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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.

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Cover photo: Cyclone havoc and newly constructed housing colony

CYCLONES AND FISHERIES: AFTERMATH OF FOUR CYCLONES IN ANDHRA PRADESH DURING 1976 TO 1979*

Introduction

A series of cyclones hit Andhra Pradesh since 1976, of which the one that battered this coast on 19th November 1977 was unprecedented in recent history, ravaging the districts of Krishna and Guntur. The 1976 cyclone affecting the districts of Prakasam and Nellore was of lesser intensity while the one that crossed this coast in May 1979 affecting the districts of West Godavari, Guntur, Prakasam and Nellore was of greater magnitude. The cyclone affected districts of Andhra Pradesh are shown in the map (Fig. 1). The 1977 cyclone lashed the Andhra coast for a period of six hours, accompanied by ghastly winds, heavy rains and huge tidal waves thereby causing untold havoc to life and property taking a toll of more than 9,000 lives and involving an overall loss of Rs. 1,000 crores due to damage to crops, livestock and private and public properties in the entire state. A huge

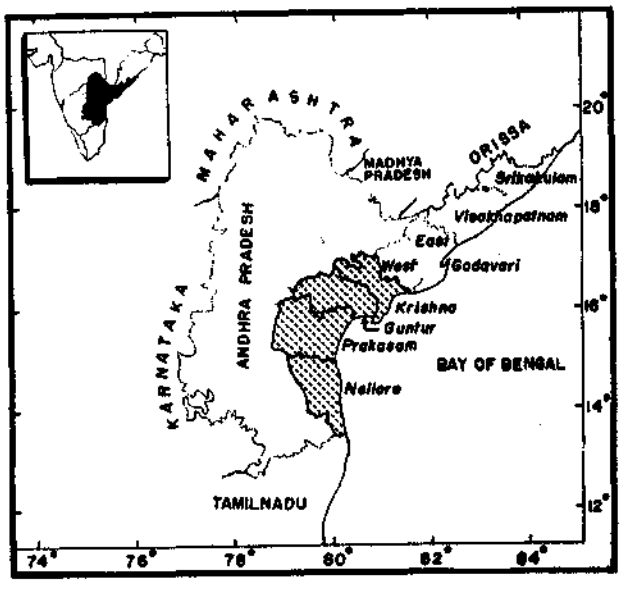

Fig. 1. Map showing cyclone affected districts in Andhra Pradesh during 1976-79.

tidal wave of about 5 m height hit the Divi and Bandar taluks of Krishna District leaving a trail of destruction along its path. A number of fishing villages along the coast were wiped out.

This report gives an account of the damage, caused by these cyclones in the worst affected areas of Andhra Pradesh and the measures taken for the relief and rehabilitation of those affected, particularly of fishermen.

Deluge and destruction

Krishna District

17 villages with 58 hamlets in Divi taluk and 14 villages with 33 hamlets in Bandar taluk situated upto a distance of 15 km from the coast were hit by the tidal wave in 1977. Nearly 80,000 people in Divi taluk and 12,000 people in Bandar taluk were affected. Fishing villages like Palakayatippa, Hamsaladivi, Nali and Sorlagondi of Divi taluk and Cambelpeta, Malaikayalanka and Garaladibba of Bandar taluk were completely washed away. About 8,000 human lives were lost and 3 lakh houses valued at Rs. 26 crores were destroyed. The loss incurred by way of destruction to fishing crafts and gears amounted to Rs. 51.17 crores. The details of losses under different items in Krishna district during 1977 cyclone are as follows:

a) Several major and minor irrigation sources including flood banks, tanks, roads and other public works were severely damaged. The details of damages are furnished in Table 1.

b) 9,742 looms of weavers were affected due to cyclone.

c) An extent of 91,310 acres of agricultural land belonging to 33,850 ryots were affected in 78 villages in Bandar and Divi Taluks.

d) 222 tanks and 406 wells were affected by the tidal wave in the two taluks.

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Table 1: *Damages due to the cyclone in Krishna District*

	Items	No.	Damages Value (Rs. in lakhs)
i)	Damage to irrigation sources etc.	737	445.39
ii)	Damage to buildings	4,836	1,477.56
iii)	Damage to roads	2,498km	1,249.54
iv)	Damage to municipalities	12	7.14
v)	Damage to launches and boats	25	1.93
vi)	Damage to drinking water tanks and P.W.S. Schemes	527	45.00
vii)	Damage to fisheries equipment	25,111	115.20
viii)	Damage to handlooms	9,742	26.04
ix)	Damage to Machilipatnam port	—	30.00
	Total		3,397.80

Among the affected fishing villages, fishermen who were interrogated at Gilakaladindi, Cambelpeta, Sorlagondi and Nali gave graphic accounts of how the tidal wave swept the villages and how they faced the ordeal. During that fateful day the sky was heavily overcast and it became dark by about 4 PM itself. Thunder showers, accompanied by strong winds with a speed of as much as 150 km per hour, poured. People rushed to pucca buildings such as schools, temples and brick houses. Then the tidal wave hit these villages and receded by about 8 PM. At Gilakaladindi majority of the people took shelter in the local Venugopalaswamy temple and thus escaped. At Cambelpeta no life was lost in spite of the entire village being washed away on account of the people taking shelter in the Rama temple of the village. However 400 persons who sought protection in the school buildings of Sorlagondi lost their lives as the tidal waters of 5 m height submerged the entire building. Luck was in favour of 30 persons who occupied the sanctum sanctorum of the Rama temple as the tidal wave got deflected and did not enter the temple due to some obstructions. At Nali as many as 600 fisherfolk who took refuge in the Ramalayam temple and in the only brick house of that village, survived. A few who perched on the tops of floating huts had miraculous escape by holding on tree tops as their huts were swept off.

Comparatively little damage was caused by the 1976 and 1979 cyclones in this district.

Guntur District

The 1977 cyclone affected the taluks of Repalle, Bapatla, Ponnur, Tenali, Mangalagiri, Guntur, Narasaraopet and Sattanapalli. Loss of human life, cattle and other categories of livestock to the tune of 1,759, 14,865 and 26,970 respectively took place. About 5 lakhs houses were either destroyed or partly damaged. The loss to the crops and other properties caused by the cyclone was estimated at Rs. 230 crores.

