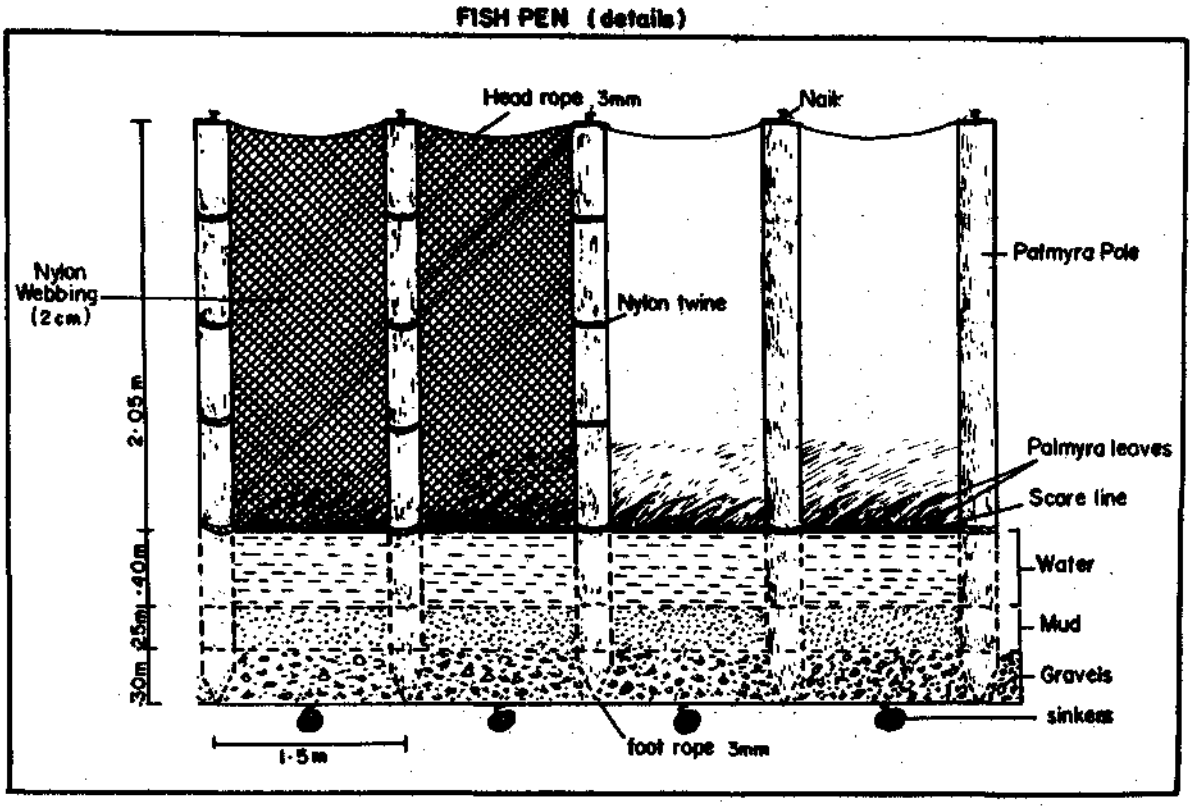


Fig.3. Details of construction of fish pens

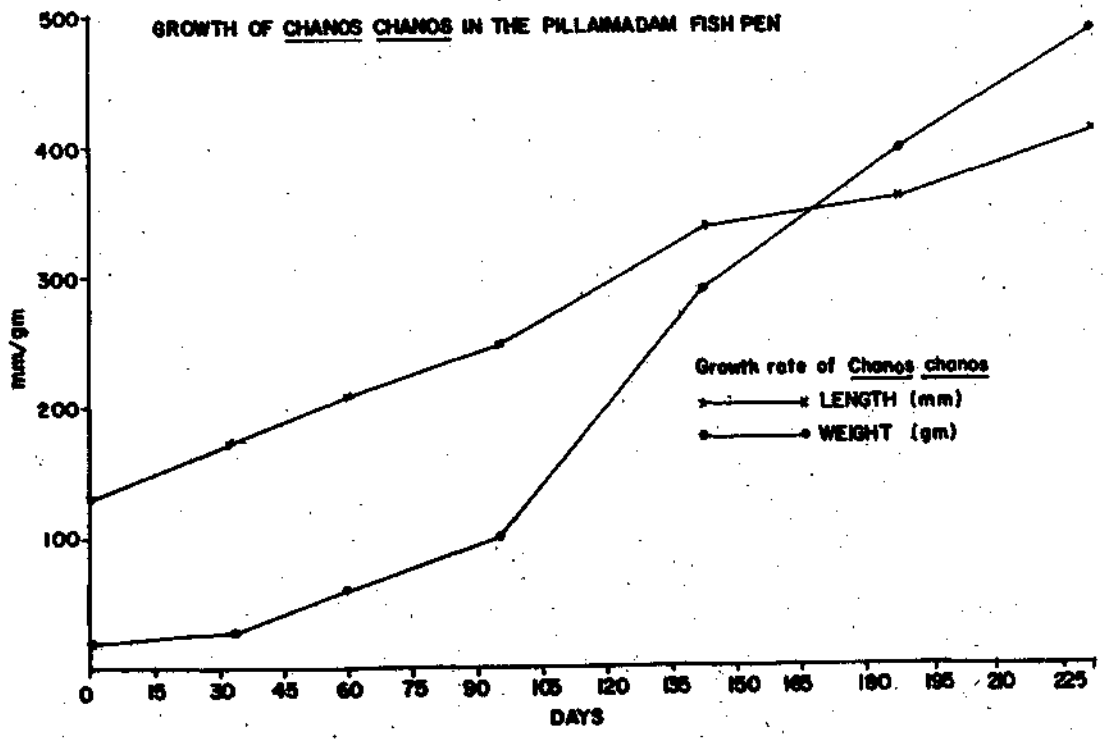


Fig.4. Growth of *Chanos chanos* in the fish pen

scare away the chanos fingerlings from coming near the webbing in their attempt to escape from the enclosure.

Stocking

Chanos fingerlings measuring 90–150 mm were collected mainly from the lagoon using a rectangular bag net measuring 12 m length, which was dragged behind a scare line made of tender palmyra leaves attached to a coir rope. The scared chanos fingerlings leap and fall into the net. The fingerlings were then transferred to plastic containers of 40 capacity and covered with nylon net. About 50 fingerlings were kept in a container and immediately transferred to the fish pen.

The 3 fish pens of 0.25 ha area each were stocked with 1000, 1500 and 2000 chanos fingerlings at the rate of 4000, 6000 and 8000 number/ha respectively.

Growth

The chanos fingerlings attained a length of 200 mm, weighing 63 g in 30 days in a 0.25 ha pen with the stocking rate of 4000/ha. The stocking size was an average of 140 mm weighing 25 g. In another pen it attained a length of 195 mm weighing 61.6 g in the first 30 days, 245 mm weighing 103 g in the next 36 days. The average growth was 1.5 mm/day. The growth rate was more or less same in the pen with the stocking of 8000/ha.

During the period of the experiment the salinity of the fish pens fluctuated from 60 to 169 ppm. The oxygen ranged from 3.8 to 4.5 ml/l.

In another experiment with a stocking rate of 6000/ha the fingerlings of length 74 mm in a 0.06 pen attained length of 405 mm weighing 400 g in 234 days (Fig.4). When salinity was about 32 ppm, a daily increment of 2.1 mm and weight 2.3 g was observed but the growth was very poor when the salinity was higher in the range of 65–70 ppm, indicating the influence of salinity on growth of the milkfish fingerlings.

These culture experiments are only preliminary. However, the possibility of making use of pens fabricated in these lagoon areas for culturing valuable fishes like milkfish and mullets is indicated. Thus large areas of water spread in this lagoon could be utilised for production of valuable protein food.

