

RESEARCH HIGHLIGHTS

1988



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

P. B. No. 2704, COCHIN-682 031

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Compiled and edited by Dr. N. Gopalakrishna Pillai, Scientist (S.G.) and
published by Dr. P.S.B.R. James, Director, C.M.F.R.I., Cochin - 682 031

PREFACE

The major achievements of the Institute during 1988 are included in the present issue of RESEARCH HIGHLIGHTS.

The CMFRI has been conducting multidisciplinary research in marine capture and culture fisheries with a view to increasing marine fish production through rational exploitation, conservation and management of the resources. During the year the Institute undertook 107 research projects besides Post-Graduate Education and Research Programmes in Mariculture. Training of the fish farmers, officials from State Fisheries Departments and prospective entrepreneurs under Krishi Vigyan Kendra and Trainers' Training Centre was continued.

The Institute recorded all-round progress during 1988 and one of the significant events during the year has been the exploratory tuna live-bait survey in the Lakshadweep group of Islands. The survey revealed the presence of several species of live-bait fishes in the vicinity of the northern islands which could be gainfully exploited for expanding the tuna pole and line fishery in these non-traditional fishing grounds. Success was achieved in breeding and rearing of five species of penaeid prawns namely, *Metapenaeopsis stridulans*, *M. hilarula*, *Parapenaeopsis maxillipedo*, *P. uncta* and *Trachypenaeus pescadorensis* for the first time. The larval stages of *Meretrix meretrix*, *Anadara granosa* and *Paphia malabarica* were also successfully reared in the laboratory.

The scientific programmes of the FORV *Sagar Sampada* were managed by the Institute and the vessel collected valuable data on oceanographic features in relation to the fishery resources of the Exclusive Economic Zone.

Cochin - 682 031,
July 1989.

P. S. B. R. JAMES
Director

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

RESEARCH HIGHLIGHTS 1988

The Institute recorded all-round progress during the year 1988. Some major achievements and results are reported here.

RESOURCES

Trends in Marine Fish Production

Annual marine fish production in India during 1988 has been estimated at 1.80 million t, showing an increase of 140,000 t (8%) over the estimate of 1.66 million t of 1987. Major groups that contributed to this increase are *Stolephorus* spp. carangids and oil sardine. The southwest region comprising Kerala, Karnataka and Goa recorded a steep increase in the landings by 183,000 t.

The pelagic resources formed 51% of the landings and demersal varieties 49%. Among the major pelagic resources *Stolephorus* spp. registered a steep increase from 51,000 t of 1987 to 100,000 t. A similar increase was observed in the production of carangids, from 80,000 t of 1987 to 127,000 t during the current year. Mackerel also showed substantial increase in catch from 79,000 t in 1987 to 104,000 t in 1988.

Of the demersal varieties, catfishes registered an increase of about 20,000 t raising the landings to 64,000 t in 1988. Similarly, catches of non-penaeid prawns increased from 36,000 t of 1987 to 49,000 t in 1988. Catches of croakers and silverbellies declined by 10,000 t and 6,000 t respectively, the respective landings in 1988 being 100,000 t and 61,000 t. Elasmobranchs did not show any conspicuous change with the landings at 57,000 t in 1988.

Landings in north east region showed a reduction of about 20,000 t from the figure of 79,000 t in 1987. Landings of croakers declined by 4,000 t in 1988 with a catch of 19,000 t. Pomfrets declined to 2,700 t from 5,300 t of 1987, while the *Hilsa* catches were reduced from 2,300 t of 1987 to 900 t in 1988.

In the southeast region the catches declined from 456,000 t of 1987 to 430,000 t in 1988. This was caused by the reduced catches of ribbon fishes from 17,400 t in 1987 to 8,500 t; other sardines from 61,000 t to 52,000 t and silverbellies from 56,000 t to 48,500 t. However, *Stolephorus* spp. and goat fishes registered increase in the landings by 9,000 t and 6,000 t respectively.

Southwest region witnessed a substantial increase in landings in 1988. The landings of this region estimated at 772,000 t in 1988 registered an increase of 183,000 t over the previous year mainly contributed by Kerala and Goa. Among the major resources contributing to this increase, *Stolephorus* spp. registered a phenomenal increase of 40,000 t over the estimated landings of 25,000 t of 1987 for this region. An increase of 37,000 t was observed in respect of mackerel, landings being 42,000 t and 79,000 t in 1987 and 1988 respectively. Similarly, carangids also witnessed an increase of 36,000 t from 48,000 t of previous year's landings. Other resources which showed increase are oil sardine by 26,000 t, catfishes 14,000 t penaeid prawns 12,000 t and cephalopods 7,000 t, the respective landings in 1988 being 123,000 t, 23,000 t 80,000 t and 17,000 t.

