



**C I B A**  
**HIGHLIGHTS**

**RESEARCH & DEVELOPMENT**  
**IN**  
**BRACKISHWATER AQUACULTURE**  
**1987-1991**

**CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE**  
**(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)**  
12, LEITH CASTLE STREET, SANTHOME, MADRAS - 600 028.

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## PREFACE

The Central Institute of Brackishwater Aquaculture (CIBA) is one of the youngest institutes of the Indian Council of Agricultural Research (ICAR) established during the VII Plan. Aquaculture of fish and shellfish in the coastal brackishwater areas has been recognised as one of the high potential areas for increasing production and for deriving economic and social benefits such as better use of unproductive and marginally productive lands, increased production of prawns and fishes, augmentation of exports and foreign exchange earnings, support to food security system, establishment of ancillary industries, generation of employment potential, uplift of the socio-economic conditions of the coastal poor and increase in GNP of the country. All these activities would need science and technology support. The ICAR decided to create CIBA to carry out research to develop economically viable technologies for different production systems of brackishwater aquaculture and established the Institute in 1987.

During the last four years (1987-1991), the Institute's main tasks have been to organize itself with infrastructure facilities, carry out research in identified priority areas and provide R&D support to this nascent sector which makes one of the highest demands on technology ranging from site selection to intensive production system. Creation of permanent infrastructure facilities and building up modern laboratories have just been started. The Government of Tamil Nadu have kindly given to the Institute lands in Madras and its neighbourhood for the permanent establishment of its Headquarters which have been gratefully accepted by the ICAR. Besides using our own facilities, to some extent we availed ourselves of facilities from sister institutes in ICAR and also from other Government organisations so that time is not lost.

Projectisation of research programmes has been under constant improvement to meet the immediate, medium-term and

long-term requirements of the industry. Our concern has ranged from technology support required for the production programmes for the poorest of the poor as in the Economic Rehabilitation of the Rural Poor (ERRP) programmes in the Chilka area to the intensive industrial culture system. We have given equal importance to fish production systems as to prawn production, including hatchery technology for both the groups. Fish/shellfish nutrition and feed technology, fish diseases and health management, and pond ecology have received priority attention in research. Basic research on physiology and aquaculture engineering has been taken up. Other areas, particularly aquaculture economics, genetic improvement of stocks and biotechnology applications are under initiation.

Transfer of technology has been accomplished through training programmes, technical assistance for project implementation for States, special investigations on request, institutional consultancy and information transfer.

For the first time, this publication entitled **CIBA Highlights** is brought out for the period 1987-1991. It will be an annual issue in future. It is hoped that the publication will be found useful by the brackishwater aquaculture farmers and industry, besides other research organizations, and will help establish greater interactions between them and this Institute.

Shri A.V.P.Rao and Dr.K.V.Ramakrishna, Principal Scientists assisted in the compilation and Shri N.Kalaimani, Scientist (SG) in the printing of this publication and I wish to record my deep appreciation to them.

K. ALAGARSWAMI  
DIRECTOR

Madras-600 028,

3rd October, 1991.

# CIBA ESTABLISHMENT AND MANDATE

## Establishment

The Central Institute of Brackishwater Aquaculture (CIBA) has its headquarters at Madras and Research Centres at Kakdwip (West Bengal), Puri (Orissa) and Narakkal (Kerala). It has a sanctioned staff strength of 209 (as on 1.4.1990) including the Director and the cadres of scientific (62 posts), technical (31 posts), ministerial (20 posts), auxiliary (7 posts) and supporting staff (88 posts).

For the establishment of the headquarters of the Institute, the Government of Tamil Nadu have transferred 10.00 acres of land in Madras, 29.50 acres in Muttukadu, 133.00 acres in Mamallapuram and further lands are in various stages of transfer. In addition 92.00 acres of land and water area at Muttukadu has been transferred from the Central Marine Fisheries Research Institute to CIBA. The infrastructure facilities such as laboratory-cum-administrative building, hatchery, farm, staff quarters etc. are under different stages of planning, development or construction. Presently all facilities are housed on a temporary basis.