UNUSUALLY HIGH LANDINGS OF SOME PENAEID PRAWNS AT BOMBAY*

New Ferry wharf is an important trawl landing centre in Greater Bombay, forming the base of operation for nearly 400 boats, most of which make 3-4 day trips in an area about 200 km north and south of Bombay. In general in the year April 1982 to March 1983 larger quantities of prawns were landed at the centre in comparison to previous years.

Very heavy landings of particularly two species of penaeid prawns have been reported from this centre, especially in October and November 1982. One of the prawns is *Metapenaeus monoceros* which is a conventional species represented in the prawn fishery of Bombay waters, occupying fourth place in abundance in the fishery in previous years. Heavy landings of this species occurred during the fortnight beginning from the last week of October, contributing to nearly two thirds of the total landings of 2,027 tonnes of the species for the year and raising the species to the second rank in abundance. The catch per fishing trip at this time was 500-900 kg. Similar catches of the species (about 1000 kg per trip) have also been reported from Sassoon Dock, another landing centre in Greater Bombay (personal communication from Shri K.B.Waghmare). During this time the area of fishing is reported to be off Harnai about 130 km south of Bombay in 60-75 m depth zone. The sizes represented in these heavy catches ranged from 78 to 183 mm in total length with proportion of females more than twice that of males.

The other species which contributed to heavy landings, especially in the first and third weeks of October is *Metapenaeopsis stridulans*, which has never been earlier reported in such large quantities in the prawn fishery of Bombay. About 75% of the annual catch of 536 tonnes of the species in the year has been landed during this period. The catch per boat trip for the species at the time averaged to 140 kg. This is a small species ranging in size from 48 to 93 mm in total length.

The value of these two species is estimated at 91 and 2 million rupees respectively for the entire year. Nearly 70% of this value has been realised from the heavy catches occurring during October-November.