There has not been any significant change in the landings of northwest region which stood at 523,000 t. The landings of penaeid prawns in this region however suffered a set back; with 46,000 t in 1988, a fall of about 13,000 t from that of 1987. An increase of 12,000 t could however be observed in respect of non-penaeid prawns with the landings at 45,000 t in 1988. Bombay duck (66,000 t) showed decline by 6,000 t and croakers by 3,000 t over the 1987 figures. The landings of pomfrets, catfishes and carangids recorded improvement; pomfrets by

9,000 t, catfishes by 8,000 t and carangids by 7,000 t, the respective landings in 1988 being 31,000 t, 31,000 t and 17,000 t.

Pelagic Fisheries Resources

Tuna catches at the different centres on the mainland and in Minicoy showed an upward trend during the year, the total catch for all the centres of observation on the mainland was 7,827 t showing an increase of 3,165 t over the previous year. The tuna catch at Minicoy during the year was 1,007.4 t, as against 964.9 t in the previous year with skipjack forming 83% and yellowfin 16.2%. In the mainland, little tunny formed the dominant species (54.4%) followed by bullet tuna (23.3%) and frigate tuna (16.4%).

The exploratory tuna live-bait survey in the Lakshadweep conducted with the support of FORV *Sagar Sampada* in Jan.-Feb. 1988, caught 56 kg of bait fishes from 81 hauls. Catch per haul was maximum at Kavaratti and minimum at Kiltan. Caesionids constituted the dominant group (40.1%) followed by apogonids (17.5%), pomacentrids (17.3%), sprats (16.6%), emmelichthyids (1.1%) and atherinids (1.5%). Species diversity was high at Minicoy, Agatti Suheli, Kavaratti, Cheriyanianam and Kadamat lagoons.

The juveniles of *Crenimugil crenilabis* collected from the tidal creeks exhibited positive chumming qualities and can be used as alternate live-bait in tuna fishery.

An artificial reef structure was fabricated and installed in the southern end of Minicoy lagoon and the fish aggregation in relation to reef age was monitored.

The oil sardine fishery was mainly sustained by the 0-year and 1-year classes to the extent of 90.2% and 8.6% respectively on the west coast and by the 0-year, 1-year and 2-year classes in the order of 51.5%, 34.4% and 14.1% on the east coast.

The whitebait landings at Mangalore showed a four-fold increase over the previous year, with purse seines accounting for 93% of the catch. *Stolephorus bataviensis* constituted the bulk of the catch. The fishery was poor at Cochin and Vizhinjam, compared to the last year.

There was improvement in the mackerel catch at all observation centres except at Cochin and Visakhapatnam where marginal decrease was noticed. The catch was dominated by 0-year and 1-year old fishes at all centres.

Bombay duck fishing indicated a sharp decline at Bombay centre. However, it was better at the northern centres. At Rajpara 12,587 t were landed as against 2,329 t at Bombay.

Bombay centre registered the best catch of ribbon fishes during the year.

Demersal Fisheries Resources

During 1988 the total demersal fish production showed a marginal increase mainly contributed by threadfin breams and catfishes.

Catfish production all along the west coast showed significant increase over the last year, the peak landing at Bombay was during pre-monsoon season, whereas post-monsoon contributed the bulk of the landing at Mangalore. At Cochin and Calicut the monsoon and post-monsoon periods contributed to the bulk of the landings. Quite interestingly, *Tachysurus thalassinus* was the major component at Cochin and *T. tenuispinis* at Mangalore and Calicut. There were no instances of brooder destructions along Mangalore-Malpe region unlike in the previous years. However, juveniles of *T. dussumieri* were caught in large quantities in trawlers and dol net from the coastal waters of Bombay during May and June.

The landings of threadfin breams showed substantial increase at most of the fishing centres, the dominant species

caught were, *Nemipterus japonicus*, *N. mesoprion* and *N. delagoae*. The monsoon and post-monsoon seasons yielded the bulk of the catches. The yield per recruit analysis of *N. japonicus* at Kakinada showed that with the current length at first capture at 120 mm, the Y/R increases with increased fishing mortality and attain maximum at an F of 1.6 and declines thereafter. The present F of 1.3 is close to one that gives MSY of this species. The Y/R of *N. mesoprion* showed F_{MSY} is at 4.6 with the current age at first capture unchanged.

