

CMFRI

Research Highlights

1995-'96



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
P.B. No. 1603, COCHIN - 682 014

About CMFRI

The Central Marine Fisheries Research Institute is one of the eight Research Organisations in the network of Central Fisheries Research Institutes under the Indian Council of Agricultural Research devoted to Research, Education, Training and Transfer of Technologies in support of development of Fisheries in India. CMFRI's mandate is to conduct researches on exploited, under- and unexploited marine fisheries resources and fisheries oceanography, to advise on rational exploitation and make forecast of abundance, development and upgradation of technologies for maximising production through mariculture and conducting teaching, training and extension programmes for development of human resources in fisheries.

The Institute with its Headquarters at Cochin and Research and Field centres all along the Indian coastline, conducts mission-oriented researches in important areas of marine capture and culture fisheries on all-India basis as well as regional basis in addition to making district-wise, species-wise and gear-wise production estimates. Besides, the CMFRI also conducts researches on short-term but frontier areas of marine fisheries through *ad hoc* projects funded by different agencies.

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Director's Introduction

The CMFRI takes pleasure in presenting its Research Highlights 1995-96. The year saw greater thrust on the development of infrastructure for mariculture and extension. Hatchery facilities have been developed at Calicut, Fisheries Harbour Laboratory at Cochin, Vizhinjam and Mandapam Camp besides the expansion of the Field Mariculture Laboratory at KVK, Narakkal (Cochin), Tuticorin and Visakhapatnam. The Field Mariculture Laboratory of the Madras Research Centre at Kovalam is being renovated to restart the seafarming programmes. Action has been initiated to develop seafarming and coastal mariculture facilities at all the Research Centres of the Institute located in different hydroclimatic zones along the maritime States of the country. The Institute conducted Fish Farmers and Fishermen Meet not only at the Headquarters, Cochin but also at most of the Research Centres regularly every month, to address their problems in seafarming, coastal aquaculture and capture fisheries. A large number of farmers, entrepreneurs and industrialists got benefitted from these monthly Meets. Action has been initiated to acquire suitable sites for the construction of laboratory buildings and hatchery-cum-growout complexes for mariculture. The government of Kerala allotted 1.7 acres of land close to the Vizhinjam Bay to construct laboratory buildings and seafarming facilities for the Vizhinjam Research Centre. A proposal was submitted to the government of Andhra Pradesh for the allotment of 6.5 acres of land on long term lease or outright transfer at Kakinada for the construction of similar facilities and also residential quarters for the Kakinada research centre of the Institute. The government of Karnataka agreed in principle to allot land at Karwar and

Mangalore for the construction of laboratory buildings and mariculture facilities. Similarly action has been initiated to obtain land for laboratory-cum-office building at Bombay from CIDCO or CIFE. Several proposals were submitted to various funding agencies in the frontier areas of marine fisheries and mariculture. A total of 54 Research Projects are being successfully implemented in addition to 12 externally funded projects. The highlights of the work done during 1995-96 are incorporated in this publication.

Cochin-14
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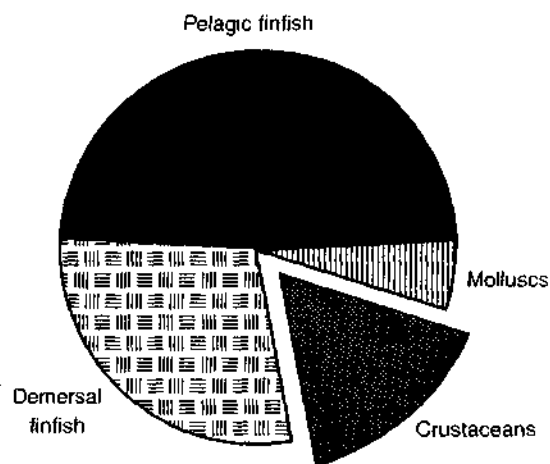
M. DEVARAJ
Director

HIGHLIGHTS OF THE WORK DONE

Estimating Fish Production

The marine fish production in India during 1995 was estimated at 2.26 million tonnes which is 3.9% less than the estimated production of 1994. The landings showed decline over the previous year in respect of penaeid prawns, mackerel, ribbonfishes, croakers and Bombayduck; the landings of carangids and lesser sardines however, showed increase.

The estimated landing of oil sardine was 57,000t which is about 10,000t more than that obtained during previous year. Mackerel registered a decline of 29,000t over previous year and Bombayduck a decline of 17,000t. The landing of penaeid prawns was 187,000t which showed decline of 38,000 t. The estimated landing of carangids and lesser sardines were 197,000t and 128,000t respectively; these groups registered increases of 58,000t and 41,000t respectively over previous year.



Composition of marine fish landings in India in 1995

The mechanized sector (including those with out-board engine) brought 87.3% of the total catch and the non-mechanized sector contributed 12.7%.