*Prepared by S. Ramamurthy and A.Y. Mestry

THE CATCH TREND OF THE COMMERCIAL TRAWL FISHERIES OFF RAMESWARAM*

Introduction

Fishery resources from the coastal waters off Rameswaram have been traditionally exploited by indigenous crafts and gears. Introduction of commercial trawling to tap the ground fishes and crustaceans along this coast has resulted in considerable expansion of the mechanised fisheries sector. The present account summarises the catch details of some of the commercially important fishes landed by the trawlers operating from Rameswaram (Verkottil) during the years 1980 and 1981.

Most of the trawlers are in the length of 30' and 32' with the horse power varying between 32.5 and 65 *(Mar. fish. Infor. Serv. T & E Ser. 11, 1979)*. Various fishing areas off Rameswaram covered by the trawlers are indicated in Fig.1.

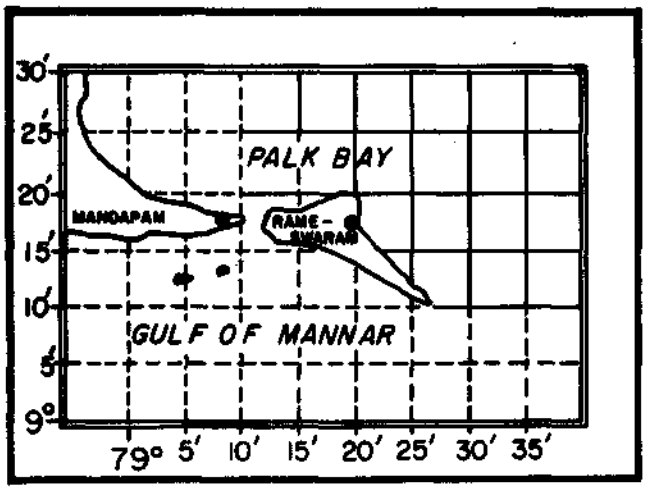


Fig. 1. Map indicating the various fishing areas off Rameswaram.

Monthly catch trend

Fig.2 represents the monthly catch trend and the estimated number of operations of units during the period. Maximum landings of 2,637 and 2,064 tonnes were recorded during June and July 1981 respectively; whereas in 1980 December and November landed more catch (1,837 and 1,632 tonnes respectively). As a whole, the year 1981 had recorded the maximum landings of 20,581 tonnes for an estimated 101449 number of operations of units showing an increase of about 43% and 38% in catch and in the number of operations of units respectively as compared to 1980. Similarly the catch per unit effort during 1981 also increased to 202.87 kg from 194.94 kg recorded in 1980.

Quarterwise catch composition

Table I shows the quarterwise catch trend and the percentage contribution of some of the important groups of fishes in the landings. The silverbellies represented by the genera *Leiognathus*, *Secutor* and *Gazza* formed the major group and contributed to about 52% and 50% of the total catch during 1980 and 1981 respectively; their catch increased from 7,474 tonnes in 1980 to 10,310 tonnes in 1981. Though maximum landings were noticed in the first quarter of both the years, good quantities were landed in the remaining quarters also. Elasmobranchs ranked second in the magnitude of the catch and formed about 16% and 17% of the catch during 1980 and 1981 respectively, the catch increasing from 2.370 tonnes in 1980 to 3,453 tonnes in 1981. While the third and fourth quarters of 1980 recorded higher landings, all the first three quarters of 1981 predominated in the landings of elasmobranchs.

Penaeid prawns mainly *Penaeus semisulcatus* and *Metapenaeus* spp. figured third in the landings; their share being about 10% of the total catch both in 1980 and 1981. The landings of prawns during 1980 showed an increasing trend from first quarter to fourth quarter. However in 1981 second and third quarters recorded higher landings. Sciaenids ranked next with 6% in 1980 and 10% in 1981. Their landings showed increasing trend from 103 tonnes in the first quarter to 371 tonnes in the fourth quarter. During 1981, all quarters registered more or less same catch trend.

Other groups in the landings viz., catfishes, red mullets, lizardfishes, flatfishes, crabs and cephalopods contributed to less than 10% of the total catch during the two years.

Table II gives monthwise landings of prawns and other groups with their percentage in the total monthly catches. The monthly percentage contribution of prawns to the total catch during 1980 ranged from 6.71 to 13.88 showing an increase in the total catch of prawns during 1981. In the case of other groups the percentage contribution during 1980 and 1981 ranged from 86.56 to 96.47 and 86.12 to 93.29 respectively.

*Prepared by P.K.Mahadevan Pillai, N.Jayabalan, M. Srinath and S. Subramani.