No deaths were reported as far as fisherfolk were concerned. However, 2,511 fisherfolk were affected in this cyclone, 2,485 houses belonging to them being damaged and 421 crafts and 939 nets lost, valued at about Rs. 16 lakhs and 20 lakhs respectively. The repairing cost of 267 boats damaged was estimated at Rs. 7.5 lakhs.

The loss of life and property in this district by the 1979 cyclone was comparatively less. Out of 728 villages only 273 were affected by this cyclone. However, the number of houses destroyed and damaged was 4,597 and 5,078 respectively amounting to a total loss of Rs. 61 lakhs. The coastal taluks of Repalle and Bapatla were badly affected. 58 fishermen lost their lives mostly belonging to Kothapalem-Dindi village of Bapatla taluk. The fishermen community suffered a loss to the tune of about Rs. 11 lakhs on account of destruction of crafts and tackles.

Prakasam District

The 1977 cyclone shattered the taluks of Ongole, Chirala, Addanki and Kandukur, the worst affected being Chirala. Destruction of livestock and damage to crops amounted to Rs. 94 lakhs and 39 crores respectively and 36 lives were lost. Altogether 77,876 houses were damaged and the loss on account of this was estimated at Rs. 4 crores. The total loss due to this cyclone was about Rs. 47 crores. Over 8,000 fishermen families suffered damages to the extent of Rs. 11 lakhs, 271 catamarans were destroyed and 205 damaged. As regards 'navas' one Kakinada nava was damaged and 18 small ones were lost. In the case of tackles, 1,567 were reported to have been lost.

Devastation caused by the 1979 cyclone that crossed this district on 12th May 1979 between Ravur of Kandakur taluk and Kothapatnam of Ongole taluk extending over a stretch of about 56 km was of greater magnitude than that of 1977 cyclone. The damage this time was mainly due to gales of high speed, heavy

rains and floods and about 585 persons lost their lives. Timely evacuation of coastal people minimised death toll. Along the path of the cyclone all the huts were razed to the ground, affecting about 3 lakh houses at an estimated loss of Rs. 40 crores. Total loss by way of destruction to houses, crops, livestock etc. came to Rs. 205 crores.

In the fisheries sector 2,844 marine fishermen were affected and 42 Kakinada navas, 1,106 catamarans and 85 dinghis costing about Rs. 27 lakhs were lost. In addition, 190 Kakinada navas, one catamaran and 32 dinghis suffered damages to the total extent of about Rs. 8 lakhs. 4,800 gears and 169 fish curing tubs were lost. One fish drying platform was damaged. The State Fisheries Department in this District also suffered a loss of Rs. 20,000 due to damages to their buildings. The details of loss in this sector totalling to Rs. 77 lakhs is given in Table 2.

Table 2. *Loss in the fisheries sector in Prakasam District*

S.No.	Items	Rs. in lakhs
1.	Losses and damages to marine fishing crafts.	35.93
2.	Loss of fishing tackle	38.54
3.	Damages to fish curing tubs and drying platforms	0.29
4.	Losses to inland fishermen	2.41
5.	Damages to departmental buildings	0.20
	Total	77.37

Nellore District

The effect of two cyclones in 1976 and one in 1977 was not much felt in Nellore District. However, in 1976, 832 fishermen were affected resulting in a loss of 73 Pulicat navas and 189 catamarans. In 1977, 20 boats were lost, valued at one lakh rupees and 5 boats damaged, costing about Rs. 8,000 in south of the district in Pulicat lake area. In Sulurpet Taluk 18 gill nets were lost costing Rs. 4,500. Also in Kovur Taluk 42 gill nets belonging to the fishermen of Utukurupallipalem and Ramatheertham Pattapalem costing Rs. 10,500 were lost.

As observed in Prakasam District, the impact of the 1979 cyclone was much more severe here than its three predecessors, affecting the entire Nellore District. A total of 83 deaths occurred, 1.8 lakhs of houses were destroyed and 2.0 lakh houses damaged, the total loss amounting to Rs. 13 crores. Road, rail and telecommunications were completely disrupted. The damage to the crop amounted to Rs. 15 crores. 1,320 crafts consisting of 1,023 catamarans and 247 navas valued at Rs. 24 lakhs and 9,482 gears comprising 9,410 gill nets, 50 boat seines and 22 shore seines valued at Rs. 12 lakhs were damaged during this cyclone. In all, 2,407 marine fishermen were affected.

West and East Godavari districts

The May 1979 cyclone caused comparatively less damage in the West and East Godavari districts. In Narasapur Taluk of West Godavari district several boats were damaged. In addition, one big boat (36′) was also lost. In East Godavari district May 1979 cyclone has affected 12 villages, resulting in damages of about 25 catamarans and 40 boats costing about Rs. 50,000. Fortunately no loss of human life has been reported. The details of the damages are given in Table 3.

To sum up, during 1976–79, due to the cyclones more than 46,210 crafts and gears were either lost or damaged amounting to a loss of over Rs. 2.84 crores (Table 4).

Relief and rehabilitation measures

Catastrophy created by the 1977 cyclone drew world wide attention and sympathy. Help in the form of funds and materials began to pour in from different parts of the globe. State and Central services including defence and innumerable voluntary philanthrophic organisations, national and international, rushed to the affected areas and rendered yeoman service by way of transporting the cyclone victims to safer places, distribution of food packets, clothes and blankets to them, dropping of food packets to marooned victims and rendering medical help. Exgratia payment of Rs. 150 per victim was made immediately. The Central Government made 45,000 tonnes of rice and wheat each available for the victims free of cost. Temporary shelters were erected to accommodate the victims. Bamboos and palmyra leaves were supplied to them for reconstruction of their huts. Orphanages were opened for the benefits of children who lost either both or one of their parents. Pucca houses were built at a cost of Rs. 5,000 each with 50% matching grant from the Government. Government of India constituted the cyclone Distress Mitigation Committee to go into the problem and suggest remedial measures for relief and rehabilitation of the cyclone victims.

