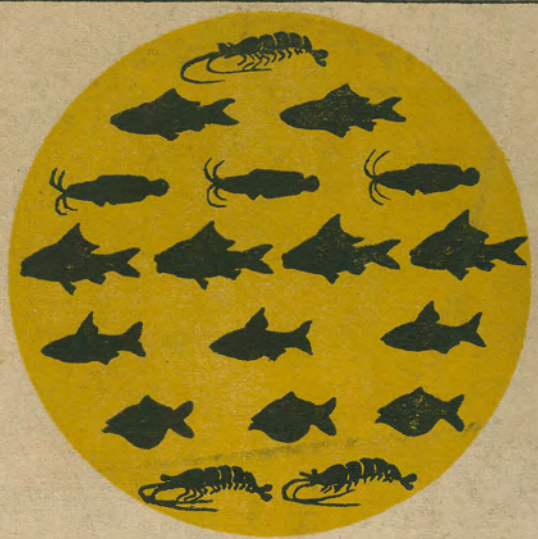

1978

ANNUAL REPORT

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE

BARRACKPORE

ICAR

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

ANNUAL REPORT

for the year

19 8

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

CREDITS

Edited by	:	Shri B. N. Saigal
Compiled by	:	Shri B. N. Saigal
	:	Shri Amitabha Ghosh
	:	Shri B. Venkatesh
	:	Shri K. S. Banerjee
	:	Smt. Anjali De
	:	Smt. Sukla Das
Technical assistance	:	Shri A. R. Chaudhuri
	:	Shri M. J. Bhagat
	:	Dr. V. K. Unnithan
Photographs by	:	Shri J. Ghosh
	:	Shri A. R. Majumder
	:	Shri P. K. Ghosh
Cover design	:	Shri P. Dasgupta
Secretarial Assistance	:	Shri D. Chatterjee
		Shri S. K. Pramanick
	:	Shri B. K. Ghosh
	:	Smt. Namita Chaudhuri
Printed at	:	USHA, a house for printing Abakash - Port Blair Lines - Barrackpore

Published by :—
Dr. A. V. Natarajan, Director, Central Inland Fisheries Research Institute,
Barrackpore-743101, West Bengal

CONTENTS

ANNUAL REPORT 1978
CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

1. DIRECTOR'S INTRODUCTION

History :

The Central Inland Fisheries Research Institute was formally established in March 1947 under the Ministry of Food and Agriculture, Government of India for the purpose of conducting scientific studies on inland fisheries of the country. The Institute is since June 1959, housed in its own buildings at Barrackpore on the left bank of the river Hooghly on an area covering about 5.2 ha. It came under the administrative control of the Indian Council of Agricultural Research on October 1, 1967.

Objectives :

The main objective of the Institute is to elucidate the scientific principles which can be applied for full utilisation of all available inland waters of the country for maximising fish production. Such an objective entails evolving sound fish husbandry techniques along modern concepts of aquaculture ; acquiring understanding of the biology of food fishes ; conducting investigations on hydrology and ecology of different types of fishery waters ; performing research on population dynamics of fish in natural capture fishery waters, like those of rivers, lakes, reservoirs, estuaries, etc. ; formulating artificial feeds of high conversion values and evolving feeding techniques ; besides, developing fishery manage-

ment techniques relating to both fresh- and brackishwater environments. While the investigations are conducted on long range research projects that are of a continuing nature, in consideration of the ever increasing consumer demand of fish in the country, due emphasis has also been laid on short term production oriented research projects, the solutions of which are apt to lead to rapid development of inland fisheries, specially in the field of aquaculture in rural areas of the country where both perennial and seasonal water bodies abound and which can be effectively utilised for fish production through pisciculture. The scientific work of the Institute is divisible basically into two aspects—(a) Culture Fisheries Research and (b) Capture Fisheries Research. The former involves researches on culture of fish in impounded fresh- and brackishwater bodies, like ponds, tanks, *beels*, *bheries*, etc., whereas the latter is mostly observational in nature, the data being drawn mainly from the commercial fishing units operating in lakes, reservoirs, *mans*, rivers and estuaries.

With a view to achieving these objectives, three major divisions *viz.*, Freshwater Aquaculture Division, Riverine & Lacustrine Fisheries Division and Estuarine Fisheries Division were established and they are presently located at Bhubaneswar, Allahabad and Calcutta respectively to deal with the research problems of freshwater pond culture, riverine & lacustrine fisheries and estuarine culture and capture fisheries. Freshwater Aquaculture Division will be shifted to Dhauli near Bhubaneswar (Orissa) when the experimental fish farm and the laboratories are constructed.

Organisational structure :

The aforesaid three divisions of the Institute with their research centres at Kakinada & Tadepalligudem in Andhra Pradesh ; Gauhati in Assam ; Bhagalpur & Buxar in Bihar ; Srinagar in Jammu & Kashmir ; Bangalore in Karnataka ; Bhubaneswar & Cuttack in Orissa ; Madras in Tamil Nadu ; Allahabad in Uttar Pradesh; Barrackpore, Kalyani, Bokkhali, Calcutta, Kakdwip & Rahara in West Bengal ; Freshwater Aquaculture Research & Training Centre ; Krishi Vigyan Kendra (Matsya) ; and the Trainers' Training Centre (Fisheries) at Dhauli in Orissa continued to function during the year. Basides, Economics, Statistics, Extension, Library & Documentation, Administrative, Accounts, Audit, and Stores Sections, situated at the Headquarters of the Institute at Barrackpore, the Kalyani Research Centre and the Krishnanagar Operational Research Centre in West Bengal functioned under the direct control of the Director.

Institute based All India Co-ordinated Research Projects ; *viz.*, (i) Ecology & Fisheries of Freshwater Reservoirs (with main centre at Allahabad and sub-

centres at Bhavanisagar. Bilaspur, Nagarjunsagar, Ranchi and Rihand ; (ii) Composite Fish Culture & Fish Seed Production of Indian & Exotic Fishes (with main centre at Bhubaneswar and subcentres at Badampudi, Barrackpore, Bhavanisagar, Gauhati, Jaunpur, Kalyani, Karnal, Pune and Ranchi ; (iii) Air-breathing Fish Culture (with main centre at Barrackpore and subcentres at Bangalore, Patna, Gauhati, Kalyani and Palair) and (iv) Brackishwater Fish Farming (with main centre at Barrackpore and subcentres at Ernakulam, Kakdwip, Kakinada, Keshpur, Madras and Panaji) continued to function during the year. Diagrammatic representation of the organisation of the Institute is presented in the Organisation Chart appended to this report (Appendix II).

Library and Documentation :

During the year under report 157 books, 117 reprints, 65 miscellaneous publications and 1,112 issues of periodicals were added to the library of the Institute. Thirty eight foreign and 48 Indian journals were subscribed. The library obtained either as free gift or in exchange additional 138 Indian and foreign journals. The present library holdings inclusive of the year's arrivals comprise 3,833 books, 3,735 outside reprints, 1,849 miscellaneous publications excluding the stock of journals, pamphelets, maps, departmental publications, etc. Besides maintaining exchange relationship with 384 Institutions and organizations, 19 new exchange relationships were established during the year. "Accession Lists" for the period October to December, 1977 were brought out and circulated. Fifty five technical and non-technical quaries from India and abroad were attended to by the Library and Documentation Section. The Institute supplied a number of publications to the Zoology Department, Gauhati University, Assam ; INSDOC, Delhi ; Central Marine Fisheries Research Institute, Mandapam Camp, Tamil Nadu ; Southern Regional Station, Zoological Survey of India, Madras ; National Environmental Engineering Research Institute, Nagpur ; Directorate of Fisheries, Punjab, Chandigarh ; Office of Commander Works Engineers, Barrackpore, 24-Parganas ; Department of Zoology, Government College, Ganj Basoda, Madhya Pradesh ; Department of Aquatic Biology and Fisheries Aquarium, University of Kerala, Trivandrum ; Zoological Survey of India, Calcutta and Indian Statistical Institute, Calcutta on inter-library loan service.

During the year, 65 reports on progress of research were compiled and sent to the ICAR Bibliography of Indian Fisheries, Vol. **16** (3-4), 1977 ; "CIFRI Newsletter", Vol. **2** (3-4) and **3** (1-2), 1978 ; Bulletin Nos. 26-28 entitled "A report on coppersulphate treatments of fishery ponds for the control of weeds, 1952-1970", "Operational Research Project on Aquaculture in West Bengal", and "Recommendations for stocking silver carp

in Govindsagar (H. P.) and Nagarjunasagar (A. P) together with an account on the scope and limitations of silver carp stocking in rivers and reservoirs in India" respectively ; and Miscellaneous Contribution No. 14 entitled "Note on the breeding , care and management of common carp (*Cyprinus carpio* Linnaeus)" were brought out. The 1977 Annual Report was also brought out in printed form during the year. Eightynine scientific paper emenating as a result of research investigations conducted at this Institute were published in different Indian as well as foreign journals. Besides the above, 325 sketches/diagrams, 150 posters & charts, 5,000 photographs, 200 slides, 75 cover designs and 450 miscellaneous reprographic thems on verious research activities and achievements of the Institute were prepared.

Honours, Awards, etc.

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute visited Bangkok, Thailand to attend the Working Party Meeting of Inland Fisheries Experts during the period 16th to 20th January, 1978.

Dr. V. R. P. Sinha, $Scientist_3$ of this Institute was deputed to Bangladesh by the World Bank, Washington during March 13—May 2, 1978 to provide functional specifications of physical investment required for developing the Ox-bow lakes of the country.

Dr. V. R. P. Sinha, $Scientist_3$, was again deputed to Hungary during May 3—July 31, 1978 by the Food and Agriculture Organisation of the United Nations, Rome to render expertise to strengthen the integrated research programme on fish culture at Fisheries Research Institute at Szarvas, Hungary.

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute attended, as India's representative, the FAO/UNDP Ad-hoc Consultation on Aid for Aquaculture Development held in La Toja (Pontavedra), Spain during 20-30 June, 1978.

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute was deputed by the Ministry of External Affairs, Government of India, as an adviser for Aquaculture to the Government of Guyana, South America during 27 June—10 July, 1978. Dr. Jhingran rendered experts suggestions to the Government of Guyana on verious aspects contributing to the development of freshwater and brackishwater aquaculture of the country.

Shri R. N. Pal, $Scientist_2$ was deputed to U. S. A. for training in Fish Health Programme organised by the Fisheries Academy and National

Fish Health Research Laboratory of the United States. In connection with this training, he visited different Institutes, *viz.*, Eastern Fish Disease Laboratory, National Fisheries Centre—Lactown; US Fish and Wildlife Service, Kearneysville; US Fish and Wildlife Service, Washington; Pennsylvania Fisheries Department, Pennsylvania; Huntsdale State Fish Culture Station, Pennsylvania; Lama National Fish Hatchery and Development Centre, Pennsylvania; Benner Spring Research Station, Pennsylvania and Rosewell Park Memorial Institute, Buffalo, New York from 4th September, 1978 to 9th March, 1979 under the CIFRI/IDRC Project on Rural Aquaculture.

Sarvashri N. C. Basu, T-6 and P. Ravichandan, $Scientist_1$ were deputed to Philippines for a training course on Prawn Breeding and Culture for a period of 12 weeks (November 27, 1978—February 23, 1979) under a collaboration work plan for scientific and technical cooperation between the Indian Council of Agricultural Research (ICAR) and the SEAFDEC Aquaculture Department.

Mr. K. H. Ibrahim, $Scientist_2$ and Shri N. K. Thakur, $Scientist_2$ of this Institute were awarded Ph.D. degree by the Utkal University and the Bihar University respectively during the year.

Distinguished visitors :

The following scientists and distinguished persons visited the Institute and its various establishments during the year under report:

Dr. Y. B. Abu-Gideiri	Dean, Faculty of Science, Professor & Head, Department of Zoology, University of Khartoum, Khartoum, Sudan.
Sri Charles Pereira	Consultant Mission on Agricultural Research C/o IDRC, U.K.
Dr. W. H. L. Allsopp	Consultant, IDRC, Vancouver, Canada.
Dr. John Gerover	World Bank Consultant, Auburn University, Alabama, U. S. A.
Dr. William J. Royce	World Bank Consultant, Seattle University U.S.A.
Prof. J. R. Snow	Department of Fisheries, Auburn University, Auburn, Alabama, U. S. A.

Mr. Albert Montague	Director, CRGD Region III, Philadelphia, US-EPA.
Mr. David R. Collon	Senior Scientific Adviser, HERP US—EPH RTP
Mr. J. J. Sehueneman	Senior Scientific Adviser, HERP, US EPH RTP.
Mr. V. L. C. Preters	Secretary, Ministry of Fisheries, P. O. Box 1707, Colombo, Sri Lanka
Mr. C. H. M. T. Chandrarehern	Director of Fisheries, Ministry of Fisheries, Colombo, Sri Lanka
Mr. A. S. Mendis	Director (Research), Ministry of Fisheries, Colombo, Sri Laaka.
Mr. G. A. Maksood	Legal Adviser, State Fisheries Co., Baghdad, Iraq.
Mr. Fouad Ahmed Haddad	First Secretary, Iraqi Embassy, E 8/10 Vasant Vihar, New Delhi
Dr. A. Amin	Planning Manager, State Fisheries Company, Baghdad, Iraq
Dr. Atalla Muhasin Ali	Director of Research & Fish Culture, Department Laffarania, Baghdad, Iraq.
Dr. Lee Kam Wing	Project Coordinator, Waste Water Reclamation Global Project, International Development Research Centre, Tonglin, P.O. Box 101, Singapore 10.
Dr. Peter Edwards	Associate Professor of Aquaculture, Agricultural & Food Engineering Division, Asian Institute of Technology, Bangkok.
Dr Galina V. (Sadasyuk)	Senior Scientist, Institute of Geography, Academy of Sciences, USSR, Moscow, U.S.S.R.
Mr. George S. Atkins	Senior Aquacultural Commentator, Canadian Broadcasting Corporation, Toronto, Ontario, Canada.
Dr. Cartalino R. Dela Cruz	Project Director, Central Luzon State University, Nueva Ecija 2320, Philippines.

Dr. Fumio Yamazaki	Associate Professor, Faculty of Fisheries, Hokkaido University, Japan.
Dr. Katsuzo Kuronuma	International Development Research Centre (IDRC), Vancouver, Canada.
Dr. P. Yamazaki	Associate Professor, Hokkaido University, Japan.
Dr Menasueta Deb	Secretary General, SEAFDEC, Tigbauen, Iloilo City, Philippines
Dr. Ali Piernomo	Scientist, Inland Fisheries Research Institute, Bogor, Indonesia.
Mr. Levy Mare	Agronomist, France
Dr. J. Kurundu	Professor & Head of the Department of Chemistry, University of Sri Lanka, Sri Lanka
Dr. J. K. P. Ariyaratne	Professor & Head of the Department of Zoology, University of Sri Lanka, Sri Lanka.
Dr W. L. Chan	Senior Officer, Fishery Research, Hongkong
Mrs. & Mr. Ole Gert Sperber	Expert in Fishery Biology, Denmark.
Dr. John Brandford	Fishery Expert, Bangladesh
Mr. Panto Hargreeves	Yokohama University, Japan
Miss Kuniko Libosi	Yokohama University, Japan
Dr. Frando Dolberg	Adviser in Pisciculture & Animal Husbandry, Noakhali Project, IRDP—DANIDA
Shri B. R. Shetty	Director, NRDC, Bhubaneswar, Orissa
Shri K. M. Mandal	Director of Fisheries, Govt. of West Bengal, Calcutta
Shri D. P. Bagchi	Secretary to the Government of Tripura, Agriculture & Allied Departments, Agartala
Shri B. Bhatia	School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
Shri Lilamoy Das	Minister of State, Fisherles, Government of Assam, Dispur, Gauhati, Assam
Shri Sakti Kumar Sircar	Member of Parliament, Gosaba, 24-Parganas

Brig. V. N. Agrawal	Director, Army Headquarters, New Delhi
Lt. Col. S. J. Sarwate	Army Quarters, Barrackpore, 24-Parganas West Bengal
Mrs. P. P. Trivedi	Agriculture Production Commissioner, Gauhati, Assam
Shri J. K. Ganguly	I.F.S., Adviser, Government of West Bengal, Calcutta
Dr. Bireswar Banerjee	Professor of Geography, Calcutta University Calcutta-19
Shri Bhakti Bhusan Mondal	Minister for Fisheries, Govt. of West Bengal, Calcutta, West Bengal
Shri Pritiman Sarkar	Orissa Maritime & Chilka Area Development Corp. Ltd., Bhubaneswar, Orissa
Shri S. S. Barnala	Minister for Agriculture & Irrigation, Govt. of India, New Delhi
Shri Nilamani Routray	Chief Minister, Orissa, Bhubaneswar
Dr. R. Raghu Prasad	Assistant Director General (Fisheries), ICAR, New Delhi
Dr. C. Prasad	Assistant Director General (CDN), ICAR, New Delhi
Dr. B. I. Sundararaj	Professor, Department of Zoology, Delhi University, Delhi
Dr. M. N. Kutty	Professor & Special Officer, Fisheries College, Tuticorin, Tamil Nadu
Dr. C. V. Kulkarni	Ex-Director, Department of Fisheries, Maharashtra, Bombay
Dr. G P. Dubey	Prof of Life Sciences, University of Bhopal, M.P.
Dr. B. N. Choudhury	Senior Scientist, KVK, ICAR, New Delhi.
Dr. D. R Naik	Utkal University. Bhubaneswar, Orissa
Dr. A. C Sathyanesan	Benaras Hindu University, Varanasi

Dr. R. N. Saxena	Delhi University, Delhi
Dr. A. L. Mukherjee	Technical Manager, Agriculture Division, Cynamid Ltd., Bombay
Shri S. K. Hazarika	Secretary to the Assam State Fisheries, Gauhati, Assam
Shri P. K. Sengupta	Joint Director of Fisheries, Govt. of West Bengal, Calcutta
Lt. Col. Kaul	Indian Army Corps., Barrackpore
Shri T. N. Singh	Hon'ble Governor of West Bengal, Calcutta
Shri Jotirmoy Basu	Member of Parliament, New Delhi
Shri Prabhash Chandra Roy	Minister-in-Charge for Irrigation, West Bengal, Calcutta
Shri P. S. Mazumder	Vice-Chancellor, Assam Agricultural University, Jorhat, Assam
Major Virendra Kumar GE(P)	Fort William, Calcutta
Major N. Bhatway	Army Medical Corps., Pune, Maharashtra
Brigadier V. K. Agarwal	Fort William, Calcutta
Dr. Jaswant Singh	Head, Agricultural Engineer, IIT, Kharagpur, West Bengal
Shri A. Mathew	Adviser, Maritime Area Development, Orissa
Shri Bhanji Bhai Patel	Hon'ble Minister for Port & Fisheries, Government of Gujarat, Gujarat
Shri P. Navate	Dy. Commissioner of Fisheries, Government of Gujarat, Gujarat
Shri S. Gopalan	Chairman, Marine Products Export Development Authority, Cochin
Dr. Y. R. Tripathi	Director of Fisheries, Government of Uttar Pradesh, Lucknow
Dr. S. K. Moitra	Professor, Department of Zoology, University of Burdwan, West Bengal
Dr. T. R. Dutta	Director, Central Agricultural Research Institute, ICAR, Port Blair, Andamans

Dr. Hanumant Rao	Prof. & Head, Department of Zoology, Andhra University, Hyderabad
Shri M. Dey	Dy. Secretary, Department of Fisheries, Government of West Bengal, Calcutta
Shri A. K. Gorai	Secretary, Department of Fisheries, Government of West Bengal, Calcutta
Dr. T. Ghosh	Director, JARI, Nilganj, Barrackpore
Dr. L. N. Mandal	Dean, Faculty of Agricultural Sciences, Bidhan Chandra Krishi Vishwa Vidyalaya, Mohonpur, Kalyani, West Bengal
Dr. G. L. Roy	Assistant Director (Agricultural Extension), BCKVV, Mohonpur, Kalyani, West Bengal
Shri G. N. Mitra	Fisheries Adviser, Government of Orissa, Bhubaneswar
Shri P. Basu	Commissioner, Fisheries, Government of Gujarat, Ahmedabad
Shri R. B. Raizada	Chief Warden Fisheries, Delhi Territory, Delhi

Important events :

West Bengal Governor visits Brackishwater Experimental Fish Farm :

Shri T. N. Singh, Governor of West Bengal, Shri Provash Roy, Minister for Irrigation, Government of West Bengal and Shri Jyotirmoy Basu, Member of Parliament accompanied by Shri H. C. Moitra, M.L.A. and other local Government dignitaries visited the Brackishwater Experital Fish Farm of the CIFRI in lower Sundarbans on March 7. 1978. Research at this farm has led to development of many important techniques of mono- and polyculture of estuarine prawns and fishes Recent achievements in the field of induced maturation and breeding of commercially important prawn and fish species are of cosiderable significance. Current work programmes on brackishwater fish seed prospecting, location of their abundant occurrence and improvisation of collection gear efficiency in addition to other research programmes will lead to rapid development of the brackishwater aquaculture in the country specially in the field of pisciculture in *bheries*, creeks and impoundments abounding in the remote areas of the lower Sunderbans.

Photograph 1 : Dr. V. G. Jhingran, Director, CIFRI discussing a point with Shri T. N. Singh, Governor, West Bengal (Centre) and Shri Provash Roy Irrigation Minister, Governmant of West Bengal (Left)

Photograph 2 : Shri T. N. Singh, Governor, Shri Jyotirmoy Basu, M.P. and Dr. V. G. Jhingran with others at the Kakdwip Inspection Bungalow

Photograph 3. Shri S. S. Barnala, Union Minister for Agriculture & Irrigation and Dr. V G. Jhingran, Director CIFRI going round the KVK & TT Centre museum at Kausalyagang. Dhauli, Orissa

Dr. V. G. Jhingran, Director, CIFRI while welcoming the Governor and others at the Kakdwip Inspection Bunglow, highlighted the research accomplishments of the Institute and stressed on the high potentiality of brackishwater aquaculture based on scientific fish farming. Dr. Jhingran pointed out its role not only in augmenting the fish production from such environments but also in upgrading the socio-economic status of the rural people of the lower Sunderbans.

Photograph 4: Shri T. N. Singh, Governor and the members of the party witnessing a netting demonstration at the Brackishwater Experimental Fish Farm, Kakdwip (West Bengal).

At the farm site, demonstration of standing crops in the ponds particularly with mixed farming of prawns and mullets and also single species culture of Bagda and Bhetki was witnessed by the visitors. Prawn and mullet seed collected from natural resources and the international award winning films of the Institute were shown to the dignitaries.

Union Minister for Agriculture and Irrigation visits CIFRI complex at Dhauli.

Shri Surjit Singh Barnala, Union Minister for Agriculture and irrigation visited the Freshwater Aquaculture Research and Training Centre of CIFRI at Dhauli (Orissa) on February 9, 1978. Dr. V. G. Jhingran, Director of the Institute received the Union Minister at the Dhauli Complex and

showed him round the different construction activities then in progress at the centre. On his arrival at the Krishi (Matsya) Vigayan Kendra and the Trainers' Training Centre (KVK and TTC) of the CIFRI at Kausalyagang (Orissa), Shri Barnala was explained the scope and the activities of the KVK and TTC. Later the Union Minister was introduced to the scientists of the Institute. He was also shown a netting demonstration of fish cul-

Photograph 5 *:* Shri S. S. Barnala and others at the KVK & TTC farm site at Kausalyagang (Dhauli), Orissa.

tured by the trainess and the technique of induced breeding of common carp being practised by the fish farmers. The Minister showed much interest in the museum of the Krishi (Matsya) Vigyan Kendra and Trainers' Training Centre.

Minister for Fisheries, Assam visits Air-breathing Fish Culture Project Centre of CIFRI

Shri Lilamoy Das, Minister for Fisheries, Government of Assam visited the Air-breathing Fish Culture Project Centre of the CIFRI, located at the State Government Fish Farm at Hajo (Assam), on May 20, 1978. Shri Das expressed high satisfaction over the progress so far made by the project conducting intensive research to install a totally new kind of culture fishery of the commercially important air-breathing fishes with an accetn to exploitation of hitherto unexploited derelict weed infested swampy waters

of the State of Assam in collaboration with the State Fish Farm at Hajo. Shri Das besides pin pointing the great scope that can be made available to meet the present day's unemployment crisis by establishing sufficient numbers of fish farms thereby augmenting the fish production as well, hinted at the significant role of the scientists and the State officials working in the project and the farm respectively in popularising the modern techniques of scientific fish farming among the pisciculturists of the State through teaching scheme and field demonstrations. A demonstration of the mixed culture of koi, singhi and magur, in progress, was arranged for Shri Das in the farm. The Minister expressed his satisfaction over the encouraging average growth (200 g) attained by the species in a very short period involving remarkably low input.

Photograph 6 : Shri Lilamoy Das, Minister for Fisheries, Government of Assam, appreciating magur *(Clarias batrachus)* raised at Hajo Fish Farm, Gauhati (Assam) under Air-breathing Fish Culture Project of the CIFRI.

Shri M. Ahmed, Director of Fisheries, Government of Assam, accompanying the Minister, highlighted the achievement of production of fish to the tune of 2,100 kg/ha/yr (in 1976-77) in the Hajo Fish Farm through composite fish culture and assured the best coordination of the State in converting the air-breathing fish culture to a totally popularised fish culture system in the State.

Important achievements :

Cheaper diet for magur and singhi culture

Major input in the intensive culture of commercially important air-breathing catfishes, magur (*Clarias batrachus*) and singhi (*Heteropneustes fossilis*) — is the supplementary feed as in any other fish culture system. But recently, the scientists of this Institute have shown that these fishes are capable of assimilating non-protein nitrogen from urea. In the course of experiments which continued for four weeks, the fishes were fed with standard diet in which up to 50% of the protein component was replaced by non-protein nitrogen from urea. Neither toxicity was apparent nor any mortality of the test animals was recorded during the course of experiments. This observation is significant since the possible replacement. of 50% protein by urea in the supplementary diet, used in the culture of magur and singhi, would considerably reduce the cost of production.

Breakthrough in breeding Bagda—Penaeus monodon

The CIFRI has succeeded in inducing maturation and breeding of the marine tiger shrimp, *Penaeus monodon*— commonly known as 'BAGDA CHINGRI'— in impounded brackishwater ponds in Sunderbans. The shrimp, amongst the marine products, is India's largest foreign exchange earner. Bagda naturally matures and breeds in seas. Recently, the scientists of this Institute procured completly immature specimens from virtually freshwater ponds in Sunderbans, induced their maturation in a brackish-water pond at the Bakkhali Fish Farm of the Institute by eye-stalk ablation and made three specimens breed in a cloth enclosure placed in a split bamboo cage installed in a creek. Eye-stalk ablation is a technigue in which an incision is made on the eye-ball and the cotents of the eye-stalk are squeezed out for faster gonadal development.

It is envisaged that when the experimental phase is over and the technique commercialised, pond-reared bagda will be bred in the same manner as other commercial fish species are bred in ponds. Such a development will give a boost to bagda culture and with selective stocking of *bheries* in West Bengal, the production of bagda will be enhanced significantly. The CIFRI has already developed a technique of producing about 1,000 kg/ha/yr of bagda in three crops from brackishwater ponds.

Successful artificial breeding of hilsa

Scientists of the Bhagalpur Research Centre of the CIFRI have

achieved success in breeding *Hilsa ilisha* by artificial fecundation at Farakka on the River Ganga. About one lakh hilsa hatchlings were produced in two sets of experiments conducted on October 21 and 29, 1978. The hilsa hatchlings in the size range of 3.5-4.0 mm were transported under oxygen packing from Farakka and were stocked @ 50,000, 30,000 and 20,000 hatchlings in three nursery ponds at Rajoun Fish Farm near Bhagalpur.

The hatchlings stocked on 1.11 78 have grown in the size range of 9.0-12.0 mm and those stocked on 24 10.78 have attained a size range of 23 0 to 25.0 mm

Successful breeding of Schizothorax

Schizothorax niger which forms an important fishery in the Himalayan regian has been bred successfully for the first time by stripping under laboratory conditions and eggs reared in still and flowing waters. The incubation period was found to range between 10 and 15 days in still water while it was more than 40 days in running water. Percentage of fertilisation and survival from egg to early fry ranged as 90-95 and 85-90 respectively. These successful results throw open the possibilities of large scale breeding of *Schizothorax* sp. and also provide new avenues for developing the fishery of the species in the upland waters.

Mass culture of Daphnia rosea

Mass culture of *Daphnia rosea* has been successfully achieved under controlled conditions in the laboratory at the Srinagar Research Centre of the Institute. A peak population of 8,172 organisms/l could be obtained from an initial inoculum of 50 organisms/l in about 2 weeks time using filtered pond water as an ambient medium. The technique employed was the use of cow-dung extract @ 2 g/l every third day as a source of nutrient. Under favourable conditions, during the course of the experiment, *D. rosea* was found to have 6 pre-adult and 12 post-adult instars. Each female produced 10-25 broods at a time and an average of 78.67 broods during its life span of about 18 days.

The technique of mass culture of *Daphnia rosea* offers possibilities of its utilisation as feed for *Schizothorax niger*, a fish of upland waters with great commercial importance, is further being improved.

Fingerling raising alongwith paddy cultivation at Cuttack Research Centre, Cuttack (Orissa)

With the advent of verious high yielding and economically viable scientific fish culture technologies, intensive fish farming is fast gaining

popularity among rural entreprenuers resulting in high demand of quality fish seed. Insufficient space available for ground nurseries stands as a major impediment for optimising fingerling production even when techniques for raising fish seed under stocking densities as high as 10 millon/ha exist. As such, to explore the possibilities of raising fingerlings from paddy plots, experiments have since 1975 been initiated at the Cuttack Research Centre of the CIFRI in collaboration with the Central Rice Research Institute (CRRI) at Cuttack (Orissa). Preliminary experiments in 1975, indicated practicability of growing fingerlings of common carp, rohu and mrigal in paddy plots under the agroclimatic conditions of Orissa. In 1976, experiments on elaborated scale were conducted in two paddy plots at CRRI, 'CR 1014' variety of paddy was sown in the plots and exotic carp *(Cyprinus carpio)* was stocked in each plot @ 7,250 nos./ha. The average growth exhibited by the fish after 119 days of rearing was highly promising (131.0 mm/75.3 g and 126.5 mm/68.1 g) besides, the estimated net fish yield of 85.2 and 72.0 kg/ha. Yield of paddy from the two plots was 2,800 and 2,638 kg/ha showing no adverse effect on the production due to fish stocking. Though the plots ware fertilised with organic and inorganic fertilisers, no supplementary feeding was resorted to for the fish.

With the gradual modification of the technique, the results obtained in the follow up experiments at Dhauli (Orissa) have further strengthened the soundness of fingerling raising in course of paddy cultivation. At Dhauli Fish Farm of the CIFRI, common carp was stocked in a plot (@ 12,000 nos./ha) where a hybrid paddy—CHINA 1039 variety— was sown. The survial of fingerlings at the end of 99 days rearing was worth reporting (88%) and comparable to that achieved in nursery ponds. The resultant estimated net fish production was 127.6 kg/ha.

The experiments indicated that rearing fishes for reasonable duration in plots growing deep water paddy and at constant water depth of 15—30 cm with provision of supplementary feeding would yield better results. Also the control of insect pests of paddy may be more effective by a larger fish population, manifesting in higher production ef paddy, too.

Paddy-cum-fish culture at Rahara Research Centre, West Bengal

An experiment on peddy-cum-fish culture was initiated at the Rahara fish farm of the Institute in the year 1977. Waterway for fish culture was of the shape of trapezoidal canal which ran all along the perimeter of the agricultural field. The top and bottom width of the canal, excavated for the purpose, was 6m and 3.6 m respectively and its average depth

was 1.2 m. The excavated earth from the canal was utilised for building the surrounding dykes for protecting the fish stock and paddy field from getting flooded during the monsoon months.

A deep water pest resistant hybrid paddy ('JALADHI-II') was sown and the Indian major carps (catla, rohu and mrigal) was stocked @ 6,000 fingerlings/ha in the ratio C 4 : R 3.5 : M 2.5. The 'Jaladhi' crop was harvested in December, 1977 and about 1,880 kg/ha of paddy was produced without any application of fertiliser and pesticides. This was followed by cultivation of another high yielding variety of paddy. "Jaya" seedling, grown in a specially prepared nursery bed, was transplanted to the main plot in February, 1977. Fertilisation of the paddy plot was done in two instalments in this case, one soon after the transplanted seedlings had taken root, and the other in flowering stage. During "Jaya" cultivation pesticide operations ware also continued. Harvesting of "Jaya" paddy was made in the first week of June and an estimated production of 4,613 kg/ha was achieved. After completion of paddy harvesting, the paddy plot was allowed to dry up and the fishes took shelter in the perimeter canal. In this culture system, the fish and the paddy had grown together for a period of five months since stocking in July, 1977. To accelerate the fish growth within the limited rearing period in paddy field, external managements such as supplementary feeding with mustard oilcake and rice bran (1 : 1) was resorted to @ 2—4% of the body weight of the stocked fishes. The fishes were reared for the full year in this system of culture (5 months in the paddy plot and rest 7 months in the perimeter canal). The total fish harvested was 708.65 kg and the calculated gross production as per perimeter canal area (0.27 ha) was 2,624 kg/ha/annum; but when the entire area of the culture system (1.02 ha) was considered for estimation, the production achieved was about 700 kg/ha/annum.

Prospect of fish culture at Jalpaiguri

The acidic nature of soil and water is considered to be a major impediment in raising production of fish. The CIFRI/IDRC Project on Rural Aquaculture, through its centre at Jalpaiguri (North Bengal), has been exploring the possiblities of obtaining sustained high fish yield from ponds, at and around Jalpaiguri, inheriting acidic soil. In the first set of experiments, the viability of composite fish culture technology, involving catla, rohu, mrigal and exotic silver carp as components, was demonstrated and a maximum production @ 4,900 kg/ha/yr was obtained which is comparable to those recorded in different States having favourable agroclimatic conditions. The achievement of such high production, despite the prevailing

adverse hydrobiological conditions at Jalpaiguri, will play a great role in converting the traditional system of fish culture to a totally controlled scientific fish farming in years to come.

Air-breathing fish culture in Burdwan

Scientific culture of air-breathing fishes has been gaining popularity for its high potency to produce fish crop from fallow impoundments, unsuitable for carp culture, without involving additional inputs in terms of fertilizers and supplementary feed. To spread the modern techniques of air-breathing fish culture in the rural West Bengal, the CIFRI/IDRC Project on Rural Aquaculture has convincingly demonstrated at its Burdwan Centre, noteworthy production of 7,274 kg/ha/6½ months of magur *(Clarias batrachus)* and 4,814.5 kg/ha/6¼ months of singhi *(H. fossilis)*—the catfishes of high commercial demand. The management measures in these experiments included periodic replenishment of pond water in magur ponds only, which otherwise restricted the production to a range of 4,015 3—3,361.0 kg/ha/5-6 months recorded in simultaneous experiments without water replenishment. The demonstration resulted in generating interest among the local entreprenuers to switch on the modern method of controlled culture of air-breathing fishes developed under the Co-ordinated Research Project of CIFRI.

Research collaboration with Institutes, Universities, Colleges and other Organisations at National level :

Through a net work of centres under the Institute based All India Co-ordinated Research Project on Composite Fish Culture of Indian and Exotic Fishes & Fish Seed Production, operating in different agroclimatic conditions, the State Governments continued the joint investigations on composite fish culture and fish seed production. Experiments were continued at Badampudi (Andhra Pradesh), Gauhati (Assam), Ranchi (Bihar), Godhra (Gujarat), Karnal (Haryana), Khutelabhata (Madhya Pradesh), Pune (Maharashtra), Kausalyagang (Orissa), Bhavanisagar & Coimbatore (Tamil Nadu) Jaunpur (Uttar Pradesh) and Kalyani (West Bengal).

At Pune Centre, extraordinarily high rate of production of 10,194 kg/ha/yr has been achieved which is an all time record of production from freshwater ponds in India. The most notable feature of this experiment has been the use of fry (av. size : 34 mm/0.6 g) of six species of Indian and exotic carps as the stocking material instead of fingerlings. High rates of production have also been achieved at Karnal (5,909 kg/ha/6 months), Gauhati (6,537 kg/ha/yr) and Jaunpur (7,371 kg/ha/yr). At Ranchi

where acidic conditions of soil and water prevail, the production to the tune of 3,526 kg/ha/yr could be achieved,

At Badampudi, the compatibility of *Macrobrachium malcolmsonii* with six species of Indian and exotic carps was tested. In two sets of experiments with six species combination, the rates of gross production of the prawn recorded were 10.33 & 35.8 kg/ha/10 months as against 56.7 kg/ha/10½ months and 80.8 kg/ha/10 months recorded in other two experiments with five species combination (excluding grass carp). This suggests that *M. malcolmsonii* is not compatible with grass carp, perhaps because the latter is destructive to habitats of the prawn.

Fish Seed Production: Indian major carps were successfully induced bred at all centres, except at Ranchi where breeding of Chinsse carps alone was taken up. Five sets of mrigal were bred twice at Bhavanisagar after an interval of 45 days. Breeding of Chinese carps was successfully carried out at Assam, Kalyani, Ranchi, Jaunpur, Badampudi, Bhavanisagar, Pune and at Dhauli. Silver carp was induced bred for the first time at Badampudi centre. A total quantiy of 363.0 lakhs of spawn was produced during the year, consisting of 245.1 lakhs of Indian major carps, 12.5 lakhs of silver carp and grass carp, 0.2 lakhs of *P. gonionotus* and 105.2 lakhs of common carp.

The All India Co-ordinated Research Project on Air-breathing Fish Culture in its joint venture with different State Fisheries Departments continued investigations on different production oriented problems. 'Semi intensive and intensive culture of magur and singhi were carried out in West Bengal, Bihar and Delhi.

In semi intensive culture, production to the tune of 4 t/ha/4 months of singhi and 3-7 t/ha/6 months of magur have been achieved at Patna (Bihar) and Kalyani (West Bengal) respectively from seasonal ponds Intensive culture of singhi and magur, conducted in a private entrepreneur's pond at Khanpur (Delhi) yielded production as high as 55 t/ha of magur and 35 t/ha of singhi in 7 months. The technology employed included replenisment of pond water and provision of supplementary feed In mixed culture of magur, singhi and *Channa marulius*, the yield ranged from 4—5.5 t/ha/6 months under provision of supplementary feeding as against 1.25 t/ha/6 months recorded earlier without supplementary feeding. In mixed culture of *Channa striatus* and *Anabas testudineus*, a production of 914 kg/ha/6 months was obtained indicating both the species to be compatible to each other.

Induced breeding of magur in small paddy plots has been successfully demonstrated in Bihar, West Benga and Assam. In Karnataka, magur could be successfully bred in freshly inundated ponds. Survey on seed resourcss of air-breathing fishes indicated wild water in North Bihar, lower Assam and West Bengal to be productive sources of murrel fry and fingerlings. Seed of singhi and koi (*Anabas*) were also abundantly available in these States. To avoid wastage of seed of air-breathing fishes and discourage its use as food fish, seed trade of air-breathing fishes has been established in South Bihar and West Bengal, as a result a substantial consignment of seed of magur and singhi was transported to Delhi, Assam and Karnataka. A significant achievement in the field of seed transportation has been the successful transport of seeds of magur (97,000 nos.) and singhi (45,000 nos.) without being packed under oxygen. This would help economising seed trade in years to come.

The All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs in collaboration with the State Fisheries Departments continued its investigations on the physico-chemical characteristics of soil and water, primary production, fish food resources, fish yield and fishery biology in Bhavanisagar, Nagarjunasagar, Rihand, Getalsud and Govindsagar reservoirs.

In Bhavanisagar, the fish yield during the calendar year 1978 was 45 3 kg/ha as against the previous year's yield of 74.7 kg/ha. The low yield during 1978 was due to the high water level that prevailed throughout the year and underfishing in the lotic zone of the reservoir. *L. calbasu* was the most dominant species in the catch followed by *M. aor*, and *L. rohita* which ranked second in 1977, was significant by its poor landings during 1978. The catfish dominated the catch in Nagarjunasagar reservoir and recorded a higher production of 10.1 kg/ha. The estimated total landings from Getalsud reservoir was 18.30 kg. with *C. catla* contributing to the extent of 91.16%. *C. catla* also dominated the total catch (104 t) of Rihand reservoir where fishing was carried out only for 133 days.

In Govindsagar, the fish yield touched an all time record of 71 kg/ha, the total production being 827 tonnes. The exotic silver carp, *H. molitrix* has well established in the reservoir as indicated by the increasing occurrence of fry and fingerlings.

The All India Co-ordinated Research Project on Brackishwater Fish Farming with its institute based sub-centre at Kakdwip in West Bengal and six centrally sponsored sub-centres in Andhra Pradesh, Goa, Kerala, Orissa, Tamil Nadu and Maharashtra continued to pursue the studies on

brackishwater shell- and fin-fish farming. At Kakdwip Centre, a major breakthrough has been achieved in artificially inducing maturation and breeding *P monodon* in brackishwater impoundment by eye-stalk ablation technique which has far reaching significance in removing the major constraints of inadequate supply of pure seed of this highly priced marine shrimp. Under mono-culture of *P. monodon* a significantly high production of 1,185 kg/ha in 3 short term crops has been achieved.

Mono-culture of *P. indicus* has been successfully demonstrated at Madras Centre with a production of 427.3 kg/ha/120 days. In Goa, monoculture of pearlspot yielded 511 kg/ha/year. Pearlspot culture tried at varying densities under different harvesting systems at Kerala gave yields ranging from 384 kg/ha/9 months to 1,118.7 kg/ha/10 months.

In order to strengthen exchange of research publications, new exchange relationships were established with fourteen organizations, *viz.*, The Deputy Director of Fisheries, Brackishwater Fish Farm, Andhra Pradesh Agricultural University, Kakinada ; The Project Director (Pulses), Indian Agricultural Research Institute, Kanpur; The Head, Library & Information Services, Bhabha Atomic Research Centre, Trombay, Bombay; The Joint Director, ICAR Research Camplex for N. E. H. Region (Tripura Centre), Lembucherra, West Tripura; The Principal, Bihar, Agricultural College, Rajendra Agricultural University, Sabour. Bhagalpur (Bihar); The Director, Exploratory Fisheries Project, Botawala Chambers, Bombay ; The Director, Central Agricultural Research Institute for Andaman & Nicobar Group of Islands (ICAR), Port Blair ; The Scientist-in-Charge, Kakinada Research Centre of the Central Institute of Fisheries Technology, Sreeramanagar, Kakinada, A P. ; Dr. B. I. Sundararaj, Professor, Department of Zoology, Delhi University, Delhi; Dr M. N. Kutty, Professor of Fishery Science & Special Officer, Tamil Nadu Agricultural University, Tuticorin, Tamil Nadu; Dr. S. K. Garg, C/o Dr B. I. Sundararaj, Professor of Zoology, University of Delhi, Delhi; The Chief Executive Officer, Fish Farms' Development Agency, Ramalinganagar, Woriur, Trichy; The Secretary, Indian Institution of Agricultural Technologists, Directorate of Agriculture, Bangalore and the Assistant Secretary to the Government of West Bengal, Fisheries Department, Calcutta.