Table 1. *Quarterwise landings of trawlnets (in tonnes)at Rameswaram (Verkottil) and the percentage contribution of various groups (in parenthesis) during 1980 and 1981.*

Groups	1980					1981				
	I Q	II Q	III Q	IV Q	Total	I Q	II Q	III Q	IV Q	Total
1. Elasmobranchs	410 (13.03)	309 (10.41)	754 (20.43)	897 (19.61)	2370 (16.48)	888 (16.44)	1116 (19.39)	810 (16.79)	639 (14.00)	3453 (16.78)
2. Catfishes	30 (0.95)	39 (1.31)	77 (2.09)	33 (0.72)	179 (1.24)	18 (0.33)	27 (0.47)	2 (0.04)	32 (0.70)	79 (0.39)
3. Sciaenids	103 (3.27)	146 (4.92)	196 (5.31)	371 (8.11)	816 (5.68)	517 (9.52)	575 (9.99)	506 (10.49)	528 (11.54)	2126 (10.33)
4. Leiognathids	2046 (65.05)	1720 (57.95)	1680 (45.53)	2028 (44.34)	7474 (51.98)	3035 (55.86)	2631 (45.70)	2318 (48.05)	2326 (50.84)	10310 (50.08)
5. Red mullets	45 (1.43)	60 (2.02)	87 (2.35)	148 (3.24)	340 (2.36)	137 (2.52)	145 (2.51)	121 (2.30)	105 (2.30)	508 (2.47)
6. Lizard fishes	20 (0.64)	20 (0.67)	40 (1.08)	55 (1.20)	135 (0.94)	51 (0.94)	53 (0.92)	49 (1.02)	52 (1.14)	205 (1.00)
7. Flatfishes	35 (1.11)	28 (0.94)	43 (1.17)	30 (0.66)	136 (0.95)	30 (0.55)	44 (0.76)	47 (0.97)	48 (1.05)	169 (0.82)
8. Prawns	167 (5.31)	338 (11.39)	360 (9.76)	502 (10.98)	1367 (9.51)	382 (7.03)	730 (12.68)	570 (11.82)	419 (9.15)	2101 (10.20)
9. Crabs	40 (1.27)	76 (2.56)	146 (3.96)	139 (3.04)	401 (2.79)	105 (1.93)	203 (3.53)	172 (3.57)	160 (3.50)	640 (3.11)
10. Cephalopods	10 (0.30)	21 (0.71)	31 (0.84)	23 (0.60)	90 (0.63)	27 (0.50)	47 (0.82)	46 (0.95)	38 (0.83)	158 (0.77)
11. Others	240 (7.63)	211 (7.11)	276 (7.48)	343 (7.50)	1070 (7.48)	243 (4.47)	186 (3.23)	183 (3.79)	220 (4.82)	832 (4.04)
Total	3146	2968	3690	4574	14378	5433	5757	4824	4567	20581
Eatimated number of operations of units	16861	16374	22013	23510	73758	23316	26658	26398	25077	101449
Catch per unit effort (kg)					194.94					202.87

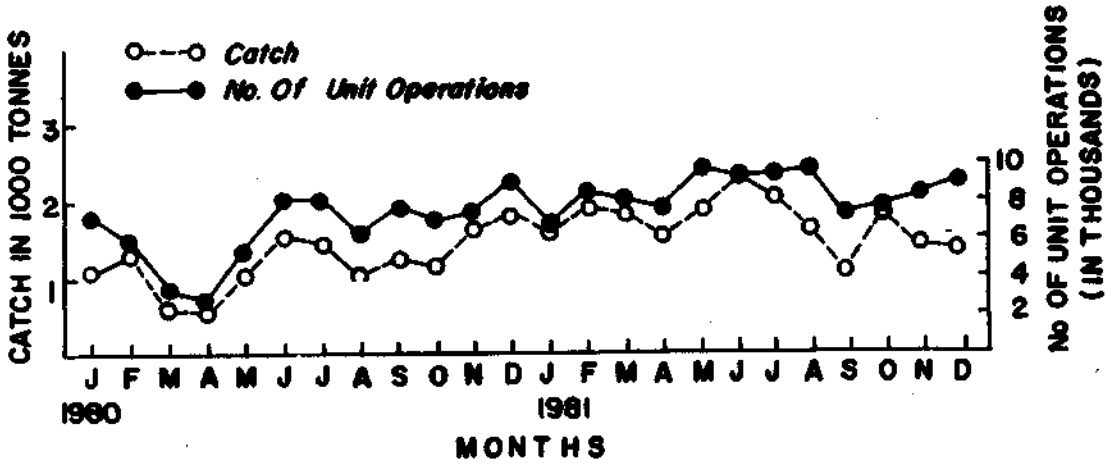


Fig. 2. Monthly catch trend and the number of unit operations during 1980-'81 at Rameswaram (Verkottil)