Table 3. *Details of damages caused to the crafts of the fishing villages in East Godavari by the cyclone in May* 1979

S. No.	Name of the fishing village	Name of the landing centre	No. of craft & tackle damaged	Total loss in rupees
1	Putrayyapakala	Backwater landing centre	1 Shoe Dhoni	500-00
2	Kothakakinada	Kothakakinada	15 Catamarans	19,380.00
3	Kondalpeta	Kondalpeta	6 Catamarans	4,700.00
4	Subbampeta	Subbampeta	4 Boats (Navas) (30′–3 and 33′–1)	3,700.00
5	Kothapatnam	Kothapatnam	1 Boat (Nava of size 33′)	1,000.00
			1 Catamaran	100.00
6	Jaggarajupet	Uppada	14 Boats (Navas) (30′–13 and 27′–1)	7,700.00
			1 Catamaran	
			1 30′ boat (Nava) and	
			1 Catamaran completely lost	3,900.00
7	Ramisettipeta	Ramisettipeta	8 Boats (Navas)	4,000.00
8	Sorradipeta	Sorradipeta	3 Boats (Navas)	1,100.00
9	Mayapatnam	Mayapatnam	3 Boats (Navas) 1 Catamaran	1,380.00
10	Aminabad	Aminabad	3 Boats (Navas)	2,000.00
11	Yelliahpeta	Yellrahpeta	1 Boat (Nava)	1,000.00
12	Addurpeta	Addurpeta	1 Boat (Nava)	8,000.00
			Total	58,460.00

Table 4. *Damages caused to fishing sector during the different cyclones*

District	Period	No. of fisher-men affected	No. of Crafts	Equip-ments Gears	Value (Rs. in crores)
Krishna	1977	N.A.		25,126	1.17
Guntur	1977	2,511	688	939	0.44
–do–	1979	N.A.	N.A.	N.A.	0.11
Prakasam	1977	8,000	495	1,567	N.A.
–do–	1979	2,844	1,456	4,800	0.75
Nellore	1976	832	252		N.A.
–do–	1977	N.A.	25	60	0.01
–do–	1979	2,407	1,320	9,482	0.36
Total		16,594		46,210	2.84

N.A.— Not available.

The Central assistance towards the rehabilitation programme amounted to about Rs. 70 crores. Affected fishermen were provided with money and material in the form of crafts and gears. Towards the rehabilitation of fishermen alone, a sum of Rs. 1.6 crores was spent. A major outcome of the cyclone disaster was the construction of a number of community shelters by various voluntary organisations in response to the scheme of matching grants from the Chief Minister's Relief Fund. These structures are meant to provide shelter to the villagers during the time of cyclone and also to serve as schools, hospitals or common halls for any other community purposes. Electricity and transport facilities were extended. The details of relief and rehabilitation measures in different districts are given below.

Krishna District

In this district, out of a total allotment of Rs. 21 crores by the Government, the relief afforded towards re-construction and repair of damaged houses came to Rs. 5.24 crores. An amount of Rs. 0.73 crores was distributed as exgratia relief for loss of human life. Feeding arrangements and free supply of rice and wheat cost Rs. 3 crores. 350 bore wells were dug to solve drinking water problem in Divi and Bandar taluks, where many drinking water wells became useless due to the tidal wave. Drinking water was also supplied by tankers in such of those villages where digging of the wells were unsuccessful. Steps have been taken to prevent epidemics and medical facilities have been provided in the form of inoculations, treatment of diarrhoea cases etc. Many of the affected villages have been electrified and roads have been laid.

The worst affected community was that of fishermen. Relief totalling Rs. 1.2 crores was given to

this community towards replacement and repair of damaged crafts (0.65 crores), distribution of tackle (0.52 crores) and supply of boats (0.05 crores). 1,132 boats, 52,625 kg of nylon yarn, 9,360 boxes of cotton yarn and 17,788 kg of filament ropes were distributed to them.

As on 30.9.'79 out of the proposed 111 shelters, 27 have been completed, 46 are in progress and the rest are to be taken up for construction. In the case of the worst affected coastal fishing villages, out of 17 community shelters proposed, six have been completed and out of 2,463 houses proposed 1,432 have been completed (Table 5). More than 50 voluntary organisations participated in relief and rehabilitation work in one way or other, contributing not less than 50% of the total outlay.

Gilakaladindi (Bandar Taluk)

This village is about 5 km east of Machilipatinam. In this village 100 single tenement housing units have sprung up out of proposed 350 units. This colony named as 'Sakal Nagar' has been built through the agency of the Rotary Club of Machilipatinam out of the funds raised by a Pune based newspaper 'Sakal'. Roads have been relaid and electricity facilities improved. Drinking water and lavatory facilities remain to be provided.

Cambelpeta

It is located about 3 km from Machilipatinam, and is named after one Mr. Cambel, one of the District Collectors of Krishna District, by the fisherfolk of this village in remembrance of him. A new colony has come up few km away from the original site of Cambelpeta which was completely washed off by the tidal wave during the 1977 cyclone. As observed at Gilakaladindi here also a voluntary organisation, Maharashtra Citizens Cyclone Relief Committee has built 52 housing units of two tenements each sheltering 104 families. A community hall is under construction by the same voluntary organisation. Schooling facilities up to Vth standard are made available for the benefit of the children of the colony. This new colony has been electrified. However, road and drinking water facilities are yet to come. Since the only source for supply of drinking water is by tankers, villagers have to supplement their water needs by fetching water from a distance of about 2 km.

Sorlagondi

Sorlagondi a fishing hamlet, 22 km from Avanigadda, was devastated by the cyclone and the tidal wave in November 1977. It has since been reconstructed into a modern fishing colony (Fig. 10) by the Andhra Pradesh State Police Force who built 84 housing units (Fig. 11) comprising 4 tenements each, accommodating 336 families who had lost their huts during the cyclone. The village has one community shelter, police out post, school and post office. A good road has been laid linking it with nearby important places. A regular bus service is available. To increase the marketing facilities for the fish caught, an ice plant costing Rs. 3 lakhs, a van with trailor at a cost of Rs. 1.5 lakhs and a fish curing yard at the expense of 0.8 lakh have been planned for this centre. The Central Government has given a grant of Rs. 28 lakhs for providing these facilities along with roads and drinking water. The village has been electrified.

Nali

The village is situated a km north of Sorlagondi and has been reconstructed by Tata Relief Committee. A colony of 246 single tenement housing units (Fig. 12) has come up after the cyclone. A community shelter has been built (Fig. 13) and roads are being laid to connect Nali with the neighbouring towns. At present the fish catches are transported to other places through mechanised boats and fishes are dried and sold at Nagayalanka, the nearest town. This village badly needs transport service and better marketing facilities for fish and prawns.

Guntur District

In this district about 14,000 tonnes of rice and wheat were distributed to the victims of 1977 cyclone. Immunisation programme was immediately taken up to prevent epidemics. Rs. 7.61 crores were distributed towards house construction. In addition, Rs. 15.62 lakhs were paid to the nearest relatives of deceased persons. In all, 5,543 permanent homes and 55 community shelters were to be constructed by the Government and voluntary agencies.