The silverbelly catches of Visakhapatnam and Kakinada showed a decreasing trend. The peak catches were during June, September and December along Visakhapatnam and January to April along Kakinada. The important species were *Leiognathus bindus* and *Secutor insidiator* in both the centres. The yield of this resource at Madras showed an increasing trend in the landings and the dominant species was again *L. bindus*, with peak occurrence in July and October. At Mandapam, the peak landings were during June and October with *L. jonesi* dominating the catches. The population dynamics of *L. bindus* based on data from Kakinada showed that Y/R under the current age at first capture shows that F_{MSY} in the present fishing grounds is 2.8 when the present F is already 3.1, therefore, there is no scope of increasing effort on the presently fished trawl grounds.

Crustacean Fisheries Resources

Cochin witnessed an unprecedented heavy landing of 'Karikkadi' (*Parapenaeopsis stylifera*) in September 1988 following the partial ban on shrimp trawling during the southwest monsoon period. In September alone, the landing amounted to about 4,500 t with a CPUE of 432 kg/boat, which is quite unusual for this centre. About 40% of this catch was of juveniles. This calls for proper conservation measures.

A new version of indigenous gear called 'mini trawl' has been introduced into the artisanal fishery of Kerala. Examination of catches landed by these nets revealed large scale destruction of 'Karikkadi' juveniles. It is necessary to impose

restriction on the operation of this gear to protect the prawn juveniles.

Along the northeast coast, analysis of data on prawn catches by large trawlers showed a steady declining trend for the past three years, indicating a state of overfishing in the region. Some of the trawlers therefore migrated to Kerala coast and carried out commercial exploitation of deep-sea lobsters during February-May 1988.

Molluscan Fisheries Resources

During the year an estimated landing of 17,391 t of cephalopods, dominated by squids were landed, of which 16,283 t (93.63%) was from west coast and the rest, 1,107 t (6.37%) from east coast. Unusual occurrence of the non-conventional species of squid, *Doryteuthis singhalensis* in huge quantities during August-September was a notable feature in the cephalopod landings of Cochin. Participation in the squid jigging programme organised by CIFNET and FSI under the supervision of Japanese expert showed good congregation of *Loligo duvaucelii*, *Doryteuthis sibogae* and *D. singhalensis* off the coast between Vizhinjam-Cochin.

MARICULTURE

Prawn Culture

Five species of penaeid prawns namely, *Metapenaeopsis stridulans*, *M. hilarula*, *Parapenaeopsis maxillipedo*, *P. uncta* and *Trachypenaeus pescadorensis* were bred in captivity and their eggs reared successfully through all the larval and post-larval stages for the first time.

At Mandapam, *Penaeus semisulcatus* post-larvae released in Pillaimadam lagoon recorded an average growth of 75 mm in two months.

Culture of Molluscs

Lagoon systems have been proved to be suitable for culture of *Perna viridis*. Bag and pole methods were tried, wherein good yield could be obtained by the former method and good growth by the latter.

In the experiments on pearl culture, the percentage of 'A' grade pearls were more, when the graft tissue treated with eosin was used. The size group 40-50 mm showed higher pearl production (56.7%) than other groups. At a depth of 3 m, 'A' grade pearls were more (52.2%). The oysters implanted at spent stage produced 72.4% of pearls when compared with other oysters in different maturity stages.

Hatchery Technology for Molluscan Seed Production

Success was achieved in the induced spawning and rearing of three commercially important clams. A total of 33,130 seeds of *Meritrix meritrix*, 8,090 seeds of *Anadara granosa* and 76,900 seeds of *Paphia malabarica* was produced. Tolerance studies revealed that the optimum salinity for the young ones of these species were 14-21 ppt, 19-26 ppt and 28-33 ppt respectively. 74,470 seeds of *Perna viridis* was produced in the hatchery by induced spawning. Good growth of the seed was observed when fed with mixed algae, at a density of 8 larvae/ml and salinity 25-40 ppt. It has been proved that the spawners of *Crassostrea madrasensis* can be made available for hatchery work throughout the year by successfully maintaining them in the ripe condition without spawning for 6 months. *C. cristagalli* was bred in the hatchery, producing 5,490 spats. Success was achieved in breeding *Pinctada margaritifera* brought from Andamans. 15,000 hatchery seeds of pearl oyster were sea ranched.

Rearing of the cephalopods, *Septoteuthis lessoniana* and *Sepia pharaonis* and the gastropod *Trochus radiatus* from hatching to adult stage was carried out.