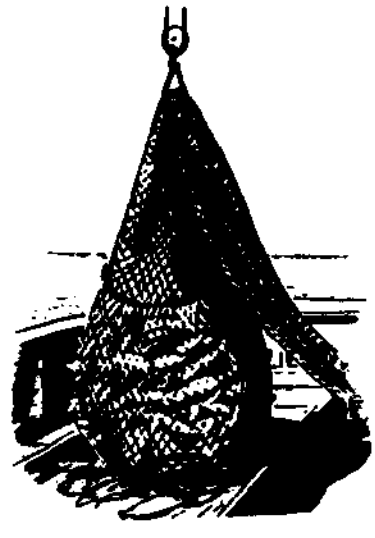
Table 2. *Monthwise landings of prawns and other groups (in tonnes) at Rameswaram (Verkottil) and their percentage contribution during 1980 and 1981.*

	Prawns		Other groups	
	Catch	Percentage	Catch	Percentage
1980				
January	90	8.23	1004	91.77
February	48	3.53	1312	96.47
March	29	4.19	663	95.81
April	31	6.31	460	93.69
May	105	10.78	869	89.22
June	202	13.44	1301	86.56
July	148	10.50	1261	89.50
August	87	8.67	916	91.33
September	125	9.78	1153	90.22
October	103	9.32	1002	90.68
November	163	10.00	1469	90.00
December	236	12.85	1601	87.15
Total	1367		13011	
1981				
January	121	7.31	1534	92.69
February	137	7.10	1793	92.90
March	124	6.71	1724	93.29
April	194	12.49	1359	87.51
May	255	13.88	1582	86.12
June	281	11.87	2086	88.13
July	235	11.39	1829	88.61
August	197	11.70	1487	88.30
September	138	12.83	938	87.17
October	133	7.19	1716	92.81
November	132	9.48	1259	90.52
December	154	11.55	1173	88.45
Total	2101		18480	

Remarks

The introduction of mechanised trawlers along the coast off Rameswaram had resulted in considerable expansion of traditional fisheries of silverbellies, while elasmobranchs, prawns and sciaenids form other important fisheries. The catch trend of the present study indicates the availability of silverbellies in large quantities throughout the year. As the operation of bottom trawl nets during the day time yields better catches of silverbellies, intensive day fishing will bring the required quantities of fishes as raw material to the fish meal plant located at Mandapam.

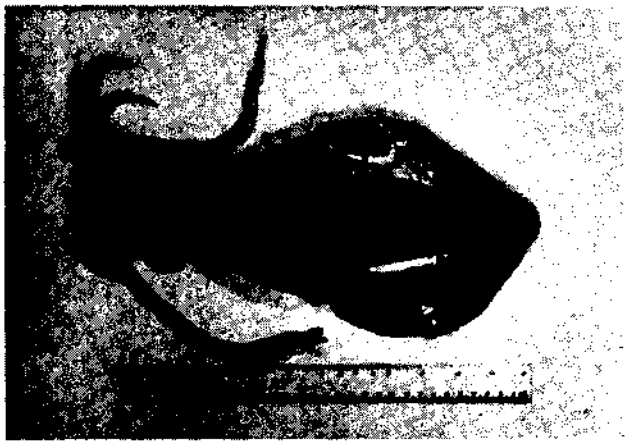
The study revealed that an increase of 38% in the number of unit operations in 1981 has resulted in an increase of 43% in the landings. The increase in the number of units in operation in 1981 is noticed in the first two quarters of the year and along with that substantial increase in catch also is recorded in these two quarters. The overall increase in catch per unit effort in 1981 is, however, marginal, rising from 194.9 kg to 202.9 kg. Since the increase in input of effort has resulted in a substantial increase in the catches along with increase in catch per unit effort, and the area of operations remaining more or less the same, it would appear that there is scope for further increased exploitation of resources available in this area, especially, silverbellies, elasmobranchs, prawns and sciaenids.



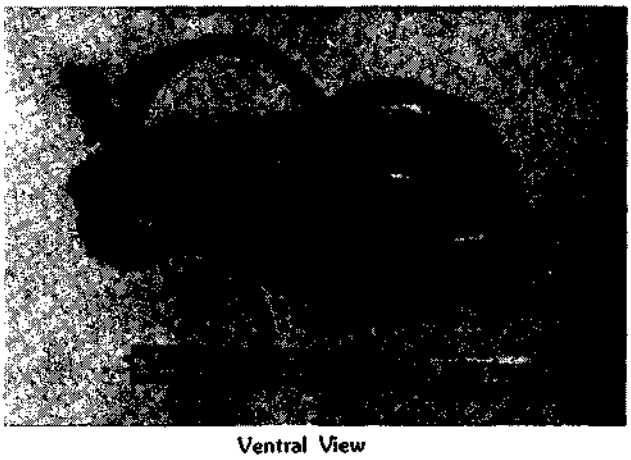
Squid Sepioteuthis lessoniana recorded off Saurashtra Coast