The northeast region (West Bengal and Orissa) contributed to 5.1% of the total landings, southeast coast (Andhra Pradesh, Tamil Nadu and Pondicherry) 25.8%, the southwest coast (Kerala, Karnataka and Goa) 31.4% and the northwest region (Maharashtra and Gujarat) contributed to 36.2% of the total marine fish landings of India. The contribution of Union Territories of Andamans and Lakshadweep was about 1.5%.

Studying Fishery and Resource Characteristics

In the context of the production from the presently exploited grounds reaching near optimal levels and in an endeavour not only to increase the production but to sustain the yield, the Institute continued its efforts in developing scientific database through its research projects in capture fisheries.

Pelagic Finfish: Work was carried out on sardines, mackerel, whitebait, seerfish, tunas, billfishes, Bombay duck and ribbonfish. All relevant data were collected. In the case of sardines a significant improvement was observed during the year particularly along the west coast Centres. The oil sardine, which has been yielding declining landings, showed signs of revival during the year. Recruitment of this species was observed during September and January at Mangalore and from September to November at Cochin. In the case of mackerel, purse-seine and ring-seine were the principal gears along the west coast and trawl and gillnet along the east coast; the landings at Mangalore and Cochin showed decline due to the decline in the purse-seine effort. The length range in the catch

was 55-279 mm. The recruitment length varied from 55 mm in boat-seine to 135 mm in purse-seine. Fishes smaller than 100 mm occurred in the catches during November and February at Mangalore, May and June at Cochin, April and May at Kakinada and April and January at Visakhapatnam. There is indication that fishing pressure is heavy along Tuticorin region requiring regulations in the mesh size and effort.

Whitebait was exploited by purse-seine, ring seine and trawl. The length ranges of exploited species were 40-114 mm in *S. bataviensis*, 40-99 mm in *S. devisi*, 55-84 mm in *S. macrops*, 60-94 mm in *S. buccaneeri*.

The seerfish fishery showed appreciable improvement at all the centres except Mangalore and Calicut. The peak periods of landings were April at Madras, August at Tuticorin, September at Visakhapatnam, Cochin and Calicut, October at Mangalore and Bombay and September and December at Veraval. *Scomberomorus commerson* was the principal species along the southern centres and *S. guttatus* along the northern centres. The length range in former species was 58-114 cm in hooks and lines, 48-66 cm in large mesh gillnets and 14-66 cm in trawl net and small mesh gillnet. In *S. guttatus* the length range was 20-48 cm.

Gillnet was the principal gear exploiting tunas and billfishes along the mainland centres and pole and line in the Lakshadweep region. *Thunnus tonggol* was the principal tuna at Veraval and Malpe, *Auxis rochei* at Vizhinjam, *Euthynnus affinis* at other centres. Skipjack and yellowfin tunas contributed to the pole and line fishery.

In the case of Bombay-duck, there was marginal increase in the dol net landings in Maharashtra but decline in the same in Gujarat.

The length range in the catch was 30-139 mm at Bombay and 30-314 mm at Veraval. Young fish smaller than 74 mm occurred in the catches in considerable quantities in all the months at Bombay.

The ribbonfish catch declined at almost all the major centres and trawl continued to be the principal gear. *Trichiurus lepturus* is the principal species in the landings; the species appears to spawn during November-June. The exploitation of *T. lepturus* off Mangalore is at optimal level.

Demersal Finfish: The Institute carried out research on the major exploited demersal finfish resources such as elasmobranchs, large perches, catfishes, threadfin breams, silverbellies, croakers, flatfishes, flatheads, goatfishes, threadfins, lizard fishes and whitefish. In elasmobranchs, the trawlers landed maximum quantities, though other gears such as long lines and bottom set nets also landed these fishes. At Madras, *Rhinoptera javanica* was in the length range of 20-169 cm and *Dasyatis jenkinsii* at 20-140 cm. At Mandapam *Dasyatis uarnak* was the major species with the length range of 84-122 cm. At Cochin the long lines yielded the catch rate of 213 kg per unit. The bottom trawlers at Bombay landed 2656 t of elasmobranchs which showed a 19% decline over that of the previous year; sharks formed 73% of the elasmobranch catch and *S. laticaudus* was the most dominant species.

Trawl accounted for the bulk of the catches of larger perches and only at Vizhinjam these species were exploited by hooks and lines and to a very small extent at Tuticorin also. At Madras also the bulk of the catches of perches was taken by hooks and lines.

For larger perches, October-December was the peak period at Bombay; *Epinephelus diacanthus* was the dominant species, its length

range was 12-44 cm.

At Cochin *E. diacanthus* and *Pristipomoides typus* were the most dominant components of the perch fishery; August and September were the months of peak landings. The length range of *E. diacanthus* was 20-45 cm and that of *P. typus* was 30-62 cm.