A sum of Rs. 22 lakhs was provided to the affected fishermen of which Rs. 13 lakhs was for construction of and repairs to boats and Rs. 9 lakhs for gears. A total of 206 boats were constructed and handed over to the victims. In addition, 7,200 kg of yarn and 1,360 boxes of cotton yarn were also distributed to 1,174 fishermen. Also at the rate of 5 logs each, a

Table 5. *Details showing no. of community shelters and houses constructed in the fishing villages of Krishna District and voluntary agencies involved as on* 30-9-1979.

	Name of the fishing village	Community shelters		No. of houses			Name of the voluntary agencies
		Completed	Under construction	Proposed	Completed	To be completed	
	Divi Taluk						
1	Elichetla dibba	—	1	—	—	—	—
2	Natchugunta	—	1	—	—	—	Baptist Federation of Canada
3.	Edurumondi	—	1	—	—	—	Indian Red Cross Society
4.	Sorlagondi	1	—	336	336	—	Tata Relief Committee and Special Police, Krishna District.
5.	Gullalamoda	1	—	360	316	44	Divine Life Society and Andhra Pradesh State Road Transport Corporation.
6.	Nali	1	—	246	246	—	Tata Relief Committee
7.	Sangameswaram	1	—	200	—	200	Tata Relief Committee and Indian Red Cross Society.
8.	Pathaupakali	—	—	151	—	151	Red Cross Society
9.	Palakayatippa	1	—	112	112	—	Ramakrishna Mission
10.	Hamsaladivi	—	1	150	150	—	Tirumala Tirupathi Devasthanam and Viswa Hindi Parishad
	Bandar Taluk						
11.	Gilakaladindi	1	—	350	100	250	Sankat Nivaran Society and Rotary Club, Machilipatinam
12.	Cambelpeta	—	1	104	104	—	Maharashtra Citizens Cyclone Relief Committee
13.	Manginapudi	—	—	80	—	80	Women's wing of Maharashtra Citizens Cyclone Relief Committee
14.	Chinnagolla palem	—	1	—	—	—	Indian Red Cross Society
15.	Malaikayalanka	—	—	34	—	34	Women's Wing of Maharashtra Citizens Cyclone Relief Committee
16.	Polatitippa	—	1	—	—	—	Karnataka Government
17.	Garaladibba	—	1	210	—	210	Tirumala Tirupathi Devasthanam and Orthodox church of India
18.	Chinnkari Agraharam Pallipalam	—	1	75	68	7	Rotary Club, Machilipatinam and Maharashtra Citizens Cyclone Relief Committee
19.	Kanuru	—	1	—	—	—	Indian Red Cross Society
20.	Krithivenu pallipalem	—	1	55	—	55	Tirumala Tirupathi Devasthanam and Union Carbide Company.
	Grand total	6	11	2,463	1,432	1,031	

total of 135 logs were distributed to 27 affected families for the construction of catamarans. The other details are given in Table 6.

Under relief measures taken after the 1979 cyclones, a sum of Rs. 11 lakhs was given as cash relief towards damages at the rate of Rs. 150 per fully damaged house and Rs. 75 per partly damaged house. 973 quintals of rice were distributed at the rate of 10 kg per affected family. In addition, free clothing including a pair of dhoties, a sari and one blanket for each family valued at Rs. 50 was supplied. Various Government departments have been authorised to incur an expenditure upto Rs. 30 lakhs towards repairs of damages of buildings, roads etc.

Fig. 2. Damaged electric transformer in Krishna district in 1977 cyclone.

Fig. 3. Decayed dead body in Krishna district in 1977 cyclone.

Fig. 4. House in which 200 lives were saved at Nali in Krishna district in 1977 cyclone.

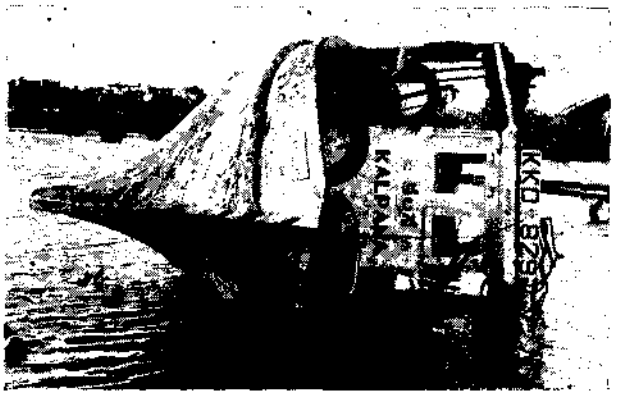

Fig. 5. 33′ trawler at Gilakaladindi (Machilipatinam) in 1977 cyclone.

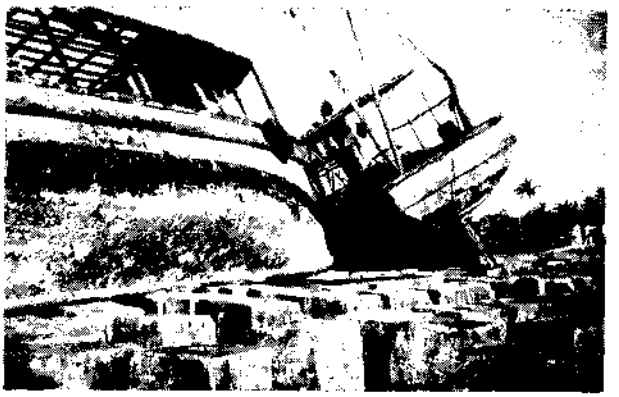

Fig. 6. Trawlers washed ashore on cement boulders at Gilakaladindi (Machilipatinam) in 1977 cyclone.

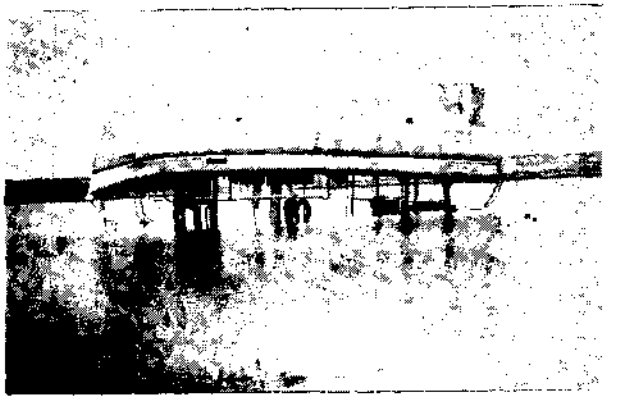

Fig. 7. Trawler (pablo) near Machilipatinam backwaters standing upside down in 1977 cyclone.