Sepioteuthis lessoniana Lesson (Loliginidae, Cephalopoda) has been recorded off Saurashtra Coast of India for the first time. This species is widely distributed in the Indo Pacific, Red Sea, Arabian Sea and Bay of Bengal. In India it forms a seasonal fishery in the Palk Bay from February/March to June. The species has been recorded along the Malabar Coast. The present record is based on a specimen obtained on 17th March 1980 from the trawl landings at Veraval. It is a male measuring 266 mm dorsal mantle length and weighing 710 g (Fig.1 & 2)

Reported by H.Mohamed Kasim



Dorsal View



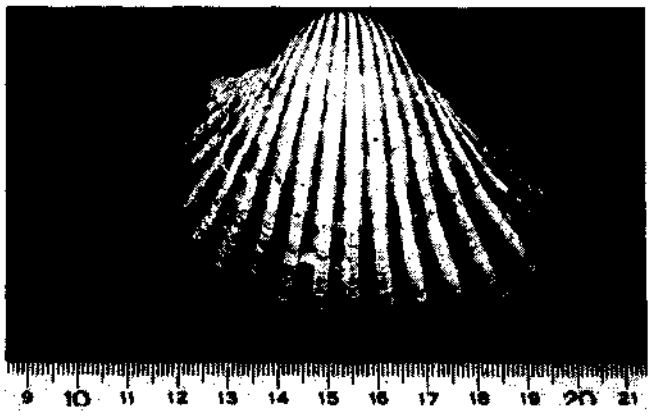
Ventral View

Trial export of blood clam to Japan

The Central Marine Fisheries Research Institute (CMFRI) assisted one of the sea-food exporting companies at Cochin in developing, for the first time, the export potential for the blood-clam *Anadara granosa* (Fig.1). The Japanese buyers have accepted the quality of the blood-clam meat from India. The resource information was provided to the entrepreneur who was also given a field trip to the clam beds by the Kakinada Research Centre of the Institute.

The blood-clam, also known as cockle in the South-east Asian countries, occurs in the Kakinada Bay and there is a regular fishery for the clams, with annual landings of about 1,000 tonnes. The meat is eaten locally only to a limited extent and exploitation is mainly for the shells used in production of lime. Therefore, finding an export market for the blood-clam meat will give a great economic advantage to the exploitation of this resource.

In view of its export potential, the CMFRI is immediately taking up a programme to assess the blood-clam resource of the Kakinada Bay (area 130 sq.km). Present exploitation is only from the shallow waters and the clam is not fished from the deeper waters. The survey would attempt to assess the potential and exploitable resource quantitatively from all regions of the bay.



Anadara granosa

Anadara granosa is traditionally cultured in Malaysia, Thailand, Vietnam and the Philippines. The CMFRI has conducted a series of experiments on culture of blood-calm in Kakinada Bay over the last three years and simple transplanation of seed in the shallow waters has given an yield of up to 2.6 tonnes/ 625 m^2 area/5½ months (for details please refer *Mar. Fish. Infor. Serv. T & E Ser.*, 23:7-9, September 1980). The blood-clam fishery at present is restricted to Kakinada Bay in India and the annual production is low. It would, therefore, be imperative to resort to culture of

this species if an export market for this clam has to be sustained.

Fin whale washed ashore in Rameswaram Island

Fin whale *Balaenoptera physalus* (Linnaeus) is the most numerous of all the whalebone whales. This whale is taken in greater numbers than any other species in the commercial whaling operations in the Atlantic Ocean. It is Ocenic and cosmopolitan in distribution, being found in Atlantic, Pacific, and Indian Oceans. This whale usually occurs in groups of 2 to 3 or more.

Fig. 1. Fin whale *Balaenoptera physalus* (Linnaeus) washed ashore at Akkamadam (Rameswaram Island) in a putrified condition.

Fig. 2. Fin whale *Balaenoptera physalus (Linnaeus)* being examined.

The stranding of young fin whale is quite rare. There were two earlier reports of the stranding of this species along the west coast of India, one from Bomaby (Kharbari *et al., J. mar. biol. Ass. India,* 8 (1): 226-227, 1966) and another from Surat (Kharbari, *Indian J. Fish.* 20 (2): 639-640, 1973). On 22nd January 1983 at about 0800 hrs the local fishermen at Akkamadam in Rameswaram Island noticed a young whale dead and washed ashore in a putrified condition.

