Central Inland Capture Fisheries Research Institute

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

1986-87
ANNUAL REPORT

ANNUAL REPORT

1986-87

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE-743 101 WEST BENGAL
INDIA

Credits

Edited and compiled by	:	G. K. Vinci V. K. Unnithan M. J. Bhagat V. V. Sugunan
Assisted by	:	Anjali De H. Chaklader F. Manna Sukla Das
Hindi translation	:	P. R. Rao
Cover design	:	P. Dasgupta
Typing assistance	:	Sefali Biswas Swapna Talapatra S. K. Tikader M. Kachhap B. Balmiki
Published by	:	A. G. Jhingran Director Central Inland Fisheries Research Institute Barrackpore-743 101, West Bengal
Printed at	:	Sree Saraswaty Press Ltd. (A West Bengal Government Undertaking) 32, A. P. C. Road, Calcutta-700 009

CONTENTS

ANNUAL REPORT 1986-87

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

BARRACKPORE

BRIEF HISTORY

The Central Inland Fisheries Research Station was formally established in March, 1947 in Calcutta under the Ministry of Food and Agriculture, Government of India. From the modest beginning as an interim scheme, the organisation has since grown to the status of premier research institution in the field of inland fisheries in the country. By the year 1959, the Station acquired its status as Central Inland Fisheries Research Institute (CIFRI) and moved to its own buildings at Barrackpore, West Bengal. Since 1967, the Institute is under the administrative fold of Indian Council of Agricultural Research (ICAR). At present, CIFRI is one of the biggest research institutes under ICAR with about 250 scientific and technical research personnel working under 36 centres spread across the country. According to the changed mandate, the technical programme for the year 1986-87 has been revised giving emphasis to capture fisheries investigations.

MANDATE

The Institute was set up to conduct research for developing systems for monitoring and improving fish production in natural and man made inland water resources through stocking, optimum exploitation and conservation (Revised mandate).

ORGANISATION

The Institute has 3 Divisions, *viz.* (*i*) Riverine & Lacustrine Division, (*ii*) Estuarine Fisheries and Brackishwater Aquaculture Division, and (*iii*) Freshwater Aquaculture Division. The Riverine and Lacustrine Fisheries Division based at Allahabad works on capture fisheries relating to rivers, lakes, reservoirs, beels, etc. This Division also gives emphasis on ecology of these water bodies and studies relating to water pollution and aquatic productivity. The Estuarine Fisheries and Brackishwater Aquaculture Division with its present headquarters at Barrackpore studies all aspects relating to ecology and management of fisheries of estuaries and lagoons. This Division also works on brackishwater aquaculture for which necessary infrastructure facilities have been developed at Kakdwip. The Freshwater Aquaculture Division located now at Dhauli works on all aspects of pond culture. The Rahara Research Centre concentrates on fish culture in sewage-fed waters and paddy-cum-fish culture and the Kalyani Centre on breeding and culture of frogs. In addition, the Institute has Extension Section at Barrackpore, KVK on brackishwater fish farming at Kakdwip and KVK/TTC on freshwater aquaculture at Dhauli, Kausalyagang and one Operational Research Project at Krishnagar. Library and Documentation Section, Administrative, Accounts, Audit, Stores and other sections also function at the headquarters.

The four All-India Coordinated Projects, *viz.* Composite Fish Culture and Fish Seed Production, Air Breathing Fish Culture in Swamps, Reservoir Fisheries and Brackishwater Fish Farming have been completed during 1985. After the reorganisation consequent to the closure of Coordinated Project Centres, the Institute has 24 research centres and 9 survey centres apart from the KVK at Kakdwip and KVK/TTC at Dhauli.

IMPORTANT ACHIEVEMENTS

BREEDING OF *HILSA ILISHA*

Artificial fecundation and seed raising of Indian shad *Hilsa ilisha* was successfully conducted at Farakka during October 1986. Fully mature males (450-750 g) and females (750-1,300 g) of hilsa were collected from the river and they were subjected to wet-stripping. Out of 5 sets tried, successful fertilization was achieved in 2 cases. The percentage of fertilization was as high as 75-80. Developing eggs were incubated under laboratory as well as natural conditions. About 35,000 hatchlings obtained are being reared in ponds at Barrackpore.

Fishery of anadromous hilsa has been on the decline in riverine stretches above the Farakka Barrage. Successful seed production of hilsa will pave the way for restocking hilsa in the depleted stretches of the River Ganga.

CAGE CULTURE OF TILAPIA

The Bangalore Centre of CIFRI has developed a cage culture technology for tilapia, *Oreochromis mossambica* which is not suitable for direct culture in open waters due to ecological reasons. Preliminary observations were conducted in Sankey Tank, Bangalore, employing circular net cages of varying sizes ranging from 5 to 10 sq.m. The net production of fish was estimated as 8.94, 16.38 and 14.18 t/ha/month in the three experiments.

BHETKI AS A BIOCONTROLLING AGENT FOR TILAPIA

To evolve a suitable biological control of tilapia, laboratory experiments were conducted along with field trials to assess the efficacy of bhetki, *Lates calcarifer* in controlling the recruitment of tilapia (*Oreochromis mossambica*) which has created enormous management problems related to overall fish production from wetlands.

In laboratory trials, it was observed that *Lates* of 45-72 mm size actively predates upon tilapia of 11.0 to 18.5 mm size. *Lates* of smaller sizes, however, didn't predate on tilapia.

In a field trial conducted in sewage-fed pond (0.17 ha) it was observed that *Lates* effectively controlled the recruitment of tilapia.

RECOVERY IN HILSA FISHERIES OF HOOGHLY ESTUARINE SYSTEM

During 1986, the hilsa fisheries of the Hooghly Estuary was the highest recorded after 1981. An estimated total of 2,253 tonnes of hilsa was brought to shores from the estuary during November, 1985 to October, 1986. This accounted for about 25% of total fish landings from the estuary excluding winter bagnet fishery. *Hilsa* catch was 111% more than the estimated catch (1,067 t) recorded during the corresponding period of the last year and

about 56% more than the average catch reported since 1982 to 1985. The monsoon hilsa landings accounted for 71% of the total hilsa landings during 1986.

These observations set at rest the apprehensions expressed by some quarters that hilsa fishery of Hooghly was facing a decline.

NEW LIGHTS ON PREDATORY HABITS OF AQUATIC INSECTS

Studies on the life history and biology of the predatory bug *Diplonychus annulatum* revealed that the early larval stages were more harmful to fish spawn in the rearing ponds. The instar stages I and II of the fly consumed $2\frac{1}{2}$ times more hatchlings compared to the later larval stages and adults. The predatory efficiency was estimated at 9.9 hatchlings per nymph in 24 hrs in case of early larvae but it was only 4 hatchlings for late larvae as well as adults. This significant finding helps in better pest management in rearing ponds.

PHENOMENAL GROWTH OF CATLA IN RESERVOIR

Fingerlings of *Catla catla* stocked in Aliyar Reservoir in 1983 registered a remarkable growth of 5.3 to 11.5 kg within a period of 2 years. Dorsal fins of the carp fingerlings were clipped before stocking in the reservoir and their growth was studied through the recovered specimens from commercial catches.

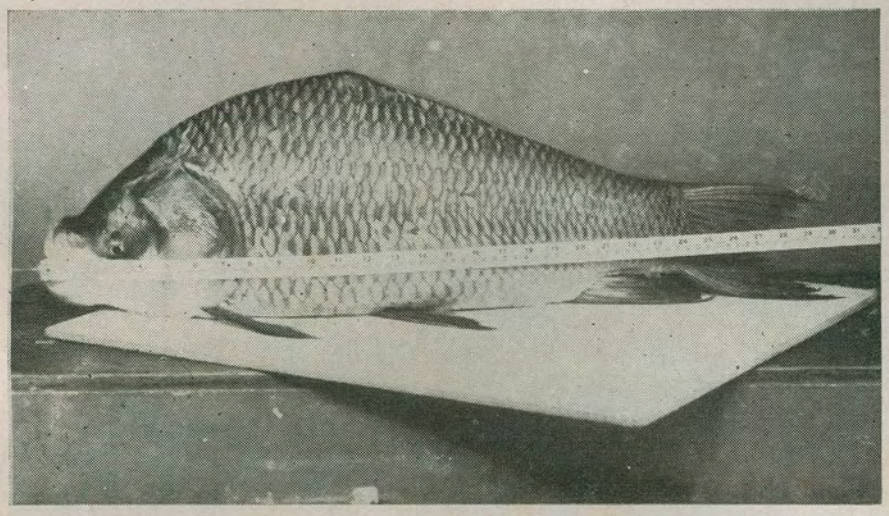
INTRODUCTION OF DECCAN MAHSEER (*TOR KHUDREE*) IN BENGAL

In order to evaluate the growth potential of Deccan Mahseer and to ascertain whether pond reared specimens can attain maturity in Bengal waters, a consignment of 3,700 fry of *Tor khudree* was brought from Lonavala farm of Maharashtra to Barrackpore. Rearing experiments were initiated in the Institute's cemented ponds at Barrackpore provided with recirculatory filtering systems. The fry were fed on conventional feed comprising rice bran and mustard oil cake 1 :1 ratio (fortified with 5% Nuvimen Forte) given twice daily. In a rearing period of one month, the fry attained an average length of 45 mm from the initial average length of 14 mm. The hardy nature of this mahseer species was well demonstrated when a survival rate of 55% was achieved while transporting the consignment over a period of 55 hours. The experiments are in progress.

MAJOR CARP FISHERY IMPROVES IN THE UPPER STRETCHES OF RIVER BRAHMAPUTRA

A recent study on the catch structure of Brahmaputra fishery, based on the fish landings, indicates an improvement of major carp fishery in the upper stretches of the river. Seventy eight tonnes of fishes were estimated to have landed during July-December, 1986, at two centres, viz., Uzanbazar and Fancybazar. Out of the total catches, major carps contributed 12.8% at Uzanbazar and 37.8% at Fancybazar, while catfishes amounted to 15.2% and 7.2%. Minor carps were only 6% and 1% at the two respective centres. *Labeo rohita* dominated among major carps, followed by *Catla catla* and *Cirrhinus mrigala;* while *Wallago attu* and *Mystus seenghala* dominated among catfishes. Among minor carps, *Labeo gonius* and *L. bata* were the dominant species.

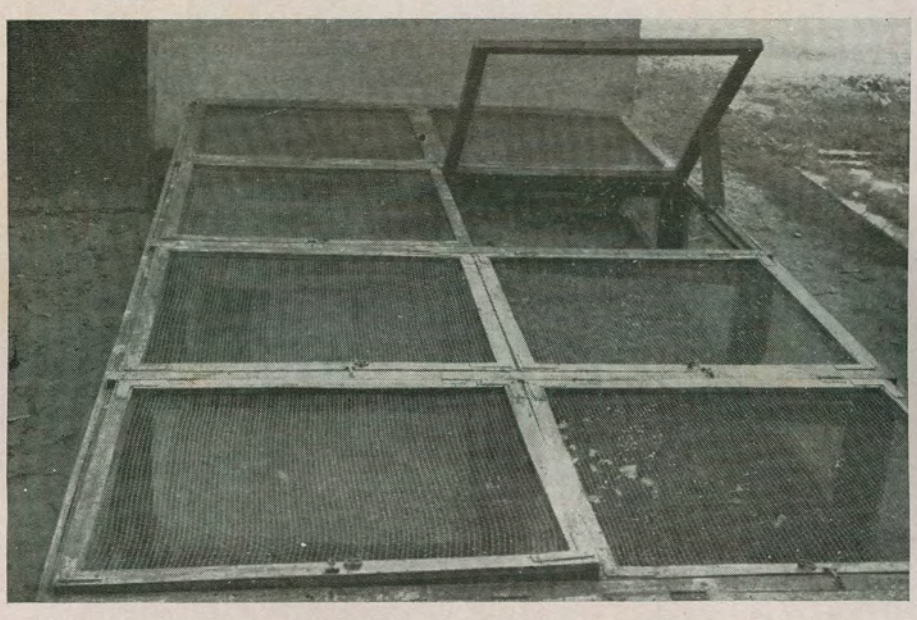
The investigations reveal that the fishery of Indian major carps shows an increasing trend in contrast to the observations made in earlier years (1975-80) when the fishery in these stretches mainly comprised catfishes and minor carps.



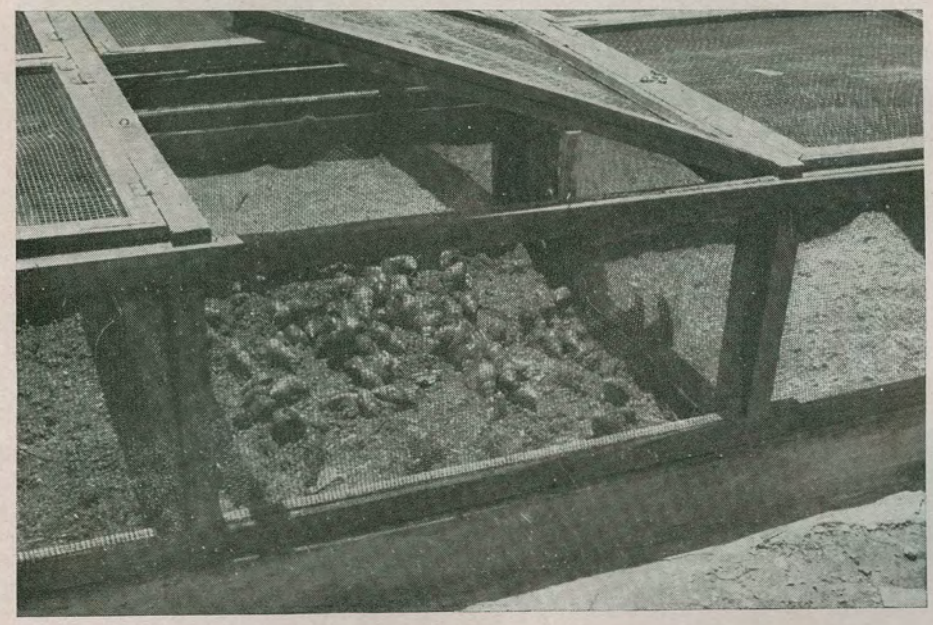
Phenomenal growth of catla in Reservoir.

Deccan mahseer *Tor khudree* being reared in glass jar aquaria at Barrackpore.

SNAIL HOUSE DESIGN DEVELOPED AT CIFRI



A Snail house has been designed at CIFRI to rear the giant African snail *Achatina fulica*. The structure measuring 5 m × 2 m × 0.5 m can rear up to 3,000 snails at a time. (see page 87)



वार्षिक रिपोर्ट 1986-87

केन्द्रीय अंत:स्थलीय मत्स्यकी अनुसंधान संस्थान

बैरकपुर

संक्षिप्त इतिहास

केन्द्रीय अंत:स्थलीय मत्स्यकी अनुसंधान केन्द्र की स्थापना कलकत्ता में मार्च 1947 में भारत सरकार के खाद्य तथा कृषि मंत्रालय के अंतर्गत किया गया। प्रारम्भ में एक अन्तरिम योजना के रूप में आरम्भ होनेवाला यह संगठन अब अंत: स्थलीय मत्स्य अनुसंधान के क्षेत्र में एक प्रमुख संस्थान बन गया है। यह केन्द्र सन् 1959 में एक अनुसंधान संस्थान का रूप ग्रहण कर बैरकपुर (प० बंगाल) स्थित अपने निजी भवन में स्थान्तरित हो गया। सन् 1967 से यह संस्थान भारतीय कृषि अनुसंधान परिषद (आई. सी. ए. आर.) के प्रशासनिक प्रबन्ध में है। वर्त्तमान में यह संस्थान भारतीय कृषि अनुसंधान परिषद के सबसे बड़े संस्थानों में एक है जिसमें 250 वैज्ञानिक एवं तकनीकी अनुसंधान कर्मचारी समस्त भारत में स्थित ३६ केन्द्रों में कार्यरत हैं। बदले हुये अधिदेश के अनुसार प्रग्रहण मत्स्यकी को महत्व देते हुए 1986-87 के तकनीकी प्रोग्राम में संशोधन किया गया है।

अधिदेश

प्राकृतिक एवं मनुष्य द्वारा निर्मित अंत:स्थलीय जल स्रोतों में संग्रहण, उचित समुपयोजन एवं संरक्षण द्वारा मछली उत्पादन में वृद्धि के लिये अनुसंधान करने हेतु इस संस्थान की स्थापना की गयी थी।

संगठन

उक्त उद्देश्यों को प्राप्त करने के लिए तदनुसार संस्थान का संगठन किया गया। इसके तीन प्रभाग हैं—(1) नदीय तथा सरोवरीय प्रभाग, (2) ज्वारनदमुखी मत्स्यकी तथा लवणीय जल-संवर्धन प्रभाग, (3) अलवणीय जल-संवर्धन प्रभाग।

इलाहाबाद स्थित नदीय तथा सरोवरीय प्रभाग नदियों, झीलों एवं सरोवरों इत्यादि के प्रग्रहण मत्स्यकी पर कार्य करता है। यह प्रभाग इन जल स्रोतों के पारिस्थितिकी तथा जल-प्रदूषण एवं जलीय उत्पादकता पर भी विशेष जोर देता है। ज्वारनदमुखी मत्स्यकी तथा लवणीय जल-संवर्धन प्रभाग जो बैरकपुर में स्थित है ज्वारनदमुख एवं समुद्र ताल के मत्स्यकी प्रबन्ध एवं परिस्थितिकी से संबंधित सभी समस्याओं का अध्ययन करता है। यह प्रभाग लवणीय जल-संवर्धन पर भी कार्य करता है जिसके लिए काकद्वीप में उचित सुविधाएँ उपलब्ध हैं। अलवणीय जल-संवर्धन प्रभाग धौली में स्थित है तथा तालाबों में मत्स्य-पालन के सभी पहलुओं पर कार्यरत है। रहारा अनुसंधान केन्द्र में मल-पोषित जल में मत्स्यपालन तथा धान के साथ मछली पालन के सभी पहलुओं पर अनुसंधान कार्य होता है। कल्याणी केन्द्र में मेढ़कों के उत्पादन एवं संवर्धन पर कार्य होता है।

इन प्रभागों के अतिरिक्त बैरकपुर में प्रसार अनुभाग, काकद्वीप में लवणीय जल मत्स्य संवर्धन का कृषि विज्ञान केन्द्र तथा धौली में अलवणीय जल संवर्धन पर कृषि विज्ञान केन्द्र एवं प्रशिक्षक प्रशिक्षण केन्द्र भी इस संस्थान के अन्तर्गत है। संस्थान के मुख्यालय में पुस्तकालय एवं प्रालेखन अनुभाग, प्रशासन, लेखा एवं भंडार अनुभाग अपने-अपने कार्यभार सम्भाले हुए हैं।

चार अखिल-भारतीय समन्वित परियोजनाओं (समिश्र मत्स्य संवर्धन एवं मत्स्य बीज उत्पादन, वायु-श्वासी मछलियों का संवर्धन, जलाशय मत्स्यकी, लवणीय जल मत्स्य संवर्धन) का कार्य सन् 1985 में समाप्त हो गया। समन्वित परियोजनाओं के बन्द होने के फलस्वरूप पुन:संगठित संस्थान में अब 24 अनुसंधान केन्द्र तथा 9 सर्वेक्षण केन्द्र हैं। इनके अतिरिक्त काकद्वीप में कृषि विज्ञान केन्द्र तथा धौली में कृषि विज्ञान केन्द्र/प्रशिक्षक प्रशिक्षण केन्द्र भी हैं।

मुख्य उपलब्धियाँ

हिलसा-ईलिशा का प्रजनन

हिलसा-ईलिशा का कृत्रिम निषेचन तथा बीज उत्पादन फरक्का में सन 1986 अक्तूबर में सफलतापूर्वक किया गया। नदी से संग्रहित पूर्णतः परिपक्व नर (450-750 ग्रा०) व मादा (750-1300 ग्रा०) हिलसा मछलियों के पाँच जोड़ों का 'वेट-स्ट्रिपिंग' किया गया। इनमें से दो जोड़ों में उचित निषेचन प्राप्त हुआ। निषेचन दर 75-80 प्रतिशत प्राप्त किया गया। परिवर्धरित अंडों को प्राकृतिक तथा कृत्रिम परिस्थितियों में ऊष्मायित किया गया, जिसके द्वारा लगभग 35,000 अंडजों की उत्पत्ति हुई जिनका पालन बैरकपुर में किया जा रहा है।

फरक्का बाँध के ऊपरीय परिक्षेत्रों में उद्धावी (एनाड्रामस) हिलसा की संख्या घट रही है। गंगा नदी के इन परिक्षेत्रों में हिलसा मछली के पुनःसंग्रहण की दिशा में इसका सफलतापूर्ण बीज-उत्पादन एक प्रमुख उपलब्धि है।

तिलापिया का पंजर-पालन विधि (केज कल्चर)

केन्द्रीय अंतःस्थलीय मत्स्य अनुसंधान संस्थान के बैंगलूर केन्द्र ने तिलापिया (**ओरियोक्रोमिस मोजमबिका**) पालन के लिए एक नयी तकनीक विकसित किया है। तिलापिया कुछ पारिस्थितिक कारणों से विस्तरित जल क्षेत्र में पालने योग्य नहीं है। प्रारम्भिक तौर पर इस तकनीक का प्रयोग बैंगलूर के 'सान्के टैंक' में विभिन्न मापों के (5 से 10 वर्ग मी०) गोल जालीदार पिंजड़ों को लगाकर किया गया। इन प्रारम्भिक तीन प्रयोगों में उत्पादन दर क्रमशः 8.94, 16.38 तथा 14.18 टन।हे०।महीना प्राप्त हुआ।

तिलापिया के जैविक नियंत्रक के रूप में भेटकी

जलीय क्षेत्रों से मछली उत्पादन की दिशा में तिलापिया मछली (**ओरियोक्रोमिस मोजमबिका**) की अत्याधिक बीज-उत्पादन क्षमता एक समस्या है। इसके जैविक नियंत्रक के रूप में भेटकी मछली (**लेटस केलकारिफर**) की क्षमता निर्धारण करने हेतु कई प्रयोग प्रयोगशाला तथा क्षेत्र में किए गए।

प्रयोगशाला प्रयोगों से यह स्पष्ट होता है कि 45-72 मि० मी० लम्बाई वाले भेटकी मछलियाँ 11.0 से 18.5 मि० मी० आकार वाले तिलापिया पर घातक प्रहार करते हैं, किन्तु छोटे मछलियाँ तिलापिया पर प्रहार नहीं करते।

मल-पोषित तालाब (0.17 हे०) में किए गए क्षेत्रीय प्रयोगों में यह पाया गया है कि भेटकी मछलियाँ सक्रिय रूप से तिलापिया की बढ़ती हुई संख्या का नियंत्रण करते हैं।

हुगली के ज्वारनदमुखी क्षेत्रों में हिलसा मत्स्यकी का पुनरुत्थान

सन् 1981 के बाद हुगली ज्वारनदमुख क्षेत्र में सबसे अधिक हिलसा का उत्पादन सन् 1986 में प्राप्त किया गया। नवम्बर 1985 से अक्तूबर 1986 तक की अवधि में लगभग 2,253 टन हिलसा इस ज्वारनदमुख क्षेत्र से प्राप्त किया गया जो पूरे मत्स्य-स्थलन का करीब 25 प्रतिशत है (शीतकालीन 'बैगनेट' मत्स्यकी को छोड़कर)। हिलसा की प्राप्ति

पिछले वर्ष के आकलित स्थलन (1,067 टन) से 111 प्रतिशत तथा 1982-85 के औसत-स्थलन से 56 प्रतिशत अधिक रहा।

इस अध्ययन से प्राप्त परिणामों द्वारा यह भय दूर हो जाता है कि हुगली में हिलसा मत्स्यकी का ह्रास हो रहा है।

जलीय कीटों के परभक्षी गुणों पर एक नया प्रकाश

परभक्षी कीट (**डिप्लोनिकस एनुलेटम्**) के जीवन-वृत्त तथा जैविक गुणों के अध्ययन से यह पता चला है कि यह कीट डिम्भ अवस्था में रियरिंग तालाबों में संचित मत्स्य अंगुलिकाओं के लिए ज्यादा घातक सिद्ध होता है। यह कीट डिम्भ अवस्था के प्रथम व दूसरे रूप में बड़े कीट की तुलना में मत्स्य अंगुलिकाओं पर करीब २५० प्रतिशत अधिक घातक है। इस जलीय कीट की डिम्भ अवस्था में परभक्षीय क्षमता 9.9 अंगुलिकाऐं।निम्फ।प्रतिदिन जबकि प्रौढ़ अवस्था में यह सिर्फ ४ अंगुलिकाएँ थी।

यह विशेष जानकारी रियरिंग तालाबों में नाशी जीवों के अच्छे प्रबन्ध में सहायक हो सकता है।

जलाशय में कतला का परिघटनात्मक वृद्धि

सन् 1983 में अलियार जलाशय में संचित किये गये **कतला कतला** के अंगुलिकाओं में, दो वर्ष की अवधि में असाधारण वृद्धि (5.3 से 11.5 कि० ग्रा०) हुई। जलाशय में कार्प अंगुलिकाओं के संचयन से पूर्व उनके पृष्ठ पंखों को थोड़ा काट दिया गया था और इनकी वृद्धि का परिक्षण व्यापारिक संग्रहण में पाये गये नमूनों के निरीक्षण द्वारा किया गया।

बंगाल के तालाबों में डेक्कण महसीर का प्रवेशन

डेक्कण महसीर की वृद्धि क्षमता तथा बंगाल के तालाबों में इसकी परिपक्वता जानने के लिए महाराष्ट्र के लोनावला फार्म से **टोर खुड़री** के 3,700 फ्राई बैरकपुर लाए गए। बैरकपुर स्थित संस्थान के सिमेन्ट वाले तालाब (जिसमें पानी का पुनःसंचारण व्यवस्था है) में इनका प्रायोगिक तौर पर संवर्धन शुरू किया गया। फ्राई को आहार के रूप में चावल की भूसी तथा सरसों की खली (1 : 1 अनुपात में) प्रतिदिन दो बार दिया गया। एक महीने के इस संवर्धन अवधि में इनकी औसत लम्बाई 45 मि० मी० हो गई जबकि आरम्भ में इनकी औसत लम्बाई केवल 14 मि० मी० थी। इस महसीर जाति की सहिष्णुता 55 घंटे के वहन काल में अच्छी तरह परिलक्षित हुई। प्रयोग अब भी जारी है।

ब्रह्मपुत्रा नदी के ऊपरीय परिक्षेत्रों में मेजर कार्प मत्स्यकी में सुधार

ब्रह्मपुत्रा मत्स्यकी से संग्रहित मत्स्य संपदा के संरचना का वर्त्तमान निरीक्षण से यह सूचित होता है कि नदी के ऊपरीय परिक्षेत्रों में मेजर कार्प की संपदा में वृद्धि हुई। सन् 1986 के जुलाई से दिसम्बर तक की अवधि में उजमबाजार और फैंसीबाजार केन्द्रों से लगभग 78 टन मछलियाँ प्राप्त किया गया। इस संग्रहित मत्स्य संपदा में मेजर कार्प की मात्रा उजमबाजार में 12.8 और फैंसीबाजार में 37.8 प्रतिशत पाया गया जबकि शिंगटी मछलियाँ क्रमशः 15.2 और 7.2 प्रतिशत रहा। इन दोनों केन्द्रों से मैनर कार्प मछलियाँ क्रमशः 6 और 1 प्रतिशत ही पाये गये। संग्रहित मेजर कार्प मछलियों में **लेबियो रोहिता** प्रचुर मात्रा में पाया गया तथा इसके बाद का स्थान **कतला कतला** और **सिरहनस म्रिगाला** का रहा। प्राप्त शिंगटी मछलियों में **वालागो अट्टू** और **मिस्टस सिंघाला** प्रमुख रहा जबकि मैनर कार्पों में **लेबियो गोनियस** और **एल. बाटा** जाति के मछलियों का प्राधान्य रहा।

इस अध्ययन से यह स्पष्ट होता है कि भारतीय मेजर कार्प मत्स्यकी में काफी वृद्धि हो रही है, क्योंकि पिछले अध्ययन समय (1975-80) में इन परिक्षेत्रों में शिंगटी तथा मैनर कार्प मछलियों का प्राधान्य था।

COLLABORATION

NATIONAL

Scientists from CSSRI collaborated in the Project BF/A/18 on "Paddy-cum-brackishwater fish farming".

A collaborative project FA/B/7 on "Certain physiological aspects of reproduction in carps with special reference to purification and assay of gonadotropins" was carried out with the Dept. of Zoology, Visva-Bharati University, Santiniketan.

Ganga Action Plan Authorities work in close liaison with the Institute in utilising the technologies available for waste recycling and also understanding the impact of wastes on the biota of Ganga River System. The CIFRI technology for recycling the sewage waste through aquaculture is a basic component of the Ganga Action Plan.

A collaborative research project has been started by the CICFRI, CIFE and CMFRI to elucidate the dynamics of hilsa populations, their breeding and feeding habits, migratory. traits etc.

There is a joint venture by CICFRI and the Farakka Barrage Authorities to set up a hatchery on the basis of CICFRI technology of artificial fecundation and seed rearing of hilsa.

MANPOWER DEVELOPMENT

Dr. Sree Prakash, S-2 and **Shri D. R. Kanujia,** S-1 under went five week training course from 25/2/86 to 4/4/86 on Seed production of freshwater prawns at Chachoengsao Fisheries Station, Thailand. The programme was sponsored by NACA.

Dr. T. Ramaprabhu, S-3 at Bangalore Centre of the Institute attended a meeting of selected former IDRC Research Associate Awardees in Bangkok, Thailand from 26-27 February, 1986.

Mrs. G. K. Vinci and **Shri Hardial Singh,** Scientists (S-2) underwent 6th one year Post-Graduate Training Course for Senior Aquaculturists from 10th March, 1986 held at Regional Lead Centre of Network of Aquaculture Centres in Asia (NACA) in Philippines.

Shri Kamil Lakra, T-I-3 underwent 6th training course in Integrated Fish Farming at Wuxi, China from 18th April, 1986 to 16th August, 1986. The course was sponsored by FAO/NACA.

Shri Dilip Kumar, S-2 participated in the Expert Consultation on Ulcerative Fish Diseases in Asia-Pacific Region in Bangkok, Thailand from 4-8th August, 1986. The programme was sponsored by NACA/FAO/UNDP.

Dr. K. M. Das, S-2 underwent second short-term training course on small scale shrimp hatchery/nursery operations and management in Philippines from 4th August, 1986 to 30th September, 1986. The course was sponsored by UNDP Regional Project RAS/76/003-NACA.

Shri H. C. Karmakar, Scientist underwent short-term training course on Use of Computer in Agricultural Research at IASRI, New Delhi from 1-27 September, 1986.

Drs. M. K. Mukhopadhyay and **K. Chandra,** Scientists attended the School on Toxicology held at Regional Research Laboratory, Hyderabad from 20-31 October, 1986.

Sarvashri S. P. Ghosh, T-II-3, **H. K. Routh,** SSG-III and **K. K. Das,** SSG-III underwent training on Maintenance of Aquaria at Zoological Garden, Calcutta and in Taraporevala Aquarium, Govt. of Maharashtra, Bombay from 21 October, 1986 and 4-10 January, 1987 respectively.

Shri R. K. Tyagi, Scientist underwent training on "Use of Computer in Agricultural research" held at IASRI, New Delhi from 5-31 January, 1987.

Dr. H. C. Joshi and **Shri M. M. Bagchi,** undertook training on Analytical Instrumentation in Environmental Engineering at NEERI, Nagpur from 13-23 January, 1987.

Dr. B. N. Saigal, Scientist S-3 underwent training on Agricultural Research Management at NAARM, Hyderabad from 16-30 January, 1987.

Drs. V. Pathak, Krishna Chandra, M. J. Bhagat and **Sarvashri P. K. Sukumaran, N. P. Srivastava, A. R. Choudhuri, V. K. Sharma, S. K. Sarkar, B. K. Banerjee, S. K. Majumder, G. C. Laha, V. Kolekar** and **R. K. Dwivedi,** Scientists of this Institute completed the twenty-first Orientation Course on Agricultural Research Management held from 20th January, 1987 to 19th February, 1987 at NAARM, Hyderabad.

Dr. S. P. Ayyar and **Shri R. N. Pal,** Scientists S-3 underwent training on Agricultural Research Management at NAARM, Hyderabad from 2-13 March, 1987.

HONOURS, AWARDS, ETC.

Shri D. N. Singh, Scientist at Guwahati Centre of CIFRI was awarded the Degree of Doctor of Philosophy by Banaras Hindu University for his thesis *"Limnology and Productivity of McPherson Lake, Allahabad."*

Shri R. K. Singh, Scientist (Soil Science) was awarded the Ph.D. degree by Indian Agricultural Research Institute, New Delhi for his studies on *"Phosphatic equilibria and its availability in salt-affected soils."*

Shri P. R. Sen, Scientist at Rahara Research Centre of this Institute was awarded the Ph.D. degree by the University of Calcutta for his thesis *"Survival, growth, maturity and hypophysation of Labeo rohita (Ham.) in freshwater ponds."*

Shri Manas Kumar Das, Scientist at Barrackpore was awarded the Ph.D. degree by the University of Kalyani for his thesis entitled *"Studies on the protozoan parasites in fishes of intensive fish culture ponds of West Bengal."*

Shri P. K. Ghosh, Scientist at Calcutta Centre of the Institute was awarded the Ph.D. degree by the University of Calcutta for his thesis *"Studies on some aspects of neurosecretion in female tiger prawn, Penaeus monodon (Fabricius)."*

Shri B. C. Jha, Scientist at Mazaffarpur Centre of the Institute was awarded the degree of Doctor of Philosophy (Faculty of Science) in Botany by the Ranchi University for his thesis entitled *"Comparative ecological studies of periphytic members of Bacillariophyceae in different water bodies, like Getalsud reservoir and Swarnarekha river of tribal belt of Ranchi, Bihar."*

Shri Surendra Narain Singh, Scientist at Ranchi Centre of the Institute was awarded the Ph.D. degree by the University of Gorakhpur for his thesis *"A study of the biotic communities of Getalsud reservoir with particular reference to plankton and benthos."*

Shri Kuldip Kumar, Scientist of this Institute at Barrackpore was awarded the Ph.D. degree by the Bhagalpur University (Bihar) for his thesis *"Hydrobiological investigation of a freshwater beel with special reference to its fish production potentialities."*

Shri C. B. Joshi, Scientist of this Institute was awarded the Ph.D. degree by the Garhwal University, Srinagar (U.P.) for his thesis *"Ecological studies of some hill streams in middle stretch of Sutlej river system feeding Gobindsagar reservoir in Himachal Pradesh."*

Shri D. K. Kaushal, Scientist at Bilaspur Centre of the Institute was awarded the Degree of Doctor of Philosophy for his thesis *"Studies on the aquatic fauna of Gobindsagar reservoir in relation to fish and fisheries"* by the Meerut University, Uttar Pradesh.

Shri Vijay Kumar Sharma, Scientist of this Institute at Bilaspur Centre has been awarded the Ph.D. degree by the Punjab University for his studies on *"The biology and fishery of Cyprinus carpio Linn. from the Gobindsagar reservoir, Himachal Pradesh, India."*

Shri A. K. Ghosh, Scientist at CIFRI, Barrackpore has been honoured by the Chairman, II Asian Congress of Parasitology, Lucknow by presenting the cash award (Rs. 200/-) and a "Certificate of commendation" for the best poster presentation award in the group Taxonomy, for the scientific paper entitled "The breeding biology and the taxonomic status of *Argulus raychoudhurii,* new species on freshwater fishes of West Bengal, India." The paper was jointly presented by A. K. Ghosh and N. C. Datta.

TRANSFER OF TECHNOLOGY

EXTENSION AND NATION BUILDING ACTIVITIES

Visitors: Information on CIFRI's activities and the recent advances in inland fisheries research were imparted to following visitors through film shows, field visits, discussions, lectures, demonstrations etc.:

India: About 300 students from various universities, 506 fish farmers, 35 Govt. officials from various Institutions and 31 other dignitaries.

Abroad: A batch of 19 Senior Aquaculturist trainees (FAO/UNDP) representing 8 Asian countries who were undergoing post graduate course in SEAFDEC, Iloilo, under the University of Philippines visited the Institute along with the Dean, Dept. of Aquaculture, Univ. of Philippines.

Seven other foreign dignitaries visited the Institute. Professors Edison Lawrance and Dean Akiyama of Texas University delivered lecture on "Shrimp cultivation". Dr. W. A. Tomey Consultant Biologist, Netherlands delivered a talk on "Ornamental fishes and how to make aquaria."

Advisory Services: The advisory services were extended to 179 fish farmers, 58 Govt. agencies, 10 entrepreneurs, 6 financial organisations, 2 educational institutions, 4 voluntary agencies, 2 cooperative societies, 5 foreign agencies, 1 foreign bank and 1 agricultural University. Senior extension scientists visited farms in Nandannagar, Belgharia, Cossipore and Ichapore to advise the farmers regarding fish health and sanitation, fertilization, etc. About 12 fish farmers were advised over telephone regarding control measures of fish mortality and pond management practices.

Training: A total of 12 training courses were conducted with durations ranged from one day to 6 months for Indian as well as foreign officers.

Talks: Thirty four extension lectures were delivered and group discussions held by the extension scientists of the Institute. More than fifty fish farmers were benefitted by these discussions.

Extension literature: Self explanatory and illustrated extension literature, transparencies, recorded commentory on various aspects of aquaculture, etc. were supplied to more than 16 parties.

Demonstrations: Netting operations and weed eradications were demonstrated to fish farmers at Zaffarpur, and Kalyanbati.

Seed production: A total of 17 lakh spawn of common carp (Desmukha village) and 50,000 fry of common carp (Chanditala) were produced and supplied to fish farmers.

Exhibitions: The Institute participated in 8 exhibitions. Thousands of people viewed the achievements made by the Institute through the exhibits in the CIFRI pavilions.

KRISHI VIGYAN KENDRA

During the period under report a total number of 1,456 trainees have been trained under different disciplines in the on-campus and off-campus training courses organised and conducted at Krishi Vigyan Kendra, Kakdwip. Out of the 77 training courses 32 courses were under on-campus (302 trainees) and 45 were (1,154 trainees) under off-campus training programme.