At Vizhinjam, *Lethrinus lentjan*, *Lutjanus* sp. and *Epinephelus undulosus* were the dominant species. At Tuticorin July-September was the period of abundance of larger perches. At Madras, *Epinephelus tauvina* was in the length range of 25-110 cm.

In the case of catfish, the northwest coast showed some increase in the production. At Bombay the dominant species were *Tachysurus dussumieri*, *T. caelatus*, *T. sona* and *O. militaris*. The highest catch rate was obtained in September. At Cochin, the catch rate of gillnets was around 3.3 kg per unit. At this centre, mature and ripe females of *T. serratus* occurred in August and September. At Madras, maximum catch of catfish was landed in August and *T. dussumieri* was the dominant species.

In the case of threadfinbreams, the fecundity of *Nemipterus japonicus* at Veraval was estimated as ranging from 14212 to 48287. At Bombay the fishing mortality in *N. japonicus* was found to be very high; there was a steep fall in the catches of this species when compared to the last year. At Mangalore the maximum sustainable yield of *N. japonicus* was estimated as 4947 t which is slightly larger than the present yield. At Cochin the landings of threadfin breams showed a decline of 76%. At Madras the landings of threadfin breams were 10% greater than the maximum sustainable yield level.

Leiognathus bindus and *Secutor insidiator* were the most dominant species in the silverbelly catch at Madras, Kakinada and Visakhapatnam.

In the case of croakers, the biological characteristics of different dominant species (numbering a total of about 15 species) along both the coasts of India were studied. Among the lizard fishes, *Saurida tumbil* and *S. undosquamis* were the principal species. The length range of *S. tumbil* was 15-46 cm at Veraval, 21-38 cm at Mangrol, 11-45 cm at Bombay and 15-38 cm at Beyppore and the same of *S. undosquamis* was 10-28 cm at Madras, 12-34 cm at Cochin and 16-28 cm at Visakhapatnam.

In threadfins the trawl catches showed increase of 16% at Veraval and 212% at Mangrol, though there was a decrease in effort by 8% at Veraval and an increase of only 6.5% at Mangrol.

Cynoglossus macrostomus was the most dominant flatfish at Mangalore. Almost the entire catch was from trawlers. At Calicut also, *C. macrostomus* was the dominant species and April, May and June were the peak months of landings of flat fishes. At Cochin, most of the adults of *C. macrostomus* were in advanced maturity stages during April-December.

At Madras, there was a steep decline in goatfish landings during April-September from 1,981 t of previous year to 263 t during the year under report.

In the survey of the ornamental fish resources of Lakshadweep a total of 3695 specimens of 115 species were collected by conducting fishing using gillnets, encircling nets and drag nets. Data on biology of

30 important species were collected and growth parameters and mortality rates of 4 important species were estimated.

Crustacean shellfish: With a total production of 3.6 lakh tonnes, crustaceans contributed to 15.86% of the country's annual marine landings in 1995. The landings declined by 13.48% over the previous year. Penaeid prawns accounted for 51.89% of the crustacean fishery followed by nonpenaeids (20.58%), stomatopods (18.45%), crabs (8.54%) and lobsters (0.54%). Landings of penaeid prawns, lobsters and stomatopods declined by 12.13%, 29.13% and 32.35% respectively whereas crabs improved by 6.10%. Nonpenaeids marginally increased by 0.68%.

82% of the total penaeid prawn catch was taken by trawlers. When compared to the previous year, penaeid prawn landings declined by 23.82% in Maharashtra, 29.19% in Goa, 7.54% in Karnataka, 39.86% in Kerala, 7.09% in Tamil Nadu, 41.66% in Pondicherry and 11.64% in Andhra Pradesh. Substantial increases of 56.94% in Gujarat, 168.81% in the West Bengal and 112.30% in Orissa were recorded.

Parapenaeopsis stylifera dominated the trawl fishery at most of the centres along the west coast except Veraval and Mangalore where *Solenocera crassicornis* and *Metapenaeus monoceros* respectively were important constituents. On the east coast, the principal constituents were *Penaeus semisulcatus* at Tuticorin, *Parapenaeopsis maxillipedo* at Pamban, *Metapenaeopsis stridulans* at Mandapam, *Metapenaeus dobsoni* at Madras, *Metapenaeus monoceros* at Kakinada and Visakhapatnam and *Parapenaeopsis* spp. at Paradeep.

Diversification of trawling in recent years has resulted in the

emergence of nonconventional penaeid prawn resources along both coasts of India. Prominent among them are *Metapenaeopsis stridulans* at Bombay (6.8%) and Mandapam (55.8%); *Trachypenaeus* spp. at Mangalore (4.1%) and Sakthikulangara (10.0%); *Parapenaeopsis maxillipedo* at Tuticorin (15.6%), Pamban (36.3%) and Madras (11.9%); *Trachypenaeus pescadorensis* at Mandapam (8.8%) and Pamban (7.0%) and *Solenocera* spp. at Visakhapatnam (22.6%) and Paradeep (12.9%).