Research collaboration at International level with FAO, Ford Foundation, etc.

In order to further strengthen exchange of research publications, new exchange relationships at International level were established with 4 additional organizations ; *viz.*, The Editor & Publication Officer, Government of

People's Republic of Bangladesh, Bangladesh Agricultural Research Council, 130-C, Dhanmundi, Road No. 1, Dacca-5, Bangladesh; The Head, State Fisheries Company, Planning Department, Baghdad, Iraq; The Head, Library Section, Centro De Information, Cientifica Y Humanistica, Universidad Nacional, Autonoma De, Apartado Postal 70-392, Mexico 20, DF; and The Director, Freshwater Aquaculture Centre, Central Luzon State University, Nueva Ecija 2320, Philippines.

In collaboration with the International Development Research Centre, Canada, the "CIFRI/IDRC Project on Rural Aquaculture in India" was continued at four centres in two States, *viz* ; West Bengal and Orissa.

WEST BENGAL CENTRES :

In Burdwan Centre during demonstration on induced breeding techniques, 2 million common carp and 2.45 million Indian major carp spawn were produced. Under demonstration of nursery management technique at a high stocking density of 10.21 million/ha and feeding with protein rich diet fortified with yeast, gave a remarkably high survival rate of 80.73% with an average production cost of Rs. 3.79/1000 fry. A total of 1.75 million fry and 47,000 fingerlings of Indian major carps were distributed among 5 and 57 farmers respectively, for stocking their own pond. Composite fish culture demonstration at a stocking density of 7,500/ha of six species in different ratios gave production ranging from 3,644—6,062 kg/ha.

In mono-culture of singhi (*Heteropneustes fossilis*) a production of 4.8 t/ha/4½ months was obtained at a stocking density of 2,50,000/ha. In semi-intensive culture, magur (*Clarias batrachus*) stocked @ 50,000 fishlets/ha gave production ranging from 3.3 t/ha/5 months to 4.0 t/ha/6 months without water replenishment. With water replenishment, a production of 7.3 t/ha/6½ months was obtained when stocked at 2,00,000 fishlets/ha.

Two training programmes were organised, one each at Sanko and Nabastho where 74 farmers, educated unemployed youth, social workers and teachers were trained. A 'Farmer's Day' was also organised in each village.

In Jalpaiguri Centre, composite fish culture technology was demonstrated in 13 ponds The acidic nature of the soil was corrected by applying lime @ 165 kg/ha for the first six months and 82 kg/ha for the next six months. At a stocking rate of 6,000 fingerlings/ha of silver carp, catla, rohu and mrigal, production ranging from 2.1 to 4 9 t/ha/year (average 3.1 t/ha/yr) was achieved in these ponds. Eight lakh spawn of common carp, 9 lakh spawn and 23,718 fingerlings of major carps produced during the demonstrations were distributed among the farmers.

A cooperative society entitled "Unemployed Young Men's Pisciculture Cooperative Society Limited" was organised at this centre. A 6-day trining progromme was organised wherein 25 persons were trained.

ORISSA CENTRES :

Investigations under Rural Aquaculture Project at three centres viz ; Puri, Cuttack and Aska were continued.

The work at Puri Centre was terminated in February, 1978 and the harvesting of all the ponds yielded a total production of 16.359 tons, with an average production of 3,046.41 kg/ha. The pond owners received a total amount of Rs. 1,14,513/-.

In order to demonstrate the feasibility of fish culture in large ponds, a 3 ha pond of the Fisheries Co-operative Society of Ayatpur was selected and stocked at a low stocking density of 2,500 fingerlings/ha. However, the water spread area dwindled to less than 1 ha due to draught condition and the fishes were harvested after 5 months rearing, yielding a total production of 1,350 kg of fish.

Production to the tune of 2,001 kg/ha/6 months could be obtained in a 0.4 ha pond belonging to a Harijan Fishery Cooperative Society in Pubasasan village. A complex chemical fertilizer "Gromor" was used instead of urea and superphosphate.

At Aska, the second crop of fishes harvested so far yielded a total quantity of 23.21 tons during a rearing period of nearly 18 months. The average production per hectare recorded so far is 4,210 kg, with a range of 3,072 to 5,772 kg. The per kg cost of fish production varied from Rs. 2.12 to 4 24, with an average of Rs. 2.87.

Hatchling to fry rearing was demonstrated in six village nurseries. A total of 3.88 lakhs of hatchlings of catla, rohu and mrigal were reared and 2.15 lakhs fry were harvested demonstrating a survival rate of 70%. The same met the needs of 50 per cent of the fry requirement of Aska Revenue Block.

Research Associations :

The scientists and the technical staff took active interest in the organisation and management of the "Inland Fisheries Society of India". During the year, Vol. 10 of the journal was published by the Society.

The Institute continued to have institutional membership of the following societies and associations :

Indian :

1 Asiatic Society, Calcutta
2 Indian Science Congress Association, Calcutta
3 Inland Fisheries Society of India, Barrackpore
4 Marine Biological Association of India, Cochin
5 Indian Society of Ichthyologists, ZSI, Madras
6 Association of Agricultural Librarians & Documentalists of India, New Delhi
7 Indian Association of Special Libraries & Information Centres, Calcutta

Foreign :

1 Societas Internationalis Limnologiae, Michigan, U.S.A.

Advisory Service Received and Provided :

Information on different aspects of inland fisheries research and development, *viz.* ; fish breeding, culture of fish food organisms, integration of aquaculture with animal husbandary and agriculture ; farming of fresh- and brackish-water prawns ; biology of different fishes ; water pollution and biological effects of pesticides, etc. were communicated to various scientific personnel and to a number of institutions in public and private sectors in India and abroad.

Information on elver resources of commercially important eel species from different river systems in India and brackishwater shrimp farming were supplied to Dr. T. A. Mamen, Director, MPEDA, Cochin ; a note on the mass culture of *Daphina lumholtzi* by using poultry manure was sent to Dr. K. H. Mohamed, FAO/UNDP Fisheties Biologist, Kuwait ; pamphlets on fish culture and a note on the classification of animals and plants were sent to Sri S. C. Choudhuri, Asstt. Collector of Customs, Bassein Division, Orissa and Sri B K. Lal, Lucknow respectively ; technical information on "Culture and seed supply of *Macrobrachium* spp." ; "Systematics and biology of Loaches" ; "Effects of water pollution on biological life bioefficiency of different pesticides under Indian conditions" and "Canal breeding of Indian major carps" were passed on to Sri R. Mahadevan, Dolphin Fisheries Pvt. Ltd., Bombay ; Sri M. Selvanathan, Assistant Professor of Zoology, Scott Cristian College, Tamil Nadu ; Director General, Health Services, New Delhi ; Ministry of Agriculture, Government of India ; and Sri S. R De, Superintendent of Fisheries, Government of West Bengal.

A note giving details of research facilities available at the CIFRI was sent to Sri B.B.L. Mathur. List of literature on *Macrobrachium* spp. was sent to Dr. G. C. Negi, Director, Animal Husbandry cum-Chief Warden of Fisheries, Himachal

Pradesh. Three publications on effects of pesticides on fishes were sent to IDRC—Asian Regional Office, Singapore. "Report on fish culture prospects in the Collair Lake" was sent to Nagarjuna Fisheries Ltd., Hyderabad. Information on minimum length of fish at maturity for 15 different species was sent to the Jt. Director of Fisheries, Okha Port, Gujarat.

List of references on *Macrobrachium* spp., Brochure on the activities of the CIFRI and pamphlets on fish culture ; and Annual Report 1976 were sent to Project Officer, Pilot Project on Murrel Culture ; Dr. B V. Parameswara Rao, Secretary, the Bhagabatula Charitable Trust, Yellamanchili and Dr. Vaulot Danial, Division Aquaculture, Et Amenagements Littoraux, France respectively.

A note on the contribution of CIFRI towards the fisheries development of Assam was sent to Dr. M. S. Swaminathan, Director General, Indian Council of Agricultural Research, New Delhi and a write-up on the main contributions of CIFRI was sent to Sri K. E. Sankaran, Chief Publicity and Public Relations Officer, ICAR.

Suggestion on the introduction of *Tilapia nilotica* was given to Shri M. P. Devasundaram, Deputy Commissioner (Inland Fisheries), Government of India and information on sewage-fed fisheries was given to IDRC—Asian Regional Office, Singapore.

Advice regarding the possibilities of culturing *Macrobrachium* spp. in Himachal Pradesh was rendered to Sri Ranjit Singh, Member of the Parliament. Questianaires on "National Survey of Scientific and Technical Activities 1976-77" was attended to and relevant information passed on to Dr. (Mrs.) A. R. Rajeswari, Principal Scientific Officer, Department of Science and Technology, New Delhi.

Filled in proformae on the activities of CIFRI for inclusion in the "Directory of Institutes for higher education" ; "Directory of organization engaged in the field of air and water quality monitoring" ; "List of research workers of the Institute" for inclusion in the "List of research workers in the Agricultural Services in the Commonwealth and in the Republic of Ireland" ; information regarding ongoing research projects and research problems on which the work has been completed ; information on the activities of the Institute for inclusion in the "Regional Union Catalogue of Scientific Serials" ; and in the "World directory of institutions sources of information in food science and technology ; and list of "Mission oriented research problems" which may be taken up by the Post Graduate students and others working in the agricultural as well as general universities were sent respectively to Secretary, Ministry of Education and

Social Welfare, Government of India ; Dr. B. B. Sundersan, Director and Project Coordinator, ENDP Project, NEERI, Nagpur ; Dr. C. Kempanna, Assistant Director General (Cord.) ICAR, New Delhi ; Sri S. N. Dutta, INSDOC, New Delhi ; The Head, Food Science and Technology Information Service, Central Food Technological Research Institute, Mysore ; and Dr. M. S. Swaminathan, Director General, Indian Council of Agricultural Research, New Delhi.

A list of 'holdings of thesis' available at the Institute's Library was sent to the Chief Librarian, ICAR, New Delhi for inclusion in the 'Union Catalogue of Thesis'.

A write-up on "Review of the present status of research and identification of major gaps for preparation of new schemes in fisheries" was sent to Prof. S. K. Mukherjee, Assistant Director General (E), ICAR, New Delhi.

A write-up highlighting the functions of this Institute was sent to Dr. C. Kempanna, Assistant Director General (Cord.), ICAR, New Delhi.

A brief resume' of the salient contribution of CIFRI in the field of biology, microbiology, and biochemistry was sent to Shri P. C. Bose, Agricultural Research Information Centre, ICAR, New Delhi.

Particulars required for the "Directory of Gazetted Statistical Personnel" was sent to the Deputy Director, Ministry of Planning, Department of Statistics, Central Statistical Organisation, New Delhi.

A list of CIFRI Publications on water pollution was sent to Dr. B. K. Handa, Sr. Chemist, Central Ground Water Board, Lucknow.

Extension and Nation Building Activities :

Experiments were undertaken at Krishnanagar (West Bengal) to evolve suitable systems of combining live stock rearing with fish culture, to assess the efficiency of dung of these animals/birds as fertilizer in fish culture, and to assess economic viability of the technology in integrated fish farming. Combinations tried were i) fish-cum-pig rearing and ii) fish-cum-duck rearing.

Fish-cum-pig rearing

Under the Operational Research Project on composite fish culture, a production to the tune of 7,300 kg/ha/yr could be achieved through six species culture of Indian and exotic carps when the pond was periodically fertilised with swine dung from the pig-sties constructed near the pond at Krishnanagar, West Bengal. No supplementary feeding was done except for grass carp which were fed on cattle fodder such as *barseem* and hybrid napier grass. The pigs registered

a weight increment of 73 kg during the period. The production cost of fish was worked out to be only 0.95 paise per kg.

Fish-cum-duck rearing

A high yield of about 4,500 kg/ha/yr of fish could be achieved from a large pond of 1.48 ha area through the culture of Indian and exotic carps at the Operational Research Centre, Krishnanagar. No feeding and fertilisation was resorted to except for manuring the pond with duck droppings at an estimated rate of 10 t/100 birds/yr and automatically recycled from a specially designed floating duck house constructed on the pond. In addition to fish crop, 1,835 duck eggs were also produced.

Training and demonstration under the Rural Aquaculture Project in Jalpaiguri

The Rural Aquaculture Project is covering a group of three villages within a radius of 10 km at its Jalpaiguri Research Centre for demonstrating scientific techniques of fish culture to the pond-owners. Fish culture, even in the traditional manner, has not been a normal practice with pond owners in Jalpaiguri District. 13 ponds (0.1—1.9 ha) covering an area of 5.12 ha being utilised for the purpose of demonstration and training.

Induced breeding of mrigal was taken up at this centre for the first time during the 1977 monsoon season and 2 lakh spawn handed over to the pond owner. Seven lakhs of common carp spawn was produced and handed over to the Block Development Officer for rearing and distribution of fry to the pond owners in the Sadar Block.

Twenty five persons including pond owners, educated unemployed youth, teachers and farmers underwent a six-day training programme in fish breeding and culture from March 27—April 1, 1978. Five of these trainees are the members of a cooperative society called "Unemployed Young Men Pisciculture Cooperative Society Limited" which has been organised recently.

A 'Farmers' Day' was organised at Joradighi on May 4, 1978. Shri Ahmed, S.D.O., Jalpaiguri, was the Chief Guest at the function. Shri Ahmed, in his address, appreciated the work done under the project in Jalpaiguri District and thanked the ICAR for establishing a centre for demonstration of scientific fish culture in Jalpaiguri where fish culture as such did not exist. He was happy to note that a number of participants underwent a training programme and were showing interest in scientific fish farming. Shri Ahmed distributed certificates to the participants who underwent the training programme in April, 1978.

A netting demonstration was also arranged on this occasion at Joradighi and a token catch of 2 quintals of fish was handed over to the pond owners. Those who participated in the programme were greatly impressed to see the growth of catla which had grown over 1 kg in six months in Joradighi. Acidic nature of soil and water of fish ponds in Jalpaiguri District are largely responsible for slow rate of growth in fishes in contrast to which the growth of catla has been a remarkable one.

Photograph 7: Dr. V. G. Jhingran Director CIFRI (Second from left) handing over the fish, raised at the Jalpaiguri (North Bengal) Centre of the IDRC Project, to the pond owner.

The impact of this project is already being felt in the area and many pond owners are keenly interested in undertaking scientific fish culture in their ponds. One of the farmers has already started constructing a fish farm for rearing seed of cultivable species, facilities for which are not locally available in the District. The project also undertook fish breeding programme at Jalpaiguri during June—July, 1978.

Training in brackishwater prawn and fish farming

A 10-week field oriented training in brackishwater prawn and fish farming was organised at the Brackishwater Experimental Fish Farm of the Institute at Kakdwip (West Bengal) during December 26, 1977 to March 5, 1978. Officials from the State Fisheries Department, Orissa, State Fisheries Development Cor-

poration, West Bengal and a private entrepreneur of West Bengal received the training. Immediate impact of the training has been the initiation of brackish-water prawn and fish farming on scientific lines in lower Sunderbans by the private pisciculturist—a participant in the training.

A field oriented two month training course in brackishwater prawn and fish farming was organised by the Extension Section of the Institute during August 1, to September 30, 1978 and was held at the brackishwater fish farms of the Kakdwip Research Centre of the Institute at Kakdwip, West Bengal.

The training course comprised lectures and practicals on the package of practices on brackishwater prawn and fish farming right from the collection of seed to the production of marketable prawn and fish. The economic viability of the various techniques was demonstrated through the active participation of the trainees in actual farming operations.

Thirty enterprising fish farmers and 10 officials from State Fisheries Development Corporation, Wilson and Associates and Neogi Sea-Food, Calcutta; Marine Products Export Development Authority, Cochin ; Cifoods Ltd., Orissa ; and Mathur Marine, Puri, Orissa received the training.

Pilot project on control of water hyacinth

A pilot project initiated in March 1978, sponsored by the North Eastern Council in collaboration with the Manipur Fishery Department under technical guidence of Shri V. Ramchandran, Fishery Scientist of the Institute, on the control of 400 ha of dense water hyacinth *(Eichhornia)* infestation in 500 ha Takmu Fishery Lake in Manipur has progressed well to cover 200 ha so far. Complete kill and disintegration of the weed have been demonstrated by adopting dosage computation and treatment techniques evolved by the Institute. No adverse effect on fish fauna is likely or reported so far. The overall cost of clearance in this case is expected not to exceed Rs. 700/- per hectare which is one half of the usual cost by manual clearance.

Third Workshop of the All India Coordinated Research Project on Brackishwater Fish Farming

The third workshop of the All India Co-ordinated Research Project on Brackishwater Fish Farming, jointly organised by CIFRI and Kerala Agricultural University, was held at Central Institute of Fisheries Technology, Cochin ; on November 9 and 10, 1978

Welcoming the Chief guest, Shri N. Kaleeswaran, Vice-Chancellor, Kerala Agricultural University and participants, Dr. V. G. Jhingran, Director, CIFRI stressed the need for developing brackishwarer fish farming in the country. He

said that there has been upsurge all over the world for aquaculture during the last decade and discussed the factors which have contributed to the upsurge.

Photograph 8 : Dr. V. G. Jhingran, (third from left), Director, CIFRI welcoming the delegates to the inaugural session of the the 3rd Workshop of the All India Co-ordinated Project on Brackishwater Prawn and Fish Farming at CIFT Conference Hall, Cochin. Dr. M. V. Pylee (extreme left. Chairman) Vice-Chancellor, Cochin University, Shri N. Kaleeswaran (Chief guest, seated next to Dr. Pylee), Vice Chancellor, Kerala Agricultural University and Dr. E. G. Silas (extreme right) Director, Central Marine Fisheries Research Institute are also seen.

Dr. Jhingran highlighted the achievements made by the project during the last few years and said "it has done excellent work".

Dr. R. Raghu Prasad, Assistant Director General, ICAR speaking on the occasion invited the participants to examine the achievements made under the project and help in formulating the wotk programme fot the next year.

Delivering the inaugural address, Shri N. Kaleeswaran, stressed that proper utilisation of the water resources of the country under aquaculture programme was urgently needed as done for land resources and remarked that if malnutrition is to be erased it is necessary to improve the fish production of the country and make it available to the poor people. He stressed that the land resources development through agriculture has received the attention of

the country but the water resources await development. As the green revolution in India started with the use of high yielding dwarf variety of wheat, he stressed that, the aquaculture techniques developed by the CIFRI have suitability to revolutionise the fish production in India. Discovery of a new technology is essential to bring about a revolutionary development of a country. He further

Photograph 9 : Dr, R. Raghu Prasad (Centre) Assistant Director General (Fisheries) addressing the inaugural session of the 3rd Workshop of the All India Co-ordinated Research Project on Brackishwater Prawn and Fish Farming at CIFT Conference Hall, Cochin. Shri K. H. Alikunhi (left), and Director of Fisheries Kerala are also seen.

emphasised that the technology developed by the scientists should be transferred to the common farmers in understandable simple language. He also pointed that the high cost sophisticated technology which can only be adopted by Government on large scale cannot be utilised by farmers because of capital constraints and, therefore, low cost technology which takes into account the capital constraints in the society, should be developed.

Earlier Dr. Pylee, Vice-Chancellor, Cochin University, Chairing the inaugural session pointed out the need for adoption of scientific aquaculture to cope up with the ever increasing demand of the country for fish. He was happy

to know that the stage of experimentation was over and the scientific practices evolved are going to be implemented in the field.

Fourth Workshop of the All India Coordinated Research Project on Air-breathing Fish Culture

Fourth workshop of the All India Coordinated Research Project on Air-Breathing Fish Culture was inaugurated by the Hon'ble Minister-in-Charge, Fisheries, Government of West Bengal, Shri Bhakti Bhusan Mandal at the Central Inland Fisheries Research Institute, Barrackpore on December 12, 1978.

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute welcoming the Hon'ble Minister and delegates highlighted the achievements under the Coordinated Research Project on Air-breathing Fish Culture and commented that since a totally new system of fish culture was developed with such non traditional species, the task before the project was rather difficult and complex ; yet within a short span, the project developed techniques to breed and rear young ones of all the commercially important species of air-breather and could conduct production demonstration with viable economics.

The Hon'ble Minister for Fisheries, Government of West Bengal, in his inaugural address expressed happiness over the reported achievements under the Coordinated Research Project on Air-breathing Fish Culture and commended those who have made it possible to culture these species to achieve yields upto 5.2 tons/ha/6 months and 55 tons/ha/6 months under semi-intensive and intensive operations respectively. The Hon'ble Minister also mentioned that culture of air-breathing fishes may play a dominant role in utilising small back-yard ponds in village and for the purpose Government of West Bengal has planned to set up demonstration centres in various blocks of the State.

Dr. C. V. Kulkarni, as the Chairman of the inaugural session suggested that the reports of successful demonstrations of semi-intensive and intensive culture techniques in farmers' ponds render the necessary credibility to the technology developed at the Central Inland Fisheries Research Institute.

The workshop was conducted through three different sessions under the Chairmanships of Shri K. M. Mondal, Director of Fisheries, West Bengal, Shri P. Basu, Commissioner (Fisheries), Government of Gujarat and Shri R. B. Raijada, Chief Warden, Fisheries, Delhi Territory when progress reports of the project centres were discussed.

Dr. P. V. Dehadrai, Project Coordinator reviewing the projects' achievements informed that the production potential of air-breathing fishes is by and

large commensurate with inputs and magnitude of operational management. Dr. Dehadrai informed the workshop that research on nutritional and reproduc-

Photograph 10 : Dr. P. V. Dehadrai, Project Co-ordinator, All India Co-ordinated Research Project on Air-breathing Fish Culture presenting his report during the 4th Workshop of the project held at CIFRI, Barrackpore, West Bengal.

tion aspects has brought about measurable breakthrough and the results will soon be ready for field application to bring down the operationai cost and to ensure abundant availability of seed.

Culture of air-breathing catfishes, he pointed out, is of rural relevence with low inputs as well as adaptable to factory farm basis with intensive operation.

Fourth Workshop on All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production

Fourth workshop on All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production was held at Raj Bhavan, Puri on 21– 22 December, 1978. Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute welcoming the guests and participants from different States of the country apprised the progress achieved and the role being played by the All India Coordinated Research Project on extensively extending the technology

throughout India through adaptive research. Dr. Raghu Prasad, Assistant Director General (F), ICAR, added that the Project had not only achieved the objective and targets, but it had created substantial impact in certain States.

Progress reports of the work done during the period September, 1975 to September, 1978 on the composite fish culture experiments and fish seed production at Institute based and centrally sponsored (State besed) centres of the project were presented and discussed in three technical sessions under the Chairmanship of Shri G. N. Mitra, Fisheries Adviser, Government of Orissa ; Dr. G. P. Dubey, Prof of Life Sciences, University of Bhopal, M. P. ; and Prof. S K. Moitra, University of Burdwan, West Bengal.

Dr V. R. P. Sinha, Project Coordinator, reviewed the achievements of the project made during the last three years and enumerated in detail the remarkable fish production of over 10,000 kg/ha/year achieved at Pune (Maharashtra) with fry as stocking material instead of fingerlings. Dr. Sinha also assessed in detail, the role of supplementary feed and fertilizers in composite fish culture ; fresh-water prawn, *Macrobrachium malcolmsonii* as component of composite fish culture ; nutrient status of soil and water of ponds, as well as nitrogen balance and nitrogen utilization efficiency in certain composite fish culture ponds ; and expenditure pattern of the fish production under composite culture.

Dr. Sinha while speaking about the salient achievements in fish seed production of cultivated Asiatic carps said that fish seed production has significantly risen from about 112 8 lakhs during 1976 to about 339.2 lakhs in 1977 and 543 lakhs in 1978. He also spoke about the relation between the hydration of the female fish with hypophysation and successful induced breeding.

In addition, discussions on the development of composite fish culture and seed production in tribal regions of the country were held in the fifth technical session. It has been stressed that there is an urgent need for improving the fish culture techniques in tribal regions to improve the income of poor folk.

Dr. C. V. Kulkarni, Retd. Director of Fisheries, Maharashtra, Chairman of the Sixth technical session congratulated the staff of the Coordinated Project for the excellent work done and high production achieved.

Finance :

The provision of funds for the financial year April, 1978 to Match, 1979 was as under :

Non-Plan	:	Rs. 68,76,000.00
Plan	:	Rs. 98,00,000.00
TOTAL	:	Rs. 1,66,76,000.00

Against the above provision, the expenditure from 1.4.78 to 31.12.1978 was as foilows :

Non-Plan	:	Rs. 51,74,383.00
Plan	:	Rs. 34,68,165.00
TOTAL	:	Rs. 86,42,548.00

Table I : Spawn, Fry, Fingerlings supplied to various agencies in 1978

AGENCIES	Indian major carps		Exotic carps			Common carp
			Silver carp		Grass carp	
	Spawn (lakhs)	Fry and Fingerlings (Nos.)	Spawn (lakhs)	Fry and Fingerlings (Nos.)	(Nos.)	Fry and Fingerlings (Nos.)
1) I. D. R. C.	—	28,000	—	7,650	1,680	1,100
2) Orissa Fisheries Dept.	1.52	1,11,830	0.45	16,200	2,090	—
3) Operational Research Project (Aitpur, CRRI, etc. and OUAT Bhubaneswar)	3 5	7,100	—	1,510	—	950
4) Co-ordinated project, Dhauli	—	—	—	3,000	—	—
5) Pantnagar Agricultural University	—	—	—	600	650	—
6) Gowalior Fish Farm	—	—	—	1,000	—	—
7) Govt of Sikkim	—	—	—	500	—	—
8) State Bank of India (Bhubaneswar & Cuttack)	—	6,100	—	500	—	250
9) CIFRI (Barrackpore)	—	20 200	—	2,700	600	—
10) Departmental Stocking C. I. F. R. Substation, Cuttack	7.6	11,500	1.6 (Dhauli)	9,100	3,200	2,500
11) Private Party	—	81,000	—	1,500	1,500	500
Total :	12.62	2 65,730	2.5	44,260	9,720	5,300

2. PROGRESS OF RESEARCH

Research investigations on twentythree research projects (excluding Project 7 and Project 15) of the Institute, twentythree research problems of the Institute based All India Co-ordinated Research Projects and seven research problems of the CIFRI/IDRC/WB Project were continued during the year 1978 as per scheduled programme. Each project has several problems to be handled on priority basis. Due to practical difficulties, investigations on ·23 undermentioned research problems had to be suspended in 1978.

Problem	:	5.27	Surveying of Kankramari Char and Kakdwip and designing brackishwater fish farm.
Problem	:	5.30	Shapes and structure of ponds, feeder canal and dykes relative to stability, water management and fish culture under brackishwater environment.
Problem	:	5.33	Nursery management in the culture of *Eleutheronema tetradactylum*.
Problem	:	5.49	Evaluation of different supplementary feed used in mullet farming.
Problem	:	8.6	Standardisation of brackishwater seed prospecting collection and transporting techniques.
Problem	:	8.8	Studies on size distribution of commercially important clupeids of the Hooghly-Matlah estuary.
Problem	:	8.9	Studies on size distribution of commercially important perch and sciaenid of Hooghly-Matlah estuary.
Problem	:	8.10	Studies on size distribution of commercially important thread fin and mullet of the Hooghly-Matlah estuary.
Problem	:	13 8	Standardisation of trout hatchery practices.

Problem	:	13.19	Breeding of brown trout at Uttar Kashi, U. P.
Problem	:	14.6	Effect of major environmental changes on the fisheries of commercially important stocks of the Hooghly-Matlah estuary.
Problem	:	14.11	Statistical evaluation of sampling and estimation techniques of plankton.
Problem	:	18.1.7	Mixed culture of magur in combination with *Tilapia* male.
Problem	:	18.1.8	Bio-chemical and bacteriological studies on fishes reared in ponds fertilised with domestic waste water.
Problem	:	18.1.9	Studies on merits and demerits in working of the existing sewage-fed hfis farming of West Bengal.
Problem	:	22.1 (a)	Carp culture in running water in the Ganga.
Problem	:	22.1 (b)	Carp culture in running water in the river Brahmaputra.
Problem	:	22.1 (c)	Carp culture in still water 'Kol' of the Ganga in cages.
Problem	:	CFCSP-9	Composite fish culture in running water.
Problem	:	CFCSP-12	The pituitary gonad feed back relationship in *Mystus vittatus* (Bloch).
Problem	:	CFCSP-16	Evaluation of fish production and loss due to poaching from cultivated resources.
Problem	:	CFCSP-17	A test on the equal catchability of tagged and non-tagged animals in mark recapture studies.
Problem	:	CIFRI/ IDRC/WB-4	Feed-input fish-yield relationship for freshwater fish culture operations.

Moreover, research work on *"Project-7* Murrel and live fish culture" was discountinued as the investigations are being conducted under the Institute based All India Co-ordinated Research Project on Air-breathing Fish Culture and *"Project-15* Fish pathology" under which no fresh problem was taken up,

(a) Research completed

Since the Institute embarked on time bound project programe in 1967, investigations on 129 problems; *i. e.*, one problem in the year 1969, seven in 1970, four in 1971, nineteen in 1972, twentyfour in 1973, five in 1974, eleven in 1975, sixteen in 1976, twentyeight in 1977, and eleven in 1978 were completed. Brief reports of the problems completed during 1978 are presented below :

Project I : Optimum per hectare production of fry, fingerlings ana fish in culture fishery operations.

Problem	: 1.37	Devising effective sampling technique for estimating production.
Personnel	:	M. Rout and R. D. Chakraborty
Duration	:	Two years

Different sampling procedures were adopted in ponds (0.15 to 0 5 ha) to sample fish growth for estimating production. Effect of variables such as, size of net, duration of actual fishing time, manpower, floats, etc, on sampling system were studied by repeated netting to reduce the sampling error. The error variation in sampling could be reduced by subdividing the aggregates into subpopulations. The sampling variance of the estimated mean from subsampling was of maximum accuracy when compared against other sampling systems. Estimates for near values of length and weight from successive samples collected from different hauls did not differ significantly. Weight loss in fish during the course of sampling affected the estimates of production. Average loss was observed to range between 1.86 and 2.38%, the highest being 3.43% for silver carp and 0.97% for common carp within the first four hours after harvest. Coefficient of variation of loss in weight, calculated for seasons, ranged from 16.0 to 51.6%.

Project 2 : Induced fish breeding

Problem	: 2.4	Hatching of eggs of major carps in newly designed hatchery under controlled conditions.
Personnel	:	R.M. Bhowmic, R.K. Jena and S.D. Gupta
Duration	:	Nine years six months

A model hatchery complex for carps has been designed and installed in 1970 at Cuttack. It consists of 1) Water supply unit, 2) Breeding tank, 3) Incubation and hatching jars, and 4) Spawnery. The tanks are used for breeding the fish and they also serve as spawneries (receptacle for spawn) when the spawning operation is over. Four sets of fish can be bred and 2 million of eggs (50,000/jar) can be hatched in the hatchery in a single operation.

Besides, the eggs of Indian major carps, those of silver carp and grass carp, which often fail to develop in cloth hapas fixed in ponds, were successfully hatched in this indoor hatchery complex.

The breeding of common carp has also been done in the hatchery. The eggs were degummed successfully and healthy hatchlings were obtained by hatching the eggs in the jars. During the year 1973-78, about 28.4 million of carp spawn has been produced using the small model hatchery complex containing 40 jars. The average price of 28.4 million spawn @ Rs. 300/- per million is Rs. 85,200/- in the open market. The hatchery which is simple and easy to operate, eliminates field hazards and ensures higher survival of fish seed than that of the hapa fixed in ponds. In fact, the hatchery is capable of working like a small factory for raising fish seed on large scale.

Project 5 : Brackishwater fish farming

Problem	: 5.31	(Research work completed in 1978. Final report is being prepared)
Problem	: 5.41	(Research work completed in 1978. Final report is being prepared)

Project 14 : Riverine and estuarine fish catch statistics

Problem	: 14.13	(Research work completed in 1978. Final report is being prepared)

Project 20 : Water pollution investigations

Problem	: 20.7	Bio-assay of selected industrial wastes disposed into the Hooghty estuery.
Personnel	:	P. Roy, B.B. Ghosh, M M. Bagchi and S. K. Majumdar
Duration	:	Three years

The LC_{50} values determined by bio-assay experiments (96 hr) for shrimp with wastes of paint and rubber complexes were 19.0 to 20 0% and 32% (by volume) respectively. Using application factor as 0 01, in a given situation involving the wastes, the safe concentration of the waste in the receiving water is calculated to be 19% to 20% in case of paint waste and 32% in case of rubber waste. *Daphnia similis*, however, showed LC_{50} to be 6% by volume with paint weste.

Project 24 : Freshwater aquaculture in urban and near urban areas

Problem	: 24.2	(Research work completed in 1978. Final report is being prepared)

Project CFCSP : All India Co-ordinated Research Project on composite fish culture and fish seed production.

Problem	: CFCSP 7	(Research work completed in 1978. Final report is being prepared).
Problem	: CFCSP 8	Composite fish culture without fertilisation and feeding.
Personnel	:	D. N. Mishra, H. A. Khan and B. C. Tyagi
Duration	:	Three years

To assess the role of supplementary feeding and fertilisation in the composite fish culture, two sets of experiments, each of one year duration were conducted in seven ponds at Jaunpur Centre of the project employing six species combination of Indian and exotic carps. The ponds were stocked @ 6,000 fingerlings/ha in identical composition after effecting pre-stocking management. The experiments involving supplementary feeding

alone yielded production as high as 4,710 kg/ha/yr as against 2,145 kg/ha/yr with provision of pond alone, and 1,665 kg/ha/yr in the control without supplementary feeding and fertilisation. However, the ponds, wherein both supplementary feeding and fertilisation were adopted, yielded production as high as 7,371 kg/ha/yr. The production obtained in these experiments clearly indicates the major role played by supplementary feed compared to fertilisation of ponds in enhancing production in composite fish culture.

So far as the growth of individual species is concerned, in first set of experiments, catla did not register any significant growth rate in ponds which were only fertilised but grew two to three times better in ponds where supplementary feed alone was provided. The same trend was also noticed in rohu as well. Silver carp did not show any appreciable growth difference.

Project CIFRI/IDRC/WB : Rural Aquaculture in India

Problem	:	CIFRI/IDRC/WB/1	Composite culture of carps and certain air-breating fishes
Personnel	:		S. D. Tripathi, A. K. Datta, K. K. Sengupta, K. M. Das, S. Patra, D. Nath, M. L. Bhowmick and M. Ghosal
Duration	:		Three years

BURDWAN CENTRE :

Seed production of Indian and Chinese carps :

During demonstrations on seed production, a total of 2 million common carp spawn was produced, of which 1.39 million was distributed to 10 fish farmers. During demonstration on induced breeding techniques of Indian major carp, 2.45 million spawn was produced.

A farmer who received training from IDRC scientists could himself produce about 50,000 spawn of silver carp and reared the same to fingerling size with an average survival of 60%.

Rearing of spawn to fry and fingerling size :

Induced-bred spawn of Indian major carp when stocked at an average rate of 10.21 million/ha and fed with protein rich diet fortified with yeast resulted

in a survival of 80.73% fry with an average production cost of Rs. 3 79/1000 fry. A total of 1.75 million fry was distributed among 5 farmers and 47,000 fingerlings of Indian major carps were distributed to 57 farmers for stocking their own ponds.

About 0.61 million common carp spawn was utilised for demonstration of fry and fingerling rearing techniques and over 75,000 fry and 22,000 fingerlings were distributed to 49 and 45 fish farmers respectively.

Composite culture of Indian and exotic carps :

Fingerlings when stocked at 7,500/ha in three combinations of the six species (*i.e*, catla 15, rohu 28, mrigal 15, silver carp 25, common carp 15, grass carp 2% ; catla 10, rohu 28, mrigal 10, silver carp 30, common carp 20, grass carp 2%, and catla 12.5, rohu 18, mrigal 20, silver carp 27.5, common carp 20 and grass carp 2%), the production ranged from 3,644—6,062 kg/ha with an average production of 5.3 t/ha. Supplementary feed comprising ground-nut oilcake and rice bran was given at 1-3% of the bodyweight.

Fingerlings when stocked at 6,000/ha in the same species ratio as mentioned at (i) above gave production ranging from 3,797 to 6,733 kg/ha with an average production of 5.1 t/ha. The rate and composition of supplementary feed was the same as in (i) above.

The average cost of production with these two stocking densities worked out to Rs. 4.29/kg.

Culture of singhi :

In singhi (*Heteropneustes fossilis*) culture, a production of 4.8 t/ha/6¼ months was obtained when fishlets were stocked at 2,50,000/ha. The fishes were fed with a mixture of cowdung and rice bran (2 : 1) at about 200kg/ha/day. The feed was occasionally reinforced with meat offal.

Culture of magur with and without replenishment of water :

In semi-intensive culture, magur (*Clarias batrachus*), when stocked at 50,000 fishlets/ha gave a production ranging from 3.3 t/ha/5 months to 4.0 t/ha/6 months without water replenishment. In intensive culture with water replenishment, a production of 7.3/t/ha/6½ months was obtained when stocked at 2,00,000 fishlets/ha. The fishes were fed with a mixture of dried marine trash fish/fish meal, rice bran and ground-nut oilcake (6 : 1 : 1) at 6-10% bodyweight.

JALPAIGURI CENTRE :

A total of 13 ponds (water area 5.12 ha) were selected for demonsatrtion of the techniques of composite fish culture. Initially the pond soil was acidic

(pH 5.1—5.8) but finally as a result of regular liming @ 165 kg/ha for the first six months followed by 82 kg/ha for the next six months the ponds turned productive. Stocked at 6,000 fingerlings/ha (silver carp 37 5, catla 18.75, rohu 25.0, and mrigal 18.75%), a total of 16 95 t of fish was harvested from these ponds, the range of production being 2.1—4.9 t/ha/yr.

In induced breeding experiments, 8,00,000 spawn of common carp was produced and handed over to the Fisheries Extension Officer, Jalpaiguri. During demonstration of breeding techniques, 9,00,000 spawn of Indian major carps was produced and handed over to the farmers for rearing. A part of the spawn was reared in nurseries and 23,718 fingerlings raised and distributed to the fish farmers.

A Cooperative Society entitled "Unemployed Young Men's Pisciculture Cooperative Society Limited" was organised and registered at this centre.

A 6 day training programme was also organised and 25 persons trained. As a follow up measure 6,00,000 spawn of Indian major carps and 1,00,000 silver carp spawn was produced at Malda.

Problem	: CIFRI/IDRC/WB/2	Chemical and biological characteristics of ponds under semi-intensive fish culture.
Personnel	:	D. Nath, S. D. Tripathi, M. L. Bhowmick
Duration	:	Two years

Based on a study of the soil and water characteristics of 10 ponds in Burdwan and 12 ponds in Jalpaiguri districts, the values of certain important parameters observed are given below :

Water	*Burdwan*	*Jalpaiguri*
pH	6.4—7.8	5.8—9.2
Dissolved Oxygen (ppm)	1.5—10.8	1.2—10.8
Total alkalinity (ppm)	25—184	Trace—196 0
Calcium (ppm)	5—48	Trace—32 0
Nitrate (ppm)	0.04—0.09	0.04—1.2
Sp. conductivity (micro mhos cm)	165—1600	56—520
Phosphate (ppm)	0.02—0.7	0.02—0.3
Soil		
pH	6.0—7.4	5.1—7.1
Available N (mg/100g)	20—112	4—47.6
Organic Carbon (%)	0.72—3.06	1.5—4.1

Initially the pond soil at Jalpaiguri was acidic (5.1—5.8) but the pH finally increased as a result of regular liming and the ponds turned productive.

Plankton population showed two peaks, one in December—January and the other in April at Burdwan Centre while a single peak was recorded in March at the Jalpaiguri Centre. Plankton volume ranged from 0.1 to 6.0 ml. (average 0.9 ml) and 0.1 to 10.0 ml (average 1.1 ml)/50 litre of water at Burdwan and Jalpaiguri Centres respectively *Microcystis* blooms predominated in Jalpaiguri ponds.

(b) **Research in hand**

Researches on different problems under 23 Projects operating at the Institute, 7 problems under CIFRI/IDRC Project, and 15, 7 and 1 problem of the All India Coordinated Projects on - - -"Composite Fish Culture and Fish Seed Production", "Air-breathing Fish Culture in Swamps" and "Reservoir Fisheries" respectively were continued during the year 1978. The progress achieved under each project is outlined in the following pages.

Project I : Optimum per hectare production of fry, fingerlings and fish in culture fishery operations

Problem	:	1.1	Composite culture of Indian and exotic species
		1.1.1.1	Rearing of Indian major carp fry to fingerlings for optimum survival and growth under high stocking density
Personnel	:		P. R. Sen, S. N. Datta, S. Jena, D. R. Kanujia & A. N. Mohanty
Duration	:		One year six months

Catla, rohu and mrigal fry were stocked at a combined density of 2 lakhs/ha in the ratio of 1 : 1 : 1 in two rearing ponds. Fertilisation @ 1.6 tonnes/ha of cowdung and artificial feeding with groundnut oilcake+rice polish (1 : 1) (at about 2.16 tonnes/ha/3 months) were done periodically. All the species registered satisfactory growth and resulted in production of healthy fingerlings (catla : 3.5-9.0 g, rohu : 1.5-11.0 g, and mrigal : 4.3-15.0 g) in 3 months in the ponds. The final survival is being assessed.

1.1.2.2 Composite culture of Indian and exotic carps to raise marketable fish

Personnel : R. D. Chakrabarty, P. R Sen, N. G. S. Rao, S. Jena, S. R. Ghosh and D R. Kanaujia

Duration : Three years

The experiment, set in March-April 1978 in two farm ponds, is in progress. Stocking of major Indian and exotic carps was done in a phased manner. Initial stocking was @ 5,000 fish/ha in November, 1978. This manipulation of stocking density was to avoid overcrowding during periods of low water level. Incresed water level is taken advantage of by increasing the number of fishes and by providing more feed and fertilisers. At the end of 8 and 7 months of rearing, estimated productions of 3,100 kg/ha and 2,000 kg/ha have been recorded with 80% survival.