Table I

Area		Crop production		Horticulture		Fisheries		Home Science		Total	
duration		(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
1 day	On campus	—	—	—	—	—	—	—	—	—	—
	Off campus	4	98	6	128	12	450	1	14	23	690
2-6 days	On campus	7	70	7	66	10	99	5	44	29	279
	Off campus	6	205	—	—	8	112	8	147	22	464
7-15 days	On campus	—	—	—	—	—	—	3	23	3	23
	Off campus	—	—	—	—	—	—	—	—	—	—

(*a*) Number of courses conducted (*b*) Number of trainees participated

LAB TO LAND PROGRAMME

BARRACKPORE CENTRE

Paddy-cum-Magur culture at farmers' field: Under the Lab-to-Land Programme the extension scientists of the Institute undertook an experiment on Paddy-cum-magur culture in farmers' field with 12 plots at Kalyanbati village under Chanditala Block in Hooghly District. After plantation of high yielding paddy variety 'Boro', magur (125 mm/16g) was released in 11 plots and one plot was kept as control. Each plot was provided with a perimeter canal (1'x1') and two trenches (2'x2') were constructed to facilitate fish feeding and sampling. Harvesting of fish and paddy were made after 3 and 4 months respectively. The paddy yield was 1,800 kg/ha in control plot and 3,900-4,500 kg/ha in plots stocked with fish. A total of 105 kg fish was harvested from the total area (1,690 m^2) which corresponds to 622.77 kg/ha/3 months.

Under Lab-to-Land Programme 25 farmers in the Minakhan Block of North 24-Parganas were involved in the transfer of technology on *"Integrated Farming (Rice-based Aquaculture)"* up to June 1986. Earlier these farmers were getting 2-2.5 t/ha of kharif paddy only from their monocropped fields. Through paddy-cum-brackishwater fish farming 23 farmers obtained in an average 0.82 t/ha of prawns and fishes costing about Rs. 23,000/- and 2.7 t/ha of paddy. Through rice-based freshwater aquaculture 2 farmers got in an average 0.79 t/ha of fishes and prawns costing about Rs. 10,500/- and 4.8 t/ha of paddy from two crops annually.

Carp production achieved under Lab-to-Land Programme during 3rd phase ranged from 2,370-5,130 kg/ha/yr which covered 100 fish farm families.

The Programme for the 1st year of 4th phase consisted of 100 farm families at Agapur (New Barrackpore) was continued.

The coordination work of Lab-to-Land Programme at 6 centres covering 400 farm families was continued in the 1st year of 4th phase.

LIBRARY & DOCUMENTATION SERVICE

CIFRI Library played a very significant role in the progress of reasearch and developmental activities of the Institute. The library was used fruitfully not only by the scientists of the Hqs. and centres but also used frequently by the research scholars, teachers and trainees from different universities, institutes and other organizations. The library maintained an active relationship with leading national and international agricultural research information centres and procured primary, secondary and tertiary sources of information regularly from different parts of the world.

The library had acquired 5,689 books, 4,024 reprints and 2,368 misc. publications up to 1986 and added a total of 211 books, 81 reprints, 125 miscellaneous publications and 1,300 loose issues of periodicals during January 1986 to March 1987. The library also preserved an attractive collection of pamphlets, bulletins, brochures, theses, photocopies and a core of grey literature. A total of 49 foreign and 71 periodicals had been subscribed and 250 periodicals including Newsletters and reports of different Institutes both National and International were also received in exchange or as gift which brought the total to 370.

During the year 14 new exchange relationships were established which would further strengthen the information flow to the library in addition to 265 existing parties. The Institute library also continue to supply a number of publications to INSDOC and other institutes on inter-library loan. An amount of Rs. 6,11,306.53 was spent on books, periodicals etc. during 1986-1987.

INFORMATION AND REPROGRAPHY SERVICES

As usual the section took the responsibilities in monitoring the progress of research and recording the research results of the scientists.

About 150 technical and non-technical queries from India and abroad were attended to by the staff of the section. In addition reports on Progress of Research were compiled and sent to ICAR. Research papers of the scientists were processed for publication in various journals during the year. All the scientific journals were scanned thoroughly and abstracts of papers on Indian fisheries appeared in various journals were prepared. Three issues of bimonthly CIFRI Newsletter were published by the section in 1986 intending to serve a large section of clientele comprising research workers, farmers, extension personnel etc. Annual progress reports of over 33 research projects and the contributions of about 193 scientists during the current year were recorded in Primary Project Files and Scientists' Biodata Files.

The section maintains an active unit for photography and reprography services. Photographs and photocopies were supplied to the research personnel of the Institute as well as to other organizations and institutes.

The section also maintains a duplicating (cyclostyling) and binding unit to serve the various units of the Institute.

The following departmental publications were brought out by CIFRI during the year January 1986 to March 1987.

1. Annual Report for the year 1985
2. Indian Fisheries Abstracts, 20 (3-4), 1981; 23 (1-2), 1984
3. CIFRI Newsletter, 8 (3-4), 1985; 9 (1), 1986
4. Bulletin No. 39. Synopsis of Biological Data on Singhi *Heteropneustes fossilis* (Bloch, 1794) by N. K. Thakur and P. Das
5. Bulletin No. 40. Synopsis of Biological Data on Koi *Anabas testudineus* (Bloch, 1792) by N. K. Thakur and P. Das
6. Bulletin No. 41. Synopsis of Biological Data on Magur *Clarias batrachus* (Linnaeus, 1758) by N. K. Thakur and P. Das
7. Bulletin No. 42. Report on the use of Alkali soil and Sodium carbonate as sealants for controlling seepage loosses in Fish ponds by K. L. Shah, B. C. Tyagi & S. K. Kamra.
8. Bulletin No. 43. Status paper on Fish Seed Standardization by A. G. Jhingran
9. Bulletin No. 44. List of CIFRI Publications, 1977-1984
10. Bulletin No. 45. Artificial Recruitment and Fisheries Management of Indian Reservoirs by A. G. Jhingran
11. Bulletin No. 46. Ecology and Fishery Management of Brackishwater Bheries in West Bengal
12. Bulletin No. 47. Training in Giant Freshwater Prawn Farming
13. Bulletin No. 48. Training in Integrated Farming System for West Bengal Fisheries Officers
14. *Bharatiya Mukhya Karp Machliyou Ka Prerit Prajanan* (Pamphlet in Hindi)
15. *Nursery Talabon Ka Prabandh* (Pamphlet in Hindi)
16. *Rearing Talabon Ka Prabandh* (Pamphlet in Hindi)
17. *Misrit Machli Palan* (Pamphlet in Hindi)
18. *Kommon Karp Ka Prajanan* (Pamphlet in Hindi)

CONFERENCES, SYMPOSIA, ETC.

The following are the important Meetings/Workshops organised by the Institute during 1986:

First World Conference on Trade in Frog legs, Vis-a-Vis Environmental Considerations, held in Calcutta on 10th & 11th April, 1986, sponsored jointly by the Marine Products Export Development Authority and the Central Inland Fisheries Research Institute.

Annual Staff Research Council Meeting of CIFRI, 7-8 May, 1986.

ICAR Regional Committee No. II—8th Meeting held on June 23-24, 1986.

Trainings on "Integrated farming system" for the benefit of the State Fisheries Officials of West Bengal, from 9-23, September, 1986.

Meeting of the Central Joint Staff Council from 5-7 December, 1986.

Eighth Local Management Committee meeting of KVK/TTC held at Kausalyagang on 15 December, 1986.

Ex-Trainees' Sammelan at Krishi Vigyan Kendra and Trainers' Training Centre, Kausalya-gang on 30 December, 1986.

KVK Local Management Committee meetings held at Kakdwip on 25 May 1986 and 4 February 1987.

The scientists of the Institute participated in various Conferences/Symposia/Seminars and Meetings held during 1986-87 wherein they presented their research findings and exchanged views with the delegates. List of scientists who participated/presented papers in such gatherings is furnished below:

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Indian Science Congress Association, 73rd Session, Women Scientists Forum (2nd January to 7 Januay, 1986)	Indian Science Congress Association, New Delhi	Extension education to women agriculture (fisheries) labourers and the role of women scientists	T. Rajyalakshmi
		Some observations on the faunal changes resulting from construction activities in the Kakinada Bay	T. Rajyalakshmi
Seminar on Veterinary and Fisheries (16 January, 1986)	M.P. Government at Nehru Sanskrit Bhavan, Sector-1, Bhilai, M.P.	—	P. K. Pandit

8th MEETING OF THE

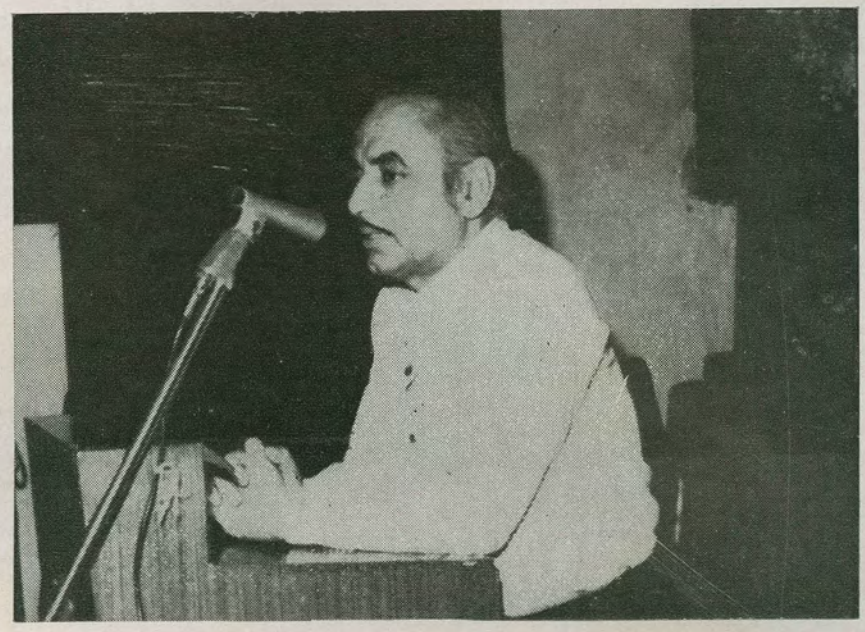
ICAR REGIONAL COMMITTEE No. 2

Dr. N. S. Randhawa addressing the members of Regional Committee meeting. Seated on either side of Dr. Randhawa are Prof. D. Dasgupta, Vice-Chancellor, B.C.K.V.V., West Bengal (on left side), Shri V. P. Ramachandran, IAS, Secretary, Ministry of Agriculture, Govt. of West Bengal and Dr. D. Chaliha, Vice-Chancellor, Assam Agrl. University (on extreme right).

The Regional Committee meeting in progress.

A section of the delegates who participated in the RCM.

Dr. Arun G. Jhingran, Director, CIFRI inaugurates the training course on integrated farming system on 9.9.1986.



Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Symposium on Pollution Control of Industrial Effluents (16 to 18 January, 1986)	Dept. of Civil Engineering, L. E. College, Gujarat	An overview of aquatic pollution in Hooghly estuary	B. B. Ghosh
Workshop on Sedimentation Problems in Coastal Aquaculture Farm (11-13 February, 1986)	Agricultural Engineering Deptt., I.I.T., Kharagpur, West Bengal	Design aspect of brackishwater fish farms (Abstr.)	C. Saha
-do-	-do-	Strengthening of tidal embankment of brackish-water aquafarm by sedimentary processes in silt cage	A. B. Mukherjee and N. C. Basu
Second Asian Congress of Parasitology (13 to 16 February, 1986)	Indian Society of Parasitology and CDRI, Lucknow	Seasonal fluctuations of myxobolid parasites of importance to *Catla catla* of West Bengal, India	A. K. Ghosh
-do-	-do-	The breeding biology and the taxonomic status of *Argulus raychoudhuri* m. sp. of freshwater fishes of West Bengal, India	A. K. Ghosh
National Seminar on Recent Trends in Plant Science Research (18 to 19 February, 1986)	Deptt. of Botany, Visva Bharati, Santiniketan, West Bengal	Recent trends of aquatic weed management through proper utilisation	K. Naskar
Regional Workshop cum Training on Krishi Vigyan Kendra (20-23 February, 1986)	Seva Bharati Krishi Vigyan Kendra, Kapgari, Midnapore	Status paper on Krishi Vigyan Kendra, Kakdwip	J. G. Chatterjee *et. al.*
		Experiences in women development through KVK	M. Sen *et. al.*
Second Workshop on the All India Coordinated Research Project on Pesticide Residues (16-17 February, 1986)	ICAR at Coimbatore	—	H. C. Joshi
National Conference on Water Pollution (22-24 February, 1986)	Deptt. of Zoology, Dr. Harising Gour Visva Vidyalaya, Sagar, M.P.	Observations on the toxicity of certain pesticides on a freshwater fish *L. rohita*	R. N. Seth
Seminar on Fish Seed Production (25-26 February, 1986)	M.P. State Fisheries, Bhopal	—	V. R. Desai
Annual Conference of Indian Society of Weed Science (20-21 March, 1986)	Agricultural Experiment Station of HAU, Durgapura, Jaipur	Efficacy of sprinkler bottle shaker oxadiazon herbicide to control weeds in transplanted rice	S. K. Mukhopadhyay and A. K. Chattopadhyay

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
International Symposium on Science, Technology and Development (20-25 March, 1987)	World Federation of Scientific Workers, New Delhi	The role of Science and Technology in India's Coastal Zone Management	T. Rajyalakshmi
Symposium on Conservation and Management of Fish Genetic Resources of India (11-13 April, 1986)	National Bureau of Fish Genetic Resources, Allahabad	Genetic improvement of Indian major carps for aquaculture industry	V. R. P. Sinha and H. A. Khan
-do-	-do-	—	D. D. Halder and P. Das
-do-	-do-	Genetic differences in the erythrocytes of rohu *Labeo rohita* (Ham.) and mrigal *Cirrhinus mrigala* (Ham.) as an adaptation to the environment	S. D. Tripathi
-do-	-do-	Predicted response to selection for faster growth rate in pearlspot, *Etroplus suratensis*	P. Das *et al.*
-do-	-do-	The relevance of selective breeding for genetic improvement of farmed fish	R. A. Gupta and A. G. Jhingran
-do-	-do-	Studies on the intergeneric hybrid, common carp *Cyprinus carpio communis* L. X mrigal, *Cirrhinus mrigala* (Hamilton)	S. D. Gupta *er al.*
-do-	-do-	Evaluation of fish genetic stocks of ox-bow lakes in Bihar (India)	V. R. Chitranshi
-do-	-do-	Fish fauna of the Brahmaputra drainage with special reference to the conservation of carps	M. Chowdhury and Y. S. Yadava
-do-	-do-	Some recent trends in fish genetics research in India	George John & P. V. G. K. Reddy
-do-	-do-	An account of naturally occuring and artificially produced *Cyprinus* hybrids in India	H. A. Khan & G. V. Kowtal
-do-	-do-	Population studies on *Notopterus notopterus* (Pallas) with reference to racial investigations	M. A. Khan & V. G. Jhingran

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Symposium on Conservation and Management of Fish Genetic Resources of India (11-13 April, 1986)	National Bureau of Fish Genetic Resources, Allahabad	Need for in situ conservation of fish genetic resources of *Clarias batrachus* (Linnaeus) in Chhotanagpur (South Bihar)	D. Kumar
-do-	-do-	Studies on cryogenic preservation of carp spermatozoa	Kuldip Kumar
-do-	-do-	Introduction of *Tor* sp. in Kharagpur Lake: an approach for its conservation	A. K. Laal *et. al,*
-do-	-do-	Vanishing genetic resources of commercially important endemic fish of uplands of India and their possible conservation	K. L. Sehgal
-do-	-do-	Preliminary studies on raciation of *Labeo calbasu* from a stretch of River Yamuna	R. N. Seth & R. K. Tyagi
-do-	-do-	Relative effects of fishes from different genetic background of feed consumption, conservation efficiency and growth of fishes	B. N. Singh
-do-	-do-	Domestication of air breathing fishes in Assam	D. N. Singh & Y. S. Yadava
-do-	-do-	On raciation of *Labeo gonius* (Hamilton) among population in lakes in and around Udaipur (Rajasthan)	V. K. Unnithan & V. S. Durve
-do-	-do-	On the conservation of *Hilsa ilisha* (Hamilton) in the water bodies of Assam	Y. S. Yadava *et al.*
Meeting of Fisheries Development Committee of the Tungabhadra Board (24 April, 1986)	T. B. Dam	—	B. V. Govind
EIFAC Symposium on Selection, Hybridisation and Genetic Engineering in Aquaculture of Fish and Shellfish for Consumption and Stocking (27-30 May, 1986)	E.I.F.A.C. France	Gonadal sex manipulation of *Oreochromis mossambicus*	P. Das *et al.*
		A method to increase mitotic metaphase spreads and permanent chromosome preparations for Karyological studies in fishes	P. V. G. K. Reddy & George John

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
National Conference on National Heritage Conservation (4-5 June, 1986)	Orissa Environmental Society, Berhampur	Some observations on the present status of the biology and fisheries of prawns of the Chilka lagoon	T. Rajyalakshmi
-do-	-do-	An ecological interpretation on the distribution of early stages of penaeid prawns along Orissa coast	S. M. Pillai *et al.*
-do-	-do-	On the growth of *Penaeus monodon* in pens in Chilka lagoon and its ecological significance	P. Ravichandran *et al.*
Seminar on Inland Pisciculture in Kolleru Area	Indian Overseas Bank, Padaminkolanu, West Godavari Dt.		Ch. Gopalkrishnayya & R. M. Rao
Second National Fish Seed Congress (3-4 July, 1986)	West Bengal State Department of Fisheries & the Ministry of Agriculture, Govt. of India	Co-chaired the Session on Induced breeding of Fin fish	A. G. Jhingran
-do-	-do-	Present status and prospects of fin-fish and shell fish seed production	A. G. Jhingran & V. V. Sugunan
-do-	-do-	Low cost carp hatchery	P. Das & M. Sinha
-do-	-do-	Induced maturation and breeding of tigar shrimp through eye stalk ablation	D. D. Halder
-do-	-do-	Rearing of commercially important brackishwater shell fish and fin-fish for promoting aquaculture	Apurba Ghosh, M. L. Bhowmick & P. K. Chakraborty
-do-	-do-	Bracksihwater seed prospecting present status & future prospect	M. L. Bhowmick, R. K. Chakraborty, Apurba Ghosh & P. K. Chakrabotry
-do-	-do-	Fish seed nutrition—a prerequisite for successful aquaculture	P. K. Mukhopadhyay
-do-	-do-	Sympathetic breeding of carps in dry bunds	B. K. Sharma
-do-	-do-	Seed supply sub-system—Key issues in economics of production and marketing	S. Paul
-do-	-do-	Shrimp and carp hatcheries and their aeration requirements	C. Saha

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Second National Fish Seed Congress (3-4 July, 1986)	West Bengal State Department of Fisheries & the Ministry of Agriculture, Govt. of India.	Fin-fish and shell fish seed transport	U. Bhowmick, P. K. Pandit & B. K. Banerjee
-do-	-do-	Diagnosis of fish diseases in aquaculture management	R. N. Pal, A. K. Ghosh & M. K. Das
-do-	-do-	An efficient gear for shrimp seed collection in Sunderbans	N. C. Basu
ICAR Regional Committee Meeting (17-18 July, 1986)	Indian Inst. of Horticultural Research, Hisaraghatta	—	B. V. Govind
Expert Consultation on Ulcerative Fish Diseases in Asia-Pacific Region (4-8 August, 1986)	Bangkok, Thailand (Sponsored by NACA/ FAO/UNDP)	—	Dilip Kumar
Workshop on Conservation of Mahseer Resources in India (23-24 August, 1986)	Organised by TATA Electric Company Lonaval, Maharashtra	On the breeding and hatchery practices of golden Mahseer, *Tor putitora* at Bhimtal in the Kumaon Himalayas (U.P.)	C. B. Joshi & K. C. Malkani
-do-	-do-	Ecological studies of mahseer streams with special reference to the development of sport fisheries in Assam	Kuldip Kumar
-do-	-do-	—	M. D. Pisolkar
Seventh Pesticide Environmental Pollution Advisory Committee Meeting (28 August, 1986)	Krishi Bhavan, New Delhi	—	H. C. Joshi
Workshop on Environmental Pollution— Management and control (29-30 August, 1986)	RIB Industrial and Business Management Consultants Ltd., Calcutta	—	B. B. Ghosh
Short duration training course on fisheries financing (8 Sept., 1986)	Staff Training College of United Bank of India, Calcutta	Fisheries potentials and exploitation	A. G. Jhingran
ICAR Regional Committee Meeting I (10-13 Sept., 1986)	Shimla	—	G. K. Bhatnagar
Symposium on Parya varan-2001 (13 Sept., 1986)	Vigyan Parishad, Allahabad		H. C. Joshi
International Large River Symposium (14-23 Sept., 1986)	Department of Fisheries & Oceans, Toronto, Canada	Environmental impact of Ganga basin development on gene pool and fisheries of Ganga River System	A. V. Natarajan

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Special Seminar on Land Evaluation for Multipurpose land-use and utilization and National Seminar on Recent Advances in Soil Research (23-25 Sept., 1986)	Indian Society of Soil Science, IARI, New Delhi	Possibilities of integrating brackishwater aquaculture in paddy fields of high rain-fed coastal saline areas	G. N. Chattopadhyay, C. R. Biswas, A. Ghosh, P. K. Chakraborty, A. K. Bandopadhyay
-do-	-do-	Physico-chemical characteristics of soils of Nagarjunasagar Reservoir	R. K. Das
Seminar on Brackishwater Prawn Farming, Cannanore (12-14 Oct., 1986)	MPEDA (Ministry of Commerce), Govt. of India, Cochin	Prawn Farming Management Practices	A. G. Jhingran & Apurba Ghosh
National Seminar on Rice Hoppers, hopper borne virus and integrated management (23-26 Oct., 1986)	Bidhan Chandra Krishi Visva Vidyalaya, Kalyani	Pest management in rice-fish culture	G. N. Chottopadhyay, P. K. Chakraborty and Apurba Ghosh
School on Toxicology of Pesticides (24-29 Oct., 1986)	Regional Research Laboratory, Hyderabad	—	T. Ramaprabhu
56th Annual Session of the National Academy of Sciences, India (25-27 Oct,, 1986)	Rajasthan University, Jaipur	Some observation on the biology of the banana prawn *Penaeus merguiensis* DeMan off Orissa coast	T. Rajyalakshmi, *et al.*
-do-	-do-	Histogenesis of the hypothalmo hypophysial system in snow trout *S. niger*	Usha Moza
Socio-Economics of Aquaculture Development (28-31 Oct., 1986)	UNDP Regional Project on Network of Aquaculture Centres in Asia, Bangkok, Thailand	—	M. Ranadhir
Conference on Environmental Sanitation and Related aspects (5-7 Nov., 1986)	Ministry of Urban Development (CPHEE), Govt. of India	Aquaculture as a potential system of sewage disposal—A case study	A. G. Jhingran & Apurba Ghosh
7th National Seminar on Recent Advances in Life Sciences (10-12 Nov., 1986)	Indian Society of Life Sciences and Gulbarga University, Gulbarga	A new method of controlling *Argulus* sp. crustacean parasite of cultivable carps in freshwater ponds	A. K. Ghosh

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Indo-US Workshop on Biological Conservation and Biomonitoring in receiving water (10-14 Nov., 1986)	Jawaharlal Nehru University, New Delhi	Factors relevant to the management and conservations of Ganga fishery resources	A. G. Jhingran
-do-	-do-	As observer	Apurba Ghosh
National Seminar on Extension Education in Human Resources Development (14-17 Nov., 1986)	Andhra Pradesh Agricultural University, Hyderabad. Jointly Organised by ISEE & A.P.A.U.	—	U. Bhaumik
Ganga Basin Conference and Exposition (28-29 Nov., 1986)	Dept. of Environment, Govt. of West Bengal, Calcutta	Techno-economic aspects of Sewage-fed fish culture—A case study of suburban waste recycling	Apurba Ghosh
Seminar on rural development (1 December '86)	IOB Ltd., Banpura, Midnapur	—	B. K. Banerjee
Seminar-cum-workshop on Limnology for College Teachers in Biological Sciences (14 December, 1986)	Sponsored by Dharwad Environmental Association as part of National Environment Awareness Campaign of Environmental Services Group, New Delhi	—	S. P. Ayyar
National Symposium on fish and their Environment. (15-18 December, 1986)	Gurukul Kangari Vishwavidyalaya, Hardwar	Studies on the possibilities of culturing air-breathing fishes in jute retted water	R. N. Pal, A. K. Ghosh, V. Gopalakrishnan, S. K. Saha, S. K. Mondal
-do-	-do-	Introduction of *Tor* sp. in Kharagpur Lakes: An approach for its conservation in N.B.F.G.	A. K. Laal
-do-	-do-	Cage culture of carps, *Catla catla* (Hamilton) in a freshwater tank in Bangalore	P. K. Sukumaran, S. L. Raghavan, M. F. Rahman, S. Ayyappan & S. Parameswaran
-do-	-do-	Culture of Tilapia, *Oreochromis mossambicus* (Peters) in cages	P. Kumariah, S. Parameswaran & P. K. Sukumaran
BOBP Workshop on Shrimp Culture Potential in the East Coast States of India (16-18 December, 1986)	Madras	—	A. G. Jhingran

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
Sixth All India Seminar on Ichthyology (21-24 December, 1986)	Department of Life Sciences, Manipur University, Canchipur, Imphal, Manipur	Management of small reservoirs in India (Chaired the session "Fisheries and Fish Biology")	A. G. Jhingran
-do-	-do-	Reproductive biology of *Aorichthys seenghala* in the Ganga river system	B. N. Saigal
-do-	-do-	Fisheries of Nagarjuna-sagar reservoir (A.P. India) vis-a-vis some of the fish food biotic communities	V. V. Sugunan
-do-	-do-	Limnology and product-ivity of beels in West Bengal	M. J. Bhagat, V. Pathak & S. B. Saha
7th National Congress of Parasitology, (26-29 December, 1986)	Indian Society of Para-sitology and Ravishankar University, Raipur	Studies on trichodinid infestation on *Labeo rohita* in Hooghly District, West Bengal	A. K. Ghosh N. C. Dutta & G. C. Laha
National Seminar on Problems and Manage-ment of Coastal Eco-system (29-31 Dec., 1986)	Organised by CSSRI, Canning at Calcutta	Present status of bracki-shwater bheri fishery in West Bengal with refer-ence to its soil and water qualities problems, and management for impro-ving fish and prawn production	G. N. Saha *et al*
-do-	-do-	Effect of monsoon on the culture of tiger shrimp, *Penaeus mono-don* (Fabricius)	M. L. Bhowmik, *et al.*
-do-	-do-	Problems of fish health in bheries of the districts North & South 24-Par-ganas, West Bengal	R. N. Pal *et al*
-do-	-do-	Preliminary observations on the ecology of animal parasites in estuarine fisheries of deltaic West Bengal	M. K. Das, R. N. Pal and P. B. Das
-do-	-do-	Engineering aspects of designing prawn farms in tidal regions of Sunderbans	A. B. Mukherjee & Apurba Ghosh
-do-	-do-	—	B. N. Saigal
-do-	-do-	A note on cestode, *Ligula* sp. found in the viscera of *Catla catla* (Ham.) in a pond near Puri Coast	A. K. Ghosh

Conferences/ Symposia	Organized by	Papers presented	Authors/ Participants
National Seminar on Problems and Management of Coastal Ecosystems (29-31 Dec. 1986)	Organsied by CSSRI, Canning at Calcutta	Occurrence of the Isopod parasite *Palaecgyge bengalensis* (Bopyridia Isopoda; Crustacea) on hither to unknown host *Macrobrachium malcolmsonii* (Decapoda; Crustacea) in Orissa	A. K. Ghosh & N. Sarangi
-do-	-do-	Seed estimation and abundance of commercially important prawns, *Penaeus* monodon (Fab.) and *Macrobrachium rosenbergii* (DeMan) in West Bengal	G. C. Laha, P. B. Das, H. C. Karmakar, A. K. Ghosh & S. K. Mondal
-do-	-do-	Preliminary observations on impact of some industrial wastes on fisheries of Hooghly estuary	M. K. Mukhopadhyay, B. B. Ghosh & M. M. Bagchi
-do-	-do-	Aquaculture in coastal India	A. G. Jhingran & Apurba Ghosh
-do-	-do-	A study on rice-fish culture in coastal saline soils	G. N. Chattopadhyay, C. R. Biswas, Apurba Ghosh, P. K. Chakraborty & A. K. Bandyopadhyay
-do-	-do-	Effect of monsoon on the culture of tiger shrimp *Penaeus monodon* (Fabricius)	M. L. Bhowmick, P. K. Chakraborty, S. K. Mondal & Apurba Ghosh
-do-	-do-	Carnivorous fishes and their culture possibilities in coastal areas	N. M. Chakraborty, P. K. Chakraborty & Apurba Ghosh
Training under Loksiksha Parisad (30 Jan.-1 Feb., 1987)	Ramakrishna Mission Narendrapur, West Bengal	Aquafarming in rice-based cropping system	Apurba Ghosh
7th Indian Seafood Trade Fair (13-15 February, 1987)	MPEDA, Madras	Research problems in fish seed production	A. G. Jhingran
State-level Seminar on Fish-Seed Production (25-26 February, 1987)	Bhopal	—	A. G. Jhingran
Indian Water Congress (11-13 March, 1987)	Indian Centre for Public Health & Environment at New Delhi	Aspects of inland water management for fisheries	A. G. Jhingran & V. K. Unnithan
Symposium on Physiology of Crustacea (26-27 March, 1987)	Marathawada University, Aurangabad	—	A. K. Ghosh

VISITORS

The following is a list of distinguished personalities and scientists from different parts of the country and abroad who visited the Institute. They were taken round the research laboratories, experimental and demonstration centres to appaise them of the achievements of the Institute.

Abadian, B. A.	..	Harvard University, Cambridge
Abadian, S. (Dr.)	..	-do-
Akiyama, Dean (Prof.)	..	Texas University. U.S.A.
Angell, Charles	..	BOBP/FAO
Baweysa, G. C.	..	Member, FAO Consultancy Mission
Catling, H. D.	..	IRRI, Manila, Philippines
Chakraborty, N. K. (Dr.)	..	Director, JARI, Nilgunj
Clsiyama, Dean M.	..	American Soybean Association, Singapore
Choudhury, B. N. (Dr.)	..	Member, FAO Consultancy Mission
Das, Nilamani	..	Minister of Agriculture, Assam
Das, Umesh Chandra	..	Minister of State for Fisheries, Assam
Das Gupta, A. B.	..	Vice-chairman, West Bengal Science & Tech. Committee, Calcutta
Das Gupta, P. K.	..	Begumpur Reigional Rural Development Project
Dowell, M. M.	..	Asstt. Prof., College of Fisheries, Mangalore
Dupree, H. K. (Dr.)	..	National Fisheries Research Laboratory, La Cross
Silas, E. G. (Dr.)	..	Officer-on-Special Duty, Central Institute of Brackishwater Aquaculture, Madras
George, P. C. (Prof.)	..	Advisor, FAO/UNDP, Dhaka, Bangladesh
Guha, Kamal	..	Minister, Govt. of West Bengal, Calcutta
Hazra, S. (Miss)	..	Editor, Intensive Agriculture, Directorate of Extension, New Delhi
Jeswani, L. M. (Dr.)	..	Member, FAO Consultancy Mission
Kamal, M. Y. (Dr.)	..	Assistant Director General (Fisheries), ICAR, New Delhi
Kaushik, S. J. (Dr.)	..	Zabo, Nutrition des Poissous, INRA. Nivelle, France
Lawrence, Edison Lee (Prof.)	..	Texas A & M University, Corpus Christi, Texas

Shri Umesh Chandra Das, Hon'ble Minister of Fisheries, Assam (second from right) visits the fish pathology laboratory of CIFRI.

Shri Nilmoni Das, Minister of Agriculture, Govt. of Assam at the Kakdwip centre of CIFRI.

USDA AQUACULTURE TEAM AT ALLAHABAD

A team of US Fisheries Experts, visited the Riverine and Lacustrine Division of CIFRI, from 25 to 26 October 1986. The visit was sponsored by the Indo-US Sub-Commission on Agriculture through the USDA for preparation of a design for projects on Aquaculture/ Fisheries Research. The team was led by Dr. F. P. Meyer, Director of National Fisheries Research Laboratory, La Cross. The other members of the team were Dr. V. E. Mezainis, Dr. L. Torrans and Dr. H. K. Dupree. The US team accompanied by Dr. M. Y. Kamal, Assistant Director General (Fisheries), ICAR was apprised of the achievements of Riverine Division. They also visited the spawn rearing ponds at Sirhir.

Mahana, S. (Dr.)	..	Dy. Director of Fisheries & Crocodile Project, D.V.C. Soil Conservation Dept., Hazaribagh
Mahiuddin, Md.	..	Gram Vikas Kendra, Rameswarnagar, Howrah
Meyer, F. P. (Dr.)	..	Director of National Fisheries Research Laboratory, La Cross
Mezainis, V. E. (Dr.)	..	-do-
Millous, Olivier	..	FAO/UNDP
Mishra, D. K. (Dr.)	..	Member, FAO, Consultancy Mission
Mukherjee, S. K.	..	Member, -do-
Mukhopadhya, Amritendu	..	Minister, Govt. of West Bengal, Calcutta
Nagarajarao, D.	..	Nagarjuna University, Nagarjunanagar, A.P.
Nanda, Kiranmoy	..	Minister for Fisheries, Govt. of West Bengal, Calcutta
Nandi, S. B.	..	Sr. Trainer, Training & Research Centre, Dhaka, Bangladesh
Pahwa, D. V.	..	Sr. Scientist, ICAR, New Delhi
Pandey, S. N. (Dr.)	..	Director, JTRL, Calcutta
Radhakrishna, Y. (Prof.)	..	Nagarjuna University, Nagarjunanagar, A.P.
Ramchandran, V. P.	..	IAS, Secretary of Agriculture, West Bengal, Calcutta
Randhawa, N. S. (Dr.)	..	Director General, ICAR, New Delhi
Reyntjens, D. J. R.	..	FAO/Bay of Bengal Programme, P.O. Box 1505, Colombo, Sri Lanka
Roy, D. J. (Dr.)	..	Zonal Coordinator, Zone II of Lab. to Land Programme of ICAR, BCKVV, Mohanpur, West Bengal
Saha, N.	..	Fishery Officer, Mython Fish Farm, Bihar
Sanyal, A. K.	..	Development Manager (R & D), Rallis India Ltd.
Sarat, J. N.	..	Member FAO Consultancy Mission
Sharma, R. D.	..	Chief Editor, ICAR Publications, New Delhi
Singh, Harinder, K. (Miss)	..	American Consulate, Calcutta
Sudupa, K.	..	Asstt. Prof., College of Fisheries, Mangalore
Toney, W. A. (Dr.)	..	Consultant Biologist Rotherdam, Netherland
Torrans, L. (Dr.)	..	National Fisheries Research Laboratory, La Cross
Trichirean, Jaques	..	IFRENER, Paris

FINANCE

Expenditure for 1986-87 (April '86-March '87)

Non-plan	:	Rs.	2,31,77,917.00
Plan	:	Rs.	24,16,488.00
Total		Rs.	2,55,94,405.00

Expenditure for 1986 (January '86-March '86)

Non-plan	:	Rs.	42,62,160.65
Plan	:	Rs.	3,56,526.99
Total	:	Rs.	46,18,687.64

PROGRESS OF RESEARCH

CENTREWISE LIST OF ONGOING PROJECTS 1986

BARRACKPORE (HQS.)	FA/B/7	BF/A/11
	FC/A/4	AN/B/6
	FC/A/6	AN/A/7
	BF/B/2	AN/A/9
	BF/B/3	AN/A/10
	BF/B/8	CSS/1
	BF/A/2	
ALLAHABAD	FC/B/7	
	FC/B/8	
	FC/A/2	
BANGALORE	FA/A/13	
	FC/A/12	
BHAGALPUR	FC/B/7	
BILASPUR	FC/A/7	
BUXAR	FC/B/7	
CALCUTTA	BF/B/2	
CANNING	BF/B/3	
	BF/B/8	
DIAMOND HARBOUR	BF/B/3	
	BF/A/2	
DIGHA	BF/B/3	
	BF/A/2	
ELURU	FC/B/5	
GUWAHATI	FC/B/9	
	FC/A/13	
KAKDWIP	BF/B/9	
	BF/B/10	
	BF/A/14	
KALYANI	FA/B/6	
	FA/A/27	
	AN/A/4	
	CP/CFCSP/10	
KARNAL	Scheme on culture of large catfishes	
KRISHNAGAR	CP/CFCSP/10	
KVK/KAKDWIP	Extension, training & demonstration	
LALGOLA	FC/B/7	
MUZAFFARPUR	FC/A/5	
PATNA	FC/B/7	
POLLACHI	FC/A/10	
PUNE	FC/A/7	

RAIDIGHI	BF/B/3
RAIPUR	FC/A/7
ULUBERIA	BF/B/3 BF/A/2

RESEARCH PROJECTS MERGED DURING 1986-87

1. FA/B/2	: Ecology of Sewage-fed fish ponds	Merged with FC/A/11
2. FA/A/10	: Culture of fishes in sewage-fed ponds	
3. FA/A/12	: Sewage water paddy-cum-fish culture	
4. FA/A/14	: Culture of commercially important fishes and prawns in cages, pens and trench type of ponds in Kolleru area	Merged with FC/B/5
5. FA/A/26	: Breeding and culture of *M. birmanicum* choprai	Merged with FC/B/7
6. FA/A/35	: Breeding and nursery management of endemic hilsa, *Hilsa ilisha*	
7. FA/A/32	: Non-seasonal and seasonal breeding of Indian and exotic carps	Merged with AN/A/11
8. FA/A/33	: Breeding and culture of peninsular carps and catfishes	Merged with FC/A/12
9. FC/A/1	: Ecology and fishery management in Peninsular tanks	
10. BF/B/1	: Ecology and productivity management of brackishwater ponds	Merged with BF/B/9
11. BF/A/1	: Breeding and culture of brackishwater fin fishes in ponds and bheris	
12. BF/B/6	: Studies on the effect of industrial agricultural and metropolitan wastes on the estuarine environment and adjoining impoundments in West Bengal	Merged with BF/B/3
13. BF/A/10	: Fish diseases in brackishwater sewage eco-systems	
14. AN/B/7	: A study on aquatic microbiology of sewage-fed ponds and other eco-systems	
15. BF/A/15	: Culture of *Lates calcarifer* in sweage-fed ponds using *O. mossambicus* as forage fish	Merged with BF/A/2
16. BF/A/20	: Studies on biotic and abiotic factors in aqua-culture systems fed by Calcutta sewage	
17. AN/B/1	: Studies on energy flow in different aquaculture ecosystems	Merged with FC/A/4

ONGOING PROJECTS

PROJECT FA/B/6 : **STUDIES ON THE DIGESTIVE ENZYMES OF *RANA TIGRINA* AND *R. HEXADACTYLA* FROM BENGAL**

Personnel : A. K. Mondal and S. C. Mondal

Duration : 1980-1987

Location : Kalyani

In an experiment on brood frog rearing, 20 females of *R. crassa* fed with a diet of silkworm larvae showed excellent development of their ovaries and maturation of eggs and were freely induced to breed.