The Kakdwip Research Centre has permanent facilities of laboratories, tide-fed farm and staff quarters in a 35.29 acres campus. The Narakkal Research Centre has a semi-permanent hatchery and nursery facility in a 4.60 acre farm area leased by Government of Kerala. The Puri Research Centre is housed temporarily and the Government of Orissa has been requested for allotment of land to develop facilities.

## **Mandate**

- To conduct research leading to development of economically viable system of technology for aquaculture of fish and shellfish in brackishwater areas to increase production and productivity;
- to assess brackishwater aquaculture potential taking into account the requirement of maintaining ecological balance and environmental health; and
- to act as a nodal agency for providing scientific information and transfer of technology for the development of brackishwater aquaculture in the country.

## **RESEARCH HIGHLIGHTS**

### **Prawn hatchery technology**

Techniques for breeding and seed production of *Penaeus monodon*, *P. indicus*, *P. japonicus* and *P. semisulcatus* have been developed through experiments in broodstock management, induced maturation, larval rearing, larval and post-larval diets and water quality management.

**Induced maturation:** *Penaeus monodon* was successfully induced to mature through unilateral eye-stalk ablation, employing flow through system with 200% exchange of sea water per day, and using a maturation diet consisting of fresh flesh of squid, mussel and crab given @ 15% of the total biomass, supplemented with goat liver, polychaete worms/

*Artemia* biomass/earthworms. Successful and repeated spawnings were observed at a salinity of 31-36 ppt. Egg and nauplii production was the highest with polychaete worms as supplement followed by *Artemia* biomass and earthworms.

The technique of induced maturation of *P. indicus* through unilateral eye-stalk ablation was perfected and standardised.

Induced maturation was successfully achieved in *P. japonicus* also following the procedures adopted for *P. monodon*.

**In vitro fertilisation:** A break-through was achieved in developing a technique for production of larvae of *Penaeus indicus* by *in vitro* fertilization of eggs. In this technique, fully mature females which were not impregnated were selected, their ovaries removed and the eggs were mixed with a thick suspension of sperms collected from the thelycum of an impregnated female and terminal ampoule of vas deferens of a male. The rate of fertilization of eggs mixed with sperms from the thelycum was 88% while that of eggs with sperms from terminal ampoule was 40.4%. The technique of *in vitro* fertilization developed at the Institute will find application in production of hybrids of penaeid prawns and solving the problem of mating failure.

**Larval rearing:** Larval rearing of *P. monodon* was done @ 100 nauplii/litre using different larval feeds such as *Chaetoceros affinis*, *Tetraselmis* sp., green mussel suspension, egg yolk suspension, *Artemia* biomass in suspension form, *Brachionus plicatilis*, egg custard and *Artemia* nauplii. Of these, use of *Chaetoceros affinis*, egg yolk suspension and San Francisco strain of *Artemia* nauplii as larval feeds resulted in extremely robust and healthy post-larvae. A maximum survival of 42.9% between N6 and PL2 was obtained.



Using the same feeds, in the case of *P. semisulcatus*, a survival of 80.6% was obtained in larval rearing. Larval rearing of *P. indicus* was done using mixed culture of diatoms dominated by *Chaetoceros* sp. as larval feed. A maximum survival of 61.0% from nauplii to PL5 was obtained. With squilla powder and clam meat suspension a survival of 53.8% and 52.3% respectively was obtained.

**Post-larval rearing:** *P. monodon* postlarvae were reared upto PL20 at densities 20-25/litre, with egg custard and *Artemia* nauplii as feeds. An average survival of 67.3% from PL3 to PL20 was obtained.

In case of *P. indicus*, a maximum survival of 80.5% was obtained from PL5 to PL20.

### Backyard hatchery technology

Nauplii of *P. indicus* stocked @ 100 nauplii/litre were reared in 2-tonne FRP tanks upto PL-20 in the same tank. Upto PL3 stage no water exchange was done but subsequently 33% of water was exchanged on alternate days, which was increased to 50% at later stages. Mixed phytoplankton upto PL1 and squilla powder thereafter were the feeds used. The survival rate between nauplii and PL-1 was 60.3% and that between nauplii and PL20 was 37.6%. The average production of PL20 per tonne of water was 35,494. The production trials were carried out in the open space under polythene sheet roof cover at Narakkal Research Centre.