Finfish Culture

The mariculture of finfishes in tanks, cages and pens was continued at Madras, Mandapam and Tuticorin. The culture of milk fish *Chanos chanos* with a stocking density of 5,000/ha in culture ponds at Madras registered an average growth rate of 262 mm/149 g and achieved production of 575 kg/ha. The same experiment conducted at Mandapam with artificial fertilization of ponds yielded 1,000 kg/ha, with a growth rate of 280-377 mm/150-375 g. The survival rate has ranged from 44-80 percent. At Tuticorin, the average growth rate for *Chanos chanos* was 246 mm/105 g after a period of 236 days with a survival rate of 10 percent.

Culture experiments of *Mugil cephalus*, *Liza parsia* and *L. tade* were continued and brood stocks of *M. cephalus* were raised upto 2nd stage of gonadial maturity in the net pens at Muthukadu. The average growth rate recorded at Tuticorin farm for *L. macrolepis* was 17 mm/10.5 g per month.

PHYSIOLOGY, NUTRITION AND PATHOLOGY

Effect of osmotic stress was studied in prawns in salinities of 10‰ and 25‰. Free amino acids and ammonia excretion were higher in the 10‰ saline media. Studies on phenoloxidase in prawns showed no activity in the rostrum and telson of pre-moult stages, while low activity was recorded in the carapace, abdominal segments and haemolymph. Electrophoretic studies on pituitary fractions of *Liza parsia* showed 5 bands in mature ones as against 3 in immature ones. Biochemical components of the gonads and soma in *Metapenaeus dobsoni* were influenced by the maturity stages. Studies on *Penaeus monodon* showed the metabolic rate to be directly proportional to temperature. *M. dobsoni* had a better survival rate than *P. monodon* at low salinities (10-15‰).

Protein requirements of *P. latisulcatus* juveniles was found to be 27.5-50% in the diet, while it was <35% for juveniles

of *P. monodon*. A feed prepared for *Chanos chanos* fry showed no deterioration even after 60 days. The feed was acceptable and no deficiency signs were noticed in the fry. The feed prepared for *P. indicus* also showed good acceptability.

Studies were conducted on the pathobiology of finfishes. *Vibrio fischeri* was isolated from the gill lesions of *Epinephelus diacanthus* and *Trichiurus lepturus* while *Aeromonas hydrophila* and *Flavobacterium* sp. were isolated from skin lesions of *E. diacanthus*. The lesions were characterised by necrosis of the dermis and infiltration by mononuclear cells. Furunculosis was recorded for the first time in laboratory reared *Lates calcarifer*.

Physio-pathological effects of DDT on *Liza parsia* showed changes in swimming behaviour and drop in blood glucose levels accompanied by neutropenia and lymphocytosis. Exposure to mercuric chloride resulted in marked histo-pathological changes in the skin, gills, hepatic cells, brain and kidney.

Diploid chromosomes of two cytogenetic models *Villorita cyprinoides* and *Liza parsia* were found to be 38 and 48 respectively. Differential staining of sister chromatids was demonstrated in *Terapon* sp., *Oreochromis mossambicus* and *L. parsia*. Genotoxicity of malathion was manifested as chromosomal breaks and gaps in *L. parsia*.

The diploid chromosome number in *Crassostrea madrasensis* was found to be 20 and all were metacentrics. PAG electrophoresis for esterases, α GPDH, G6PD and GPI revealed 4, 1, 2 and 2 loci respectively in the specific tissues.

FISHERY ECONOMICS AND EXTENSION

The costs and returns data collected from OBM gillnets operated at selected centres in Maharashtra and Gujarat showed that the operating expenditure per unit was varying from Rs. 0.9 - 1.1 lakh and income of a labourer was about Rs. 13,500 per annum. The returns to labour and management of the boat owner was calculated at about Rs. 15,500 per annum.

For IBM gillnet unit capital investment was about Rs. 2.3 - 2.6 lakhs per unit with an annual fixed cost of Rs. 45,000-54,000 fetching a gross revenue of Rs. 2.3 - 2.7 lakhs per year indicating a pay back period of 4-5 years. Since the investment is less and operation is economical, OBM unit however gained popularity over the IBM units.

Studies on the economic efficiency of different sizes of trawlers (30', 32' and 34-36') at Tuticorin Fisheries Harbour indicated an average annual net profit of Rs. 60,000 for a 30 footer, Rs. 66,000 for a 32 footer and Rs. 76,000 for 34 - 36 footers. The study further showed that 56% of the annual gross revenue of 30 footer, 67% of 32 footer and 66% of 32-34 footers were realised from finfishes only, indicating the diminishing trend of over dependence of trawlers on prawn catches. However, of the 3 types, 34-36 footers were found to be comparatively more efficient.