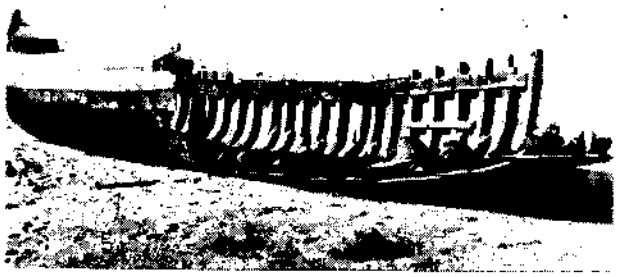

Fig. 8. Damaged boat aground at Prakasam district in 1979 cyclone.

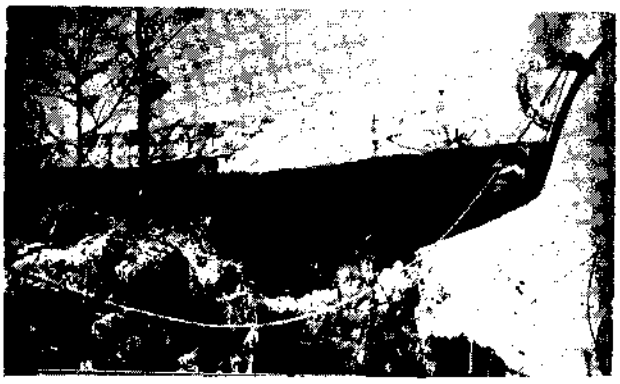

Fig. 9. Boat washed ashore about a furlong inside in 1979 cyclone.

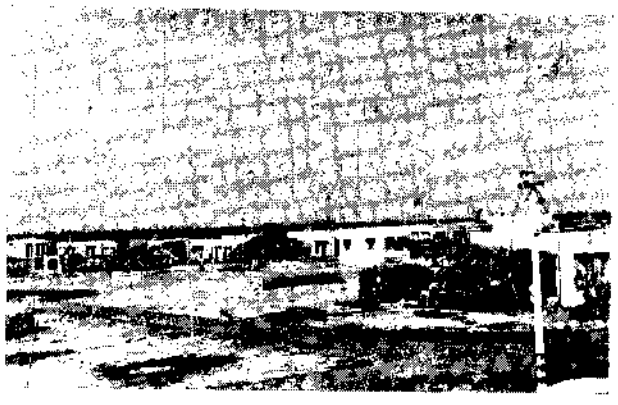

Fig. 10. Newly constructed fishermen colony at Sorlagondi.

Fig. 11. Housing unit in the new colony at Sorlagondi.

Fig. 12. Newly constructed housing unit at Nali in Krishna district.

Fig. 13. Newly constructed community hall at Nali in Krishna district.

Table 6. *Details of distribution of grants (in lakhs of rupees) & number of shelters in Guntur District*

Name of the coastal taluk	Exgratia to families of deceased	Loss of houses	Feeding & Rations	Medical & Public health	Other items	Total	No. of shelters
1. Repalle	1.54	122.63	0.09	0.10	1.37	125.73	41
2. Bapatla	5.88	104.69	2.71	0.94	1.41	115.63	14

Prakasam District

After the 1977 cyclone, immediate relief measures by way of free distribution of rice, clothing, kerosene etc. were taken up in the worst affected areas of this district. Medical assistance was rushed to the areas of disaster. Out of the 43 proposed community shelters costing about Rs. 43 lakhs in the coastal taluks of Chirala, Ongole and Kandukur, 3 have been completed and majority of the rest are nearing completion. The voluntary agencies that have come forward for the construction of these shelters are Indian Red Cross, UNICEF, Karnataka Cyclone Relief Committee, Tirumala Tirupathi Devasthanams, European Economic Community, Rotary club, Chirala and Rotary club, Bapatla. The State Government allotted 700 tonnes of rice and wheat each, for distribution among the cyclone victims. Of this about 6,600 affected fishermen families received 140 tonnes of rice and wheat each, 55, 42 and 43 tonnes of rice and wheat each in Chirala, Ongole and Kandukar taluks respectively.

Apart from the aid of voluntary agencies, the Government allotted a sum of Rs. 3 crores for various rehabilitation measures. In the fisheries sector a sum of Rs. 5.5 lakhs were allotted for crafts and tackles each respectively. Small navas were constructed in the mini boat yard at Vadarevu for 18 fishermen. In addition, for construction of catamarans, orders of supply of 1,323 logs were placed with Kerala State through the forest Department. Nylon yarn worth Rs. 4.31 lakhs was purchased from the Andhra Pradesh Fishermen Central Co-operative Society and distributed to 2,029 beneficiaries at 2½ kg of nylon yarn upto 1 count and 3 kg of 2 count and above.

In the 1979 cyclone after the forewarning issued by the authorities, about 51,000 persons were evacuated to safe places just before the onset of the cyclone. After the cyclone, marooned people were supplied with food packets dropped from helicopters. Road obstructions and debris were cleared to restore communication facilities in the earliest possible time. 5,862 tonnes of rice, 1,61,000 pairs of dhotis and the same number of sarees and bedsheets were distributed to the affected families. A sum of Rs. 4 crores has been allotted as cash assistance to those whose houses have been damaged. Besides 50,800 bamboos and 1,31,224 palmyra leaves were also distributed to them. Essential drugs and medicines worth about Rs. 2.3 lakhs have been purchased and made available to the cyclone victims. Power supply was restored wherever it was affected. So far, not less than Rs. 5 crores has been spent towards the rehabilitation of the affected persons.

Measures are under way to provide 50% subsidy to the fishermen who sustained losses by way of damages to their crafts and gears so as to enable them to restore their normal avocation. However, for the construction of fish curing depots and drying platforms 100% subsidy is being given. Orders were placed with Andhra Pradesh Fisheries Corporation for supply of 61 Kakinada navas of 36′ size and 51 dinghis of 21′ size. In addition, a sum of Rs. 2.2 lakhs was allotted towards repair charges of damaged boats. A quantity of about 4,300 kg of nylon yarn was distributed to 2,000 beneficiaries. About 6,000 kg of monofilament rope and 790 boxes of cotton yarn were distributed.