### Fish breeding

*Liza macrolepis*, a commercially important mullet was successfully bred at Ennore and 50,000 hatchlings were produced. The larvae were fed *Chlorella* the first two days, *Chaetoceros* and

*Brachionus* from third day, and artificial feed in powder form from day 15. A total of 11,000 fry were produced and they were raised to juvenile stage in 1.75 t FRP tanks.

*Mugil cephalus* was induced bred at the camp site at Arkhakuda near Chilka mouth by injecting mature fish with mullet pituitary @ 4-72 mg/kg and pimozide @ 8-40 mg/kg. The size of males was 300 to 350 g and females 750 to 1200 g. The one day old larvae were transported to Puri Research Centre and reared for 10 days in 2 t FRP tanks feeding them with rotifers and copepods.

Breeding of pearlspot *Etroplus suratensis* in ponds has made good progress at Narakkal and Ennore.

#### Live feed culture

*Chaetoceros affinis* and *C. calcitrans* were mass cultured in filtered sea water, enriched with modified 'F' medium in tanks which are exposed to sunshine and cell densities ranging from 1.0 - 3.6 lakh/ml were achieved. In axenic cultures under controlled temperature the cell density attained was 2.8 million per ml in Walne's medium.

*Brachionus plicatilis* was raised in the salinity range of 11.5-28.0 ppt with cultured *Chlorella* and baker's yeast and achieved a maximum production of 75-140 individuals per ml of the medium from an initial level of 20/ml. When cultured in the medium enriched with groundnut oil cake, urea and superphosphate at the rate of 200 g, 2 g and 2 g respectively, the rotifer population reached 200-250 individuals per ml in 6 days.

In the laboratory experiment, 140 g *Artemia* biomass per tonne of water was obtained in 20 days when 160 *Artemia* nauplii

per litre was stocked and aged clear solution of pig manure was used to fertilize the medium, while 50 g biomass per tonne was realised with cattle dung.

*Artemia* cyst production experiment was carried out in one 0.4 ha pond of a private salt-pan at Kelambakkam in which urea, superphosphate and diammonium phosphate were used as fertilizers at the rate of each 25 kg/ha/application and 21.34 kg/ha cyst production was achieved.

### Prawn culture

The Institute participated in the semi-intensive prawn culture project of Marine Products Export Development Authority, implemented by TASPARG at Nellore during the second crop (April-July 1991) for environmental and biological monitoring of the production system. Disease investigations were also carried out and control measures suggested. The project achieved an average production of 4.56 tonnes of *P. monodon* per ha per crop.

In tide-fed ponds at Kakdwip stocked with *P. monodon* @ 2 lakhs/ha production rate of 1194.1 kg/ha/crop (average size 18.3 g) was obtained in 90 days using a pelletized feed with 45.93% crude protein and 7.1% lipid. The feed consisted of prawn head powder, duckweed, wheat flour, rice bran, fish meal, vitamins and mineral mix. Aeration was improvised by lifting pond water by diesel pump and splashing it on a platform made of split bamboo mats and it was found to be effective.

With pelleted feed of a different formulation and stocking @ 1 lakh seed/ha a production rate of 718.3 kg/ha was obtained in 123 days without aeration. These experiments proved the limitations of a tide-fed system in achieving high feed conversion efficiency.

In the confined ponds constructed by BFDA, Puri district, Orissa under antipoverty schemes, this Institute undertook detailed studies on the ecology of ponds with reference to shrimp culture and suggested improvements for soil amelioration which will enhance the shrimp production.

### **Fish culture**

The Institute conducted experiments on pen/cage culture of milkfish and mullets at Pulicat which has now been shifted to Muttukadu. Mono and polyculture of *Liza tade* and *L. parsia* has been carried out at Kakdwip. Culture of seabass *Lates calcarifer* is in progress at Kakdwip. In finfish culture, based on the experience so far gained, the Institute is striving to develop cost-effective production technology for the priority species.