1.2.2.3 Intensive culture of Indian major carps

Personnel : R. D. Chakrabarty, P. R. Sen, N G. S. Rao, S. Jena, S. R. Ghosh & D. R. Kanujia

Duration : Three years

Catla, rohu and mrigal were stocked in the ratio of 4 : 3 : 3 at a combined density of 6,000 fish/ha in two farm ponds. Loss of fish due to poaching adversely affected production. The experiment had to be concluded at the end of 7 months culture. The experiment has been reset in September 1978.

1.1.6 Composite culture of Indian and exotic carps to raise marketable fish with the use of fertilisers and supply of macro-vegetation

Personnel : N.G.S. Rao, P.R. Sen, S. N. Datta, S. Jena, D. R. Kanaujia and A. N. Mohanty

Duration : Three years

The experiment, reset in two ponds in 1978, with catla, rohu, mrigal, silver carp and common carp stocked at 6,000/ha in the ratio of 1.5 : 2.0 : 1.5 : 2.5 : 2.5, is in progress. Estimated average production at the end of 10 months culture has been above 1,800 kg/ha. An important change in the management has been daily provision of organic manure. Available phosphorus in soil

(16.4-25.2 mg) and dissolved phosphorus in water (0.08-2.1 mg) being considerable, no phosphatic fertiliserser is used. Lower level of nitrogen indicates their ready utilisation by plankton and hence, the need for using nitrogenous fertilisers. The costly input, supplementary feed, is eliminated.

Problem	:	1.2	(Research work suspended since 1975)
Problem	:	1.3 & 1.4	(Research work completed in 1972)
Problem	:	1.5	(Research work completed in 1970)
Problem	:	1.6	(Research work completed in 1972)
Problem	:	1.7	(Research work completed in 1973)
Problem	:	1.8	(Research work completed in 1971)
Problem	:	1.9 to 1.11	(Research work completed in 1972)
Problem	:	1 12	(Research work completed in 1973)
Problem	:	1.14	(Research work suspended since 1975)
Problem	:	1.15	(Research work suspended since 1973)
Problem	:	1.16	(Research work completed in 1971)
Problem	:	1.17	(Research work suspended since 1975)
Problem	:	1.18	(Research work completed in 1975)
Problem	:	1.19	(Research work completed in 1973)
Problem	:	1.20	(Research work completed in 1974)

Problem	:	1.21	Carp fry rearing for optimum survival and growth under high stocking density
Personnel	:		P. R Sen and D. K. Chatterjee
Duration	:		Two years

Two sets of experiments, one with catla (stocked @ 3.75 million/ha) and the other with rohu spawn (stocked @ 2.50 million/ha), were conducted with provision of cobalt chloride to catla (@ 0.01 mg/fish/day) and cobalt chloride + manganese (both at 0.01 mg/fish/day) to rohu spawn. Survival achieved was 63.3% and 75.0% in case of catla and rohu respectively as against 44 0 and 62% in control.

Problem	:	1.22	(Research work completed in 1976)
Problem	:	1.22.1	Culture and life history of Cladocera from fish ponds
Personnel	:		D. R. Kanaujia
Duration	:		Three years

Simocephalus vetulus, *Ceriodaphnia cornuta* and *Moina micrura* were collected from ponds and reared in laboratory for studying their life cycle and culture possibilities. *Simocephalus vetulus* was observed to pass through 3-7 pre-adult and maximum of 20 adult instars depending on the media used for culture. An adult produces 543 eggs within its life span of 40 days. The maximum number of eggs in one brood was observed to be 61. The multiplication of the species was found to be maximum in pond water medium containing smaller phytoplankton. Two pre-adult and a maximum of 25 adult instars were observed in *C. cornuta* within its life span of 31 days. The adult produces 150 eggs in 24 broods and the maximum number of eggs in one brood was found to be 13. The species could be cultured successfully in media with cowdung alone or in combination with other organic and inorganic fertilisers. *Moina micrura* could also be cultured successfully in pond water medium.

Problem	:	1.23	(Research work completed in 1976)
Problem	:	1.24	(Research work completed in 1977)
Problem	:	1.25	Mass culture of phyto- and zooplankton in field to feed fish
Personnel	:		A. C. Nandy, S. K. Majumdar and R. K. Chakraborty
Duration	:		Six years

Phytoplankton culture :

Sustained growth of *Navicula cryptocephala* and *Gyrosigma angulatum* has been obtained by using urea, single superphosphate and sodium silicate (100 : 10 : 5). Maximum cell density of 1.2 and 1.5 million could be obtained from an initial inoculum of 2,462 and 2,900/ml respectively in 10 days. Large scale production of *Skeletonema costatum* could be achieved in plastic pools (250 l) by using N-P-Si in the ratio of 100 : 5 : 10 at 385 ppm. Maximum cell density (2.5 million/ml) was obtained in 10 days from an initial inoculum of 1,150/ml and the maintenance of the culture was found to be the best at 19.5‰ salinity.

Zooplankton culture :

Large scale production of *Daphnia lumholtzi* could be achieved in farm system. From an initial inoculum of 10/ l, the density could be raised to 32,000/ l in 20 days when they were cultured in the medium fertilised with poultry manure @ 280 ppm. Gravimetrically 56 g/m²/10 days could be harvested round the year.

A production of 500 mg of dried eggs/m²/10 days round the year of *Artemia salina* has been achieved.

Problem	:	1.26	(Research work completed in 1977)
Problem	:	1.27	(Research work completed in 1976)
Problem	:	1.28	(Research work could not be carried out due to technical difficulties)
Problem	:	1.29	Comparative study of the efficacy and economics of available fish poisons of plant origin
Personnel	:		S. Jena, V. Ramachandran and S. R. Ghosh
Duration	:		Three years

Data on effective dose of mohua oilcake, its effect on plankton biomass, bottom biota, etc , have been collected and are being analysed.

Jar experiments, conducted in the laboratory, indicated that tamarind husk powder when applied @ 5-10 mg/ l effectively killed *Tilapia, Cyprinus carpio, Channa marulius, Labeo rohita, Catla catla* and *Cirrhinus mrigala* within two hours of its application.

Problem	:	1.30	Fish culture in rural areas of Orissa
Personnel	:		C. Selvaraj, M. A. V. Lakshmanan and A. N. Mohanty
Duration	:		Four years

Small and marginal farmers of 3 villages of Cuttack district, who were trained in raising quality fish seed through hypophysation, could raise 88,235 fry of Indian major carps in their small ponds of 0.01-0.03 ha.

Problem	:	1.31	Use of anaesthetics in transport of carp seed
Personnel	:		S. N Datta and A. N. Mohanty
Duration	:		Four years six months

In a series of yard experiments chemical anaesthetics, amyl alcohol and tertiary amyl alcohol, at different dosages have been tried on the fry and fingerlings of catla, rohu and mrigal. The reduction in oxygen consumption, carbon-di-oxide production and excretion of nitrogenous wastes were ascertained by chemical analysis of the ambient water before and after each treatment and also by way of comparison with the control.

Problem	:	1 32	(Research work completed in 1977)
Problem	:	1.33	Studies on the detection of digestive enzyme complex of freshwater culturable food fishes
Personnel	:		B. N. Saigal, Amitabha Ghosh, and K. S. Banerjee
Duration	:		Five years

The work could not be carried out during the year as the staff of the project were engaged in other assignments.

Problem	:	1.34	Observations on cultural possibilities of fish in jute-retted pond water
Personnel	:		B. N. Saigal, Amitabha Ghosh, S. K. Saha and K. S. Banerjee
Duration	:		Four years

Observations on the physico-chemical & biological conditions of a jute-retted pond (0.24 ha) at JARI, Nilgunj were continued The temperature, pH,

DO, CO_2, alkalinity, NH_3-N, NO_2-N, NO_3-N, PO_4 and OC values ranged between 17.8° and 30.5°C ; 6 2 and 8.4 ; Nil and 4.6 ppm ; Nil and 120 ppm ; 295-600 ppm ; 0.1 and 5.4 ppm ; trace and 0.04 ppm ; 0.03 and 0.43 ppm ; 1.06 and 7 5 ppm ; and 2.6 & 52.4 respectively during January to September, 1978. Zooplankters were principally represented by *Brachionus* sp. and *Cyclops* sp., and phytoplankton by diatoms.

Problem	:	1.35	Culture of fish alongwith deep water paddy
Personnel	:		S. N. Datta, S. L. Kar, R. K. Pati and R. K. Nigam
Duration	:		Three years

Experiments are in progress in a 0.05 ha plot at Killa fish farm where two crops of paddy, *viz.*, 'Jaya' in the Ravi and 'CR 1014' in the Kharif, are grown with one crop of fish (common carp, mrigal, catla and rohu). A good crop of 'Jaya' paddy (4.5 tonnes/ha) was obtained before the transplantation of 'CR 1014' variety of paddy. The fish production was 1,200kg/ha/10 months.

Problem	:	1.36	(Research work suspended in 1978)
Problem	:	1 37	(Research work completed in 1978)
Problem	:	1.38	(Research work suspended since 1977)
Problem	:	1.39	Effect of lime on pond soils
Personnel	:		D. K Chatterjee and K. C. Pani
Duration	:		Four years

Effects of various forms of lime, *viz.*, CaO, $Ca(OH)_2$ and $CaCO_3$ were studied in the laboratory using acid soil (pH 5.6). CaO, $Ca(OH)_2$ and $CaCO_3$ were tried at three different concentrations (250, 500 and 1,000 kg/ha on equivalent CaO basis) with three replicates for each. Total alkalinity showed maximum increase (174.0 ppm) with $CaCO_3$ at 1,000 kg/ha followed by CaO and $Ca(OH)_2$ at 500 kg/ha while dissolved inorganic nitrogen showed higher

concentration at 500 kg/ha with all the three forms, the dissolved phosphate remained more or less uniform at 250 and 500 kg/ha with CaO and $Ca(OH)_2$ at the water phase after 30 days of treatment.

Problem	:	1.40	Comparative efficiency of organic manures on the fertility of pond soils
Personnel	:		D. K. Chatterjee, C. Selvaraj and K. C. Pani
Duration	:		Five years

Transformation of cowdung, poultry manure, musterd oilcake and compost *(Pistia)* were studied in the laboratory using soil with low organic matter (0.45% organic carbon). Each manure was tried at 3 concentrations of 300, 600 and 1,200 kgC/ha with three replicates for each. All the manures raised the pH and total alkalinity of water according to the increased rate of treatment. While the dissolved inorganic NH_4+NO_3-N and phosphate showed an increase with all the treatments, the increase in dissolved phosphate from 300 to 600 kg C/ha was more or less proportional.

In another laboratory experiment, the efficiency of these organic manures at 300, 600 and 1,200kg C/ha were studied using soil with medium organic matter (1.33% org. carbon). Each treatment were replicated thrice. Rohu spawn was stocked @ 20/jar and reared for 20 days. All these manures recorded higher survival at 1,200 kg C/ha, the maximum being for cowdung (45%) followed by poultry manure (36.7)%, mustard oilcake (23.3%) and compost (8.33%).

In the yard experiments, these manures were tried at higher rate (1,200kg C/ha) using the same soil type. The water qualities, *viz* , total alkalinity and dissolved inorganic NH_4+NO_3-N and phosphate showed an increase over the control. Poultry manure recorded maximum increase in dissolved phosphate (1.36 ppm) and primary production (0.361 mg C/l/hr).

Problem	:	1 41	Effect of size of stocking material on production in composite fish culture

Personnel	:	V. R. P. Sinha, R. D. Chakraborty and K. K. Sukumaran
Duration	:	Three years

Different size group of major carp fingerlings are being reared in separate ponds for stocking experimental ponds.

Problem	:	1.42	Statistical relationship between the inputs and fish production in composite fish culture
Personnel	:		M. Rout
Duration	:		Two years

Data (on inputs and production) collected from various experiments showed that profit ratio to operating cost was maximum (173%) for eastern region followed by central region (151%), southern region (86%) and western region (33%). The relative cost structures for feed to fertilizer were 9.15, 5 52, 2.89 and 2.56 for western, southern, central and eastern regions respectively. It also showed some trend of increase in cost of production with increase in water area. The ratios of average cost for feed and fertilizers to the total cost were 66.56 and 7.04% respectively. The correlation coefficient for inputs and production was 0·78. A second degree semilogarithmic curve, drawn from these two variables, gave a reasonably good fit.

Problem	:	1.43	Seasonal changes in the fat content in the flesh of Indian and exotic carps under different ecological conditions
Personnel	:		N. K. Tripathy, V. R. P. Sinha, and R. Paul Raj
Duration	:		Three years

Fat content of the flesh of Indian major carps from different parts of the body has been estimated and belly flesh was found to contain maximum fat.

During the pre-spawning phase, increased deposition of fat has been observed in the liver and gonads. Fat content was more in the gonads of the females than those of males. An inverse reletionship has been found for fat and water content in all the tissues studied. Studies are in progress on the fat-water relationship and mobilisation of fat during the gonadal cycle.

Problem	:	1.44	Studies on ecological changes in newly constructed ponds at Dhauli and their management
Personnel	:		D K. Chatterjee, V. R. P. Sinha, K. K. Sukumaran and S. Jena
Duration	:		Two years

Studies on the ecological changes of the newly constructed ponds at Dhauli with low nutrient status were carried out in six ponds (0.02 ha each). Keeping one pond as control, other ponds were treated with lime alone and in combination with nitrogen, phosphorus, nitrogen+phosophrus, and organic manure (cowdung). Water qualities of these ponds did not show much variation but plankton concentration showed a slight increase and varied from 0 6—1.8 cc/50 litres after one month of application. The experiment is in progress

Problem	:	1.45	Culture of *Mystus seenghala* and *M. aor*
Personnel	:		V. R. P. Sinha and N. G. S. Rao
Duration	:		Two years

Mystus seenghala fry (average length : 38 mm) were procured in May, 1978 and reared in plastic pools for further stocking in a scientifically prepared pond. Fish were fed with tendipedid larvae twice daily. Survival of fry in plastic pools was poor (about 15%) perhaps due to cannibalistic tendencies. At the end of $1\frac{1}{2}$ months' rearing, the fishes had grown to an average size of 76mm/2.35 g.

In July 1978, 99 surviving fingerlings were introduced in a 0.04 ha pond. One month after stocking, fishes had grown to an average size of 145 mm/50 g.

In addition to forge fishes, a mixture of ground-nut oilcake and fish meal is being provided as feed to the catfishes.

Project 2 : Induced Fish Breeding

Problem	:	2.1	(Research work completed in 1970)
Problem	:	2.2	(Research work completed in 1976)
Problem	:	2.3	(Research work completed in 1972)
Problem	:	2.4	(Research work completed in 1978)
Problem	:	2.5	(Research work completed in 1973)
Problem	:	2.7	Isolation of fish gonadotropin for hypophysation of carps in large scale
Personnel	:		V. R. P. Sinha
Duration	:		Seven years six months

Work on the amino acid composition of fish gonadotropin has been initiated in collaboration with Orissa University of Agricultural Technology. The fractions from both Indian major carps and exotic carps have already been lyopholysed and ampouled, and are available in the powder form.

Problem	:	2.8	Induced breeding of important cultivable fishes (other than carps)
Personnel	:		R. M. Bhowmick, K. H. Ibrahim, G. V. Kowtal, R. K. Jana and S. D. Gupta
Duration	:		Five years six months

One set of *Pangasius pangasius* was injected with homo-plastic pituitary extract. Though ovulation took place, fertilisation of eggs could not be obtained. Further trials will be made during the breeding season in 1978.

Problem	:	2.9	Studies on the process of maturation, ovulation and resorption of gonads in Indian major carps
Personnel	:		G. V. Kowtal, R. M. Bhowmick, R K. Jana, S. D. Gupta and K. H. Ibrahim
Duration	:		Six years

Morphology and histology of gonads of *Catla catla* at various stages of maturity were made. The immature ova observed in January were spherical, transparent and showed a large nucleus and had an average diameter of 0.18 mm. The mature ova encountered in June were fully yolked and measured 0.96 mm. They were semi-transparent and showed a clear margin.

Problem	:	2.10	Pituitary gonad relationship in a free-spawning and non-free-spawning carp
Personnel	:		H. A. Khan and V. R. P. Sinha
Duration	:		Three years

Work on the histological studies of pituitary gland and gonads of common carp, mrigal and rohu, collected from both still water and running water, is in progress.

Problem	:	2 11	Effect of hormones, vitamins and feeds on maturity of carps
Personnel	:		S. D. Gupta, H. A Khan and R. M. Bhowmick
Duration	:		Four years

Cistern experiments conducted with *Cyprinus carpio* to see the effect of vitamin E and growth hormone revealed higher values of gonadosomatic index in treated fishes than those of control. Field experiments indicated higher values of gonadosomatic index in fishes (catla & rohu) treated with vitamin A than that

of control. On hypophysation, it was observed that treated fishes (rohu and catla) released more number of eggs/kg body wt of the fish than control.

Problem	:	2.12	Activities of interrenal and chromaffin tissues during the process of maturation of gonads of Indian major carps from both still and running water
Personnel	:		R. C. Das and H. A. Khan
Duration	:		Three years

Materials (from interior kidney) were collected from *Labeo rohita* throughout the year at monthly intervals and were fixed in Bouin's fluid. These materials were processed for standardising histological techniques and stained with Azan's stain, haematoxylin and eosin and Mallory's tripple stain and the distributional pattern of the interrenal and chromaffin tissues were studied.

Problem	:	2.13	Studies on the factors responsible for multiple spawning of carps
Personnel	:		R. M. Bhowmick
Duration	:		Three years

It has been possible to breed the same specimens of major carps twice in a year in successive years. During 1978, induced bred females (1 rohu, and 3 mrigals) were released in a pond for second maturity of which two mrigals attained gonadal maturity for the second time.

Project 3 : Reservoir Fisheries

Problem	:	3 1 to 3.5	(Research work completed in 1972)
Problem	:	3.6	(Res arch work completed in 1976)
Problem	:	3.7	(Research work completed in 1970)

Problem	:	3 8	Fisheries of peninsular tanks : Introduction and propagation of cultivable species
Personnel	:		B. V. Govind; P. K. Sukumaran, S. L. Raghavan and M. F. Rahaman
Duration	:		Seven years

Puntius pulchellus brooders, both from wild sources and farm grown ones, showed differential maturity stages with reference to their sexes. The observations are being continued.

Problem	:	3.9	(Rssearch work suspended since 1976)
Problem	:	3.10	(Research wark suspended since 1973)
Problem	:	3.11	(Research work suspended since 1973)
Problem	:	3.12	(Research work completed in 1976)
Problem	:	3.13	Composite fish culture of Indian and exotic carps in tanks simulating long seasonal irrigational tanks
Personnel	:		B. V. Govind, P. K. Sukumaran, S L. Raghavan and M F Rahaman
Duration	:		One year

PHYSICO-CHEMICAL CONDITIONS : The physico-chemical conditions of water in the tanks under observation were as follows :

Physical factors	*ASC Tank* (Jan —Nov. 78)	*I. T. I. Tank* (July—Nov. 78)
Temperature (°C)	24.9—35.1	24.0—27.5
Turbidity	100—110	100—(Clear)

Chemical factors	*ASC Tank*	*I. T. I. Tank*
pH	7.3—9.25	6.9 - 9.1
DO (ppm)	5.44—13.9	5.60—9.6
Free CO_2 (ppm)	Nil—20.0	Nil—36.0
CO_2 (ppm)	Nil—16.0	Nil—24.0
HCO_3 (ppm)	108.0—180.0	68.0—188.0
Hardness (ppm)	40.0—54.0	44.0—80.0
Sp Cond ($\times 10^{-6}$ mhos)	242—260	280—302
Nitrate (ppm)	0.170—0.192	0.170—0.186
Phosphate (ppm)	Tr.—0.41	0.120—0.60
Iron (ppm)	0.06—0.10	0.072—0.82

PLANKTON : In the ASC tank, density of plankton ranged from 1,26,000 to 10,42,000 by numbers/m^3 and 1 to 8 ml/m^3 by volume, while in ITI tank plankton density ranged from 4,64,000 to 9,20,000 by numbers/m^3 and 7 to 14 ml/m^3 by volume. Maximum number of plankters were observed in September '78 in both the tanks. The phytoplankton encountered in ASC tank were Chlorophyceae, Diatomaceae, etc. while those of zooplankton were Rotifera, Cladocera and copepods. The copepods dominated in both ASC and ITI tanks followed by rotifers in the former and Cladocera in the latter.

LITTORAL AND BENTHIC ORGANISMS : In ASC tank, the density of organisms ranged from 0 to 91 u/m^2 and from 0.040 to 5.37 g/m^2 by weight. The organisms encountered were insects (*Ranatra* and *Notonecta*), fish *(Gambussia affinis)* and prawn.

In the I. T. I. tank, the density of organisms ranged from 3 to 14 units/m^2 and from 0.139 to 3.000 g/m^2 by weight. The organisms observed were insects (Dragonfly nymphs and *Ranatra)* molluses *(Lymnaea)*, fishes (young of *Channa gachua* and *Gambussia affinis*) and prawn.

FISH STOCKING AND PRODUCTIONS : With a varied stocking density of 4,095/ha of Indian and exotic carps in the second composite fish culture experiment at ASC Centre tank having a water spread of 1.25 ha during

Chemical factors	*ASC Tank*	*I. T. I. Tank*
pH	7.3—9.25	6.9 - 9.1
DO (ppm)	5.44—13.9	5.60—9.6
Free CO_2 (ppm)	Nil—20.0	Nil—36.0
CO_2 (ppm)	Nil—16.0	Nil—24.0
HCO_3 (ppm)	108.0—180.0	68.0—188.0
Hardness (ppm)	40.0—54.0	44.0—80.0
Sp Cond ($\times 10^{-6}$ mhos)	242—260	280—302
Nitrate (ppm)	0.170—0.192	0.170—0.186
Phosphate (ppm)	Tr.—0.41	0.120—0.60
Iron (ppm)	0.06—0.10	0.072—0.82

PLANKTON : In the ASC tank, density of plankton ranged from 1,26,000 to 10,42,000 by numbers/m^3 and 1 to 8 ml/m^3 by volume, while in ITI tank plankton density ranged from 4,64,000 to 9,20,000 by numbers/m^3 and 7 to 14 ml/m^3 by volume. Maximum number of plankters were observed in September '78 in both the tanks. The phytoplankton encountered in ASC tank were Chlorophyceae, Diatomaceae, etc. while those of zooplankton were Rotifera, Cladocera and copepods. The copepods dominated in both ASC and ITI tanks followed by rotifers in the former and Cladocera in the latter.

LITTORAL AND BENTHIC ORGANISMS : In ASC tank, the density of organisms ranged from 0 to 91 u/m^2 and from 0.040 to 5.37 g/m^2 by weight. The organisms encountered were insects (*Ranatra* and *Notonecta*), fish *(Gambussia affinis)* and prawn.

In the I. T. I. tank, the density of organisms ranged from 3 to 14 units/m^2 and from 0.139 to 3.000 g/m^2 by weight. The organisms observed were insects (Dragonfly nymphs and *Ranatra)* molluses *(Lymnaea)*, fishes (young of *Channa gachua* and *Gambussia affinis*) and prawn.

FISH STOCKING AND PRODUCTIONS : With a varied stocking density of 4,095/ha of Indian and exotic carps in the second composite fish culture experiment at ASC Centre tank having a water spread of 1.25 ha during

the years, a gross fish production of 1,605kg/ha/10 months was obtained. The cost of fish production in this case was only Rs. 0.51/kg.

Intensive composite fish culture experiments in the ASC tank and I.T.I. tank (0.75 ha) at Doorvaninagar with a stocking density of 5,200/ha and 4,000/ha respectively, comprising Indian and exotic carps are being continued The stocking ratio at ASC is Catla 2.2 : Rohu 2 0 : Mrigal 1.15 whereas at I. T I. tank the ratio is Catla 1.15 : Rohu 0.25 : Mrigal 0.5 : Common carp 0.5.

Problem	:	3.14	Ecology and fishery development of Gulariya reservoir
Personnel	:		A. G Jhingran, S. K. Wishard, K. P. Srivastava, S. N. Mehrotra, D. N. Singh and R. K. Dwivedi
Duration	:		Four years

HYDROLOGY : Physico-chemical aspects of Gulariya reservoir revealed minimum water temperature in January (18°C) and maximum in May (33°C). The waters showed higher clarity in March (105.0cm) which declined in August (21.0 cm), while pH ranged from 7.2—8 2. Total alkalinity was slightly higher (44.0 to 90.0 ppm) during the year as compared to the values of the previous year (24.0—80.0 ppm) and hardness ranged between 19 0 to 45 0 ppm. Calcium^{++} ion concentration varied from 17.5 to 22 0 ppm. Inorganic nutrients *viz*, nitrates and phosphates had almost similar values (0.06—0.15 ppm) as observed in the previous year while silicates showed a rising trend upto June (6.5—10.0 ppm). DO value fluctuated between 6 8—8.2 ppm. Gross and net productions ranged between 55 45—137 5 and 30.8—125 0 mg C/m^3/hr respectively whereas the community respiration values ranged between 12.5—50.0 mg C/m^3/hr. A slight overall decrease in basic production levels of water was noticed when compared to the previous year.

PLANKTON : Maximum density (0.51 ml/m^3) of plankton was observed in June and minimum (0.11 ml/m^3) in July. The numerical abundance of plankton varied from 8,546 u/l in May to 16 u/l in July as against 4,060 u/l and 476 u/l observed in the corresponding months of the previous year. Plankton abundance was at its peak when the water level was maximum during July—August.

Phytoplankton consistently dominated and the filamentous green algae, (*Hormdium* sp) constituted their main component, forming a bloom in May. Identical position was held by *Zygnema* sp. during the previous year. *Microcystis* sp. dominated the blue-greens during the period while in the corresponding period of the previous year, *Oscillatoria* sp. was the main constituent of this group followed by *Anabaena* sp. Amongst the diatoms, the most dominant plankters were *Navicula* sp., *Synedra* sp. and *Nitzschia* sp. Desmids represented by *Closterium* sp. and *Cosmarium* sp., were the least abundant as also observed in the previous year.

Zooplankton mainly comprised crustaceans, represented by *Cyclops* sp., *Diaptomus* sp., *Canthocamptus* sp , *Bosmina* sp. and *Chydorus* sp. and their composition and abundance varied considerably in different months. Rotifers were mainly represented by *Keratella* sp. and *Filinia* sp., besides frequent appearance of *Brachionus* sp. and *Trichocerca* sp. The other two genera, which appeared intermittently, were *Brachionus* sp. and *Trichocerca* sp.

MACROBENTHIC FAUNA : Macrobenthic population ranged from 396 u/m^2 in the month of July to 968 u/m^2 in March, the average population being 626 u/m^2 during this year as compared to the previous year's average of 1,634 u/m^2. The benthos were dominated by insect larvae (53.7%) followed by oligochaetes (38.5%) and gastropods (7 8%) Amongst the insect larvae, chironnmids alone contributed about 65 5%.

BREEDING OF MAJOR CARPS : With the onset of monsoons in the last week of June, the water level in the reservoir rose on 22nd July. Congregation of brood fish (Indian major carps) was observed in Koilha nullah. Subsequently intermittent showers also caused a rise in reservoir water level by about 3m. With the help of cotton hapas, dragged in the shallow marginal areas above the spillway, a total of 8,000 eggs comprising 17 0% of major carps and 83% of minor carps were collected. Later, when the reservoir water spilled over the waste weir, a total of 2,400 nos. of fry of major carps alongwith 10,000 fry of minor carps were collected with the help of $\frac{1}{8}$" meshed Midnapore type shooting nets operated in the spill channels. Major carp fry thus collected were reared and released back in the reservoir.

ESCAPEMENT : Heavy escapement of major carp fry, fingerlings and yearlings was observed through the irrigation canal and the waste weir. About

2,000 fingerlings/yearlings salvaged from these areas were released back in the reservoir.

STOCKING : The reservoir was stocked with 75,801 major carp fingerlings reared from the spawn of river Yamuna and a consignment of 75,000 fry received from the Fish Seed Syndicate. About 5% of the stocked fingerlings ware finclipped for detailed biological studies.

COMMERCIAL FISHING : Commercial fishing in the reservior commenced from 30th of May, 1978. During a period of 17 fishing days, 587.600 kg of fish was captured with the help of multi-meshed nylon gill nets, operated by the fishing parties. The catch comprised major carps (70.07%), minor carps (19.3%), catfishes (8.76%), murrels (1.38%) and freshwater eels (0.44%).

Species-wise landing of major carps showed maximum dominance of *L rohita* (271 600 kg. 46.23%) followed by *C mrigala* (79.10 kg, 13.46%), *C. catla* (34 20 kg, 5.82%) and *L. calbasu* (26.80 kg, 4.56%). Minor carps ware mainly represented by *P. sarana* (108.00 kg, 18.38%), followed by *L. bata* (3.400 kg, 0.58%), *L. pangusia* (0.500 kg, 0.08%) and *C. reba* (1.800 kg,0.31%) Catfishes were dominated by *M seenghala* (37.300 kg, 6.34%) followed by *W attu* (13.500 kg, 2.30%) and *Ompok* spp. (0,700 kg,0.12%).

Due to large waterspread area and sudden flooding of the reservoir in the month of June, drag net and trap operrtions proved ineffective and the fishing subsequently was suspended.

Project 4 : Riverine Carp Spawn Prospecting and Collection Techniques

Problem	:	4.1	(The work is being done under a Co-ordinated Project)
Problem	:	4.2	(The work is being done under a Co-ordinated Project)
Problem	:	4.3	(Research work suspended since 1972)
Problem	:	4.4	(Research work completed in 1973)

Problem	:	4.5	Yearly variation in the quality and quantity of spawn in rivers Ganga and Yamuna
Personnel	:		K. P. Srivastava, R. K. Dwivedi, N. K. Srivatava, Shree Prakash and D. P. Varma
Duration	:		Three years

Spawn prospecting investigations were conducted at Madhauka centre on River Yamuna during 6th July to 1st September, 1978.

The river experienced three floods during the period of observation, touching the peak levels of 2.69, 8.62 and 5.97 metres above the summer level on 14th July, and 14th and 28th of August respectivrly. Due to erratic monsoon, slow rate of flooding in July and early August followed by abrupt rise in water level in late August was experienced resulting in significant y poor spawn yield (2,365 ml) at the centre as compared to that recorde c in the preceeding year (13,010 ml). The spawn was mostly available in the receding phases of the first and third floods, and rising phase of the second flood. The entire spawn (C. 11,82,500 nos. of hatchlings) was collected in four spurts; the first, second, third and fourth spurts contributing 53 ml (2.24%), 807 ml (34.12%), 577 ml (24 40%) and 928 ml (39.24%) respectively. An additional quantity of 110 ml of spawn (C. 55,000 nos. of hatchlings) was also collected by operating 2-3 additional nets at the site during the availability period, taking the centre's total catch to 2,475 ml (C. 12,37,500 nos. of hatchlings).

Microscopical analysis of the spawn collected revealed 12.6%, 30 2%, 38 3% and 65 8% of major carps in the first, second, third and fourth spurt respectively. Spawn of different spurts was reared in glass jars and the percentage of major carps in the samples drawn from such rearings showed the major carps to be 12.3, 32.7, 33.3 and 41.4 in respective spurts. The overall average percentage of maior carps, on the basis of samples drawn from the jail nursery Naini, where the spawn of all the spurts had been released, was estimated to be 76. The indices of quantity and quality were estimated to be 373.4ml and 76% respectively as against 2,402 0 ml and 83.0% in 1977.

Project 5 : Brackishwater Fish Farming

Problem	:	5.1	(Research work completed in 1975)
Problem	:	5.2	(Research work completed in 1973)

Problem :	5.3	(Work programme transferred to Brackish-water Expermental Fish Farm Unit, Kakdwip)
Problem :	5.4 to 5.6	(Research work completed in 1972)
Problem :	5.7	(Research work completed in 1973)
Problem :	5.8	(Research work completed in 1975)
Problem :	5 9	(Research work completed in 1973)
Problem :	5.10	(Research work completed in 1975)
Problem :	5.11	(Research work completed in 1974)
Problem :	5.12	(Research work suspended since 1976)
Problem :	5.13	(Research work completed in 1975)
Prablem :	5.14 to 5.16	(Research work completed in 1975)
Problem :	5.17	Brackishwater shell fish culture in Madras region
Personnel :		K Raman, K. V Ramakrishna, Munawar Sultana, S. Srinivasagam, P. M. Abdul Kadir and S. Krishnan
Duration :		three years

P. monodon reared in a nursery pond showed an average growth increment of 87.5 mm/12.3 gm in $5\frac{1}{2}$ months with a survival of 46.8%.

In another experiment, *P. indicus* stocked @ 12,000/ha and fed with fish meal + rice bran + starch (2:2:1) @ 10% body weight registered a growth increment of 73.68 mm/21.67 g in $2\frac{1}{2}$ months.

P. monodon, P. indicus and M. dobsoni reared in the plastic pool with provision of pelleted feed (Fish meal + rice bran + starch alongwith vitamin B Complex) showed average growth increments of 6.5 mm/0 5 g, 3.5 mm/0 3 g, and 7.0 mm/0.4 g respectively in 35 days.

Another yard experiment was set up in cement cisterns (1.16 sq. m) with *P. indicus* (40—44.6 mm/0.3—0.58 gm) using four artificial feed mixtures *viz.*, i) fish meal + rice bran + starch, ii) prawn head powder + brack gram

husk + ground-nut oilcake + tapioca, iii) wheat bran + ragi + tapioca, and iv) wheat flour + Bengal gram husk + gingoly oilcake. In this experiment, the first feed proved to be the best. It registered a growth increment of 19.8 mm/1.43 g in a period of 60 days whereas in the control with provision of rice bran as feed, the growth increment recorded was only 0.1 mm/0.09 g.

Experiments conducted on the stocking densities of *S. serrata* and *P. pelagicus* revealed that the growth was comparatively poor at higher stocking densities. *S. serrata* recorded an average monthly growth of 8.75 mm/10.1 g at the stocking density of 1/tub as against 6 67/mm/4.3 g in 3/tub stocking density. The corresponding figures for *P. pelagicus* were 11.83 mm/3.77 g and 9-8 mm/4.3 g respectively.

Laboratory experiments were conducted to study the effect of 3 feeds, *viz.*; i) animal matter, ii) animal matter + vegetable matter, and iii) vegetable matter alone on *S. serrata*. The animal matter gave a monthly growth of 9 mm/ 7.3 g as against 6.4 mm/4.1 g with animal matter + vegetable matter, and 5.8 mm/3.8 g with vegetable matter.

Problem	: 5.18	Culture of edible oysters in Pulicat Lake
Personnel	:	K. V. Ramakrishna
Duration	:	Five years

Taking the height of oysters as an index of growth, June to September was found to be the period of fast growth for the adults while for the spat it was from March to June. Two peaks of spat fall were noticed, one during October-November (intensive) and the other during February-March (moderate)

The proper period for transferring the spat from asbestos sheets to trays could be identified, the period being 3-5 months after the spat fall.

Prawns and crabs were found to take shelter in oyster boxes/trays indicating the possibility of culturing oyster, perches, catfishes and prawns together in boxes/trays.

Oysters were made to spawn artificially in the laboratory and the fertilised eggs reared upto morula stage.

Problem	: 5.19	(Work programme transferred to Problem 5.76)
Problem	: 5.20	(Research work completed in 1976)
Problem	: 5.21	(Research work completed in 1977)
Problem	: 5.22	Rearing of fry of brackishwater fishes
Personnel	:	R. D. Prasadam, K Raman, K. V. Ramakrishna, G. R. M. Rao, C. P. Rangaswamy, M. Kaliyamurthy, S. Srinivasagam and Munawar Sultana
Duration	:	Five years

Mullet fry (av. size : 20 mm/80 mg) reared without artificial feeding in a pond attained 51 mm/1.75 g in 78 days

M. cephalus stocked @ 12,000/ha and fed with ground-nut oilcake + rice bran exhibited a monthly growth increment of 17 6 mm/0.7 g and 23.5 mm/1.4 g. With ground-nut oilcake + wheat bran, growth increment was 2 4 mm/0 6 g with 90% survival in pond and 5 0 mm/1.2 g with 100% survival in enclosure. Fingerlings of *L. macrolepis* reared with natural food alone gave monthly increment of 7 2 mm/1 4g (100% survival) in pond whereas in the enclosure, the monthly increment was 6 4 mm/0.8 g (72 7% survival).

Chanos reared in the 0.01 ha pond at Adyar with ground-nut oilcake and rice bran as food showed an increment of 42.4 mm/11.23 g in 3 months, the rate of survival being 76.5%.

Growth rates of some percoid fish fry in the yard experiments were : *Etroplus suratensis* 3 3 to 5 9 mm/month ; *Gerres* spp. 8.9 to 14 mm/ month; *S. sihama* 2.1 to 9.5 mm/month ; and *Siganus oramin* 11.2 mm/month.

Gerres filamentosus gave 6.6 mm/month growth when grown in a brackishwater pond.

Mystus gulio, reared in a 0.01 ha pond at Adyar, registered growth increment of 80.9 mm/19.7 g in 10 months (approximate).

Experiment on the food preferences of *Plotosus canius* shows that tubificid worms are readily accepted.

Experiments were successfully conducted on the artificial fertilisation of eggs of *Mystus gulio* by stripping. The fertilised eggs showed the development upto 16 celled stage.

A total of 313 specimens of *Hemirhamphus gaimardii* ranging in size from 65 to 201 mm were studied for gut content analysis. Composition of food by volume was found to be as diatoms (0.01%), filamentous algae (2.09%), plant matter (92.82%), rotifers (0.01%), cladocerans (0.01%), copepods (0.27%), amphipods (0.53%), crustacean remains (0.39%), insect remains (1.42%), molluscs (0.01%) and miscellaneous (2.44%). The sex ratio (male : female) was 42 : 58. The ova diameter range observed was 3.1 m.d. to 65.25 m.d.

Under the programme of mixed culture of chanos, mullets and prawns, the experiment on multiple stocking and single harvesting was completed. The total yield from the experiment was 821.0 kg/12 months/ha. The percentages of survival were chanos 43.7, mullets 78.8, and prawns 17.3. Experiment on multiple stocking and multiple hervesting was initiated.

Problem	:	5.23	(Research work merged with Problem 1.25)
Problem	:	5.24	(Work programme transferred to Problem 5.23)
Problem	:	5.24(a)	(Work transferred to Freshwater Aquaculture Division & new number is given as 1.47)
Problem	:	5.25	(Research work suspended since 1977)
Problem	:	5.26	(Research work completed in 1977)
Problem	:	5.27	(Research work suspended in 1978)
Problem	:	5.28	Behaviour of lake mouth bar and its bearing on the fishery of lake Pulicat
Personnel	:		K. Raman, K.V. Ramkrishna, S. Radhakrishnan, K.O. Joseph, S. Srinivasagam and P. M. Abdul Kadir
Duration	:		Four years

The bar-mouth remained open throughout the year. The highest catch was recorded in April (121.133 t) and the lowest in March (61.128 t). The highest landings from southern sector was observed in April (96.308 t) and that from the northern sector in June (46.365 t). The respective lowest figures were in August (36.486 t) and March (24.067 t).

Prawn formed the major constituent in the whole lake as well as in southern sector. Mullets topped the list of northern sector. The other groups in order of abundance in whole lake were mullets, clupeids, perches, carbs, Beloniformes and catfishes.

Problem	:	5.29	(Research work completed in 1977)
Problem	:	5 30	(Research work suspended in 1978)
Problem	:	5 31	Studies on the macrophytic flora in Lake Pulicat with special reference to their utilisation as organic manure and artificial feed for fish
Personnel	:		S. Radhakrishnan
Duratien	:		Three years six months

During the period, the biomass of *Cymodocea* sp , *Halophila* sp and filamentious algae in the lake ranged from 0.025 to 0.425 kg/m^2, 0.025 to 0.5 kg/m^2 and 0.025 to 0 575 kg/m^2 respectively. The salient water qualities like water transparency, temperature, dissolved oxygen and salinity in the vicinity of plant beds varied from 11 0 to 47 0 cm, 27.5 to 34 0 C, 6 0 to 12.0 ppm, and 6.0 to 52.0 ppt respectively. Periphyton on artificial substrata consisted mostly of diatoms and blue green forms and their density on glass panels ranged from 14,520-58,080 u/cm^2, plastic 12,100-67,760 u/cm^2, asbestos 21,780-96,800 u/cm^2 and on wooden panels from 29,040-1,16,160 u/cm^2.

Attempts to culture *Hypnea* sp. in the lake were made during the period. Fragments of *Hypnea* sp. inserted into coir rope and those kept in nylon bags soil substratum showed no appreciable growth in the lake water.

Problem	:	5.32	(Research work merged with Problem 5.17)
Problem	:	5.33	(Research work suspended in 1978)
Problem	:	5.34	Stock manipulation in polyculture of Indian and exotic carps, mullets, chanos and prawns in low saline and saline ponds in Bakkhali farm
Personnel	:		S. M. Pillai, D. D. Halder (from 9-6-78), T. Rajyalakshmi, (upto 21-8 78), P.K. Chakrabarti (from 57-10-78), P. K. Ghosh and A. K. Roy.
Duration	:		Two years six months

A 0.25 ha pond was stocked with *C. catla, L. rohita, C. mrigala, H. molitrix, M. cephalus, L tade, L. parsia, C. chanos* and *P monodon* @ 5,300 nos/ha, at different times during the year. The major carps fingerlings were stocked in October '77 and silver carp in January '78 under signle stocking programme, whereas the brackishwater fishes and prawns were stocked during October '77 to February '78 under repeated stocking and harvesting pattern. The average length and weight of the fishes and prawns at the time of stocking were : Catla 116 8 mm/ 17.2 g; rohu 136 0 mm/23.8 g; mrigal 117 8 mm/9 0 g; silver carp 115 3 mm/ 13.8 g; *M. cephalus* 135.5 mm/23.2 g; *L. tade* 69.0 mm/8 0 g; *L. parsia* 101.7 mm/ 9.0 g; *C. chanos* 163.8 mm/40.9 g ; and *P. monodon* 77.9 mm/4.3 g.

The average sizes attained in October '78 were : Catla 323.5 mm/494.0 g; rohu 258 6 mm/194.2 g; mrigal 437.6 mm/828.0 g, silver carp 272.8 mm/167.8g; *M. cephalus* 362 8 mm 514.4 g ; *L. tade* 233.4 mm/119 6 g ; *L. parsia* 163.9 mm/ 34.9 g; *C. chanos* 333.5 mm/265 0 g, and *P. monodon* 208.9 mm/71.1 g.