Nellore District

The fishermen affected during 1976 cyclone numbering 832 were provided with nylon yarn worth Rs. 2.03 lakhs and crafts and tackles worth Rs. 4.47 lakhs. The victims of 1977 cyclone in Tamapuram and Pudikuppam fishing villages were given a sum of Rs. 1 lakh towards construction of 20 boats and Rs. 8,000 towards the repair of 5 damaged boats. These amounts were distributed on 50% grant and 50% loan basis.

During 1979 Rs. 6 lakhs was allocated to the affected fishermen families, total number of beneficiaries num-

bering more than 4,500, out of which about 2,400 were marine fishermen. It was assessed that the affected fishermen need about 13 tonnes of nylon yarn, 5 tonnes of monofilament rope, 550 boxes of cotton yarn, 8 tonnes of jute and 13 tonnes of coir against which about 11 tonnes of cotton yarn, 6 tonnes of jute and 5 tonnes of coir have already been supplied. Regarding crafts, steps have been taken to replace 850 catamarans, 27 Kakinada navas, 40 Pulicat navas and 40 mechanised boats which were destroyed during the cyclone. So far 165 out of 189 damaged boats, have been repaired.

East and West Godavari Districts

In Narasapur Taluk of West Godavari Rs. 8,000 was given towards replacement of the lost boat on 50% subsidy and 50% loan basis. In the case of damaged boats, Rs. 300 was given for each affected big boat and Rs. 200 for small boat for carrying out repairs. An amount of Rs. 23,000 was also disbursed to 136 fishermen at the rate of Rs. 100-200 per fishermen towards the purchase of yarn for nets. Apart from that, financial assistance was extended through N.C.D.C. by Andhra Pradesh Fisheries Central Co-operative Society with 20% subsidy.

Effect of cyclones on fisheries

The marine catches of Andhra Pradesh comprises large variety of fishes like catfish, clupeoids, sciaenids, ribbon fish, silver bellies, seer fish and prawns. The cyclones since 1976 onwards have affected the fish catch in this state. Hence taking 1975 as the base year the effect of cyclones on fish catches may be studied during the cyclone period. From the total marine fish landings of Andhra Pradesh for the period 1975 to 1979 given below, it is clear that there has been a general declining trend in the marine fish landings in Andhra Pradesh during this period. The series of cyclones that struck Andhra Pradesh during this period may be one of the causes for this decline.

Year	1975	1976	1977	1978	1979
Catch in tonnes	1,55,638	1,31,321	1,00,756	82,116	91,182

The cyclone in 1977 and 1979 played much havoc on marine fisheries of this state. During the 1977 cyclone in November-January the worst affected districts of Krishna and Guntur showed a decrease in the catches from 2,213 tonnes in 1975-76 to 1,738 tonnes in 1977-78, suffering a loss of 475 tonnes valued at about Rs. 10 lakhs. The loss in fish production due to the 1979 cyclone in the worst affected districts of Prakasam and Nellore amounted to 2,084 tonnes valued at Rs. 42 lakhs decreasing from 2,291 tonnes in 1975 to 207 tonnes in 1979 during the months of May and June.

Though the effect of cyclone accompanied with tidal wave in 1977 was more severe in terms of loss in human life and property when compared to the cyclone of 1979, the loss in fish catches was more in 1979 than in 1977. This is because the maximum effect of the 1979 cyclone was felt in the districts of Prakasam and Nellore having a larger coast line with 88 landing centres as against lesser coast line with 33 landing centres in Krishna and Guntur Districts.

In the course of our visit to the affected fishing villages it was felt that drinking water facilities are inadequate in some of the new colonies. For instance, in Cambelpeta in Krishna District the fisherfolk have to go a long distance to collect fresh water for drinking purposes. However, in many of the newly sprung up colonies water tanks have been constructed to relieve the water shortage. In certain remote fishing villages such as Sorlagondi lack of marketing facilities have hampered fishermen from getting good price for their catches. For want of quick transport facilities fishes are normally dried and sold at lesser prices in the nearby towns. To overcome this handicap, the State Government with Central assistance has initiated action for the construction of ice plant and cold storages and purchase of insulated van for transport of fish. There are still some villages which are not connected by proper roads and do not have any bus service. Hence it is necessary to lay good roads and extend transport facilities to these villages. The overall impression obtained by talks with many villagers was that they did not rise to the occasion to help themselves as much as the other agencies did for them. However, this can be achieved by creating an awakening in them for the best use of their talents and the facilities extended by other agencies in their rehabilitation work.

Never before has such a large scale rehabilitation work been done in Andhra Pradesh in so short span of time and the credit for this goes mainly to the various voluntary agencies, both national and international, who worked round the clock with zeal, enthusiasm and devotion. In addition, the State and Central Government departments have also done commendable work. It appears that but for the cyclone and the subsequent timely relief and rehabilitation work, some of these villages would not have developed such houses,

roads, electricity and other modern facilities in the near future. The sudden disappearance of entire coastal villages in the tidal wave and appearance of colonies with modern housing units and other facilities in the place of hutments, thus changing the entire landscape as if by the trick of a magician, may amply justify the statement that these cyclones have proved to be a blessing in disguise.

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CULTURE OF BROWN MUSSEL *PERNA INDICA* AT VIZHINJAM*

Two species of sea mussels occur along the Indian coasts. The green mussel *Perna viridis* has a wide distribution on both the east and west coasts of India. On the other hand, the brown mussel *Perna indica* (Fig. 1) has a very restricted distribution along the south-west coast from Cape Comorin to Quilon. A traditional sustenance fishery exists for the brown mussel in Cape Comorin, Muttom, Enayam and Vizhinjam and a few other centres. The mussel meat is considered a delicious food item by the coastal people. At Vizhinjam the annual production of brown mussel from the natural beds varies from 50-150 tonnes.

In the recent years the Central Marine Fisheries Research Institute has given priority for developing appropriate technologies for coastal aquaculture. As a part of this programme, experiments on the culture of brown mussel were initiated at the Vizhinjam Research Centre of the Institute in 1971. The work has been carried out in the Vizhinjam Bay, which is about 16 km south of Trivandrum. The breakwaters constructed for the Fishing Harbour afford protection from heavy wave action during the monsoon. Natural settlement of mussel seed is abundant in the intertidal rocky area around Vizhinjam, meeting one of the needs of mussel culture. Experiments have been conducted almost uninterrupted through the years developing suitable techniques for the culture of the brown mussel in the bay. Besides, work on mussel culture in the open sea outside the bay were initiated in 1978. The present report contains some of the results obtained during the period 1976-1979.