Analysis of the data for the last 5 years along the south east coast revealed a gradual decline of *Penaeus semisulcatus* in the fishery. This is more evident at Mandapam where small sized prawns like *Parapenaeopsis maxillipedo* and *Trachypenaeus pescadorensis* have replaced the large-sized green tiger prawn. At Kakinada, a drastic reduction in the sizes of *P. monodon*, *P. indicus* and *Metapenaeus monoceros* took place due to overexploitation. There was a gradual decline in the proportion of bigger sized species of *Penaeus* and *Metapenaeus* in the fishery leading to the predominance of smaller species of *Metapenaeopsis*, *Parapenaeopsis* and *Solenocera* along the east coast.

With a total catch of 11,968 t in the monsoon period, *P. styliifera* registered an increase of 92% over the previous year at Sakthikulangara-Neendakara region. Widespread operation of minitrawls in the nearshore waters along the Kerala coast has resulted in the large scale destruction of juvenile population of *P. styliifera*. More than 50% of the prawns landed by mini trawl consisted of undersized prawns. The annual total prawn catch by this gear amounted to 6,407 t forming 15% of Kerala's prawn production. This gear registered an increase of 97% in landings over the previous year.

Deep sea prawn landings at Tuticorin were estimated at 1,856t with a catch rate of 438 kg/unit operation. Fishery was dominated by *Metapenaeopsis* spp and *Heterocarpus* spp. The landings increased by more than four times over the previous year.

Purse seines operating at Mangalore and Malpe landed 126 t of prawns (7.7 kg/unit) showing an increase of 158% over the previous year.

Gujarat and Maharashtra dominated the nonpenaeid prawn fishery in the country. While Gujarat registered an increase of 6% in the landings over the last year, the production declined by 9.6% in Maharashtra. *Dof* nets landed 77% of the nonpenaeid prawn catch in Maharashtra. However, with the operation of close-meshed trawl nets in Gujarat, 83% of the catch is landed by trawlers. *Acetes* spp. (99.6%) formed nearly the entire nonpenaeid catch in trawlers at Veraval whereas in Bombay *Nematopalaemon tenuipes* formed 99.5%.

Gujarat (64.2%) led in lobster production followed by Tamilnadu (15.11%), Maharashtra (14.8%) and Kerala (4.98%). Trawlers accounted for 67% of the lobster landings in the country. While *Thenus orientalis* (56%) and *Panulirus polyphagus* (44%) contributed to the lobster fishery at Veraval, *P. polyphagus* was the exclusive component of the landings in Bombay. Sand lobster *Thenus orientalis* disappeared totally from Bombay waters because of overexploitation.

In the artisanal fishery along the southwest coast, *P. homarus* was dominant whereas at Tuticorin *P. ornatus* and *P. homarus* were almost equally represented in the landings. At Madras *Thenus orientalis* contributed to more than 81% of the landings in trawlers. Fishing at a depth of 300 m, the deep sea vessels landed 29 t (12 kg/unit) of deep

sea lobster *Puerulus sewelli* at Tuticorin.

Tamilnadu (37.7%), Gujarat (33.9%) and Andhra Pradesh (9.7%) contributed to the bulk of the crab fishery in India. Trawlers accounted for 75% of the crab landings in the country. While the crab fishery was exclusively supported by *Charybdis lucifera* at Veraval, the dominant constituent was *Charybdis cruciata* at Bombay (69%), Malpe (44%) and Mangalaore (67%). *Portunus sanguinolentus* was the principal component of trawl landings at Madras (39%) and Kakinada (67%). Deep sea swarming crab *Charybdis smithii* (17%) supported sizable fishery at Madras.

Molluscan shellfish: The annual cephalopod production in the country was estimated at 116,841 t registering an increase of 2,900 t over the previous year. The fishery was supported by *Sepia pharaonis*, *S. aculeata*, *S. elliptica*, *Sepiella inermis*, *Loligo duvauceli*, *Doryteuthis* sp and *Octopus* sp.

The green mussel along Malabar coast contributed 2,472.4 t, registering a decline of 1,252.6 t over the previous year. The estimated annual landings of brown mussel along Vizhinjam, Mulloor, Pulinkudi, Kolachel and Enayam coast was 397.2 t. The clam production in the Kakinada bay was estimated at 889.5 t comprising of *Anadara granosa*, *Meretrix meretrix*, *M. casta*, *Paphia malabarica*, and *Katylisia opima*. The production from the Mulki estuary was 239 t, and from the Karwar bay 8.38 t. The estimated production of *Villorita cyprinoides* was 56,400 t showing a decline of 1,102 t over the previous year.