The whale was found to be an young female measuring 9.90 m (Fig.1), estimated to be four years old and weighing about 5 tonnes. Most of the observed characters agree fully with the diagnostic characters of fin whale or common rorqual *Balaenoptera physalus*

The body colour of the fin whale was generally grayish black dorsally, white ventrally including tail flukes; left ramus grayish externally. The fore part of the head when viewed from the dorsal side was wedge shaped. Posterior middorsal region distinctly and acutely ridged; dorsal fin small, situated posterior to middle of body; major baleen plates 350-400, white and bluish grey in colour. The body measurements are given below:

Morphometric Characters	Measurements (cm)
Total length (tip of lower jaw to tip of caudal fluke)	990
Tip of lower jaw to origin of flipper	150
Breadth at the base of flipper	32
Height at the flipper	22
Length of the flipper (from the base to the tip of flipper)	60
Tip of lower jaw to origin of dorsal fin	520
Length of dorsal fin base	45
Height of the dorsal fin	15
Tip of lower jaw to origin of genital region	460
Tip of lower jaw to origin of anus	510
Breadth of head	96
Body depth at the origin of flipper	480
Length of lower jaw	276
Body depth at the origin of anus	120
Tip of lower jaw to origin of the eye	184
Height of the body	258
Estimated weight	5 tonnes

Reported by P.Nammalwar, S.Krishna Pillai and S.Sankaralingam

Noise pollution affects shrimps

Two French scientists Michele Regnault and Jean-Paul Lagardere working at CNRS Laboratory, Biological Station, Roscoff, France have reported their findings which indicate that the European commercially important shrimp *Crangon crangon (L)* is affected by the level of the ambient noise expressed as sound pressure. Preliminary studies in this field have proved that high sound level causes in this particular shrimp some modifications in behaviour like increased cannibalism and also growth delay. Noticeable physiological changes were observed in oxygen consumption and ammonia excretion rate, indicating the metabolic response of the animal to changes in noise level.

Marine Ecology 11, February 1983

PROVEN TECHNOLOGY

5. TECHNOLOGY OF EDIBLE OYSTER CULTURE*

Highlights: Oysters are cultured by the Central Marine Fisheries Research Institute at Tuticorin by rack and tray method. The spat of the edible oyster *Crassostrea madrasensis* are collected using lime-coated semi-cylindrical country tiles and other suitable spat collectors and when the spat grow to a size of about 25 mm, they are scraped, reared in cages and, after a period of further growth, grown in trays kept over racks erected in coastal waters. The oyster reaches a harvestable size of 80–90 mm, weighing 100–120 g shell-on, in about a year. Regular shaped oysters are produced in the farm by this method.

Operational details: The site for oyster farm is selected based on the following criteria: The area must be protected by nature against violent wind and wave action and a natural population of oysters must be present nearby in sufficient numbers to ensure adequate spatfall. There should be tidal flow and salinity range must be between 25 ppt and 37 ppt. The water must contain abundant phytoplankton suitable as food for oysters and larvae.

Fig. 1. Edible oyster farm of CMFRI at Tuticorin showing the rack-and-tray method of culture.

The oyster spawns during two seasons, namely March-April and August-September in Tuticorin area. After a free swimming life of about three weeks, the larvae settle on a hard substratum and become spat. Oyster spat are collected on a large scale using lime - coated tiles. The tiles are given double coating of lime and sand, dried in shade and are kept in trays placed over racks set up in the neighbourhood of breeding oysters during the spawning season in shallow coastal waters, bays or creeks. Spat are also collected on other materials such as oyster shells strung on rope and asbestos sheets. On the spat growing to a size of 25 to 30 mm they are removed from the spat collectors using a chisel and reared in cages of 40 × 40 × 10 cm size, stocking at a density of 300–350 spat per cage. After two or three months, the oysterlings are transferred to rectangular trays of 90 × 60 × 15 cm for further growth. About 250 oysterlings are put in each tray and the trays are kept tied on racks erected in interdidal zone. Each rack measures 24 × 12.5 m and is constructed by fixing six teakwood or casuarina poles 2.5 m in height in two rows 2 m apart. The two rows of vertical poles are connected by horizontal poles and a platform-like structure is provided for the culture trays to be kept. Farm maintenance is carried out regularly and pests and predators are eliminated. The oysters grow fast and attain average size of 80–90 mm weighing 100–120 g with meat forming 8–10% at the end of the year. The harvested oysters are purified with filtered sea water treated earlier with chlorine in 3 ppm strength.

Production: From the culture operations in a three year period in 0.25 ha area the estimated production of oyster would be 125 tonnes with a meat yield of 10 tonnes. At the end of each year approximately 42 tonnes of oyster could be harvested. Apart from the meat, the oyster shells fetch a substantial return as by-product since they are used in the manufacture of calcium carbide and cement.