The fish marketing study conducted in Kerala indicated that the present marketing system and price structure do not provide any inducement to fishermen to increase the fish production. In consumer's one rupee, fishermen's share was observed to be about paise 50 for low priced fishes. Another study in the Madras region revealed that the percentage of marketing margin in consumer's price for 20 major varieties of fish was more than 40% indicating the inefficiency of the marketing system.

EDUCATION AND RESEARCH PROGRAMME IN MARICULTURE

The Post-Graduate Education and Research Programme in Mariculture of the Institute continued to impart courses in mariculture leading to M.Sc. and Ph.D. degrees. The 7th batch (1986-88) of M.Sc. completed the course. The syllabus for the M.Sc. course has been revised.

Under the Ph.D. programme 3 candidates were awarded doctorate by the Cochin University of Science and Technology for their theses respectively on (i) 'Larval biology of the spiny

lobsters of the genus *Panulirus*', (ii) 'Biochemical genetics of selected commercially important penaeid prawns' and (iii) 'Studies on certain nitrogen cycle bacteria in the prawn culture fields of Kerala'.

In the study on spiny lobsters the controversial naupliosoma was observed and found to transform into first phyllosoma without moulting. Occurrence of more than one moult between two stages was confirmed. The major cause for the larval mortality was lack of proper feed.

In the thesis on nitrogen cycle bacteria in perennial and seasonal culture ponds nitrogen fixation was more in the latter than in the former and bacterial nitrogen fixation was significantly influenced by environmental parameters. Thirteen strains of *Azotobacter chroococcum*, 9 of *A. vinelandii* and 8 of *A. bijerinckii* were identified. Heterotrophic, proteolytic and amonifiers were more abundant than nitrifiers, denitrifiers and nitrogen fixers.

As regard the study on biochemical genetics of prawns 7 polymorphic loci in *Penaeus indicus* and 6 in *Parapenaeopsis stylifera* were detected. *P. indicus* at Cochin, Tuticorin, Madras and Waltair and *P. stylifera* from Cochin and Bombay appeared to belong to a single unit. However, a polymorphism in the enzyme octanol dehydrogenase noticed in *P. indicus* from Waltair suggests probable existence of an isolated population there.

VESSEL-BASED RESEARCH PROGRAMMES

FORV *Sagar Sampada*

During the year 1988, FORV *Sagar Sampada* made 16 research cruises spending 261 days at sea. The work programmes included surveys for pelagic, demersal, mesopelagic as well as physical, chemical and biological oceanographic observations. During January-February 1988, *Sagar Sampada* functioned as a supporting vessel for undertaking tuna live-bait resources survey

around Lakshadweep islands. The survey revealed the presence of several species of live-bait fishes in the vicinity of the northern islands which could be gainfully exploited for expanding tuna pole and line fishery in these non-traditional grounds. Survey of demersal fishery resources of the Quilon Bank indicated the presence of large quantities of deep sea fishes, prawns and lobsters. Pelagic trawling during early morning and night yielded oceanic squid *Symplectoteuthis oualaniensis* between latitudes 15° and 20°N in the Northern Bay of Bengal, mainly between 40 m and 100 m depth during March. Rich fishing ground for black pomfrets and large perches were located at 19°53'N latitude 86°36'E longitude in the Bay, where a CPUE of 650 kg/hr for black pomfrets and 520 kg/hr for large perches were obtained.

Scientists, technical assistants and research scholars of this Institute, Central Institute of Fisheries Technology, Central Agricultural Research Institute, Fishery Survey of India, Zoological Survey of India, Indian Institute of Technology, Vikram University, Berhampur University, Andhra University, Annamalai University, Madras University, Kerala University and College of Fisheries of the Kerala Agricultural University participated in the cruises.

R.V. Cadalmín

The vessels of this category stationed at six research centres monitored the environmental parameters in the inshore waters. Studies on young fishes and benthos were also carried out with these vessels.

PUBLICATIONS

The following publications were issued during the year.

1. *Indian Journal of Fisheries*
Vol. 34, Nos. 3 and 4
2. *Bulletin of Central Marine Fisheries Research Institute*
Nos. 41 and 42

3. *CMFRI Special Publications*
Nos. 41, 42, 43 and 44
4. *Marine Fisheries Information Service, T & E Series*
Nos. 76 to 90
5. *R & D Series for Marine Fishery Resources
Management.*
Nos. 17 and 18
6. *CMFRI Newsletters*
Nos. 36, 37, 38 and 39
7. Research Highlights 1987-88
8. CMFRI Annual Reports 1986-87 and 1987-88