Induced bred tadpoles of *R. hexadactyla* showed uniformly good growth, metamorphosis and survival when fed on a diet of *Spirogyra* or *Wolffia*. Rearing of early frogs of *R. hexadactyla* on second instar silkworm larvae are in progress.

PROJECT FA/B/7 : **CERTAIN PHYSIOLOGICAL ASPECTS OF REPRODUCTION IN CARPS WITH SPECIAL REFERENCE TO PURIFICATION AND ASSAY OF GONADOTROPIN**

Personnel : P.K. Mukhopadhyay (up to July, 1986), Amitabha Ghosh, V.K. Unnithan (All from CIFRI); Samir Bhattacharya and Arun Ray (Both from Santiniketan)

Duration : 1984-1986

Location : Barrackpore/Santiniketan

Investigations on the seasonal changes of total protein, total lipid, cholesterol, ascorbic acid and moisture in gonad showed no significant trend in total protein content except that comparatively lower values were obtained at peak breeding season while total lipid had no definite trend of fluctuations. Ascorbic acid however, demonstrated higher values at mature phases and so also the moisture content. Cholesterol increased during maturation but subsequently dropped at fully matured stage. The GSI for females was found to be less than 1 during February which gradually increased to around 20 in May-June. In males the value increased from less than 0.5 to around 4.0 during this period.

Serum protein and ascorbic acid levels in blood followed similar patterns as in gonads. Serum cholesterol level was higher in stage III and IV compared to immature and fully mature stages.

Investigations on the histology of ovary showed that in the month of March oocytes of different stages of development were present. Resting oocytes had a number of nucleolus at the periphery of the nucleus. Some of these oocytes show signs of development as is evident from the appearance of a ring of minute vacuoles in the periphery of the oocytes. The oocytes further develop and in April-May tend to occupy most of the space in the ovary. In some cases matured ova are also seen. In April-May the testes were found to be full of sperms.

Assay of gonadotropin in serum and pituitary is in progress.

PROJECT FA/A/3 : **BREEDING AND CULTURE OF MAHSEER, *TOR PUTITORA* AND MIRROR CARP AT KUMAON HILLS, U.P.**

Personnel : C. B. Joshi

Duration : 1982-1987

Location : Bhimtal (U.P.)

Breeding and Culture of *T. Putitora* at Bhimtal (U.P.): Compared to the previous years of observations, the availability of mature female mahseers was scarce and only 4 fishes could be procured for breeding experiments. The total yield of the eggs was also comparatively less than the previous years with only 1563 eggs/female. The number of eggs per kg body weight of the fish was calculated to be 2583.

Out of 6250 fertilised eggs produced during the present season only 400 eggs were found suitable for further rearing, while the remaining 5850 eggs died within 24 hrs of fertilisation. The rate of fertilisation ranged 52.0-90.0%. In the running water condition at the indoor hatchery of Bhimtal, a total of 1622 hatchlings were produced with a hatching rate of 33.3%. The total incubation period under running water conditions at a temperature range of 24.0 to 26.0°C was found to be 72-132 hrs. The process of yolk absorption lasted from 3-4 days. The rates of survival from hatchling to fry and eggs to fry was 72.0% and 22.0% respectively. The total number of fry (1022) yielded during the experiments were stocked in Bhimtal lake.

Artificial Propagation of *C. Carpio* in Kumaon Hills: The work was initiated in March 1986 with 14 brooders (6 weighing 2·6 g and 8 weighing 2.7 g) available in the fish farm of the State Fisheries Department at Bhimtal.

Out of 6 females, only 4 females responded for breeding in the hapa, fixed in Bhimtal lake, yielding 10,200 eggs. The rate of fertilisation was observed to be 54.2%. Out of 5,55,300 viable eggs 26,900 fry were produced.

Of the 26,900 fry of *Cyprinus carpio* produced during the experiment only 6000 nos. were further reared in the cages, where as the remaining 20,900 fry were stocked in the farm. The initial size of the fry was 5-7 mm. The feeding of fry was done twice daily @ 10% body weight with the formulated feed. The experiment was continued for about 3 months in the cages in Bhimtal lake. The final size of the fry ranged 60-150 mm. Since the cage was damaged due to the whirl wind in the lake in July only 43 nos. of fingerlings could be rescued while the rest escaped to the lake.

PROJECT FA/A/13 : **CAGE CULTURE OF FISHES IN TANKS**

Personnel : B.V. Govind, S.P. Ayyar, P. Kumaraiah, P.K. Sukumaran, S.L. Raghavan and M.F. Rahman.

Duration : 1985-1988

Location : Bangalore

Monoculture of catla: The experiment on the culture of *Catla catla* initiated in January 1986 in a square cage of 10 m^2 area with a stocking density of 10 fingerlings/m^2 was concluded and a total of 34.7 kg fish were harvested after a growth period of 6 months accounting to a fish production of 580 g m^{-2} $month^{-1}$. The survival of fish was 48% and $\bar{x}$ growth, 78.8 g on conclusion of the experiment.

Monoculture of rohu: The experiment on the culture of rohu, *Labeo rohita* initiated in November 1985 in a 10 m^2 area square cage with a stocking density of 48m^{-2} was concluded after a year and a total of 24 kg of fish was harvested. The production worked out to 2.4 kg m^{-2} $year^{-1}$ with $\bar{x}$ size of 209.23 mm/121.18 g.

Intensive culture of catla: Experiments on intensive culture of catla in square cages (area: 10m^2) with different stocking densities (20,25 and 30m^{-2}) were initiated on 23-12-1986. At the end of 118 days of rearing period showed a net weight increment of 240 g m^{-2}, 110 g m^{-2} and 720 g m^{-2} in the respective densities was observed.

CULTURE OF FISHES IN LARGE CAGES

Culture of tilapia: Experiments on culture of tilapia *Oreochromis mossambicus* (Peters) were carried out in circular net cages (area: 5m^2 and 10m^2; underwater depth: 1m) from December 1985 to May 1986. The fingerlings were stocked at 3 densities, *viz:* 100 ($\bar{x}$ size: 60.75 $\pm$ 5.79 mm/6.84 g), 150 ($\bar{x}$ size : 65.23 $\pm$5.82 mm/6.02 g) and 200 ($\bar{x}$ size: 78.60$\pm$ 6.44mm/7·64 g) m^{-2} in duplicate cages. The fish were fed daily at the rate of 3 to 5% body weight, with a mixture of deoiled rice bran, groundnut cake and cattle feed pellets in equal proportions by weight. The $\bar{x}$ size attained by the stock in 148, 99 and 64 days was 61.85, 46.61 and 31.37 g (individual $\bar{x}$ weight increment: 0.371, 0.410 and 0.372 g day^{-1}) the survival being 80·2, 88.8 and 63.75% in the three experiments respectively, with $\bar{x}$ food quotient of 2.30, 1.76 and 2.22. By extrapolation, the net production of fish works out 8.94, 16.38 and 14.18 ha^{-1} $month^{-1}$ in the three experiments, the best results in terms of survival percentage and biomass production being in the experiment with a stocking density of 150 fingerlings m^{-2}. The cost of the feed was Rs. 1.40 kg^{-1}. The cost *c* of feed input kg^{-1} fish produced ranged from Rs. 2.15 to Rs. 2.85 with the three stocking densities. The experiments indicate that it will be worthwhile taking up cage culture of tilapia in large water bodies wherein the species already exists.

Mixed culture of carps: Six, 10 m^2 floating round cages were stocked at densities of 25, 30 and 35 m^{-2} in two replicates with fingerlings of *Cyprinus carpio*, *C. catla* and *L. rohita* in 3:1:1 ratio. The details of stocking and sampling are given in Table II.

Fabrication of a cage fish feeder: An experimental feeder has been designed and fabricated for feeding trials in cages as an innovative step. The feed is introduced in a receiver

Table II Mixed Culture of Carps in Round Net Cages (Area: 10m²)

cage	species of fish	Density: 300 fingerlings cage⁻¹					Density: 250 fingerlings cage⁻¹					Density: 350 fingerlings cage⁻¹				
		stocking (14.11.86)			sampling (2.3.87)		stocking (30.12.86)			sampling (2.3.87)		stocking (30.12.86)			sampling (2.3.87)	
		$\bar{X}$ initial size			$\bar{X}$ size		$\bar{X}$ initial size			$\bar{X}$ size		$\bar{X}$ initial size			$\bar{X}$ size	
		no.	length (mm)	weight (g)	length (mm)	weight (g)	no.	length (mm)	weight (g)	length (mm)	weight (g)	no.	length (mm)	weight (g)	length (mm)	weight (g)
First	Common carp	180	51.200	1.800	114.000	46.000	150	73.600	4.200	131.429	61.428	210	91.700	7.500	100.142	22.142
	Catla	60	47.400	1.850	144.091	45.182	50	101.200	9.500	161.100	50.500	70	95.300	8.950	123.625	23.125
	Rohu	60	48.310	1.420	140.700	39.500	50	102.700	8.800	138.750	37.500	70	84.950	5.350	120.857	12.142
Second	Common carp	180	51.200	1.800	126.300	47.300	150	73.600	4.200	147.000	42.777					
	Catla	60	47.400	1.850	142.363	42.636	50	101.200	9.500	156.875	77.500					
	Rohu	60	48.310	1.420	134.154	34.231	50	102.700	8.800	110.212	13.818					

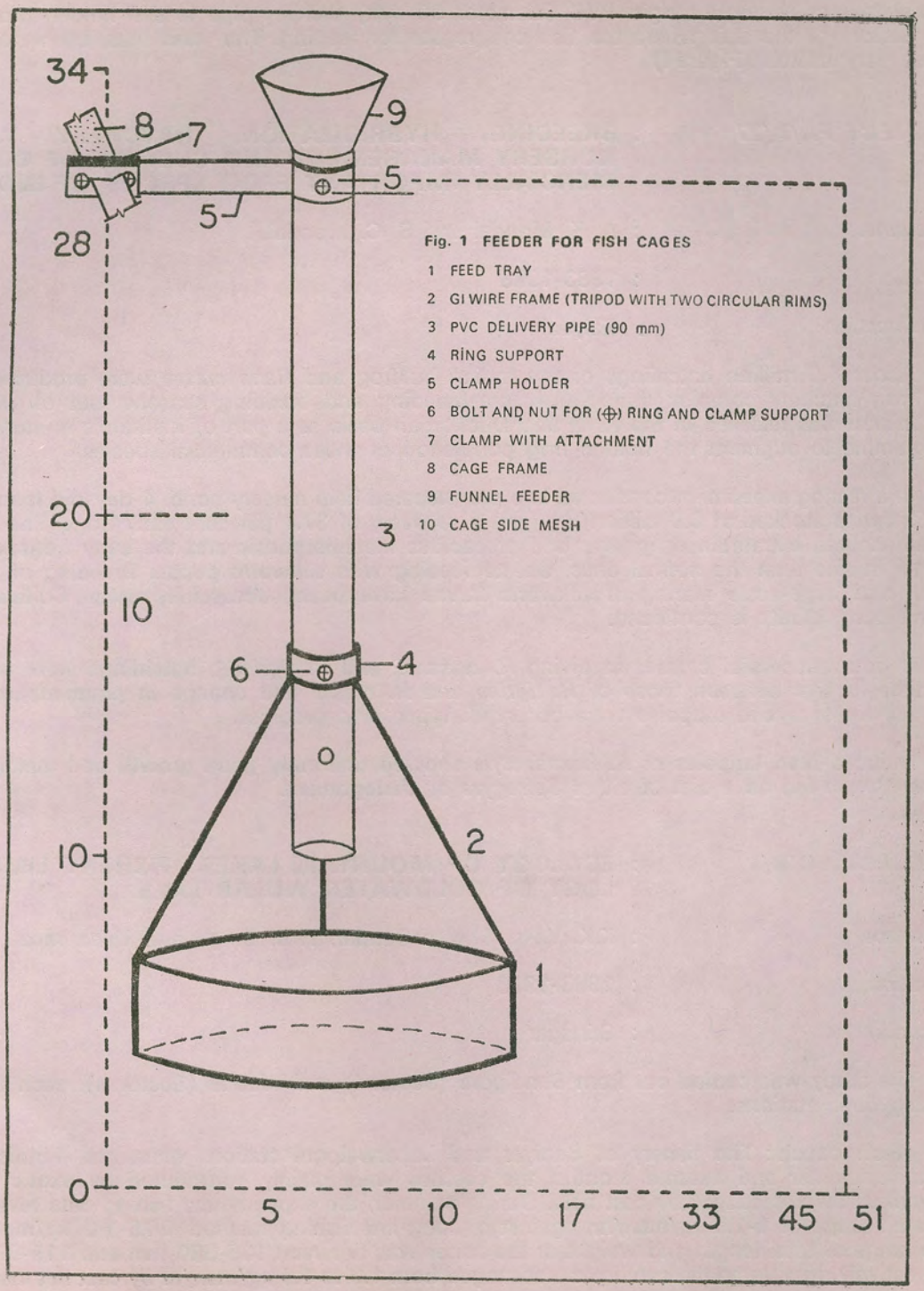


Fig. 1 FEEDER FOR FISH CAGES

1 FEED TRAY
2 GI WIRE FRAME (TRIPOD WITH TWO CIRCULAR RIMS)
3 PVC DELIVERY PIPE (90 mm)
4 RING SUPPORT
5 CLAMP HOLDER
6 BOLT AND NUT FOR (⊕) RING AND CLAMP SUPPORT
7 CLAMP WITH ATTACHMENT
8 CAGE FRAME
9 FUNNEL FEEDER
10 CAGE SIDE MESH

funnel, passes through a rigid PVC (diameter 90 mm) delivery pipe to the holder through the bottom of the unit where the fish congregate for feeding. The unit has been found to be very useful. (Figure I)

PROJECT FA/A/27 : **BREEDING, HYBRIDIZATION, HATCHERY AND NURSERY MANAGEMENT AND CULTURE OF COMMERCIALLY IMPORTANT FROG SPECIES OF INDIA**

Personnel : A. K. Mondal and S. C. Mondal

Duration : 1983-1988

Location : Kalyani

About 4.6 million hatchlings of the Indian bullfrog and *Rana crassa* were produced in the frog hatchery complex during their pre-breeding and breeding seasons, out of which 3.2 million was released in the Kulia and Dhokordah beels as a part of Institute's re-stocking programme to augment the natural frog population of these commercial species.

In a rearing experiment conducted in a pre-prepared field nursery pond, 4-day-old tadpoles of *R. tigrina* stocked at 6.0 million/ha, gave a recovery of 37.1 per cent early frogs. The tadpoles showed extraordinary growth and precacious metamorphosis and the early frogs were bigger in size than the normal ones, due to feeding with silkworm pupae. Breeding of silkmoth and large-scale rearing of silkworm larvae have been successfully done. Cultivation of mulberry plants is continued.

In four successful crosses involving *R. crassa* ♀ and *R. tigrina*♂, hatchlings were intermediate in size between those of *R. tigrina* and *R. crassa* and change in pigmentation in the tail fin of hybrid tadpoles were observed. Work is in progress.

Induced-bred tadpoles of *R. hexadactyla* showed uniformly good growth and metamorphosis when fed on a diet of either *Spirogyra* or *Oedogonium.*

PROJECT FC/B/1 : **ECOLOGY OF MOUNTAIN LAKES: FISHERY LIMNOLOGY OF COLDWATER WULAR LAKE**

Personnel : K.K. Vass, Shyam Sundar, H.B. Singh and Usha Moza

Duration : 1983-1988

Location : Srinagar

The study was carried out from Bandipore (Sector I) and Wutlab (Sector II), each comprising three stations.

Fish catch: The fishery at Baniyar and Laharwalpore stations of sector—I indicated that in summer and autumn months, the catches were mainly contributed by exotic carp (*Cyprinus carpio*) caught by cast nets. During summer, the experimental fishing data revealed a catch range of 1-1.5 kg/man/hr, against by long-line fishing method 0·75-1·0 kg/man/hr. The range of total length and weight of the fishes was between 125-380 mm and 115-670 g, respectively. In autumn the catch per unit ranged from 1.0 to 1.5 kg/man/hr by cast net method

and 1.0 to 2.0 kg/man/hr by scoop net method. The fish catches are stocked in newly dug out ponds on the bank of lake having 0.5 m depth with running water facility.

At the Wutlab sector the dominant fishery comprised exotic carp (*Cyprinus carpio*) and endemic carp (*Schizothorax* sp.). Common carp was represented by two phenotypes *viz., Cyprinus carpio specularis and Cyprinus carpio communis.*

Common carp contributed up to 80-95% (length, 160-380 mm) while the schizothoracids contributed only 5-20% (length, 160-600 mm) among the total fish landings. In experimental fishing common carp was the dominant item (87.5%) during summer while in spring *Schizothorax* sp. was the dominant item (90%). The fishing gear was long-line. The experimental fishing performed by cast net revealed the catch of *Schizothorax* as high as 92% (length range 145-320 mm).

Biological Limnology: The total phytoplankton density at Beniyar station of sector-I ranged between 34-57$\times 10^3$ units/l in surface and between 22.4-50$\times 10^3$ units/l in the bottom zone. At Laharwalpora the range was between 8-61.6$\times 10^3$ unit/l in surface and 11.2—20.8 $\times 10^3$ unit/l in the bottom water. On the other hand at Kanibathi station the phyto-density ranged between 5.6-26$\times 10^3$ units/l in surface water and between 10-38.4$\times 10^3$ units/l in the bottom water. A vertical differentiation of phytoplankton population density was maintained throughout, at all the stations. The populations were mainly dominated by Bacillariophyceae and Cyanophyceae.

The zooplankton studies from different stations of two sectors did not record much variation in population density and composition between surface and bottom layers. The average total density at Wutlab sector was 108 units/l in comparison to 98 units/l recorded at Bandipore sector. The population composition at both the sectors was similar, mainly comprised rotifers, protozoans, cladocerans, copepods and nematodes.

The macrobenthic fauna studied at different stations of sector-I during the period revealed that mollusca, diptera, naididae and tubificidae were the dominant groups. The main forms recorded from different groups in this sector were *Tubifex, Limnodrilus, Aelosoma* and *Pristinia* from Oligochaeta; *Chironomus* and *Chaborus* from deptera; and *Corbicula* and *Lymnae* from mollusca.

The benthic analysis from sector-II was conducted from five different stations. The major groups among the benthic communities comprised of oligochaetes and dipteran larvae. The major benthic forms recorded at the sampling sites were *Tubifex tubifex. Limnodrilus hoffmesteri,* among oligocheata; and *Chironomus* sp; *Chaborus* sp. and *Culicoides* sp. among diptera.

The range of physico-chemical parameters for the entire column such as water temperature 6.5-20°C, transparency 25-90 cm, depth 0.45-3.65 m, pH 7.2-8.1, free carbon dioxide (1.2-11 ppm); total alkalinity (47-98 ppm); calcium (17.2-24.8 ppm); magnesium (1.46-6.8 ppm); chloride (7.6-18.0 ppm); silicates 0.011-0.03 ppm); dissolved organic matter (8.2-20.5 ppm); and specific conductivity (210-365 us/25°C)· On the other hand the physico-chemical features during spring time were in the range of, water temperature 10-12.5°C; transparency 0.17-0.23 m; pH 8.0-8.2; dissolved oxygen 9.6-12 ppm; chloride 23.4-28 ppm; calcium 28.5-42.2 ppm; magnesium 1.9-4.7 ppm; dissolved organic matter 13.8-24 ppm; and specific conductivity 352-400 us/25°C.

Gross Primary Productivity: At different stations of sector-I, The gross production during the study period ranges between 27-47 mg C m^{-3} hr^{-1} at surface and 26-87 mg

C m^{-3} hr^{-1} in bottom at Baniyar station. On the other hand the surface production in Laharwalpore and Kanibathi ranged between 28-91 and 25-44 C m^{-3} hr^{-1}, respectively while the bottom production at the respective stations ranged between 30-65 and 18-25 mg C m^{-3} hr^{-1}. The surface production ranged between 56-78 mg C m^{-3} hr^{-1} while bottom varied from 35-137 mg C m^{-3} hr^{-1} during spring season.

The gross production of surface waters of sector-II ranged between 25-62, 24-110, 8-75 mg C m^{-3} hr^{-1} respectively for station No. 4, 5 and 6. on the other hand the bottom water production ranged between 11-46, 6-37, 6-43, mg C m^{-3} hr^{-1}, respectively for station No. 4,5 and 6. At all the three stations, in spring season, the surface production varied from 55-107 mg C m^{-3} hr^{-1} while bottom recorded a range of 52-82 mg C m^{-3} hr^{-1}. The production data indicate that good amount of carbon was being fixed by the phytoplankton population of the lake.

PROJECT FC/B/5 : **STUDIES ON THE ECOLOGY AND FISHERIES OF KOLLERU ECOSYSTEM AND DEVELOPMENT OF SUITABLE MANAGEMENT MEASURES FOR OBTAINING SUSTAINED FISH PRODUCTION**

Personnel : Ch. Gopalakrishnayya, R.M. Rao, K.V. Rao, M. Ramakrishnaiah, T.S.R. Raju and K.S. Rao

Duration : 1986-1991

Location : Eluru

Physiography of the lake: Kolleru Lake has a catchment area of 4763 km^2. The depth of the water is about 0.91 to 1.53 m for most part of the year reaching a maximum of 3.05 to 3.68 m during high floods. A number of small and big streams drain into the lake. Of these, Thammileru east and west and Budameru are important rivers.

The lake receives generally an annual inflow of 1,10,720 cusecs and its discharge into the sea through 'Upputeru', the only outlet, is only 13,600 cusecs. Length of Upputeru is about 41 km after the straight cut.

There are 46 bed villages, of which 20 are in West Godavari and 26 in Krishna Districts and 76 belt villages, of which 63 are in West Godavari District and 13 in Krishna District.

The surface of the lake is abundant in emergent and floating vegetation, viz, *Eichhornia, Pistia, Salvenia* and *Ipomea,* besides the submerged vegatation like *Vallisneria, Hydrilla, Utricularia, Chara, Nitella* etc.

The lake is getting polluted by the discharge of effluents from paper, sugar, chemical and milk project factories.

Normal tidal effect from sea is felt upto Tadinada locks and during summer it is felt up to Upputeru road bridge.

Chemical qualities of Kolleru waters: The water temperature in the lake ranged between 26.5°C and 32.5°C. The pH at different places during different hours varied between 7.6 and 8.4. The turbidity is very low around 42.5 to 71.5 cm indicating clear water without much plankton. Free carbon dioxide varied between 5 ppm and 10 ppm. Phenophthalein alkali-

nity is nil while methyl organge alkalinity varied between 150 ppm and 185 ppm. D.O. is generally low ranging between 2.2 ppm being collected at Tadinada on Upputeru and near Upputeru road bridge at 6 hourly intervals.

Fish landing statistics: The annual fish yield (January to December, 1986) from Kolleru lake was estimated to be 1,578.26 t against 1,776.02 in 1985, registering decline of 11.13%. Akiveedu centre accounted for higher landings of 45.47%, followed by Eluru (33.08%) and Bhimavaram (21.45%). Two more centres, Tokalapalli in north-east sector and Agadala-lanka in the central sector were also brought into the purview of the project during the last quarter of 1986. The monthly distribution of the catches at the three main centres is given in the following table.

TABLE III

	Eluru	Bhimavaram	Akiveedu	Total
January '86	25.23	25.52	39.15	89.90
February	24.05	16.25	34.78	75.08
March	54.03	17.61	83.17	154.81
April	6.51	10.95	90.84	108.30
May	16.88	6.40	60.94	84.22
June	4.19	7.10	15.94	27.24
July	36.60	8.50	24.90	70.00
August	41.91	43.93	18.91	104.75
September	36·32	56.85	103.18	196.35
October	142.12	43.38	87.87	273.37
November	72.20	63.21	99.93	235.34
December	62.03	38.90	57.98	158.91
Total:	522.07	338.60	717.59	1,578.26

An examination of the catches from Kolleru lake at different centres revealed that catfishes, perches, murrels and prawns formed the bulk of the fishery contributing more than 80% to the total yield, followed by carps. Among catfishes, *Heteropneustes fossilis* formed the bulk in the fishery followed by *Wallago attu* and *Mystus gulio.* Bhimavaram centre was responsible for higher landings of prawns, followed by Akiveedu.

Among the prawns, *M. monoceros, P. indicus, M. malcolmsonii, M. rude, P. monodon* and *M. rosenbergii,* were represented in the catches. Prawn landings were minimum at Eluru. *Anabas* was dominant among the perches, though *Lates calcarifer* was also recorded in low quantities, occasionally at all the centres. *Channa striatus. Channa punctata, Channa gachua* and *Channa orientalis* were represented among murrels in higher quantities at Eluru and Akiveedu. Major carps including *Catla catla, Labeo rohita* and *C. mrigala* were landed in low quantities occasionally at Eluru and Akiveedu, while they were generally absent at Bhimavaram. Huge quantities of carps including grass carp and silver carp were landed at Eluru and Akiveedu during August and September. These were probably the escapees from Kolleru tanks during high floods in August, 1986 which is reported to have been inundated and breached.

Fish Export: The important species that are exported are *H. fossilis*, *Anabas*, *Clarias magur* and *Channa striata*. The main exporting centres are Eluru and Akiveedu. While air breathing fishes are exported in live condition in iron drums with perforated tops, prawn and other fish by baskets under ice packing.

Biological studies: 300 specimens of *Anabas oligolepis* collected from different centres were examined for their food. It consisted predominantly, of plant matter in semi-decayed condition. This was followed by aquatic insects and molluscs. Fish scales also occurred in their food. Mature specimens were encountered in the size of 80 mm and above during July and August. Males were predominant in July, while in August the ratio was almost 1:1. Spent specimens were noted in August.

Sixty species belonging to 35 families were so far identified from Kolleru lake, including Uputeru. The fauna consisted of lacustrine, riverine and estuarine components.

PROJECT FC/B/7 : INVESTIGATIONS ON THE FACTORS RELATING TO DECLINE IN FISHERY OF RIVERS GANGA AND YAMUNA

Personnel : Ravish Chandra, S. P. Singh, R. S. Panwar, K. P. Srivastava, R. K. Saxena, S. K. Wishard, S. N. Mehrotra, M. A. Khan, Balbir Singh, G. N. Srivastava, R. N. Seth, R. K. Dwivedi, R. K. Tyagi, K. Chandra, Shree Prakash, P. K. Katiha, N. K. Srivastava, D. N. Srivastava, B. D. Saroj, Ram Chandra, K. S. Banerjee, A. Sarkar, Ramji Tiwari, J. P. Mishra, Bhai Lal, M. P. Singh, K. P. Singh, D. P. Verma, D. R. Kanaujia, Dhirendra Kumar, V. R. Chitransi, A. K. Laal, B. L. Pandey, S. K. Sarkar and A. R. Chaudhury

Duration : 1986-1991

Location : Allahabad, Buxar, Patna, Bhagalpur and Lalgola

HILSA FISHERIES

Landings: Total landing of hilsa during January-December, 1986 at Sadiapur, Allahabad was estimated at 1.96 t compared to 1.72 t of the corresponding period of the preceding year. The trend of the arrival remained identical in both the years, September and October accounting for the bulk of the fishery. During January-March '87, a total of 6·20 kg of hilsa was recorded at Sadiapur where all the catch coming in March only. The catch of hilsa at Allahabad comprised specimens mostly in the II and III size groups.

In the lower stretch of the river system at Buxar and Bhagalpur on River Ganga, the landings of hilsa during January, 1986 to March, 1987 were estimated at 1.67 t and 0.41 t respectively whereas it was to the tune of 18.31 t at Lalgola on River Padma.

Natural breeding of hilsa: Post-monsoon spawning of hilsa was evidenced at Allahabad and Buxar on River Ganga. The intensity of breeding was observed to be of much higher order in the stretch between Manda and Sirsa in October this year as compared to the corresponding month of the last year. The observations indicated that breeding of hilsa was confined in the stretch below the confluence unlike last year when hatchlings in underdeveloped and developed stages were encountered at all the three centres. Evidence of winter spawning of hilsa was indicated with the availability of young ones at Sirsaghat, Mandaghat and Madhauka in the shooting net collections.

Intensive natural breeding of hilsa was also reported from Buxar. In this region, the breeding commenced from mid-September and continued till the end of October. Shooting net collections constituted 80% hilsa hatchlings in September and 72% in October. Evidence of breeding was further reflected in the structure of hilsa landings in Buxar which comprised gravid specimens in the III size groups with males dominating over the females.

Juvenile fishery: Fishery of hilsa juveniles was observed to be extremely poor throughout the stretch from Allahabad to Bhagalpur. At Sadiapur (Allahabad) a total of 7.0 kg of hilsa juveniles were recorded in the landings in September. A few specimens were reported from Buxar during April and November.

POPULATION DYNAMICS OF MACROBRACHIUM BIRMANICUM CHOPRAI

An estimated landings of 96.15 kg, 1.55 kg and 1,760.82 kg of *M. birmanicum choprai* was recorded, at Patna, Bhagalpur and Lalgola centres respectively, till the end of December, 1986. The prawn was totally absent in the landings of Allahabad. A very poor landing of choprai prawn at Bhagalpur, and Patna, while a substantial landing of the same at Lalgola centre indicated the presence of different stock at Lalgola.

An estimated landing of *Macrobrachium lamarrei* at Allahabad, Patna, Bhagalpur and Lalgola centres were 1,059.62 kg, 219.40 kg, 1,266.72 kg and 1,401·63 kg, respectively.

The prawn seed prospecting investigations were carried out in the monsoon months in River Yamuna at Allahabad by operating shooting nets at weekly intervals. A catch of small sized prawns, mostly comprising *M. lamarrei,* @ 250 nos./hr was estimated. The size varied from 20-40 mm. The physico-chemical condition of water was found to range—water temperature 26-28°C, transparency 65-70 cm, pH 7.0-7.5, D.O. 6.4-7.5 ppm and alkalinity 160-175 ppm.

CATCH STATISTICS

During the period under report the landings at Sadiapur, Daraganj, Naini, Gaughat and Teliarganj centres, (all located at Allahabad) were estimated at 162.37, 20.79, 21.76, 20.88 and 17.35 t respectively. Daraganj, Teliarganj, Gaughat and Naini were brought under the purview of sampling from August, 1986 onwards in view of the fact that a good deal of catches from Rivers Ganga and Yamuna are directly brought to these centres. Daraganj, Teliarganj and Naini are basically fed by the catches from River Ganga while Gaughat from the River Yamuna. At Buxar, Bhagalpur and Lalgola centres the landings were estimated at 45.62, 66.77 and 66.28 t respectively.

The landings at Sadiapur centre did not show any major change as compared to preceding years. At Buxar centre the landings showed increasing trend as compared to preceding years. The main increase was observed in large catfish and miscellaneous group fishery. The landing at Bhagalpur centre has shown a declining trend since 1985 onwards and as compared to the period 1980-84 the landing has registered a decrease of 40%, which was true for almost all the species. Lalgola centre did not show much variation as compared to preceding years.

BIOLOGICAL INVESTIGATIONS

From the scales collected from Sadiapur centre, the growth studies for *L. calbasu* were completed. The fish registered a growth rate of 207, 311, 401, 489, 557 and 619 mm in

Ist to sixth years of the age respectively. The von Bertalanffy's growth equation was fitted as:

$$1_t = 1078(1 - e^{-0.1282\ (t+0.6474)})$$

The instantaneous mortality rate pooled for all age group was estimated to be 1.1I. The annual mortality rate and survival rate were estimated at 0.6757 and 0.3263 respectively.

Length frequency data for four major carps, three large sized cat fishes and *H. ilisha* were analysed for mean size and for the year 1986 the mean size of *C. mrigala, L. rohita, C. catla, L. calbasu, M. aor, M. seenghala, W. attu* and *Hilsa ilisha* were computed at 587, 578, 533, 446, 456, 466, 512 and 364 mm respectively.

During the period under report a sharp decline was observed in the major carps juvenile fishery at Allahabad and Buxer and it was almost negligible (72.0 kg at Allahabad and 48.0 kg at Buxar) as compared to the past. This may be attributed to very poor breeding during 1986.

STUDIES ON BREEDING AND RECRUITMENT OF SELECTED COMMERCIAL AND NON-COMMERCIAL FISHES

Carps: To study the spatio-temporal variation in the availability of spawn/fry/fingerlings of major carps, investigations were conducted during mid-July to August '86 on River Yamuna at Allahabad, and on River Ganga at Buxar, Patna and Bhagalpur. The period of investigations ranged from 31 days to 36 days depending on the availability of spawn. The centre-wise details are furnished below:

Allahabad Centre: A total of 1175 ml (*c.* 5.87 lakhs) of spawn was collected using five standard shooting nets. Three spawn spurts were encountered, two in the first flood, one each in the rising phase and receding phase of the flood, and one in second flood during the rising phase.

Hydrological parameters were also studied simultaneously. The water temperature in general varied from 18.0 to 32.0°C and during the availability period it was observed to range between 19.0 and 29.0°C. The current velocity though normally varied from 0.64 to 1.80 km/hr, it ranged between 0.97 and 1.80 km/hr during availability period of spawn. The turbidity though indicated a remarkable fluctuation (230.0-750.0 ppm) it remained in the range of 400 to 664.0 ppm. during the availability period.

The average percentage of major carp spawn as revealed by microscopic analysis of the first, second and third spurt were estimated at 34.6, 58.2 and 41.5 respectively. About 1000 ml of spawn has been stocked in Jail nursery, Naini for detailed studies.

The seasonal indices of quantity and quality were estimated at 210 ml and 52.6% respectively.

Buxar Centre: Very little spawn could be collected due to erratic flood and on rearing in plastic pools, it has been observed that the catch comprised *L. rohita, C. mrigala* and *L. calbasu* in the order of dominance. The total major carp percentage was estimated to be about 20.0% only the rest being carp-minnows, mullets, etc.

Patna Centre: Spawn investigations were conducted for 36 days from 16.7.86 to 20.8.86 at Mauzipur (Fatuha) site on River Ganga near Patna. During this period only one flood was encountered where spawn was available in the receding phase.

Microscopic analysis of the spawn samples revealed that the percentages of major carp, minor carp and 'others' ranged from 5.0 to 25.0, 75.0 to 95.0 and 5.0 to 10.0 respectively.

Bhagalpur Centre: A total of 50 ml of spawn could be collected in 31 days observation period commencing from 20.7.86. During the period, the river experienced two floods and the spawn was available in the rising phase of the first flood only. Microscopic analysis of spawn samples revealed the percentage of major carp, minor carps and 'others' to be about 65.0, 25.0 and 10.0 respectively. Samples analysed for the stray collections in the vascillation period after the second flood revealed 50.0-80.0% of clupeids and 30.0 to 46.0% of mullets.

Catfishes: Assessment of the seed resources of the large catfishes *Mystus seenghala, M. aor* and *Wallago attu* was attempted in a 5 km stretch of Rivers Ganga and Yamuna around Allahabad. The availability of the seed of the above species was observed to be poor and a few fingerlings of *M. seenghala* and *M. aor* both in the size range of 60-100 mm and *W. attu* (20.0-125 mm) were encountered. Fingerlings of small catfishes (*M. vittatus* and *C. garua*) were occasionally available.

Survey of deep pools: A stretch of River Ganga between Kara to Allahabad was surveyed during summer months and 16 numbers of deep pools were identified. Information about the fishery of these pools revealed that lesser number of major carps take shelter in them than the main-stream of the river. The fishery is mostly constituted of minor carps, catfishes, carp minnows and other trash fishes.

IMPACT OF ENVIRONMENTAL CHANGES IN THE BIOTIC COMMUNITIES

Studies were undertaken to evaluate the environmental factors responsible for decline of fishery of Rivers Ganga and Yamuna around Allahabad and Bhagalpur on River Ganga. Five sampling centres on River Ganga *viz.*, Begamsarai, (above confluence), Rasoolabad (mid-stream), Sirsa, Dumduma and Manaiya (below confluence) and two centres on River Yamuna viz., Sujawan (above confluence) and Kakarahaghat (below confluence) were selected for the study at Allahabad. Impact of domestic sewage, tannery and silk spun-mill wastes on aquatic biota at Bhagalpur was studied. Studies on physico-chemical parameters of water were made at Hanumanghat on River Ganga and at Adampurghat (BOF) on Kol of River Ganga, and at Maniksarkarghat confluence

The impact of city sewage on Rivers Ganga and Yamuna indicated lower transparency values (3-18 cm) and (1.5-13.5 cm). pH showed alkaline range (8.09-8.64) on River Ganga and (8.07-8.39) at River Yamuna O.F. The nitrates, phosphates and silicates 4.25-18.5 mg/l, 4.5-8.5 mg/l and 8-20.5 mg/l respectively were fairly rich at the outfall at both the centres on Rivers Ganga and Yamuna. Dissolved oxygen was very low (1.8-4.5 mg/l) at the outfall in both the rivers. The free CO_2 and free ammonia were higher (3.5-13.8 mg/l) and (0·5-11.5 mg/l) at both the outfalls in Ganga and Yamuna Rivers. The total soluble salt recorded higher values (347-835 micromhos/cm).