An overall net production of 1,306.936 kg/ha/yr was obtained with a survival rate of 64 36%.

The concentration of phyto- and zooplankton ranged from 150 to 300 units/l of water and 950 to 1,850 units/l of water respectively. *Anabaena, Nitzschia. Spirulina, Ankistrodesmus, Chlorella, Gyrosigma* among the phytoplankton and *Brachionus*. Calanoid and cycloid copepods, nauplius larvae, *Moina* among the zoo-

plankton were the common forms. The pH, D. O and salinity of the pond water ranged from 8. 0-9.0, 6.0-9 6 ppm and 0.72 to 2.55 ppt respectively.

Problem	:	5.35	(Research work merged with Problem 5.37)
Problem	:	5.36	(Research work merged with Problem 5.41)
Problem	:	5.37	Crop rotation under mixed prawn-cum-fish culture
Personnel	:		P. U. Verghese, T. Rajyalakshmi, (upto 20-8-78), N. K. Das, P. Ravichandran, P. K. Ghosh, N M. Chakraborty, A. K. Roy and D. D. Halder (from 9-6-78).
Duration	:		Three years

Mixed culture of brackishwater prawns : In short term (80-90 days) rearing experiment of the brackishwater prawns, *Penaeus indicus* (15-33 mm), *Palaemon styliferus* (23-29 mm), *Penaeus monodon* (80-90 mm), *Metapenaeus monoceros* (10-15 mm) and *Metapenaeus brevicornis* (21-22 mm), production from 4 crops/ year ranging from 803.5-1185.0 kg ha and 350 0 - 725.0 kg/ha with 2 lakh/ha and 4 lakh/ha stocking density respectively were achieved. The growth of prawns observed in 90 days culture period at 2 lakh/ha stocking density ranged from 86.4 mm/5 8 g-97.3 mm/7.0 g for *P. indicus*, 68 3 mm/2.5 g - 72·0 mm/3.2 g for *P. styliferus*, 132.0 mm/20.0 g-175.2 mm/60 0 g for *P. monodon*, 88.4 mm/5 g-100.0 mm/7.0 g for *M monoceros*, and 77.2 mm/4.0 g-86.2 mm/5.0 g for *M. brevicornis* and with 4 lakh/ha stocking density in the corresponding period, the observed growth of the above prawns ranged from 86 0 mm 5.0 g-115 1 mm 8 0 g ; 69.5 mm/3.0 g-73.5 mm/4.0 g ; 150.6 mm/25 0 g-160.1 mm/41 6 g ; 97.5 mm/5.0 g-99 0 mm 7.0 g, and 70.7 mm/3.1 g-73 1 mm/4 0 g respectively.

The bottom fauna available in the ponds were gammarids (160.95-790 25 nos/m^2), Tanaids (110.20-3 460.10 nos/m^2) and polychaetes (108.20-393 25 nos/m^2). The salinity range of the pond water during the experiment was traces to 18.44 ppt.

Crop rotation under prawn-cum-fish culture : Culture experiments in 0 02 ha ponds were continued during the year under report with the objective of raising 3 crops per year. Eleven such short term rearing experiments were completed, of which 3 were polyculture of prawn (*P. monodon*) and fish (*Liza tade*), one crop of mixed culture of *P. monodon* and *Metapenaeus monoceros* and seven were monoculture of *P. monodon*. In polyculture of *P. monodon* and *L. tade*, total production ranging from 941.1 kg to 1,274 55 kg/ha/yr in three crops were obtained in which the prawn alone contributed 463 6 to 1,174.3 kg. Mixed culture of *P. monodon* and *M. monoceros* yielded a production of 742.12 kg/ha/yr in 3 crops whereas the production realised from monoculture of *P. monodon* was 486.35 kg/ha 233 days in 2 crops. Growth rate of the prawns showed wide variation in relation to the change in the salinity of the water. *P. monodon* showed better growth during February to April, during which period the estimated growth rate was 42.0 mm/12.0 g per month.

Polyculture of Chanos chanos and Penaeus monodon : Polyculture of *C. chanos* and *P. monodon* at stocking densities 1,800 and 1,600 nos /ha respectively, were initiated in a 0 06 ha pond Two size groups of milkfish attained average size of 362·0 mm/291.6 g and 283.5 mm/191.4 g from an initial size of 219 mm/78.5g and 182.6 mm/51.6 g respectively at the end of 300 days First batch of prawns stocked at the size of 119.4 mm/15.8 g attained 174.6 mm/54.6 g in 80 days with 73% survival and the second batch of average size 16.5 mm stocked @ 32 000/ha have attained average size of 119 4 mm/15.6 g in 6 months. The estimated production recorded at the end of 300 days of culture was prawn 270.0 kg/ha, and 376.76 kg/ha being the standing crop of *Chanos chanos*.

The ponds were fertilised with 2,000 kg/ha/yr of poultry manure, and 240 kg/ha/yr each of superphosphate and urea provided as fertilisers. Supplementary feeding with maize powder and rice bran (1:1) was done at the rate of 3% of total body weight of milkfish stock.

Physico-chemical parameters recorded at fortnightly intervals were : salinity 1.47 - 18.44 ppt; D. O 7 2-10 8 ppm; pH 8 2 - 9 0 and alkalinity 70 0 - 124 ppm.

Problem : 5 38 Stock manipulation in selective culture of *Lates calcarifer*

Personnel : P. U. Verghese, A. Sengupta, N. K. Das, M. K. Mukhopadhyay, H. C. Karmakar, D.D. Halder (from 9.6 78) and P. K Chakrabarti (from 5.10.78)

Duration : Three years

Seed Collection : A total of 645 nos. of early post larvae (4-5 mm) of *L. calcarifer* were segregated from the shooting net collections from last week of April to June in the estuary of Kakdwip. Thereafter the larvae were not available from the shooting nets. About 700 nos. of early juveniles (10-50 mm) were collected from intertidal pits till the end of August.

Nursery Rearing ; Bhetki larvae (4-5 mm) reared in plastic pools attained size of 20-25 mm in 15 to 20 days. Rotifers and copepods collected from ponds were given as food at this stage Later the fry were transferred ton ursery ponds. Nursery rearing experiments were conducted in 4 ponds of 0.02 ha each at stock ing densities of 5000, 7500, 10,000 and 15,000 nos ha. Best result was observed in closed pond with provision of manuring to encourage the growth of zooplankton especially the mysid, *Mesopodopsis orientalis* that formed food of young bhetki. In a period 60 days, fry (20-25 mm attained average size of 96 0 mm/ 12 95 g at stocking density of 10,000/ha with 90% survival. In 3 ponds with regular flushing of tide water through sluice gates guarded by bamboo screens, the survival observed was only 15 to 40%

Culture Experiments in Feeder Canal : Bhetki juveniles measuring on average 257.01 mm/ 213.85 g were stocked @ 2,000/ha in the main feeder canal with water spread of 0 12 ha. Fish and prawn seed regularly entering the canal while taking tide water into the farm formed the food of growing bhetki. Selective harvesting of specimens above 400 g and re-stocking with smaller ones to maintain constant stocking density were done. So far 500 kg of fish ha has been harvested and the production per year based on the standing corp is estimated to be 3200 kg ha.

Problem : 5.39 (Research work merged with Problem 5.37)

Problem : 5.40 Stock manipulation in intensive farming for mullets and chanos in association with penaeid prawn

Personnel : N. K. Das, D. D. Halder (from 9.4.78), Kuldip Singh (from 19.9.78), T. Rajyalakshmi (upto 21.8.78), H. C. Karmakar, N. M. Chakrabarti and A K. Roy

Duration : Five years

Culture of mullets, chanos and prawns : Mixed culture of mullets (*Liza parsia* and *Liza tade*), milkfish (*Chanos chanos*) and prawn (*Penaeus monodon*) in the ratio of 9 fish : 1 prawn was conducted in a 0.08 ha pond at a stocking density of 10,000/ha. The size of fish and prawn at the time of stocking was *L. tade* 143.2 mm/30.79-247.2 mm/138.4 g, *L. parsia* 95.4 mm/9.0 g (av.) *C. chanos* 168.4 mm/31.4 g (av.) and *P. monodon* 117.7 mm/8.76 g. The total production achieved during the year was 2.5 tons/ha. Fishes were fed with maize powder @ 2% of the body weight of the stocked population. During periodic sampling, *L. tade* and *Chanos* weighing about 300 g and *L parsia* of 28 g size were harvested. *P. monodon* harvested at the end of 6 months measured on average 164.4mm/41.6g. In six months bigger size group of *L. tade* attained the size of 286.0 mm/299.4 g and harvested. In the next 6 months, (*i.e.*, in 12 months) the smaller specimens also attained the size of 295.0 mm/300.5 g and harvested. *L. parsia* attained the harvestable size of 130.5/mm/27.85 g in 6 months time and harvested. Thus two crops of *L. parsia* and *L. tade* could be raised. *Chanos chanos* attained the size 334.2 mm/272.0 g and *P. monodon* 164.4 mm/41.6 g in 6 months and harvested. *P. monodon* post-larvae restocked again attained the size of 130 mm/23.0 g and harvested.

Nursery rearing of Liza parsia : Four nursery ponds (0.02 ha each) were prepared by dewatering, sundrying and manuring with poultry manure @ 1,000 kg/ha/yr in 12 instalments and stocked with *L. parsia* fry at different stocking densities of 1,00,000; 1,50,000; 2,00,000; and 3,00,000 nos./ha respectively. The fry were reared for 40 days without supplementary feeding and the respective av. size attained were; 47 36 mm (av. initial size 12.90 mm), 51.22 mm (av. initial size 23.13 mm), 50 34 mm (av. initial size 23.31 mm) and 45.18 mm (av. initial size 15.10 mm) with survival of 60%, 64 0%, 72.8% and 58.0% respectively. In another rearing experiment, *L. parsia* fry (av. size 19.0 mm) stocked 1,50,000 nos /ha and with provision of artificial feeding with a mixture of rice bran + Maize powder (1:1) @ 6% of the body weight, attained an av. size of 61.11 mm/2.99 g in 115 days with a survival rate of 97.3%.

Nursery rearing of L. tade : Three different artificial feeds, *viz.* fish meal+rice bran (1:5), rice bran+wheat flour (1:1) and mustard oilcake+wheat flour (1.1) were tested for their efficacy in culture of *L. tade* in terms of growth, survival and production over aperiod of 210 days. Four ponds of 0.2 ha area were fertilised with urea+superphosphate @ 75 kg/ha/month and stocked with *L. tade* fingerlings @ 8.750/ha. The artificial feed was given at the rate of 5% of body weight in three ponds and the control pond was maintained without any feed. Maximum production of 837.9 kg/ha/210 days with 97.71% survival was achieved with wheat flour+rice bran followed by fishmeal+rice bran and mustard oilcake+wheat flour where production and survival rate of 479.45/kg/ha and 49.14% and 447.3 kg/ha and 53.14% respectively were recorded.

A 3×3 factorial experiment on the principle of randomised complete block design was conducted in the laboratory for 21 days with 3 levels of aeration (1,4 and 8 hours/day) and 3 levels of rearing density (1,2 & 3 no/l) to study the effect of aeration and rearing density on growth and survival of *L. tade* fry. Fish meal @ 5% of body weight of fry was given every day. Maximum weight increment of 151.66 mg was obtained with aeration for 8 hrs/day and maximum weight increment of 199.43 mg was achieved with rearing density 1 no/l. The fitted linear relationship between weight increment 'W' aeration 'A' is $W = 130.36 A + 85$. The fitted linear between weight increment and rearing density 'D' is $W = 130.36 - 67.4D$, where 'W' is estimated weight increment in mg.

In a similar statistically designed experiment to test the efficiency of different *viz.*, feeds and feed mixtures Fish meal, Fish meal+Rice bran (1:1), Rice bran, Mustard oilcake+Rice bran and natural food on growth and survival of *L. tade* fry (15-18 mm 60-100 mg), the best growth 209mg/21 days was achieved with fish meal alone whereas the best survival (100%) was recorded with plankton and rice bran. In another laboratory experiment to find out the optimum feeding rate of *L. tade* fry (14-16 mm/40-50 mg size) on fish meal, optimum growth of20.8 mm/175 mg was recorded when fed @ 10%of body weight of fry.

Problem : 5.41 Development of devices for large scale collection, segregation and rearing of brackishwater fish and prawn fry for stocking in intensive culture

Personnel : P. Ravichandran, T. Rajyalakshmi, (upto 21.8.78). P. U. Verghese, H. C. Karmakar, M. K. Mukhopadhyay and P. K. Ghosh

Duration : Three years

Collection of brackishwater prawn and fish seed were continued and a total of 5, 26, 786 nos. of commercially important species of prawn and fish seed have been collected spending 238.25 man-hour. Species-wise catch (nos.)/ man-hour in different months were as follows : (on next page)

Comparative study of three consecutive hourly collections in a tide was carried out during January to July and statistical analysis of the result showed that in a tide the first hour collection was found best and differed significantly from others.

During the year, a total number af 1,02,422 postlarvae of *Penaeus monodon* were segregated from shooting net spending 190 man-hour. The peak season was April (1,245.6 nos./man-hour) and May (641 5 nos./man-hour) which is in confirmity with the observations of last two years.

Best collection ground for *P. monodon* postlarvae was discovered. The collection ground is one kilometer away from Kakdwip Research Centre with an average collection of 464.7 nos./man-hour.

Lates calcarifer larvae (4.5-6 mm) appeared in the shooting net in full-moon phase of April and they were available upto June. A total number of 645 *L. calcarifer* fry were collected by shooting net whereas 455 fry were collected from intertidal pits by scoop net.

Problem : 5.42 Supplementary feed for brackishwater fishes and prawns

Personnel : Hardayal Singh, S. C. Banerjee, B. B. Pakrasi and P. K. Mukherjee

Duration : Two years

Experiments were conducted to evolve a cheap and nutritionally balanced artificial feed for brackishwater fish and prawn. Main ingredients used were

Species	Catch (nos.)/man-hour										
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
P. indicus	2,485.5	3,853.4	4,429.8	354.6	413.2	31.6	55.3	109.2	13.3	-	15.5
P. monodon	21.2	28.2	10.4	1227.5	940.0	220.7	139.2	360.2	12.4	2.9	10.8
M. brevicornis	9.5	37.1	58.3	93.0	86.5	22 9	50.8	146 9	92.5	28.5	5.0
L. parsia	20.7	13.8	45.4	1.4	32.4	2.5	-	-	-	-	-
L. tade	-	-	-	-	-	-	0.8	-	2.2	1.4	0.2
E. tetradactylum	-	-	0.7	6.3	546.1	13.8	1.6	46.5	15.3	4.9	-

fish meal, prawn powder, goat intestine, buffalo intestine, wheat flour, algal powder and yeast. A growth rate of 12-14 mm/month was exhibited by early juveniles (25-30 mm) of *P. monodon* fed upon a feed containing prawn powder as protein (45.2%) source. Water salinity and temperature were 7-9 ppt and 29°-32.5°C respectively.

Baffalo gut, procured from the slaughter house, cleaned, boiled and powdered after drying to get a fine powder containing 78.2% protein, is being tried.

Problem	:	5.43	(Research work merged with Problem 20.3)
Problem	:	5.44	(Research work completed in 1977)
Problem	:	5.45	(Research work completed in 1977)
Problem	:	5.46	(Research work merged with Problem 5.47)
Problem	:	5 47	Utilisation of industrial, agricultural and municipal wastes in aquaculture
Personnel	:		R. K. Banerjee, B. B. Pakrasi, S. C. Banerjee N. N. Majumder and S. K. Chatterjee
Duration	:		Four years

Straw and water hyacinth were treated seperately and in combination with microbes (*Aspergillus* sp) for a period of three months. The C/N ratio after 90 days of the combined compost was 10.8 and with straw compost 18.7 as against the control 31.0.

The mineralisation rate of cotton seed waste and mahua oilcake were studied both under high and low temperature in fresh and saline water. Temperature, accelerates the rate of mineralisation. In 30 days, under high temperature, 13% of the nitrogen in mohua oilcake transformed 3.5% of the organic nitrogen.

Cattle dung with an initial protein content of 2 1% was sterilised and treated with yeast and molybdenum followed by *Azotobacter*. After 15 days, the protein content increased to 12%. Rotton potato on the same treatment gave a protein content of 13.5%.

Problem	:	5.48	(Research work suspend in 1978)
Problem	:	5.49	(Research work suspended in 1978)
Problem	:	5.50	Location, collection, assessment of resources, acclimatisation and transport of brackishwater fish and prawn seed
Personnel	:		G. R. M. Rao, K. Raman, K. V. Ramakrishna, R. D. Prasadam, S. Radhakrishnan, C. P. Rangaswamy, M. Kaliyamurthy, S. Srinivasagam, M. Sultana, (Smt) and K. O. Joseph
Duration	:		Three years

Recruitment of fish and prawns in Pullicat Lake was very poor during the year under report. Velon drag net and *Kondavalai* collections were made from Pulicat, Ennore, Adyar, Kovalam and Ramapuram to study the availability of fry and fingerlings. Mullets, cat fishes, perches and prawns were transported from Ennore and Kovalam with mortality rates ranging from nil to 30.43%.

Kovalam was found to be the best seed collection centre as far as chanos, mullets and perches are concerned and Pulicat for prawns and mullets.

Problem	:	5.51	Studies on the ecology of commercial brackishwater bheris of variant productivity
Personnel	:		B. B. Pakrasi and N. N. Majumdar
Duration	:		Three years

Hydrobiological conditions of 4 brackishwater impoundments, 3 of lower salinity (northern zone) and one of higher salinity (southern zone) of the Hooghly-Matlah estuarine system, were studied till August, 1978. Subsequently, the work was continued only in the bheri at Taldi. The estimated fish production of the northern zone indicated it to be more productive than the southern zone. The soluble phosphate seems to be a decisive factor for the higher yield in low salinity waters. Further, the supernatent municipal effluent seems to be the other factor influencing the productivity. The pond soils receiving municipal effluents are having higher nitrogen and phosphorus content than those in which municipal effluents are not added.

Problem	**:**	**5.52**	**Rationalisation of frequency of fertilisation of fish ponds**
Personnel	**:**		**G. N. Saha, S. C. Thakurta, A. C. Banerjee and N. N. Sarkar**
Duration	**:**		**Four years**

Results of laboratory study on determining optimum frequency of fertilisation of fish pond using chemical fertilissrs (urea and single superphosphate) indicated that fertilisation at shorter intervals is more effective than longer intervals in maintaining higher concentration of nutrients in water phase.

Of the various intervals tried i.e., 8, 7, 14, 30 and 60 days, fertilisation after every 3 days gave maximum concentration of nutrients, *viz.*; phosphate 0.79 ppm and nitrogen ($NH_4 + NO_3$-N) 0,68 ppm, in water.

Problem	**:**	**5.53**	**Estimation of total biomass in enclosed brackishwater ecosystem**
Personnel	**:**		**Babulal, B. B. Pakrasi, S. B. Saha and G. N. Saha**
Duration	**:**		**Two years**

Quantity of bottam biots in terms of ash content varied from 125.50 to 188.85 mg/m^2 at a salinity range of 7.1 to 21.37%. Total plankton content in water column varied from 1.002 to 1.55 mg/l at a salinity range of 17.00 to 18.75%.

Dominant species among phytoplankton were *Oscillatoria* sp., *Lyngbya* sp. *Spirulina* sp. and *Spirogyra* sp., *Synedra* sp., *Nitzschia*., *Pleurosigma* sp., *Biddulphia* sp. and *Coscinodiscus* sp, ranging between 33 to 426 units/1. Zooplankton ranged from 3-96 units per litre.

Among benthos, the dominant species were tubifedid worms, gastropods (live & dead) and Chironomids.

Problem	**:**	**5.54**	**Survey of nutrient status of soils of intertidal regions of lower Sunderbans**

Personnel	:		G. N. Chattopadhyay and P. R. Das
Duration	:		Three years

Soil samples were collected from different intertidal points of Contai coast and Sagar island under different inundation conditions and were consequently analysed for different physico-chemical properties to know the nutrient status of these soils.

Problem	:	5.55	Transformation and fate of applied nitrogenous and phosphatic fertilisers in saline soils of brackishwater farms
Personnel	:		Arabindra Sen and A. C. Nandy
Duration	:		Two years

Soil samples collected from Taldi fish farm containing low salinity (5 ppt) were sterilised before setting up the experiment in JARI, Barrackpore. All possible physico-chemical analysis of soil was done prior to application of common salt to change the salinity of water (Soil : water : 1:4) at 10,20 and 30 ppt respectively. Salinity was brought according to above levels by equalibriating for more than one month.

Mass culture of unicellular algae *viz., Chlorella* sp., *Niviculo* sp. and *Nitzschia* sp. is done in water by frequent addition of Bristol solution minus P. To observe the change of growth rate of phytoplankton under different phosphorus and salinity levels turbidimetric estimation of those plankton is tried by spectophotometer, details of which will be reported after stabilising the standard curves. The change of physico-chemical characteries of soil is also studied due to change of salinity level.

Problem	:	5.56	Development of compounded feeds in relation to the nutritional requiremenrs of *P. monodon* and other prawns
Personnel	:		T. Rajyalakshmi (upto 21 8.78), D. D. Halder (from 9.6.78), S. M. Pillai, A K. Roy and P. U. Verghese

Duration : Two years

Formulation of artificial feeds for *Penaeus monodon* has been undertaken with the locally available cheap ingredients, like offal meal, squid meal, shrimp meal, fish meal, prawn protein concentrate, bombay duck meal, shell powder, wheat flour, maize flour, soyabean meal, ground-nut oilcake, rice bran and algal powder in different proportions for the eight formulations of the feeds. To tone up the nutritive value of the feed, microingredients like Brewer's yeast, calcium phosphate, sodium hexa metaphosphate and vitamin mix were added to the test diets. Binders, like sodium alginate and wheat flour, were used to increase water of the pelleted feeds All the formulated feeds were observed to be water stable for more than 6 hours. Test diets I, II, III, IV, V and VI had a protein content of 37.7, 24.2, 28.4, 21.7, 35.8 and 28.9%, respectively.

A series of experiments were conducted using various formulated feeds at stocking densities of 13 nos./litre of water for postlarvae and 4 nos./litre of water for juveniles with provision of 12 hours aeration. Postlarvae fed on feeds I, II, III, IV, V and VI registered growth increments of 5.35-24.85 mg, 10.35-39.56 mg, 12.63 mg, 4.46-61.0 mg, 16.0-59.65 mg and 9.0 mg respectively in 30 days with percentage of survival ranging from 30.8-84.6, 20 2-73.1, 40 4, 7.7-80.8, 37 5-65.4 and 59.6 respectively. In 40 days, early juveniles fed on feeds I, II, III and IV showed an average weight increment/percental survival of 121 mg/51.7, 218.5 mg/57.03, 79.2 mg/9.38 and 137.3 mg/32.81 respectively.

Field experiments were conducted in 0.02 ha ponds stocked with *P. monodon* postlarvae @ 35,000/ha using diets II, V and VI as supplementary feeds. During the culture period of 110 days, artificial feeding was practiced for the first 65 days and tolal production of 330.95 kg/ha (feed II), 355.75 kg/ha (feed V) and 209.75 kg/ha (feed VI) could be obtained.

Problem : 5.57 Mass production potentials of *Penaeus monodon* and *P. indicus* in brackishwater pond

Personnel : D. D. Halder, P. Ravichandran and Kuldip Singh (from 19.9.78)

Duration : Four years eight months

Penaeus monodon and *P. indicus* are not known to breed or even mature in the brackishwater pond conditions. Attempts have been made in various coun-

tries to spawn these species, where the prawns were collected and induced to mature in marine environment. An attempt was made to induce the pond reared *P. monodon* to mature and spawn in brackishwater pond conditions with a view to solving the problem of non-availability of spawners

For this purpose, eye-stalk ablation technique was followed. A total of 18 specimens of *P monodon* (7 females and 11 males); females ranging in total length from 195-219 mm, carapace length 79-92 mm, body weight 70-95 g and males ranging in total length from 177-202 mm, carapace length 62-83 mm, body weight 50-78 g, were collected from ponds having salinity ranging from traces to 1 ppt. They were stocked @ 6 prawns each in 3 plastic pools (0.6 $m^2 \times .05$ m). The pool water was gradually changed by pond and creek water and the salinity was raised to 15 ppt. All the female specimens were in zero stage of maturity at the time of collection.

On 26 1.1978, all the 18 specimens were unilaterally ablated. The pond water temperature was 24 4°C and salinity was 15 ppt. Four females along with 6 males, and 3 females along with 5 males were kept in 2 separate nylon hapas fixed in the same pond. A mixture of minced fresh prawn and trash fishes was given as food to the ablated prawns @ 10% of the body weight once daily throughout the period of experimentation Periodic examination of the specimen was made at weekly intervals.

On March 4, 1978 three female specimens were found to be fully mature and ready for spawning. As there was no facility for aeration or arrangement for contineous flow of water, the matured females were released in a nylon hapa (1.5 m × 1 m × 1 m) tied in a bamboo cage (1.5 m × 1 m × 1 m) fixed in the adjacent creek. The matured female specimens ranged in total length from 208-218 mm, carapace length 85-92 mm and body weight 85-95 g. The temperature and salinity of the creek water were 26 4°C and 25 ppt respectively. On 6.3.78 on examination it was found that two of the three females were completely spent and the third one was only partially so The spawning of the prawns was confirmed by an examination of the water from the hapa, filtered through a plankton net, which contained nauplii.

Project : 6 : Freshwater prawn culture

Problem : 6.1 (Research work completed in 1976)

Problem	:	6.2	Culture of *Macrobrachium malcolmsonii*
Personnel	:		J. Rao, K. V. Rao, T. S. R. Raju, K S. Rao, D. R. Rao, and P. S C. Bose
Duration	:		Three years

Experiments on mixed culture of *M. malcolmsonii*, silver carp, grass carp and catla yielded 327.13 kg/ha of *M. malcolmsonii* (in 5½ months) and 2,084.25 kg/ha of carps (in 10 months). In a similar experiment employing *M. rosenbergii* with the above carps, 330.3 kg/ha of *M. rosenbergii* were obtained (in 6 months) and 794.19 kg/ha of carps (in 10 months). Conventional management practices were followed.

Monoculture of *M malcolmsonii*, experimented in six ponds, yielded production/ha ranging between 64.0 and 334.3 kg under varying stocking densities (54,000-3,20,000). High production was obtained at highest stocking density.

Three additional zones for collection of juveniles of *M. malcolmsonii* were located in the Godavari irrigation canal system.

Problem	:	6.3 & 6.4	(Work programme transferred to Problem 14.1)
Problem	:	6.5	Culture of *Macrobrachium birmanicum choparl* in ponds
Duration	:		Six years

The larvae released by the berried females of *M. birmanicum choprai* in ponds have attained a size of 40-50 mm in a period of 75 days. The berried females were kept in a floating cage of 1/8" mesh iron netting. After the females had released the larvae, the cage alongwith the spent females was removed from the pond. It was observed that about 80% of the newly released larvae escaped from the cage into the pond. This helped to control the mortality of the larvae due to cannibalism by the adult females. The pond was manured with cowdung (@ 10,000 kg/ha/yr) and lime (@ 150 kg/ha/yr). Supplementary feed comprising mustard oilcake and rice bran (1 : 2) at 10% of the body weight was given twice a week.

A total of 4,700 juveniles of *M. birmanicum chopari* (average size 30 mm), collected from the river Ganga near Buxar and stocked in a pond of 0.07 ha, have grown to a size range of 50-61 mm in 45 days. Manuring of the pond with cow-dung @ 10,000 kg/ha/yr and liming @ 150 kg/ha/yr was done. Supplementary feeding of juvenile prawns with mustard oilcake and rice bran (1:2) at 10% of body weight was resorted to during the course of experiment.

Problem	:	6.6	Seed production of the giant freshwater prawn, *Macrobrachium rosenbergii*
Personnel	:		M. Subrahmanyam
Duration	:		Three years

During the year under report 17,176 prawn seed were produced, out of which 12,372 seed were distributed to various governmental agencies and one private farmer.

During the months of November and December '77, laboratory raised third generation seed were stocked in two 0.02 ha ponds at the Freshwater Fish Farm of C. I. F. E., Balabhadrapuram (A. P.) but the two experiments were vitiated due to fall in water level on account of evaporation and seepage. Unlike the previous experiments in 1977, the present experiments were conducted with newly metamorphosed postlarvae.

The experiments conducted at Kovvali gave encouraging results. In April '78, 440 (30,000/ha) prawn seed (10-15 mm) were stocked in a 0.0146 ha pond and were fed mainly on *Tapioca* and foot of apple snail. After 6 months, 305 prawns could be recovered, the per hectare production achieved being 709 kg (percentage survived 68.8).

During September '78, 824 (6-8 days old) prawn seed were stocked in a 0.02 ha pond at the Freshwater Fish Farm, Balabhadrapuram. The culture experiment is in progress.

Mass culture of *Chlorella*, *Chaetoceros* and rotifers was achieved with inorganic nutrints, Potassium nitrate, Potassium dihydrogen phosphate, Sodium silicate in the ratio 7 : 2 : 5 + Tritriplex III (0.05 ml/l). The larvae of *Macrobrachium rosenbergii*, fed on these cultures, survived up to 10-15 days.

Problem : 6.7 Development of artificial feeds for rearing the larvae of economically important palaemonid prawns

Personnel : K. Janakiram and T. Rama Prabhu

Duration : Three years

Cheap and indigenously available feeds like rotifers, certain anostracan nauplii; hens' egg powder, flesh of snails *(Pila)*/fish (mullet), earthworms and some plant products were screened for prawn larval rearing. Fifteen trials on *Macrobrachium resenbergii* and one trial on *M. malcolmsonii* were made, in 40 to 50% aged seawater in plastic containers with provision of continuous aeration Occasionally the medium were treated with dilute copper sulphate solution as a prophylactic measure. In a number of trials, the larvae failed to cross the third zoeal stage. However, in two of the trials encouraging results were obtained with food items like flesh of snails/fish in combination with certain plant products and nauplii of the freshwater anostracans. In one trial, one of the prawn larva reached tenth zoeal.

Culture of food organisms : In yard experiments, green water culture with *Chlorella, Chaetoceros,* and *Navicula* could be successfully maintained in 20 to 30% seawater by enrichment with KNO_3, KH_2PO_4, Na_2SiO_3 (N : P : Si - 7 : 2 : 5) and EDTA. In addition, periodic fertilization was done by urea, ammonium phosphate (N : P - 28 : 25) @ 200 ppm and agricultural wastes like ground-nut or coconut oilcakes @ 5-10 ppm.

In further trials employing fertilizers and other organic wastes like paddy husk soaked in water, straw extract and rice bran, such cultures could be maintained. The rotifers (*Brachionus* sp.) could be successfully cultured in such green waters upto a density of 15—20,000 nos./l. Seaweed compost of *Ulva, Enteromorpha* and *Gracillaria* with cowdung and fertilizers also indicated the possibility of giving good green water - rotifer culture.

The freshwater fairy shrimps *(Streptocephalus dichotomus)* were also successfully reared on weed compost and soil base for a period of 5 months. The brim produced viable eggs under laboratory conditions.

Project 7 : Murrel and Live Fish culture

(The work is being conducted under a Co-ordinated Project)

Project 8 : Estuarine and Brackishwater Lake Fisheries

Problem	:	Brackishwater fish and prawn seed prospecting of the Hooghly-Matlah estuarine system
Personnel	:	K. K. Bhanot, H. S. Majumder, R. N. De, N. D. Sarkar and B. K. Saha
Duration	:	Eleven years

Brackishwater prawn and fish seed prospecting of the Ichhamati estuarine system of the lower Sunderban has been conducted from Itindaghat, Hasnabad and Kalinagar and from Port Canning and Raidighi on the Matlah and Thakuran estuaries. Results indicate that these centres are substantial source of commercially important prawn seed like *Penaeus monodon, P. monoceros, P. indicus, Metapenaens brevicornis* and fishes like *Liza parsia, Eleutheronema tetradactylum* and *Coilia* sp.

Problem	:	8.2 & 8.3	(Research work completed in 1973)
Problem	:	8.4	(Research programme merged with Problem 8.1)
Problem	:	8.5	(Research work completed in 1976)
Problem	:	8.6	(Research work kept in abeyance)
Problem	:	8.7	Reproductive biology of cultivable brackishwater fishes
Personnel	:		K. K. Bhanot
Duration	:		Three years

Sillago panijus, Glossogobius giuris and *Liza parsia* were collected from Kakdwip and histochemical studies of their gonads are underway.

Project : 9 : Selective Breeding and Hybridization

Problem	:	9.1	(Research work completed in 1973)
Problem	:	9.2	(Research work completed in 1972)

Problem	:	9.3	(Research work suspended since 1973)
Problem	:	9 4	Hybridization of carps with special reference to cytogenetical features of the hybrids
Personnel	:		R. M. Bhowmick, R. K. Jena and S D. Gupta
Duration	:		Six years

Matured catla-rohu F_1 hybrid, injected with carp pituitary extract, yielded 0.75 lakh spawn. 4-day old F_2 hybrids were stocked in a 0.04 ha pond for raising fry and fingerlings. The F_2 hybrids have grown to an average size of 339 mm/504 g in one year.

Following 'colchicine-citrate aceto alcohol Geimsa air drying' technique a number of slides have been prepared for studying the chromosome number of F_2 offsprings.

Problem	:	9.5	(Merged with Problem 9 4)
Problem	:	9.6	To develop suitable strains of Indian major carps
Personnel	:		V. R. P. Sinha, K. K. Sukumaran and H. A. Kh n
Duration	:		Three years

Brood stock of Indian major carps is being maintained and further work will be taken up as soon as additional ponds at Dhauli Fish Farm will be available.

Problem	:	9.7	Breeding of selected of grass and silver carp
Personnel	:		S. B. Singh, R. K. Dey, P. V. G. K. Reddy, B. K. Mishra and H. K. Muduli
Duration	:		

The hybrids between grass carp female and silver carp male produced during August, 1977 are being reared in nursery and rearing ponds and their morphology, growth and maturity are being studied. Some of the hybrids have grown upto 750 g. The hybrid very much looks like grass carp. The single surviving hybrid between silver carp female and catla male has attained a size of one Kg in a nursery pond. The cross appears very much like silver carp.

Problem	:	9.8	Hybridization between *L. rohita* × *C. carpio*; *C. mrigala* × *C. carpio*; *Catla* × *H. molitrix* and *C. catia* × *C. carpio*.
Personnel	:		K. H. Ibrahim, G. V. Kowtal and S. D. Gupta

Hybrids of catla × common carp; catla × silver carp and rohu × common carp were produced. Mortality was very high during embryonic and larval development. A few surviving ones are being reared in plastic pool. Rohu × common carp hybrids praduced in 1977, had attained 142 mm/32 g in seven months.

Project 10 : Fish Farm Designing

Problem	:	10.1	(Research work completed in 1974)
Problem	:	10.2	Studying seepage losses in ponds
Personnel	:		C. Saha, G. N. Saha, C. D. Sahoo and M. D. Mantri
Duration	:		Five years

Studies on seepage loss have been conducted in 18 newly dug out ponds at Dhauli. During the month of November when the canal water flow was stopped, the average loss was recorced to be 21.1 cm (depth) per month, whereas seepage loss was negligible in other months when the nearby irrigation canal was having flowing water.

Project 11 : Economics in Fishery Investigations

Problem	:	11.1 & 11.2	(Research work completed in 1974)
Problem	:	11.3	(Research work completed in 1973)

Problem	:	11.4	(Research work completed in 1976)
Problem	:	11.5	(Research work completed in 1976)
Problem	:	11.6	(Research work completed in 1976)
Problem	:	11.7	(Research work completed in 1977)
Problem	:	11.8	Returns from investment in inland fisheries research
Personnel	:		M. Ranadhir
Duration	:		Three years

To determine the quantum of research expenditure and its pay-offs, a project in air-breathing fish culture has been selected. The size of unit investments and cost benefit analysis for a project of 20 years duration has been worked out.

Problem	:	11.9	The price spread of inland fish
Personnel	:		M. Ranadhir, S. Paul and H. K. Sen
Duration	:		Three years

The price spread of inland fish from fishermen to the consumer was found to be about Rs. 8/kg on an average of which the margin was about Rs. 2. The bulk of the price spread is between the wholesale marchant at site and the auctioneer at the wholesale market of the consuming centre. This margin is about Rs. 4/kg which includes transport and handling charges.

Project : 12 Exotic Fish Culture

Problem	:	12.1 & 12.2	(Research work completed in 1973)
Problem	:	12.3	(Research work completed in 1972)
Problem	:	12.4	(Research work completed in 1976)
Problem	:	12.5	Techniques for large scale production of grass carp and silver carp seed

Personnel	:	S. B. Singh, R.K. Dey, P. V. G. K. Reddy, B. K. Mishra and H. K. Muduli
Duration	:	Four years six months

Usefulness of recirculation and aeration in brood fish pond was established and use of an air compressor in one of the brood fish ponds proved highly effective in maintaining the stock of grass and silver carp. Hypophysation of grass and silver carp was successful only from August onwards on account of delayed monsoon which adversely affected the gonadal condition of the brood fish. During the middle of August, when regular monsoon rains commenced, good response in inducing spawning of grass carp and silver carp was obtained in riverine conditions, Due to insufficient accumulation of fresh rain water in the ponds, percentage of hatching was poor in the pond environment whereas in the glass jar hatchery it was highly encouraging. 41 sets of silver carp and 31 sets of grass carp were injected out of which 34 sets of silver carp and 16 sets of grass carp responded. As observed previously the receptivity period in grass carp females was much shorter as compared to that of silver carp.

Success was achieved in extending the breeding period of silver carp upto first week of November. This has opened up new possibilities of producing viable fry of silver carp over a prolonged period and is an important step forward towards domestication of the species. Delayed but regular monsoon, proper brood fish care, and favourable environmental conditions attributed towards the extension of the receptivity period in silver carp females.

During 1978, breeding season, the number of eggs released/kg body weight and spawn obtained were maximum in September. Even in October, production of spawn was good which would have been far better in case sufficient number of mature males were available. However, milt could be preserved in advance to overcome this difficulty in future. The dose of pituitary extract ranged from 12-20 mg/kg body weight for the females and 4-5 mg/kg body weight for the males of both grass carp and silver carp. Late in the season from September onwards the dose for the females was mostly 20 mg/kg body weight.

Incidental to research work, 5.22 lakhs of silver carp and 1.25 lakhs of grass carp spawn were produced.

Problem : 12.6 Compatibility and competition between silver carp ane Indian major carps

Personnel : R. K. Dey, S. R. Ghosh, P. V. G. K. Reddy and H. K. Muduli

Duration : Five years

A field experiment of six months duration to study the compatibility and competition between silver carp and Indian major carp (rohu) initiated in 4 nursery ponds (0.04 ha each) at a stocking density of 5,CC0/ha and species ratio c 1 Sc. 2 : R 3 & C 2 : R 3 without feeding and fertilization was concluded in June '78. The results of the experiment were in general agreement with that of the previous year indicating that the growth of rohu suffered only slightly in the presence of silver carp as compared to catla.

Problem : 12.7 Optimum production of fingerlings and fish of exotic species under composite culture

Personnel : S. B. Singh, R. K. Dey, P. V. G. K. Reddy, B. K. Mishra and H. K. Muduli

Duration : Four years

Fingerling rearing of exotic carps : An experiment of three months duration on rearing of fingerlings of silver carp, grass carp and common carp has been initiated in two rearing ponds (0.08 ha each) during September, 1978 at a stocking density of 2 lakhs/ha and species ratio of Sc 5.5 : Gc 1 : Cc 3.5. The study is in progress.

Large fish culture of exotic species :

Field experiments on composite culture of silver carp, grass carp and common carp were initiated during January '78 at a stocking density of 3,CC0/ha and species ratio of Sc 4 : Gc 3 : Cc 3 in two rearing ponds (0.08 ha each). No supplementary feeding was provided except for supplying aquatic weeds to grass carp. The experiment got vitiated due to mass poaching of fish from both the ponds in May '78.

Problem	:	12.8	**Maturity of grass carp with different feeds**
Personnel	:		**S. B. Singh, R. K. Dey, P. V. G. K. Reddy, B.K. Mishra and H. K. Muduli**
Duration	:		**Three years**

An experiment to study the maturity of grass carp with different feeds was initiated in three rearing ponds (0.08 ha each) in April '78. In each pond, 15 females and 5 males of grass carp of about 1.2 kg average weight were stocked and fed with napier grass @ 7 kg/day in RP 5, *Hydrilla* @ 7 kg/day in RP 7, and pulse waste 0.5 kg/day in RP 10. The effect of different feeds on maturity of grass carp could not be ascertained as the brood fish did not respond to hypophysation, possibly due to delayed monsoon and low water level in the ponds.

Problem	:	12 9	**Short term large fish culture of exotic carps**
Personnel	:		**S. B. Singh, R. K. Day, S. R. Ghosh, P. V. G. K. Reddy and B. K. Mishra**
Duration	:		**Three years**

An experiment of three months duration on short term culture of silver carp, grass carp and common carp was initiated in two rearing ponds (0.08 ha each) in Feb.'78 at a stocking density of 1,000/ha and species ratio of Sc 4 : Cc3 and Gc 3 under intensive feeding and fertilization. The estimated gross and net production at 80% survival of fish in both the ponds, were worked out to be 235.50 and 189.24 kg/ha/2 months, and 268.13 and 221.87 kg/ha/2 months in the two ponds respectively.

Project 13 : Coldwater Fish Culture

Problem	:	13.1	**(Research work completed in 1970)**
Problem	:	13.2	**(Research work completed in 1977)**
Problem	:	13.3	**(Research work completed in 1971)**
Problem	:	13.4	**(Research work completed in 1970)**

Problem	:	13.5	(Research work completed in 1970)
Problem	:	13.6	(Research work completed in 1972)
Problem	:	13.7	(Research work completed in 1970)
Problem	:	13.8	(Research work completed in 1977)
Problem	:	13.9	(Research work suspended since 1972)
Problem	:	13.10	(Research work suspended since 1976)
Problem	:	13.11	(Research work suspended since 1975)
Problem	:	13.12	(Research work suspended since 1975)
Problem	:	13.13	(Research work completed in 1977)
Problem	:	13.14	Mass culture of fish food organisms under temperate climate
Personnel	:		K. K. Vass, H. B. Singh, Usha Moza and R. K. Langer
Duration	:		Five years seven months

Zooplankton Culture

DAPHNIA sp. : Culture of *Daphnia* sp. was tried using silk worm pupae extract @ 2 g/l as the nutrient medium under laboratory conditions. A peak population of 1,572 organisms/l was obtained within a period of 14 days, when the initial stocking was 25 organisms/l.