Raft culture of mussel

Raft culture was adopted for the farming of brown mussel both in the bay and in the open sea. The rafts are of different sizes, ranging from 6×6 m to 10×10 m. These are fabricated with teak and bamboo poles lashed by coir or nylon ropes. Metal drums of about 200 litres capacity, treated for anticorrosion, are used as floats to give buoyancy for the rafts. The rafts are moored by anchors, by required length of anchor chain. While the rafts could be maintained in the bay

Fig. 1 Brown mussel *Perna indica* from Vizhinjam

* Prepared by K. K. Appukuttan in consultation with K. Alagarswami, C M F R I.

throughout the year, those in the open sea could be kept in position only during the calm season from January to May. The depth of Vizhinjam Bay varies from 10 to 15 m and the bottom is muddy. There is an increase in silting rate below 2 m and water becomes highly turbid from May to October. The temperature range is 20.75°C–30.05°C, the lowest in July and the highest in January/February. The salinity ranges from 31.51 ppm to 36.00 ppm. Thus the variations are narrow. But in the years 1977 and 1978 a sudden decline in salinity was noticed in November due to influx of fresh water.

The open-sea mussel culture experiments were carried out about 1-2 km away from the shore at depths ranging from 15-25 m. The sea was calm from the end of December to end of May when the rafts could be kept in position. Rest of the year, the sea is subject to heavy wave action making it difficult to maintain the rafts.

Seed availability

The brown mussel starts spawning in May which lasts till September. The period of peak spawning is July-August. Settlement of mussel seed on the rocks begins by July and high density of seed is seen during September-October. The young mussel attains the mode of 15-19 mm in length in July, 25-29 mm in August and 30-34 mm in September. Seed in the size range of 20-35 mm is considered suitable for rearing in the mussel farm. The ideal period for collection of seed from the natural beds is from September to November. The seed required for the mussel farm was collected from the rocky area between the Light House and the breakwater of Vizhinjam Bay. Mussel seed suitable for farming purposes is also available from nearby centres such as Avaduthura and Mulloor. A preliminary survey has shown that mussel seed is available in good quantities at Enayam, Colachel, Muttom and Neendakara. Good spatfall occurs inside the bay on split ropes suspended from rafts. The seed collected on the ropes were also used in the farm.

Seeding

The seed collected from different areas are washed in sea water and the fouling organisms removed. The seed are wrapped around a rope and secured by cotton netting or bandage cloth (Fig. 2). Both coir ropes and nylon ropes have been used for seeding, but the nylon rope has been found to be more economical considering the life of the rope. The length of the rope seeded ranged from 5 m to 10 m. To avoid slipping of seed in the initial stage, wooden pegs were inserted at regular intervals in the rope. The average weight of mussel seed per metre length of rope (seeded portion) ranges from 1.4-2.0 kg. Seeding is done during September-December. The seeded ropes are suspended from the rafts. Except for periodical examination for recording data on the growth of mussels and other factors the ropes are not disturbed.

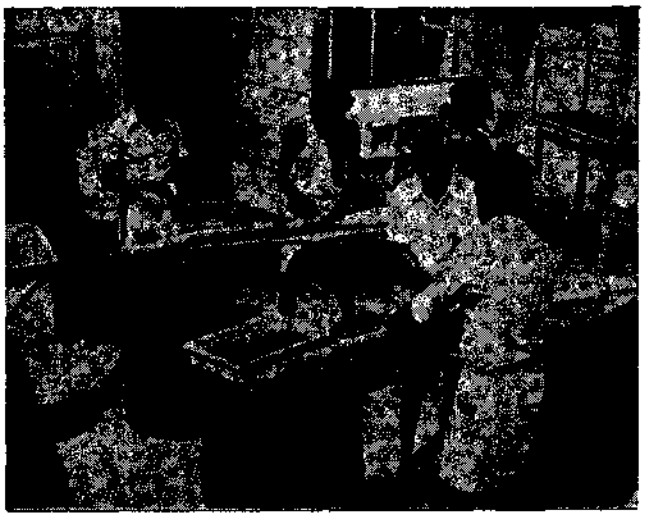

Fig. 2 Seeding of mussel on ropes

Growth of mussel and production

As mentioned before, seeding of ropes with young mussels is done during September-December period. In the Vizhinjam Bay, the brown mussel reaches the modal size of 55-60 mm in 8 months, giving an average growth of 2.94 mm per month. In the 1979 experiments the growth rate observed was 3.54 mm per month. The size 55-60 mm is marketable. The ratio of flesh weight to shell-on weight is 41.31% in May. After June, due to influx of freshwater into the bay and also increase in weight of ropes, there is a tendency for the farm-grown mussels to fall out. Hence harvesting should be done in May-June when the production is at its peak.

The open sea mussel culture is restricted to the calm season only. The growth of mussel is relatively faster in the open sea as compared to the bay. A modal size of 60-65 mm is attained in 5 months in the open sea farm, recording a growth rate of 5 mm per month. In 1979 a growth rate of 5.7 mm per month was obtained. The flesh weight constitutes 43.33% of the total weight of mussels in May. Also May is the period for harvest in the open sea farm.

The average rate of production is 10-12 kg of mussel per metre length of rope in the bay in 7 months, and 15 kg in the open sea in 5 months (Fig. 3). In a raft of 30 sq.m area, 50 ropes, each of 6 m length, can be used for growing mussels.

Prospects and problems

In the existing sustenance fishery for the brown mussel at Vizhinjam the production ranges from

Fig. 3 Growth of mussel on ropes under raft culture

50-150 tonnes a year. Based on the results obtained in experimental culture of the mussel in the bay as well as the open sea, it is possible to increase mussel production in the area by adopting raft culture techniques. The Department of Fisheries of Government of Kerala has taken up a Pilot Project on mussel culture at Vizhinjam.