The presence of ammonia and free CO_2 associated with large number of diatoms (85%) is an indication of eutrophication at both the centres. In the unaffected zone at River Ganga in upstream (Begamsarai) planktonic population recorded 150 u/l during monsoon and 6557 u/l in winter months. Zooplankton was rich (23.64) in unpolluted zone in contrast to Rasoolabad (2.38%) and Mehdauri (7.38%)· Bacillariophyceae was also low (57.01%) at this centre against very high values at sewage polluted zone at Rasoolabad (92%) and Mehadauri (85%). In River Yamuna at AOF rich fauna was encountered comprising 10.4% of blue green, 38.9% of green, 39.6% of diatoms, 1.7% of rotifers and 9.4% of crustaceans. At the BOF, however,

very few were seen and were dominated by blue green (74.5%) followed by diatoms (15%) and green algae (10.5%). The observations indicate that the sewage wastes were highly detrimental in the plankton at the O.F. Recovery was noticed approximately 100 m down the river and due to higher concentration of organic matter blue greens flourished.

The benthic population in sewage polluted areas on Rivers Ganga and Yamuna were represented mainly by dipteran larvae and annelids. Chironomids were the dominant ones among dipteran larvae which constituted upto 70%. Amongst annelids, polychaetes dominated with a density upto 2332 u/m^2. The benthic population above the outfall recorded a maximum of 2,288 u/m^2 (March) and minimum 264 u/m^2 (November). The benthic fauna zone was represented by molluscs (78.4%) and insect larvae (21.6%). The macrobenthic fauna was maximum 1,364 u/m^2 (February) and lowest 220 u/m^2 (November). The benthic fauna recorded at Sirsa centre was of very low order, 132 u/m^2 mainly represented by gastropods.

The impact of industrial wastes on River Ganga at Dumduma due to IFFCO waste and combined wastes of ITI/BPCL and Swadeshi Cotton Mill was investigated at different points. The IFFCO waste was characterised by alkaline pH (8.22-8.60), alkalinity (350-360 mg/l), sp. conductivity (845-987 micromhos/cm) and TDS (420-496 mg/l), free ammonia (3.5-21.5 mg/l) and nil dissolved oxygen. Although the toxicity of chemical wastes gradually declined the impact was apparent from the absence of fish fauna except some weed fishes at surrounding areas of Dumduma. The observations revealed that the plankton and benthic population recovered at the O.F. during monsoon and post-monsoon. The chemical wastes of ITI, BPCL, and Swadeshi Cotton Mill discharged at Mavaiya on River Ganga was characterised by alkaline pH (8.20-8.60), alkalinity (340-380 mg/l), TDS (218-318 mg/l), sp. conductivity (390-492 micromhos/cm) and cyanide (0.535-0.612 mg/l).

At BOF region average annual plankton population was found to be 820 u/l as against 297 u/l recorded at the O.F. region. Phytoplankton constituted 65.8% and zooplankton 34.2%. The planktonic composition was Chlorophyceae (36.6%) Bacillariophyceae (26.8%)' Myxophyceae (2.4%), Rotifera (7.2%), Copepoda (21.9%) and Cladocera (4.9%). The benthic fauna at this centre was represented by polychaete larvae (264-2,200 u/m^2). The AOF at this centre indicated 572 (Nov.) to 92.9 u/m^2 (March). The benthic population was dominated by molluscan larvae (46.7%), annelids (26.7%) and insect larvae (26.6%.) The gastropods were mainly represented by *Melonia tuberculate*.

Different types of isomers of DDT and BHC were detected in the sediment of River Yamuna by GLC method indicating α BHC (21 ng/g soil), BHC (22 ng/g soil), β BHC (412 ng/g soil), pp^1 DDE (21 ng/g soil), Op^1 DDT (21 ng/g soil), pp^1 DDD (11 ng/g soil) and pp^1 DDT (11 ng/g soil) respectively.

At Bhagalpur on River Ganga, the tannery waste was characterised by alkaline pH (8-8·5), alkalinity was 124.83-780 mg/1, chloride, 130.68-2,304.13 mg/l and sp. conductivity 2,328-9,900 micromhos/cm. The BOD varied from 38.40—356 mg/l for five days incubation. The phytoplankton ranged from 9,000 u/l (October) to 10,000 u/l (Jan) and comprised green algae, blue green algae and members of Euglenoids *viz. Chlorella vulgaris, Navicula* sp., *Anabaena* sp., *Spirulina* sp., *Oscillatoria* sp., *Euglena virides, E. gracilans, E. acus*, and *Phacus* sp. Luxuriant growth of Euglenoids and their dominance over others indicated poly saprolic condition attributed to higher organic contents. Further, rapid succession of algae indicated unsuitable eco-condition, a characteristic feature of the water body polluted with organic pollutants. Zooplankton population ranged from 170 u/l (Dec.) to 1,00,000 u/l (March). *Brachionus rubens* was ubiquitous and its dominance indicated that this particular species preferred putrecible organic matter.

Studies on physico-chemical parameters of water were made at Hanumanghat on River Ganga and at Adampurghat (BOF) on Kol of River Ganga. Kol was influenced by community sewage waste. Water of OF zone was more polluted than that of BOF zone in Kol and also than that of Hanumanghat in River Ganga. River Ganga exhibited polluted condition during monsoon as evidenced by lower oxygen values (5.77 mg/l), free CO_2 (4.4 mg/l) and higher bicarbonate alkalinity (102.7 mg/l). Primary productivity studies are in Table IV.

Phytoplankton population ranged from 27 u/l (Sept.) to 3,072 u/l (June). *Gonatozygon* sp. amongst desmids was ubiquitous and dominant. Others were intercalary and lesser in number. Chlorophycean algae were next to desmids in number. Diatoms were next to Chlorophyceae in density. Blue green algae was negligible and represented only by *Oscillatoria* sp. *Gonatozygon* sp. may be regarded as the best bio-indicator of oligosaprobic condition. Negligible density of myxophycean algae was probably due to oligotrophic and oligosaprobic condition of this river.

Zooplankton population ranged from 10 u/l (July-Aug.) to 222 u/l (January '86). Amongst the zooplankton, rotifers were maximum. Rhizopods like *Difflugia* sp. and *Arcella* sp. were found mainly during monsoon. Appearance of rhizopods, which are not potamoplankton is really an interesting feature and deserve elucidation.

The trophic and saprobic conditions of the Ganga river system particularly during monsoon seem to be unconducive for the fish, particularly for carp eggs and spawn. This is evidenced by abiotic and biotic parameters of the River Ganga.

ECONOMICS OF RIVERINE CAPTURE FISHERIES OPERATIONS

Data on price of fish according to size and landings were recorded at selected fish markets, viz. Sadiapur, Daraganj, Gaughat, T.S.L. Naini and Teliarganj. The analysis of data to work out price-spread and to study the relationship between price and fish arrivals were carried out. On the basis of the studies the following conclusions could be drawn:

(*a*) Major carp fetched more price as compared to other species. On the average, at the wholesale market, Sadiapur, *C. catla* fetched the maximum (Rs. 19.32/kg) and *W. attu* the minimum (Rs. 14.00/kg) while at retail centres *C. mrigala* fetched the maximum (Rs. 23.92/kg) and *W. attu* the minimum (Rs. 17.85/kg)

(*b*) Prices are directly proportionate to size of fish and as compared to prices of smaller groups the prices for larger groups were higher by 33.2 to 87.3%.

(*c*) No regular trend was observed in the prices which may be attributed to irregular trend of fishery.

(*d*) Price-spread analysis indicated that among intermediaries and producers the producer i.e. fisherman receives 69.09%, wholesaler 6.36% (including 3.18% expenses) and retailer 24.55% (incuding 6·36% retailing cost) of the price paid by the consumer. The regression analysis of price and landings data revealed that in case of medium group, a major part of variation in prices (55 to 80%) is explained by the quantity of fish landings but in case of smaller groups the price variation explained by the landings varied from 16 to 85%. This may be due to much variation in the prices of smaller groups.

PROJECT FC/B/8 : **WATER POLLUTION INVESTIGATION IN RIHAND RESERVOIR**

Personnel : K. Chandra, R. S. Panwar, Shree Prakash and J. P. Mishra

Duration : 1984-1987

Location : Rihand reservoir, U.P.

Characterization of silica and alumina in the fly ash showed very high volumes, 54.5% and 13·5% respectively. The deposition of ash was noticed to extend from 500 m (1983) to 1000 m (1986) at Renusagar Power Company site of the reservoir. The chemical parameters of the reservoir remained normal excepting temperature which was noticed to be 5 to 7°C above the normal temperature of the reservoir at few occasions. The turbidity was also recorded to be very high to a distance up to 1000 m from the outfall, transparency values being 3.5-4.0 cm at Renusagar and 6.0-8.5 cm at NTPC, Kota outfall region respectively. No fish mortality could be observed during the year at the three sampling centres. Plankton population were sparsely distributed along the outfall region. The benthic population was absent up to a distance of 1000 m from the outfall at all the three centres.

Bioaccummulation of heavy metals: For the assessment of the bioaccummulation of mercury in aquatic food chain, water, soil sediment, fish and plankton samples were collected from the affected zone of Rihand reservoir and samples were sent for analysis by AAS-methods at ITRC, Lucknow. The analysis report is awaited.

PROJECT FC/B/9 : **INVESTIGATIONS ON FACTORS RELATING TO DECLINE IN FISHERY OF THE RIVER BRAHMAPUTRA AND ITS MAJOR TRIBUTARIES**

Personnel : D. N. Singh, Y. S. Yadava and M. Choudhury

Duration : 1985-1990

Location : Guwahati

Survey of the landing centres: An extensive survey of the river stretch from Jorhat to Goalpara on the south bank and Biswanath Chariali to Dhubri on the north was carried out for selection of fish landing centres. Eight fish landing centres (Jorhat, Dhing, Guwahati and Goalpara on the south bank and Biswanath Chariali, Tezpur, Dhekiajuli and Dhubri on the north bank) were selected (stratified sampling based on geographical considerations) for regular sampling under the project.

Fish catch statistics: Except Guwahati where regular estimation was done the other centres were sampled once/twice.

A total of 98.44 m tons of fishes were estimated to have been landed at Uzanbazar (UB) and Fancybazar (FB) fish landing centres of Guwahati. UB contributed 65.09 m tons and FB 33.35 m tons during the period July 1986 to March 1987. The monthly catch fluctuated from 4127 kg (August) to 13766 kg (September) at UB and 1739 kg (March) to 5615 Kg (November) at Fancybazar. Groupwise landings are given in table V.

In the other centres sampling was conducted once/twice. Of the two centres on south

bank, Jorhat had a predominant catch structure of major carps (68.86%), catfishes (13.77%) and minor carps (12.5%) while in Goalpara, major carps (29.62%) and miscellaneous spp. (28.27%) were of almost same magnitude followed by catfishes (17.43%).

In the north bank centres, major carps (86.96%) were the dominant group in Bishwanath Chariali, major carps (88.51%) followed by catfishes (11.49%) at Tezpur; miscellaneous spp. (74.38%) in Singri and catfishes (39.04%) followed by miscellaneous species (23.26%) and major carps (21·65%) in Dhubri. The species-wise details of the above centres are presented in tables VI and VII.

Table IV: The primary productivity studies conducted at various points around Allahabad in River Ganga and Yamuna gave the following values (mg C/m^3)

	Kankarahaghat (Yamuna)	Mehadauri sewage outfall (Ganga)	Begamsarai (upstream; Ganga)	Sirsa (Ganga)	Sujawan (upstream; Ganga)
Net production	48.875-78.560	31.25-46.45	31.25-93.75	19.53-58.56	11.71-62.50
Respiration	37.500-46.560	28.125-31.25	28.125-75.00	14.06-23.00	75.00-154.68
Gross production	78.125-93.560	54.688-140.625	54.688-256.25	—	74.21-191.406

Table V: Groupwise fish landing (kg) at Fancybazar and Uzanbazar during July '86 to March '87

Groups	Fancybazar		Uzanbazar	
	Total	%	Total	%
Major carps	14411	43.22	9521	14.63
Minor carps	2818	8.45	12615	19.38
Catfishes	3424	10.26	6297	9.67
Hilsa	3315	9.94	6229	9.57
Featherback	1367	4.10	3073	4.72
Miscellaneous	8012	24.03	27359	42.03
Total	33347		65094	

Table VI: Group-wise catch statistics (kg) at selected centres on the north and south banks of River Brahmaputra

(Figures in the parentheses are the relative percentage)

Groups	Jorhat 7 & 8.1.87	Bishwanath Chariali 9.1.87	Tezpur 11.1.87	Singri (Dhekiajuli) 12.1.87	Goalpara 20.1.87	Dhubri 6 & 7.3.87	Dhubri 24.1.87	Dhubri 8 & 9.3.87
Major carps	325 (68.86)		77 (88.51)		31 (25.0)	190 (34.23)	17 (14.53)	103 (28.77)
Minor carps	59 (12.50)					45 (8.11)		5 (1.40)
Catfishes	65 (13.77)	3 (13.04)	10 (11.49)	11 (9.09)	22 (17.74)	95 (17.12)	75 (64.90)	50 (13.97)
Featherbacks	23 (4.87)					55 (9.91)		35 (9.78)
H. ilisha					1 (0.81)	30 (5.41)		50 (13.97)
Barbus spp.						50 (9.00)		25 (6.98)
Barilius spp.				20 (16.53)	20 (16.13)			
Miscellaneous spp.		20 (86.96)		90 (74.38)	50 (40.32)	90 (16.22)	25 (21.37)	90 (25.14)
Total	472	23	87	121	124	555	117	358

Table VII: Species-wise catch statistics (kg) at selected centres on the north and south banks of River Brahmaputra

Ichthyospecies	Jorhat 7 & 8.1.87	Bishwanath Chariali 9.1.87	Tezpur 11.1.87	Singri (Dhakiajuli) 12.1.87	Goalpara 20.1.87	6 & 7.3.87	Dhubri 24.1.87	Dhubri 8 & 9.3.87
L. rohita	258				6	110	10	30
L. calbasu	14					15		18
L. gonius	51					10		
L. bata						25		5
C. catla	53		7		15	30	7	40
C. mrigala			70		10	35		15
C. reba	8					10		
W. attu	25			2	15	75		40
M. seenghala	28	3	10	9	7	20	45	10
N. notopterus	3					10		15
N. chitala	20					45		20
P. pangasius	12							
B. bagarius							25	
C. garua							5	
Barbus spp.						50		25
Barilius spp.				20	20			
Prawns								
H. ilisha					1	30		50
Miscellaneous		20		90	50	90	25	90
Total	472	23	87	121	124	555	117	358

PROJECT FC/A/2 : **ECOLOGY AND FISHERY MANAGEMENT OF A SMALL RESERVOIR IN GANGA BASIN**

Personnel : K. P. Srivastava, M. A. Khan, S. N. Mehrotra, Balbir Singh, R. K. Dwivedi, R. K. Tyagi, P. K. Katiha, Ram Chandra, B. D. Saroj, J. P. Misra and Bhai Lal

Duration : 1983-1988 (Extended by three years)

Location : Bachhra reservoir, Allahabad

(A) **Water quality:** Evaluation of physico-chemical aspects of Bachhra reservoir, giving due importance to different limnological parameters of water, edaphic features and primary production was done. The water remained clear as indicated by high transparency values ranging from 36·0 to 78.0 cm. The temperature of water varied from 17.5 to 31·0°C, the lower and higher values having been recorded in January and May respectively. The water maintained an alkaline character, pH and alkalinity values were observed in the range of 7.20 to 8.34 and 94.0 to 180.0 ppm respectively. Hardness and Ca^{++} concentration were observed to range between 17.8 to 48.0 ppm and 17.8 to 23.0 ppm respectively. Looking at the aforesaid factors, the reservoir was placed under a productive category. The nutrient status was quite satisfactory, the values of nitrates, phosphates and silicates having been estimated in the range of 0.10 to 0.14 ppm, 0.09 to 0.13 ppm and 7.5 to 10.0 ppm respectively. Dissolved oxygen remained under a satisfactory level between 6.0 and 8.6 ppm whereas the carbon-di-oxide was invariably present during monsoon months in the range of 1.6 to 4.6 ppm. Specific conductance was of a high order in the range of 148.0 to 242.0 micro-mhos/cm.

Moderate to high rate of primary productivity was observed, the values of gross production and net production having been estimated in the range of 50.0 to 110.0, and 37.5 to 75.0 $mgC/m^3/hr$ respectively whereas the respiration was observed to be in the range of 12.5 to 25.0 $mgC/m^3/hr$.

(B) **Soil quality:** The soil of the reservoir was found to be sandy, the percentage of sand being in the range of 68.0-74.0% while the clay and silt formed 11.0 to 14.0% and 15.0 to 20.0% respectively. The pH of the soil was near neutral (7.6 to 7.3) while the organic carbon was fairly rich (0.5 to 1.2%) whereas the calcium carbonate indicated a narrow range of fluctuation (2.0 to 2.4%).

(C) **Plankton:** Plankton population of the reservoir ranged from 70 u/l in March 1986 to 2458 u/l in September 1986. A bi-modal pattern in the distribution of the plankters was observed. A large planktonic pulse, caused by the blooming of *Microcystis* sp. persisted from September to November and a small one was observed in January 1987.

Phytoplankters outnumbered the zooplankters in the ratio of 2.7 : 1 and the former constituted 72.6 and the latter 27.4% in the total plankton population. Amongst the phytoplankters, Myxophyceae, Bacillariophyceae, Chlorophyceae and other forms constituted 36.6, 25.0, 10.2 and 0.7% respectively whereas the zooplankters, rotifers, copepods, cladocerans and miscellaneous formed 14.7, 10.7, 0.7 and 1.3% respectively. A new record from the reservoir was *Amphithrix* sp.

The blue-green algae slumped down from 72.1 to 36.6% in 1986-87 while a 2.5 times increase in the Bacillariophyceae group was witnessed this year. The zooplankton population too increased from 10% in 1985 to 27.4% in 1986-87.

Studies on the diurnal variation of the plankton at six hourly intervals in the month of February 1987, revealed that the maximum concentration (400 u/l) occurred in the afternoon (14 hrs) followed by early morning (2 hours.).

Periphyton: Periphytic population of the reservoir ranged from 746 u/cm^2 to 1,20,000 u/cm^2. The Bacillariophyceae, constituting 45·0% in the total, dominated over Myxophyceae (43.9%) and Chlorophyceae (11·1%).

Macrobenthic fauna: The population of benthos in the reservoir ranged between 800 in July to 3234 u/m^2 in May and was dominated by insect larvae, constituting 55.6% and followed by gastropods (29.1%) and annelids (15.3%). The molluscan population indicated an improvement over the previous year. A large number of small sized gastropods, encountered in April suggested the breeding of the group in February-March.

The insect larvae showed one peak in the month of February. No zonal variation in the biotic population was witnessed.

Fish yield: The potential yield of the reservoir was computed using tropho-dynamic model and it was estimated at 149.1 kg/ha. Giving an allowance of 50% of mortality and escapement and erratic terrain of the reservoir in the form of uneven bed, presence of tree-stumps, stone boulders, etc. obstructing the fishing operations, a yield of 74.5 kg/ha was anticipated from the reservoir.

The fishery was auctioned for commercial exploitation, fetching a revenue of 63,700.00 (Rupees sixty three thousand seven hundred only) and a yield of 67.4 kg/ha was achieved as against the target 65.0 kg/ha fixed for the year 1986.

Out of 160 days available, the contractor availed only 85 days and conducted fishing operations using different types of multimeshed gears *viz.*, gill nets, drag nets, cast net, traps, etc.

A total of 4851.450 kg of fish, comprising 2327.600 kg (47·98%) of major carps, 1439.150 kg (29.66%) of catfishes, 696.400 kg (14.35%) of feather-backs, 66.150 kg (1·36%) of murrels, 52.800 kg (1.36%) of minor carps, 0.900 kg (0.02%) of eels and 268.450 kg (5.54%) of miscellaneous fish were captured.

The major carp group was dominated by mrigal, 737 specimens, wt. 1315.150 kg (27.11%) followed by catla, 149 specimens, wt. 615.800 kg (12.69%), rohu, 575 specimens, wt. 278.950 kg (5.75%) and calbasu, 117.800 kg (2.43%). In the catfish group *Mystus seenghala* was the dominant species with 1156.950 kg (23.86%), followed by *W. attu* 168.850 kg (3.48%). Other catfishes were represented by *O. bimaculatus*, *C. garua*, *E. vacha*, etc. Excepting a few specimens of *M. chitala*, *N. notopterus* was the main constituent of the feather-backs. Minor carps were mainly represented by *P. sarana*, murrels by *C. marulius* and eels by *M. armatus*. Carp minnows, clupeids, perches, gobids, etc. formed the miscellaneous group of fishes.

37 number of tagged specimens, marked by anchor tags from 1983 onwards, were recovered during commercial fishing operations, of which 15 juveniles were released back in the reservoir. On the basis of these recoveries the growth of mrigala, catla and rohu, in terms of weight were computed at 2.26, 3.18 and 2.08 g/day respectively. The average sizes of commercial catch in respect of mrigala, catla, rohu, calbasu, seenghala and wallago were estimated at 583, 644, 405, 357, 541 and 612 mm respectively. The share of catches below 350 mm was of a very low order possibly due to mesh-selectivity of the commercial gear.

Induced breeding: Induced breeding experiments were conducted at village Sirhir near Bachhra. About 9 lakhs rohu and 3 lakhs mrigala hatchlings were produced and put in the nursery ponds for rearing.

Pre-and post-recruitment studies: Pre-recruitment studies were conducted in monsoon months. No eggs, hatchlings, and fry of major carps were encountered perhaps due to drought conditions and erratic rains affecting major carp breeding.

Post-recruitment studies conducted with different fishing gears in the month of February-March, indicated that mrigala and rohu had grown in the size and weight range of 300 to 345 mm (280-450 g), while calbasu had attained the growth of 275-350 mm (160 to 500 g).

Stocking: A total of 37,000 fingerlings (514/ha) were stocked in 1985. A portion of the stocked fingerlings were fin-clipped.

Forage fish population: Population of weed fishes was estimated through drag netting and cast netting operations from time to time. It was revealed that *Amblypharyngodon mola* (79.3%) was the dominant species followed by *Osteobrama cotio* (17.4%) and *Ambasis* spp. (1.6%) the rest 1.7% constituted by carp minnows, clupeids, etc.

PROJECT FC/A/3 : ECOLOGY AND FISHERIES OF DHIR BEEL IN ASSAM—STUDIES ON SOME POPULATION PARAMETERS OF INDIAN MAJOR CARPS IN DHIR BEEL

Personnel : Y. S. Yadava and M. Choudhury

Duration : 1981-1988 (Extended by two years)

Location : Guwahati, Dhir beel, Chapar (Assam)

About 106 advanced fingerlings of Indian major carps (*L. rohita*—9 Nos., average length 208.69±19.50 mm: average weight 119.73±33.61 g, *C. mrigala*—14 Nos., average length 241.9±26.09 mm; average weight 156.4±33.05 g and *L. calbasu*—1 No., 183 mm and 70 g) were caught with the help of gill nets, tagged (anchor tags) and subsequently released in Dhir beel during the period 5.11.86 to 11.11.86.

5 specimens of *L. rohita* and 1 specimen of *C. mrigala* were recovered till March, 1987, of which only 2 specimens of *L. rohita* had complete tags on them. In others the number portion of the tag was missing on recovery. All the specimens were recovered during winter fishing in the beel. The recovery percentage was 5.49% in case of *L. rohita* and 7.14% in case of *C. mrigala* is too small to make deductions on biological parameters.

PROJECT FC/A/4 : **ECOLOGY AND FISHERIES MANAGEMENT OF BEELS IN WEST BENGAL**

Personnel : A. G. Jhingran (since 15.7.86), P. Das (up to 14.7.86), M. Sinha (since 15.7.86), S. B. Saha, Kuldip Kumar (up to 25·2·87), M. J. Bhagat, V. Pathak, Mrs. K. Mitra and S. K. Majumder

Duration : 1980-1989

Location : Barrackpore

Observations relating to various physico-chemical parameters of soil, water, primary production, plankton, detritus, benthos, macrophytes etc. were continued in Kulia beel (closed type). Bottom soil of the beel was near neutral in reaction (pH 6.4 to 7.0) with high values of organic matter (4.8 to 6.8%), available nitrogen (78.9 to 89.2 mg/100 g^{-1} soil) and available phosphorus (12.8 to 16.0 mg/100 g soil). Water was rich in alkalinity (156 to 212 mg l^{-1}), dissolved organic matter (1.8 to 3·6 mg l^{-1}) and specific conductivity (588.0 to 1100·0 micro mhos) but moderate to low in respect of nitrate (0.22 to 0.56 mg l^{-1}) and phosphate (0.02 to 0.07 mg l^{-1}). Water pH was in the range of 7.2 to 8.0 with the presence of free CO_2 (2.0 to 8.5 mg l^{-1}). A sharp diel change was noted with respect to various chemical parameters. Primary production was contributed both by phytoplankton and macrophytes. The rate of energy transformation by phytoplankton ranged between 6002 and 39,302 cal m^{-2} day^{-1} (0.31 to 1.9% of light), of which nannoplankton contributed 4,096 to 21,824 cal m^{-2} day^{-1} and the rest was contributed by net plankton. Thus 56 to 76% of the energy was fixed by nannoplankton. Chlorophyll concentration was in the range of 2.3 to 19.3 mg m^{-3} in the form of net plankton and 1.92 to 9.75 mg m^{-3} in the form of nannoplankton.

The beel was very rich in detritus (166.8 to 501 g m^{-2}) and bottom energy (17.01 to 51.1 $\times$ 10^4 cal m^{-2}). Phytoplankton ranged from 88 to 898 u l^{-1} while zooplankton ranged from 60 to 135 u l^{-1}. Major species encountered were *Chlorella, Eudornia, Melosira, Synedra* and *Navicula* among phytoplankton while rotifers and their nauplii dominated among zooplankton. Bottom macrofauna were contributed mainly by chironomid larvae and gastropods. Their numerical abundance was 72 to 136 no/ft^2. *Eichhornia* sp. was the main macrophyte of the beel, though it occured in patches.

The beel was stocked with fry and fingerlings (av. wt. 10 g each) of Indian major carps, common carp and grass carp (2,48,365 numbers or 8,279 nos ha^{-1}). The fish yield from the beel was 15,880 kg (529.33 kg/ha). *L. rohita* dominated the fish catch being 34% of total catch. This year, the society had observed a closed season for 3 months i.e. April to June, due to smaller size of the fish stock. Hence the catch was less than that of the last year. The gut analysis of important fishes showed detritus as their chief food ranging from 60-85%.

PROJECT FC/A/5 : **ECOLOGY AND FISHERIES MANAGEMENT OF OX-BOW LAKE (MAUN) IN GANDAK BASIN (NORTH BIHAR)**

Personnel : S. P. Rai, B. C. Jha, S. N. Singh, C. Lakra and R. C. Singh

Duration : 1983-1989 (Extended by two years as a mission project)

Location : Muzaffarpur (Bihar)

The left (A) and right (B) segments of Kanti maun (Muzaffarpur) were studied for their ecology and productivity status. Left segment receives domestic sewage from B.S.E.B. Colony

whereas the right segment receives ash slurry from the Kanti Thermal Power Plant. The right segment is further divided into two zones by an earthen dam to confine slurry deposition, but both are connected by hawse-pipes.

PHYSICO-CHEMICAL FEATURES OF WATER AND SOIL

Values observed during January 1986 to March 1987 are presented in tables VIII and IX.

Drastic fall in dissolved oxygen during May-June and November-December in segment A is attributed to decay of aquatic weeds. Bulk of organic production was due to aquatic weeds. This is further substantiated by the poor content of Chlorophyll in phytoplankton in both the segments. High negative redox potential in the soil is an indicator of the severe reducing condition prevailing at the bottom.

PLANKTON

(*i*) **Net plankton: Segment A:** Average plankton abundance during the period of study was 1458,369 nos/m^3 which consisted 81.84% of phytoplankton and 18.16% of zooplankton. Phytoplankton was dominated by Bacillariophyceae (38.90%) followed by Dinophyceae (26.68%) and Myxophyceae (13.71%). Copepods contributed maximum (16.32%) among zooplankton.

March was the month of highest plankton abundance whereas least abundance was recorded in October. Dinophyceae and Bacillariophyceae were the major groups contributing to the total plankton abundance in March.

Segment B: Average numerical plankton density was more in this segment (26,78,168 nos/m^3) than segment A. Like segment A, phytoplankton (89.50%) dominated over zooplankton (10.50%). Dinophyceae (66.97%) was the group of bulk contribution followed by Myxophyceae (16.08%) and Bacillariophyceae (5.59%) among phytoplankton whereas zooplankton mostly came from Copepoda (9.84%).

Ooctober was the month of highest plankton abundance which was dominantly shared by phytoplankton as a result of bloom of *Ceratium* sp (Dinophyceae). During the month *Ceratium* was observed in broken state but the rest of toxon were intact.

PLANKTERS ENCOUNTERED

Myxophyceae	..	*Microcystis* sp, *Oscillatoria* spp, *Merismopedia* sp, *Anabaena* sp & *Spirulina* sp.
Chlorophyceae	..	*Spirogyra* sp, *Sirogonium* sp, *Scenedesmus* sp & *Selenastrum* sp.
Dinophyceae	..	*Ceratium* sp & *Peridinium* sp.
Desmidiaceae	..	*Cosmarium* sp, *Closterium* sp & *Staurastrum* sp.
Bacillariophyceae	..	*Fragilaria* sp, *Synedra* sp, *Gomphonema* sp, *Diatoma* sp, *Tabellaria* sp, *Pleurosigma* sp, *Rhopaloidia* sp, *Pinnularia* sp, *Stauroneis* sp, *Navicula* sp, *Cymbella* sp, *Nitzschia* sp, *Melosira* sp, *Amphora* sp, & *Epithemia* sp.
Protozoa	..	*Vorticella* sp & *Difflugia* sp.
Rotifera	..	*Keratella* sp, *Polyarthra* sp, *Filinia* sp & *Brachionus* sp.
Cladocera	..	*Diaphnosoma* sp, *Bosmina* sp, & *Daphnia* sp.
Copepoda	..	*Phyllodiaptomus* sp, *Cyclops* sp & nauplii.

(*ii*) **Nannoplankton:** The average nannoplankton of the Kanti maun was estimated to be 38,420 u/l (segment A) and 30,880 u/l (segment B). The nannoplanktonic biomass was highly dominated by the abundance of bacterial filaments. Nannoplankton other than bacteria were only 4·50% in segment A and 2.80% in segment B.

The dominant nannoplankton encountered were:

Bacteria	..	*Leptothrix, Rhaobochromatin, Thiopedia, Chlorobium, Sarcina* and *Streptococcus* (The latter form was found restricted to segment B.)
Algae	..	*Merismopedia, Phacus, Trachelomonas, Coelastrum, Oocystis, Chlorobotrys, Askenasyella, Diploneis Pinnuria, Fragilaria, Synedra, Cyclotella* and *Navicula*
Protozoans	..	*Cilliates*

BENTHOS

Both the segments were highly dominated by molluscs to the extent of 94 and 96% respectively followed by dipterans.

PERIPHYTON

The average periphytic population of the Kanti maun (segment B) was estimated to be ranging between 630 to 2397 u/cm^2, being the highest in March and lowest in July. Broadly a "binemic" pattern of annual fluctuation was evident, the primary pulse being in spring and secondary in post-monsoon. The biomass was largely dominated by diatoms (58.13-78.19%) followed by green algae (6.39-27.31%), blue green (8.21-17.32%), protozoans (1.98-5.13%) and miscellaneous (0.50-2.53%). With regard to the vertical stratification of the population it was always highest at I m depth (925-3590 u/cm^2) followed by surface (840-3375 u/cm^2). A sharp decrease at the bottom was recorded (125 -407 u/cm^2) which may be attributed to the shadowing by heavily infested sub-merged weeds.

The periphytic studies in the segment A was initiated only from October, '86 and during the period the average biomass was estimated in the range of 2244 to 2982 u/cm^2 being the highest in number. The I m depth appeared to be the most productive followed by the surface layer. The colonization of organisms at the bottom remained much less (238-403 u/cm^2) as compared to surface and I m depths.

Bacillariophyceae (61.56-72.86%) was the most dominant group of periphyton followed by green algae (11.45-19.21%), blue green (7.84-12.31%), protozoans (4.75-8.93%) and miscellaneous (1.05-2.45). *Achnanthes, Diploneis, Navicula, Gomphonema, Cyclotella, Pseudoulvella, Coelastrum, Anabaena, Merismopedia, Centropyxis, Actinospherium* were the dominant periphyton in both the segments. However, the degree of abundances was variable.

MACROVEGETATION

Both the segments of Kanti maun were heavily infested with submerged aquatic weeds. The fresh weight of aquatic weeds observed, ranged between 4.5-7.3 kg/m^2 (segment B) and 3.9-7.1 kg/m^2 (segment A); whereas the dry weight recorded in the range of 0.34-0.56 kg/m^2 (Segment A) and 0.30-0.54 kg/m^2 (Segment B). Broadly, very little fluctuation was observed in the annual abundance of aquatic weeds. *Hydrilla, Ceratophyllum, Potamogeton* and *Najas* appeared to be the most dominant and perennial weeds, regulating the abundances of the biomass.

Qualitative composition of the hydrophytes was as under:

Hydrilla verticillata, Ipomea aquatica, Ceratophyllum demersum, Polygonum barabatum, Potamogeton nucifera, Nilambo nucifera and *Najas minor.*

The pteridophytic weed *Azolla pinnata* was found growing in the segment B which receives thermal effluents. During November and December, the entire surface area was found covered with *Azolla.*

FOOD OF FISHES

Only a few specimens of *Cirrhinus mrigala* were available for this study. The length and weight varied from 475 to 501 mm and 1,045 to 1,165 g respectively.

Gut analysis revealed the dominance of decomposed matter of plant origin. The next group in order of abundance was Bacillariophyceae.

FISH CATCH STATISTICS

A total of 5,504.63 kg of fishes were landed from the maun during January 1986 to March 1987. Major share came from air-breathing fishes, followed by miscellaneous group (18.48%). Major carps accounted for 12.25%. A sizeable contribution was from *Nandus nandus* (12.34%), *Wallago attu* (9.17%), *Notopterus notopterus* (7.40%) and shrimps (7.11%). The rest came from uneconomic groups.

Channa marulius, C. punctatus and *Heteropneustes fossilis* represented air-breathing fishes, while miscellaneous group included minor carps.

PEN CULTURE

Stocking of the pen was done in January 1986 with the following species combination: *Catla catla* 1.23; *Labeo rohita* 1.0; *Cirrhinus mrigala* 1.35. The fishes were fed with mixture of rice bran and mustard oil cake @ 2% of the body weight. Due to thermal discharge from Kanti thermal power plant, the stock faced sudden mortality on 13th and 14th June 1986. Dissolved oxygen value in the water was recorded to be below 1 ppm during those days.

The average weight recorded by the fishes after five months (at the time of harvesting) was *Catla catla* 560 g, *Labeo rohita* 240 g and *Cirrhinus mrigala* 280 g. A total of 68.1 g including 16.9 kg of breeders of *L. rohita* and *C. mrigala* was recovered. A second experiment was set up on 12.1.87 in a nursery pen of 0·06 ha area. 1,450 fingerlings of catla, rohu and mrigal (10: 3 :1.5) were stocked which recorded the following growth rates in $2\frac{1}{2}$ months time:

Species	Av. wt (g)			Av. length (mm)		
	12.1.87	13.2.87	21.3.87	12.1.87	13.2.87	21.3.87
C. catla	6.87	15.5	42.5	88.6	103.0	141.5
L. rohita	15.0	30.0	57.5	110.4	132.8	166 1
C. mrigala	10.0	*	*	108.1	*	*

*Did not figure in sample.

Table VIII: Physico-chemical characteristics of water of Kanti Ox-Bow lake, Muzaffarpur

	Segment A		Segment B	
	Average	Range	Average	Range
Air temperature (°C)	26.9	13.00-36.5	26.9	13.00-36.5
Water temperature (°C)	25.4	17.00-30.0	25.9	17.0-30.0
Depth (m)	2.74	2.00-3.77	3.41	2.5 -4.8
Transparency (cm)	211.4	180-265	27.2	10.0-65.0
Dissolved oxygen (ppm)	5.73	1.0-10.0	4.7	0.05-8·0
Carbondioxide (ppm)	5.0	0.0-20.0	11.15	0.0-30.0
Total alkalinity (ppm)	169.5	110.0-240.0	199.5	120-250
pH	7.8	6.8-8.7	7.8	7.0-9.0
Redox potential Eh (mv)	+127.8	+56.0-+216	+139.3	+35-218
Specific conductance (μmhos/cm)	499.8	250-800	631.8	350-950
P_2O_5 (ppm)	0.06	Tr-0.12	0.05	Tr-0.10
Rate of carbon fixation by plankton (μmgC/m^3/hr)	10.1	0.0-35.0	12.0	0-25
Rate of carbon fixation by aquatic weeds (mgC/kg weed)	48.0	30.0-80.0	38.5	20-70
Chlorophyll content of phytoplankton (μg/lit)	0.029	Tr-0.07	0.03	Tr-0.06

Table IX: Physico-chemical characteristics of soil of Kanti Ox-Bow Lake, Muzaffarpur

	Segment A		Segment B	
	Average	Range	Average	Range
pH	6.8	6.5-7.2	0.6	6.5-6.8
Redox potential-Eh (mv)	−238	−229-270	−306	−239-416
% organic carbon	2.65	2.5-2.8	2.65	2.5-2.8
Available P_2O_5 (mg/110 g soil)	12.05	11.5-12.5	11.68	11.0-12.2
Specific conductance (μmhos/cm)	368.7	300-425	512.9	438.5-540

PROJECT FC/A/6 : ECONOMICS OF FISHING—A CASE STUDY OF SELECTED RESERVOIRS

Personnel : S. Paul, V. V. Sugunan and H. K. Sen

Duration : 1983-1988 (Extended by two years)

Location : Barrackpore

Analysing economic data received from various states in response to questionnaires was completed and subsequent correspondence was initiated to fill the data gaps. Further processing and interpretation of data were also taken up. The possibility of extending the coverage to the study to new reservoirs was also examined.