Trials were made to germinate the ephippial eggs of *Daphnia* sp. under these climatic conditions with a view to have a constant and sustained culture of the species in laboratory and field. In first set of experiments, loose ephippia, which were collected in summer, were subjected to desiccation (for 7 days) and freezing (for 4-5 days). The eggs were initially treated at higher temperature of 30°-35°C for about 4 hours and then kept in vials at room temperature ranging 5°-15°C. Within a period of 7-9 days, the population of animals started germinating. The percentage of germination ranged between 40-61. Unicellular algae was used as feed for newly hatched young ones. In another set of experiments, ephippial eggs were collected from the fresh population in winter and kept in the vials without undergoing the

freezing and desiccation treatment at the room temperature (5°-15°C). Within a period of 10-12 days, the animals started germinating and the germinating percentage ranged between 50-65.

Culture of *Daphnia* sp. was tried in field conditions in a ditch of 1 m^2. A population of 9,125 organisms/l was obtained within a period of 16 days by using raw cowdung @ 1 kg/m^2 (every fifth day) as a nutrient medium, when the initial stocking was only 100 organisms/l.

BRANCHINECTA sp. : In order to study the biological aspects, the eggs of the freshwater fairy shrimp, *Branchinecta* sp. were collected from the nature (previous year's population and kept in laboratory conditions for germination. The egg within a period of 3-5 days (at 15°-20°C) hatched into true nauplius 0 60 mm in length, approximately twice the diameter of the egg (0.34 mm). The nauplius and the first metanauplius (0.76-1 34 mm) are opaque. The 3rd metanauplius is creamy and transparent. At this stage feeding starts. The sexes first become distinguishable at 3 0-3.5 mm length and egg production begins at 9-11 mm, at an age of 3 to 4 weeks. Maximum lengths (17 5 mm in case of females and 15.0 mm in case of males) are attained within 5-6 weeks. The population was fed on the extract (decomposed form) of yeast @ 0.5 g/l. Total number of eggs in the egg sac ranged from 55-147 in the females ranging from 7.5 to 16.5 mm in size.

CERIODAPHNIA sp. : Experimental culture of *Ceriodaphnia* sp. was tried at 24°-30°C in (i) cowdung extract @ 2g/l, (ii) Least and soil extract @ 1 g/l and (iii) urea solution @ 1 g/l as culture media. Peak populations of 1,36,6956 and 947 organisms/l from an initial inoculum of 25 organisms/l were obtained within a period of 21 days in cowdung extract, yeast and soil extract, and urea solution respectively.

Scapholebris sp. was cultured in cowdung extract of 2 g/l at 25°-30°C. A peak population of 5,003 organisms/l was obtained within 12 days with an initial inoculum @ 30 organisms/l.

Moina sp. was cultured in 4 to 16 g/l concentrations of raw cowdung extract at 25° 27°C. Maximum yield of 28,000 organisms/l was obtained with lowest concentration of 4 g/l with an initial inoculum of 25 organisms/l within 11-12 days.

Life cycle of *Moina* spp. revealed a life span of 13-14 days having 5 pre-adult instars and a post adult instar. Number of eggs/brood varied from 10-16.

GAMMARUS spp. : Biological studies of *Gammarus* spp. ware made under controlled conditions at 17°-19°C. Studies revealed that *Gammarus* is abundant in waters having pH from 6.3-7.2, DO 6.8-11.2 ppm and temperature 4°-23°C. The main contituents of its food are debris, water nematodes, diatoms and filamentous algae. It breeds more than once during its life span, with a gap of 30-33 days in between each breeding spurt. Juveniles (2 mm) attain the adult size (13-17 mm) within 30-32 days. Temperature tolerance for the species is upto 25°C and critical temperature is 28°-29°C. Rate of oxygen consumption per hour per individual at 10°C under normal light conditions was 0.19 ppm for 5-6 mm, 0.372 ppm for 12-13 mm, and 0.455 ppm for 16 mm size groups. Studies are in progress.

Problem	:	13.15	(Research work kept in abeyance)
Problem	:	13.16	Induced breeding and culture of *Schizothorax* spp.
Personnel	:		H. B. Singh, K. K. Vass, Shyam Sundar, Usha Moza and M. J. Bhagat
Duration	:		Four years one month

Two mature specimens of *Schizothorax niger* (150-170 mm in length and 40-55 g in weight) were stripped by 'dry' method which gave 1,000-1,500 eggs. After the hardening process was over, the eggs were kept in enamel trays. Percentage of fertilization ranged between 76.0-87.0. The incubation period ranged between 8-13 days and the survival from egg to fry stage was 80%. The fry were kept in plastic pools and subsequently is rearing ponds for further rearing.

Brooders of *S. esocinus* (30 nos.) and *S. plagiostomus* (60 nos.) from Kulgam (Vishaw stream) were procured by cast netting and kept in cemented tanks at Harwan but due to resorption in gonads, stripping could not be done.

Spawn of *Schizothorax* spp. (approximately 7,000 in number and measuring 10-13 mm in length) were collected from Pishpow area and 'Arh' stream and stocked in rearing ponds at Harwan.

Experiments on induced breeding of *Schizothorax micropogon* (procured from River Jhelum) were conducted in middle of April. The brooders in the ratio of 1 : 3 (F : M) were kept in the breeding hapas at Harwan hatchery ponds. Different doses of pituitary varying from 2-4-8-16 mg/kg of body weight were administered to females and 2-4-8 mg/kg to males. Both homoplastic (*Schizothorax* spp.) and heteroplastic *Cyprinus carpio*) injections of pituitery were given to fish. The fishes did not respond. On 29. 5 1978, one mature specimen of *S. micropogon* (250 g in weight) and 415 mm in length) was stripped by 'dry' method at Papchan hatchery which yielded 5,000 eggs. The fertilization ranged between 75-80%.

For the rearing of *Schizothorax* spp. eggs, an incubator was designed. The artificially stripped eggs of *S. micropogon* were successfully reared during May, 1978. The incubation period ranged between 8-15 days with 65% survival from eggs to fry stage.

At Harwan, a pond was stocked with the fry of *Schizothorax niger* @ 40 fry/m^2. Sampling, after a period of 45 days, revealed that the fry had attained a size range of 31-47 mm, when the size range at the time of stocking was 15-22 mm. In another pond, mixed spawn of *Schizothorax* spp. stocked @ 100 fry/m^2 were fed on wheat bran + mustard oilcake (1 : 1) @ 10% body weight. Sampling after 2 months, showed an increase in length ranging from 30-52 mm and in weight from 1.0-1.4 g (length and weight at the time of stocking were 12-25 mm and 90 mg). Due to continuous rain and floods, a heavy loss of fry was recorded in the ponds and fry had to be shifted in cemented tanks. On 10.10.78, fry (length range of 35-60 mm and total weight of 1.0-1.9 g) were stocked @ 340 fry/m^2 at Harwan cemented ponds. When harvested after 50 days, the fry had attained a length range of 51-77 mm and a weight range of 1.5-3 0 g. The survival was 80% throughout the period of experiment. The fry were fed on artificial feed comprising wheat bran + oilcake (1:1) + 2% salt, @ 5-6% of body weight four times a day.

In another set of experiments, fingerlings of *Schizothorax* (length range 75-130 mm and weight range 8-12 g) were stocked @ 20 fingerlings/m^2, Sampling was done after 80 days. The fingerlings had attained a length range of 95-145 mm and a weight range of 12-20 g. There was no mortality recorded during the period of experiment. The fingerlings were fed on wheat bran and mustard oilcake (1:1) @ 3-4% of their body weight four times a day.

In addition, the mixed fry of *Schizothorax* spp. (22-40 mm/0.200 g) were stocked in 6 cagas (1 m × 0.75 m × 0.75 m) @ 250 fry/cage at Dal Lake (Nehru Park) during 2nd week of August but due to habitation around and disturbances caused by petrol boats, etc ,the cages were shifted near Nishat dyke after 4 days. Each cage was restocked @ 150 fry, keeping one as control. Fry in one cage were fed with silk worm pupae @ 10% body weight. Feeding was done 4 times daily. The physico-chemical characteristics of lake water during 12.00-16.30 hours were in the following ranges: water temperature 27.5°-32.5°C ; pH 8.0-8.2 ; dissolved oxygen 7.6-8.0 ppm ; free carbondioxide 3.6-4.2 ppm ; total alkalinity 66.0-76.0 ppm and silicates 0.200-0 400 ppm. Durir g night, great losses of fish fry were noticed for which free carbondioxide (as high as 9.2 ppm at 02.00 hours) could be the possible reason. Simultaneously, fingerlings of *Schizothorax* spp. (average weight 9 g) were also stocked in 2 cages @ 20 fingerlings/cage near Nishat dyke but those also did not survive beyond 2nd week of September. In 2nd week of September, fry of *Schizothorax* spp. (0.200 g average weight) were stocked in cages @ 350 fry/cage in the running waters of Laribal farm and fingerlings (average weight: 9 g) were stocked @ 20/ cage. In either case,one cage was kept as control. In the 2nd cage supplementary feed comprising mustard oilcake + wheat bran in the ratio 1 : 1 was given. Sampling was done in the third week of November. In case of fry the average increase in weight was 0.210 g in control and 0.470 g in the case where feeding was done while in case of fingerlings the average increase was 2.0 g in control and 3.5 g in case of fish provided with supplementary feed,

Problem	:	13.17	(Research work completed in 1977)
Problem	:	13.18	(Research work completed in 1976)
Problem	:	13.19	(Research work completed in 1977)
Problem	:	13.20	Artificial propagation and culture of trout
Personnel	:		Shyam Sunder, K. K. Vass and M. J. Bhagat
Duration	:		Four years

A total of 6,240 swim-up trout fry were made available by the State Fisheries Department. Due to construction work in the Harwan laboratory, load

of silt and clay took a heavy toll of the stock. Immediately, the remaining fry were transferred to Laribal hatchery and kept in troughs for 20 days. Feeding for first 10 days was done on egg yolk and dried skimmed milk in the ratio of 1:1 @ 6-8% of the body weight for 6-8 times a day ; and for next 10 days these fry were fed on commercially prepared pelletized feed mash to train the fry for initial feeding.

On account of heavy loss of fry in initial experiments the remaining stock was restocked in 2 ponds @ 900 and 700 fry in each and fed on commercially prepared feed mash in first pond (A) ; and liver and silk worm pupae (1 : 1) on alternate days in the second pond (B) for two months, switching over later to silk worm pupae alone. During second week of July, sampling was done. 15 and 17% survival with an average weight increase of 0.950 and 1.160 g was obtained in pond A and B respectively.

The losses of brown trout fry occurred due to natural calamities *viz.* (a) heavy silt load ; (b) constant rains ; (c) constant low values of pH (6.3-6.6) and (d) sudden rise of water temperature (20.5°-26.5°C) during first week of July.

For brown trout fingerlings, feeding experiments with different dry and wet feeds were taken up. The results of first experiments are given in table 2.

Problem	:	13.21	Induced breeding and rearing of mahseer *(Tor putitora)* seed in running water ponds
Personnel	:		K. L. Sehgal and P. S. Garg
Duration	:		Two years three months

7 sets of the experiments were conducted for induced breeding of mahseer, during August-September, 1978 at Baintale mandi, Dehradun. In all 10 number of female fishes weighing 0 600-1.250 kg were injected with the extract of fresh as well as preserved pituitary glandsof mahseer, *Schizothorax* spp. and Indian major carps at a dose of 4-16 mg/kg between 8-16 hr intervals in the different trials conducted. Total extract of pituitary glands injected to individual females ranged from 14 76 mg/kg of the body weight. The trials on the stripping of mahseer females were also made from time to time, but without any gain. No breeding was observed in the above experiments.

Table 2 : Results of feeding trials with brawn trout *(Salmo trutta fario)* at Laribal during 1978

Pond No.	FEED GIVEN	STOCKED Date	STOCKED No.	STOCKED Weight (g)	REMOVED Date	REMOVED No.	REMOVED Weight (g)	Gain in weight (g)	Feed consumed (g)	CONVERSION
1.	Commercial	2.5.78	39	7410	7.8.78	35	8580	1170	5835	4.9
2.	*SWP/Boiled fish	,,	39	7410	,,	39	8073	663	5885	8.8
3.	Commercial	15.6.78	83	2988	,,	56	3984	996	1897	1.9
4.	*SWP/Boiled fish	,,	83	2988	,,	62	3486	489	2105	4.2
5.	Commercial Boiled fish	,,	83	2988	,,	76	3735	747	2297	3.0

*Silk worm pupae

Project 14 : Riverine and Estuarine Fish Catch Statistics

Problem	:	14 1	Fish catch statistics of the middle and lower stretch of the Ganga River System
Personnel	:		A. V. Natarajan, S. J. Karamchandani, R. K. Tyagi, R. A. Gupta, R. K. Dwivedi, N. K. Srivastava, Ram Chandra, B. Ghosh, A. Sarkar, D. Srivastava, B. L. Pandey, B. K. Banerjee and R. C. Singh
Duration	:		Ten years nine months

MIDDLE STRETCH OF THE RIVER GANGA : Total fish landings at Sadiapur, Daraganj and Buxar centres were estimated at 130.31 t, 28.47 t, and 8.32 t respectively during the period December 1977 to November 1978 for the first two centres and December 1977 to September 1978 for the third centre. Details of species-wise landings are given in table 3.

Fish landings at Sadiapur and Daraganj centres showed an increase by 26 and 2.0% respectively over that of the preceeding year. Mean lengths of all the commercially important species were computed and compared with their respective mean lengths recorded during 1967 and 1975. An increasing trend was observed in case of most of the species.

LOWER STRETCH OF THE GANGA RIVER SYSTEM : Estimated fish landings from two centres *viz.*, Bhagalpur and Lalgola were 87.08 t and 24.19 t respectively. Production at Bhagalpur increased by 37.94% but decreased by 41.6% at Lalgola, when compared with the preceeding ten month period.

At Bhagalpur, miscellaneous varieties (37.77%) dominated the total fish yield, followed by *W. attu* (14.53%), small prawns (10 32%), *C. catla* (8 22%), *N. chitala* (5.88%), *M. aor* (3 81%), *M. seenghala* (3.80%), *L. rohita* (3.16%), *C. garua* (2.48%), *E. vacha* (2.39%), *C mrigala* (2 38%), *Channa* sp. (1.50%), *R. rita* (1.47%), *S. silondia* (1 03%), *B. bagarius* (0.54%), *L. calbasu* (0 36%). large prawn (0.13%), *H ilisha* (0.14%) and *P. pangasius* (0.09%). *H. ilisha* (45.56%), formed the main stay of the lendings at Lalgola, followed by miscellaneous species (21 63%), *P. pangasius* (11.70%), *B. bagarius* (5.91%), *C. garua* (5.56%),

Table 3 : **Showing species-wise landing (it) in the middle stretch of Ganga River system in 1978**

(figures in parenthesis indicate percental contribution to the total landing)

Speciss	Sadiapur centre	Daraganj centre	Buxar centre
C. mrigala	10.13	3.07	0.16
	(7.8)	(10.8)	(1.9)
C. catla	4.96	0.74	0.12
	(3.8)	(2.6)	(1.4)
L. calbasu	19.55	4.32	0.23
	(15.0)	(15.2)	(2.8)
L. rohita	2.84	0.62	0.25
	(2.2)	(2 2)	(3.0)
M. aor	13.42	2.21	1.37
	(10.3)	(7.8)	(16.5)
M. seenghala	6.76	2.29	0.27
	(5.2)	(8.0)	(3.2)
W. attu	2 43	1.63	0.48
	(1.9)	(5.7)	(5 8)
Other catfishes	22.61	6.13	2.12
	(17.4)	(21.5)	(25.5)
H. ilisha	0.13	0 01	0.07
	(0.1)	(0.0)	(0 8)
Misc varieties	70.11	13.58	5.37
	(53.7)	(47·7)	(64.5)
TOTAL	130.31	28.47	8.32

M. aor (3.43%), large prawns (2.48%), *R. rita* (1.94%), small prawns (0.88%), *E. vacha* (0.54%), *N. chitala* (0.45%), *L. rohita* (0.45%), *S silondia* (0.41%), *C. catla* (0·08%), *C. mrigala* (0.04%), and *W. attu* (0.04%).

ECOLOGICAL OBSERVATIONS ON RIVER GANGA AT BHAGALPUR : During the period under report, average air and water temperature fluctuated between 14.50° & 32.00° C and 17.25° & 31.00°C respectively. Average transparency ranged from 4.50 to 30.50 cm. Average pH ranged between 7.9 and 8.5. Free CO_2 varied from nil to 3 52 ppm. Dissolved oxygen ranged from 5.4 ppm (June) to 8 53 ppm (Jan.). The carbonate and bicarbonate alkalinities varied from nil to 38.28 ppm and 115.94 to 312.05 ppm respectively Nitrate and silicate varied from 0 23 to 1.80 ppm and 6.40 to 21.00 ppm respectively.

Average gross and net carbon assimilation were 35 80 mg C/m³/hr and 21.71 mg C/m³/hr respectively. The community respiration was 16 99 mg C/m³/hr. When compared with the previous nine-month period, it was observed that gross and net production decreased by 14.27% and 21.62% respectively. The community respiration increased by 2.90%. The gross production was the maximum in the month of May (71.88 mg C/m³/hr) and the minimum in September (17.82 mg C/m³/hr). The maximum net production was recorded in the month of May (43.75 mg C/m³/hr) and the maximum in September (5.94 mg C/m³/hr). The community respiration was the maximum in the month of May (23.75 mg C/m³/hr) and the minimum in June (6.75 mg C/m³/hr).

The maximum abudance of phytoplankton was observed to be in March (3,084 units) and the minimum (162 units) in July. The yearly production decreased by 337.57% when compared with that of the preceeding year.

The zooplankton population varied from 23 organisms in July to 267 organisms/l in April. The yearly zooplankton population decreased by 720.16% when compared with that of the preceeding year.

The ratio between phyto- and zooplankton was recorded to be 1 : 0.13 during the period under report. The studies are being continued.

Problem : 14.2 (Research work merged with Problem 14.1)

Problem : 14.3 (Research work completed in 1969)

Problem	:	14.4	(Research work completed in 1971)
Problem	:	14.5	(Research work completed in 1973)
Problem	:	14.6	(Research work kept in abeyance)
Problem	:	14.7	(Research work completed in 1977)
Problem	:	14.8	(Research work suspended since 1975)
Problem	:	14.9	(Research work suspended since 1974)
Problem	:	14.10	(Research work completed in 1977)
Problem	:	14.11	(Research work suspended in 1978)
Problem	:	14.12	(Research work completed in 1977)
Problem	:	14.13	(Research work completed in 1978)
Problem	:	14.14	(Research work merged with Problem 14.1)
Problem	:	14.15	Fish population studies of the Brahamputra River
Personnel	:		M. Choudhury, R. Chandra, H.P Singh and V. Kolekar
Duration	:		Five years eight months

CATCH STATISTICS

A total of 38.09 t of fish were estimated to have been landed at the two landing centres at Gauhati *viz.*, Uzanbazar and Fancybazar out of which 13 91 t were recorded at Uzanbazar and 24.18 t at Fancybazar. The highest landings were recorded in the month of April at Uzanbazar and in May at Fancybazar, and lowest in July at both the centres.

Miscellaneous group (38.42%) dominated the catch, followed by hilsa [16.34%], catfishes [14.44%], minor carps [14 37%], major carps [12 77%] and prawn [3.66%] at Uzanbazar ; whereas at Fancybazar major carps [29.69%] dominated the catch, followed by miscellaneous [18.81%], hilsa [17.76%], catfishes [15.68%], minor carps [13.53%] and prawn [4.52%]

Length frequency data revealed the following mean lengths and range in respect of some selected fishes :

Species	Mean length (mm)	Lowest class	Highest class
L. rohita	842	600 - 650	1050 - 1100
C. catla	956	450 - 500	1200 - 1250
C, mrigala	836	500 - 550	1050 - 1100
H. ilisha	394	200 - 250	500 - 550
W. attu	1005	600 - 650	1300 - 1350
M. seenghala	993	650 - 700	1150 - 1200

HYDROLOGICAL OBSERVATIONS

The ranges of surface water temperature, pH, transparency, total alkalinity, free CO_2, D.O., nitrate and phosphate fluctuated between : 24.0° & 30.0°C, 7.6 & 7.8, 11.0 & 34.0 cm, 58 0 & 86.0 ppm, 2.0 & 5.0 ppm, 7.08 & 9·56 ppm, 0.04 & 0.09 ppm, and 0.055 & 0.10 ppm respectively.

Primary production : Gross and net organic carbon production fluctuated between 23.52 & 30.60 mg C/m^3/hr, and 16 20 & 20.0 mg C/m^3/hr respectively.

Soil analysis : Soil samples collected from the river bed were air dried, sieved and analysed in June and September, 1978 gave the following values :

Months	pH	Electrical conductivity (mhos cm at 25°C)	Organic carbon (%)	Available P_2O_5 (lbs/ acre)	Available K_2O (lbs/acre)	Texture (Field test)
June	6.6	0 250	1 2	12.0	55:0	Sandy loose
September	7.65	0.165	0 60	11.3	120.0	Sandy

PLANKTON ANALYSIS

The average monthly occurrence of plankton was 18 u/l, which consisted of 83.32% of phytoplankters and the rest zooplankters.

During the year under report, Bacillariophyceae formed the most dominant group (8 u/l) and were at their peak during April (15 u/l) and lowest during

September (4 u/l). This was followed by Chlorophyceae (5 u/l) and blue green algae (2 u/l) among the phytoplankters. The zooplankter were represented by rotifers (1 u/l), copepods (1 u/l) and cladocerans (1 u/l).

The common genera observed were : *Spirogyra, Tabellaria, Mougeotia, Navicula, Oscillatoria* and *Phormidium* among the phytoplankters ; and *Asplanchna, Filinia, Lecane, Cyclops* and *Bosmina* among the zooplankters.

Problem	:	14 16	Pilot survey to evolve sampling methodology for estimating inland resources and total catch of fish in West Bengal
Personnel	:		K. K. Ghosh, Padam Singh, S. K, Raheja, A. Srivastava, P. M. Mitra, A. Chowdhury, R. N. De, A. K. Roy, N. D. Sarkar, N. C. Mondal and A. R. Pal
Duration	:		Three years ten months

Pilot sample survey to evolve sampling methodology for estimating inland resources and to study the prevailing practices in pisciculture has been started after preliminary fact finding survey of selected cluster of villages. 24 Parganas District of West Bengal has been taken up first and 10 clusters of 4 villages each have been selected. The stage cluster sampling with equal probability has been adopted.

The villages have been listed from 1971 District Census Handbook. A village in a particular Police Station was selected randomly. The 4 adjacent villages which fell within a circle of a diameter of 2.5 km were selected as a cluster. Ten such clusters of 4 villages are under Bangaon, Habra, Basanti, Sonarpur, Budge Budge, Falta, Mandirbazar, and Basirhat Police Stations.

Detailed proformae and programme of field work has been finalised and the field work has been initiated in all the selected clusters. The principal items of information on which data are being collected are : type of water resource, area, seasonality, depth, weed condition and fish culture aspects such as pisciculture technique, species cultured, ratio & rate of stocking, feed and manure/fertilizer used, growth of fishes, average fish yield, etc.

Project 15 : Fish Pathology

Problem : 15.1 (Research work completed in 1976)

Project 16 : Weed Control

Problem : 16.1 (Research work completed in 1973)

Problem : 16.2 (Research work being done under Problem 16.7)

Problem : 16.3 Evolution and evaluation of herbicide formulations

16.3.1 Standardization of preparation and application techniques of formulations for long-term control of rooted aquatic weeds and noxious algae

Personnel : V. Ramachandran, A. K. Sahu, K. M. Das and G. C. Sahu

Duration : Ten years nine months

2, 4-D granular formulation : A nursery pond, with chronic infestations of *Nymphaea, Nymphoides* and *Ottelia* was treated with 2, 4-D-soaked brick pellets @ 5 kg *(a. i.)*/ha in February and again in May to control a thin reinfestation of the weeds. The treatment considerably reduced the reinfestation which was very heavy in an adjacent control pond. Treatment with commercial 2.4-D granules in another pond showed its noticeable effects upon lilies and *Ceratophyllum* but the cost was much higher than with brick-pellet formulation.

An 1% *a.i.* granular formulation of diuron herbicide was prepared in the laboratory and extensively tested in Assam and Orissa for control of a variety of submerged weeds and grasses and was found effective @ 5 kg (*a. i.*) /ha. Cost of treatments ranged from Rs. 700-1400/ha.

Diuron was found effective in clearing heavy mats of filamentous algae and *Ottelia* sp., when applied @ about 2.5 kg(*a. i.*)/ha. It was also found that the herbicide does not inhibit growth of plankton or bottom biota which increased abundantly after the clearance of the algal mats and macrophytes.

Diuron at a low dose (0.1 ppm or even less) was found sufficient to check the bloom of *Microcystis* sp. in incipient stages. The effect was found to last for 2-3 months after which the treatment had to be repeated.

16.3.2 Control of submerged weeds by paraquat formulation

Personnel : S. Patnaik and K. M. Das

Duration : Two years eleven months

In laboratory trials, *Hydrilla* could be cleared with 3 ppm paraquat in 18 days. *Vallisneria* and *Cerarophyllum* could be cleared with 5 ppm in 10 days whereas with lower doses partial kill was observed.

Problem : 16.4 (Research work completed in 1973)

Problem : 16 5 Eradication of weeds by chemical treatments

Personnel : E. Mitra (Miss), S. C. Thakurta and A. C. Banerjee

Duration : Three years

Laboratory and field experiments were conducted to ascertain the optimum dosage of urea and copper sulphate, required for eradicating weed infestations in fish ponds

TREATMENT WITH UREA : The rooted vegetation of *Vallisneria spiralis, Hydrilla verticillata, Nymphoides dristatum, Lagarosiphon roxburghii* and the floating plants *Azolla pinnata, Spirodela polyrrhiza* could be effectively controlled when treated with urea @ 400 kg/ha in solution. The affectation of the vegetation was gradual and complete destruction of the plants was observed within 6 months of treatments. No regrowth of vegetation was observed.

TREATMENT WITH COPPER SULPHATE SOLUTION : Thick healthy infestations of *Salvania* sp were treated with copper sulphate solution in 3 intermittent doses, each of 35 kg/ha. 95% of the *Salvinia* plants were decayed within 45-60 days and the remaining 5% were in a decaying state.

Problem	:	16.6	Autecology of aquatic weeds
Personnel	:		E. Mitra (Miss), S. C. Thakurta and A. C. Banerjee
Duration	:		Four years

Absorption of phosphorus and copper by plants has been studied. Further investigations are in progress.

Problem	:	16.7	(Research work completed in 1977)
Problem	:	16.8	(Research work completed in 1976)
Problem	:	16.9	(Research work completed in 1976)
Problem	:	16.10	Recycling of animal wastes and weeds in fish culture.
Personnel	:		V. R. P. Sinha, V. Ramachandran, A. K. Sahu K. M. Das. and G. C. Sahu.
Duration	:		Five years

Liquid wastes and washings from a cow-shed having 16 cows were allowed to flow into a 0.3 ha pond (1.5-2m depth), which was stocked with Indian major carps, silver carp and common carp @ 5000 fingerlings/ha, continuously. *Microcystis* bloom appeared every now and then but was checked by diuron treatment. The fish are growing well, particularly catla which have attained more than 1 kg in one year. No other management measure was adopted either.

Problem	:	16 11	Turn-over of major nutrients such as nitrogen, phosphorus and potassium in fish production
Personnel	:		V. Ramachandaran, V. R. P. Sinha, A. K. Sahu, M. Rout, K. M. Das and G. C. Sahu
Duration	:		Five years six months

Work could not be initiated due to technical difficulties.

Problem	:	16.12	Effects of herbicidal treatments on the bio-ecology of fish ponds
Personnel	:		A. K. Sahu, V. Ramachandran, K. M. Das and G. C. Sahu
Duration	:		Three years

Effect of diuron on pond fauna have been investigated. Plankton and bottom biota samples were collected from the pond before and after treatinig with diuron. It was found that in the pond, infested with *Pithophora*, there was practically no bottom organisms and plankton but with gradual kill of weeds, there was emergence of planktonic and benthic organisms. No mortality of fish was observed in ponds treated with diuron at 5 ppm.

Problem	:	16.13	Studies on aggressive capacity, viability and perennation of reproductive bodies of noxious aquatic weeds
Personnel	:		S. Patnaik and K. M. Das
Duration	:		Three years

Pistia and *Salvinia* were observed to grow actively during post monsoon months (August to October). Flowering in *Pistia* was observed during October to December, and in case of *Nymphoides* it was during September to January.

Project 17 : Frog Farming

Problem	:	17.1 to 17.4	(Research work completed in 1973)
Problem	:	17.5	(Research work suspended since 1972)
Problem	:	17.6	(Research work completed in 1975)
Problem	:	17.7	Development of hatchery complex for Indian commercial frog species
Personnel	:		A. K. Mondal
Duration	:		Three years

Successful hatching of eggs of *Rana tigrina* and *R. crassa* could be achieved in the miniature hatchery complex and about one lakh hatchlings were produced. Eggs used for the hatching experiment were obtained through induced breeding experiments conducted during April - August '78. Dissolution of superficial egg jelly was achieved in nine experiments by treatment [1½-2 hours] with sodium chloride [0.4%] and urea [0.3%] solutions [2 : 1] and also with a further treatment of pectinase solution [200 - 500 ppm]. In both types of treatment, good hatching was obtained under proper circulation of good quality deep tube-well water. The experiments show that the treatment with pectinase solution can even be omitted.

Problem	: 17.8 a)	Nursery management for Indian commercial frog species
Personnel	:	A. K. Mondal
Duration	:	Five years

5,000 tadpoles of *Rana hexadactyla*, were raised and reared upto early frog stage.

Investigations were conducted to study the efficiency of different feeds in controlling cannibalism in *R. tigrina* and *R. crassa*. Six experiments of 5-7 weeks duration were conducted in trays with *R. tigrina* tadpoles using frog meat and silkwrom pupae as feed. 76 and 60% survival were achieved in case of frog meat whereas with silkworm pupae it was more than 90%. In case of *R. crassa*, dried and powdered silkwarm pupae reduced the cannibalism to a great extent and 100% survival of tadpoles, reared to early frog stage, was achieved in one of the experiments.

An experiment of one month duration was conducted during September-October 1978 with 6-day-old tadpoles of *R.tigrina* at a stocking density of 15 nos./tray/4 l of water, in which 500 g of pond bottom mud was added. The controls were supplied with good quantity of zooplankters on alternate days and the treated group were daily fed with dried and powdered silkworm pupae and very little quantity of zooplankters supplied twice in a week. From an initial average weight of 22.5 mg, the tadpoles fed with silkworm pupae and zooplankters attained an average weight of 585.6 and 705.7 mg respectively in three trays in a period of 12 days, as against 65.4 and 90.0 mg in the controls fed with

zooplankters only. Their survival to early frog stage was 100, 100 and 93.33% respectively against 60.0 and 33.3% in the controls.

Problem	: 17.8 (b)	Rearing of tadpoles of *Rana tigrina* up to juvenile stage with supplementary feed
Personnel	:	S. N. Mohanty, C. R. Das and V. Panigrahi
Duration	:	Two years six months

Two different supplementary feeds *viz*, (i) fishmeal and goatmeat, and (ii) pelleted feed comprising fishmeal, boiled and dehydrated liver and wheat flour in equal proportions were tried and tadpoles metamorphosed within 25-59 days with 56% survival. The pelleted feed was found to be accepted by the tadpoles which showed healthy and homogenous growth and metamorphosed in comparatively lesser period (21-41 days), the survival being 60.5%. In control, the tadpoles exhibited acute cannibalism resulting in 16% survival and metamorphosis took place in 22 - 29 days.

Problem	: 17.9 (a)	Monoculture of *Rana hexadactyla*
Personnel	:	A. K. Mondal
Duration	:	Six years

Experiments on monoculture of *R. hexadactyla* could not be initiated due to technical difficulties.

Problem	: 17.9 (b)	(Research work completed in 1976)
Problem	: 17.9 (c)	(Research work completed in 1977)
Problem	: 17.10	Culture of earthworms for feeding frogs
Personnel	:	C. R. Das; S. N. Mohanty and V. Panigrahi
Duration	:	Four years

Ecology of *Pheretima* sp. and *Megascolex* sp. were studied. They were found to thrive best in moist loam soil where plenty of organic manure is present.

Culture experiments, conducted in yard and field, showed that compost manure, cowdung and rotten leaves applied in the ratio of 1:1:1 at a regular interval of 15 days enhanced the multiplication of *Pheretima* sp by 25 and 20 times respectively in yard and field.

Problem	: 17.11	Studies on the ecology of *Rana tigrina* (Daud) and their behaviour in nature
Personnel	:	S. N. Mohanty
Duration	:	Four years

In the observations carried out at Dhauli, *Rana tigrina* were found to come out from their hiding places at dusk and migrate to areas populated by nocturnal preys for feeding. During early monsoon rains in June and July they were noticed migrating to shallow pools & ponds for breeding. The egg mass was generally found adhered to weeds like *Cynodon, Marsilea* sp. at a depth of about 3.5 cm.

Problem	: 17.12	Culture possibilities of Brown Plant hopper *Nilaparvata lugens* for feeding the frogs
Personnel	:	S. N. Mohanty and C. R. Das
Duration	:	Three years

Experiments were conducted in specially designed wooden cages. Twenty pairs of insects were inoculated to 20 - 25 days old 'Jaya' variety of paddy seedlings. Sixty insects could be produced. Rate of multiplication decreased during summer months, even though constant humidity was maintained.

Problem	: 17.13	Optimum per hectare production of early frogs, juveniles and adult frogs of *Rana hexadactyla*
Personnel	:	C. R. Das and V. Panigrahi
Duration	:	Five years

Tadpoles obtained through natural breeding during spring and monsoon seasons were reared @ 10,000/ha and 20,000/ha in two tadpole rearing tanks. *Hydrilla* was used as food. 85% and 60% of the tadpoles metamorphosed into early frogs respectively at these two stocking densities.

Rearing experiments of the early frogs (av. l/av.wt. of 15 mm/0.5 g) were conducted in two .002 ha early frog rearing enclosures at a stocking density of 25,000/ha and 1 lakh/ha which grew to an average size of 65.4 mm/ 49.0 g in 8 months and recorded a survival of 55 and 25% with a prodctionu of 300 kg/ha and 1,225 kg/ha respectively.

In a 0.018 ha rearing enclosure, *R. hexadactyla* juveniles (av. l/av.wt. of 51.2 mm/22.1 g) stocked at a density of 6,000/ha, grew to an av. size of 67 mm/ 73.3 g in 7 months.

Problem	: 18.1.5	Culture of *Tilapia mossambica* in ponds fertilized intensively with sewage effluents
Personnel	:	Apurba Ghosh, K. K. Bhanot (Smt.) and S. K. Saha
Duration	:	Two years

In monoculture of tilapia utilising domestic sewage, a noteworthy production of 9,534 kg/ha was achieved in 14 months. *Tilapia* (134 5-141.3 mm/ 40-60 g) in the ratio of male : female — 3 : 2 stocked @ 20,000/ha in a 0.076 ha sewage pond of the Titagarh Municipality in June-July, 1977. The pond was initially fertilized with 17.8 lakh litre of sewage prior to stocking and periodic fertilization with sewage was done. Periodic harvesting of fish and fertillzing the pond with sewage were the management measures adopted.

During the course of investigation the Temp ; pH ; D.O ; COD ; CO_2 ; Total alkalinity ; Chloride ; Magnesium ; NO_2-N ; NO_3-N ; NH_3-N ; Phosphate ; Total solids ; Suspended solids; Dissolved solids and 5 days B.O.D. of RT ranged as 17.3°-30.0°C ; 7.9-8.3 ; 0.48-4.0 ppm ; 10.4-37.8 ppm ; 2 0-42.0 ppm ; 223.0-371.0 ppm ; 76.0-124.6 ppm ; 14.9-33 0 ppm ; Nil-0.1 ppm ; 0.025-0.36 ppm ; 0.98-4.2 ppm ; 1.95-6.0 ppm ; 3.00-1050 ppm ; 100-300 ppm ; 140-750 ppm ; 11.0-39.8 ppm respectively.

Problem	:	18.1.6	Production of carps in mixed culture operation with sewage effluents
Personnel	:		Apurba Ghosh, K. K. Bhanot (Smt.) and S. K. Saha
Duration	:		Four years

Composite fish culture of catla, rohu, mrigal, silver and common carp at a stocking density of 10,000/ha and in the ratio of C 1 : R 2.5 : M 2 5 : Cc 2.0 : Sc 2.0 was initiated in a 0.17 ha pond in September 1977. The pond was initially fertilised with 8,50,000 l of domestic sewage and periodic fertilisation with sewage ranging from 51,000-2,04 000 litres was done. A production of 5402 kg/ha/yr was achieved.

Chemical characteristics of sewage effluents and pond water during the course of the experiment varied as follows.

Temp : 17.3°-30.4°C, pH 7.6-8.4, D.O. 1.2-4.1 ppm. CO_2 nil-32.0 ppm, total alkalinity 190-330 ppm, COD 3 4-30.9 ppm. NO_2-N nil-0.031 ppm, NO_3-N 0.04-0.36 ppm, NH_3-N 0.13-2.0 ppm, PO_4 0.44-4.35 ppm, Ca 36.8-52.0 ppm, Mg 13.8-29.2 ppm, Chloride 80.0-110.0 ppm, total solids 440 0-960.0 ppm, suspended solids 600.0-510.0 ppm, dissolved solids 240.0-620.0 ppm, and Sp. conductivity 464×10^{-6}-1209×10^{-6}mhos.

Problem	:	18.1.7	(Research work suspended in 1978)
Problem	:	18.1.8	(Research work suspended since 1977)
Problem	:	18.1.9	(Research work suspended in 1978)
Problem	:	18.1.10	(Research work kept in abeyance)
Problem	:	18.1.11	Paddy-cum-fish culture in freshwater by renovating paddy plot
Personnel	:		Apurba Ghosh, S. K. Dutta (C.R.R.S.). K. K. Bhanot (Smt), A. B. Mukherjee, S. K. Saha and P. N. Bhattacherjee
Duration			Three years

In order to develop a system of paddy-cum-fish culture so that incidental to paddy some fish can also be produced thereby resulting in better returns, an experiment initiated in July '77 has resulted in a production of 5,000 kg of paddy (2 crops) and 708 kg of fish.

A paddy plot (1.02 ha) was renovated to suit this system of culture at Khardha, West Bengal. A trapozoid canal (0.27 ha in area), 3 m and 6m wide at the bottom and top respectively with an average depth of 1.2m running along the perimeter of the paddy plot, served as a water way for fish culture. The canal water was also used for irrigating rabi crop of paddy.

In the Kharif season, deep water, pest resistant, hybrid paddy (Jaladhi-II) was sown which was harvested in December, 1977 and about 1200 kg/ha of paddy was produced without any application of fertilizer and pesticide.

After the 'Jaladhi' crop was harvested, the plot was prepared for cultivation of a high yielding variety. "Jaya" seedling, grown in a specially prepared nursery bed, were transplanted to the main plot in February, 1978. The plot was initially fertilised @ 66.6 kg of urea, 400 kg of super phosphate and 66.6 kg of muriate of potash/ha. Two more doses of urea (106.6 kg/ha) were applied during the $4\frac{1}{2}$ months of 'Jaya' cultivation. Pesticides, *viz.*, Dimecron (533.3 ml/ha) and Benzene hexachloride (20 kg/ha) were used to control paddy pests, mainly rice hispa a paddy stem borer. Care was taken to prevent the leakage of pesticides into the perimeter canal harbouring fish.

During "Jaya" paddy cultivation in rabi season, regular irrigation was provided from the perimeter canal by adopting common lift irrigation method. Harvesting of "Jaya" paddy was made in the first week of Juneand a productiou of 3800 kg/ha was achieved Thus, a total produ ion of 5,000 kg/ha/annum of paddy was achieved from the paddy plot.

Fish culture

Indian major carps (catla, rohu, mrigal) were stocked @ 6000/ha in the ratio of C 4 : R 3.5 : M 2.5 in July '77. Paddy and fish were grown together for a period of 5 months from July-November and for the rest of the period fish was grown in the perimeter canal. The fishes were fed @ 5% body weight with mustared oilcake and rice bran in 1 : 1 ratio. The perimeter canal was fertilised with 4 tonnes/ha of cowdung,135 8 kg/ha of ammonium sulphate and 84.8 kg/ha of super phosphate.

The total fish harvested was 708.65 kg and the estimated gross production as per perimeter canal area (0.27 ha) was 2,624 kg/ha/annum but when the entire area of the culture system (1.02 ha) was considered for estimation, the production worked out to be 700 kg/ha/annum.

After harvesting, the perimeter canal was fertilized with 4.8 t of cowdung and stocked with catla, rohu and mrigal @ 4,000/ha in the ratio C 2.5 : R 4 : M 3.5. But due to unprecedented floods in September in the area all the stocked fish escaped into the adjoining canal and the experiment got vitiated.

Project 19 : *Hilsa Fisheries*

Problem	:	19.1	**(Research work completed in 1973)**
Problem	:	19.2	**(Research work completed in 1974)**
Problem	:	19.3	**(Research work suspended since 1973)**
Problem	:	19.4	**(Research work completed in 1973)**
Problem	:	19.5	**(Research work completed in 1973)**
Problem	:	19.6	**(Research work suspended since 1973)**
Problem	:	19.7	**(Research work merged with Problem 14.1)**
Problem	:	19.8	Culture of *Hilsa ilisha* (Ham.) in confined freshwaters
Personnel	:		J. C. Malhotra, K. L. Shah, B. K. Banerjee, S. K. Sarkar, M. Peer Mohamed, S. N. Mehrotra and Ramji Tewari
Duration	:		Seven years

Investigations were carried out at Farakka on the river Ganga and at Bharbhut on the river Narmada during the monsoon run of *Hilsa ilisha*.

RIVER NARMADA

Artificial fecundation : Artificial fecundation was successfully achieved through 'wet' method of stripping. Out of the fifteen experiments conducted eleven were successful (Table 4). The length of male used in the experiments ranged between 360 and 460 mm and that of females between 350 and 510 mm.