### **Prawn feed development**

Particle feed, ranging 45-1000 microns in size, for larval and postlarval rearing of *P. indicus* consisting of prawn waste (30%), fish meal (20%), groundnut oil cake (20%) and tapioca (30%) fortified with minerals and vitamins was prepared and tested with a survival of 73% in larval rearing and 86.6% in postlarval rearing.

Incorporating squid waste which has 67.8% protein and 17.5% lipid, a formulated feed containing 38.5% protein for *P. indicus* gave an FCR of 1.1 to 1.3 in a 30 day rearing experiment on juveniles of *P. indicus* (16-40 mm).

Two formulated feeds were tested on *P. monodon* for postlarval rearing with two levels of protein (37.7% and 40%) using fish meal, squid, soya cake, groundnut cake, prawn head waste, rice polish, starch, fish oil, vitamins and minerals.

Using the feed processing equipment at Ennore Field Centre 2.5 tonnes of pelleted feed (35% crude protein) was prepared and used in growout system for *P. monodon* at Kakdwip. The feed consisted of fish meal (32%), prawn head waste (8%), soy cake (25%), rice polish (15%), starch (16%), Vitamin-mineral mix (2%) and shark liver oil (2%).

A water stable shrimp (*P.monodon*) feed developed under a collaborative project with FAO Bay of Bengal Programme was tested at Kakdwip both as pellets and doughball under tide-fed conditions. The feed in pellet and doughball form had identical formulation of locally available ingredients of wheat flour, soyabean meal, soy flakes, broken rice, fish meal, shrimp head meal, squid meal, fish oil, mineral premix, choline chloride, plaster of paris and sodium alginate. The proximate analysis of this feed indicated crude protein 35.7%, total lipid 4.6%, crude fibre 2.7%, ash 10.0%, phosphorous 0.9%, calcium 2.5%, lysine 2.0%, methionine + cystine 1.2% and salt 0.4%. In an experimental culture of 99 days of *P. monodon* in tide-fed ponds the highest production of 999.6 kg per ha was obtained in the treatment natural food + fertilizer + pellets on tray followed by 901.5 kg/ha in the treatment natural food + fertilizer + pellets scattered. The feed in the two treatments had an FCR value of 2.4 to 3.3. The feed was shared by other species which entered the pond.

### Diseases and control

Several bacterial, fungal, protozoan and parasitic diseases affecting production in prawn hatcheries were investigated. In June 1990 the mass mortality of *P. monodon* larvae in a private hatchery near Madras was traced to Vibriosis caused by *Vibrio alginolyticus* and use of oxytetracycline @ 5-10 ppm was recommended for

controlling the disease. Mortality of *P. monodon* larvae in the TNFDC hatchery at Neelankarai in July, 1991 was found to be due to larval mycosis caused by *Sirolopidium* spp and use of treflan was suggested to control the disease. In the TASPARG hatchery near Visakhapatnam the larval mortality was found to be due to a mixed bacterial infection with *V. alginolyticus* and the bioluminescent *V. harveyi*. Anti-bacterial sensitivity tests revealed that polymixin B and methylene blue effectively inhibited the bacterial growth *in vitro*. Methylene blue @ 1-3 ppm was advocated for controlling the disease. The broodstock of *P. japonicus* in July 1990 suffered mortality due to black gill disease caused by *V. alginolyticus*, which is sensitive to chloramphenicol, tetracycline and polymixin B.

In prawn growout system also problems such as stunted growth, bacterial septicemia, soft shell disease and cramped tail disease were investigated. At TASPARG farm at Nellore, from the exoskeleton of the stunted animals and pond water, a bioluminescent bacterium *Vibrio fischeri* was isolated, though causes for the same could not be pinpointed. Mortality of prawns in TASPARG farm at Nellore in June 1991 was found to be due to bacterial septicemia, characterised by extension of branchiostegites, shell blisters, melanization of gill filaments, and heavy infestation by *Zoothamnium* sp. The bacterium was identified as *Vibrio alginolyticus*. Treatment of pond with potassium permanganate/iodine and optimal feeding controlled the disease. From the softshelled prawns from Narakkal and Kakdwip *V. anguillarum* was isolated. The cramped tail disease of prawns (*P. monodon*) at Kakdwip was found to be due to environmental stress.