PROJECT FC/A/7 : ECOLOGY AND FISHERIES OF FRESHWATER RESERVOIRS

Personnel : B. V. Govind, G. K. Bhatnagar, H. P. Singh, D. K. Kaushal, V. K. Sharma, P. L. N. Rao, M. D. Pisolkar, B. K. Singh, A. Kolekar, V. R. Desai and N. P. Srivasthava

Duration : 1986-1990

Location : Bangalore (Karnataka), Govindsagar, (Bilaspur, Himachal Pradesh), Ravishankarsagar (Raipur, Madhya Pradesh) and Panshet reservoir (Pune, Maharashtra)

RAVISHANKARSAGAR (GENERAL RESERVOIR)

The work was initiated at this centre since 12.9.86 only. Ravishankarsagar reservoir is constructed across the River Mahanadi at Raipur. This reservoir has a catchment area of 3,670 sq. km.

Fish yield data of the reservoir: The monthly fish landings during 1986-87 is given in Table X.

It is evident from the table that the fish catch of Gangrel reservoir showed predominance of catfishes such as *M. aor, M. seenghala* and *W. attu* (44·6-76.6%) and the major carps which accounted for 8.0-29.4% in the total catch, were mainly represented by *C. mrigala* (7.6-21.6%). It was remarkable to note that in the catches of March 1987, the group of local minor fish represented by feather-backs and carp minnows was very predominant (46.38%), which was exclusively caught by scoop nets.

According to the stocking figure collected from M. P. Fisheries Corporation, a total of 81,04,050 fish fry were stocked in the reservoir from 1983 to 1986.

1. WATER LEVEL AND INFLOW AND OUTFLOW RECORDS

(*a*) **Govindsagar Reservoir** (Himachal Pradesh) : The water level of the reservoir fluctuated by 49.06 m. The minimum inflow and outflow were recorded in February '86 whereas maximum of both were in July. The total inflow and outflow were 20,15,897 ha. m. and 22,51,937 ha. m. respectively. The total rainfall was 1,257.4 mm.

RAVISHANKARSAGAR RESERVOIR

Table X: Monthly fish catch (by weight in Kg) from November 1986 to March 1987*

Month with fishing days	Major Carps (Kg)			Total	Cat fishes	Miscellaneous	Gr. Total
	C. catla	*L. rohita*	*C. mrigala*				
NOV. '86 (22 days, 36 men, 18 boats, gillnets of 100 kg twine wt.)	62.0 (2.7%)	120.0 (5.1%)	501.0 (21.6%)	683.0 (29.4%)	1541.4 (66.4%)	97.3 (4.2%)	2321.7
DEC. '86 (31 days)	—	34.0 (3.0%)	206.5 (18.0%)	240.5 (21.0%)	879.5 (76.6%)	28.0 (2.4%)	1148.0
JAN. '87	Fishing restricted to 2 days only (10.0 kg)						
FEB. '87	No fishing						
MAR. '87† (21 days, 30 men, 12 boats, 180 feet of gill nets)	8.5 (0.4%)	—	140.2 (7.6%)	148.7 (8.0%)	826.5 (44.6%)	859.5 — (46.4%)	1834.7

*As per the data recorded by M. P. Fisheries Corporation, species-wise data is available only for major carps. other are grouped into two categories, cat fishes and miscellaneous. The fishing was initiated as late as November, '86.

†Catch through illegal fishing=18.5 kg (1.0%).

(*b*) **Panshet Reservoir** (Maharashtra) : The Panshet Reservoir has an average level of 624.696 m, the maximum being 635.76 m during September '86 and the minimum being 605.01 m in June '86. A total precipitation of 1,656.55 mm was recorded. Because of draught prevailing outflow was restricted from the month of July onwards. The average outflow was of the order of 299.218 cusecs, maximum being 789.03 (January '86) and the minimum during July '86 (24.03 cusecs).

2. PHYSICO-CHEMICAL CHARACTERS OF SOIL

Govindsagar Reservoir: The soil of the reservoir was alkaline (7.4 pH) having poor nutrients. The organic carbon and available P_2O_5 ranged between 0.02-0.21% and 1.0-10.0 mg/100 g, respectively.

3. PHYSICO-CHEMICAL CHARACTERS OF WATER

Govindsagar Reservoir: The lowest water temperature, nitrate and phosphate concentration were observed in the upper reaches of the reservoir. Thermal stratification was observed either at sub-surface or at higher depths in lotic, lentic and Lunkhar Khad of the reservoir. Thermal stratification was always associated with chemical stratification specially in respect of pH and dissolved oxygen. The range of water temperature, transparency, pH, dissolved oxygen, free CO_2, total alkalinity, calcium, magnesium, nitrate, phosphate, silicate and specific conductivity fluctuated between 9.0 to 32.0°C, 36.0-639.0 cm, 7.4 to 8.4, 2.56 to 13.44 ppm, nil to 6.0 ppm, 60.0 to 88.0 ppm, 21.0 to 26.0 ppm, 2.2 to 2.8 ppm, 0.055 to 0.12 ppm, 0.05 to 0.09 ppm, 1.8 to 2.8 ppm and 138.6 to 267.3 μmhos/cm, respectively.

4. PRIMARY PRODUCTIVITY

Govindsagar Reservoir: The gross and net organic carbon production varied from 250.0 to 750.0 mgC/m^3 /day and from 125.0 to 450.0 mgC/m^3/day respectively. The respiration values fluctuated between 150.0 and 360.0 mgC/m^3 /day. Higher values were observed at 1.5 m depth.

5. PLANKTON

Govindsagar Reservoir: Plankton population of the reservoir revealed an average standing crop of 2.64 ml/m^3 with 2,998 units/litre. Phytoplankton formed 94.22% of the total plankton. *Ceratium hirundinella* was observed to play an important role in the formation of primary peak in April and secondary peak in November. Lunkhar Khad was found rich in plankton (3.32 ml/m^3; 3,683 μ/l). Proliferation of *Ceratium* resulted in plankton bloom of a minor magnitude both in March 86 and 87. Diurnal variation in plankton showed abundance of *Ceratium* and *Peridinium* at 24 hrs. and 04 hrs. Plankton at upper reaches was dominated by bacillariophycean forms.

Chlorophyll 'a' in subsurface water from lentic zone varied from 6.6825 mg/m^3 to 1.0414 mg/m^3. Similarly, in Lunkhar Khad it ranged between 1.0414 mg/m^3 to 3.4714 mg/m^3. Concentration of chlorophyll 'a' indicated richness of Lunkhar Khad as compared to lentic zone which was also evident from the study of plankton abundance in both these sectors.

6. BOTTOM BIOTA

Govindsagar Reservoir: Studies of macrobenthos revealed an average density of bottommacrofauna of 545 u and 2.91 g/m^2. Further the benthos was observed to be richer in lentic zone with 724 nos/m^2 and 4.5 g/m^2. Qualitatively, oligochaetes dominated in Lunkhar Khad and lentic zone while dipteran larvae were predominant in lotic zone. Benthos showed maximum concentration at 10-15 m depth in lotic zone, 8-10 m and 30-40 m depth in Lunkhar Khad.

7. AQUATIC PLANTS AND ASSOCIATED FAUNA AND FLORA

Govindsagar Reservoir: Periphytic communities remained dominated by Bacillariophyceae both qualitatively and quantitatively (40.04-90.60%).

8. FISH FAUNA

Panshet Reservoir: About 22 species of fishes have been recorded from the reservoir.

9. YIELD ESTIMATION

Govindsagar Reservoir: Fish landing records showed 418 tonnes of fish landing resulting to a gross yield of 460 tonnes. This gave 40.73 kg/ha/14 months of fish production which showed a decline in the production rate compared to that of 51.87 kg/ha during 1985. *H. molitrix* dominated the catch with 42.05% followed by *L. dero* (35.12%), *C. carpio* (21.37%), *C. catla* (5.39%), *T. putitora* (2.0%) *L. rohita* (1.88%) and *C. mrigala* (0.78%). Maximum catch was during May-June accounting to 26.87%. The landings were poor during November-December. Small mesh bar nets (45-75 mm) were found effective and were commonly used for fishing, *L. dero, T. putitora, L. dyochielus, C. carpio, C. catla* and *L. calbasu.* In commercial landings *C. catla* dominated in the size range of 560-619 mm, *L. rohita* in 500-579 mm, *C. mrigala* in 540-659 mm, *L. calbasu* in 400-499 mm and *C. carpio* in 420-519 mm.

PROJECT FC/A/10 : ECOLOGY AND FISHERIES OF THE SMALL RESERVOIRS IN ALIYAR BASIN (MISSION PROJECT)

Personnel : C. Selvaraj, V. K. Murugesan, P. K. Aravindakshan, M. Kaliyamurthy, Mathew Abraham and K. O. Joseph

Duration : 1985-1990

Location : Pollachi/Aliyar Nagar (Tamil Nadu)

During January '86 to March '87, the water level in the reservoir exhibited a wide fluctuation of 23.21 m. The reservoir received a total inflow of 4,242.19 cumecs as against the total outflow of 4,804.76 cumecs.

The water was poor in respect of nutrients like nitrate, phosphate, calcium and magnesium, while silicate content was fairly high.

Large scale fish mortality occured on 3rd and 4th March, 1987. Due to low water level and intermittant release of water from Navamalai Power Plant and flushing the exposed

bottom slush of the lotic sector by the inflow water bringing in oxygen consuming flocculant organic matter.

Thermal stratification was absent. However, chemical stratification in respect of dissolved oxygen, pH, specific conductivity and bicarbonate was present. Sand content was less, while clay was more in lentic sector soil compared to that of lotic sector. The basin soil was found to be slightly acidic in reaction (6.75—6.85), low in available phosphorous (3.2-4.0 $P_2 O_5$ mg/100 g soil) and medium in organic carbon (0.85-1.04%).

The quantitative analysis of the plankton samples has revealed that in general the littoral areas were more productive. By analysis of the seasonal abundance of plankton, it has become clear that there was only one plankton maxima during the period which was during May-August with the peak during June with an average abundance of 22.2 ml/m^3. The average standing crop of plankton for the whole reservoir during the period was 6.20 ml/m^3.

The qualitative analysis of the plankton has shown that the bulk of the plankton is composed of phytoplankters, about 90% numerically. Among the phytoplankters itself numerically 97% was constituted by *Microcystis.* Other phytoplankters rarely encountered were *Mougeotia, Staurastrum, Synedra, Anabaena* and *Ceratium.*

Zooplankters in general formed only about 10% of the total plankton numerically. The presence of zooplankton was inversely related to *Microcystis* abundance. Zooplankters were mainly represented by *Cyclops, Diaptomus, Keratella, Brachionus* and nauplii. Almost all the forms were represented in all the stations.

Primary productivity studies were conducted in euphotic zones of lentic and intermediate sectors of the reservoir. The average gross production ranged from 0.131-0.699 g C/m^2/day while net production ranged from 0.093 to 0. 385 g C/m^2/day.

Bottom biota samples were collected from every 2 m depth intervals up to 10 m and then at 5 m depth intervals. It was seen that fauna was increasing towards the deeper zones and the maximum fauna was encountered at 15 and 20 m depths. And it was least at 2 m depth. Among the three sectors, maximum fauna was encountered in the lentic sector with 275 units and 2.25 g/m^2. This was followed by the intermediate and lotic sectors. The average standing crop of bottom fauna for the whole reservoir during the reporting period was 173 units and 0.979 g/m^2. The bottom fauna of the reservoir was purely composed of oligochaetes and larvae of *Chironomus* and *Chaoborus.*

The population density of periphytic organisms in the lentic zone varied from 5 to 65 u/mm^2 and in the intermediate zone from 6 to 58 units/$mm.^2$

With the recording of *Clarias batrachus* during the year, a total of 46 species of fishes have been recorded in the reservoir. Gonad samples were collected weekly from major carps to determine their maturation and the details are given below:

Catla: A total of 45 specimens were examined. Immature fish (I to III) were available almost althrough the year. Ripe specimens were absent.

Rohu: Throughout the year immature fish were observed in large numbers. Gonads in resorption stage were observed in August and September. Ripe specimens were absent.

Mrigal: Developing gonads in I to III stages of maturation were recorded all round the year in fairly good numbers. Ripe specimens were not met with among females. In the later

part of July and August a few specimens were seen in resorption stage. However, a few males were seen in oozing condition during June to September.

Common carp: They were observed to be in I to IV stages of gonadal maturity all round the year. Males were seen oozing milt during June to August.

Weekly samples of trash fishes were also examined. They were *P. filamentosus, P. mahecola, D. jerdoni* and *M. malabaricus.* The items varied from detritus to filamentous algae. Stray specimens of *G. giuris, P. dorsalis, P. denisoni,* Tilapia, *E. maculatus* etc. were also examined.

There has been a record yield of 115.65 kg/ha/annum during the period from April '86 to March '87 when compared to the yield of 78.7 kg /ha/annum during 1985-'86. The bulk of the landing was contributed by the stocked species of the major carps (99.06%). There has been a gradual decline in the contribution by the minor carps and other miscellaneous fishes. There has been substantial increase in the catch/unit effort also (8.02 kg) as against 5.64 kg during 1985-86. The studies here clearly established the advantage of stocking the reservoir with fingerlings of 100 mm and above for enhancing the yield.

To study the effect of tagging and clipping on the growth of fishes, catla fingerlings were used for the experiment in 3 ponds along with control. In case of full clipped fins regeneration observed in total absence of the fin to the total regeneration. Altogether 55 sets of Indian major carps and 38 sets of Chinese carps were hypophysed during 1986 breeding season and 3.0, 0.05, 6.68, 7.613 and 0.003 lakhs hatchlings of *C. catla, L. rohita, C. mrigala, H. molitrix* and *C. idella* respectively were produced. A breeding canal of 10 mX 1 m was made with provision to collect the eggs in a chamber in the rear end. Further, a circular hatchery having a diameter of 4' and height of 3' was designed and fabricated locally using G.I. sheet.

The probable hydrochemical reasons for the failure and poor fertilization of eggs during the breeding of carps were identified. Laboratory experiments were conducted to elucidate the same. The reservoir water with its poor water quality is probably not conducive to successful breeding of carps. Corrective measures to improve the water quality were undertaken and better fertilization of eggs and percentage survival of spawn were obtained in laboratory experiments conducted at Aliyar fish farm.

Mono-species rearing of fry of *C. catla, L. rohita, C. mrigala* and *C. carpio* was carried out in 11 ponds having a water spread area of 0.2 ha and a total of 39.741 fingerlings were raised and harvested. Mixed-species rearing of fry of *C. catla, L. rohita, C. mrigala, H. molitrix* were undertaken in 12 cemented nursery ponds. Partial harvest of these nurseries yielded a total of 22,936 fingerlings.

During the period under report, the reservoir was stocked with a total of 91,972 nos. of fingerlings (100 m and above) consisting of *C. catla* (35,114), *L. rohita* (18,483), *C. mrigala* (17,412), *C. carpio* (16,254) and *H. molitrix* (4,709).

PROJECT FC/A/12 : ECOLOGY & FISHERIES MANAGEMENT OF PENINSULAR TANKS

Personnel : B. V. Govind, T. Ramaprabhu, Chari Appaji, H. C. Joshi, S. P. Ayyar, P. K. Sukumaran, P. Kumaraiah, S. L. Raghavan and M. F. Rahman

Duration : 1985-90

Location : Bangalore

Ecology and productivity of a typical peninsular tank (Lalbagh tank).

Prospects of aquaculture in Lalbagh tank (area: 12 ha) in Bangalore city was investigated. Samples of water, plankton, littoral and benthic fauna and soil were collected from three sampling points every fortnight and studied. Primary production was also studied employing the "dark and white bottle technique".

Phytoplankton dominated over zooplankton throughout the period of study. The volume of plankton ranged from 0.02 to 0.25 ml l^{-1} and the total counts from 204 to 55·600 units l^{-1}. The phytoplankton was represented mainly by *Microcystis aeruginosa, Coelosphaerium* sp., *Nephrochystium* sp., *Ulothrix* sp., *Spirogyra* sp., and diatoms. Zooplankters encountered were *Polyarthra* sp, *Filinia terminalis, F. longiseta, Testudinella* spp, *Keratella tropica, Brachionus forficula, B. angularis, Moina brachiata, Bosmia* spp., *Daphnia similis, Diaphanosoma* spp., *Mesocyclops leukartil, M. hyalinus, Heliddiaptomus viduus* and nauplii.

The density of littoral fauna in the tank ranged from 1 to 12 units m^{-2} (0.008 to 1.054 gm^{-2} by weight). The organisms encountered were aquatic insects, *Notonecta glauca, Ranatra elongata, Nepa* sp., *Gerris* sp., *Limnometra fluviorum, Laccotrephes maculatus, Diplomychus rusticum,* dragonfly and mayfly nymphs, water spider and fish young ones.

The bottom fauna was mostly represented by chironomid larvae. The number ranged from 755 to 11,554 m^{-2} and weight, from 1.24 to 32.35 g m^{-2}.

The $\bar{x}$ gross primary production in the tank ranged from 90.63 to 356·25 mg C m^{-3} h^{-1} and net primary production from 43.75 to 131.25 mg C m^{-3} h^{-1}, and respiration from 146.25 to 412.50 mg C m^{-3} h^{-1}.

Till July 1986, a total of 795.5 kg of fish comprising catla, rohu, mrigal, *Heteropneustes fossilis, Clarias batrachus, Channa punctatus* and *C. striatus* were harvested, giving a production of 66.3 kg ha^{-1} in the year.

AQUAPHYTE PRODUCTIVITY, MANAGEMENT AND IMPACT STUDIES

Byramangala Reservoir (c 450 ha) was studied in February, May, August and November in 1986.

Samples of water, soil and waterhyacinth collected were digested and analysed for heavy metals. The data for February, May, August and November presented in Table XI showed significant uptake of heavy metals zinc, chromium, and copper by waterhyacinth and its possible role in the abatement of pollution in the reservoir.

The wet standing crop of waterhyacinth was 613 t (146×10^4 plants) ha^{-1} in February which changed to 250 t (45×10^4) ha^{-1} in May due to increase in size of the plants ($\bar{x}$ weight:

305 g in February '86 and 560 g in May '86). By February '87 the weed biomass increased to 846 t (282×10^4) ha^{-1}.

An interesting observation of waterhyacinth management in the reservoir by natural draw-down due to drought conditions and flooding following heavy rains was recorded in August 1986. The plants mostly rooted, lacked buoyant leaf stalks, and failed to float up to the surface by the sudden rise in water level to a depth of 10 m and the entire infestation was cleared by the natural water level changes and the reservoir was free from weed problem. However, the infestation developed freshly by November, from multiplication of new plants occuping marginal bayous, sprouting with receding water level advents of favourable conditions for weed multiplication and recolonization.

The water remained practically with very little plankton in February and May '86 samples because of weed infested conditions prevailing in the reservoir. With the disappearance of waterhyacinth the plankton appeared in the reservoir in August with phytoplankton dominating over zooplankton. The volume of plankton ranged from 0.01 to 0.2 ml^{-1} and the total counts from 148 to 263^{l-1}. The phytoplankton was represented by *Spirulina* sp., *Ulothrix* sp., *Oedogonium* sp., *Navicula* sp., *Pinnularia* spp,· *Keratella tropica, Brachionus calciflorus, B. hidentata, Moina brachiata, Mesocyclop leuckartiil, Heliodiaptomus viduus* and copepod nauplii were the zooplankters frequently encountered.

The density of bottom fauna in the reservoir ranged from 27 to 178 m^{-2} (0.022 to 1.253 g m^{-2} by weight). The organisms encountered among aquatic weeds were *Diplonychus* sp., *Ranatra elongata, Belostoma* sp., Cybister larvae, molluscs (*Gyralus* sp, and *Lymnae* sp.) chironomid larvae.

A low-cost rope wick applicator has been designed and fabricated for field application of herbicides on floating aquatic weeds.

POTENTIAL EFFECT OF ALGICIDES AND HERBICIDES ON FISHES

Static bioassay tests employing advanced fry of common carp, *C. carpio* ($\bar{x}$ size: 1 g LC50). The herbicide/algicide diuron formulation of active ingredient 80% 3-(3.4 dichlorophenyl—1) dimethyl urea was tested for its toxicity to fish. Treatments of 30 mg and 60 mg l^{-1} in three replicated doses with no treatment controls were evaluated. The experiment indicated acute distress to fish at the highest concentration tried and gradual recovery on transfer to fresh-water after 96 h exposure. The toxicant remained in water mostly in suspension and as fine residue due to low solubility (42 mg l^{-1}).

The growth of fish exposed to diuron (80% dimethyl urea) for 96 h at 3, 30, 60 mg l^{-1} in the above experiment transferred to basket cages in Sankey tank indicated no significant variations in net weight increment between the treated and untreated fish.

Weed utilization: Feed testing experiments conducted with grass carp, *Ctenopharyngodon idella* using three types of feeds, viz., dehydrated grass pellets (SP), fresh *Hydrilla* (FH) and 1 : 1 mixture of rice bran and groundnut cake (RB-GC) in basket cages for 55 days showed the increment in fish length was 0·341, 0.671 and 0.628 mm day^{-1} with SP, FH and RB-GC respectively.

BREEDING AND CULTURE OF PENINSULAR CARPS AND NON-PREDACIOUS CATFISHES IN COMBINATION WITH EXOTIC AND INDIAN CARPS

Preliminary surveys were conducted in N. R. Pura, Thirthahalli, B. R. Project, Hebbe and Harihar in stretches of rivers Tunga and Bhadra for breeders of *P, pulchellus* mature specimens

Table XI: Heavy Metal uptake by Water, Soil and Waterhyacinth Samples from Byramangala Reservoir (Months: February, May, August and November 1986)

Month	Sample	Metal content in range (mg l^{-1})			
		Zn	Cu	Cr	Cd
February	Soil	26.0-100.0	12.0-130.0	34.0-138.0	52.0-59.0
	Water	0.15-0.4	0.07-0.08	0.085-0.105	0.08-0.10
	*Wh. roots	86.0-176.0	29.0-30.0	28.0-40.0	74.0-77.0
	Wh. leaves	86.0-101.0	19.0-20.0	23.0-32.0	68.0-79.0
May	Wh. roots	42.6-50.5	10.6-12.7	Nil	Nil
	Wh. leaves	280.0-307.0	33.2-50.6	Nil	Nil
August	Soil	83.0-106.0	24.3-40.6	9.6-14.5	Nil
	Wh. roots	40.8-43.1	12.2-15.3	Nil	Nil
	Wh. leaves	193.0-224.0	43.1-58.0	Nil	Nil
November	Soil	89.0-138.0	19.0-42.0	12.0-72.0	Nil
	Water	0.12-0.17	0.01-0.04	Nil	Nil
	Wh. roots	43.7-52.0	5.8-18.1	Nil	Nil
	Wh. leaves	205.0-290.0	15.0-62.5	Nil	Nil

*Wh=Waterhyacinth.

collected in Tunga river near Sringeri temple (size 400-608 mm/2.8 to 7.5 kg) on 18.3.1986 were injected with carp pituitary gland (extract) in two doses at an interval of 6 h in the case of females and in one dose to the males at the time of second injection to the females. Spawning occured in 8 sets (73%) hypophysed, 5 to 8h after the second injection to the females. A total 2,31,248 eggs (ranging from 16,977 to 1,61,135 eggs female) were obtained from the 4 days breeding operations. The fully swollen, yellowish coloured eggs measured 1.76 to 3.00 mm in diameter. In none of the instances of successful spawning, viable eggs were obtained, probably because the females were not in conditions.

INDUCED BREEDING OF CARPS AND CATFISH *WALLAGO ATTU* USING THE PITUITARY ANALOGUES AND REARING OF EMBRYOS AND YOUNG ONES

The leftover stock of the test sample of Hoe vet (H) and progesterone (P) supplied during 1985 was used for induction of spawning of carps in the fish farm of Tungabhadra Board at T. B. Dam. Out of the few sets of L. *rohita* injected with H and P, two responded. One set of C. *mrigala* injected did not respond. Possible reduction in potency of sample analogue supplied last year may be the reason for the poor results compared to the previous year.

BENCH MARK SURVEY OF FISHERMEN COMMUNITIES

A structured schedule was prepared in order to conduct the bench mark survey of the inland fishermen communities which comprises two parts, *viz.,* (*i*) household schedule and (*ii*) technical details regarding fisheries.

Data on the major and minor tanks in the Bangalore rural district along with the villages surrounding each of the tanks was collected.

The schedule was pre-tested on a group of 15 fishermen communities, with an idea to modify, add or delete the items of the schedule and against ambiguity and redundancy. The data were collected by personal interview method.

Very few (20%) of the fishermen were engaged in fishing as full time occupation. Most of the respondents had joint families, an average size of the family being 8.

53% of the respondents had either high or medium socio-economic scores and were the members of more than one organisation. Only 33% of the fishermen possessed coracles. Majority of the fishermen (60%) did not posses any agricultural land, but were living in own houses. 53% respondents possessed livestock, 40% of the fishermen had taken credit up to Rs. 1,000/- while the other's loan amount ranged between Rs. 1,001/- and Rs. 4,000/-; the major source of credit was from money lenders.

Majority of the fishermen engaged in capture fisheries operate up to 100 m net length on shared basis, employing up to 200 man days annually. The average catch per day being more than 5 kg the average annual catch was above 800 kg with a gross income of Rs. 6,000/-. The operating cost per annum was above Rs. 700/-.

The fishermen engaged in culture fisheries were operating in the tanks. They were employed for more than 120 days per annum. Most of them did monoculture of common carp, the stocking densities being less than recommended. The annual production was about 2,000 kg with a gross income of Rs. 10,000/-, operating cost being up to Rs. 3,000/-.

HYDROBIOLOGICAL STUDIES IN RIVER TUNGABHADRA NEAR HARIHAR

Survey of Tungabhadra river downstream and upstream of Birla Polyfibre Factory near Harihar in Chitradurga was done during the year under report in collaboration with Karnataka

State Pollution Control Board. 21 species of fishes belonging to six families were recorded here. They had a slight discolouration and foul odour. Specimens collected from the lower stretches had mainly empty stomach and the blood vessels lining their digestive tracks and adjoining body musculature within the abdominal cavity appeared conjested and swollen. In several fishes the liver had become discoloured and pulpy to touch. Microscopic examination revealed that fat digestion had set in.

The bottom and littoral fauna examined revealed two species of bivalves and six species of gastropods in dead condition in the downstream of the effluent discharge spot.

PROJECT BF/B/2 : ECOLOGY AND FISHERIES MANAGEMENT OF ESTUARINE WETLANDS (BHERIES)

Personnel : Apurba Ghosh, K. M. Das, G. N. Saha, S. C. Thakurta, G. C. Laha, P. K. Ghosh, P. B. Das, S. K. Chatterjee, P. K. Chakrabarti, G. N. Chattopadhyay, Amitabha Ghosh, K. R. Naskar, S. K. Mandal, A. Hajra, N. N. Mazumder, R. K. Das and C. R. Das

Duration : 1986-1989

Location : Barrackpore and Calcutta

BARRACKPORE CENTRE

Yields from wetlands are often hampered due to prolific breeding of Tilapia which imbalances the stocking densities. Studies revealed that *Lates calcarifer* could be a prospective controlling agent of Tilapia. In laboratory Lates of 45-72 mm size actively predated upon *Oreochromis* sp. of a maximum size of 18.5 mm. Withdrawal of Lates from the culture system made the reappearance of spawn and fry of Tilapaia.

Bacterial load in Titagarh wetland was found to be poor due to low intake of sewage effluent. The values are as follows:

	In sediment (Lakh/g)	In Water (hundred/ml)
Heterotrophic Bacteria	4.3-26.0	1.9-2.2
Aerobic ~~Nitrifying~~ Nitrogen fixing bacteria	1.5- 2.3	0.1-2.1
Denitrifying Bacteria	2.5	0.18

Gross primary production and 0_2 consumption rate during day were 416.6 mg C/m^3/hr and 0.01-0.033 mg/l/hr, the plankton density being 0.5-0.7 cc/50 l. Dominant biota were *Cyclops* sp., *Moina* sp., Nauplii, *Brachionus* sp., *Keratella* sp., *Synedra* sp. *Closterium* sp. and *Spirogyra* sp. in the plankton and *Vivipara* sp., *Pila* sp., Chironomids, odonate nymphs and *Spirogyra* sp. in the benthos.

Studies on food and feeding habits of wetland fishes revealed, *Scatophagus argus* as herbivorous and *Glossogobius giuris* as carnivorous with 2.2 and 0·35 RLGs respectively.

Biotic ecosystem had general dominance of *Lyngbya* sp., *Amphora* sp., *Closterium* sp. and *Brachionus* sp. in all wetlands; planktonic *Chlorella* sp. with benthic *Scenedesmus* sp.,

Moina sp. in non-saline wetlands; and planktonic mysis with benthic *Gammarus* sp., herpecticoids, nematodes, tanaeids in saline wetlands. Besides recording typical biota for each type of wetland, the richly occuring common forms for all zones were also noted which were:

Plankton .. *Euglena* sp., *Anacystis* sp., *Phormidium* sp. and *Cyclops* sp.

Benthos .. *Cypris* sp. (in non-saline wetlands only), *Vivipara* sp. chironomids, *Thiara* sp. (excepting wetlands with strong sewage).

The qualitative aspects of plankton and benthos were:

Wetlands	Mean density	Fluctuation over mean density	Av. ratio of zoo & phyto forms	Seasonal variation in conc. of Flora/Fauna
Plankton	(thousand units/l)	(thousand units/1)	(:)	(%)
Saltlake	11.2	3.7	1 : 2	39.8
Bantala	7.3	0.9	1 : 2	31.1
Hundipota	2.7	0.8	2 : 3	44.2
Minakhan-Malancha	5.5	4.3	1 : 9	32.0
Nazat	1.4	0.7	1 : 2	47.8
Benthos	(thousand units/m^2)	(thousand units/m^2)		
Saltlake	167.7	25.4	—	28.4
Bantala	198.4	14.0	—	22.4
Hundipota	9.0	2.4	—	18.1
Minakhan-Malancha	81.1	18.8	—	26.6
Nazat	90.6	30·6	—	1.3

Average abiotic features are shown in table XIII.

CALCUTTA CENTRE

The details of the work is summarised in tables XIV-XVI.

The availability of commercial and non-commercial species of fish and prawn seed in the ingress waters of bheries was recorded. Water qualities of ingress water were also monitored. Most important commercial prawn *P. monodon* postlarvae were recorded in ingress water at Nazat, Golabari, Malancha and Hasnabad, maximum being at Malancha. The other commercial species of prawn like, *M. brevicornis M. monoceros, P. indicus* and *P. styliferus* were recorded in all centres maximum being at Malancha (155/net/hr.). Commercial fish seed was not encountered in any of the above centres except one *L. parsia* at Golabari. The ingress waters were very rich in non-commercial fish and prawn seed.

Ingress water qualities of different collection centres ranged from pH 7.2-8.3, D.O. 1.4-8.0 ppm, CO_2 2.6-14.9 ppm and salinity traces—32‰.

Table XIII : Abiotic features

Non-saline wetlands							Saline wetlands						
Area	BOD_5 (ppm)	Dissol N_2 (ppm)	Sal. P (ppm)	Av. D.O. (ppm)	pH	Alk. (ppm)	Area	Dissol N_2 (ppm)	Sal. P (ppm)	Mid-Day D.O. (ppm)	pH	Alk. (ppm)	Salinity (mmhos/cm)
Saltlake	15.0	0.5	0.3	5.2	7.2-8.0	108-180	Minakhan	0.1	0.1	6.0	7.2	120	12.8
Bantala	9.4	0.3	0.1	6.4			Malancha	0.2	0.1	7.2	7.4	140	16.4
Hundipota	6.2	0.1	0.1	7.2									

Table XIV : WATER QUALITIES

	pH	Salinity (ppt)	D.O.	T. alk (ppm)	P_2O_5 (ppm)	NO_3N	Primary production mg c/m³/hr.
	1	2	3	4	5	6	7
Low saline bheries	7.2-7.6	tr- 9.7	4.6-6.8	76.0-148.0	0.04-1.4	0.02-0.9	35-280
Medium saline bheries	6.8-7.5	tr-17.4	2.4-7.0	84.0-138.0	tr-1.2	0.04-1.1	45-330
High saline bheries	7.4-7.8	0.9-31.7	4.4-7.1	76.0-130.0	0.06-1.8	tr-0.6	68-460

Table XV : SOIL CONDITIONS

	pH	E.C. m. mho/cm.	Org. C (%)	Av. P_2O_5 mg/100 gm
	1	2	3	4
Low saline bheries	7.8-8.1	1.2- 3.8	0.61-0.75	6.0- 8.2
Medium saline bheries	7.7-8.1	1.5- 5.3	0.28-0.75	2.4- 9.0
High saline bheries	7.0-8.1	3.1-21.7	0.3 -0.7	5.3-10.0

Table XVI : BIOLOGICAL CONDITIONS

	Plankton volume (cc/50 l)	Bottom biota (Units/m²)	Prawn and fish production (kg/ha/yr)
Low saline bheries	0.01-3.0	70-1660	230.13-1257.00
Medium saline bheries	0.02-5.0	10-3090	435.00- 481.26
High saline bheries	0.01-4.0	360-1430	717.87- 863.33

PROJECT BF/B/3 : **ECOLOGY AND FISHERIES OF HOOGHLY-MATLAH AND KULTI ESTUARINE SYSTEMS**

Sub Project : Assessment of fishery resources, biological investigations and stock recruitment studies and monitoring of ecological parameters of the estuarine systems.

Personnel : B. N. Saigal, P. M. Mitra, H. C. Karmakar, D. K. De, M K. Mukhopadhyay, M. M. Bagchi, S. B. Saha, H. S. Majumdar, A. Chowdhury, R. N. Dey, S. N. Sar, A. K. Roy, N. D. Sarkar, N. C. Mondal, A. R. Paul, S. P. Ghosh, N. P. Saha, A. K. Banerjee, P. B. Das, T. Chatterjee, P. Biswas, S. Chakraborty and Keya Saha

Duration : 1983-1987

Location : Barrackpore

Monthwise and zonewise catch structure as well as total fish landings from November 1985 to October 1986 is presented in Table XVII. An increase at 1.5% is marked compared to last year.

Species composition is shown in Table XVIII. The increase in the annual landing was mainly due to Hilsa fishery (Table XIX).

BAGNET FISHERY

Zonewise bagnet catches, other than their winter migratory bagnet fishery, were as in Table XX indicating a sharp decrease than the previous year.

Centrewise catch, effort and CPUE in winter migratory fishery during November, 1985 to October, 1986 were as shown in Table XXI. Contribution of dominant fish and prawns (in t) in winter migratory bagnet fishery is furnished in Table XXII.

ECOLOGICAL INVESTIGATIONS IN THE HOOGHLY ESTUARY

The pH ranged from 7.9-8.4, D.O. from 5.6-9.6 mg/l, total alkalinity from 58-142 ppm; specific conductivity from 327-33962 umhos/cm, hardness from 48-4600 ppm. Nitrate from trace —0.06 ppm, phosphate from trace —0.20 ppm and silicate from trace —15.6 ppm in the Hooghly-Matlah-Rupnarayan estuarine ecosystem during the reported period.

Soil characteristics in the entire stretch indicated a variation of pH from 6.9-7.2, organic carbon (%) from 0·057-0.641, total nitrogen (%) from 0.014-0.062 and C/N from 3.16-12.1.

Primary productivity was lowest in the middle stretch (max. NP: 15.6 mg $C/m^3/h$) at Nababgang lying in industrial belt and highest between Uluberia and Kakdwip (Max. NP: 100 mg $C/m^3/h$) in lower zone of the estuary. However, the maximum value (Max. NP: 114 mg $C/m^3/h$) was recorded at Digha.

A homogeneous plankton structure was recorded in lower stretch of the estuary excepting at Sagar where predominance of marine varieties of plankton was noticed in summer and winter months.

TABLE XVII : Zonewise total catch (t) in different months

Months / Zones	Nov. 85	Dec. 85	Jan. 86	Feb. 86	Mar. 86	Apr. 86	May 86	Jun. 86	Jul. 86	Aug. 86	Sep. 86	Oct. 86	Total	%
I (Upper estuary-Nabadwip to Calcutta)	42.3	62.6	34.5	36.9	37.2	67.8	40.2	27.6	41.4	29.2	37.7	40.5	497.9	1.88; 5.62 *
II (Mid estuary-Calcutta to Diamond Harbour)	13.1	16.7	12.3	36.7	42.0	47.1	109.5	46.3	49.0	31.2	86·7	45.9	536.5	2.03; 6.06 *
III (Lower estuary)	8,699.6 (775.3) *	5,935.6 (621.0) *	4.794.7 (452.2) *	471.1	559.6	50.6	144.4	103.1	732.6	694.9	1,152.7	1,450.3	24,789.2 (7,207.8) *	93.77; 81.40 *
IV (Rupnarayan)	42.9	51.7	141.8	33.7	71.8	48.8	36.9	30.9	18.8	34.4	80.4	19.9	612.0	2.32; 6.91 *
Total	8,797.9 (873.6) *	6,066.6 (752.0) *	4,983.3 (640.8) *	578.4	710.6	214.3	331.0	207.9	841.8	789.7	1,357.5	1,556·6	26,435.6 (8 854.2) *	100.00; 99.99 *
%	33.28; 9.87 *	22.95; 8.49 *	18.85; 7.24 *	2.19; 6.53 *	2.69; 8.02 *	0.81; 2.42 *	1.25; 3.74 *	0.79; 2.35 *	3.18; 9.51 *	2.99; 8·92 *	5.13; 15.33 *	5.89; 17.58 *		100.00; 100.00 *

*Excluding winter fishery.