Table 4 : Showing detailed results of experiments conducted in river Narmada on artificial fecundation of hilsa through 'wet' method during 1978

Sl. No.	Date	Time in hrs.	BREEDERS DETAIL				Number of eggs (in lakhs)	fertilization (%)	SOURCE	Hydrological Parameters		
			Females		Males					Temperature (C)	pH	DO (ppm)
			T. L. in mm	Maturity	T. L in mm	Maturity						
1.	12.8.78	17 00	450	VI	410	Oz	10	0.0	River	28	8.2	6.2
					360	,,						
2.	12.8.78	17 45	510	VI	435	Oz	11	0.0	,,	28	8 2	6.2
					460	,,						
3.	13.8 78	16 30	460	VI	420	Oz	8	0.0	,,	28	8.2	6.2
					435	,,						
4.	13 8.78	17 15	480	VI	450	Oz	9	0.0	,,	28	8.2	6.2
					440	,,						
5.	14.8.78	17 30	510	VI	380	Oz	10	70	,,	28	8.2	6.0
					405	,,						
6.	14.8 78	18 00	490	VI	370	Oz	8	60	,,	27	8.2	6.2
					400	,,						
7.	15.8 78	16 30	480	VI	420	Oz	10	90	,,	27	8 2	6.2
					410	,,						
8.	15.8.78	17 10	390	VI	400	Oz	8	90	,,	27	8.2	6.0
					410	,,						

Contd.

Oz—Ozing

Table 4 (contd.)

Sl. No.	Date	Time in hrs.	BREEDERS DETAIL				Number of eggs (in lakhs)	fertilization (%)	SOURCE	Hydrological Parameters		
			Females		Males							
			T. L. in mm	Maturity	T. L in mm	Maturity				Temperature (°C)	pH	DO (ppm)
9.	15.8.78	18 30	490	VI	390	Oz	10	90	,,	26	8.2	6.0
					410	,,						
10.	16.8.78	16 30	470	VI	380	Oz	8	80	,,	28	8.2	6.4
					450	,,						
11.	16.8.78	19 00	350	VI	360	Oz	6	90	,,	26	8.0	6.4
					390	,,						
12.	19.8.78	19 10	490	VI	400	Oz	11	90	,,	28	8.0	6.4
					420	,,						
13.	20.8.78	19 30	480	VI	390	Oz	12	70	,,	27	8.0	6.0
					410	,,						
14.	20.8.78	16 30	440	VI	440	Oz	10	70	,,	27	8.0	6.0
					410	,,						
15.	21.8.78	19 30	490	VI	400	Oz	9	80	,,	28	8.0	6.2
					360	,,						

Oz—Oozing

The rate of fertilisation ranged from 60 to 90 percent. It was observed that Hilsa specimens in the right stage of maturity for stripping were available only between 16.00 and 22.00 hours in the catches from the Narmada river. In the four unsuccessful experiments the male used had died about 60 minutes prior to stripping.

Hatching of fertilised eggs : The resultant fertilised eggs were hatched out in markin and nylon cloth hapas ($2 \times 1 \times 1$ m) fixed in ponds at Attalai, Bharbhut, Ukai and in a hatchery where flowing water was available all through the experimental period.

At Attalai and Bharbhut, it was observed that only 10 to 30 per cent of the fertilised eggs hatched out and all the hatchlings died within an hour of their hatching. This low magnitude of hatching and total mortality of the hatchlings could be attributed to high concentration of iron (11.0 to 18.6 ppm) and low concentration of antagonistic calcium ions (20 to 40 ppm). In the ponds at Ukai where iron and calcium concentration ranged between 0.16-0.18 and 30-40 ppm respectively, the percentage of hatching fluctuated between 70 and 80 and only about 10% of the hatchlings died during the next 24 hours of rearing in the hapas.

In the indoor hatcheries, wherein continuous flow of water was maintained, the hatching success varied between 90 and 95%. The iron and calcium contents of the hatchery waters ranged between 0.16-0.18 and 30-40 ppm respectively.

Segregation of eggs and egg shells : Experiments were conducted to segregate dead eggs and egg shells, employing inner hapa of 1/15" meshed monofilament nylon netting in double walled hatching hapa in ponds. This did not give satisfactory results as all the eggs invariably passed through the inner hapa. Therefore, hatchlings were segregated mechanically. But when the incubator of the hatchery was made of 1/15" meshed monofilament nylon netting, 60 to 80% of the hatchlings could be segregated from dead eggs and egg shells.

Transport of the hilsa eggs and spawn : Fertilised eggs of hilsa was successfully transported in 18 litre capacity sealed polythene bags under oxygen. About 1.2 lakh eggs were packed in each bag containing 6 l of well water, and transported by road to a distance requiring 6-8 hours to cover. Mortality during transport ranged between 5 to 10 per cent only.

Successful experiments were also carried out for the transportation of hilsa spawn under oxygen in polythene bags of 18 l capacity. About 1.2 lakh hatchlings (3.0-3.5 mm in T. L.) were packed in each bag containing 8 litres of well water. Only 5% mortality occured during a period of 8 hours road journey.

Rearing of hilsa hatchlings : Two nursery ponds (area 100'×50') at Lingda Fish Farm and two ponds (area 100'×50') at Ukai Fish Farm were stocked with 1.2 lakh hatchlings (3.0-3.5 mm T. L.) of hilsa for nursery rearing.

In the stagnant water pond at Ukai, the hatchlings attained an average length of 75 mm in length range of 72 to 78 mm after 50 days of pond life (18.8.78 to 6.10.78). On November 3, 1978 they had grown to a size range of 72 to 82 mm and were thriving well. About 25 days prior to stocking, the pond was manured with cow-dung, poultry manure, monosuper phosphate, urea and lime @ 375, 375, 40, 20 and 10 kg per hectare respectively.

In the other pond at Ukai, wherein continuous flow of water was maintained, there was no survival despite artifical feeding of the hatchlings and transplantation of yard cultured plankton.

In both the ponds at Lingda, total mortality was obseved, the causes of which could not be ascertained immediately and are being looked into.

Metabolic rate :

Routine metabolism of pond reared fingerlings of hilsa (wt. 4.2 g ; T.L. 72 mm) was calculated as 144 mg/kg/hr while standard metabolism rate was 103 mg/kg/hr. The maximum and the minimum activity recorded was 80 and 20 counts/hr respectively. The asphyxial oxygen level for the fish was observed at 1.20 mg/l.

RIVER GANGA

1.0 lakh spawn of hilsa produced through 'wet' method of stripping at Farakka of the river Ganga was stocked in three ponds at the Rajourn Fish Farm. In two ponds in 19 days, 3 5-4.0 mm hatchlings had attained a size range of 9.0-12.0 mm while in the third pond in 28 days of rearing they had grown in the size range of 23.0-25.0 mm and are thriving well in all the ponds.

Problem	:	19.9	Fluctuations in the hilsa fisheries of the Hooghly estuary
Personnel	:		D K. De, G.P. Bhattacherjee and B.K. Saha
Duration	:		Six years

Studies were carried out in the upper stretch of the Hooghly estuary to delimit hilsa spawning grounds and to assess the spawning intensity of *Hilsa ilisha*. Larval collections were made by means of 1/2 metre organdi tow net and standard shooting net (1.6 mm mesh) at two centres *viz.* Balagarh and Monirampur along the Hooghly estuary during September to November. The observation revealed that the larval availability was very poor (3-4/net/hr) at Balagarh during October - November and nil at Monirampur.

Maturity stages of *H. ilisha* were studied in the Hooghly estuary around Nawabganj to ascertain its breeding grounds. Random samples of 55 ovaries were collected and the maturity and fecundity of the fish were studied. Variations in weight, length and width between paired ovaries were also worked out. The number of ova produced by a female in one spawning burst was found to range between 2,14,680 to 13,25 520 in specimens, ranging in total length and weight from 32.0 to 46.0 cm and 411 to 1,020 g respectively and averaged 5,73,706 eggs per kg of body weight. Ova diameters of 41 gonads were recorded, the ova were classified in terms of the International scale, into five stages. Ripe eggs ranged from 0.69 to 8.87 mm. Fish and ovary weight were plotted against number of ova and linear relationships were obtained. Ova diameter increased with increasing fecundity.

Project 20 : Water Pollution Investigations

Problem	:	20.1	(Research work completed in 1973)
Problem	:	20.2	(Research work completed in 1975)
Problem	:	20.3	(Research work completed in 1977)
Problem	:	20.4	(Research work completed in 1977)

Problem	:	20.5	Investigations on the Ganga and the Yamuna river ecosystems at Allahabad to determine the biological indicators of water quality
Personnel	:		S. N. Mehrotra and S. P. Singh
Duration	:		Six years

Sampling was done at three points *viz.* above outfall (AOF), outfall (OF) and below outfall (BOF) Studies have revealed that the discharge of city sewage in the two rivers affects the aquatic biomass primarily through uptake of oxygen. Low levels of DO were often noticed (0.8-4.8 ppm) near the outfall areas of the river Yamuna. The sewage carried a BOD load of 180-196 mg/l which gets stabilised near the outfall region. The river Yamuna showed more symptoms of pollution (BOD : 108-125 mg/l) as compared to the river Ganga (BOD : 74-86 mg/l) mainly because of high discharge rate in the Yamuna (700 litres/sec.). The sewage increased the downstream nutrient level in respect of nitrates (0.68-2.6 ppm), phosphates (0.8-2.0 ppm) and silicates (16-20 ppm). The outfall area was rich in mineral ions especially calcium (30 5-36 ppm) and magnesium (4.8-9.6 ppm). Free NH_3 was frequently observed at OF areas (1.6-11.8 ppm) in the Yamuna. The sewage also increased the alkalinity and hardness of water. Free CO_2 was invariably present at the OF area (1.2-20 ppm). No appreciable difference in water temperature was noticed but transparency and pH declined at the OF regions.

Plankton : Phytoplankton dominated over zooplankton in each zone of the river Ganga and Yamuna. AOF areas of both the Ganga and the Yamuna were dominated by Myxophyceae followed by Bacillariophyceae. OF and BOF areas were characterised by the abundance of *Microcystis* sp., *Oscillatoria* sp., *Hormidium* sp., *Synedra* sp , *Nitzschia* sp., and zooplankton was completely absent during January to August but appeared in September represented by *Kratella* sp.

Benthos : AOF area was mainly represented by gastropods (*Viviparus* sp., *Melanoides tuberculatus, M. lineatus*) and bivalves (*Corbicula* sp.) in the river Yamuna and gastropods (*Viviparus* sp.) and bivalve (*Corbicula* sp.) in the river Ganga. Oligochaetes (*Tubifex* sp.) were largely present in the river Yamuna. The OF area was dominated by chironomids followed by oligochaetes (*Tubifex*

sp. and *Nais* sp.) in both the rivers. In river Yamuna, dead molluscan shells were often encountered in the OF region. The BOF area was characterised by the dominance of *Chironomus* sp. followed by gastropods and bivalves in both the rivers.

Fish fauna : The fish species encountered at the three observational centres did not differ and were represented by *Mystus cavasius, Rita rita, Clupisoma garua, Setipinna phasa* and *Gadusia chapra.*

Problem	:	20.6	(Research work completed in 1977)
Problem	:	20.7	(Research work completed in 1978)
Problem	:	20.8	Pollution studies in inland waters caused by pesticides
Personnel	:		R. S. Panwar, R. N. Seth, Balbir Singh, D. N. Singh and R. K. Tyagi
Duration			Four years

Bio-assay studies, conducted with three pesticides *viz.*, DDT, Y-BHC and Malathion (Emulcifiable concentration) using *Cyprinus carpio* (T. L. 5.1 to 6 0 cm) and *Cirrhinus mrigala* as test fish, under static and continuous flow systems at 31° to 33°C water temperature, revealed toxicity in the following order : Y-BHC, DDT Malathion. The toxic effect of these pesticides was more pronounced on *Cirrhinus mrigala* than *C. carpio.*

The test fish, *Labeo rohita*, when treated with 0.005 ppm DDT for 60 days showed changes in its intestine and liver structure. Degeneration of the epithelial lining was observed in the intestine. Mucosa got ruptured with some villi dislocated and deshaped. The hepatic cells were swollen and ruptured in places. The accumulation of pesticide (DDT, 0.01 ppm) in the tissues of *L. rohita* in 30 days exposure was also studied using linear Readout grating Spectrophotometer. The accumulation of DDT was found more in liver than in the intestine.

Problem	:	20.9	The impact of pesticides on respiratory metabolism and energy utilisation in aquatic animals

Personnel : M. Peer Mohamed, G. N. Srivastava, R. A. Gupta and S. N. Mehrotra

Duration : Four years

Experiments were conducted to estimate the standard motabolism of *L. rohita* and the effects of short term (24 and 48 hr) exposure to 0.02 ppm ethyl parathion. The exposure of *L. rohita* (av. wt. 1.3 g) to 0.02 ppm ethyl parathion increased the standard metabolic rate from 75 (control) to 116 and 125 mg/kg/hr for 24 hr and 40 hr exposures at 20°C. At 30°C, the standard rate of metabolism of control fish (128 mg/kg/hr) increased to 157 and 190 mg/kg/hr for 24 hr and 48 hr respectively. It was observed that the increase in temperature from 20° to 30°C resulted in an increase of the standard metabolic rate of the fish from 35 & 72% in control and in exposed fish (0.02 ppm ethyl parathion) respectively.

Experiments were performed to find out the upper temperature tolerance limit in fishes. From the results, it was found that *L. rohita* (av. wt. 1.0 g) can tolerate upto 42.8°C in control water ; and *C. mrigala* (av. wt. 3.1 g) upto 39.5°C, in 0.005 ppm Gammaxene. During abrupt change in temperature from 30°to 35°C, the time taken for 100% mortality in *L. rohita* (av. wt. 2.0 g) was 165 minutes.

Experiments on low ambient oxygen tolerance in fishes showed that *C. mrigala* (av. wt. 1.9 g) can tolerate upto 0.8 mg/l, *L rohita* (av. wt. 15.0 g) upto 0.6 mg/l and *C. catla* av. wt. 3.0 g upto 0.6 mg/l at 25°C.

Problem : 20.10 Pollutional effects of industrial wastes on aquatic ecosystem

Personnel : R. S. Panwar, R. K. Saxena, D. N. Singh, R. K. Tyagi and Krishna Chandra

Duration : Two years

The pollutional effects due to discharge of industrial wastes of Kanoria Chemicals, (manufacturing caustic soda, bleaching powder and Gammaexna) in the ecosystem of Rihand reservoir were observed upto 100 m from the confluence during pre-monsoon, upto 30 m in monsoon and 50 m during post-monsoon months. The combined effluent was characterised by high pH [9-9.8] and

transparency values varying between 6.5 and 12.0 cm. pH at confluence showed alkaline range [8.4-8.6]. Free chlorine ranged between 24.72-185.68 ppm. Conductance ranged from 482 4 to 1 346.26 micro-mhos/cm Free chlorine was estimated at 0.5 to 5.8 ppm at 20 m distance from the confluence, while at 50 m distance, it was found in traces. At other points [100 m, 200 m, 400 m and 800 m from the confluence] pH ranged from 7.4 to 7.8 other parameters *viz.*, DO, conductance, chloride, hardness and total alkalinity ranged from 5.4-8 96 ppm, 76.7 to 411.8 micro-mhos/cm, 12-16 ppm ; 17.9-21.56 ppm and 36-82.0 ppm respectively.

The highly toxic effect of the effluent was indicated by the total absence of phyto- and zooplankton and benthos near the confluence. Benthos seemed to be severely affected upto 200 m from the confluence. Zooplankters were observed in dead condition upto 20 to 50 m from the confluence. Fish mortality was observed within the affected zones. The dead fishes observed in the affected zones were : *Mystus aor*, *Clupisoma garua*, *Catla catla*, and some weed fishes.

Problem	:	20.11	Environmental pollution in the Hooghly estuary with reference to heavy metals disposed through industrial wastes
Personnel	:		B. B. Ghosh, N. N. Sarkar and M. M. Bagchi
Duration	:		Two years eight months

While zinc content in the effluent of rayon, paints & varnish and rubber industries was recorded as 2.02, 0.60 and 00.2 ppm respectively, higher accumulation of zinc to the extent of 3 84, 2 28 and 3.86 ppm was observed in the bottom sediment near the outfall areas of the respective industries. Zinc accumulation noted in the bottom mud near the outfall was also higher as compared to that of above the outfall [traces-1.50 ppm]. The most toxic environment was noted around the rayon outfall as reflected from highly acidic condition [pH 3 3], low DO (1.9 ppm) and hardness (100 ppm as $CaCO_3$) of estuarine water and bioaccumulation of zinc (0 20 ppm) in *Macrobrachium rosenbergii*.

Problem	:	20.12	Physico-chemical and biological characteristics of soil around the outfall area of a paper mill (soda process)

Personnel : S. B. Saha, P. Ray and S. P. Ghosh

Duration : One year

Soil samples collected from 5 different sites around the 2 main discharge points of the Tribeni Tissue Mills (soda process) were kept in glass jars (5 sets with 2 replications) to study the reappearence of plankton. After 30 days, plankton growth was observed in samples from centres 1 (unpolluted) & 5 (recovery zone) followed by centres 2 and 4 (polluted).

After 2 months the phytoplankton biomass ranged from 3-10u/l and zooplankton 2-5u/l.

During monsoon, phytoplankton growth showed similar trend of growth but during winter, sudden increase was observed when the biomass was : phyto - 5-24/ul. (*Nitzschia* sp., *Surirella* sp., *Navicula* sp., *Closterium* sp., *Oscillatoria* sp.,) and zooplankton - 2-15/ul (ciliates, *Euglena* sp., rotifer and nematodes). Centres 2 & 4 were comparatively less productive.

Effect of pollution below the outfall areas (centres 2 and 4) is appreciable during summer months due to decomposition of pulp associated with other organic materials which reduces oxygen to the extent of 82-94% against 55 0 - 55.2% observed at other centres (unpolluted and recovery zones, 1 & 5).

It is evident from the study that the bottom soil in a streatch of 600 m. (from above the 1st. outfall to below the 2nd outfall) is polluted due to decomposing pulp and other organic matters.

Problem : 20.13 Effect of supernatant waste water on the fisheries of Kulti estuary

Personnel : P. Ray, B. B. Pakrasi, S. B. Saha, A. B. Mukherjee and N. N. Sarkar

Duration : Three years

To study the effect of supernatant waste water of Calcutta Metropolitan area on the fisheries of Kulti estuary, two centres in the main Kulti canal carrying the municipal waste of Calcutta have been selected.

The chemical paramaters of the water, like pH, DO, BOD and specific conductivity ranged from 7.9-8.0, nil - 4.0 ppm, 60 ppm and 10684×10^{-6} mhos

respectively at the lock gate while above the lock gate (2 km) the values were 7.3, nil, 40 ppm and 2170×10^{-6} mhos. The soil pH, sp. conductivity, oxidation-reduction potential and organic carbon content were 7.78, 2778×10^{-6} mhos, —0.43 mv and 1.23-1.56% respectively at the lock gate, and 6.76, 1543×10^{-6} mhos, —0.49 mv and 0.78% at the point below the lock gate.

Phytoplankton and zooplankton ranged from 85 - 112 and nil - 7 units/litre at the lock gate while 2 km above the values were 125 and 5 units/litres respectively. The dominating species of phytoplankton were *Oscillatoria* sp. *Spirulina* sp. and *Microcystis* sp and among zooplankton *Diaptomus* was dominating. Among benthos tubifecids (350 and 690 nos /sq. ft) were dominating at both the points.

Project 21 : Fisheries of River Basins

Problem	:	21.1	Ecology and development of *Mans* in Gandak Basin
Personnel	:		V. R. Chitranshi, R. N. Seth and D. Kapoor
Duration	:		Three years

Based on a preliminary survey of the 'mans' in and around Muzaffarpur, two 'mans' *viz.*, Sikandarpur and Manika have been selected for detailed studies.

Project 22 : Fish Culture in Running Water

Problem	:	22.1(a), (b) & (c)	(Research work suspended in 1978)
Problem	:	22.2	Catfish culture in running water
Personnel	:		S. P. Singh, J. C. Malhotra, K. P. Srivastava and Krishna Chandra
Duration	:		Eight years

(i) Assessment of catfish seed :

To assess the availability of seed of catfishes, *Mystus seenghala* and *M. aor*, in time and space, a 10 km stretch in river Ganga around Allahabad was sur-

veyed during March-June. 25 live breeding pits of *M. seenghala* were located during a period of 10 days yielding c 8,000 hatchlings/early fry (size range: 10-40 mm). The number of hatchlings per live breeding pit ranged between 200-500. The river received freshets in the month of June submerging the breeding grounds and no more pit could be located thereafter.

(ii) Rearing experiments :

Experiments on rearing the hatchlings/early fry of *M. seenghala* were undertaken in floating nylon cages (size 1 × 1 × 1 m) in the river Ganga at Shankerghat. The hatchlings were given 1 ppm Acriflavin bath before stocking them in the cages. The feed provided were chironomid egg mass for first 10 days followed by semi-boiled trash fish. The length increments attained and the periods of rearing are presented below :

Expt. No.	No. of fry	Size range (av. size) (mm)	No. of rearing days	Size range attained (av. size) (mm)
I	100	26 - 38 (28)	143	160 - 225 (180)
II	200	10 - 35 (20)	139	140 - 185 (157)
III	250	15 - 35	111	90 - 194 (117)
IV	300	15 - 35 (30)	124	93 - 185 (113)

Experiments on the monoculture of *M. seenghala* fingerlings (100 nos.), reared in floating nylon cages of 1 m^3 size were conducted in the river Ganga at Shankerghat. Semiboiled trash fish was provided as feed @ 5% of body weight twice daily. The fingerlings (size range 116-182 mm, & average size 146 mm), attained an average length of 228 mm in the size range of 193-300mm in 220 days of rearing.

During August, sudden mortality in cages was observed. The affected fingerlings developed a dull shade at the caudal region and became lethargic ultimately settling at the bottom before death. Other catfishes *viz. C. garua, S. silondia* and *A. coila* encountered in the catches from the same area were also

found to be similarly infected at the caudal region and showed similar symptoms before death. The carps encountered in the catch had no such infection. Bath in 1 ppm $KMnO_4$ solution, however, resulted in reducing the mortality and finally controlling it after two days.

Laboratory experiments were conducted to evolve a substitute for chironomid egg-mass for rearing the hatchlings. The jelly like mass formed when "Isabgol" seed *(Planlago* sp.) were soaked in water for a minimum period of 12 hours was provided to the hatchlings of average size 20 mm collected from the pits. Nibblings on the mass and its presence in the guts of the fry was observed. Trials in this direction are being continued.

The first successful attempt towards long distance transport of *M. seenghala* early fry (size range 29-50 mm) in sealed plastic bags under oxygen, by rail from Allahabad to Cuttack was made in May. The mortality reported was 2.5% only.

Problem	:	22.3	Cage culture in lentic water
Personnel	:		A. V. Natarajan, R. K. Saxena, N. K. Srivastava and B. D. Saroj
Duration	:		Five years

The rearing of fish stocked in $\frac{1}{6}$" wire mesh iron cages was further continued at Jari tank upto 23 4.78. In January 1978, the density was reduced to 300 fish each in two cages ($2 \times 1.5 \times 1.5$ m area) for providing more space. Fish meal was included in the feed, containing soyabean powder, ground nut oilcake and rice polish along with the mineral compound "milkmin mix" and was tried in cage 2. No change in growth was recorded in fish in cage 2 as compared to the fish in cage 1 to which only soyabean powder, ground-nut oilcake and rice polish were given. Fish meal and mineral mix were, therefore, discontinued after two months trial.

The cages were shifted from Jari to Gulariya reservoir on 24.4.78 and 25 4 78. 95 fishes suffered mortality during transport. Resulting infection was controlled by giving a bath of 2% NaCl and Acriflavin (1 ppm) daily for about a

week. The remaining fish were transferred to 3 wire-meshed cages, cage 1 & 2, having 100 fish each and cage 3 about 285 fish. Feed comprising soyabean powder, ground-nut oilcake and rice polish was given @ 10% of the body wt. in cage 1 & 2 whereas Nuvimin forte - a vitamin trace mineral feed supplement was added @ 0.2% in the feed and fed to the stock in cage 3 from 19.6.78 onwards. The wire mesh of cage 3 gave way in the month of July and as a result except for 8 catla, all mrigal found entry into the reservoir. The catla were transferred to cage 1 on 19.7.78. Feeding schedule for cage 1 was,therefore, changed from 29.7.78 and Nuvimin forte was included in the feed.

As in the previous year, growth recorded during winter months was poor. In a period of about 22 months of rearing in cages, catla attained an average length of 405.4 mm (370-430 mm) and an av.wt. of 1030 g (780-1,150 g), mriga recorded an average of 267.1 mm (236-302 mm) in length and 188.5 g (130-270 g) in weight.

544 fingerlings of major carps, reared from spawn stage in a cage were released in Gulariya reservoir on 24.4.78 after eight months' of rearing.

The nylon hapa cages, for rearing riverine spawn, were provided with split-bamboo screen covers to mitigate the impact of strong waves and wind prevalent in the Gulariya reservoir. About 40,000 (130,000,000/ha) and 44,000 (140,000,000/ha) young hatchlings collected from the river Yamuna on 6-7 August and 9-11 August, 1978 were stocked in two separate nylon hapas of $\frac{1}{16}$" mesh netting on 17.8.78. By 28.8.78, the hatchlings attained an average length of 14.00 mm (10-17 mm) and 12.3 mm (9-15 mm) from an initial average size of 7.0 and 7.6 mm respectively.

Problem : 22.4 Pen culture in lentic waters

Personnel : V. Kolekar, H. P. Singh, M. Chaudhury and R. Chandra

Duration : Three years

Dighalimari beel, situated at a distance of 38 km from Gauhati, was selected for conducting pen culture experiments using common carp fingerlings.

During the first year of experiments, trials were made for judging the suitability of pen material. To start with, a bamboo frame work was installed in the beel.

One hundred common carp fingerlings, collected from Ulubari Fish Farm, Govt. of Assam, have been stocked in the pen on 8.9.78. The fingerlings are being fed with artificial feed (rice bran and oilcake) in the ratio of 1 : 1 @ 4% of body weight. The growth till October had, however, been practically negligible.

Hydrological observations :

Fortnightly surface water samples from inside and outside the pen were collected and analysed. The ranges of water temperature, pH, total alkalinity, free CO_2, Dissolved oxygen, nitrate and phosphate fluctuated between 27.0° & 32.0°C, 6.4 & 6.6, 36.0 & 38.0 ppm, 12.0 & 20.0 ppm, 3.60 & 6.60 ppm, 0.16 & 0.19 ppm, and 0.20 & 0.22 ppm respectively inside the pen ; whereas their respective values fluctuated between 28.0° & 34.0°C, 6.4 & 6.8, 24.0 & 30.0ppm, 4.0 & 10.0 ppm, 6 75 & 7.16 ppm, 0.13 & 0.15 ppm, and 0.17 & 0.18 ppm outside the pen. It was observed that free CO_2 was high and D.O. was quite low inside the pen water compared to the outside water.

Project 23 : Bundh Breeding

Problem	:	23.1 (a)	Breeding of major carps through 'Canal breeding Technique'
Personnel	:		G. N. Mukherjee, S. J. Karamchandani, G. N. Srivastava, K. Chandra and A. V. Natarajan
Duration	:		Four years

Investigations on the breeding of major carps *L. rohita* and *C. mrigala* through canal breeding technique were repeated at the site Basehra, where success was achieved during the preceeding year. Based on previous year's experience, necessary charges were affected in the general lay-out. Additional spawning ground was provided near the outlet of the breeding chamber and a masonary structure was erected at the outlet for fixing the meshed screen. The 'breeding chamber' was also extended to accomodate more brood fishes for the experiment.

Heavy shower occurred in June-end and the gonads of the brood fishes too were in the ripe condition. However, due to non-availability of water in the canal, the experiment could not be initiated. Prolonged drought conditions prevailed thereafter with intermittent mild showers in July when brood fishes (mrigal and rohu) were released in the chamber. Although congregation and some sex-play was observed, no breeding occurred. The water temperature remained above 30°C throughout July. Although the weather conditions improved in August, gonads of brood fishes were seem to be undergoing resorption and the experiment had to be suspended.

Problem	:	23.1 (b)	Bundh breeding of major carps
Personnel	:		S. K. Wishard, Balbir Singh and S. N. Mehrotra
Duration	:		Eight years

Experiments were conducted on the breeding of major carps in three dry bundhs of Nowgong (Chhatarpur, M.P.). The first experiment was carried out in the main dry bundh by releasing fully mature brood fishes comprising 24 female and 36 male catla, 30 female and 45 male rohu, and 2 female and 3 male mrigal in the ratio of 1:5 by weight and 1:2 by number between male and female of individual species.

Maximum depth of water in the dry bundh was 1.40 m on the 5th July 1978 and the weather was cloudy with intermittent showers between 14.30 hr and 17.30 hr, when the brood fish were released. Sex-play commenced around mid-night and continued till 07.00 hr of 6.7 78. About 180 lakhs eggs were collected and incubated in 150 hapas for hatching in the bundh. Fertilisation was estimated at 84% and hatching at 66.6%. The total yield of hatchlings was estimated to be about 120 lakh.

Physical and chemical parameters of the bundh water were : air and water temparatures 27.0°C, turbidity 250 ppm, pH 6.6, DO 6.0 to 6.8 ppm, total alkalinity 20-40 ppm, chloride 5.0-8.0 ppm, calcium 6.7 ppm, Mg 0.61-0.65 ppm and specific conductivity 190 0-195 0 mhos/cm at the time of breeding. Soil analysis showed a pH of 7.2 with percentage of sand, silt and clay being 68, 11 and 21 respectively.

The second experiment was conducted in Chhatrsaal dry bundh by releasing 50 catla, 50 rohu and 8 mrigal on 14.7.78 between 13.00 hr and 17.00 hr.

The catchment area did not receive any rain until 48 hours after the release of the brood stock. Consequently, no breeding was observed. A moderate rainfall on 21.7 1978 did not provide sufficient stimulus to cause breeding.

Air and water temperatures varied from 26.0°-32°C and 27°-29°C respectively. Turbidity, pH, free CO_2, total alkalinity and DO were recorded at 270-300 ppm, 6.4-7.2, 2.8-12.0 ppm, 20-24 ppm and 3.8-4.8 ppm respectively. Ca^{++}, Mg^{++} and Cl^{-} content of water were in the range of 4.6-4.0 ppm, 0.30-0.32 ppm and 8.0-9.2 ppm respectively. Soil pH was slightly acidic (pH 6.8) with percentage of sand, silt and clay being 60, 24 and 16 respectively.

In Alipura dry bundh, 30 female & 30 male catla, 40 female & 50 male rohu, and 1 female & 3 male mrigal were introduced on 27th July 1978 between 17.00 hr and 23.00 hr. Sex play commenced soon after the release of the fish despite unfair weather (no rain and clouds), and continued till 17.00 hr of the next day. Very few pairs of rohu mated and check trials made for the collection of eggs yielded stray eggs in each haul. Breeding was partial until a moderate shower on 30.7.1978 when even catla responded.

Physico-chemical parameters were observed to be : Air and water temperature 26 0°C, pH 6.6, DO 3.8 to 4.8 ppm and turbidity 660.0 ppm. Soil was alkaline (pH 7.2) with percentage of sand, silt and clay being 60, 24 and 16 respectively.

Investigations on the inter relationship of environmental conditions and the breeding of carps indicated declining trend in total alkalinity, Cl^{-}, and specific gravity, and an increasing trend in Ca^{++}, Mg^{++}, total iron, hardness and SO_4 in the water regime at the time of breeding. Specific conductivity at 190-195 mhos (29.0°C) and pH at 6.6 and turbidity above 120 5 ppm were found conducive for breeding carps in these bundhs.

Project 24 : Freshwater Urban Aquaculture

Problem : 24.1 Intensive rearing of Indian major carps in circulatory-filtering system

Personnel : V. G. Jhingran, K. K. Sehgal, B. B. Ghosh and Kuldip Kumar

Duration : Three years

In a set of two ponds at the CIFRI campus, Barrackpore a circulatory-filtering system was installed in the first half of November 1978. In the last week of November 1978, one pond holding 290 m^3 of water was stocked with fingerlings of *Catla catla* of an average length of 35 mm and average weight of 2.2 g at the rate of 38 fingerlings/m^3. In the second pond holding 235 m^3 of water, *Labeo rohita* fingerlings of an average length of 45 mm and average weight of 2.9 g were stocked at the rate of 32 fingerlings/m^3. Circulation of water was carried out for six hours between dawn and dusk. The fingerlings were fed on commercial pellets having 26-28% crude protein level supplemented with essential vitamins and minerals at the rate of 5% of body weight. The daily ration was divided into three meals. In a period of 19 days of rearing catla attained an average length of 76 mm (68-114 mm) and an average weight of 5.0 g. Rohu fingerlings in the same period attained an average length of 95 mm (88-134 mm) and average weight of 10 g. The conversion rate is 1.4 in catla and 1.1 in rohu while feed efficiency is 65% in catla and 74.9% in rohu.

Problem : 24.2 Estimation of 'satiation rate' and utilisation of pelletised feed by *Labeo rohita* and *Clarias batrachus*

Personnel : Kuldip Kumar and M. K. Mukhopadhyay

Duration : One year

Experiments were undertaken to estimate the feeding capacity and utilisation of feed by *Labeo rohita* and *Clarias batrachus*. In all six feeding trials were conducted with 14 specimens each of *L. rohita* and *C. batrachus* (mean weight 131 g and 94 g respectively). 'Conditioning' of the fry was done by feeding the fry @ 2-3% body weight thrice daily for two weeks. Pellets of the size range 5.0-80 mm comprising oilcakes and rice bran (1:1) were given to *L. rohita* whereas *C. batrachus* were fed on a mixture of fish meal, rice bran, casein, flour and becadex. On fifteenth day of feeding, a known amount of feed totalling 5-7% of body weight, was presented to the fish every five minutes constantly for one hour. Left out metabolites were siphoned out, dried and weighed. Thirty minutes after the last feeding fishes were killed to remove and weigh the gut contents. Details of the experiments have been indicated in table 5.

Table 5 : Showing details of experiments on estimation of 'satiation rate' and utilisation of pelletised feed rohu and magur.

Fish	Month of Experiments	No. of Specimen	Mean wt (g)	Total feed given (g)	% of body wt.	Feed consumed (g)	% of body wt.	Feed removed/utilised (g)	% of bodywt.	% of specimen with full gut
Labeo rohita	Feb. '78	12	89	4.45	5	3.20	3.6	1.24	1.4	33
	Jul. '78	17	120	7.20	6	5.00	4.2	2.16	1.8	41
	Sep. '78	12	99	7.00	7	4.15	4.1	2.99	2.9	33
Clarias batrachus	Feb. '78	14	69	3·45	5	2 60	3.8	0.85	1.2	57
	Jul. '78	16	80	4.80	6	3.60	4.5	1.20	1.5	68
	Sep. '78	12	71	4.90	7	3.30	4.7	1.65	2.3	50

Experiments showed that out of the presented feed @ 5%, 6% and 7% body weight *L. rohita* consumed @ 3.6%, 4.2% and 4.1% body weight while *C. batrachus* consumed @ 3.8%, 4.5% and 4.7% body weight respectively. Presentation of higher rate of feed did not make any significant differences in the acceptance of the feed and the 'push effect' had least impact on the total intake. Fishes were found to be satiated after feeding 3.9% of the body weight of feed in case of *L. rohita* against 4.4% body weight in case of *C. batrachus*.

Project 25 : Beel Fisheries

Problem	:	25.1	Ecology and fishery management of a selected beel in Assam
Personnel	:		Ravish Chandra, H.P. Singh, M Choudhury, V. Kolekar and R. K Sinha
Duration	:		Five years

Hydrobiological studies have been initiated in June. The ranges of surface water temperature, pH, transparency, total alkalinity, free CO_2^{-}, D.O., nitrate and phosphate fluctuated between 28 0° and 32 0°C, 6.2 and 6.9, 20.0 and 21 0 cm., 15.0 and 30 0 ppm. 4.0 & 24 0 ppm. 3.66 & 9.28 ppm, 0.12 & 0 27 ppm, and 0 16 & 0 36 ppm respectively. The gross and net organic carbon production fluctuated between 1.75 and 25.00 mg C/m^3/hr and 12.5 and 18.74mg C/m^3/hr respectively.

Project CFCSP : Composite Fish Culture and Fish Seed Production

Problem	:	CFCSP 1.1	Composite fish culture and fish seed production
Personnel	:		V.R P. Sinha, K.K, Ghosh, K.K. Sukumaran, D.V. Pahwa, M.Y. Kamal, R.M. Rao, K. N. Krishnamurthy, M. Sinha, B. N. Singh, K. G. Rao, P. M. Mathew, J.B Rao, D.N. Mishra, B.C. Tyagi, P. K. Aravidakshan, J. C. Markandey, A. Mukherjee, D. P. Chakraborty,

Dhirendra Kumar, P. K. Saha, B. K. Singh, P. C. Mahanta and P. N. Jaitly

Duration : Nine years

The project, conducting investigations to intensify scientific fish farming through wide-scale implementation of composite fish culture technology under varied agro-climatic conditions of various States of the country, achieved the record high fish production of 10,194kg/ha/yr at its Pune Centre surpassing the previous highest production of 9,400 kg/ha/yr recorded in the experimental ponds of the Institute at Cuttack in 1974. The production now stands to be the highest recorded from freshwater ponds and is favourably comparable to the highest production records in still water ponds in the world. The other stricking feature of the experiment has been the use of fry (av. size : 34 mm/0.6 g) of six species of Indian and exotic carps as stocking material instead of fingerlings as is usually done. The rate of survival was highly encouraging (98 8%) indicating the feasibility of introducing fry as stocking material in ponds free from predators and adequately managed The significance of the experiment may be far reaching in curtailing one step of rearing fry to fingerling stage and is economical and advantageous in view of shortage of available rearing space. In another experiment, with five species combination (excluding grass carp) and fry as stocking material, the production obtained was 7,043 kg/ha/yr.

Considerably high production was also achieved at Karnal (5,909 kg/ha/6 months), Jaunpur (7,371 kg/hr/yr), Gauhati (6,537 kg/ha/yr), and in Ranchi, where acidic character of water prevails, the production recorded was 3,526 kg/ha/yr.

At Badampudi, the compatibility of *Macrobrachium malcolmsonii* with six species of Indian and exotic carps was tested. In two experiments with six species combination, the rates of gross production of the prawn recorded were 10.33 & 35.8 kg/ha 10 months (4.3 and 15 4% survival) as against 56.7 kg/ha/10½ months and 80.8 kg/ha/10 months (19.4 and 35.4% survival) recorded in other two experiments with five species combination (excluding grass carp) This suggests that *M. malcolmsonii* is not compatible with grass carp perhaps because the latter is destructive to the habitat of the prawn.

Fish Seed Production: Indian major carps were successfully induced bred at all centres, except at Ranchi where breeding of Chinese carps alone was taken up. Five sets of mrigal were bred twice at Bhavanisagar after an interval of 45 days. Breeding of Chinese carps was successfully carried out at Assam, Kalyani, Ranchi, Jaunpur, Badampudi, Bhavanisagar, Pune and at Dhauli. Silver carp was induced bred for the first time at Badampudi centre. A total quantity of 363.0 lakhs of spawn was produced during the year, consisting of 245.1 lakhs of Indian major carps, 12.5 lakhs of silver carp and grass carp, 0.2 lakhs of *P. gonionotus* and 105.2 lakhs of common carp.

Problem	: CFCSP 1.2	Composite fish culture and fish seed production
Personnel	:	V. R. P. Sinha, H.L. Bhatia, S. K. Mohanti, V. Natarajan, P.E.B. Menon, N. G. Mazumdar, R.L. Thawati, K.E. Chaudhary, V. R. Khadre, N. Sukumaran and P.V. Rao
Duration	:	Four years

Investigations at the centrally sponsored centres also yielded encourging rate of fish production. At Kausalyagang (Orissa), production at the rate of 4,107 kg/ha/6 months was achieved. The production at this centre has significantly improved from that of recorded earlier (1,929 kg/ha/10 months). Fish production with different combinations of Indian and exotic carps ranged as 3,968-4,248 kg/ha/14 months at Godhra (Gujarat) ; 3,279-3,338 kg/ha/yr at Khutelabhata (Madhya Pradesh) and 1,600 kg/ha/7 months - 3,578 kg/ha/9 months at Coimbatore (Tamil Nadu).

Fish Seed Production : At Kausalyagang, 65.46 lakhs of Indian major carps and 51.23 lakhs of common carp seed were produced. Grass carp was bred successfully at this centre during the year. At Godhra, 16.55 lakhs of Indian major carps and 5.89 lakhs of common carp hatchlings were obtained. Grass carp was induced bred for the first time. At Kutelabhata, silver carp was bred by hypophysation for the first time, resulting in the production of 3,000 numbers of spawn. Induced breeding of common carp was also successfully carried out. At Coimbatore, induced breeding of Indian major carps yielded 8.0 lakhs of spawn.

Problem	:	CFCSP 2	(Research work completed in 1977)
Problem	:	CFCSP 3	Reproductive physiology of Indian and Chinese carps
Personnel	:		V.R.P. Sinha, H.A. Khan, K.K.Sukumaran and M. Sinha
Duration	:		Five years

The relation between hydration and spawning of the female carps during hypophysation has been established. On capture, the female spawners lose weight and continue to lose, while the injection of exogenous pituitary material induced hydration of the fish and fishes show increase in weight. The sum total of gain and loss of weight indicates the success of hypophysation. Those still showing loss of weight at the time of 2nd injection or stripping do not ovulate, whereas 70% of the fish which show gain at the time of second injection or stripping ovulate. The phenomenon can help predicting the success of induced breeding and thus, it should be a common practice that the female spawners may be weighed (without anaesthetising) before the first injection of the pituitary extract. Those fishes which still show loss of weight before the second injection may not be injected and put back to the pond, and fishes showing increase in weight should be injected.

Problem	:	CFCSP 4	Efficacy of Bramhaputra silt as a fertilizer in composite fish culture
Personnel	:		K. G. Rao and P. C. Mahanta
Duration	:		Two years

Experiments were carried out in two ponds (0.06 ha each) at Gauhati, one treated with riverine silt (@ 30 tons/ha/yr in equal quarterly instalments) as fertiliser, and the other with organic (cowdung @20 tons/ha/yr) and inorganic (urea-200 kg ; single superphosphate-250 kg ; and muriate of potash-40 kg/ha/yr in monthly instalments in alternative combination). Both the ponds were stocked with five species combination of Indian and Chinese carps (excluding grass carp) @3,000 fingerlings/ha. The pond treated with riverine silt (pH 6.5, organic carbon

0.3%, P_2O_5 33.37 and K_2O 83.42 kg/ha) yielded a production of 1.270 kg/ha/6 months whereas the other pond recorded a production of 1,868 kg/ha/6 months. Soil of both the ponds was found to be acidic (pH 5.6-5.7) in nature. However, the pond treated with riverine silt showed increased pH level and improved nutrient conditions. Data on other aspects are being analysed.