A total of 104 chanks were collected, tagged and released in the open sea at Pulipoondu paar, northeast of Tuticorin harbour.

From the Kakinada Bay, 1,143 t of gastropods were landed comprising *Cerethedium* sp (34.7%), *Telescopium* (14.3%), *Umbonium* (6.9%) and *Thais* (0.4%). At Madras, 14.9 t of gastropods comprising *Bursa* sp, *Rapana bulbosa*, *Hemifusus pugilinum*, *Babylonia spirata*, *Ficus ficus*, *Turitella* sp, *Oliva* sp and *Thais* sp, was landed. At Mandapam, an estimated 10,000 chanks were landed. In Rameswaram, directed exploitation of chanks, was carried out by using a modified shrimp trawl known as 'chank madi'; the landings by this net amounted to 1.5 lakh chanks.

Monitoring the Fishery Environment

In the environmental impact assessment studies on dredging activities in the Cochin harbour, data generated for one year revealed variations in nutrient levels, turbidity, oil and grease in the water samples and heavy metals in the bottom sediments.

Systematic monitoring of 7 oceanographic stations located in and around the proposed mining area in front of the Indian Rare Earths Ltd. for a period of one year revealed typical coastal conditions. The monitoring will be continued during and after mining operations.

Remote Sensing and Potential Fishing Zones (PFZs)

Validation of PFZ forecasts received from National Remote Sensing Agency, Hyderabad between November, 1995 and March, 1996 undertaken from a total of 15 landing centres along the Kerala coast revealed very good correlation between PFZ forecasts and selected pelagic/column fishing activity. In general, comparatively higher catches were obtained for fishing activities carried out within the PFZ for Purse seining and gill netting. In the case of bottom trawling activity, no definite

relationship was found during November-January.

Mariculture Technologies

In the experiments on the seed production of the crab, *Portunus pelagicus*, zoeae were reared in one ton capacity FRP tanks and they metamorphosed to baby crabs within 20-21 days. *Chlorella*, rotifer and egg prawn custard were used as feed for zoea and 8-9% survival was observed in the initial experiments.

At Tuticorin molluscan hatchery, a total of 1.49 lakhs cultchless spat and over 2 lakhs attached spat of edible oyster were produced from 19 spawnings.

Although 10 spawnings of the pearl oyster, *Pinctada fucata* occurred, there was no spat settlement due to poor water quality. There was profuse spawning of *P. margaritifera* brought from the Andamans in January, but no settlement occurred. In January, *P. sugilata* also spawned and spat settlement occurred in February.

In the clam hatchery, there were two successful spawnings in *Paphia malabarica* which resulted in 7.11 lakhs spat. For the first time, this species spawned in April which is outside the normal spawning period. For nursery rearing of *P. malabarica*, stocking density of seed (of 4.63 mm) at the rate of 1000 per velon screen bag of 25 x 25 cm size was found to be the optimum.

At Vizhinjam, a two-in-one cage was designed and experimented from a raft in the Vizhinjam bay. Spat settlement of the pearl oyster and also the occurrence of some economically important fishes and lobsters in the cages was reported.

A laboratory was set up at Tuticorin for tissue culture in pearl oyster and at Calicut a mussel hatchery.

Selecting suitable sites for bivalve culture

Visakhapatnam: Pearl oysters earlier held in cement tanks in 'SIRIS' hatchery (a private hatchery near Kakinada) were shifted to Visakhapatnam fishing harbour. Nuclei were implanted in 82 pearl oysters in June 95 of which 35 oysters rejected the nuclei. Of the remaining, only three oysters produced good quality pearls. This is the first time that good quality pearls were obtained from the northeast coast of India through culture.

Madras: Oysterlings of 21 mm size transplanted to Chunnambaru near Pondicherry, attained good growth and maturity, but spatfall did not occur in that area.

Tuticorin: 500 implanted pearl oysters and 30 mother oysters were transported to Kakinada in June. High mortality occurred due to high temperature during transport. In October, a total of 6000 pearl oysters were transported to Mandapam and 1000 to Madras for onshore pearl culture.

Cochin: Good spatfall of oyster, *Crassostrea madrasensis* was obtained in the Ashtamudi lake and the spat have grown to marketable size in 8 months. 2.4 t of oysters were harvested with a meat yield of 240 kg.

Pearl oyster seed of 16 mm size reared in cages on longline at Andakaranazhi, Cochin, recorded good growth. Pearl culture at this place yielded 33.3% pearl production.

Another batch of 450 pearl oyster spat and 89 adult oysters were

transported to Andakaranazhi from Tuticorin.