From brood fish of *Liza macrolepis* at Ennore, *Caligus* sp. a crustacean ectoparasite was identified and potassium dichromate was

found to be effective in eradicating the parasite. Epizootic ulcerative syndrome affected grey mullets in the Institute's ponds at Kakdwip in a mild form and treatment with  $KMnO_4$  was found to be effective. Very recently, during August-September 1991, the Institute investigated the EUS disease in fishes of Vembanad Lake in Kerala. From the ulcerous lesions of murrel, pearlspot, freshwater shark, cat fish and beloniform fish, a gram negative bacterium, *Aeromonas hydrophila* has been isolated. The same bacterium has also been isolated from blood samples obtained from pearlspot, freshwater shark and halfbeak. Another bacterium, a gram positive cocci, *Micrococcus varians* was also isolated from murrel, pearlspot, halfbeak, freshwater shark and beloniform fish. A fungus, *Saprolegnia* sp. was found to be associated with the lesion of *Puntius* sp. *Aeromonas hydrophila* and *Micrococcus varians* were also found to occur in water and soil samples obtained from Kumarakom and Thanneermukkom areas.

### Workshops/Seminars

The Institute organised a National Seminar on "Status and Prospects of Brackishwater Aquaculture in Orissa" at Puri on 14th October, 1988. A Workshop on "Brackishwater Finfish Breeding and Seed Production" was held on 6th and 7th December, 1989 at Madras. The scientists actively participated in several Workshops/Seminars/Symposia organised by other agencies.

## R&D SUPPORT

For the development activities of brackishwater aquaculture in the country, the Institute has been able to make some significant contributions which are briefly listed below.

- Continuation of technical assistance to the prawn hatchery (10 million capacity) under construction at Kumta by Brackishwater Fish Farmer Development Agency, Department of Fisheries, Government of Karnataka.
- Design and technical assistance to a small-scale prawn hatchery (2 million capacity) under construction at Chinnaveeranpattinam by the Department Fisheries, Government of Pondicherry.
- Training of Officers of Department of Fisheries, Government of Andhra Pradesh in prawn farming protocol and use of analytical equipments under the CIBA/BOBP project on prawn feed development for artisanal sector.
- Collaboration with The Andhra Pradesh Shrimp Seed Production and Research Centre (TASPARC) in semi-intensive prawn farming at Nellore.
- Investigations and advice to TASPARC on diseases in their prawn hatchery at Visakhapatnam.
- Investigation and advice to Tamil Nadu Fisheries Development Corporation on diseases in their prawn hatchery at Neelankarai.
- Collaboration with Central Institute of Coastal Engineering for Fishery in microlevel survey of brackishwater lands in Andhra Pradesh and macrolevel survey in Nayachar Island in West Bengal.
- Technical examination of Departmental fish farm of Department of Fisheries, Government of Gujarat in Valsad District and suggestions for improvement.



- Investigations on the problems of prawn farm of Government of Kerala in Poyya and suggestions for improvement.
- Survey on the feasibility of taking up brackishwater aquaculture in four districts of Rajasthan using the groundwater potential at the request of Government of Rajasthan.
- Institutional consultancy on the feasibility of brackishwater aquaculture in Bhal area, Gujarat State for St. Xavier's Non-formal Education Society, Ahmedabad.
- Technical assistance to Punjab Agro Industries Corporation in introduction of freshwater prawn farming through seed transportation from West Bengal and acclimatization and stocking in ponds in Punjab.
- Training courses in prawn culture for the fisheryouth sponsored by the Department of Fisheries, Government of Gujarat at the Institute's Research Centre at Kakdwip since 1987.
- Training courses in Prawn Hatchery Technology for State Government fisheries Officers at the Institute's experimental hatcheries at Narakkal and Ennore.
- Field visits, lectures and practicals to several farmers and in-service officers at the Institute's facilities as required by the State Fisheries Departments and Marine Products Export Development Authority.

The Institute also conducted three training courses in shrimp hatchery technology and shrimp culture technology during 1988 for the fisheries officers from Vietnam, sponsored by the Food and Agriculture Organisation of the U.N.