Problem	: CFCSP 5	(Research work suspended since 1975)
Problem	: CFCSP 6	Biology and role of grass carp, *Ctenopharyngodon idellus* in composite fish culture
Personnel	:	K. K. Sukumaran
Duration	:	Four years

Experiments initiated in two ponds at Kausalyagang (Orissa) could not be continued till completion due to some technical difficulties.

Problem	: CFCSP 7	(Research work completed in 1978, final report is being prepared)
Problem	: CFCSP 8	(Research work completed in 1978)
Problem	: CFCSP 9	Composite fish culture in running water
Personnel	:	K.N Krishnamurthy and P.K. Arvindakshan
Duration	:	Four years

The work could not be initiated due to some technical difficulties.

Problem	: CFCSP 10	Operational Research Project on Composite Fish Culture
Personnel	:	B K. Sharma, M.K. Das, S. R. Das and Dilip Kumar
Duration	:	Seven years

Experiments were undertaken at Krishnanagar (West Bengal) to evolve suitable systems of combining live stock rearing with fish culture, to study the efficiency of dung of these animals/birds as fertilizer in fish culture, and to assess economic viability of the technology in integrated fish farming. Combinations tried were i) fish-cum-pig rearing and ii) fish-cum-duck rearing.

Fish-cum-pig rearing experiment was conducted in a 0 1 ha pond stocked with six species of Indian and exotic carps. Pig-dung collected from the pig-sties was applied in the pond every day. About 2,000kg of pigdung was recycled in one years time. No other management measure was adopted either. All the stocked fishes except common carp recorded remarkable growth rates. Silver carp, grass carp, catla, rohu and mrigal attained average weights of 2.1, 1.3, 1.1 and 0.89 kg respectively in 12 months' rearing. A fish yield of 7,300 kg/ha/yr was achieved. The average cost of production of fish worked out to 95 p/kg. Two lots of piglets were raised during 12 months' time and 1095.7kg of pig flesh was produced.

A profit of Rs 4,881.93 was made from the fish produced. An additional profit of Rs. 1,578 85 was also made from pig rearing. It is estimated that about 40 pigs should be raised for manuring 1 ha water area.

Fish-cum-duck rearing experiment was conducted in a 1.48 ha pond. Six species culture of Indian and Chinese carps stocked @ 6,000 fingerlings/ha was carried out alongwith the rearing of 100 ducklings (Bengal runner and cross breed of Bengal runner and Khaki Campble). A floating duck horse (50 × 3 ft) was designed and constructed on the pond from where the duck droppings directly went into the pond and automatically recycled. During day time, remaining night collections were broadcast over the pond. No other management measure was adopted for the fish culture but for the ducks supplementary feed, comprising poultry feed (50%), mustard oilcake (20%) and molluscs (30%), was provided @ 150 g/day/bird.

A total fish yield of 6,397 kg, corresponding to a production rate of 4.328 kg/ha/yr was recorded from this pond. The cost of production of fish worked out to Rs. 1.38/kg. Incidental to fish produced, 1,835 duck eggs were also collected. An overall profit of Rs. 27,095.00 was made from fish-cum-duck rearing. It is estimated that 100-150 ducks are required for manuring a pond of 1 ha.

The integration of fish culture with livestock rearing has unveiled a new horizon of high fish production at very low cost. Besides providing protein rich food, it has proved to be an effective method of waste disposal, with considerable savings in fertilizer and supplementary feed.

Problem	:	CFCSP 11	Biology of silver carp, *Hypophthalmichthys molitrix* (C & V) and its performance in composite fish culture
Personnel	:		B. K. Sharma
Duration	:		Five years

Studies on the developmental stages (from fertilised egg to fry stage) of silver carp were completed during the year. Camera Lucida diagrams were drawn and photographs of various selected stages were taken. Food and feeding habits of the fish during various months of the year were studied by analysing gut contents. Fecundity studies were also continued.

Problem	:	CFCSP 12	The pituitary gonad feedback relationship in *Mystus vittatus*
Personnel	:		Ardhendu Mukherjee and V.R.P. Sinha
Duration	:		Five years

The work could not progress due to some technical difficulties.

Problem	:	CFCSP 13	Composite fish culture for demonstration to the fish farmers
Personnel	:		P. Das, D. Kumar, B. Roy & U. Bhowmick
Duration	:		Two years

One pond was stocked with the fingerlings of catla, rohu and mrigal @7,000 fingerlings/ha. The pond was manured with organic and inorganic fertilizers and supplementary feeding was given to fishes. Gross and net produc-

tions @ 4,063.5 and 3,841.5 kg/ha/13 months respectively were recorded. *Argulus* infection which adversely affected the growth of stocked fishes was controlled by 3 doses of gammaxene treatment each @ 0.2 ppm.

Another demonstration-cum-production oriented experiment has been initiated in a pond at Kharda and is in progress.

Problem	:	CFCSP 14	(Research work suspended in 1978)
Problem	:	CFCSP 15 & 17	(Research work completed in 1977)
Problem	:	CFCSP 16	(Research work suspended in 1978)
Problem	:	CFCSP 18	Fish nutrition : I. Protein, Carbohydrate & Vitamin requirements of certain Indian major carps in relation to temperature
Personnel	:		B.N. Singh and V.R.P. Sinha
Duration	:		Two years six months

Experiments were carried out with fry and fingerlings of mrigal and rohu with artificial and synthetic test diets of different protein contents (27-45%). The carbohydrate content of the feeds was adjusted between 38-58%. Vitamins (Thiamine, Folic acid, Ascorbic acid and Pantothenic acid) and vitamins A, B_1, B_2 and D_2 were also added in certain diets. The results obtained indicated greater role of protein and vitamin in the growth of fry. The growth rate of mrigal fry was more than double (daily increment in net weight 898 mg) and test diet cotaining 45% protein and vitamins A, B_1, B_2 and D_2 compared to the diets having about 32% protein and devoid of Vitamins (daily increment 343 mg) at 28°-30° C ambient water temperature. The growth rate of fingerlings was still higher (daily increment 1,270 mg) with test diets having 45% protein and water soluble vitamins (Thiamine, Folic acid, Ascorbic acid, Pantothenic acid) and vitamins B_1, B_2, A and D_2 and fats and minerals.

Problem	:	CFCSP 19	Use of some cactii as piscicide
Personnel	:		Dilip Kumar

Duration : Two years

Emulsions of various concentrations (1-50 ppm) were prepared out of latex extracted from *E. verifolia* and *E. antiquorum*. The effect of latex thus collected from both, upon different forms of zooplankton was observed under laboratory conditions. It was observed that the zooplanktons survived even at 50 ppm after 24 hours.

Problem : CFCSP 20 Popularisation of modern aquacultural techniques

Personnel : P. Das, A.K. Ghosh, U. Bhowmic and D. Kumar

Duration : Continuing

For the rapid development of culture fishery of the country, it is essential to steadily convert the traditional system of fish culture to scientific fish farming based on modern concept of aquaculture. This needs to communicate information on techniques of modern aquaculture evolved through intensive research to the rural fish farmers, State Fisheries Departments and other allied agencies through various extension activities, *viz* ; demonstration ; advisory services ; field training ; and publicity. Progress made during the year is summerised below :

DEMONSTRATION : In demonstration-cum-production oriented experiment, conducted in a 0.25 ha pond located at Vivekananda Centenary College, Rahara (West Bengal), gross and net production obtained from mixed culture of Indian major carps were 4,063.46 kg and 3,641.46 kg/ha/13 months respectively. Nine demonstrations at various stages of the experiment were arranged for the fish farmers. In the second set of experiment, now in progress, stocking of fingerlings of Indian and exotic carps was also demonstrated.

ADVISORY SERVICE : Advice on various aspects of freshwater and brackishwater aquaculture were rendered for 301 ponds owned by 108 fish farmers. A total of 154 quaries on various aspects of modern fish culture was attended and replies mailed to concerned fish farmers, private organisations and Universities. At the spot suggestions were offered on management of eight ponds located at different places.

TRAINING COURSES : A 10-week field oriented training course on brackishwater prawn and fish farming was organised at the Brackishwater Fish Farm at Kakdwip during 26.12.77 to 5.3.78. Coordinated and deputed 21 candidates (village level workers, farmers and teachers) to the Rural Aquaculture Project centre for one week training in freshwater aquaculture. A 2-month field oriented training on brackishwater prawn and fish farming was organised for the farmers and officials of different organisations which was held at the Brackishwater fish farm at Kakdwip from 1.8.78 to 30.9.78. A total of 40 candidates wete trained.

EXHIBITIONS : Participated in the fallowing exhibitions by sending suitable exhibits : (a) Indian Exhibition at Moscow, (b) Burdwan Agricultural Fair from 30.1.78 to 2.2.78, and (c) Bankura Exhibition from 25.3.78 to 27 3.78.

PUBLICITY THROUGH RADIO, TV AND NEWSPAPER : Arranged broadcasting of the news about the Institutes success in breeding *Penaeus monodon* through the AIR and TV and also its publication as a news article in Newspapers on 21.3.78 and 23.3.78.

OPERATIONAL RESEARCH PROJECT : Necessary suggestions on composite fish culture were given to the Operational Research Projecr (ORP) of JARI at Gosaba and Nilganj. Silver carp fry (500 nos.) were also supplied to the ORP of JARI for the composite fish culture at Gosaba.

MEETINGS : Four meetings of the Core Expert Committee for formulation of a detailed schema for diploma course on Fisheries Technology, organised by the Ministry of Education, Govt. of India were attended.

TALKS DELIVERED : Extension personnel delivered talks on various aspects of inland aquaculture to various batches of trainees and students and also to the foreigners who visited the Institute during the year.

Project ABF : All India Co-ordinated Research Project on Air-breathing Fish Culture

Problem : ABF 1 Propagation and stocking of air-breathing fishes for culture in swamps

Personnel : P. V. Dehadrai, R. N. Pal, N. K. Thakur, S. C. Pathak, Y. S. Yadav, S. K. Munnet, V.K.

Murugesan, P. Kumaraiah and M. P. Singh Kohli

Duration — Eleven years nine months

Semi-intensive and intensive culture of magur and singhi were carried out in West Bengal, Bihar and Delhi. In semi-intensive culture, production to the tune of 4 t/ha/4 months of singhi and 3-7 t/ha/6 months of magur have been achieved at Patna (Bihar) and Kalyani (West Bengal) respectively from seasonal ponds. Intensive culture of singhi and magur, conducted in a private entrepreneur's pond at Khanpur (Delhi) yielded production as high as 55t/ha of magur and 35 t/ha of singhi in 7 months. The technology employed included replenishment of pond water and provision of supplementary feed.

In mixed culture of magur, singhi and *Channa marulius*, the yield ranged from 4-5.5 t/ha/6 months under provision of supplementary feeding as against 1 25 t/ha/6 months recorded earlier without supplementary feeding.

Compatability within the species of air-breathing fishes of high commercial demand was tested. In an experiment at Gauhati, a production of 914 kg/ha/6 months was achieved from mixed farming of *C. striatus* and *Anabas* (koi) indicating both to be compatiable to each other. Earlier experiments conducted at Kalyani and Patna on the compatibility of magur with carps gave excellent results.

Induced breeding of magur in small paddy plots has been successfully demonstrated in Bihar, West Bengal and Assam. In Karnataka, magur could be successfully bred in freshly inundated ponds. Survey on seed resources of air-breathing fishes indicated wild water in North Bihar, Lower Assam and West Bengal to be productive sources of murrel fry and fingerlings Seed of singhi and koi were also abundantly available in these States. To avoid wastage of seed of air-breathing fishes and discourage its use as food fish, seed trade of air-breathing fishes has been established in South Bihar and West Bengal and as a result a substantial consignment of seed of magur and singhi was transported to Delhi, Assam and Karnataka. A significant achievement in the field of seed transportation has been the succesful transport of seeds of magur (97,000 nos.) and singhi (45 000 nos.) without being packed in oxygen. This would help economising seed trade in years to come.

Problem : ABF 2 Nutrient balance of the soil and water in weed infested swamp

Personnel : R. K. Das & P. V. Dehadrai

Duration : Four years

Experiments to quantify the amounts of the nutrients available in the solution phase after each raking for primary, secondary and consequently, for tertiary production indicated that the nutrients already present (organic carbon 7.2%, 76 mg of available P_2O_5/100 g of soil, 105 mg of available nitrogen/100 g of soil, C : N 19.5) in the bottom soil will last atleast for 10 years with envisaged productivity if raking is repeated once every fortnight. Raking once in a fortnight has been found to be effective in keeping the nutrients in their optimal level (CO_2 below 20 ppm and water pH around 6 5 to 7.5 from its initial acidic range). Each raking has been found to remove 2 kg of available P_2O_5/ha out of 1,727 kg (average) available P_2O_5/ha and 9.3 kg of available nitrogen/ha out of 2,386 kg/available nitrogen/ha.

Though addition of lime enhances the rate of mineralisation considerably, it was also found effective in faster removal of nutrients. This needs addition of low cost organic matter to keep the nutrients in their optimal level for higher tertiary production.

Problem : ABF 3 Food conversion among air-breathing fishes and studies on the effect of photoperiod and temparature on the gonadal maturity of *C. batrachus*

Personnel : R. N. Pal, P. V. Dehadrai and R. K. Dey

Duration : Six months

The work could not be initiated due to technical difficulties.

Problem : ABF 4 & 5 (Research work completed in 1977)

Problem : ABF 6 Nutritional and biochemical studies on air-breathing catfish, *Clarias batrachus*

Personnel : P. V. Dehadrai and P. K. Mukhopadhya

Duration : Four years

Studies have been carried out on the haematological parameters *viz.* erythrocyte count, total and differential count of WBC, haemoglobin and haematocrit values and eosinophil counts. Levels of certain biochemical indices particularly total protein, cholesterol, IDNA, NAA and glycogen in liver and total free aminoacids total protein in serum have been assessed in *C. batrachus*. Studies on the effect of diets on growth and certain other biochemical factors are in progress.

Problem : ABF 7 (Research work completed in 1977)

Problem ; ABF 8 (Research work merged with Problem ABF13)

Problem : ABF 9 (Research work completed in 1977)

Problem : ABF 10 (Research work merged with ABF 3)

Problem : ABF 11 Economic potential of air-breathing fish culture and plans for its development in certain pockets of West Bengal

Personnel : P. V. Dehadrai, M. Ranadhir, R. N. Pal, S. K. Barua and P. N. Bhattacharya

Duration : Two years

Size-group wise price data and the seasonal variations in arrival of the air-breathing fishes have been collected. Average price of singhi during the year varied from Rs. 5 10 to 10.38 for the size 15-25 cm whereas *Clarias* was the costliest with a range from Rs 9.31 to 12.46 for the same size group. Price of *Anabas*, however, varied from Rs 4.33 to 9.17 during the year for the size group of upto 10 cm. whereas, the murrels were the cheapest but showed a short term abundance. *Clarias* constituted 13 00% of the total landings of air-breathing fishes at Canning, West Bengal. Peak abundance of air-breathing catfishes was found in January - February.

Problem : ABF 12 (Research work completed in 1977)

Problem	: ABF 13	Some aspect of toxicity of metabolism and malathion and carbonuron in the air-breathing catfish *Clarias batrachus* in relation to its culture in paddy fields
Personnel	:	P. K. Mukhopadhya (in collaboration with Dr. D. K. Dube of Biochemistry Department, Calcutta University) and P. V. Dehadrai
Duration	:	Two years

Use of malathion in agricultural operations is highly effective on the target pests but its effect on non-target organisms, particularly on fishes, necessitates detailed investigation.

Studies revealed that following exposure to malathion at a concentration of 1.0 ppm for 30 days, specific activity of acid phosphatase in gill and liver depressed significantly ($P < 0.01$). B-gluouronidase activity in liver as well as in gill was stimulated ($P < 0.01$) over their respective control values.

Malathion exposure at a sublethal concentration of 1.0 ppm enhanced the activity of the drug metabolising system in liver and gills, manifested by an increase in N- and O- demethylase activity and increased cystochrome P- 450 contents. There was slightly more enzyme activity in the liver than that in the gill.

There has been significant decrease in the total ascorbio acid and level in serum, liver, kidney and spleen in malathion exposed fishes.

Gel electrophoretic patterns of serum proteins of fish exposed to malathion exhibited marked differences both in the qualitative make up and electrophotatic mobility from those in control fish.

Histological structure of tissues from intestine, gill, liver and kidney of *C. batrachus* under malathion exposure indicated necrossis even under exposure of fish to a low concentration of 1.0 ppm substantiating biochemical evidences.

Data summerising the effect of malathion exposure on liver protein synthesis as measured by incorporation of l-lysine-U-C^{14} indicated that there was significant inhibition of protein synthesis when the fishes were exposed to malathion

(0.5 ppm) for forty days. The inhibitory effects could not be reversed even though the fishes were fed with more protein than their maintenance requirement.

In the present study an inhibition in the esterase activities in liver could be demonstrated whereas in gill and serum the activities were more or less unchanged.

The gas chromatographic studies showed that residual accumulation occurred mostly in gill whereas other tissues *viz.*, kidney, liver, intestine and body muscle did not indicate any trace of malathion. This suggests that *Clarias* has an effective detoxification excretory mechanism for malathion when the ambient water has a contamination level of 500 mg/l. There are excellent possibilities of integrating magur with paddy cultivation without endangering the consumer with pesticide hazard.

Problem : ABF 14 "Biochemical investigations on nutrient utilization and energy metabolism in blood and tissues of air-breathing catfish *Clarias batrachus* and *Heteropneustes fossilis*

Personnel : Ansuman Hajra and P. V. Dehadrai

Durtaion : Two years

Neither any mortality nor any apparent symptoms of toxicity could be noticed in fishes *(Clarias* and *Heteropneustes)* in a sixty days' cistern experiment when 50% (approx) protein of the diet was replaced by urea, supplying equivalent nitrogen. With such replacement of protein of the standard test diet by urea, growth performance of *Heteropneustes* was found to be exceedingly well when compared to groups fed on standard test diet (complete test diet for fish nutrition studies). Growth recorded in *Clarias* was also comparable with those of standard diet fed fishes. Introduction of about 1.0 g rumen digesta (from goat intestine) per fish was also tried in addition to experimental diets, but with no apparent change in growth values. This clearly indicated the occurrence of ureolytic activity bearing enzyme in the fishes.

Project R : All India Coordinated Research Project on Reservoir Fisheries

Problem : R 1 Ecology and Fisheries of Freshwater Reservoirs

Personnel : A. V. Natarajan, G. K. Bhatnagar, Ch. Gopalakrishniah, V. R. Desai, Y. Rama Rao, M. Ramkrishniah, A. Mathew, B.P. Gupta, V.V. Sugunan, R. K. Singh, V. Pathak, N. P. Srivastava, D. K. Kaushal, S. N. Singh, V. T. Prabhakaran and G. K. Vinci (Smt.)

Duration : Continuing

Bhavanisagar (Tamil Nadu) : Based on the total catch for 10 months period (1,39,792.5 kg), the total yield for 12 months was calculated to be 1,67,751.0 kg giving a production of 45.3 kg/hactare. In the total landings *L. calbasu* ranked first forming 52.10% followed by *M. aor* (14.80%). Major carps *(C. catla, L. rohita* and *C. mrigala)* did not constitute much in the catches.

Fishing effort was gradually increased from 15.9.78 (25 units as in 1977) reaching a maximum of 32 units in the last week of October.

Per hectare production during the year decreased considerably from that of previous year (74.7 kg). This was mainly due to reservoir water level being high throughout the year and due to inadequate fishing in the Lotic area by the Fisheries Development Corporation. Experimental fishing could be started only from '78 onwards. Sixteen days of fishing (four days in each sector) was done in each month. 32 nets of 16 mesh (40-300 mm) sizes with hung length of each mesh size being 35 × 2 m, were operated in duplicate.

24 days of fishing each in Moyar and Intermediate sectors, 22 days in Lentic sector and 20 days in Lotic sector were carried out at selected centres of the zones Daily average catches per 35 × 2 m net pieces were in the order of 2,827 kg in Lotic ; 2,319 kg in intermediate ; 1.939 kg in Moyar ; and 1,389 kg in Lentic Section showing thereby the maximum fish congregation in Lotic Sector and the least in Lentic Sector

Maximum catches were available in 75 mm, 90 mm and 100 mm mesh sizes. The catch composition in different mesh sizes revealed that the catches in 40, 50, 60 and 70 mm mesh sizes included only trash fishes and undersized *L. bata* and *C. reba*. Commercial sizes were available only from 75 mm mesh size onwards. The catches in these nets mainly included *L. bata*,

L. calbasu, *M. aor*, *P. sarana*, *W. attu* and rarely *C. mrigala*, *L. rohita* and *C. catla*. In the total catches excepting the trash and undersized fishes, *L. calbasu* ranked first quantitatively. *L bata*, *M. aor* and *P. sarana* also contributed almost equally. *W. attu*, *L. rohita*, *C. mrigala* and *C. catla* were caught only rearly. The trash fishes caught in the smaller mesh nets mainly included *O. bimaculatus*, *Puntius* spp. and *R. cotio*.

Test on the efficacy of nets with foot rope and without fopt rope showed no significant difference.

Reservoir management

A total number of 2,25,360 fingerlings were stocked in the reservoir by the State Fisheries Development Corporation during the year. The details of stocking are given below :

Species	Nos. stocked	Total length range (mm)
C. carpio	25,590	20.5 - 35.0
L. fimbriatus	31,120	22.5 - 63.0
C. mrigala	95,150	18.0 - 70.0
C. catla	25,330	20.0-109.5
L. rohita	49,170	18.0-102.0

Nagarjunsagar (Andhra Pradesh) : Fish yield in this reservoir was estimated at 186.35 t (10.1 kg/ha) during the year showing increase in the yield over that of the preceding year. This improved yield to some extent may be attributed to exploitation of intermediate sector during January-March. Catfishes (80%) dominated the catch. *P. pangasius* was the most dominant species forming 33 42% followed by *S. childreni* (16 38%), *M. aor* (13.12%), *L. fimbriatus* (12.34%), *M. seenghala* (5 85%), *L. calbasu* (4.43%), *C catla* (2.07%), *W. attu* (1.97%), *M. punctatus* (1.54%), *C. mrigala* (0.74%), *L. rohita* (0.36%) and miscellaneous. Biological studies on *Labeo fimbriatus*, *L. calbasu*, *T. khudree*, *P. pangasius*, *S. childreni*, *M. aor*, and *M. seenghala* more or less confirmed earlier findings. *L. fimbriatus* was found to breed during July-September in the upper reaches of the reservoir. Mature specimens were in the range of 385-660 mm.

L. calbasu with maturing ovaries were encountered during April and spent ones during May and June. *Pangasius* were fully mature during May. The species appeared to breed in the upper reaches of the river. *M. aor* was found to mature during April to Septemebr. The breeding waa found extended to a longer period and breeding grounds were observed to be in lentic sector and bays. Maturing *M. seenghala* were observed in July and August. Only immature specimens of *T. khudree* could be collected. *S. childreni* with maturing ovaries could be collected from the lotic sector. But no fully mature ovary in this species could be collected. The reservoir was stocked by the S. F. D. in October, 1978. The stocking detail is presented below :

Species	Nos. stocked
C. catla	9,500
L. rohita	1,48,250
C. mrigala	1,54,250

Hydro-biological studies were also continued. Water temperature was maximum (31.0°C) during April. Water transparency ranged from 545.5 cm in January (lentic sector) to 5.8 cm in September (lotic sector). Maximum pH (8.7) was observed in summer and minimum (7.8) was recorded during the inflow of flood water and appearance of free CO_2. Bicarbonate calcium, magnesium, total hardness and specific conductivity increased from January to May and reduced due to flood water. Dissolved organic matter varied from 0.135 to 0.-6 ppm. Nitrate nitrogen was high (0.40 ppm) from Jnnuary to March and declined during April and May (0.18 ppm) and later increased. Iron showed higher values (1.0-1.2 ppm) in lotic sector, during June and September. Depth studies indicated the presence of weak chemical stratification in March, which got strengthened in subsequent months. In April and May a weak thermocline is indicated.

Peddemungal bay showed maximum gross (in April) and net carbon assimilation (in April) followed by lentic sector (in January). Primary production showed declining trend during floods.

Trends of plankton production were similar to those of previous years. The standing crop recorded the maximum in March (7.426 ml/m^3 and 16,08,532 units/m^3) and the minimum was in August (0.029 ml/m^3) and the average during the period was 2.203 ml/m^3 and 3,62,187 units/m^3. Peddamungala

showed maximum production and reached peak in March with the blooming of *Microcystis*. Generally, phytoplankton dominated over zooplankton. Myxophyceae was the dominant group except during June and August, when Chlorophyceae and Bacillariophyceae respectively dominated. Copepods formed the major component of zooplankton except during March, April and June when rotifers dominated.

Getalsud Reervoir (Bihar) :

During the year, total landings from this reservoir was calculated to be 1,830 kg. Bulk of the landings was constituted of *Catla catla* (91.16%) followed by *C. mrigala* (3.8%), *L. rohita* (1.59%) and *L. calbasu* (0.30%).

A total of 7,90,340 fingerlings of major carps were stocked in the reservoir during the year. Shooting nets and drag nets operated in the reservoir showed no sign of natural breeding or recruitment of major carps.

Planktological studies conducted in the reservoir during the year showed irregular trend of abundance as a whole and within the sectors studied. The maxima (interms of nos/m^3) was observed to be in October for intermediate sector (due to *Microcystis* bloom) ; June for lentic sector (due to Myxophyceae) ; and February for lotic sector (due to *Attheya* sp.). However, October was found to be the most productive month for each sector. In all the sectors zooplankton represented mainly by Cladocera, Rotifera and Copepods, of March, April, May & July whereas reverse was the case in other months.

The periphyton of the Getalsud reservoir showed a bimodel pattern of abundance, the primary maximum being in September and the secondary one in January. February and November were the lean months. Highest accumulation of periphyton numerically, was observed either at the surface or one meter depth. Beyond that a regular decrease in the population was observed. Qualitative differentiation in lentic, lotic and intermediate sectors was evident due to the dominance of different groups of algae in different sectors. The lentic sector was observed to be more productive than the lotic and intermediate sectors. Greater abundance of diatoms both by quality and quantity was recorded from lentic sectors whereas, the lotic sector was marked by greater abundance of green algae. The intermediate sector showed equally dominance of diatoms and Xanthophyceae. Diatoms were the only group of algae consistantly recorded from all the depths.

Benthos showed highest abundance in lotic sector followed by intermediate and lentic sectors. No definite pattern of bathymetric distribution was, however, observed.

The hydrophytes of the reservoir were observed to be restricted in pockets and without any regular pattern of infestation. These were recorded more in lotic sector followed by intermediate and lentic sectors *Eichhornia crasipes* was most dominant hydrophyte. *Najas* sp., *Ceratophyllum* sp., and *Cyperus* sp. were the other important vegetation recorded. *Ipomea* sp. was found in abundance in the lotic and intermediate zones.

Rihand : During the year, commercial fishing continued from January to May only. During the period of 133 days of fishing, a total catch of 1,04,307 kg (=104 t) was found to have been landed. *C. catla* (90.6%) was the most dominant followed by *C. mrigala* (5 0%), *L. calbasu* (0,8%) and *L. rohita* (0.5%) among the other carps. Among the cat-fishes, *W. attu* (1.3%) was the most significant followed by *S. silondia* (1.1%), *M. seenghala* (0.2%) and *B. bagarius* (0.2%). The featherbacks were represented by *N. chitala* (0.3%). As seen from the catch/net data the fish abundance was more in April (0.902 kg) and May (0.744 kg). The low fish yield in 1977 and 1978 was attributable to reduced fishing effort as well as reduction in mesh bar from 150-196 mm to 55-165 mm.

GOVINDSAGAR : In Govindsagar the fish yield touched an all time record yield of 827 tonnes. The catch per hectare works out to 71 kg/ha which is a record for any large reservoir in India.

Plankton : The average planktonic biomass for the enrire reservoir during the reported period was 3.316 ml/m^3 with 417,814 units/l of plankters. The ratio between zooplankton and phytoplankton was found to be 1 : 5.0. Phytoplankton was mainly represented by *Ceratium, Peridinium, Synedra, Diatoma, Fragillaria, Coelosphaerium, Staurastrum, Volvox, Botryococcus, Pediastrum, Oedogouinm Coelastrum* and algal filaments. On the other hand zooplankton was represented mainiy by *Daphnia, Diaphanosoma, Cyclops, Diaptomus,* nauplii, *Hexarthra, Polyarthra, Brachionus, Keratella, Trichocerca, Asplonchna, Arcella* and *Actinosphaerium.*

Bottom biota : The main organisms encountered in the samples of shallows were *Chironomus* and *Eristalis.*

Gut contents of silver carp *(H. molitrix),* which is gradually getting establi-

shed in the reservoir,was found to be mainly substingon phytoplankters (consuming mainly *Ceratum*). *Catla catla* was found to subsist mainly on zooplankton.

Spawn observations: A maximum of 273.3 ml/hr/net of eggs were collected during the year in Lumkhar khad. Because of unusual conditions major carp spawn was not present in collections. Spawn from Seer Khad contained cat fish eggs and larvae together with those of minor carps. *Drag net collections* have yielded young ones of *C. carpio* and *T. putitora* from upper reaches of the reservoir indicating spawning activity of these species and also suggested at least two spawning seasons for *T. putitora*.

Recruitment of major carps: Drag netting was conducted at Bilaspur, Jagat Khana, and Lathiani. During the collection the major carps *C. carpio* (100 nos), *T. putitora* (138 nos) and *L. calbasu* (11) were collected alongwith other trash fish.

Stocking: The fingerlings of *C. carpio* numbering 5.8 lakhs were stocked in the reservoir.

Plankton samples were collected from different sectors of Dighali beel. In all the three sectors of the beel, zooplankters dominated over phytoplankters, ranging between 100 and 142 units/l. The important phytoplankters encountered were : *Spirogyra, Pediastrum, Ulothrix, Mougeotia, Arthrodesmus* and *Navicula*. Among zooplankter *Cyclops*, nauplii of copepods *Diaptomus, Keratella, Alonella, Filinia* and *Centropyxis* were the dominant species.

Project CIFRI/IDRC/WB : Rural Aquaculture in India

Problem	: CIFRI/IDRC/WB 1 & 2	(Research work completed in 1978)
Problem	: CIFRI/IDRC/WB/3	Effect of different diets on the digestibility and growth of grass carp, *Ctenopharyngodon idella*
Personnel	:	K. M. Das and S. D. Tripathi
Duration	:	Three years

Studies on the digestibility of protein by grass carp, *Ctenopharyngodon idella* fed on an artificial diet prepared from LPC and containing 30% protein

showed the digestibility to be as high as 71% as against 52% from natural diet (*Lemna minor*).

To determine the protein requirement of grass carp fingerlings during low temperatures, an experiment was carried out at an average water temperature of 20°C. The fishes were fed at five protein levels (i.e. 24, 27, 30, 33 and 36%) with an artificial diet comprising LPC. The maximum growth was recorded at 36% protein level.

Investigations on the distribution of digestive enzymes *viz.* amylase, cellulase, protease and lipase in the hepatopancreas and gut of fingerlings and adult grass carp were carried out. Fingerlings reared in cisterns and fed separately on *Lemna* and LPC diet and the adult fish reared in ponds under semi-intensive fish culture were utilised for the study. Maximum enzyme activity of all the four enzymes were noted in the hepatopancreas of both fingerlings and adult. An increase in the proteolytic activity in the hepatopancreas was recorded in fingerlings fed on LPC diet than that of fishes fed on *Lemna*. Cellulase activity was recorded in the hepatopancreas, intestine and intestinal bulb. Considerable lipase activity was found in the hepatopancreas and gut of the adult fish while little activity was recorded in fingerlings.

Problem	: CIFRI/IDRC/WB 4	(Research work suspended in 1978)
Problem	: CIFRI/IDRC/WB 5	Fish diseases in semi-intensive fish culture and their remedial measures
Personnel	:	R. N. Pal and S. D. Tripathi
Duration	:	Four years

A number of cases of new bacterial diseases were recorded in the form of reddish lessions on the body of silver carp and complete loss of barbels in magur. These were cured by administration of water-soluble pediatric terramycin tablets at 450 mg/kg of feed. The course comprised administration of 100 mg/kg of feed for the first 3 days followed by 50 and 25 mg/kg each for the next two 2-day periods. Identification of the causative organisms is in progress.

Problem	:	CIFRI/IDRC/WB 6	(Research work suspended since 1976)
Problem	:	CIFRI/IDRC/WB 7	(Research work kept in abeyance)
Problem	:	CIFRI/IDRC/WB 8	Nutritional requirement of silver carp
Personnel	:		D. N. Swami and S. D. Tripathi
Duration	:		Four years

Locally available feeds namely ground nut oil cake, rice bran, wheat bran, mustard oil cake, linseed oilcake and neem oilcake were analysed for protein, fat, carbohydrate, ash and moisture to prepare a feed for siiver carp. The feed will be tested at winter, spring and summer temperatures with different levels of crude protein ranging from 25 to 30%.

Problem	:	CIFRI/IDRC/WB 9	Village response survey of the Rural Aquaculture Project and constraints in adoption of scientific techniques for fish and seed production
Personnel	:		S. D. Tripathi, M. Ranadhir, M. L. Bhowmick and A. Datta
Duration	:		Two years

A proforma was devised and tested in the Hanspukur area. Replies received from seven parties comprising private fish culturists and philanthropic organisations at Hanspukur-Bishnupur Complex, which received CIFRI/IDRC assistance in fish culture operations. The beneficiaries have accepted the new technology and got confidence in its economic viability. The bottlenecks faced by the fish farmers are in regard to procurement of fish seed of exotic carps, aquatic weeds and finance. The fish is sold at Rs. 7 to Rs. 8/kg at site, both retailars and wholeselers coming to the pond site and collecting the fish at their own cost.

(c) Research contemplated :

Over and above the problems on which the investigations are already in progress as per the project programmes inforce, a number of problems under different projects have been proposed to be taken up during 1979. The details of such new problems are presented below :

Project 1 : Optimum Per Hectare Production of Fry, Fingerlings and Fish in Culture Fishery Operations

Problem : 1.48 Alternative cheap protein source for carp fry and fingerlings
(Attempts will be made to evolve cheap protein diet from plant and and animal sources for carp fry and fingerlings. Relative efficiency of protein in terms of growth from various animal and plant sources will be tested)

Project 2 : Induced Fish Breeding

Problem : 2 13 Studies on the factors responsible for multiple spawning of carps
(Studies will be undertaken to findout the factors responsible for second maturity and spawning of carps in the same season)

Problem : 2 14 Studies on interrelation between thyroids and genads of the major indigenous carps from both confined and running waters
(Histological studies of thyroid glands of carps will be made to findout their activities during different seasons in relation to the process of gonodal maturation)

Problem : 2.15 Biochemical changes associated with the gonodal cycle in certain freshwater carps
(Quantitative changes in protein, carbohydrate, lipid and water content of the muscle, liver and

gonads during different phases of gonodal cycle and embryonic development of certain carps will be studied to evaluate the changes of different biochemical parameters in different organs and blood)

Project 3 : Reservoir Fisheries

Problem : 3.15 Ecology and fisheries of Peninsular tanks
(Studies on the eco-morphology of the Peninsular tanks in relation to hydrobiology will be taken up to evaluate the production potential of such water bodies)

Problem : 3.16 Biology of *Puntius dorsalis* (Jerdon)
(Some aspects of the biology of the carp minnow will be studied)

Project 5 : Brackishwater Fish Farming

Problem : 5.58 Development and viability testing of fish feeds based on cultured natural food organisms in fresh and brackishwater experimental ponds
(The technique developed in laboratory for mass culture of phyto- and zooplankton and *Artemia* sp. will be tested in the field conditions. Food preferences and growth rate of fry and fingerlings with reference to selected plankters will be studied. Dried algal powder mixed with dried and powdered zooplankters will be tested as feed)

Problem : 5.59 Studies on the role of orgnnic matter and redox potential in maintaining nutrient status of brackishwater pond soils
(Studies will be conducted to assess the role of organic matters in maintaining sustained nutrient level and to estimare the quantum of nutrients in organic matters, available after mineralisation, for fish production)

Problem : 5.60 Standardisation of transport techniques of commercially important brackishwater prawn and fish seed
(Attempts will be made to develop techniques for successful transporatation of brackishwater prawn and fish seed)

Problem : 5.61 Studies on the ecology of brackishwater ponds with special reference to culture of commercial penaeid prawns
(Ecological studies of brackishwater ponds will be made to find out the corelation between physico-chemical and biological conditions, and survival and growth of penaeid prawns)

Problem : 5.62 Multiple cropping of *P. monodon* and mullets in low saline ponds at Bakkhali
(Depending upon the seasonal abundance of different brackishwater fish and prawn seed, multiple cropping of these fish and prawn species will be attempted to achieve a production of at least 2,000kg/ha/yr)

Problem : 5.63 Culture of *P. monodon* in large water bodies
(Monoculture of *P. monodon* in large water bodies of 0.4 ha area will be tried to obtain a production of 1,200 kg/ha/yr)

Problem : 5.64 Estimation of standing crop and evaluation of supplementaty feed for brackishwater fishes at different stages of growth
(Studies will be made to evolve an artificial feed with 3 : 1 conversion ratio with a view to obtaining high survival rate and growth during nursery and culture stages of brackishwater fishes)

Problem : 5.65 Induced breebing of brackishwater fishes in Madras region

(Hypophysation of brackishwater fishes will be attempted. Attempts will also be made to findout the suitable substitute for induced breeding)

Project 8 : Estuarine and Brackishwater Lake Fisheries

Problem : 8.11 Studies on prawn seed trade in West Bengal based on sample census
(Potentialities of cultivable prawn seed harvested from Hooghly-Matlah estuary will be assessed to work out the strategy of establishing prawn seed trade for development of large scale brackishwater prawn farming)

Project 10 : Fish Farm Designing

Problem : 10.3 Surveying of Kankramari char and designing brackishwater fish farm
(Contour survey of the island will be made. Tidal amplitude, velocity of current, etc. will be studied to efficiently design a brackishwater fish farm)

Problem : 10.4 Studies on the shape of the feeder canal relative to the siltation and velocity of current under tidal environment
(Studying the shape and cross section is a prerequiste for designing a feeder canal. Studies will be conducted on these aspects with a view to developing efficient management techniques of brackishwater fish farms)

Problem : 10.5 Estimation and control of erosion in brackishwater fish farm dyke
(Impact of tide and rainfall on siltation in brackishwater ponds will be assessed and attempts will be made for divicing suitable controlling measures for dyke erosion)

Project 11 : Economics in Fishery Investigations

Problem : 11.10 The evaluation of existing infrastructural base in relation to institutional finance, marketing and legislation for propagation of aquaculture in West Bengal
(Studies will be made on the existing infrastructural base with a view to determining the factors responsible for accelarating or retarding the development of aquaculture and also to identify the prevailing imperfections in respect of marketing mechanism, institutional finance and legal frame work including leasing rights)

Project 13 : Coldwater Fish Culture

Problem : 13.22 Rearing of brown and rainbow trout fingerlings to table size
(The project is aimed at producing table-sized trout on commercial scale through cheap, and nutritive artificial/natural foods)

Problem : 13.23 Studies on biology of *Schizothorax esocinus/micropogon* (Hackel) from River Jhelum
(Studies will be conducted to determine the possibilities of culturing *S. esocinus/micropogon* in confined waters of river Jhelum)

Project 18 : Sewage-fed Fisheries

Problem : 18.2 Culture of *Clarias batrachus* in oxidation pond using *Tilapia* as forage
(Experimental culture will be taken up to evolve a system for culturing magur in oxidation pond using *Tilapia* as the forage fish)

Project 20 : Water pollution investigations

Problem : 20.14 Aquatic pollution in the Hooghly estuary with reference to Haldia Oil Refinery complex

(Investigations will be taken up to assess the impact of pollution on the fisheries of the Hooghly estuary receiving effluents from Haldia Oil Refinery Complex)

Problem : 20 15 Studies on pollution in Buckingham canal and its effect on the confluent estuarine ecosystems
(Investigations will be taken up to assess the effect of industrial and urban pollution on the ecology of Lake Pulicat and Ennore estuary and to suggest ways and means to ameliorate the conditions for fishery conservation)

Problem : 20.16 Impact of fertilizer factory wastes on the hydrobiology of river Ganga
(The extent of pollution caused by the factory effluents of IFFCO - plant (Phulpur), Allahabad, drained in the river Ganga will be assessed. Attempts will be made to determine their safe disposal unit)

Project 22 : Fish culture in running water

Problem : 22.5 Fish culture in running water pond
(With a view to utilising the vast net work of irrigation canals in the estuary, techuique of running water fish culture will be developed)

Problem : 22.6 Nutritional and biochemical studies of captive carps
(Studies will be conducted to evolve nutritionally balanced diets for cage culture of carps. Caloric values of different artificiai feeds will also be determined)

Project 24 : Freshwater aquaculture in urban and near urban areas

Problem : 24.3 Intensive rearing of magur, *Clarias batrachus* in circulatory filtering system

(Culture of *C. batrachus* with high stocking density will be conducted in circulatory water ponds with a view to achieving maximum yield of magur within a short rearing period)

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture ond Fish Seed Production

Problem : CFCSP 21 Biology of *Punitus gonioroius* in composite fish culture ponds
(Maturity, fecundity, breeding and the growth of the exotic carp will be sludied under pond conditions. Efficacy of the fish in controlling aquatic weeds will also be studied)

Problem : CFCSP 22 Ecological study of zooplankton and phytoplankton of integrated fish farming ponds
(Plankton population of fish culture ponds, manured with different livestock wastes will be studied to get a clear picture of seasonal variation of plankton in these ponds which will help in determining the stocking density and species ratio)

Problem : CFCSP 23 Oxygen requirement of the fish biomass in composite fish culture ponds
(The work is aimed at studying the oxygen requirement of all the species cultured in composite fish culture in relation to size group, state of activity (resting or active), sex and temperature prevailing in different seasons with a view to finding out the optimum stocking density by synchronizing oxygen budget of the

fishes to be stocked and the DO of the pond)

Problem : CFCSP 24 Study of the causative organisms of parasitic fish diseases in the integrated fish farming ponds
(With the development of integrated spstem of intensive fish farming at Krishnanagar where livestock are raised on the pond site and their dung recycled in the ponds, some fish diseases are likely to manifest causing reduction in the total production of Indian and exotic carps. Investigations will be taken up to study the diseases in their ecological and biological aspects and derive suitable remedial measures for combating the specific disease)

Project ABF : All India Co-ordinated Research Project on Air-Breathing Fish Culture

Problem : ABF 15 Study on some biochemical factors in the eggs of *Clarias* and *Heteropneustes*
(Biochemical constituents of eggs of *Clarias* and *Heteropneustes* at different stages of development will be studied. The study of the eggs constituents may help to understand the genetic identity of the fish species and will be useful for improvement of diet for fish culture as the two catfishes have specific trends in regard to their fat and protein metabolism)

Problem : ABF 16 Intensive culture of *Clarias batrachus* and *Heteropneustes fossilis*
(Demonstration programme will be taken up to demonstrate intensive culture of air-breathing catfishes *C. batrachus* and *H. fossilis* adopting high stocking density, in-

tensive feeding and water management with a target of 100 tons/ha/6 months)

Problem : ABF 17 Intensive culture of *Clarias batrachus*
(Culture of magur will be taken up to demonstrate intensive culture of air-breathing catfish *Clarias batrachus* adopting high stocking density, intensive feeding and water management with a target of 80 tons/ha/6 months)

Project R : All India Co-ordinated Research Project on Reservoir Fisheries

Problem : R 2 Studies on the possibility of augmenting the yield of fishery from reservoirs by adopting pen culture in shallow areas
(Pen culture experiments will be taken up to evaluate the operational cost of the pen culture in reservoirs and the rate of production per unit area of pen)

3. PUBLICATIONS

The following publications were broughtout by the Institute during the year 1978 :

Alagaraja, K. 1977
A simple model to test equal catchability of marked and unmarked animals in capture - recapture studies. *J. Inland Fish. Soc.India,* 9 : 201-202

..... 1977
Studies on gill net selectivity. *J. Inland Fish. Soc. India,* 9 : 1-8

Banerjee, S. C. and R. K. Banerjee 1977
Effect of storage on disolved oxygen values. *J. Inland Fish. Soc. India,* 9 : 205-207

Barrackpore, Central Inland Fisheries Research Institute 1977
Annual Report, 1977

Barrackpore, Central Inland Fisheries Research Institute 1978
CIFRI Newsletter, 2 (3 and 4) and 3 (1 and 2), 1978

Bhatnagar, G.K.. S J. Karamchandani and M.D. Pisolkar 1977
Observations on the spawning of major carps in Govindgarh reservoir, Madhya Pradesh. *J. Inland Fish. Soc. India,* 9 : 193-195

Bhowmick, R.M., G.V. Kowtal, R.K. Jana and S D. Gupta 1977
Experiments on second spawning of major Indian carps in the same season by hypophysation. *Aquaculture,* 12 (2) : 149-155

Bhowmick, Utpal 1978
Abenchite, Kshatikar jalaja aagacha theke pukur mukto rakhun (in Bengali) (Weeds are generally menace in fish ponds and remove them) *Nabanya Bharati,* 10 (11-12) : 858-863

Chakraborty, Deviprasanna 1978
Matsya chaase sarer proyojaniyata (in Bengali) (Fertilisation of ponds augments fish production) *Nabanya Bharati,* 10 (11-12) : 841-843

Chakraborty, R.K., M. Subrahmanyam and B B. Pakrasi 1977
A note on the collection and segregation of prawn seed for selective stocking. *J. Inland Fish. Soc. India,* 9 : 181-183

Chandra, Ravish 1976
On the occurrence of *Psilorhynchus sucatio* (Ham) in the river Ganga at Allahabad and Buxar with notes on the distribution of *Psilorhynchus* spp. *(Matsya,* 2 : 81)

Chaudhuri, H., R M. Bhowmick, G.V. Kowtal, R K. Jana and S.D. Gupta 1977
Efficacy of partially purified salmon pituitary gonadotrophin (SG-G 100) in inducing spawning in Indian major carps. *J. Inland Fish. Soc. India,* 9 : 162-164

Chaudhuri, H., R.M. Bhowmick, G.V. Kowtal, M M Bagchi, R K Jana and S.D. Gupta 1977
Experiments in artificial propagation and larval development of *Mugil cephalus* Linnaeus in India. *J. Inland Eish. Soc. India,* 9 : 30-41

Das, Punyabrata 1978
Matsyachase baijagynik padhyati deshe matsya biplab ante jachhe (in Bengali) (Modern fish farming can revolutionise country's fish production) (*Nabanya Bharati* 10 (11-12) : 871-874)

Das, P., M. Sinha, D. Kumar, D.P. Chakraborty and M.K. Guha Roy 1977
Culture of Indian major carps with record yield in a demonstration pond. *J. Inland Fish Soc. India.* 9 : 105-110

David, A. and K. V. Rajagopal 1969
On some aspects of the fish populations of the Tungabhadra reservoir. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29, 1969 : 457-474.