In an attempt to rear pearl oysters in pond system, 327 pearl oysters were transplanted to a pond at Munambam, in January 96, of which 176 were implanted in February 96.

A longline mussel farm of 400 sq.m was established in October at Andakaranazhi, 50 km from Cochin, at 10 m depth. A total of 100 seeded ropes, varying in length from 4.5 to 6 m were suspended in the farm. In 4 months, the brown mussel recorded growth of 66.03 mm and 17.5 g average total weight while green mussel attained 56.76 mm and 9.75 g total weight.

Calicut: P from Tuticorin were reared in Puthiappa Bay, implanted after six months and pearls of good quality were harvested. 10% pearl yield was obtained.

Upgradation, location testing and transfer of technology

In the Tuticorin harbour four rafts were maintained, 5940 pearl oysters were implanted and a total of 534 pearls weighing 77.49 g were produced and sold for Rs. 45,550. The farm at Valinokkam was closed due to sand drift.

Pearl oyster spat were reared in a private shrimp hatchery adopting onshore pearl culture technique. A total of 22,475 pearl oysters were supplied to Mandapam, Madras, Kakinada, Visakhapatnam and Cochin for this purpose. At Mandapam, 460 oysters were implanted and reared both in the sea in cages and in onshore tanks.

Three training programmes on pearl culture were conducted at Tuticorin.

A total of 200 blacklip pearl oysters, *Pinctada margaritifera* were transported from Andamans to Mandapam and Tuticorin. As there was mortality at Tuticorin, they were shifted to Mandapam.

Popularising and transferring oyster culture technology along Kerala coast

A demonstration farm was set up at Dalavapuram, Ashtamudi estuary, in an area of 0.22 ha adopting rack and ren method in November 1994. The oysters reached harvestable size in August, 95 and 2.4 t of oysters were harvested.

The demonstration of the technology of edible oyster farming motivated six farmers at Dalavapuram, one at Munambam, one at Chettuval near Trichur to take up edible oyster farming.

Similarly, demonstration of edible oyster culture at Dharmadam (Cannanore) encouraged a farmer to venture into edible oyster as well as mussel farming in Padanna, Kasargode. For the first time oysters and mussels were cultured from the same farm.

Improving mariculture technologies

Nutrition: For formulation of high nutrient diets, feed ingredients and prepared feeds were screened. P/N ratios (Phosphorus/Nitrogen) were found to be less than one for fish meal, clam meal, groundnut oilcake, shrimp meal and prepared feeds. Tapioca flour had a P/N value of 7.74.

Endocrinology: The characteristics of protein bands in the extracts of neuroendocrine centres from mature *Penaeus indicus* using molecular weight markers was carried out. Bioassay studies conducted with extracts

of eyestalk elucidated the capacity for arresting moulting in premoult animals. Bioassay studies using lyophilised powder of thoracic ganglion and brain at a protein load of 1.13 mg/100 μ and 0.67 mg/50 μ respectively, stimulated ovary development upto 5th day which remained thus till the 12th day. The ovary development was observed upto stage II and ova diameter varied from 100 to 150 μ m.

Physiology: Molluscs were tested for their salinity tolerance levels at 29°C through four sets of experiments. Their ranges of salinity tolerance and optimum salinities are:

<u>Species and size</u>	<u>Tolerance range</u>	<u>Optimum</u>
<i>Crassostrea madrasensis</i> (20-25 mm)	5-45 ppt	30-35 ppt
<i>Paphia malabarica</i> (9-12 mm)	5-30 ppt	10-15 ppt
<i>Meretrix casta</i> (35-40 mm)	5-25 ppt	15 ppt
<i>Meretrix casta</i> (41-45 mm)	5-30 ppt	15-20 ppt

Biotechnology: Dimethylsulfoxide (DMSO) and glycerol were used as cryoprotectants independently and in combination for the cryoprotection of gametes and embryos of penaeid prawns. Wherever revival of nauplii was observed, the composition of the extender used, percentage of different cryoprotectants used, effect of different percentages of cryodiluents and cooling conditions on survival rate of nauplii were documented.

Pathology: White spot disease syndrome was identified in farms in and around Cochin. Gill infestation with *zoothamnium* and blue green

algae were recorded from ponds which reported mortality. Branchiostegite region was found swollen in many cases. Microsporidian infection was recorded from a few prawns collected from Narakkal.

Mortalities were reported from various farms near Velankanni. Use of disinfectans and antibiotics delayed mortality.

A study of the bacterial flora of sea water, estuaries and culture ponds was conducted in Nagapattinam Qaid-e-millath district of Nagapattinam and Karaikkal as a part of environmental impact assessment study.

Studies on the 'red disease' problem in spiny lobster *Panulirus ornatus* revealed the presence of gram negative organisms in haemolymph and hepatopancreas. Further studies are being carried out on the isolated bacteria.