Table XVIII: Contribution of dominant fish species and prawns (t)to the total estuarine fish catch

Name of the species	Contribution to total catch		% in the total catch		Contribution to total catch excluding winter fishery		% of Col. 6	% of Col. 7
	Nov. 85-Oct. 86	Nov. 84-Oct. 85	Nov. 85-Oct. 86	Nov. 84-Oct. 85	Nov. 85-Oct. 86	Nov. 84-Oct. 85		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hilsa ilisha	2252.7	1066.8	8.5	4.1	2252.7	1024.6	25.4	16.0
Pama pama	3908.4	3501.4	14.8	13.4	354.4	288.1	4.0	4.5
Setipinna spp.	2055.8	2269.7	7.8	8.7	192.3	227.4	2.2	3.6
Trichiurus spp.	1473.0	4818.3	5.6	18.5	64.4	7.3	0.7	0.1
Harpodon nehereus	5197.7	4111.7	19.7	15.8	261.7	247.1	3.0	3.9
Tachysurus jella	702.3	584.8	2.7	2.2	479.1	261.6	5.4	4.1
Stromateus cinereus	344.4	193.2	1.3	0.7	236.3	186.7	2.7	2.9
Polynemus paradiseus	106.5	278.2	0.4	1.1	93.9	216.5	1.1	3.4
Coilia spp.	479.1	625.1	1.8	2.4	86.6	23.9	1.0	0.4
Ilisha elongata	315.7	359.3	1.2	1.4	115.6	29.0	1.3	0.5
Sciaena biauritus	602.3	78.2	2.3	0.3	32.9	59.5	0.4	0.9
Prawns	1892.4	2323.4	7.2	8.9	675.8	788.4	7.6	12.3
Others	7105.3	5833.1	26.9	22.4	4008.5	3043.6	45.3	47.5
Total	26435.6	26043.2	100.2	99.9	8854.2	6403.7	100.1	100.1

Table XIX: Zonewise total hilsa catch, effort, CPUE by different hilsa gears in 1985-86 and 1984-85

Zone	Gear	Catch (kg)		Effort (net tides)		CPUE (kg)	
		1985-86 (Nov.-Oct.)	1984-85 (Nov.-Oct.)	1985-86 (Nov.-Oct.)	1984-85 (Nov.-Oct.)	1985-86 (Nov.-Oct.)	1984-85 (Nov.-Oct.)
I	Purse	13,945	12,462	43,227	60,221	0.32	0.21
	Drift	78,539	72,073	2,62,297	2,75,085	0.30	0.26
	Set-gill	20,062	18,680	17,588	16,542	1.14	1.13
	Bag	7,710	61,750	—	—	—	—
	Small Seine	1,076	—	—	—	—	—
	Total	1,21,332	1,64,965*				
II	Drift	2,09,529	1,44,627	2,19,351	1,87,879	0.96	0.77
	Bag Seine	1,039	12,664	—	—	—	—
	Total	2,10,568	1,57,291	—	—	—	—
III	Drift	16,39,558	4,75,470	—	—	—	—
	L. Seine	87,922	1,08,590	—	—	—	—
	Others	40,500					
	Total	17,67,980	5,84,060	—	—	—	—
IV	Drift	1,50,732	71,500	1,52,005	1,42,896	0.99	0.50
	Bag	2,121	41,074	—	—	—	—
	Total	1,52,853	1,12,574	—	—	—	—
Total		22,52,733	10,18,890*				

*A negligible quantity (5,664 kg) of hilsa is captured by other nets in zone I.

Table XX: Zonewise total bagnet catch, effort and average CPUE in 1985-86 and 1984-85 excluding winter fishery

Zone	1985-86			1984-85		
	Catch (kg)	Effort (net tides)	Average CPUE (kg)	Catch (kg)	Effort (net tides)	Average CPUE (kg)
I	1,51,843	32,607	4.66	3,50,662	77,638	4.52
II	2,80,826	1,27,997	2.19	2,33,080	1,25,206	1.86
III	3,57,819	—	—	3,64,362	—	—
IV	4,52,872	1,10,957	4.08	7,10,858	1,38,586	5.13
Total	12,43,360			16,58,960		

BIOLOGICAL INVESTIGATIONS

Polynemus paradiseus mainly feed on prawns.

The age and growth studies on *Hilsa ilisha* were continued during the reported period and the fish was found to attain an average size of 517.3 mm on the 6th year of its life time.

ESTUARINE FISH AND PRAWN SEED PROSPECTING

L. parsia and *P. indicus* were available in saline zone 10.5-11.6% and *P. monodon, M. brevicornis* and *M. monoceros* in zone having 9.2-16.2 ppt salinity.

Sub Project : Studies on the impact of industrial, agricultural and metropolitan wastes on the estuarine environment in West Bengal

Personnel : B. B. Ghosh, M. K. Mukhopadhyay, H. C. Joshi, M. M. Bagchi, R. K. Das, A. Hajra, R. K. Banerjee, B. N. Saigal, A. Ghosh, A. K. Banerjee, K. P. Saha and Keya Saha

Duration : 1985-1988

Location : Barrackpore

MONITORING OF EFFLUENT CHARACTERISTICS IN THE HOOGHLY ESTUARY

Contribution of BOD was highest from the effluents of the IPP, Hazinagar (max. BOD: 326 mg/l). High OC values were also recorded in the pulp effluent (max. 340 mg/l). Methylene blue active substances (detergents) were also recorded in the municipal wastes drained around Hazinagar (2.8 mg/l).

Bandel Thermal Power Plant discharged hot waters (36-40°C) into the estuary. Hot water discharges also showed BOD level of 14.4 mg/l (max.). Lowest D.O. was recorded in pulp and paper mill effluent (nil) while it was 3.6 mg/l in case of hot water waste.

Zinc and copper concentration in water near the coal washing discharge point of Bandel thermal plant ranged between 0.108-0.18 mg/l and 0.05-0.08 mg/l respectively while Chro-

Table XXI: Centrewise catch, effort and CPUE in winter migratory bagnet fishery in lower estuary during 1985-86

Centre	Estimated catch (t)				Estimated effort (net tides)				CPUE (kg)		
	Mid. Oct. & Nov. 85	Dec. 85	Jan. & early Feb. 86	Total	Mid. Oct. & Nov. 85	Dec. 85	Jan. & early Feb. 86	Total	Mid. Oct. & Nov. 85	Dec. 85	Jan. & early Feb. 86
Frasergunj	399.1	397.7	192.1	988.9	4415	4172	3156	11743	90.39	95.33	60.87
Bakkhali	769.5	607.1	586.8	1963.4	3178	3132	3919	10229	242.13	193.84	149.73
Upper Jamboo	1734.4	1448.8	1589.2	4772.4	6282	5735	7330	19347	276.09	252.62	216.81
Lower Jamboo	3216.0	1151.2	1046.5	5413.7	7054	5898	8486	21438	455.91	195.18	123.32
Kalisthan	1275.1	1306.0	842.4	3423.5	5172	5393	6932	17497	246.54	242.17	121.52
Sagardwip	530.2	403.8	85.5	1019.5	21637	8388	3550	35575	22.43	48.14	24.08
Total	7924.3	5314.6	4342.5	17581.4	49738	32718	33373	115829	159.32	162.44	130.12
								Av. CPUE:	151.79		

Table XXII: Contribution of dominant fish species and prawns (t) in winter migratory bagnet fishery in lower estuary during mid October 1985 to early February 85 and mid Oct. 84 to early Feb. 85

Name of the species	Contribution to total catch		% in the total catch	
	1985-86	1984-85	1985-86	1984-85
Harpodon nehereus	4936.0	3864.6	28.1	19.7
Pama pama	3554.0	3213.3	20.2	16.4
Setipinna spp.	1863.5	2042.3	10.6	10.4
Trichiurus spp.	1408.6	4811.0	8.0	24.5
Saina biauritus	569.4	18.9	3.2	0.1
Coilia spp.	392.5	601.2	2.2	3.1
Tachysurus jella	223.2	323.2	1.3	1.6
Ilisha elongata	200.1	330.3	1.1	1.7
Stromateus cinereus	108.1	6.5	0.6	—
Polynemus paradiseus	12.6	61.8	0.1	0.3
Prawns	1216.5	1535.0	6.9	7.8
Others	3096.9	2831.3	17.7	14.4
Total	17581.4	19639.4	100.0	100.0

mium was not detectable in aqueous phase. In the sediments collected from the corresponding site, Zn, Cu and Cr ranged between 20-69 mg/l, 9-27 mg/l and 6-15 mg/l (dry wt.) respectively. Out of 40 sediment samples collected from Nayasarai-Kalyani-Hazinagar stretch, 12 samples showed presence of DDT residues. Other pesticides were not detectable in sediments.

Lower primary production was noted in the mid-stretch between Kuntighat and Shalimar lying in the industrial belt (max. GP: 66.6 mg C/m^3/hr, max. NP: 33.3 mg C/m^3/hr) as compared to higher production in the upper non-industrial stretch between Nabadwip and Medgachi (max. GP: 83.4 mg C/m^3/hr; max. NP: 41.7 mg C/m^3/hr) and lower non-industrial stretch between Uluberia and Kakdwip (max. GP: 109.4 mg C/m^3/hr; max. NP: 100.0 mg C/m^3/hr).

The pollution effect on microbial population was comparatively low near Bandel Thermal Plant than around pulp and paper mill at Hazinagar.

A sharp rise in Cyanophyceae (*Oscillatoria* sp., *Lyngbya* sp., *Nostoc* sp., *Phormedium* sp., *Anabaena* sp.) and fall in Mixophyceae population in association with presence of Oligochaete worms (*Tubifex* sp.) indicated organic contamination in the industrial zone of the Hooghly estuary.

The hot water (38-40°C) discharge from Bandel Thermal Power Plant was detrimental for macrobenthic organisms like prawns and crabs as evident from the presence of dead ones at the outfall point.

WATER QUALITY MONITORING IN THE KULTI ESTUARY

The mean BOD load (210 mg/l) and SS (970 mg/l) at the influx point reduced to 90 mg/l and 325 mg/l, respectively at Ghusighata, the point of confluence with the Kulti estuary. Nitrate and phosphate level in the liquid phases varied from 0.4 to 1.02 mg/l and 5 to 20 mg/l respectively. The respective concentrations of Zn, Cu and Cr in the aqueous phase were 0.2-0.92, 0.08-0.27 and 0.10-0.32 mg/l and that of Hg was 0.2-0.48 ug/l.

Presence of plankton like *Spirulina* sp., *Lyngbya* sp., *Nostoc* sp., *Brachionus* sp. indicated organic pollution near the confluence (Ghusighata).

In situ toxicity test using *Rita rita* (70-130 mm; 6.2-10.5 gm) in aluminium cages near the IPP outfall indicated that the pulp and paper effluents causes 50% mortality within 48 hrs at the outfall. Haematological studies of the fishes revealed respiratory stress in the surviving test fishes.

Under long-term exposure with 2 ppm mixture of Cr, Cu & Zn (1 : 1 : 1), retarded growth, anaemia and delayed reproduction were noticed in *O. mossambicus* after 120 days.

M. rude, an estuarine prawn was found to be highly sensitive to Cu (LC_{50}, 24 hrs—0.065 ppm) and Zn (5.98 ppm). Their sensitivity was more during moulting period.

Static bioassay experiments conducted under the laboratory condition, using natural water as the test medium, have revealed that Quinolphos and Endosulfan are highly toxic to the early life stages of the tiger prawn, *P. monodon.*

Impact of Polyfibre and Rayon factory wastes on the water quality and aquatic life in the River Tungabhadra near Harihar in Karnataka, have been studied in detail. The detailed report have been submitted to the Karnataka State Pollution Control Board, Bangalore.

Sub-Project : Investigations of diseases of fishes encountered from estuarine, lacustrine and bheri fisheries.

Personnel : R. N. Pal, A. K. Ghosh, M. K. Das, P. B. Das, S. P. Ghosh and A. C. Ghosh

Duration : 1980-1990

Location : Barrackpore

The results have furnished in Tables XXIII & XXIV

Extensive and intensive surveys conducted in the Collair lake (Andhra Pradesh), in connection with fish disease problems arising in man-made impoundments constructed near the bed and belt villages, have shown that most of the diseases are caused due to lack of proper managerial practices viz. over stocking of fishes, non-removal of aquatic weeds, utilization of large quantities of rice-bran as fish feed.

Bacteriological examination of water from sewage fed and control ponds (MPN of coliforms/100 ml) around Titagarh Municipality was done for a period of three months. Results are furnished in Table XXV.

Table XXIII: Parasitic afflictions in estuarine fishes from bheries

Host	Weight (g) range	Total nos. of fishes examined	No. of fishes affected	Parasitic species			% of infection
				Protozoan	Acanthocephala	Crustacea	
L. parsia	20-60	150	52	Trichodina sp.	—	Ergasilus sp.	34.6
L. calcarifer	60-300	51	10	—	—	—	19.6
L. tade	100-200	65	—	—	—	—	—
L. tetra-dactylum	40-100	20	—	—	—	—	—
M. gulio	25-80	100	40	Trichodina sp.	Acanthocephala	—	40
O. rubicundus	10-30	40	—	—	—	—	—
G. giuris	50-150	85	20	Trichodina sp.	—	—	23.5

Table XXIV: Parasitic afflictions in fishes of Hooghly-Matlah estuary

Host	Weight (g) range	Total no. of fishes examined	No. of fishes affected	Parasitic species			% of infection
				Protozoan	Helminth	Crustacea	
L. parsia	8-70	80	28	Myxozoa	—	Copepod	35
L. tade	110-200	25	12	—	—	,,	48
P. pangasius	30-200	40	12	—	—	,,	30
S. panijius	50-225	40	5	—	—	,,	12.5
S. phasa	40-80	60	18	—	Cestode	—	30
P. paradiseus	20-40	65	30	—	Trematode	—	46.15
S. miles	20-50	45	18	—	,,	Copepod	40
O. rubicundus	20-50	20	—	—	—	—	—
C. rumearati	25-50	70	28	—	Trematode	—	40
H. nehereus	80-150	35	8	—	,,	—	22.8
L. corsula	30-70	10	1	—	Nematode	—	10
M. gulio	10-50	60	10	Trichodina sp.	—	—	16
L. tetra-dactylum	30-150	35	—	—	—	—	—

Table XXV: Bacteriological examinations of water from sewage-fed and control ponds (MPN of Coliforms/100 ml) around Titagarh Municipality

Source of collection	Dilution factor	Date of collections				Remarks
		15/1	28/1	12/2	25/2	
SF_1	10^{-3}	275	35	140	275	
SF_2	10^{-3}	225	1600	275	130	
SF_3	10^{-3}	225	170	225	35	The study was made for one year only.
SF_4	10^{-3}	30	350	275	275	
Control	10^{-3}	110	20	20	35	

Preliminary studies on the microbial load of the sewage fed Kulti estuarine system have been undertaken, which showed wild fluctuations of coliform bacteria.

Sub Project : Studies on the Productivity of estuarine and connected impoundments using Radioisotopes, Carbon-14

Personnel : Babu Lal

Duration : 1986-1988

Location : Nabadwip, Barrackpore, Diamond Harbour, Frazerganj and Kolaghat

'In situ' experiments were conducted to measure the primary productivity of the Hooghly estuary at various places (Nabadwip, Barrackpore, Diamond Harbour, Frazerganj and Kolaghat) every month by 14C- technique. Rate of carbon assimilation at various places during monsoon months was 38.00, 22.62, 37.66, 44.51 and 29.16 mg C^{-3} day^{-1} at Nabadwip, Barrackpore, Diamond Harbour, Frazerganj and Kolaghat respectively. During the post monsoon months the rate of carbon assimilation (mg C m^{-3} day^{-1}) was 95.64, 95.16, 75.05, 57.40 and 53.01 mg C m^{-3} day^{-1} at Nabadwip, Barrackpore, Diamond Harbour, Frazerganj. The contribution of nannoplankton towards productivity was higher than the net plankton in the estuarine system.

Utilization of energy from solar radiation by the primary producers of the Hooghly estuary from Nabadwip to Frazerganj was calculated to be 0.075% which is very low value as compared to other systems.

PROJECT BF/B/8 : ECOLOGICAL STUDIES ON TROPICAL MANGROVE VEGETATION ON WESTERN FRINGE AREA OF THE SUNDERBANS

Personnel : P. K. Chakraborti, Apurba Ghosh, D. Nath, M. L. Bhowmik, D. Sanfui, K. R. Naskar, G. N. Chattopadhyay, R. N. De, N. N. Mazumder and S. K. Mandal

Duration : 1984-1986

Location : Barrackpore and Kakdwip

About one-third of the total Sunderbans covering an area of 4,266.6 sq km is in West Bengal. Of these, 41.7% water areas along with the intertidal fringe areas offer lucrative

fisheries while phytotelmates and tide pools amidst mangrove vegetations serve as excellent nurseries for estuarine prawns and fishes. Starting from the river bed at the lowest low tide level up to the main forest land beyond the banks of the estuaries and creeks offers I to III formative zones and the mesophytic zone. The characteristic features of the floral and the faunal distributions in these zones have been studied. Qualitative and quantitative aspects of these biotic communities have also been studied in relation to season and ecological niches *viz.* freshwater flushed low saline zone, denuded and sewage influenced low saline zone, human interfered high saline zone, semi-core high saline zone, and core areas with and without guano effect in high saline zone. Studies were restricted to Kakdwip, Gosaba, Malancha, Durga Duani, Sajinakhali and Sudhannyakhali to cover core and semi-core areas, high and low saline zones and denuded stretches with sewage, night soil and subjected to other types to human interferences.

Plankton and benthos of these regions were analysed seasonwise and stretchwise for qualitative and quantitative estimates recording more phytoforms (66.6-97.5%). The ranges are:

Area	Plankton (u/l)	Benthos (u/m^2)
Kakdwip	1,125-1,400	nil
Malancha	1,133-1,520	62,317-93,399
Gosaba	2,613-2,711	998-1,211
Durga Duani	1,139-1,703	5,117-6,170
Sudhannyakhali	1,479-1,702	613-1,107
Sajinakhali	1,633-2,011	4,136-4,224

More or less universal dominance of *Lyngbya* sp., *Cyclops* sp. and *Brachionus* sp. in the plankton and of *Lyngbya* sp., *Phormidium* sp., diatoms, nauplii and polychaetes in the benthos were recorded.

Abiotic features of mangrove areas in low and high saline zones were:

Low saline phytotelmates of Kakdwip mangrove

Water phase				Soil phase	
D.O.	5.2-8.4 ppm	E.C.	5.9-15.3 mmhos/cm	Ph	8.3
Salinity	2.5-17 ppt	Total alk	80-110 ppm	Org. C	0.24-0.48%
Inorg. N.	0.4-0.8 ppm	Free CO_2	nil-Trace ppm	Available N.	26.31 mg/100 g
Phosphate	0.07-0.3 ppm	pH	8.3-8.4	Available P.	4 mg/100 g
				E.C.	5.3-5.5 mmhos/cm

High saline phytotelmates of Gosaba—Sajinakhali (water phase)

D.O.	5.6-8.4 ppm
pH	7-7.6
Alkalinity	120-220 ppm
Dissolved N	tr-0.1 ppm
Phosphorus	0.01-0.06 ppm

Nutrients were more in the phytotelmate-water than in the waters of the open estuaries as were for sewage influenced Malancha area.

PROJECT BF/A/2 : **FISHERY AND BIOLOGY OF HOOGHLY HILSA WITH SPECIAL REFERENCE TO BREEDING AND RECRUITMENT**

Personnel : M. Sinha, B. N. Saigal, M. K. Mukhopadhyay, D. K. De, S. B. Saha, P. M. Mitra, N. P. Saha and S. C. Moitra

Duration : 1986-1990

Location : Estuarine Division, Barrackpore

Experiments on artificial fecundation of *H. ilisha* were conducted just below Farakka Barrage during the month of October, 1986. Live mature oozing males (450-750 g) and females (750-1,300 g) were collected from bag (Sanglojal) and drift gill nets (*Chandi and Phasla jal*) and wet stripping was done. Of the six sets of experiments conducted, success in fertilization could be achieved in three sets with the average percentage of fertilization ranging between 75-80. Hatching was done in laboratory conditions (Water temperature 24-30°C, D.O. 5.2-8.0 ppm). A total of 35,000 (1-3 days old) hatchlings were transported to Barrackpore in open as well as closed containers (under oxygen). Hatchlings were stocked in cemented ponds at Barrackpore and provided with live minute zooplankton, as food, @ 5 cc by Vol/day. They survived for 47 days (after hatching) and attained an average length of 40 mm.

To conduct experiment on hilsa culture in pond (0.1 ha), the fry of hilsa ranging in size from 16-30 mm were collected from Hooghly river around Barrackpore with the help of fine meshed nylon dragnet. About 500 numbers of fry were stocked in the well-prepared pond during March, 1987 for this purpose.

To study the population difference, if any, morphometric measurements of 318 nos. of *H. ilisha* from down and up stream of Farakka barrage and feeder canal were recorded. Statistical analysis of the data is in progress. Electrophoresis studies of blood were also initiated during the year for the abovesaid purpose.

Data of catch and fishing effort of the species below Farakka were collected at different centres. Detailed report regarding the same is furnished under project BF/B/3.

PROJECT BF/A/11 : **ECONOMICS OF BRACKISHWATER FISH FARMING**

Personnel : S. Paul and H. K. Sen (up to May, 1986)

Duration : December, 1986

Location : Barrackpore

Lumpiness of investment in brackishwater fish farming was brought out along with the factors influencing the viability of the operations.

PROJECT AN/B/6 : ECOLOGY AND CONTROL OF AQUATIC INSECTS

Personnel : Krishna Mitra and Kuldeep Kumar

Duration : 1983-1986

Location : Barrackpore and Kalyani

Biology of two species were done during the period and the details are as follows:

Ranatra filiformes: Biology of *Ranatra filiformes* revealed that the bug completes its life cycle from egg to adult within 41.7 days during monsoon. The developmental period increased gradually at lower temperature. The eggs are laid singly, in a row embedded in the tissue of aquatic plants preferably *Hydrilla*. The frequency of laying is greater initially. It is also observed sometimes that female ceases laying for one or two days and again starts with vigorously. The total number of eggs are 30-63 per female. Males are slightly smaller than female (Male: 23-25 mm and Female: 26-31 mm without respiratory siphon).

Spherodema rusticum: This bug apparently resemables *Diplonychus annulatum* but for its smaller size (Male: 15-16 mm Female: 17-18 mm); a spot of fine bristle present on the middle towards the inner edge of hemielytra and low fecundity.

This bug completes its life cycle on an average 51 days from egg to adult, incubation period being 8-10 days. Like *annulatum* this bug also lay eggs on the dorsum of male. The fecundity ranges 45-79. These bugs are more harmful than *annulatum* consuming about 8.2 hatchlings of 12-15 mm size within 24 hours.

Erradication of unwanted aquatic insects through the application of insecticides

The laboratory expeiiments were conducted to control *Anisops* and *Ranatra* the most destructive species of aquatic insects which are capable of destroying large quantities of spawn and hatchlings.

Better control is possible through Demicron (10 ppm) for Anisops (100% mortality) and Ranatra (66% mortality) within 24 hrs. The calculated LC50 values are 5.9 ppm in case of *Anisop* and 9.4 ppm for *Ranatra* at temp. 29-31°C. The observed mortality in both the cases at this concentration is over 60%.

PROJECT AN/A/4 : ROLE OF FROGS AS PREDATORS OF PADDY PESTS

Personnel : A. K. Mondal and S. C. Mondal

Duration : 1983-1988

Location : Kalyani

Amphibian surveys conducted in the pre-monsoon and monsoon months of 1986-87 in the paddy fields of Kalyani and Ranaghat (Nadia district) and Basirhat (24-Parganas) of West Bengal could locate 12 species of Salientia; of which six species belonged to genus *Rana,* two to *Bufo,* one species of *Rhacophorus,* and three *Microhylid* species belonging to genera *Microhyla, Uperodon* and *Kaloula.* Their food habits as studied are presented in a tabular form. The frogs were induced bred and food habits of the tadpoles were confirmed through culture.

Frogs and toads encountered in paddy fields at Kalyani and Ranaghat (Nadia district) and Basirhat (24-Parganas) and their food habits

Species	FOOD ITEMS		
	Juveniles & Adults	Early & small frogs	Tadpoles
Rana tigrina	Mostly frogs and toads, earthworms, alugs, and large land insects and crabs and in addition centipedes, millipedes, small snakes, carp minnows, etc.	Ants, small beetles, grass hoppers, terrestrial flies, earthworms, tubificid worms, some times large insects larvae and tadpoles.	Highly carnivorous and posses cannibalism, Feed on zooplankton and detritus.
R. crassa	Small toads and frogs, earthworms and slugs and some land insects mostly dipteran flies.	-do-	-do-
**R. cyanophlyctis*	Small toads and frogs, fry and carp minnows, tadpoles, molluscs, land and aquatic insects, millipedes, centipedes, earthworms etc.	-do-	-do-
**R. limnocharis*	Land insects mostly grasshoppers, earthworms, small toads etc.	-do-	Zooplankton and detritus.
**R. breviceps*		Ants, small beetles, grasshoppers, terrestrial flies, earthworms, some tubificid worms. Sometimes large insect larvae and tadpoles.	Zooplankton and detritus.
R. erythreae	Land insects mostly, ants, grasshoppers and dipteran flies, moths and butterflies, earthworm etc.	Mostly ants, grasshoppers and small beetles.	Phyto and zooplankters.
**Bufo melanostictus* *B. stomaticus*	Ants, land insects including caterpillars and grasshoppers, earthworms etc.	Mostly ants, grasshoppers and small beetles, termites and earthworms.	Mosty soft algae, aquatic weeds and phytoplankton. Also take zooplankton at premetamorphic stages.
Rhacophorus maculatus	Ants, grasshoppers, dipteran flies, dragon flies, moths, earthworms etc.	Same as *R. erythreae*.	Mostly phytoplankton, soft algae and aquatic weeds, in addition to zooplankton.
Uperodon globulossum	Ants, termites, small beetles, earthworms, etc.	Ants, termites	Mostly zooplankton and detritus.
Kaloula pulchra taprobanica			
**Microhyla ornata*			

N.B. 1. Species marked with asterisk commonly occur in paddy fields. The remaining species mostly migrate to paddy fields during the rainy months for breeding.

2. In areas of mild salinity, *R. cyanophylyctis B. melanostictus* and *R. limnochris* and *R. breviceps* are common. In non-saline areas, only the first three species are common. *R. crassa* preponderates over *R. tigrina.*

3. Populations of the non-commercial species constitute more than ninety per cent. Adult mosquitoes were not found in the gut contents of any of the species. Mosquito larvae were taken as incidental food by *R. rigsisa, R. crassa* and *R. cyanophlyctis* under culture.

PROJECT AN/A/7 : ECOLOGY AND PRODUCTION BIOLOGY OF EDIBLE INLAND MOLLUSCS

Personnel : G. K. Vinci, V. K. Unnithan and V. V. Sugunan

Duration : 1984-1987

Location : CICFRI. Barrackpore

DESIGNING AND FABRICATION OF SNAIL HOUSE

A design of the snail house based on the biological requirements and behavioural pattern of the snail *Achatina fulica* was finalised and an estimate as prepared in consultation with the scientist of the Engineering Section. The cage has the dimensions $5 \times 2 \times 0.5$ m consisting of 10 chambers of 1 sq. m each. The estimate worked out to be Rs. 5,000/- (approx.). House is capable of rearing 3,000 snails at a time with a production rate of (65 g/6 months) 200 kg in six months at the present level of management.

EVALUATION OF EFFICACY OF VARIOUS FEEDS

In the absence of a snail farm experiments even restricted to glass terraria providing an assortment of kitchen refuse, supplemented with ash gourd, water lettuce, spinach, etc. The growth obtained was an average of 28.8 g in $3\frac{1}{2}$ months and the conversion ratio worked out to be 6.2 : 1 for the period.

BREEDING TRIALS

A. fulica was bred in glass terraria, cement cisterns and also in perforated plastic baskets. Fecundity for the six snails bred during the months of April and May varied from 112 to 228 eggs for the snails weighirg 30.15 g to 62 g. Breeding started as early as 16th April.

Eggs kept in soil in the terraria, failed to hatch in spite of treatment with 0.5% $kMnO_4$ or 0.2% malachite green. Breeding snails separated out into jar containing pebbles was found successful in hatching. Hatched out snails removed to moist soil and fed with ash gourd and powdered egg shell survived.

POPULATION STUDIES

Impact of exploitation on the population of snails in a plot of about 1.5 ha is being studied.

PROJECT AN/A/9 : DEVELOPMENT OF SUITABLE DESIGNS OF PENS AND CAGES FOR AUGMENTING FISH PRODUCTION IN LAKES AND RESERVOIRS

Personnel : A. B. Mukherjee

Duration : 1986-1991

Location : CICFRI Barrackpore

For developing design of pen enclosures for fish culture at Kanti ox-bow lake, Muzaffarpur, engineering surveys have been conducted at the proposed site to collect information on the following aspects—

(*a*) Physical characteristics of the ox-bow lake.
(*b*) Details of bed profile.
(*c*) Catchment area particulars.
(*d*) Area, depth dynamic loads etc.
(*e*) Meteorological data.

Based on detailed hydrological studies of a pen enclosure covering total area of 0.645 ha comprising 6 nos. of stock ponds each of 0.1 ha and 1 no. of nursery pond of 0.045 ha has been prepared.

PROJECT CSS/I : DEVELOPMENT OF INLAND FISHERIES STATISTICS

Personnel : R. A. Gupta and S. Paul

Duration : 1984-1989

Location : CICFRI, Barrackpore

The entire fishery resource was classified into various production regimes in order to evolve suitable collection and estimation methodologies. Standardised concepts, definitions and terminologies were formulated and separate proforma schedules were designed for collection of statistics on resources and fish catch for ponds, rivers, reservoirs and estuaries based on various attributes such as area under water units, type of water unit, utilisation, seasonality, cultural practices, stocking of various species, type of gears used and adoption of ultimate sampling unit etc. for getting more reliable estimate of resource and catch of fish with high degree of precision.

SAMPLE DESIGN FOR ESTIMATING AREA UNDER PONDS AND TANKS

The sampling design adopted for estimating the extent of area under water resource was stratified two stage cluster sampling. A district was divided into four strata of approximately equal size in respect of area/no. of villages. A sample of two cluster of five villages each were selected from each stratum. Cluster of villages constituted the first stage unit and the ponds within village as the second stage unit. Selected villages were surveyed completely and all the water units in the village were enumerated for estimating the average area under water units.

SAMPLE PROCEDURE FOR PHASE II—CATCH ESTIMATION

For estimating the total catch of fish five ponds/tanks were selected from each village at random from the total number of ponds in the village.

SAMPLING DESIGN FOR ESTIMATING CATCH OF FISH FROM RIVERS AND ESTUARIES

The sampling design for estimating the catch from this resource was adopted to be stratified two stage random sampling with landing centres and the boats constituting the first and the second stage units respectively.

COORDINATION, TRAINING AND SUPERVISION

The scheme was launched in eight States under the technical coordination and guidance of CIFRI. The planning and analysis of data was undertaken at CIFRI whereas the collection of data was assigned to the staff of the fisheries department of their respective States.

Officers and the field staff of all the eight States were imparted training on collection of data, selection of sample and various other aspects of the technical programme.

PUBLICATIONS 1986-87

Adhikari, A. K., D. Bhowmik, M. B. Chakraborty, V. B. Chandorkar, P. K. De, U. K. Katre, R. Roychowdhury & Y. S. Yadava. 1986
Limnology and productivity of Ox-bow lakes. *In* Proc. Workshop on Data Analysis of Life Sciences, ISI, Calcutta, Jan.-Feb., 1984 : 223-235.

Ayyappan, S., J. Dish, S. L. Raghavan, V. R. P. Sinha, & C. S. Purushothaman. 1986
Macrophyte decomposition in two tropical lakes. *Arch. Hydrobiol.,* **106** (2) : 219-231.

Barrackpore, Central Inland Fisheries Research Institute. 1986
Training in Freshwater Prawn Farming held at Prawn Breeding Unit, Kakinada. *Bull. Cent. fnland Fish. Res. Inst. Barrackpore,* No. **47** : 75 p.

Barrackpore, Central Inland Fisheries Research Institute. 1986
Training Systems for West Bengal Fisheries Officers. *Bull. Cent. Inland Fish. Res. Insr., Barrackpore.* No. 48.

Basu, N. C. 1986
An efficient gear for shrimp seed collection in Sunderbans. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986 : 124-126.

Bhaumik, U., P. K. Pandit, & B. K. Banerjee. 1986
Fin fish and shell fish seed transport. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 99-101.

Bhaumik, U., P. K. Pandit, B. K. Banerjee & D. D. Halder. 1987
Scope of aquaculture extension in alleviation of poverty in West Bengal. *In* International Workshop on Management of Agricultural Extension for Poverty Alleviation organised by National Institute of Rural Development. Rajendranagar, Hyderabad held during February 23-27, 1987 : 219-232.

Bhowmick, M. L., R. K. Chakraborty, Apurba Ghosh & P. K. Chakraborty. 1986
Brackishwater seed prospecting—present status & future prospect. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 95-98.

Bhowmick, R. M., G. V. Kowtal, R. K. Jana & S. D. Gupta. 1986
Observations on hypophysation and rearing of albino catla, *Catla catla* (Ham.) *Indian J. Anim. Sci.* **56** (4) : 482-484.

Chakraborti, N. M., H. C. Karmakar & A. K. Roy. 1980
Observations on the effect of supplementary feed on growth and survival of grey mullet *Liza parsia* (Ham.) fry in brackishwater nursery ponds at Kakdwip. *In Proc. Symp. Coastal Aquaculture* Pt. 3 : 797-802.

Chakraborty, R. K., & M. L. Bhowmick. 1985
Ecology and productivity of a brackishwater paddy cum fish culture on river Hooghly. *J. Ind. Soc. Coastal agric. Res.,* **3** (2) : 137-148.

Chakraborti, R. K., P. Ravichandran, D. D. Halder, S. K. Mandal & D. Sanfui. 1985
Some physico-chemical characteristics of Kakdwip brackishwater ponds and their influence on the survival, growth and production of *Penaeus monodon* (Fabr.) *Indian J. Fish.,* **32** (2) : 224-235.

Chakraborty, R. K., D. D. Halder, N. K. Das, S. K. Mandal & M. L. Bhowmick. 1986
Growth of *Penaeus monodon* (Fabr.) under different environmental conditions. *Aquaculture,* **51** (3-4) : 189-194.

Chandra, K. 1985
River pollution in India: Impact on inland fisheries. *Indian J. Agric. Chem.,* **18** (1) : 123-131.

Das, M. K. & D. P. Halder. 1986
Studies on protozoan parasites from fishes: two new species of the genus Neothelohanellus n. gen. (Myxosporidia) *Arch. Protistenk Protistetkd,* **132** (2) : 125-130.

Das, P., D. Kumar, U. Bhaumick, B. Roy & D. P. Chakraborty. 1982
Observations on four species culture of major Indian carps and exotic silver carp. *J. Inland Fish Soc. India,* **14** (1) : 18-22.

Das, P. & P. K. Mukhopadhyay. 1986
Give air breathing fish a chance. *Intensive Agriculture,* **24** (10) : 20-22.

Das, S. R., B. K. Sharma & N. K. Das. 1982
An indigenous earthen pot hatchery for breeding, hatching & rearing of cultivable fishes. *J. Inland Fish. Soc. India,* **14** (1) : 36-43.

Das, Sukla & Anjali De. 1986
List of CIFRI Publications 1977-1984 (with index from 1948 to 1984) *Bull. Cent. Inland Fish. Res. Inst., Barrackpore,* No. 44, 103 p. (*Mimeo*).

Datta N. C., P. R. Sen & A. N. Mohanty. 1987
Studies on the blood glucose of major Indian carp fingerlings—rohu, *Labeo rohita* (Ham.) and mrigal, *Cirrhinus mrigala* (Ham.) in starvation and its recovery with the provision of graded protein diets. *In* Proceedings of the Second International Conference on Warm water Aquaculture—Finfish held on the Brigham Young University, Hawaii Campus, February 5-8, 1985.

Desai, V. R., N. P. Srivastava & D. N. Misra. 1981
Breeding success of major carps in Rihand reservoir (U.P.) *Intl. J. Acad. Ichthyol.,* **2** (2) : 5-11.

Desai, V. R. & N. P. Srivastava. 1986
Mahseer machli ko bachaiye (In Hindi) *Kheti,* **39** (7) : 29-31.

Dutta, B. R., Nirmal K. Thakur & C. Selvaraj. 1983
Performance of a deformed *Catla catla* (Ham.) in a fish culture pond. *Sci. & Cult.* **51** (4) : 131-132.

Dutta, S. K., D. Konar, P. K. Banerjee, S. K. De, P. K. Mukhopadhyay & P. K. Pandit. 1986
Applied technology research and development—Prospects of increasing food production in India through different systems of paddy-cum-fish culture in freshwater areas—a case study. *Inretnarional Rice Commission Newsletter,* **35** (1) : 31-39.

Ghosh, Apurba. 1985
Shrimps as an important component in crop sequence in brackishwater production system—Observation on seed availability. *Proceedings of rhe Seminar on Present Status of Prawn Farming in India, Bhubaneswar,* 8-9 May, 1985 : 184-189.

Ghosh, Apurba & M. L. Bhowmik. 1986
Breakthrough in brackishwater aquaculture. *Intensive Agriculture,* **24** (10) : 26-31.

Ghosh, Apurba, M. L. Bhowmick & P. K. Chakraborty. 1986
Rearing of commercially important brackishwater shellfish and finfish for promoting aquaculture. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. Of India, Calcutta, July 3-4, 1986 : 102-105.

Ghosh, B. N. & K. Chandra. 1986
Treatment of agrochemial wastes from coal/coke processing units of steel plants. *Indian J. Agric. Chem.,* **19** (2) : 93-100.

Ghosh, P. K., A. K. Roy & M. K. Mukhopadhyaya. 1985
Preliminary observations on rearing of milkfish *Chanos chanos* (Forskal) fingerlings in brackishwater ponds at Kakdwip. West Bengal. *J. Ind. Soc. Coastal agric. Res.,* **3** (2) : 125-129.

Govind, B. V. 1984
Status of composite fish culture in Karnataka. *In* Proceedings of the Seminar on Inland Fisheries in Karnataka, August 18, 1984 held at Institution of Agricultural Technologists, Bangalore, Karnataka : 57-59.

Gupta, B. P. 1982
Soil characteristics of Bhavanisagar reservoir. *J. Inland Fish. Soc. India,* **14** (1) : 52-57.

Gupta, D. D. & Ravish Chandra. 1985
Some observations on an uncommon catfish, *Batrachocephalus mino* (Ham. Buch.) (Family: Aridae) with a note on the asymmetry of its parts. *Readings in Zoology,* **2** (2) : 7-10.