The Central Marine Fisheries Research Institute is now engaged in two important areas of research in mussel culture to make the technology viable for large-scale commercial operation. At present we are depending on the mussel seed collected from the natural beds for stocking the farm. Settlement of spat on the rocks is seasonal and subject to natural fluctuations. This cannot meet the seed requirements of large-scale operations. It would be necessary to develop a technology for induced spawning and rearing of larvae and the young mussels in hatcheries upto a stage suitable for transplantation to the rafts. Investigations on these aspects are in progress. The second major area of research relates to developing suitable methods for year-round operations in the open sea. The growth of mussel and production rate are higher in the open sea than in the bay. If suitable raft or long-line culture methods could be developed for rearing the mussel in the open sea throughout the year, it will enable two crops in an year giving higher returns. Experimental work on these aspects are being carried out at Madras and Calicut besides at Vizhinjam.

NEWS—INDIA AND OVERSEAS

Hexagonal meshes for fishing nets proved advantageous

A new type of purse seine with six-sided meshes has been tested by the Norwegian Institute of Fishery Technology Research and has been found to offer great economic and operational advantages over traditional nets. The economic advantages lie in the fact that the hexagonal mesh offers about 15 per cent larger net area than does the square mesh with the same amount of netting. For the purse seine this will lead to big savings. Fishing trials have shown that this type of net sinks faster and is easier to haul in than traditional nets.

Theoretical views on the characteristics of hexagonal meshes and their possibilities for use in fishing gear were originally expressed in a Soviet periodical in 1975. This was not followed up in the USSR but the Norwegians were quick to see its possibilities and started experimenting with hexagonal meshes in 1976 and now appear to have achieved a breakthrough.

FNI 18 (7): July 1979

Big beam trawler boom in Holland

Since last year a rush among Dutch fishermen is noticed for construction of new beam trawlers of sizes even more than 40 m (131 ft) long. There is, however, some criticism about the increase in size of the beam trawlers up to 40 m. Some observers feel that the vessels are too large to be economic. Leading naval architects and fishing boat designers suggested that boats of around 30 m will be the optimum for the future. This is borne out by experience in other EEC countries where this size is becoming common as the fishing pattern changes. Whether these new vessels can be made to operate economically or not, their building is providing Dutch yards with a boom which many thought would never happen.

Most of Holland's big-name fishing vessel builders are sharing in the country's boom. The small yards are also benefiting through sub-contract work. In some cases whole vessels are farmed out by the larger yards so that early delivery dates can be offered.

FNI 18 (11): November 1979

Fuel from seaweed

Research in the United States indicates that giant seaweed, *Mycrocystis pyrifera* could provide a major source of methane gas and help solving the energy problem.

According to a report in a French journal, a 42,000 hectare marine plantation could produce the energy equivalent of hundreds of thousands of tonnes of petroleum. This figure is based on present, inefficient conversion methods. By the year 2000 a production of 40 tonnes per ha might be possible. According to the article the fuel needs of the French fishing fleet could be met by a 20 sq. km seaweed (locally known as kelp) farm, as extraction technology improves.

However, such suppositions appear to bring little comfort to French fishing interests, who are against proposals to plant kelp beds in selected areas off the coast of Brittany. They fear that the kelp would soon spread out of control, with its rapid growth, endangering inshore fishing grounds and shellfish beds.

Giant kelp has been harvested in California and other places in U. S. A. for some time now. It is used in the manufacture of food additives, to stabilise ice cream and to produce agar jelly on which bacteria cultures are grown.

FNI 18 (11): November 1979.

Prospects for developing giant Pacific Octopus fishery

Mysterious and often misunderstood, the giant Pacific Octopus, *Octopus dofleini*, could provide a new fishery for some countries. The species ranges from northern California through to Alaska and west along the Aleutian Islands to the USSR, Korea and Japan. Throughout its range it can grow to nearly 50 kg. Undoubtedly, the most developed and extensive fishery is in Japan.

In Hokkaido the northernmost island of Japan, immature octopuses migrate inshore and offshore twice a year. They stay in shallow water from May to July and from November to January and migrate offshore to deeper water from February to April and from August to October. So the larger animals apparently remain in the deep water regions. The bulk of the Japanese fishing effort is centred on these immature octopuses which are generally smaller than about 15 kg. This is probably because of the price structure for different sized octopuses.

The Japanese octopus fishing roughly falls under two categories, namely hooking which takes advantage of the predatory nature of the animal and pot fishing which relies on the need of the octopus for cover. Hooking with long lines is the most popular method and different ways of operation of these longlines are prevalent.

Though octopuses appear to prefer a wide variety of shellfish for food, they seem to be opportunistic feeders, eating any fish that they can catch. In Alaska, octopuses are notorious for raiding crab pots, but they have also been observed feeding on cockles and other clams. In general they are aggressive predators with voracious appetites. The possibilities for developing good fishery for the octopuses in all the areas of their distribution on the lines of the Japanese fishery are quite bright.

FNI 18 (11): November 1979.

BOOKS

Marsh-estuarine systems simulation: Edited by R. F. Dame. University of South Carolina Press, Columbia, South Carolina. pp. 260, 1979.

The volume, the eighth in an ongoing series devoted to marine science, contains the papers presented at a symposium organised by the Belle W. Baruch Institute for Marine Biology and Coastal Research in January 1977. The computer simulation of environmental processes at an ecosystem level has gained considerable attention in recent years, ever since the pioneering work of H. T. Odum in 1960. Many of these simulation efforts have centred on salt marshes and estuaries because of man's impact on those highly productive and valuable systems. Progress in this field is summarised and well documented in this compilation.

Thirteen papers by twenty-eight contributors are included in this first book on the subject of simulation and modelling of marsh-estuarine systems. The computer and microcosm simulations address a variety of marsh-estuarine ecosystems including salt marshes, sea grasses, water columns, microecosystems and marsh-estuarine complexes. Natural and man-stressed systems are described. A historical review of marsh-estuarine modelling supplements the new data, methods and analysis.

Marine Biology: By John Reseck. Reston Publishing Company, Inc., Reston, Virginia. pp. 257, 1979.

The topic of marine biology is dealt with in very simple terms in this book with a view to acquaint the student with marine environment. The basic information is treated in a light readable style for the student to read rather than as a reference text. The general principles of the field, major taxonomy and basic ecology are covered in a manner easy to read and understand.

It is written in three parts, namely, basic understandings dealing with some of the basic principles, physical, chemical and other considerations and man's use of the sea, environments of the oceans detailing the different environmental subdivisions and various environments and finally animals of the marine environments giving a brief account of the marine animals under a major classification. It would be useful to instructors and students alike.

Compiled and prepared by M. J. George, S. K. Dharmaraja and G. Subbaraju. Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute, Cochin-682 018