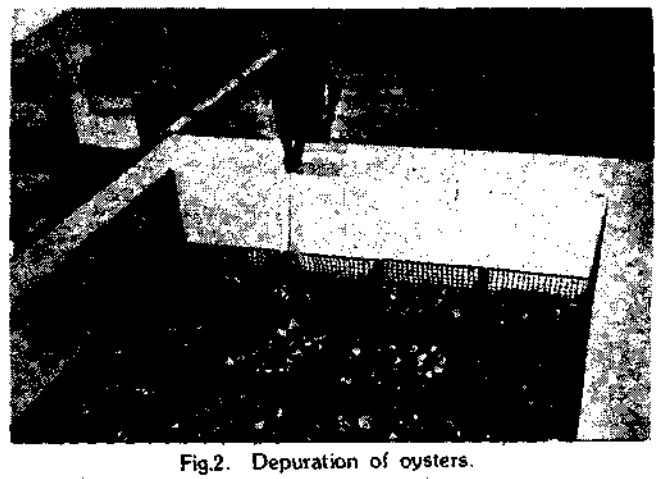


Fig.2. Depuration of oysters.

Inventory and cost: The materials involved in oyster culture such as racks, dinghy, iron cages, trays and other farm accessories can be used for three

years. For a three year project the expenditure would be as follows: capital cost of materials Rs.96,000, contingent expenses for seed collection Rs.10,000 and wages Rs.35,000. Total estimated cost would be Rs.1,41,000. The estimated cost of production determined based on current cost of materials is Rs.15/- per kg of oyster meat.

Prospects: There are good prospects for culturing edible oyster *Crassostrea madrasensis* adopting the method described above in the large stretches of shallow coastal waters, creeks, and bays. The high rate of spatfall, the fast growth of oysters and its nutritional value makes *C.madrasensis* an ideal species for farming which could step up production substantially. The Sonapore backwaters, Pulicat lake, Killai backwaters, Tuticorin bay, Punnakayal estuary, some of the backwaters in Kerala and low lying areas adjoining some of the estuaries of Karnataka are suitable for oyster culture. The edible oyster has at present a limited domestic market potential in metropolitan cities and this should be enlarged. Processed oyster meat has an export potential.

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*Prepared by Molluscan Fisheries Division

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BOOKS

Estuarine comparisons Ed. by Victor S. Kennedy, Academic Press, New York, pp 709, 1982

This is the proceedings of the sixth biennial Conference of the Estuarine Research Federation held at Gleneden Beach, Oregon during Nov. 1981. The book includes reviews of published literature and presentation of new information. In the first section, a number of comparisons of different kinds are made among estuaries after attention has been drawn to problems with the making of measurements on which such comparisons are based. The second section includes review papers on aspects of the diverse interactions that occur on or in marsh soils, coupled with new and complementary information derived from recent studies. The matter of retention of invertebrate larvae in seaward draining estuaries is examined in another section; insights from physical oceanograpy, behavioral experiments, field sampling, and genetic studies are brought to bear on the problem. The final section draws attention to the Chang Jang estuary in China, juxtaposing historical data spanning two millenea with recent knowledge derived from use of space satellites.

Aquatic oligochaeta of the USSR by O.V. Chekanovskaya, Amerind Publishing Co., New Delhi. pp 513, 1981.

Oligochaete worms are found in every type of continental water (fresh and saline). Some are habitual dwellers of the littoral zone and partially of the sublittoral zone in seas. Many river and lake biotopes are often dominated by oligochaetes, which constitute a considerable percentage of the benthic fauna. They may comprise 50 to 80% and even 100% of the benthic biomass. This fact has captured the attention of research workers throughout the world. Oligochaete worms dwelling in the profoundal zone of lakes play an important role in the exchange of matter in a reservoir and are responsible to a notable degree for the rate of mud formation and mineralization of bottom sediments. The preserve of a large population of saprophytic species of oligochaetes is an important factor in the self-purification of polluted waters. Studies have also shown the importance of oligochaete worms in the nutrition of some commercially important fish. These facts indicate the major place held by oligochaetes in maintaining the natural cycle and in augmenting the national economy.

The English translation (by Mrs. Indira Kohli) of the Russian book includes a rather detailed introduction to the morphology of the oligochaetes. Information on the physiology of aquatic oligochaetes has been provided in most of the cases. Information of the ecology and occurrence of the species had been taken primarily from reports which refer to the water reservoirs of the USSR.

Aquarium systems Ed. by A.D. Hawkins, Academic Press Inc. London pp 452, 1982.

This is a practical guide to fish-keeping in the laboratory and is the result of collaboration among working scientists with first hand experience to specific subjects.

Among the many problems to be overcome in working with live fish for laboratory experiments, collecting and keeping them in a healthy state suitable for experimental study is the most important and involves problems in handling, transferring from tank to tank, anaesthetization and treating in various ways. The volume considers the basic aspects of aquarium design and construction, the supply of aquarium water and its treatment to make it suitable for fish, water quality management and other practical aspects of fish husbandry. Problems of handling of fish, their capture and transport and their health and well being in captivity are also dealt with in different sections.

Compiled and prepared by M.J. George, G. Subbaraju and S.K. Dharmaraja.
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