Hajra, A., A. Ghosh, P. K. Chakraborty, M. L. Bhowmick & S. K. Mandal. 1986
Influence of source and dietary level of energy on growth and performance in tiger prawn (*Penaeus monodon*) (F.) *J. Ind. Soc. Coastal agric. Res.,* **4** (2) : 121-131.

Halder, D. D. 1986
Induced maturation & breeding of tiger shrimp through eye stalk ablation. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 92-94.

Ibrahim, K. H., G. V. Kowtal & R. K. Jana. 1986
Contribution to hybridization among Indian carps. II Embryonic and larval development among *Labeo rohita* (Ham.) (X) *Cyprinus carpio* (L) Hybrid. *Bamidgeh.* **38** (3) : 89-95.

James, P. S. B. R., A. G. Jhingran & K. Madhusudhana Rao. 1986
Present status and future scope for fish production in cages and enclosures in India. *Indian J. Anim. Sci.* **56** (3) : 453-458.

Jhingran, A. G. 1986
Artificial recruitment and fisheries management of Indian reservoirs. *Bull. Cent. Inland Fish. Res. Inst., Barrackpore,* No. 45, 60 p.

Jhingran, A. G. 1986
Factors relevant to the management and conservations of Ganga fishery resources. *Paper ptesented at the Indo-US Workshop on Biological Conservation and Biomonitoring, held at Jawaharlal Nehru University, New Delhi, during* 10-14 *November,* 1986, 14 p.

Jhingran, A. G. 1986
Status paper on fish seed standardisation. *Bull. Cent. Inland Fish. Res. Inst.,* No. 43 : 9 p.

Jhingran, A. G. 1987
Research problems in fish seed production. *Paper presenetd at the State Level Seminar on Fish Seed Production held at Bhopal from* 25-26 *February,* 1987, 8 p.

Jhingran, A. G. & Apurba Ghosh. 1986
Aquaculture as a potential system of sewage disposal—A case study. *Paper presented at the Conference on "Environmental Sanitation and Related Aspects"* organised by Ministry of Urban Development (C.P.H.E.E.) Govt. of India, at Vigyan Bhavan, New Delhi, 5-7 November, 1986, 10 p.

Jhingran, A. G. & Apurba Ghosh. 1987
Aquafarming in coastal India. *J. Indian Soc. Coastal Agric. Res.,* **5** (1) : 1-8.

Jhingran, Arun Gopal & Maniranjan Sinha. 1986
Machlipalan—nadi—pukur and taltalaibo mey (in Hindi) *Kheti.* **39** (7) : 11-16.

Jhingran, A. G. & V. K. Unnithan. 1986
Blue print for blue revolution. *Intensive Agriculrure* **24** (10) : 5-11.

Jhingran, A. G. & V. K. Unnithan. 1987
Aspects of inland water management for fisheries. *Paper presented at the Indian Water Congress* organised by the Indian Centre for Public Health & Environment at New Delhi from 11-13 March. 1987, 17 p.

Jhingran, A. G. & V. K. Unnithan. 1987
Blue print for blue revolution. *Aquawotld,* **2** (4) : 109-112.

Jhingran, A. G. & V. V. Sugunan. 1986
Present status and prospects of finfish and shell fish seed production. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986 : 25-27.

Joshi, C. B. 1980
Procurement of stocking material of Mahseer *Tor putitora* from the hill streams in U.P. and Himachal Pradesh with special reference to collection techniques. *Intl. J. Acad. Jchlhyol.* (Proc. IV AISI) 5 : 169-172.

Joshi, H. C. 1986
DDT residues in fish in the river Hooghly. *Proc. Symp. Pest. Resid. & Env., Pollu.,* 93-96 P.

Joshi, H. C. 1986
Jal Ki machli kare guhar, gondale jal se karo udhar. (*In Hindi*) *Kheti,* **39** (7) : 50-53 & 64.

Joshi, H. C., M. K. Mukhopadhyayay, U. Bhaumik & P. K. Pandit. 1986
Compatibility of phosphamidon application with rearing of carp fry in paddy fields. *Indian J. Anim. Sci.,* **56** (6) : 708-710.

Kaliyamurthy, M. 1980
Observations on the larvae and juveniles of *Sillago sihama* from the Pulicat lake. *In* Proc. Symp. Coastal Aquaculture, Part 3, : 758-764.

Karmakar H. C. & A. N. Ghosh. 1980
Experiment for optimisation of feeding rate and feeding intensity during nursery rearing of *Liza parsia* (Ham.) *In* Proc. Symp. Coastal Aquaculture. Pt. 3 : 803-806.

Karmakar, H. C., A. K. Roy & D. D. Halder. 1986
On the efficiency of some natural feed for successful nursery rearing of *Lates calcarifer* (Bloch) by using a 3×3 factorial experiment. *J. Ind. Soc. Coastal agric. Res.,* **4** (2) : 133-136.

Kaushal, D. K. & Y. Rama Rao. 1982
A note on the occurrence and biological parameters of exotic grass carp. (*Ctenopharyngodon idella*) in Govindsagar reservoir. *J. Inland Fish. Soc. India,* **14** (1) : 98-100.

Kaushal, D. K., H. C. Joshi & Y. Rama Rao. 1984
Observations on the vertical distribution of plankton in Gobindsagar Himachal Pradesh. *Nat. Acad. Sci. Letters,* **7** (2) : 65-69.

Khan, M. A., R. A. Gupta & M. Peer Mohamed. 1986
Toxicity of zinc and mercury to chironomid larvae. *Indian J. Environ. Health.* **28** (1) : 34-38.

Kohli, M. P. Singh, Nirmal K. Thakur & S. K. Munnet. 1982
Seasonal changes in plankton population of some freshwater ponds at Patna, Bihar (India). *J. Inland Fish. Soc. India,* **14** (1) : 69-76.

Kowtal, G. V. & S. D. Gupta. 1986
A note on breeding of *Liza macrolepis* (Smith) in captivity. *Bamidgeh,* **38** (1) : 26-29.

Kowtal, G. V., S. D. Gupta, S. R. Ghosh, S. R. Jana & R. M. Bhowmick. 1982
Efficacy of conventional and formulated fish feed in rearing carp spawn. *J. Inland Fish. Soc. India,* **14** (1) : 80-83.

Kuldip Kumar. 1985
Seasonal variation of periphyton in a freshwater beel of West Bengal. *In* Proc. Nat. Symp. Pure & Appl. Limnology. *Bull. Bot. Soc. Sagar,* **32** : 229-235.

Kuldip Kumar, K. L. Sehgal & Shyam Sunder. 1982
General creel census of the two principal trout streams of Kashmir. *J. Inland Fish. Soc. India,* **14** (1) : 11-17.

Kuldeep Kumar & B. N. Singh. 1984
Preliminary observations on utilization of pelletized poultry litter as feed for common carp. *Intl. J. Acad. Ichthyol,* (Proc. IV AISI) 5 : 151-154.

Kumaraiah, P. & S. Parameswaran. 1982
A modified measuring board for air breathing fishes. *J. Inland Fish. Soc. India,* **14** (1) : 77-79.

Laal, A. K., A. Sarkar, S. K. Sarkar & K. L. Shah. 1982
Species diversity of periphyton as an index of pollution of river Ganga. *J. Inland Fish. Soc. India,* **14** (1) : 44-51.

Mehrotra, S. N. & A. G. Jhingran. 1986
Evaluation of limnological characteristics and trophic status of Gulariya reservoir. *Proc. Nat. Acad. Sci. India*, B, **56** (3) : 204-209.

Mondal, A. K. & A. G. Jhingran. 1986
Working paper on impact of frogleg industry on agriculture and public health. *Presented at the Meeting of the Technical Group to study the effect of depletion of frog population on Agriculture and Health systems*, 9 p.

Mukherjee, A. B. & A. Ghosh. 1985
Coastal aquacultural engineering for developing prawn farming with particular reference to Sunderban region. *In* Proceedings of the Seminar of "Present Status of Prawn Farming in India," Bhubaneswar, 8-9 May, 1985, 55-60.

Mukhopadhyay, M. K. & H. C. Karmakar. 1982
Effect of food and space on the growth and survival of the fry of Bhetki *Lates calcarifer* (Bloch). *J. Inland Fish Soc. India*, **14** (1) : 23-27.

Mukhopadhyay, P. K. 1986
Fish seed nutrition—a prerequisite for successful aquaculture. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 61-63.

Mukhopadhyay, Pratap K. & Ansuman Hajra. 1986
Intestinal protease activity and liver protein synthesis in *Clarias batrachus* (Linn.) fed isonitrogenous diets with variable energy level. *Sci. & Cult.*, **51** (7) : 230-233.

Mukhopadhyay, P. K., A. Hajra & M. Y. Kamal. 1986
Growth response of *Clarias batrachus* fed with isonitrogenous diets with variable energy levels. *Proc. Nat. Acad. Sci. India*, **54B** (4) : 329-334.

Mukhopadhyay, S. K. & N. Sarangi. 1985
Survival, growth and production of freshwater prawn. *Environ. & Ecol.*, **3** (2) : 198-201.

Naskar, Kumudranjan. 1985
A short history and the present trends of brackishwater fish culture in paddy fields at the Kulti—Minakhan areas of Sunderbans in West Bengal. *J. Ind. Soc. Coastal agric. Res.*, **3** (2) : 115-124.

Naskar, Kumudranjan, S. K. Saha & P. K. Saha. 1985
Compost of water hyacinth for agriculture and aquaculture. *Environ. & Ecol.*, **3** (2) : 249-253.

Naskar, Kumudranjan 1986
Role of *Avicennia* L., plantation on the brackishwater fisheries with special reference to their taxonomy and ecological note in tidal mangrove forests of Sunderbans. *J. Ind. Soc. Coastal agric. Res.*, **4** (2) : 137-142.

Naskar, Kumudranjan, A. C. Banerjee, N. M. Chakraborty & Apurba Ghosh. 1986
Yield of *Wolffia arrhiza* (L.) Horkel ex wimmer from cement cisterns with different sewage concentrations and its efficacy as a carp feed. *Aquaculture*, **51** (3-4) : 211-216.

Natarajan, A. V. 1985
Potential and prospects of inland fisheries in India. *In* Harvest and Post-harvest Technology of Fish (Based on the symposium on Harvest and Post-harvest Technology of Fish, sponsored by the Society of Fisheries Technologists (India) during 24-27 November, 1982 at Cochin ed. by K. Ravindran, et al. Cochin, Society of Fisheries Technologists (India), 14-18.

Natarajan, A. V. & Apurba Ghosh. 1986
Economic and environmental consideration of a coastal ecosystem—a case study in respect of Sunderbans. West Bengal. *In* Environmental Biology, Coastal Ecosystem, 43-55.

Natarajan, A. V. & V. Pathak. 1985
Tropic structure and energy flow in different aquatic ecosystems. *In* Proc. Nat. Symp. Pure & Appl. Limnology, (*Bull. Bot. Soc. Sagar*) **3v** : 164-176.

Olah, J., V. R. P. Sinha, S. Ayyappan, C. S. Purushothaman & S. Radheyshyam. 1986
Primary production and fish yields in fish ponds under different management practices. *Aquaculture*, **58** (1-2) : 111-122.

Pal, R. N., A. K. Ghosh & M. K. Das. 1986
Diagnosis of fish diseases in aquaculture management. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 113-117.

Parameswaran S. & V. K. Murugesan. 1984
A note on an inexpensive coracle. *Indian J. Fish.*, **31** (3) : 387-389.

Pathak, V., M. J. Bhagat and S. B. Saha. 1986
Limnological significance of nannoplankton as producers in beel ecosystem. *J. Hydrobiol., 2* (3 & 4) : 73-79.

Paul, S. 1986
Financing Inland aquaculture—problem areas and policy options. *Fish Coops,* **1** (1) : 43-46.

Paul, S. 1986
Seed supply sub-system—Key issues in economics of production and marketing. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal & Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 72-74.

Paul, S. 1987
Inland Fisheries—a need for closer linkages between research and development. [Presented at the National Seminar on Current Status of Agro-based Technologies and Futuristic Approaches to Rapid Rural Industrialisation held at Narendra Deva Universitv of Agriculture and Technology, Faizabad (U.P.) from February 7-9, 1987.

Peer Mohamed M. & M. N. Kutty. 1986
Influence of ambient oxygen and random swimming activity on metabolic rates and quotients in the freshwater mullet *Rhinomugil corsula* (Hamilton). *Proc. Indian Acad. Sci.,* (Anim. Sci.), **95** (1) : 67-76.

Pillai, S. M. 1986
Observations on the gonadal maturation of a penaeid prawn *Metapenaeus brevicornis* H. M. Edwards from brackishwater ponds. *J. Ind. Soc. Coastal agric. Res.,* **4** (1) : 57-62.

Pillai, S. M., P. K. Ghosh, T. Rajyalakshmi & A. K. Roy. 1980
Observations on growth survival and production of grey mullets *Mugil cephalus* (Linnaeus), *Liza parsia* (Hamilton) and *Liza tade* (Forskal) in a coastal low saline polyculture pond. *Proc. Symp. Coastal Aquaculture,* Pt. 3 : 776-781.

Rai, S. P. & R. C. Singh. 1986
Happy in a pen. *Intensive Agriculture,* **24** (10) : 23-25.

Rajyalakshmi, T., S. M. Pillai, A. K. Roy & P. U. Verghese. 1982
Studies on rearing of *Penaeus monodon* Fabricius in brackishwater ponds using pelleted feeds. *J. Inland Fish. Soc. India,* **14** (1) : 28-35.

Rajyalakshmi, T. 1985
Brackishwater fish culture technology of India and its role in coastal-zone management. *In* Biology of Benthic Marine Organisms—Techniques and Methods as applied to the Indian Ocean. Ed. by Mary—Frances Thompson et al. Oxford & IBH Publishing Co. New Delhi.

Rajyalakshmi, T. & G. Maheswardu. 1986
On the culture of *Macrobrachium rosenbergii* (De Man) in Andhra Pradesh, India. *J. Ind. Soc. Coastal agric. Res.,* **4** (1) : 25-41.

Rajyalakshmi, T., S. M. Pillai, A. K. Roy & P. U. Verghese. 1986
Feeds and nutrition of the prawn *Penaeus monodon. Environ. & Ecology,* **4** (3) : 414-422.

Rajyalakshmi, T., G. Maheswarudu, D. M. Reddy & H. C. Joshi. 1986
An approach to environmental impact study in the Kakinada Bay. *In* Environmental Biology-Coastal Ecosystem : 125-140.

Ramachandran, V., T. Ramaprabhu & S. R. Ghosh. 1985
Control of noxious bloom of *Peridinum* in fish pond with ammonia. *Environ. & Ecol.,* **3** (3) : 378-382.

Ramakrishnaiah, M. & S. K. Sarkar. 1982
Plankton productivity in relation to certain hydrological factors in Konar reservoir (Bihar). *J. Inland Fish. Soc. India,* **14** (1) : 58-68.

Ramaprabhu, T., S. R. Ghosh, A. N. Mohanty & K. M. Das.
Some observations on the use of ammonia as a fish toxicant. *Indian J. Comp. Anim. Physiol,* **4** (1) : 39-48.

Rangaswamy, C. P. 1980
On the identification of fry of grey mullet *Valamugil cunnesius* (Valenciennes). *In* Proc. Symp. Coastal Aquaculture, **3** : 970-975.

Rao, G. Ramamohana, K. Raman, K. V. Ramakrishna and M. Kaliyamurthy. 1980
Observations on the seasonal abundance of larvae and juveniles of some percoid fishes entering into lake Pulicat. *In* Proc. Symp. Coastal Aquaculture, Part 3 : 750-757.

Roy, A. K., H. C. Karmakar & B. Basak. 1985
Observations on silt load distribution in relation to tidal amplitude and lunar periodicity and its control in brackishwater fish farming. *J. Ind. Soc. Coastal agric. Res.,* **3** (2) : 107-114.

Roy, A. K., H. C. Karmakar, N. M. Chakraborty & D. D. Halder. 1986
Studies on the effect of rearing density on the growth survival and net yield of *Liza tade* (Forskal). *J. Ind. Soc. Coastal agric. Res.,* **4** (1) : 43-55.

Saha, C. 1986
Shrimp and carp hatcheries and their aeration requirements. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal, Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986 : 75-78.

Saha, G. N., S. B. Saha & S. P. Ghosh. 1980
Effect of fertilization at different frequencies on the growth of mullet fry *Liza parsia* (Hamilton) in brackish-water pond soil. *In* Proc. Symp. Coastal Aquaculture, Pt. 3 : 876-880.

Saha, G. N., S. C. Thakurta, G. C. Laha, A. C. Nandy, H. C. Karmakar, K. R. Naskar, P. B. Das & S. K. Chatterjee. 1986
Ecology and fishery management of brackishwater bheries in West Bengal. *Bull. Cent. Inland Fish Res. Inst.,* Barrackpore, No. 46, 23 p.

Sarkar, S. K., Datta, B. R., Kuldeep Kumar & B. N. Singh. 1984
Preliminary observations on the possibility of adopting the simplified technique of induced fish breeding in rurual Orissa—a case study. *Intl. J. Acad. Ichthyol.,* (*Proc IV* AISI) 5 : 177-180.

Saxena, R. K. 1986
Effect of anaesthetic interval sodium on fingerlings and hatchlings of fish. *Proc. Nat. Acad. Sci. India,* **56B** (3).

Selvaraj. C., Nirmal K. Thakur, B. R. Dutta, Kuldip Kumar, C. S. Purushothaman, Radheyshyam & S. R. Sarkar. 1982 Induced breeding of grass carp *Ctenopharyngodon idella* (Val.) at Kausalyaganga (Orissa), with special reference to an instance of its natural spawning at unusually high temperature. *J. Inland Fish. Soc. India,* **14** (1) : 91-94.

Sen, P. R., N. G. S. Rao, R. D. Chakraborty, S. L. Kar & S. Jena. 1978
Effect of additions of fertilizer and vegetation on growth of major Indian carps in ponds containing grass carp. *Prog. Fish. Cultr,* 40 (2) : 69-70.

Sen, P. R. & A. N. Mohanty. 1985
Observations on the rate of feeding conversion and growth of rohu fry. *In* Proceedings of the Second International Conference on Warm Water Aquaculture—Finfish held on the Brigham Young University, Hawaii Campus, February 5-8, 1985 : 131-140.

Shah, K. L., B. C. Tyagi & S. K. Karma. 1986
Report on the use of alkali soil and sodium carbonate as scalants for controlling seepage losses in fish ponds, (Collaborative research programme, Centre Inland Fisheries Research Institute, Barrackpore and Central Soil Salinity Research Institute, Karnal). *Bull. Cent. Inland Fish. Res. Inst.,* Barrackpore, No. 42 : 4 p.

Sharma, B. K. 1986
Syampathetic breeding of carps in dry bundhs. *In* Second National Fish Seed Congress, Fisheries Department, Govt. of West Bengal, Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986, 68-71.

Sharma, B. K. & M. Sinha. 1986
Paying partners. *Intensive Agriculture,* **4** (10) : 15-19.

Sharma, V. K. 1979
On a rare Glyptostermoid fish from Kangra Valley of H.P. *J. Zool. Soc. India,* **31** (1 & 2) : p. 91.

Shree Prakash. 1986
Culturable freshwater prawns of India. *Seafood export J.,* **18** (1) : 17-21.

Shree Prakash & G. P. Agrawal. 1986
Studies on the correlation between juvenile abundance of freshwater prawn juvenile in relation to physico—chemical conditions of the environment. *J. Sci. Res. B.H.U.,* Varanasi, **36** (1).

Singh, Balbir. 1985
A note on the preliminary observations on the food of *Labeo rohita* (Ham.) from Govindgarh Lake, Rewa, (M.P.). *J. Sci. Res.,* **35** (2) : 121-123.

Singh, B. N., Radheyshyam & Kuldeep Kumar. 1984
On the retardation of growth of abnormal fry, fingerlings and table size specimens of *Labeo rohita* (Ham.) in village ponds. *Intl. J. Acad. Ichthyol.,* (Proc. IV AISI 5) : 131-137, 1984.

Singh, D. N. 1986
Effect of *Lernaea* parasitism in composite fish culture ponds of Assam and their control. *In* Proc. Symp. New Dimensions Parasite 18-19 January, 1986 : 117-118.

Singh, D. N., S. N. Mehrotra & K. Chandra. 1985
Role of aquatic macrophytes in the limnology of McPherson Lake, Allahabad. *In* Proc. Nat. Symp. Pure & Appl. Limnology (Bull. Bot. Soc. Sagar), **32** : 89-95.

Singh, D. N., R. S. Panwar, R. K. Tyagi & R. N. Seth. 1986
Toxicity of three chemical toxicants on freshwater fish, *Cyptinus catpio* Communis (Linn.). *J. Assam Science Society,* **v8** (2) : 21-25.

Singh, R. K. 1983
The role of the littoral (shallow) zone in reservoirs productivity. *Acta hydrochema et hydtobiol,* **11** (1) : 101-107.

Singh, R. K. 1985
Limnological observations on Rihand reservoir (Uttar Pradesh) with reference to the physical and chemical parameters of its water. *Int. Revue ges. hydrobiol.,* **70** (6) : 857-875.

Singh, S. N. & B. C. Jha. 1982
Attheva zachatiasi Burn.—A new record of diatom from India. *J. Inland Fish. Soc. India,* **14** (1): 84-85.

Singh, S. P. 1980
Spawn prospecting in the Brahmaputra river. *J. zool. Soc. India,* **32** (1 & 2) : 55-66.

Sinha, M. 1986
Age and growth of *Plotosus canius* Hamilton from Hooghly-Matlah estuary. *Indian J. Anim. Sci.,* **56** (1) : 116-126.

Sinha, M. 1986
Functional morphology, anatomy and histology of the digestive organs of the catfish *Plotosus canius* (Hamilton). *Proc. Indian Acad. Sci. (Anim Sci.),* **95** (1) : 23-44.

Sivakami, S. & Abraham Mathew. 1982
Food preference of fry of *Labeo calbasu* (Hamilton) in nurseries at Bhavanisagar reservoir. *J. Inland Fish. Soc. India,* **14** (1) : 95-97.

Srinivasagam, S. 1982
An instance of large scale parasitism of *Heterosaccus dollfusi* Boschma on the edible crab *Portunus sanguinolentus* (Herbst) in Pulicat lake. *J. Inland Fish. Soc. India,* **14** (1) : 88-90.

Srinivasagam, S. & K. Raman. 1985
Crab fisheries of Pulicat lake with special reference to catches from the Southern Sector. In Harvest and Post-harvest Technology of Fish (Based on the Symposium on Harvest and Post-harvest Technology of fish sponsored by the Society of Fisheries Technologists (India) during 24-27 November, 1982 at Cochin ed. by R. Ravichandran : 63-68.

Sukumaran, P. K. 1986
On the biology of *Puntius dorsalis* (Jerdon) *Geobios New Reports,* **5** : 128-133.

Sultana, Munawar, K. Raman, P. M. Abdul Kadir, S. Srinivasagam & G. R. M. Rao. 1980
Observations on the biology of *Hemirhamphus gaimardi* (Cuvier and Valenciennes) of Pulicat Lake. *J. mar. biol. Ass. India,* **22** (1 & 2) : 89-109.

Thakur, Nirmal Kanta. 1986
Machli-machhi-machhi (*In Hindi*). *Kheti,* 38 (7), p. 16.

Thakur, N. K. & P. Das. 1985
Synopsis of biological data on singhee, *Heteropneustes fossilis* (Bloch). *Bull. Cent. Inland Fish. Res. Inst., Barrackpore,* No. 39, 32 p.

Thakur, N. K. & P. Das. 1985
Synopsis of biological data on Koi, *Anabas testudineus* (Bloch, 1972). *Bull. Cent. Inland Fish. Res. Inst., Barrackpore,* No. 40, 47 p.

Thakur, N. K. & P. Das. 1985
Synopsis of biological data on magur, *Clarius batrachus* (Linnaeus 1759). *Bull. Cent. Inland Fish. Res. Inst., Barrackpore,* 41, 82 p.

Thakurta, S. C. & B. B. Pakrasi. 1980
Some experiments on acclimatising, packing and transport of mullet fry *Liza parsia* (Hamilton). *In* Proc. Symp. Coastal Aquaculture, Pt. 3 : 964-969.

Tripathi, S. D. 1986
Carry on with carp culture this way. *Intensive Agriculture,* **24** (10) : 33-37.

Venkatesh, B., P. K. Mukhopadhyay & P. V. Dehadrai. 1986
Growth and metabolism of the catfish *Clarias batrachus* (Linn.) fed with different experimental diets. *Proc. Indian Acad. Sci.* (Anim. Sci.), **95** (4) : 457-462.

Vinci, G. K. 1986
Biology of *Mystus seenghala* (Sykes) from Nagarjunasagar reservoir, Andhra Pradesh. *Indian J. Anim. Sci.,* **56** (7) : 814-821.

Yadava, Y. S. & M. Choudhury. 1986
Banas fishing in beels of Assam. *J. Bombay Nat. Hist. Soc.,* **83** (2) : 452-456.

PERSONNEL

The following scientists rendered their services to the Institute during 1986-87.

Dr. A. V. Natarajan, Director, Barrackpore (up to 23.5·1986)
Dr. Arun G. Jhingran, Director, Barrackpore (from 24.5.1986)

FRESHWATER AQUACULTURE DIVISION

Dhauli

Shri S. D. Tripathi, S-3 (Per. Gr.), Head, FARTC & National Project Director, FAO/UNDP Project
Shri N. G. S. Rao, S-3
Shri K. K. Sukumaran, S-3
Shri H. A. Khan, S-3
Shri S. Patnaik, S-3
Shri M. Ranadhir, S-3
Shri K. K. Bhanot, S-2
Smt. K. K· Bhanot, S-2
Shri D. K. Chatterjee, S-2
Shri G. V. Kowtal, S-2
Shri M. Rout, S-2
Shri R. K. Jana, S-2
Shri G. R. M. Rao, S-2
Shri Dilip Kumar, S-2
Shri S. D. Gupta, S-2
Shri K. J. Ram, S-2
Shri R. K. Dey, S-2
Dr. R. C. Das, S-2
Shri B. K. Mishra, S-2
Shri A. K· Sahoo, S-2
Shri S. Ayyappan, S-2
Dr. S. N. Mohanty, S-2
Shri D. Narayanaswamy, S-1
Shri C. S. Purushothaman, S-1
Shri S. Jena, S-1
Shri P. V. G. K. Reddy, S-1
Shri P. K. Saha, S-1
Shri M. S. Tantia, S-1

Cuttack Centre

Shri S .N. Dutta, S-1
Shri N. K. Tripathi, S-1
Shri S. L. Kar, S-1

RIVERINE AND LACUSTRINE DIVISION

Allahabad Centre

Dr. K. L. Sehgal, S-3 (Head, R & L Division)
Shri Ravish Chandra, S-3
Shri S. P. Singh, S-3
Dr. G. N. Mukherjee, S-2 (up to 30.6·1986)
Dr. R. S. Panwar, S-2
Shri G. N. Srivasthava, S-2
Shri R. N. Seth, S-2
Dr. M. A. Khan, S-2
Shri R. K. Saxena, S-2
Shri K. P. Srivasthava, S-2
Shri Balbir Singh, S-2
Shri Shreeprakash, S-2
Shri S. N. Mehrotra, S-2
Shri R. K. Tyagi, S-1
Shri S. K. Wishard, S-1
Shri R. K. Dwivedi, S-1
Dr. K. Chandra, S-1
Shri P. K. Katiha, S-1

Bangalore Centre

Shri B. V. Govind, S-3
Dr. S. P. Ayyar, S-3
Dr. T. Ramaprabhu, S-3
Mr. P. Kumariah, S-2
Mr. P. K. Sukumaran, S-1
Mr. Appaji Chari, S-1

Bhagalpur Centre

Dr. A. K. Laal, S-2
Dr. B. L. Pandey, S-2
Mr. S. K. Sarkar, S-1

Bhimtal Centre
Shri C. B. Joshi, S-2

Bilaspur Centre
Dr. Y. Rama Rao S-3 (up to 31·3.86)
Mr. G. K. Bhatnagar, S-2
Mr. D. K. Kaushal, S-2
Dr. H. P. Singh, S-2
Shri V. K. Sharma, S-1

Buxar Centre
Shri D. R. Kanaujia, S-1

Eluru Centre
Shri Ch. Gopalakrishnaya, S-3
Dr. M. Ramakrishnaiah, S-2
Shri K. V. Rao, S-2
Shri R. M. Rao, S-2
Shri J. B. Rao, S-2

Guwahati Centre
Dr. D. N. Singh, S-2
Shri Y. S. Yadava, S-2
Shri M. Chowdhury, S-1
Shri S. K· Munnet, S-1

Kakinada Centre
Dr. M. Subrahmanyam, S-3
Dr. K. J. Rao, S-2

Karnal Centre
Shri K. L. Shah, S-2
Shri B. C. Tyagi, S-2
Shri D. N. Mishra, S-2

Lalgola Centre
Shri A. R. Chowdhury, S-1

Muzaffarpur Centre
Dr· S. P. Rai, S-2
Shri S. N. Singh, S-1
Shri B. C. Jha, S-1

Patna Centre
Shri Dhirendra Kumar, S-2
Shri V. R. Chitranshi, S-1
Shri P. N. Jaitly, S-1

Pollachi Centre
Shri C. Selvaraj, S-3
Dr. M. Kaliamurthy, S-2
Dr. Mathew Abraham, S-2
Shri P. K. Aravindakshan, S-2
Shri V. K. Murugesan, S-2
Shri K. O. Joseph, S-1

Pune Centre
Shri P. L. N. Rao, S-2
Shri B. K. Singh, S-1
Shri V. Kolekar, S-1
Shri M. D. Pisolkar, S-1

Raipur Centre
Dr. V. R. Desai, S-3
Shri N. P. Srivasthava, S-1

Srinagar Centre
Dr. K. K. Vass, S-2
Dr. Shyamsunder, S-2
Dr. H. S. Raina, S-2
Dr. (Smt.) Usha Moza, S-2

ESTUARINE FISHERIES AND BRACKISHWATER IMPOUNDMENTS SECTIONS

Barrackpore Centre

Estuarine Fisheries
Dr. B. N. Saigal, S-3 & Head, Estuarine Division
Shri R. N. Pal, S-3
Shri B. B. Ghosh, S-3
Dr. M. Sinha, S-2
Dr. V. Pathak, S-1
Shri P. M. Mitra, S-2
Shri M. K. Das, S-2

Shri A. K. Ghosh, S-2
Dr. M. K. Mukhopadhyay, S-2
Shri S. B. Saha, S-2
Dr. H. C. Joshi, S-2
Shri R. K. Das, S-2
Shri M. M. Bagchi, S-2
Shri D. K. De, S-2
Shri H. C. Karmakar, S-1
Shri H. S. Mazumder, S-1
Shri A. Chowdhury, S-1
Dr. Babu Lal, S-1
Shri J. N. Pal, S (on leave)

Brackishwater Impoundments Section

Shri Apurba Ghosh, S-3
Dr. K. M. Das, S-2
Dr. Amitabha Ghosh, S-2
Shri A. Hajra, S-1
Dr. G. N. Chattopadhyay, S-2

Calcutta Centre

Shri G.N. Saha, S-3
Dr. C. R. Das, S-3
Shri S. C. Thakurta, S-2
Shri G. C. Laha, S-1
Shr P. K. Ghosh, S-1

Digha Centre

Shri S. N. Sar

Kakdwip Centre

Dr. M. L. Bhowmick, S-2
Shri S. R. Das, S-2
Shri D. Nath, S-2
Shri R. K. Chakraborty, S-2
Shri A. Mukherjee, S-2

K. V. K., Kakdwip

Shri J. G. Chatterjee, S-2

Madras Centre

Shri K. Raman, S-3
Dr. A. V. P. Rao, S-3
Shri K. V. Ramakrishna, S-2
Shri K. N. Krishnamurthy, S-2
Dr. B. P. Gupta, S-2
Dr. S. Radhakrishnan, S-2
Dr. R. D. Prasadam, S-2
Dr. L. H. Rao, S-2
Shri S. Srinivasagam, S-2
Shri C. P. Rangaswamy, S-1
Smt. M. Sultana, S-1
Dr. K. Gopinathan, S-2

Puri Centre

Dr. (Smt.) T. Rajyalakshmi, S-3 (Per. Gr.)
Shri P. Ravichandran, S-2
Dr. S. M. Pillai, S-2

Pulicat Centre, Madras

Dr. A. V. Natarajan, S-5

OTHER CENTRES/SECTIONS

Barrackpore Centre

Beel Fisheries Division

Dr. (Mrs.) Krishna Mitra, S-1
Shri S. K. Mazumdar, S-1
Dr. M. J. Bhagat, S-1

Extension Section

Shri D. D. Halder, S-3, Incharge, Extn, Lib. & Doc. & LRP
Shri U. Bhaumik, S-2
Shri P. K. Pandit, S-2
Shri B. K. Banerjee, S-1

Engineering Section

Shri A. B. Mukherjee, S-2

Economics Section

Shri S. Paul, S-2

Inland Molluscs Section

Mr. V. V. Sugunan, S-2
Mrs. G. K. Vinci, S-2
Dr. V. K. Unnithan, S-2

Canning Survey Centre

Shri P. K. Chakraborti, S-2

Kalyani Centre

Dr. A. K. Mondal, S-3
Shri D. P. Chakraborti, S-2

Krishnagar Centre

Mr. N. K. Das, S-2

KVK/TTC, Kausalyagang

Shri B. K. Sharma, S-3 & Chief Training Organiser
Dr. B. N. Singh, S-3
Dr. N. K. Thakur, S-3

Dr. S. K. Sarkar, S-2

Rahara Centre

Shri P. R. Sen, S-3
Dr. S. K. Mukhopadhyay, S-3
Dr. R. K. Banerjee, S-2
Shri A. K. Dutta, S-2

Shri A. K. Roy, S-2
Dr. K. R. Naskar, S-2
Shri A. C. Nandi, S-2
Shri A. Sengupta, S-1

Central Sector Scheme for Inland Fisheries Statistics

Shri R. A. Gupta, S-3

Shri S. K. Mondal, S-1

Scientists on deputation/Lien

Dr. P. V. Dehadrai, S-3 (Per. Gr.), Ministry of Agriculture, New Delhi
Dr. V. R. P. Sinha, S-3 (Per. Gr.) (on deputation abroad)
Dr. M. Y. Kamal, S-3, ICAR, New Delhi
Dr. P. Das, S-3 (Per. Gr.), NBFGR, Allahabad
Mr. D. V. Pahwa, S-2 ICAR, New Delhi
Dr. K. M. Rao, S-2, ICAR, New Delhi
Dr. Y. Rama Rao, S-3, North Eastern Council Secretariat at Shillong
Dr. P. K. Mukhopadhyay, S-2, ABD Project on Deep Water Rice at Calcutta under the International Rice Research Institute, Manila.
Shri S. K. Saha, S-2, Planning Commission, Govt. of India, New Delhi.
Dr. C. Saha, S-2, Orissa Shrimp Seed Production Supply and Research Centre of MPEDA.
Dr. Kuldip Kumar, S-2, State Fisheries Department, Himachal Pradesh.
Shri N. M. Chakraborty, S-1, Central Institute of Coastal Engineering for Fishery, Govt. of India, Bangalore.