Genetics: Multiphore electrophoretic methods for extraction, separation and detection of muscle protein patterns in *Rastrelliger kanagurta* were standardized. Five zones of protein bands were observed in individual specimens. Polymorphic protein phenotypes were detected in fast moving zones. Genetic variability at the apparent four polymorphic loci was estimated in sample populations from Mangalore, Neendakara and Goa. Protocols for extraction of mtDNA from ovary/liver and its detection by agarose gel electrophoresis were standardized. The screening of mtDNA patterns in specimens revealed presence of polymorphic haplotypes within the species.

Body dimensions in sample populations were also recorded for truss network analysis of morphometric variability.

The study of intraspecies genetic polymorphism in *Penaeus indicus* and *P. monodon* was continued.

The polymorphic electrophoretic patterns of the enzymes (AO, ALD, ODH, HK, GPDH and SDH) were screened in sample populations of *Penaeus indicus* from Cochin, Chavakkadu, Kaippamangalam and Madras. The estimated allelic frequencies indicated population heterogeneity of Cochin population only at two of the six loci compared. Morphometric data from sample populations from Madras and Cochin were also collected.

Studying Fisheries Economics

Analysis of data on costs and earnings at Mangalore, Malpe and Karwar landing centres revealed that the average initial investment of the trawler ranged from Rs 6.73 lakh at Karwar to Rs 9.16 lakh at Malpe. The average annual revenue worked out to Rs 7.77 lakh at Mangalore, Rs 8.13 lakh at Malpe and Rs 4.90 lakh at Karwar. Prawns accounted for about 35 per cent of the gross revenue. The average annual operating cost worked out to Rs 3.96 lakh at Mangalore, Rs 4.09 lakh at Malpe and Rs 2.25 lakh at Karwar. The average annual net profit worked out to Rs 95,205 at Mangalore, Rs 1.01 lakh at Malpe and Rs 43,327 at Karwar. The rate of return for trawlers was estimated at 23 to 29 per cent and the pay back period ranged from 4 to 5 years. The average cost of production per kg of fish was Rs 13 and the value realised per kg of fish was Rs 15. The analysis of the utilisation pattern revealed that about 30-35% of the catch goes for export and the remaining for domestic consumption and drying.

Transferring Technologies

The *mahima* feed production technology was transferred to four more groups sponsored by Auxilium Centre, Palluruthy, KSWDC, Karunagapally, DW CRA, Nayarambalam and PMRY, Kumbalangi. The Palluruthy unit commenced production in June and the Nayarambalam unit has become operational. The feed was marketed in Ernakulam, Thrissur and Alapuzha districts in Kerala and was sold to farmers in Karnataka and Andhra Pradesh.

In the programme on integration of small scale mariculture with small scale fisheries along the Peninsular India, Fishermen-Farmers-Industry-Institution Meets were organised every month and the state of affairs on Management for sustainable fisheries development, mussel farming, crab farming, fish diseases, oyster culture, *mahima* shrimp feed, pearl culture, artificial fish habitats, small scale shrimp farming, sustainable prawn farming, clam farming and composite fish culture were discussed. Literature pertaining to the above subjects was published in local languages (Kannada, Malayalam, Tamil, Telugu) besides Hindi and English and were distributed to the participants.

Training and Education Activities

As in the past, the CMFRI has taken active role in training and education programmes through its Krishi Vigyan Kendra (KVK), Trainers' Training Centre (TTC) and Post-Graduate Programme in Mariculture (PGPM). Under the PGPM, a total of about 2200 man-hours was devoted by the scientists of the Institute in teaching the M.Sc./M.F.Sc. students and Ph.D. scholars. Under the Master's programme, the second and

third semesters of the 13th batch, comprising of 9 students, were completed and the students were admitted to the final semester for dissertation work in the subjects of their specialisation. The 14th batch comprising of 10 students completed the Deficiency course and the first semester of the Regular course. One B.F.Sc. candidate selected during 1995 was admitted to the regular course of 14th batch. Four students were admitted to the M.F.Sc. programme in September 1995 (15th batch) and their first semester of the Deficiency course was completed during the period under report. Under Ph.D. programme, 5 candidates were awarded Doctoral degrees by Cochin University for their theses. Another 6 candidates completed their research work and submitted Ph.D. theses to Cochin University. Four Senior Research Fellows working under Cochin University registration have progressed well in their work. The four Ph.D. students (12th Ph.D. batch) who joined last year under the Deemed University regulation have completed their course work and started their research work. The 13th Ph.D. batch comprising of 5 students was admitted and the course work is being completed.

During the year under report, the Trainers' Training Centre of the Institute conducted 9 training programmes and one workshop dealing with mariculture and post harvest technologies developed by the Institute. 121 participants representing the State Fisheries Departments, NGO's and industry were benefitted from these programmes.