The following members of staff (Technical/Auxiliary) rendered their services during the year:

T-8

Shri M. A. V. Lakshmanan (up to 31.7.1986)

T-7

Shri N. C. Basu

Shri B. B. Satpathy

T-6

Dr. A. K. Chattopadhyay
Shri S. K. Sadhukhan
Smt. Mira Sen
Shri J. P. Verma

Smt. Lekha Sanfui
Shri D. Dalai
Shri Radheshyam

T-5

Shri P. B. Das
Shri J. Ghosh
Smt. Anjali De
Shri Ashis Chowdhury
Shri A. R. Majumder
Shri S. K. Das
Shri P. K. Ghosh
Shri R. C. Satpathy
Shri M. D. Mantry
Shri C. D. Sahoo

Dr. P. K. Das
Shri B. R. Dutta
Shri Kuldeep Kumar
Shri S. L. Raghavan
Shri D. R. Rao
Shri B. K. Saha
Shri K. Subba Rao
Shri T. S. Rama Raju
Shri R. N. De
Shri R. C. Singh

T-4

Smt. Sukla Das
Shri Sanjoy Kr. Manna
Shri N. K. Srivastava
Dr. N. Sarangi

Shri Sukumar Saha
Smt. Dipti Manna
Shri Chandranath Mukherjee

Technical Assistant T-II-3

Shri H. K. Sen
Shri A. K. Roy
Shri S. P. Ghosh
Shri H. Chaklader
Shri A. K. Banerjee
Shri Fatik Manna
Shri N. N. Majumder
Shri T. Chatterjee
Shri Pintu Biswas
Shri P. Dasgupta
Miss Keya Saha
Shri K. M. Das
Shri H. K. Muduli
Shri A. N. Mohanti
Shri K. C. Pari
Shri Satyendu Sarkar
Shri D. N. Srivastava
Shri K. S. Banerjee
Shri B. D. Saroj
Shri Ram Chandra
Shri Ranjit Singh
Shri Kishan Deo
Shri Donald Singh
Shri Camil Lakra
Shri K. K. Agarwal
Shri H. C. Banik
Shri N. C. Mondal
Shri M. F. Rahman
Shri P. S. C. Bose
Shri B. K. Biswas
Shri Ramji Tiwari
Shri G. P. Bhattacharjee
Shri Bhaskar Ghosh
Shri S. Krishnan
Shri P. M. A. Kadir
Shri S. K. Srivastava

Technical Assistant T-I-3

Shri K. L. Das
Shri M. M. Das
Shri S. C. Bhowmick
Shri S. Bhattacherjee
Shri S. C. Das
Shri S. N. Sadhukhan
Shri N. P. Saha
Shri N. C. Roy
Shri R. M. Roy
Shri Swapan Chatterjee
Shri A. K. Banerjee
Shri S. C. Moitra
Shri G. C. Sahoo
Shri B. B. Sethi
Shri D. Tarai
Shri Narsing Guin
Shri N. D. Sarkar
Shri A. R. Paul
Shri A. N. Mohanty
Shri D. P. Verma
Shri M. P. Singh

Technical Assistant T-2

Shri A. K. Majumder
Shri R. K. Halder
Shri S. K. Deb
Shri Kanchan Dutta
Shri R. L. Balmiki
Shri Surja Bahadur
Shri Badal Lal Singh
Shri N. C. Biswas
Shri U. K. Chatterjee
Shri C. R. Das
Shri T. P. Ghosh
Shri B. Kahali
Shri B. K. Behera
Shri S. K. Chatterjee
Shri J. P. Mishra
Shri Bhai Lal
Shri Harihar Dash
Shri Alekha Naik
Shri B. B. Roy
Shri Debasis Sanfui
Shri S. C. Mondal
Shri K. P. Singh
Shri Dipak Kr. Biswas
Shri Pasupati Lal
Shri K. R. Deb
Shri B. B. Das
Shri M. G. Subramanyam

Technical Assistant T-1

Shri B. N. Das
Shri K. L. Chakraborty
Shri Md. Samood
Shri Swapan Das
Shri Sisir Chakraborty
Shri Hatto Jally
Shri M. C. Pal
Shri Ch. Shyamala Rao
Shri U. N. Jally
Shri R. N. Saha
Shri Nazir Ahmed Mir
Shri S. Kotaiah
Shri G. N. Burman
Shri J. L. Bose
Shri S. K. Biswas
Shri N. K. Saha
Shri Rabindra Tarai
Shri S. K. Dey
Shri K. Ganesan
Shri B. Berjory
Shri Purna Ch. Mohanty
Shri Aloke Sarkar
Shri Ch. G. Rao
Shri L. K. Parbat

Auxiliary

Shri P. R. Rao (Hindi translator)

Shri A. K. Goswami (Driver)

The following members of staff of Administrative Section rendered their services during the year:

Senior Administrative Officer

Shri L. M. Nandy

Accounts Officer

Shri A. N. Mukherjee

Assistant Administrative Officer

Shri K. C. Roy (up to 31.7.86)
Shri M. L. Biswas

Shri P. C. Kanungo
Shri K. B. Rajani

Senior Stenographer/P.A. to Director

Shri G. Lahiri

Senior Stenographer
Shri R.C. Srivastava

Superintendent

Shri A. K. Sengupta
Shri B. C. Dutta
Shri M. R. Roy
Shri S. C. Roy

Shri F. A. Zaidi
Shri A. K. Das
Shri T. P. Das
Shri S. C. Saha

Assistant

Shri B. C. Bhattacharjee
Shri S. K. Bose
Smt. Bani Roy
Shri N. H. Baidya
Shri N. K. Sarkar
Shri S. Dasgupta
Smt. S. Majumder
Shri M. M. Neogi
Shri D. K. Banerjee

Shri D. C. Bose
Shri C. C. Das
Smt. Namita Chowdhury
Shri R. C. P. Singh
Shri S. K. Pramanick
Shri Mahesh Prasad
Shri Abdul Halim
Shri S. P. Shastri

Stenographer

Shri G. M. Chakraborty
Shri H. Chaklader (up to 24.5.86)
Shri A. K. Banerjee (up to 24.5.86)
Shri U. K. Ghosh

Shri T. K. Roy
Shri Asoke Kumar Saha
Shri P. Jena

Senior Clerk

Shri S. K. Kar
Shri N. K. Mitra
Shri J. C. Patra
Shri Keshab Prasad
Shri H. K. Nath
Shri N. N. Banerjee
Shri H. K. Sarkar
Shri D. N. Baidya
Shri H. B. Sutar
Shri S. R. Halder
Shri H. L. Sarkar
Shri B. B. Mukherjee
Shri B. C. Majumder
Shri T. K. Majumder
Shri S. Bhowmick
Shri M. K. Das
Shri D. K. De Sarkar
Shri R. R. Mukherjee
Shri M. Kachhap
Shri A. B. Biswas
Shri Ranjit Kr. Ghosh
Shri L. P. Mishra
Shri Baij Nath
Shri Kallu Singh Verma
Shri I. N. Kodandraman
Shri P. K. Ghosh
Shri B. K. Ghosh
Shri G. B. Das
Shri M. Subramaniam
Shri S. S. Sinha
Shri Jagadish Rai
Shri S. N. Paramanick
Shri T. K. Sreedharan

Junior Stenographer

Shri S. Bhattacherjee
Shri D. C. Sahoo
[redacted]
Shri Jairam Biswal
Shri S. K. Halder
Shri P. Prasad

Junior Clerk

Shri D. Chatterjee
Shri S. B. Roy
Shri Samir Kr. Roy
Shri P. K. Dutta
Shri P. Lahiri
Smt. Sikha Majumder
Smt. Narayani Banerjee
Smt. Anita Majumder
Shri Babul Kanti Das
Shri P. K. Sethy
Shri Samir Kr. Bose
Shri N. R. Kundu
Shri Jyotirmay Roy
Shri B. N. Saha
Miss Bulbul Mondal
Smt. Anjali Neogi
Shri U. Bhattacherjee
Smt. Anita Chakraborty
Smt. Arati Panigrahi
Shri S. Karmakar
Shri P. K. Ghosh
Miss Jaysri Das
Smt. Geeti Majumder
Shri P. K. Ray
Shri Sukumar Sarkar
Shri Tridib Bhattacherjee (up to 7.2.87)
Shri Achinta Kr. De
Shri K. Subba Rao
Shri Malay Joardar
Miss Swapna Talapatra
Miss Sefali Biswas
Shri Sujit Kr. Ghosh
Shri R. R. Debnath
Miss Shyamali Samanta
Shri Brahamapal Balmiki
Shri S. K. Tikadar
Shri R. K. Panda
Shri Purna Ch. Behara
Shri N. C. Naik
Shri Ramesh Ch. Mohapatra
Shri Kunja Behari
Shri Chottelal
Shri Ambika Lal
Shri C. K. Narayan Sahi
Shri K. Manjhi
Shri R. C. Behara
Shri A. B. Mandal
Shri S. K. Bindu
Miss A. Manjula
Shri P. B. V. S. Murthy
Shri G. S. Rao
Shri M. L. Biswas
Shri D. Chowdhury
Shri Ram Deo Singh
Shri C. K. Pandey
Shri Surendra Kumar
Shri R. L. Raina
Shri K. Mani
Smt. S. Bhaghirathi
Shri S. K. Maranappan

Smt. M. Banerjee
Shri S.P. Mondal

The following members of staff of supporting grade rendered their services during the period.

Supporting Grade IV

Shri K. Prasad
Shri B. Sasmal
Shri P. V. Verghese
Shri Trilokya Behera
Shri Mool Chand Raikwar
Shri Sitaram Nisad
Shri B. N. Behera
Shri L. Panda
Shri U. Bhuyan
Shri Oghar Jally
Shri Chanda Das
Shri B. R. Samal
Shri J. N. Biswas
Shri Madan Lal
Shri P. V. N. Das
Shri N. Barik
Shri D. N. B. Singh
Shri Mewa Lal
Shri Balaram Dalai
Shri N. N. Mohanti
Shri Sankar Barik
Shri P. C. Sethi
Shri B. Majhi
Shri Damodar Sahoo
Shri Krishan Ch. Jena

Supporting Grade III

Shri H. K. Pramanick
Shri S. C. Balmiki
Shri M. I. Raju
Shri R. C. Biswas
Shri H. K. Das
Shri D. Bhuloka
Shri B. Appa Rao
Shri K. C. Behera
Shri P. Mishra
Shri H. B. Lama
Shri Chattar Singh
Shri R. L. Raikwar
Shri Dhaneswar Sahoo
Shri D. Barik
Shri Natabar Jena
Shri D. Nayak
Shri Alekha Behara
Shri Lalu Ram
Shri Sitaram Balmik
Shri Nar Bahadur
Shri H. K. Routh
Shri A. M. Patra
Shri K. B. Jally
Shri J. M. Kujur
Shri S N. Burman
Shri B. R. Mhnda
Shri Anti Ram Das
Shri K. Gopal
Shri Bakshi Ram
Shri B. Bhoi
Shri Bhikari Nayek
Shri Durga Dutt Pandel
Shri Budh Prakash
Shri K. B. Behera

Supporting Grade III

Shri H. K. Samal
Shri N. Bhuyan
Shri S. R. Patnaik
Shri Lakshmidhar Jally
Shri H. L. Biswas
Shri K. K. Das
Shri T. K. Biswas
Shri S. K. Das
Shri M. S. Burman

Supporting Grade II

Shri K. Kalianan
Shri M. V. Krishnan
Shri C. K. Vava
Shri A. Ramaswamy
Shri K. L. Balmiki
Shri Tek Bahadur
Shri S. S. Burman
Shri C. P. Singh
Shri A. Sahani
Shri Rajendra Ram
Shri A. E. Raju
Shri M. Ramalingam
Shri Nitya Nanda Mondal
Shri P. Manikyam
Shri S. K. Boral
Shri K. D. Raju
Shri L. Samalu
Shri P. Sayalu
Shri P. Seshenna
Shri M. B. Naik
Shri D. Bhanja
Shri J. R. Das
Shri S. Burman
Shri G. C. Mondal
Shri N. K. Burman
Shri S. P. Yadav
Shri A. L. Yadav
Shri S. Parameswar
Shri B. N. Mondal
Shri R. N. Tiwar
Shri S. S. Maity
Shri Biswanath Mondal
Shri M. N. Biswas
Shri A. K. Biswas
Shri K. M. Das
Shri Prakash Ch. Saha
Shri R. C. Bhoi
Shri Damodar Barik
Shri Fakir Parida
Shri M. S. Behera
Shri Balaram Burman
Shri J. Biswas
Shri R. L. Dev Roy
Shri Dhaneswar Das
Shri Debendra Nath Sahoo
Shri Shyam Bhoi
Shri Rajkishore Behera
Shri B. Hajarika
Shri K. Appana
Shri R. Yesia

Supporting Grade II

Shri B. Narasappa
Shri N. C. Jena
Shri Sitaram Bahadur
Shri Amulya Bijali
Shri Shyamlal Dhanuk
Shri Rash Behar Das
Shri B. K. Jana
Shri N. C. Samanta
Shri A. K. Mondal
Shri N. Bhuniya
Shri Gour Hari Jana
Shri S. C. Mondal
Shri Phani Gharami
Shri Sasadhar Betal
Shri Kalipada Mondal
Shri Sita Ram Das
Shri G. Das
Shri B. Dhanuk
Shri L. C. Manna
Shri G. D. Santra
Shri G. C. Narendra
Shri L. Sahoo
Shri R. N. Swain
Shri S. N. Parida
Shri P. C. Das
Shri Mosa Das
Shri Gangadhar Sahoo
Shri Khalia Behera
Shri D. N. Bhuiyan
Shri S. S. Singh
Shri Narendra Behera
Shri Japhu Ram
Shri Sant Ram
Shri J. N. Mallah
Shri N. K. Mondal
Shri Keshab Behera
Shri B. N. Mondal
Shri Suraj Bahadur
Shri S. Chakraborty
Shri H. K. Burman
Shri S. N. Burman
Shri A. K. Biswas
Shri Khem Chand Balmiki
Shri S. K. Burman
Shri Jungali
Shri Ram Prasad
Shri Gulab Shaw
Shri Karam Raj
Shri Munshi Ram Balmiki
Shri S. G. Biswas
Shri K. M. Sahoo
Shri B. K. Nayam
Shri Giridhary Das
Shri Panchanan Jena
Shri Basudev Dehuri
Shri K. Behera
Shri N. L. Das
Shri Bhim Bahadur
Shri S. N. Chaki
Shri Sukchand Biswas
Shri Bideshi Lal
Shri Maha Singh

Supporting Grade I

Shri Ram Sunder
Shri Jugal Kishore
Shri L. K. Halder
Shri B. B. Das
Shri Prahlad Singh
Shri Balaram Bhanja
Shri H. S. Burman
Shri Satyendra Burman
Shri M. C. Behera
Shri Balaram Das
Shri Baman Jally
Shri Mohan Ch. Das
Shri D. C. Das
Shri B. C. Das
Shri P. C. Bose
Shri Bhabalu Bore
Shri Khagendra Ch. Das
Shri P. C. Kachari
Shri Y. Rajagopal
Shri R. Rajaratham
Shri M. C. Rao
Shri M. Satyanarayana
Shri Rahiman Sariff
Shri B. Tata Rao
Shri A. Kamparase
Shri Malige Gowda
Shri K. Neogi Gowda
Shri Basudev Gharami
Shri Tapan Kr. Gayen
Shri Patit Paban Halder
Shri Sk. Munsur Ali
Shri Pranesh Ch. Saha
Shri Abhimannu Naskar
Shri Nitai Ch. Som
Shri Rahitosh Kr. Roy
Shri P. S. Samanta
Shri N. C. Mondal
Shri Suresh Kumar Chakraborty
Shri B. C. Paik
Shri G. C. Bain
Shri Ramesh Ghadai
Shri Sudama Behara
Shri Lakshman Bhoi
Shri Sridhar Kahali
Shri Muralidhar Bhoi
Shri Y. Parida
Shri J. R. Das
Shri Subramani
Shri M. Anjanappa
Shri M. Mahadeva
Shri B. N. Krishnappa
Shri B. P. Mishra
Shri B. B. Samanta
Shri A. K. Routh
Shri Rampada Halder
Shri Nayantara Dalui
Shri Gour Gharami
Shri Mohim Gharami
Shri M. S. Bhoi
Shri K. Subramanian
Shri A. Murugesan
Shri V. Mariappan
Shri S. Govindarajan
Shri K. Subbiayan

Supporting Grade I

Shri R. Palameswamy
Shri S. Mahendran
Shri N. K. Das
Shri Joydev Patra
Shri Hiralal Bose
Shri Anil Chandra Das
Shri S. Guin
Shri J. Mukhia
Shri Rabin Kumar Das
Shri Ranjan Kumar Das
Shri Narayan Adhikari
Shri Lal Bahadur
Shri Ananda Biswas
Shri Resham Bahadur
Shri Md. Yusuf Dar
Shri Jairam Prasad
Shri Jaydev Paria
Shri N. Mani
Shri R. Subramani
Shri S. K. Venkatachalam
Shri B. Pugalendi
Shri P. C. Pramanick
Shri Gunadhar Dhibar
Shri N. K. Jana
Shri B. K. Barik
Shri A. Mahalik
Shri K. C. Jally
Shri Paramananda Parida
Shri Bonomali Maliick
Shri Rama Behera
Shri Trinath Pradhan
Shri Shyama Bhoi
Shri Purna Bhoi
Shri S. T. Govate
Shri S. S. Bondre
Shri G. J. Roundali
Shri T. H. Ghume
Shri P. N. Rao
Shri A. Gangaiah
Shri A. Krishtaiah
Shri U. Satyanarayan
Shri Syed Jaan
Shri P. Atchaiah
Shri Joseph Kerketta
Shri P. H. Chowdhury
Shri S. N. Halder
Shri Pasupati Das
Shri Gobinda Pada Burman
Shri Nemai Ch. Mirtania
Shri Dil Bahadur
Shri Kawalpati Ram
Shri Lakshi Ram
Shri S. Rajak
Shri M. P. Bind
Shri R. V. Moochi
Shri U. Chowdhury
Shri S. Pari
Shri P. Arumugam
Shri Sachindra Mondal
Shri Sital Chandra Halder
Shri Gopal Ch. Mallick
Shri Indra Bahadur
Shri Astha Bahadur
Shri Kalipada Singh

Supporting Grade I

Shri Biswanath Halder
Shri K. C. Samal
Shri Bijoy Bhoi
Shri Kuldip Singh
Shri Om Prakash
Shri Paras Ram
Shri Sitala Prasad
Shri Attiullah
Shri Nanda Dulal Saha
Smt. Lakshmi Ram
Shri Dukharam Sahani
Shri D. Pallai
Shri C. Samal
Shri J. Khatua
Shri Chhakai Behera
Shri K. C. Nayak
Shri R. Khan
Shri G. Lal
Shri Sree Nath
Shri Nunnilal Mallah
Shri Rajdhari Mallah
Shri Joseph Khalko
Shri Rajkishore Sahoo
Shri Sultan Khan
Shri N. Pallai
Shri S. Swain
Shri R. K. Behera
Shri K. C. Jena
Shri N. Samal
Shri K. Barik
Shri H. K. Behera
Shri K. K. Barik
Shri Golokha Behera
Shri Ranjan Swain
Shri Banamali Behera
Shri U. Nayak
Shri S. Das
Shri S. Banerjee
Shri Sadhan Ch. Sadhukhan
Shri Sibulal Das
Smt. Mina Biswas
Shri U. Nayak
Smt. Anjali Rani Dutta
Shri Sudarsan Nayak
Shri Gandharb Mallick
Shri Gayadhar Behera
Shri Bawri Bandhu Ghada
Shri Phali Bhoi
Shri Debahari Behera
Shri Ramesh Chandra Swain
Shri Jatadhari Swain
Shri Mahadev Parika
Shri N. Rajak
Shri Lalta Prasad
Shri Gopal Chand
Shri Sita
Smt. Kalosashi Mondal
Shri K. C. Lanka
Shri Sridhar Parida
Shri Bhaskar Pradhan
Shri Pitambar Swain
Shri Prafulla Kr. Nayak
Shri B. B. Patnaik
Shri Parasuram Das

Supporting Grade I	Supporting Grade I	Supporting Grade I
Shri G. C. Nayak	Shri S. N. Nan	Shri Man Bahadur
Shri Golok Parida	Shri M. Balmiki	Shri S. L. Bairagi
Shri Ramesh Ch. Jena	Shri Dipak Chakraborty	Smt. Biramkala Devi
Shri Gajendra Kr. Sahoo	Shri Biswanath Bose	Shri R. K. Sardar
Shri Sarat Chandra Khuntia	Smt. Rupali Chatterjee	Shri Kartik Ch. Malakar
Shri Birbar Sahoo	Shri Asoke Kr. Dey	Shri Dilip Kr. Das
Shri Bania Nayak	Shri A. K. Barui	Smt. B. Sakuntala
Shri Monomohan Bhoi	Shri Iswar Ram Balmiki	Shri Ananta Kr. Bhanja
Shri R. K. Bhoi	Shri M. L. Saha	Shri Kamal Kr. Dhir
Shri Dhanu Behera	Shri C. P. Singh	Smt. Godhuli Mondal
Shri Nishamani Jena	Shri G. C. Pramanick	Shri H. P. Bhanja
Shri P. Ghosh	Shri Karna Bahadur	Shri A. C. Ghosh
Shri J. Balmiki	Shri Monoranjan Saha	Smt. Mina Rani Bahadur
Shri Manabendra Dutta	Shri T. P. Ghosh	Shri Kharban Kumar
Smt. Hemlata Halder	Shri Sankar Bose	Shri A. Bhattacharjee
Shri Balkrishna Balmiki	Shri Mukti Pada Das	Shri Bhaskar Sardar

PROMOTION

On recommendation of the Agricultural Scientists Recruitment Board the following Scientists of this Institute were promoted as shown below:

Name	Designation	Promoted to	W.E.F.
Shri G. V. Kowtal	S-2	S-3	1.1.84
Shri Ch. Gopalakrishnayya	S-2	S-3	1.1.84
Shri G. K. Bhatnagar	S-2	S-3	1.1.84
Shri D. V. Pahwa	S-2	S-3	1.1.84
Shri K. V. Ramakrishna	S-2	S-3	1.1.84
Dr. G. N. Mukherjee	S-2	S-3	1.1.84 (Since retired)
Shri C. P. Rangaswamy	S-1	S-2	1.1.84
Shri J. B. Rao	S-1	S-2	1.1.83
Shri K. J. Rao	S-1	S-2	1.1.83
Shri Balbir Singh	S-1	S-2	1.1.83
Shri G. N. Srivastava	S-1	S-2	1.1.83
Smt. G. K. Vinci	S-1	S-2	1.1.83
Shri B. K. Mishra	S-1	S-2	1.1.83
Dr. S. M. Pillai	S-1	S-2	1.7.83
Shri P. K. Aravindakshan	S-1	S-2	1.7.82
Shri R. C. Das	S-1	S-2	1.7.83
Shri M. K. Das	S-1	S-2	1.7.83
Shri S. K. Wishard	S-1	S-2	1.7.83
Shri S. D. Gupta	S-1	S-2	1.7.82
Shri S. N. Mehrotra	S-1	S-2	1.7.82
Shri V. R. Chitranshi	S-1	S-2	1.7.84
Dr. M. A. Khan	S-1	S-2	1.1.84

The following Scientists were awarded advance increments as shown below:

Name	Designation	No. of advance increments	W.E.F.
Shri B. K. Banerjee	S-1	3	1.1.84

The following members were promoted as below on the recommendation of the Assessment Committee.

Name	Designation	Promoted to	W.E.F.
Shri B. B. Satpathy	T-6	T-7	1.1.86

Retirements during 1986-87

Name	Designation	Place of posting	Date of retirement
Shri M. R. Bose	SSG-III	Barrackpore	31.3.86
Dr. G. N. Mukherjee	S-2	Allahabad	30.6.86
Shri M. A. V. Laksmanan	Technical Officer	Madras	31.7.86
Shri J. Naik	Fieldman	Dhauli	31.7.86
Shri K. P. Saha	T-2	Barrackpore	30.6.86

Resignation

Name	Designation	Date of acceptance
Shri Tridib Bhattacharjee	Jr. Clerk	7.2.87

Following appointments were made during the year 1986-87

Name	Designation	Place of posting	Date of appointment
Shri B. N. Das	Field Farm Asstt. T-I	Barrackpore	9.4.86
Shri P. R. Rao	Hindi Translator (Aux.)	-do-	2.6.86
Shri Purna Ch. Mohanty	Driver (Auxiliary)	Puri	2.6.86
Shri P. K. Sethy	Jr. Clerk	Dhauli	31.5.86
Shri P. K. Ghosh	Sr. Clerk	Kalyani	27.5.86
Shri Fatik Manna	Doc. Assistant, T-II-3	Barrackpore	19.6.86
Shri H. Chaklader	Publication Asstt. T-II-3	-do-	26.5.86
Shri A. K. Banerjee	Publication Asstt. T-II-3	-do-	26.5.86
Shri Ram Deo	Jr. Clerk	Kalyani	27.5.86
Shri A. B. Biswas	Sr. Clerk	Barrackpore	26.5.86
Shri Sujay Kr. Manna	Sr. Technical Asstt. (Instrumentation) T-4	Dhauli	16.6.86
Shri Satyendu Sarkar	Lab. Technician (Fish Nutrition)	-do-	18.6.86
Shri Ranjit Kr. Ghosh	Sr. Clerk	Barrackpore	5.9.86
Shri Ramesh Ch. Mahapatra	Jr. Clerk	Dhauli	15.9.86
Kumari Shyamali Samanta	Jr. Clerk	Barrackpore	2.12.86
Kumari Keya Saha	Enumerater, T-II-3	-do-	14.1.87
Shri Pintu Kr. Biswas	Enumerater, T-II-3	-do-	9.1.87
Shri T. Chatterjee	Farm Manager, T-II-3	-do-	15.1.87
Shri K. C. Pani	Farm Manager, T-II-3	Dhauli	12.1.87
Shri M. P. Singh	Farm Manager, T-II-3	Patna	15.1.87
Shri Dipak Kr. Biswas	Farm Manager, T-II-3	Bhagalpur	14.1.87
Shri Benoy Kishna Biswas	Farm Manager, T-II-3	Guwahati	28.1.87
Shri Saket Kr. Srivastava	Enumerator, T-II-3	Patna	19.1.87
Shri Haran Ch. Banik	Enumerator, T-II-3	Raipur	30.1.87
Shri A. N. Mohanty	Farm Manager, T-II-3	Dhauli	31.1.87
Shri C. K. Pandey	Jr. Clerk	Bhagalpur	22.5.86
Shri P. Dasgupta	T-II-3	Barrackpore	29.8.86
Shri Camil Lakra	T-II-3	Muzaffarpur	29.8.86
Shri C. G. Rao	T-I	Eluru	29.8.86

Name	Designation	Place of posting	Date of appointment
Shri R. N. Saha	T-I	Kalyani	29.8.86
Shri S. Kotaiah	T-I	Eluru	29.8.86
Shri S. K. Chakraborty	T-I	Barrackpore	92.8.86
Shri L. K. Parbat	T-I	Calcutta	29.8.86
Shri N. K. Saha	T-I	Barrackpore	29.8.86
Shri S. Krishnnan	T-II-3	Madras	24.2.87
Shri R. C. Satpathy	T-5	Barrackpore	24.5.86
Shri B. B. Satpathy	T-7	Dhauli	1.1.86

TRANSFERS

The following members of CIFRI were transferred during the period 1st Jannary 1986 to 31st March 1987

Name	Designation	From	To
Shri R. A. Gupta	S-3	Allahabad	Barrackpore
Shri S. N. Pramanik	Sr. Clerk	Rahara	Calcutta
Shri Brahmapal Balmiki	Jr. Clerk	Kakdwip	Barrackpore
Shri K. K. Agarwal	T-II-3	Rihand	Raipur
Shri S. K. Dey	T-I	Dhauli	Cuttack
Shri Donald Singh	T-I-3	Muzaffarpur	Allahabad
Dr. C. R. Das	S-3	Dhauli	Calcutta
Shri G. Lahiri	Sr. Steno	Rahara	Barrackpore
Shri G. B. Das	Sr. Clerk	Kalyani	Rahara
Shri S. L. Kar	S-1	KVK/TTC (Dhauli)	Cuttack
Shri A. C. Nandi	S-2	Rahara	Calcutta
Shri R C. Singh	T-5	Muzaffarpur	Patna
Shri S. N. Dutta	S-2	Ccuttak	Canning
Shri Kisan Deo	T-I-3	Allahabad	Muzaffarpur
Shri Ram Deo Singh	Jr. Clerk	Kalyani	Muzaffarpur
Shri C. K. Sahi	Jr. Clerk	Muzaffarpur	Patna
Shri S. N. Mehrotra	S-2	Allahabad	Guwahati
Shri K. O. Joseph	S-1	Pollachi	Pulicat
Dr. V. Pathak	S-1	Barrackpore	Patna
Shri S. G. Biswas	SSG-II	Kakdwip	Barrackpore
Shri J. M. Kujur	SSG-III	Ranchi	Patna
Shri Resham Bahadur	SSG-I	Allahabad	Rahara
Shri Munnilal Mallah	SSG-I	NBFGR, Allahabad	Allahabad
Shri J. K. Patra	SSG-I	Digha	Calcutta
Shri R. L. Deb Roy	SSG-II	KVK/KAK	Kalyani
Shri Manabendra Dutta	SSG-I	Kakdwip	Barrackpore
Shri S. N. Burman	SSG-II	ORP, Krishnanagar	Allahabad
Shri B. Pugalendi	SSG-I	Pollachi	Pulicat
Shri S. K. Venkatachalam	SSG-I	Pollachi	Pulicat
Shri Lal Bahadur	SSG-I	Rahara	Barrackpore
Shri Karam Raj	SSG-II	Jaunpur	Allahabad
Shri Rajdhari Mallah	SSG-I	Jaunpur	Allahabad
Shri Bholanath Das	T-I	NEH, Shillong	Barrackpore
Dr. V. R. Desai	S-3	Rihand	Raipur
Dr. M. R. Sinha	S-2	Kalyani	Barrackpore
Shri R. M. Rao	S-2	Kakinada	Eluru
Shri D. N. Mishra	S-2	Jaunpur	Karnal
Shri A. Mukherjee	S-2	Ranchi	Kakdwip
Shri S. N. Singh	S-1	Ranchi	Muzaffarpur
Shri N. P. Srivastava	S-1	Rihand	Raipur

Name	Designation	From	To
Shri Sakti Pada Mondal	Jr. Clerk	Kakdwip	Barrackpore
Shri J. Khalko	SSG-1	Ranchi	Allahabad
Shri B. R. Munda	SSG-III	Ranchi	Buxar
Shri J. Mallah	SSG-II	Rihand	Raipur
Shri Sitala Prasad	SSG-I	Rihand	Raipur
Shri Attaullah	SSG-I	Rihand	Raipur
Shri P. Seshanna	SSG-II	Kakinnada	Eluru
Shri B. Tata Rao	SSG-I	Eluru	Kakinada
Shri Lalta Prasad	SSG-I	Muzaffarpur	Allahabad
Shri T. K. Roy	Stenographer	Kakdwip	Barrackpore
Shri K. B. Rajani	Adm. Officer (Ad-hoc)	Allahabad	Barrackpore
Dr. Mathew Abraham	S-2	Pollachi	Madras
Shri M. B. Naik	SSG-II	Kakinada	Eluru
Shri M. P. Bind	SSG-I	Bhagalpur	Patna
Shri Ansuman Hajra	S-1	NBFGR, Allahabad	Barrackpore
Shri K. Mani	Jr. Clerk	Bangalore	Madras

Relieved from the Institute to take up new assignment to other organisations

Name	Designation	Relieved on	To Join at
Dr. Y. Rama Rao	S-3	31.3.86	North Eastern Council Secretariat at Shillong.
Dr. P. K. Mukhopadhyay	S-2	15.7.86	ABD Project on Deep Water Rice at Calcutta, under the International Rice Research Institute, Manila.
Dr. P. Das	S-3	14·7.86	NBFGR, Allahabad
Shri Wilson Guria	Jr. Clerk	31.7.86	Inter Institutional transfer to LAC Research Instt., Ranchi.
Shri K. C. Roy	Asstt. Adm. Officer	4.8.86	JTRL, Calcutta.
Shri N. M. Chakraborty	S-1	13.8·86	Central Institute of Coastal Engineering for Fishery, Govt. of India, Bangalore.
Shri K. P. Nath	Jr. Steno	5.9.86	ICAR Lab. to Land Programme, Zone-II, BCKVV, Mohanpur.
Shri S. K. Saha	S-2	1.12.86	Planning Commission, Govt. of India, New Delhi.
Dr. Chandi Ch. Saha	S-2	7.2·87	Orissa Shrimp Seed Production Supply and Research Centre of MPEDA.
Dr. Kuldip Kumar	S-2	25.2.87	State Fisheries Dept., Himachal Pradesh.
Shri S. K. Bose	Assistant	17.3.87	ICAR Lab. to Land Programme, Zone-II' BCKVV, Mohanpur.

APPENDIX I

Ministry/Department/Office of the Central Inland Fisheries Research Institute (I.C.A.R.), Barrackpore, West Bengal. Statement showing the total number of I.C.A.R. servants and the number of Scheduled Castes and Scheduled Tribes among them as on 31 March, 1987

Group/Class	Permanent/ Temporary	Total No. of employees	Scheduled Castes	Percentage of total employees	Scheduled Tribes	Percentage of total employees	Remarks
Gr. A (Cl.I) Permanent—							
(*i*) Other than lowest rung of Cl.I		151	8	5.03	—	—	
(*ii*) Lowest rung of Cl.I total		39	5	12	—	—	
Temporary—							
(*i*) Other than lowest rung of Cl.I		—	—	—	—	—	
(*ii*) Lowest rung of Cl.I		—	—	—	—	—	
Gr. B (Cl.II)	Permanent	20	2	10	1	5	
	Temporary	6	4	125	1	20	
Gr. C (Cl.III)	Permanent	197	35	18	4	2	
	Temporary	81	14	17.28	7	10	
Gr. D (Cl.IV) Excluding sweepers	Permanent	305	50	16.6	10	3	
	Temporary	99	46	46	3	3	
Gr. D (Cl.IV) Sweepers	Permanent	16	13	81	—	—	
	Temporary	2	1	50	1	50	

APPENDIX II

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(ICAR) : BARRACKPORE : WEST BENGAL

Address List of Research/Survey Centres

Research/Survey Centre	Telegram/Telephone
1. **Central Inland Fisheries Research Institute,** Barrackpore-743 101 West Bengal.	FISHSEARCH BARRACKPORE 53-161 53-322
2. **Allahabad Research Centre,** Central Inland Fisheries Research Institute, 24, Pannalal Road, Allahabad-211 002, U.P.	FISHSEARCH ALLAHABAD-2
3. **Bakkhali Research Centre,** Central Inland Fisheries Research Institute, Bakkhali, 24-Parganas Dist., West Bengal.	52-245
4. **Bangalore Research Centre,** Central Inland Fisheries Research Institute, No. 51, 8th Cross Road, 7th Main, Malleswaram, Bangalore-560 003, (Karnataka).	FISHSEARCH BANGALORE-3 36-6610
5. **Bhagalpur Research Centre,** Central Inland Fisheries Research Institute, Khanjarpur, Beatson Road, Bhagalpur-812 001, (Bihar).	1385
6. **Bhimtal Research Centre,** Central Inland Fisheries Research Institute, Bhimtal, Dist. Nainital, U.P., Pin-263 136.	
7. **Bilaspur Research Centre,** Central Inland Fisheries Research Institute, Roara Sector, Bilaspur-174 001, Himachal Pradesh.	

Research/Survey Centre	Telegram/Telephone
8. **Buxar Research Centre,** Central Inland Fisheries Research Institute, 1/644, Sidhanathghat, Buxar-802 101, Bihar.	
9. **Calcutta Research Centre,** Central Inland Fisheries Research Institute, 39, Rabindra Sarani, (3rd Floor), Calcutta-700 073, West Bengal.	
10. **Canning Survey Centre,** Central Inland Fisheries Research Institute, R. N. Tagore Road, Canning-743 329, West Bengal.	
11. **Paddy-cum-fish Culture Unit,** Central Inland Fisheries Research Institute, CRRI Campus, Cuttack-753 006, Orissa.	
12. **Diamond Harbour Survey Centre,** Central Inland Fisheries Research Institute, House of Bidhu Bhushan Bhuiya, New Madhavpur, P.O. Diamond Harbour, 24-Parganas, West Bengal.	
13. **Digha Survey Centre,** Central Inland Fisheries Research Institute, Digha, Midnapur Dist., West Bengal.	
14. **Eluru Research Centre,** Central Inland Fisheries Research Institute, Sastry Bhavan, D.M.C. Home Street, Kandukuruvarithota, Patehbad, Eluru-2, West Godavari Dist., Andhra Pradesh.	
15. **Freshwater Aquaculture Research & Training Centre,** Central Inland Fisheries Research Institute, P.O. Kausalyagang, (Via) Bhubaneswar-751 002, Orissa.	AQUACULTURE BHUBANESWAR 53084
16. **Guwahati Research Centre,** Central Inland Fisheries Research Institute, Natun Sarania, Guwahati-781 003, Assam.	23831

Research/Survey Centre	Telephone/Telegram
17. **Kakdwip Research Centre,** Central Inland Fisheries Research Institute, Kakdwip-743 347, West Bengal.	FISHSEARCH KAKDWIP 72
18. **Kakinada Research Centre,** Central Inland Fisheries Research Institute, 16-23-1, Sambamurthi Nagar, Kakinada-533 001, A.P.	
19. **Kalyani Research Centre,** Central Inland Fisheries Research Institute, B/11/226, Central Avenue East, Kalyani, Dist. Nadia, West Bengal.	
20. **Karnal Research Centre,** Central Inland Fisheries Research Institute, Govt. Fish Seed Farm, P.O. Saidpura (CSSRI), Karnal-132 001. Haryana.	3382
21. **Krishnagar Operational Research Centre,** Central Inland Fisheries Research Institute, P.O. Netaji Subhas Sanatorium, Kalyani, Dist. Nadia, Pin-741 251, West Bengal.	
22. **Krishi Vigyan Kendra,** Central Inland Fisheries Research Institute, P.O. Kakdwip-743 347, Dist. 24-Parganas, West Bengal.	
23. **Krishi Vigyan Kendra/TTC (Matsya),** Central Inland Fisheries Research Institute, P.O. Kausalyagang, (Via) Bhubaneswar-750 002, Orissa.	
24. **Lalgola Survey Centre,** Central Inland Fisheries Research Institute, Lalgola, Dist. Murshidabad, West Bengal, Pin-742 148.	
25. (*a*) **Madras Research Centre,** Central Inland Fisheries Research Institute, 1, Karaneeswarar Koil Street, (Near All India Radio), Mylapore, Madras-600 004.	ULNADMEEN MADRAS
(*b*) **Madras Research Centre,** Central Inland Fisheries Research Institute, 12, Leith Castle Street, Santhome, Madras-600 028.	

Research/Survey Centre	Telephone/Telegram
26. **Muzaffarpur Research Centre,** Central Inland Fisheries Research Institute, House No. 113, Ward No. 27, Damuchak, Muzaffarpur-842 001, Bihar.	
27. **Patna Research Centre,** Central Inland Fisheries Research Institute, 2-C(A), Peoples Cooperative (2nd Floor), Kankarbagh, Patna-800 020, Bihar.	26285
28. **Pollachi Research Centre,** Central Inland Fisheries Research Institute, 10, Chakrapani Iyer Street, Venkatesa Colony, Pollachi-642 001, Tamil Nadu.	
29. **Pulicat Survey Centre,** Central Inland Fisheries Research Institute, Pulicat, Chingelpet Dist., Tamil Nadu.	
30. **Pune Research Centre,** Central Inland Fisheries Research Institute, Flat No. 6, Indraprasta Housing Society, Godital-Hadapsar P.O., Pune-411 028, Maharastra.	
31. **Puri Research Centre,** Central Inland Fisheries Research Institute, No. 12, M.I.G. Quarters, Water Works Road, Puri-752 002, Orissa.	
32. **Rahara Research Centre,** Central Inland Fisheries Research Institute, Rahara Fish Farm, P.O. Rahara-743 186, Dist. 24-Parganas (North), West Bengal.	
33. **Raidighi Survey Centre,** Central Inland Fisheries Research Institute, Raidighi, 24-Parganas, West Bengal.	
34. **Raipur Reservoir Fisheries Research Centre,** Central Inland Fisheries Research Institute, 32-B, 'Ashirbad' Main Road, Shankar Nagar, Raipur-492 007, M.P.	
35. **Srinagar Research Centre,** Central Inland Fisheries Research Institute, Harwan, Srinagar-191 123, Kashmir.	FISHSEARCH SRINAGAR
36. **Uluberia Survey Centre,** Central Inland Fisheries Research Institute, Uluberia, Dist. Howrah, West Bengal.	

APPENDIX III

ORGANISATION CHART, 1986-87

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE-743 101, WEST BENGAL