The KVK of the Institute conducted 35 courses in various disciplines and 737 persons were trained.

PROVIDING CONSULTANCIES AND R&D SUPPORT

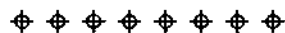
CONSULTANCY SERVICES OFFERED / TO BE SIGNED DURING 1996

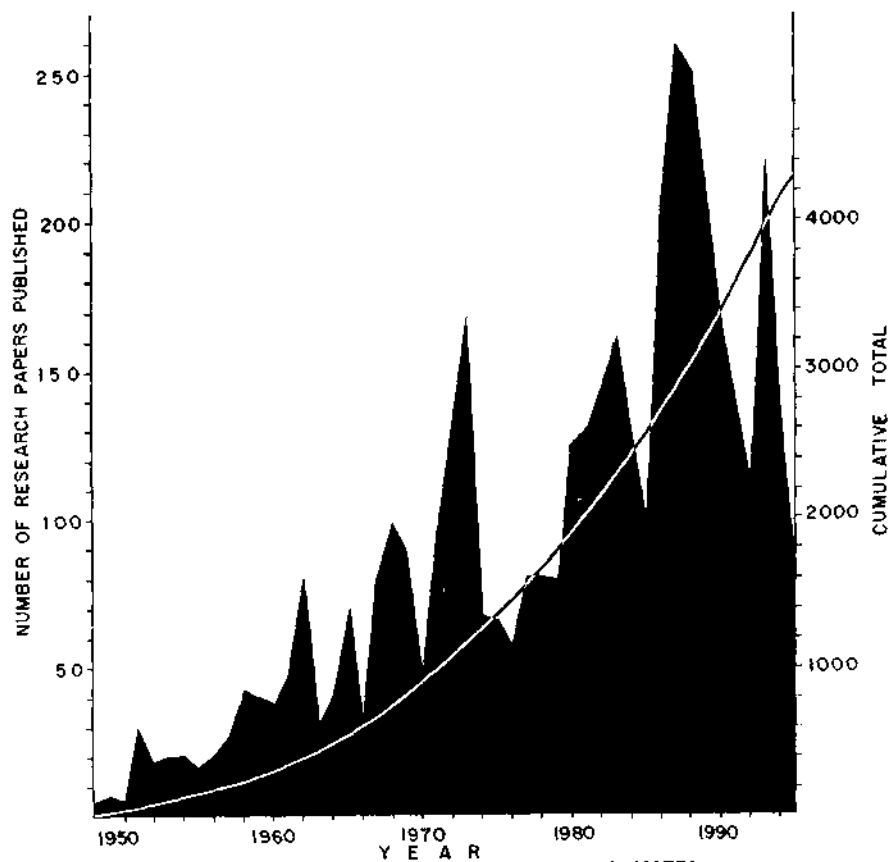
<u>Sl.No.</u>	<u>Name of the Entrepreneur</u>	<u>Location & activity</u>	<u>Amount(Rs)</u>
1.	Shri K. Jagadeswara Rao	Visakhapatnam Pearl Culture	45,000
2.	Shri V. Sarala	Visakhapatnam Pearl Culture	45,000
3.	M/s N.C.C. Bluewater Products Ltd.	Chandanada (A.P) Pearl Culture	84,000
4.	M/s Balaji Bio-Tech Ltd., Nellore	Thupilipalem Pearl Culture	1,66,250
5.	M/s Aqua Prime Inter- national (India) Ltd.	Nellore Pearl Culture	2,01,350
6.	M/s Gem Holiday Resorts Ltd.	Madras Pearl Culture	4,30,750
7.	M/s Sterling Shrimpex (P) Ltd.	Chirala (A.P.) Pearl Culture	
8.	M/s Kalinga Aquatics Ltd.	Bhuvanesar(Orissa) - Crab Farming	
9.	M/s Pink Gold British Exports Ltd.	Raigarh (Maharashtra) Crab Farming	1,94,000

Publishing the Research Results

As during the previous years, the results of research work carried out at the Institute were published in National and International scientific journals and in the proceedings of the Symposia/Workshops/Seminars. Besides, the Institute has brought out the following publications during 1995-96.

1. Marine Fisheries Information Service, T&E Series, Nos. 136—139
2. CMFRI Newsletter Nos. 65-67
3. CMFRI Special Publication Nos. 61-64
4. CMFRI Bulletin No. 48
5. CMFRI Annual Report 1994-95
6. CMFRI Research Highlights 1994-95
7. Brochure on CMFRI (English & Hindi)
8. Marine Biodiversity Conservation and Management (Book)
9. Contribution of CMFRI to R&D in Marine Fisheries of Andhra Pradesh
10. Mussel culture leaflet (Hindi)





Number of research papers published by the staff of CMFRI every year from 1948 to 1995 and the cumulative total