.....1969
Experimental fishing and observations on commercial fishing methods. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29, 1969 : 503-516

De Dilip Kumar 1978
Bijnanvithic matsya bijer uthpadan lavjanak. (in Bengali) (Scientific raising of fish seed is profitable) (*Nabanya Bharati,* 10 (11-12) : 844-850)

De, D. K 1977
On the procurement and transportation of chapra *Penaeus indicus* (H. Milne—Edwards) seed under oxygen packing *J. Inland Fish Soc. India,* 9 : 189-190

Halder, Dharma Das
Nonajole bagda chingri, parse, bhangan, bhetki machhchas bises lavjank (in Bengali). (Culture of Bagda, parse,bhangan, bhetki, etc. inbrackishwater is highly lucrative) (*Nabanya Bharati,* 10 (11-12) : 875-879)

Ghosh, Ajoy Kumar 1978
Machher rog nirnay O tar pratikar (in Bengali). (Fish diseases is no more a problem in farming) (*Nabanya Bharati,* 10 (11-12) : 868-870

Ghosh, Amitabha, A.K. Datta and B.N. Saigal 1977
Observations on the digestive enzymes of *Heteropneustes fossilis* (Bloch) : proteinase and lipase. *J. Inland Fish. Soc. India*, 9 : 197-198

Ghosh, A.N. and K.V. Rao 1969
Problems of fisheries development in newly constructed reservoir. *Proceeding of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29 : 605-620

Ghosh, Apurba 1978
Mayla jale kom kharche matsyachaaser sambhabana (in Bengali). (Sewage can be utilised for high fish production). (*Nabanya Bhareti* 10 (11-12) : 890-894.

Gopalkrishnan, V. and R. N. Pal 1969
Spawning of carps in some reservoirs of India *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIHRI*, Barrackpore, November 27-29. 1969 : 215-226

Gopalakrishnan, V. and R. M. Rao 1969
Development of prawn fisheries in Indian reservoirs *Proceedings of the Seminor on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29, 1969 : 551-560

Govind, B.V. 1969
Planktological studies in the Tungabhadra reservoir and its comparison with other storage reservoirs in India *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29, 1969 : 72-92

Govind, B.V. 1969
Bottom fauna and mauovegetation in the Tungabhadra reservoir and their role in the food chain of fish communities. *Proceedings of the seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29. 1969 : 99-128

Govind, B. V. and M.A. Khan 1969
Pre-recruitment studies in Tilaiya reservoir (Bihar) in context of stocking. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29. 1969 : 275-288

Govind, B.V., M.F. Rahman and K.V. Rajagopal 1978
Occurrence of elevers of *Anguilla nebulesa* (Gray and Hardu.) in Tunga river Karnataka State. *Sci and Cult.*, 44(7) : 329-330

Jhingran, V.G. 1978
Advances in fish culture in India. *Souvenir, Dairy Unit of Don Bosco*, Krishnagar, 1-2 p.

Jhingran, V.G. 1977
Recent advances in brackishwater prawn and fish farming in India. *Indian Seafd*, 12(4) and 13(1) : 5-6

Jhingran, V.G. and A.V. Natarajan 1969
An assessment of fisheries of the D.V.C. reservoirs in relation to stocking. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29, 1969 : 429-456

Jhingran, V.G. and A.V. Natarajan 1977
Forecasting possibilities of Chilka lake fisheries under present rate of exploitation. *J. Inland Fish. Soc. India*, 9 : 154-160

.....1979
Recommendations for stocking silver carp in Govindsagar (M.P.) and Nagarjunsagar (A.P.) together with an account of the scope and limitations of silver carp stocking in rivers and reservoirs in India. *Bull. Cent. Inland Fish. Res. Inst.*, Barrackpore No. 28, 7 p. *(Mimeo.)*

Jhingran, V.G. and B.K. Sharma 1978
Operational research project on aquaculture in West Bengal. *Bull. Cent. Inland Fish. Res. Inst.*, Barrackpore, No. 27. 68. *(Mimeo.)*

Jhingran, V.G. and K.L. Sehgal 1978
Coldwater Fisheries of India. Barrackpore, Inland Fisheries Society of India, 1978 : 239 p.

..... 1978
Note on the breeding care and management of common carp *(Cyprinus carpio* Linnaeus). *Misc. Contr. CIFRI*, Barrackpore, No. 14. 11 p. *(Mimeo)*.

Jhingran, V.G. and S.D. Tripathi 1969
A review of the measure adopted for the development of the fisheries of reservoirs in India. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29, 1969 : 637-651

Kaliyamurthy, M. 1974
Observations on the environmental characteristics of Pulicat lake. *J. mar. biol. Ass. India*, 16(3) : 683-688

Kowtal, G.V. 1977
Some observations on the breeding of *Lates calcarifer* (Bloch) from the Chilka lake. *J. Inland Fish. Soc.* India, 9 : 191-192

Krishnamurthy, K.N. 1969
Commercial fishing methods and experimental fishing operations in artificial impoundments. *Proceedings of the Seminar on the Ecology and Fisheries of*

Freshwater Reservoirs, sponsored by ICAR at the CIFRI, Barrackpore, November 27-29, 1969 : 517-526

Kumaraiah, P., V.K. Murugesan and P V. Dehadrai 1977
A new record of a bacterium causing eye disease and mortality in *Channa marulius* (Hamilton). *J. Inland Fish. Soc. India*, 9 : 214-215

Mathew, P.M. 1969
Limnological investigations on the plankton of Govindgarh lake and its correlation with physico-chemical factors. *Proceedings of the Seminar on the Ecology and Fisheries of Ereshwater Reservoirs. sponsored by ICAR at the CIFRI*, Barrackpore, November 27-29, 1969 : 46-65

Mitra, Eva 1977
A report on copper sulphate treatments of fishery ponds for the control of weeds 1952-1970. *Bull. CIFRI*, Barrackpore No. 26, 26 p. *(Mimeo.)*

Mitra, P.M., G.C. Laha and K.K. Ghosh 1977
Projections of expected fish catches from Hooghly-Matlah Esturine system during 1976-1980. *J. Inland Fish. Soc. India*, 9 : 131-137.

Mukherjee, A.B. 1977
Closed box type wooden sluice in brackishwater impoundment - its merit and demerit. *J. Inland Fish. Soc. India*, 9 : 111-126.

Mukhopadhyay. P.K. and P.V. Dehadrai 1978
Malathion toxicity and impairment of drug metabolism in liver and gills of the catfish *Clarias batrachus* (Linn.) *Indian J. exp. biol*. 16(6) : 688-689

Mukhopadhyay, P.K., P.V. Dehadrai and S.K Banerjee 1978
Studies on intestinal protease : isolation, purification and effect of diatary proteins on alkaline protease activity of the air-breathing fish, *Clarias batrachus* (Linn.) *Hydrobiologia*, 57(1) : 11-15

Munnet, Siddhartha K., N.K. Mishra and M.P S. Kohli 1978
A case of ambisexuality in an air-breathing freshwater teleost, Clarias batrachus (L.) *Curr. Sci.*, 47(21) : 834-835

Murty, D.S., R.K. Dey and P.V.G.K. Reddy 1978
Experiments on rearing exotic carp fingerlings in composite fish culture in India. *Aquaculture*, 13(4) : 331-337

Murugesan, V K. and P. Kumaraiah 1977
Observations on the biology of *Channa marulius* (Hamilton) based on the recovery of tagged specimens. *J. Inland Fish. Soc. India*, 9 : 216-217

Nandy, A.C , P.R. Das and S.K. Mazumder 1977
Teehnique to obtain sustained culture of a cladoceren *Daphnia lumholtze* Sars, *Proc. Symp. warm water zool. spl. publ* : UNESCO/NIO : 540-542.

Nandy, A.C., S.K. Majumder and R.K. Chakraborty 1977
Experiments on the mass culture of *Brachionus mulleri* Pellas in glass aquaria. *Proc. Symp. Warm Water. zool. Spl. Publ.*, UNESCO/NIO : 538-539.

Pal, Radha Nath 1978
Kom Kharche dami magur machher chas (in Bengali) Produce priced magur at low cost). *(Nabanya Bharati,* **10**(11-12) : 851-854)

Pal R.N. and V. Gopalakrishnan 1969
Parasitic diseases of fishes in Indian reservoirs. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29. 1969 : 163-168

Pal R.N., S.C. Pathak, D.N. Singh and P.V. Dehadrai 1977
Efficacy of different feeds in survival of spawn of *Anabas testudineus* (Bloch). J Inland. Fish. Soc. India, 9 : 165-167

Pandit, Piyus Kanti 1978
Pronodita prajanan padhyatite pukuraei unnatta maner machher deem photan (in Bengali) (you can produce quality fish seed in the pond itself through induced breeding) *(Nabanya Bharati* **10**(11-12) : 836-840)

Parameswaran, S , M.A. Khan and M. Ramkrishniah 1969
Pre-recruitment studies in Konar reservoir, Bihar. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29, 1969 : 235-248

Rajyalakshmi T. 1975
Colair lake offers a source of highly lucrative fishing. *Seafd. export J.*, 7(8) : 25-31.

Rajyalakshmi, T. and P L.N. Rao 1969
Recruitment of juveniles in river Godavari impoundment and discussion on the fall in catfish populations of the river. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29, 1969 : 475-502

Raman, K. 1977
An interesting instance of aquatic oligochaets using molluscan shells as 'house'. *J. Inland Fish Soc India,* **9** : 168

Rangaswamy, C.P. 1976
Length-weight relationship in the grey mullet, *Mugil cephalus* Linnaeus *Matsya,* **2** : 19-22

Roy P. 1969
Hydrology of Vanivilas Sagar reservoir. *Proceedings of the seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29 1969 : 93-98

Roy, P. and R.K. Banerjee 1969
Hydrological studies of Tungabhadra reservoir. *Proceedings of the Seminar on the Ecology and Fisheries of Freshwater Reservoirs, sponsored by ICAR at the CIFRI,* Barrackpore, November 27-29 1969 : 129-154

Saha, G N. and D.K. Chatterjee 1977
A preliminary study on the comparative efficiency of two mixed chemical fertilizers in both productive and unproductive fish pond soils. *Proc. nat. Acad. Sci. India,* B, 47(II) : 93-100.

Saha, S.B., B.B Ghosh and V. Gopalakrishnan 1975
Plankton of the Hoogly estuary with special reference to salinity and temperature. *J mar. biol. Ass. India,* 17(1) : 107-120

Sarkar, S.K. 1977
A note on some preliminary observations on the fertilisation of fish ponds in the Chilka area (Keshpur Fish Farm). *J. Inland Fish. Soc. India,* 9 : 209-211.

Sehgal, K.L 1977
Studies on Indian freshwater copepoda IV. Food of *Heliodiaptomus viduus* (Gurney) and *Mesacyclops luckarti* (Claus) in warm water fish ponds at Cuttack, Orissa. *Proc. Symp. warm water Zool spl. publ* : UNESCO/NIO : 399-405.

... .1977
Studies on Indian freshwater copepoda V. Observation on the uti ization of *Heliodiaptomus viduus* (Gurney) and *Mesocyclops leuckarti* (Claus) as food by fry of *Catla catla* (Ham.) and *Labeo rohita* (Ham.). *Proc. Symp. warm water. Zool. Spl. Publ* , UNESCO/NIO : 550-557

Selvaraj. C. and P.L N. Rao 1977
On the predatory behaviour of the freshwater cyclops *Mesocyclops leuckarti* (Claus). *Proc. Symp. warm water Zool. Spl. Publ.* UNESCO/N IO : 406-411

Sen, P.R , N.G.S. Rao, S.R. Ghosh and M. Rout 1978
Observations on the protein and carbohydrate requirments of carps. *Aquaculture,* 13(3) : 245-255

Shah, K.L,, B.C. Jha and A G. Jhingran 1977
Observations on some aquatic phycomycetes pathogenic to eggs and fry of freshwater fish and prawn. *Aquaculture,* 12(2) : 141-147

Shah, K.L. and S.B. Raizada 1977
Preliminary observations on the creel census and angling pressure in a stretch of River Beas in Kulu Valley. *J. Inland Fish. Soc. India,* 9 : 117-124

Sharma, B.K., Dilip Kumar and Amitabha Ghosh 1978
The promise of composite fish culture technique. *Souvenir, Dairy Unit of Don Bosco,* Krishnanagar.

Sharma, Neelima and Ashish Prasad Mukherji 1978
An examination of environmental factors for the cause of a summer fishkill in a tank near Allahabad. *Curr. Sci.*, 47(11) : 389-391

Singh, B.N. 1976
Metabolic energy requirements and energy budgets of certain Indian air-breathing fishes. *Natural Sciences Journal Marathwada University*, Aurangabad, 15(8) : 3-9

Singh, B.N. 1977
Oxygen consumption and the amount of oxygen required for transport of rohu and mrigal fingerlings. *J. Inland Fish. Soc. India*, 9 : 98-104.

Singh, S.B. 1977
Note on control of *Ceratophyllum* in a large tank by grass carp. *J. Inland Fish. Soc. India*, 9 : 178-180

Singh, S.B. 1977
Some observations of diurnal vertical fluctuations in a pond having permanent blood of *Microcystis flos-aquae*. *J. Inland Fish. Soc India*, 9 : 125-130

Singh, S.B., R K Dey and P.V.G.K. Reddy 1977
Observations on feeding of young grass carp on mosquito larvae. *Aquaculture*, 12(4) : 361-363

Sukumaran, P.K. and S.L. Raghavan 1978
Note on two deformed specimens of the Indian carp *Labeo rohita* (Hamilton). *Sci. and Cult.*, 44(7) : 322.

Thakur, N.K. 1977
Feeding behaviour, ingestion and ejection in magur *Clarias batrachus* (Linn.) *J. Inland Fish. Soc. India*, 9 : 176-177

..... 1978
Makkana culture. *Indian Fmg.*, 27(10) : 23-27

Thakur, N.K. and M.P. Singh Kohli 1976
Forked barbel in an air breathing catfish *Clarias batrachus* (Linn.). *Matsya*, 2 : 74

4. EXTENSION

The Institute continued to provide extension services to the public, to the fish farmers and to the State Government Agencies.

DEMONSTRATION PROGRAMME : Demonstration of mahua oilcake application, lime application, organic manuring, inorganic manuring, stocking, supplementary feeding, sampling & harvesting, were arranged for fish farmers and other interested persons on several occasions at different places.

The demonstration pond at Khardah was stocked during September and November, 1978 with catla, rohu, mrigal and silver carp fingerlings @ 7,000 fingerlings/ha in the ratio of 2.25 : 2.0 : 3.5 : 2.25 respectively. The average growth of fishes in two months was, catla 336 g, rohu 275 g and mrigal 150 g. At this pond, different stages of pond management was also demonstrated prior to stocking.

TRAINING IMPARTED : A one month Summer Institute on Inland Aquaculture for the University teachers, research workers, etc. was organised and conducted at Barrackpore from 19.6.78 to 18.7.78.

Twenty one candidates from village level workers, farmers and teachers were imparted one week training on freshwater aquaculture organised and conducted by the Rural Aquaculture Project of the Institute at Nabastha, Burdwan.

One week training on composite fish culture and induced breeding of carps was arranged for Sarvashri Debabrata Haldar and Tapash Kumar Kotal of Non formal Education and Social Welfare, Saharahat at the Composite Fish Culture Centre at Kalyani (Kalia) which was conducted by the Officer-in-Charge of the cenrre.

A 2-month field oriented training course on Brackishwater prawn and fish farming was organised at Kakdwip Research Centre from 1.8.78 to 30.9.78 wherein 40 candidates received training.

A 10-month Institutional training for ARS probationers of the Institute was organised where 10 probationers under went training in different aspects of Inland fisheries at different centres of the Institute under the respective Officer-In-Charge.

ADVISORY SERVICE : On the request of the Director of Fisheries, Government of Andhra Pradesh, Dr. (Mrs.) T. Rajayalakshmi, Scientist-2 of the Institute visited the fish passage in the Barrage at Dowlaiswaram on river Godavari. In consultation with the Executive and Chief Engineer of the Barrage Division, she submitted a preliminary report on the type of fish passage to be established on the branches of the river.

Necessary advice/suggestions on composite fish culture, nursery and rearing pond management, induced fish breeding, common carp breeding, fish patholony, weed control, air-breathing fish culture and techniques of brackish-water fish and prawn culture, were rendered to 116 fish farmers.

Information regarding various aspects of fish culture was provided to 161 farmers, Government agencies, Private organisations and college & universities, and relevant extension pamphlets were also sent to them for guidance.

Extension personnel visited 16 ponds and rendered at the spot suggestions on fish culture, induced breeding of carps and identification of brood fishes.

NEWS FLASH : The All India Radio, Calcutta and the Doordarshan Kendra, Calcutta covered the newse of breakthrough in breeding *Penoeus monodon* achieved at Kakdwip Research Cntre of CIFRI in their broadcast on 22 3 78 and 21 3.78 respectively. The news also appeared in the Statesman—an english daily on 22.3.78.

FISH SEED SUPPLY : A total of 500 silver carp fingerlings were supplied to Operational Research Project Centre of the Jute Agricultural Research Institute (JARI) at Gosaba for conducting composite fish culture in ponds at lower Sunderbans.

PARTICIPATION IN MEETINGS : Scientist (Extension) attended the following meetings during the year under report :

Meeting of the Expert Core Committee of the Ministry of Education, Government of India held on 12 5.78 for formulation of a detailed scheme for a

diploma course in fisheries in the Eastern Region and the meetings of the Expert Subcommittee to recommend structureof the above diploma course in fisheries held at the Office of the Ministry of Education, Calcutta, on 24.5.78, 7.6.78 and 31.8.78.

Meeting of the Advisory Committee of Operational Research Project of the JARI held at Barrackpore on 14.6.78,

VISITORS : 85 fish farmers (in two batches) of Gujarat visited Institute's Headquarters during May and June, 1978. They were appraised of the achievements of the Institute through discussion, charts, posters and film shows.

STUDENTS TRAINEES : Students/trainees from the following Institutes visited Institute's Headquarters. Lectures on various aspects of Inland Fisheries and field visits were arranged for them.

Trainees of the Central Fisheries Extension Training Centre, Hyderabad on 3.2.78.

Students of Shivaji University. Kolhapur on 13.2.78

Students of Jessus and Marry (T) Convent School on 17.2.78.

Students of Siksha Niketan Vidyalaya, Calcutta on 24.2 78

Stndents of Institute of Education of Women, Alipore on 27.2.78

Students of IVRI, Izatnagar on 2.6.78

ARS probationers of Central Staff College for Agriculture Hyderabad on 7.6.78

WBGS Officers (on training) from Orientatron Centre

Students of Cantonment Girls High School, Barrackpore in two batches on 7.8.78 and 11.8.78

Students of RBC College, Naihati on 29.8.78

Trainees of CIFE, Bombay in October, 1978

FILM SHOWS : Film on Induced breeding and composite fish culture were screened for Fish Farmers of Gujarat, Fish Farmers of Burdwan, Distinguished visitors, Student/Trainees of different Institutions and Scientists of NOCIL, Bombay and Calcutta.

EXHIBITION : The Institute participated with exhibits like charts, posters, models, specimens, blow up photographs, etc., in the following exhibitions.

i) Indian National Exhibition at Moscow, USSR.

ii) Burdwan Agricultural Fair, organised by the Directorate of Agricultre, West Bengal from 30.1.78 to 2.2.78.

iii) Bankura Zilla School, Bankura in collaboration with Directorate of Fisheries, West Bengal from 25.3.78 to 27.3.78.

ICAR GOLDEN JUBILEE CLEBRATION : The ICAR Golden Jubilee Celebration at different centres of the Institute is being coordinated by the Extension Section of the Institute. The Lab to Land manual for transfer of inland fisheries technology during the Golden Jubilee year 1979 of the ICAR has been finalised.

TRAINING PROJECT : A project for fisheries training and distribution of extension pamphlets for flood affected fish farmers of West Bengal to help them restore fish culture has been submitted to ICAR.

COFERENCES AND SYMPOSIA

The 65th Session of the Indian Science Congress Association was held in Ahmedabed during January, 1978 and two undermentioned papers were presented by the Scientists under the Section "Zoology, Entomology and Fisheries".

Vass, K.K., Shyam Sunder & H.S Raina
Some observations on spawning and rearing of *Schixothorax niger* Heckel from Dal lake, Kashmir.

Shyam Sunder
Aqeatic entomo fauna of some cold water streams in Jammu and Kashmir State.

Sarvashri K. Raman & K.V. Rama Krishna, Scientists of this Institute attended the Estuarine Session of the Symposium on 'Environmental Modelling of Physical Oceanographic Features as Applied to ths Indian Ocean' held at Cochin during 23rd & 24th February, 1978 and presented one paper entitled "Influence of a navigational canal on an estuary on the east coasts of India".

Sarvashri M, A. V. Lakshmanan and N. K. Tripathi, Scientists of this Institute attended the "Third Seminar on Modern Management Techniques" held in hyderabad during 1-4, March, 1978.

National Seminar on 'Resources, Development and Environment in the Himalayan Region' was held during 10-15 April, 1978 at Department of Science and Technology, National Committee on Environmental Planning and Co-ordination, New Delhi and the undermentioned papers by Dr V. G. Jhingran and Cr. K. L. Sehgal were presented.

Jhingran, V. G. & K. L. Sehgal
Resources and development of aquatic life of the Himalayas with special reference to coldwater fisheries.

Jhingran, V. G. & K. L. Sehgal
Changing aquatic environment of the Himalaya ecosystems and its effect on trout.

A Summer School of Fishery Biology sponsored by Indian National Science Academy, New Delhi was held at the College of Fisheries, Mangalore during 10th to 14th April, 1978. The Scientists of this Institute participated in the Summer School and contributed the undermentioned 3 papers.

Rajyalakshmi, T.
Food and feeding in prawns in hatchery and semi-intensive rearing system.

Rajyalakshmi, T.
A comparative study on the biology of *Mocrobrachium malcolmsonti* of Hooghly and Godavari river systems.

Kamal, M. Y.
Assessment of fish seed potentiality of a stretch of river Ganga in Bihar.

The following papers were presented by the Scientists of this Institute at the Seminar on the "Status of Fisheries Research and Development in Karnataka from 21st to 24th April, 1978 held at the College of Fisheries, Mangalore.

Govind, B. V. *et al*
A Pilot study on culture of major carps in a tank at Bangalore (Karnataka)

Govind, B. V. *et al.*
Tank fisheries research development, achievement, constraints and future scope in Karnataka.

Summer Institute on "Inland Aquaculture" was held at Barrackpore during 19th June to 18th July, 1978 and a number of scientists from different University/Institutes/State Fisheries Departments participated in the same.

The Symposium on "Fin Fish Nutrition and Food Technology" was held at Hamburg, West Germany during 20-23 June, 1978 and three undermentioned research papers were presented.

Sen, P. R. & D K. Chatterjee
Increased production of major Indian carp fry by addition of growth promoting substances.

Sinha, V.R.P.
On the contribution of supplementary feeding in increasing fish production through composite fish culture in India.

Singh, B.N., V.R.P. Sinha & D P. Chakrabarty
Effects of protein quality and temperature on the growth of fingerlings of rohu, *Labeo rohita* (Hamilton).

The Scientists of the Institute participated in the Symposium on "Shrimp Farming" held during 16th to 18th August, 1978 at the Central Institute of Fisheries Education, Bombay under the auspices of the Morina Products Export Development Authority and the undermentioned 4 papers were presented.

Ha'der, D.D.
Breeding of *Penaeus monodon* in farm pond under captivity.

Verghese, P.U
Potential of brackishwater prawn culture in India.

Songupta, A.K.
Construction and maintenance of shrimp farms for commercial production.

Mukherjee A.B.
Design and construction of sluices for shrimp farms in India.

7 papers by the Scientists of the Institute were presented at the Symposium on Environmental Biology which was held at D.A.V. College, Muzaffarnager during 9th-10th October, 1978. The titles of the papers are given below.

Peer Mohamed, M. *et al.*
Influence of sublethal ethyl parathion on the activity metabolism in the carp *Labeo rohita* (Hamilton)

Panwar, R.S. *et al.*
Studies on pollutional effects of industrial wastes on the Rihand reservoir ecosystem

Mehrotra, S.N. & S.P. Singh
Some observations on the impact of municipal sewage on the quality of water and benthos in river Yamuna.

Ray, P., B.B. Ghosh & M.M. Bagchi
Effects of pulp and paper mill waste (Soda Process) around the out fall in the Hooghly estuary with reference to plankton.

Ghosh, B.B *et al.*
Biotic and abiotic conditions of the Hooghly estuary in the vicinity of a rubber industrial complex.

Pay, P.
Some considerations on the control and abatement of distillery wastes with special reference to aquacultre.

The Third Workshop of the All India Co-ordinated Research Project on Brackishwater Prawn and Fish Farming jointly organised by Central Inland Fisheries Research Institute and Kerala Agricultural University was held at Central Institute of Fisheries Technology, Cochin during 9-10 November, 1978. Besides the Scientists working under the project, delegates from various State Fisheries Departments, Universities and a number of fishery industrialists participated in the workshop.

Dr. V.G. Jhingran, Director, CIFRI presided over the First Session of the Seminar on 'Exploitable Biological Resources' (Fisheries and Wild life) of Andra Pradesh' held on the occasion of Diamond Jubilee Celebrations of the Department of Zoology, Osmania University on 25.11.78 and also contributed a paper entitled "Scope and Progress of Aquaculture in Andhra Pradesh".

The Symposium on "Recent Development in Applied Analytical Chemistry was held on 25.11.78 and 26 11 78 on the occasion of Golden Jubilee Celebrations of the Institution of Chemists (India), Chemical Department, Medical College, Calcutta and a paper entitled "Industrial pollution in the Haoghly Estuary due to disposal of trade effluents from Kraft pulp and paper mills" was presented by the Scientists of the Institute.

Two undermentioned papers from the Institute were contributed at the XI Annual Convention of the Indian Society of Agricultural Chemists held at the National Diary Research Institute, Karnal, Haryana on 27th and 28th November, 1978.

Chandra, K.
Formaldehyde abosorption on the surface of some common Indian clay minerals in aqueous system.

Banerjee, R K.
Effect of continued submergence on the soil of saline swamps in lower Sunderbans.

Seminar on "Role of Small Scale Fisheries and Coastal Aquaculture in Integrated Rural Development" organised by the Central Marine Fisheries Research Institute, was held in Madras during 5-9 December, 1978 and Dr. V.G. Jhingran, Director attended the Symposium and delivered his keynote address "Manpower requirements and training".

6. SUMMARY

Project I :

1.1 1.1. Catla, rohu, mrigal fry were stocked at 200,000/ha in 1 : 1 : 1 ratio and encouraging growth of fingerlings was obtained with fertilization of ponds and supplementary feeding.

1.1.2.2 Indian and exotic carps @ 5000/ha were stocked in two phases in two farm pond and at the end of 7-8 months of rearing, production of 2,000-3,100 kg/ha has been estimated with 80% survival.

1.1.2.3 Catla, rohu, mrigal (4 : 3 : 3) were stocked @ 6000/ha in two ponds. The experiment could not be completed due to loss of fish due to poaching and is being reset.

1.1.6 An estimated production of above 1,800 kg/ha 10 months could be achieved when catla, rohu, mrigal, silver carp and common carp stocked @ 6,000/ha were cultured without supplementary feeding but with daily provision of organic manure.

1.21 Catla and rohu spawn stocked separately @ 0.75 million/ha and 2.5 million/ha and given a treatment of cobalt chloride and cobalt chloride + manganese registered a survival of 63.3% and 75% respectively.

1.22.1 *Simocephalus vetulus, Ceriodaphnia cornuta* and *Moina micrura* were found to thrive in media with abundant nano plankton; fertilised with cowdung, and in pond water fertilised with oganic and inorganic fertilisers.

1.25 Sustained culture of *Navicula cryptocephala* and *Gyrosigma angulatum* could be achieved using urea, single superphosphate and sodium silicate. Large scale culture of *Skeletonema costatum* could also be achieved with N-P-Si. Density of *Daphnia lumholtzi* (initially 10 units/l) could be raised to 32,000 units/l in 20 days using poultry manure (@ 280 ppm) as fertiliser.

1.29 Tamarind seed husk powder when applied @ 5-10 mg/l effectively killed *C. marulius, T. mosambica, C. carpio* and Indian major carps under laboratory conditions.

1.30 5 pond owners tn villages around Cuttack raised 18,235 fry of Indian major carps under technical guidance of the scientists of the Institute.

1.31 Amyl alcohol and tertiary amyl alcohol in different dosages were tried on fry of Indian major carps and the rate of respiration and excretion were assessed before and after each treatment against the control.

1 34 Hydrobiological investigations in a jute retted pond were continued.

1.35 In paddy-cum-fish culture, production @ 4 5 tonnes/ha of Jaya paddy and 1,200 kg/ha/10 months of fish was obtained.

1.39 $CaCO_3$ @ 1000 kg/ha resulted in maximum increase in total alkalinity followed by CaO and $Ca(OH)_2$ whereas, concentration of dissolved inorganic nitrogen was observed to be higher with all the three @ 500 kg/ha.

1.40 Rohu spawn recorded higher percentage of survival in jars treated @ 1200 kg/ha with a mixture of cowdung (45%), poultry manure (36.7%), mustard oilcake (23.3%) and compost (8.33%).

1.41 Fingerlings of Indian major carps are being reared for stocking in experimental ponds.

1.42 In various experiments of composite fish culture, the profit ratio to operating cost was maximum for eastern region (173%), followed by central region (151%), southern region (86%) and western region (33%). The relative cost structures for feed to fertilizer were 2.56, 2.89, 5 52 and 9.15 respectively.

1.43 Belly flesh of Indian major carps was found to contain maximum quantity of fat. Increased deposition of fat in liver and gonads was observed in pre-spawning phase and this was found to be more in females.

1.44 The water qualities in the newly constructed ponds at Dhauli did not show appreciable variation after stocking with fish. Slight increase in plankton forms was observed after one month of stocking.

1.45 *M. seenghala* fry (38 mm/0 044g) at the end of $1\frac{1}{2}$ months, rearing, reached 76mm/2 35 g in the yard. The fingerlings attained 145mm/50g

after one month of stocking in a nursery pond. The fry were fed with tendipedid larvae and the fingerlings with groundnut oilcake and fish meal in addition to forage fishes.

Project 2 :

2.7 The fractions from pituitary glands of cultivated carps have been lyopholysed and are now readily available in ampoules in powdered form.

2.8 The time required for evaluation for female *P. pangasius* after second injection was found to be more than for carps.

2.9 Immature ova (0.18 mm) of *C. catla* encountered in January were spherical and showed a large nucleus. The mature ova (0.96 mm) encountered in June were fully yolk laden, semi-transparent and showed a clear margin.

2.10 Different adenohypophyseal cell types have been identified. Histological studies on pituitary gland and gonad of pond bred common carp, mrigal and rohu, collected from both still and running waters, are in progress.

2.11 In cistern experiments *C. carpio* treated with vitamin E and growth hormone showed higher G.S.I. than in control. In the field, catla and rohu, treated with vitamin E, showed larger ova and on hypophysation underwent complete spawning compared to partial spawning in the case of controls.

2.12 Histological preparations of the kidney head containing interrenal cells and chromaffin tissues were made and their distribution pattern was studied.

2.13 Of the four induced bred females (1 rohu, 3 mrigals) released in ponds for second maturity, 2 mrigals attained maturity for the second time.

Project 3 :

3.8 The *Puntius pulchellus* breeders from wild water and ponds showed differential stages in both the sexes.

3.13 Observation on the physico-chemical conditions of water in both A.S.C. and I.T.I. tanks were made The latter showed more plankton production than the former but the bottom fauna was richer (5.37 g/m^2) in

A S.C. tank. A fish production of 1606 kg/ha/10 months was obtained in A.S.C. tank with minimal feed and fertiliser inputs.

3.14 Hydrobiological studies of the Gulariya reservoir were continued. Maximum plankton density was observed in June. Macrobenthic fauna ranged between 396 u/m^2 (July) and 268 u/m^2 (March). A total of 2,400 fry of Indian major carps were collected, reared to fingerling stage and released back into the reservoir The reservoir was stocked with 1,50,801 fingerlings of Indian major carps. During a period of 17 fishing days, a total of 587.600 kg of fish was harvested of which the major carps contributed the maximum.

Project 4 :

4.5 The spawn yield at Madhuka was poor as compared to those of previous years. A total of 2365 ml of spawn was collected in 4 spurts. The percentage of major carp spawn ranged from 12.3 to 41. 4, the highest being in the 4th spurt.

Project 5 :

5.17 *P. monodon, P. indicus* and *M. dobsonii* reared in a plastic pool showed average growth increment of 6.5 mm/0 5 g, 3 5 mm/0.3 g and 7 0 mm/0.4 g respectively in 36 days.

Scylla serrata (25-37) mm and *P. pelagicus* (28-34 mm) were reared in glass jars and plastic tubs with artificial feed and the monthly average gro wth rates were 6.67 mm/3.4g and 9 83 mm/4.6 g respectively.

5.18 Oysters kept on trays showed better growth than on asbestos sheets (height range : 25-105 mm and length range : 25-82 mm).

5.22 Mullet reared without and with artificial feed showed an average growth increment of 20mm/0.7 g and 23 7 mm/1.4 g in a month respectively. *Chanos chanos* reared with artificial feed registered an average increment of 14.1 mm/3.7 g in a month *Etroplus suratensis* reared in plastic pools using tap water and lake water showed length increments of 1.3 mm and 1.7 mm respectively.

5.28 Estimated total landings from Pulicat lake was 1022.787 t and the major constituents were prawns (53.78%) and mullets (35.4%).

5.31 The biomass of the aquatic flora *Cymodocea* sp. and *Helephila* sp. and filamentous algae ranged from 0.1 to 9.425 kg/m^2, 0.05 to 0.5 kg/m^2 and 0.45 kg/m^2 respectively.

5.34 Stock manipulation in polyculture experiments with Indian major carps, exotic carps and brackishwater fishes and prawns was carried out in low saline ponds. With a stocking density of 8000 nos./ha, a production of 1400 kg/ha/yr was obtained. In this experiment *P. monodon* attained a size of 196 mm/60 g in 120 day.

5.37 Mixed culture of prawns *viz., P. indicus Palaemon styliferus, P. monodon, M. monoceros* and *M. brevicornis* at a stocking density of 2 lakh/ha yielded a production of 863·5-1,185.0 kg/ha/yr and 350.0-725.0 kg/ha/yr in 4 crops respectively.

5.38 Culture of *Lates calcarifer* at a stocking density of 2000/ha has been carried out in the main feeder canal. The estimated production based on the standing crop is 3200 kg/ha.

5.40 In mixed culture of mullets, chanos, and prawns at a stocking density of 10 000/ha through multiple stocking and repeated harvesting yielded estimated production of 25,000 kg/ha/yr.

5.41 A total of 5,26,766 number of commercially important species of prawn and fish seed were collected by spending 238.25 man hours.

5.42 Artificial feed with ingredients like fish meal, prawn powder, goat intestine, buffalo intestine, algal powder, yeast, etc., was formulated for prawns. A growth rate of 12-14 mm/month was obtained with feed containing 45.2% protein.

5.45 Of the five trace elements tried in the laboratory for enhancing the nutrient status of brackishwater ponds, molybdenum, boron and zinc gave better results.

5.47 Mineralisation rate of cotton seed cake has been studied under high and low temperature of 33°C and 18°C respectively with fresh

and saline water. The rate increases by 2 5% under high temperature. Utilisation of cowdung as feed for fishes has been tried by increasing its protein content from 2.1 to 12% with microb treatment. Rayon factory waste contains high SO_4 in acid conditions which may efficiently be utilised after proper chemical treatment for reclamation of alkaline soils

5.50 Recruitment of post larvae and juveniles of fish and prawns into the lake was very poor. Kovalam was found to be the best seed collection centre for chanos, mullets and perches and Pulicat being next for prawns and mullets. Mullets, catfishes, perches and prawns were transported over a distance of 25 and 50 km with mortality ranging from nil to 43%.

5 51 Ecological studies of commercial brackishwater *bheris* reveal that in low saline waters (1.29—4.22‰) soluble phosphate is 0.84 ppm. This seems to have helped to obtain better production in low saline waters.

5.52 Experiments on rationalisation of frequency of fertilisations have revealed that application at intervals of 3 days maintains maximum concentration of nutrients.

5.53 A methodology for biomass study in brackishwater impoundments has been successfully worked out.

5.54 Soil samples collected from different intertidal points have been analysed.

5.55 Soil samples collected from Taldi fish farm were analysed. Common solt was applied to change the salinity to 10, 20 and 30 ppt. Mass culture of *Chlorella* sp. *Navicula* sp. and *Nitzschia* sp. was done by the use of Bristol solution minus P.

5.56 With locally available cheap ingredients, eight feeds were formulated for *P. monodon* having protein values ranging from 21 7 to 37.7%. One of the feeds having 35.8% protein yielded a conversion value of 2.5 : 1.

5.57 Immature specimens of *P. monodon* collected from freshwater ponds were induced to mature and breed in brackishwater by eye-stalk ablation technique.

Project 6 :

6.2 In mixed culture experiments a production of 327.13 kg/ha/ 5½ months of *M malcolmsonii* and 2,084.25 kg/ha/10 months of fish could be achieved. Monoculture of *M. malcolmsonii* yielded production ranging from 64.0 to 334.3 kg/ha under varied stocking densities

6.5 Larvae of *M. birmanicum choprai* attained 40-50 mm size in 75 days. The berried females were kept in specially designed cages. Spent females were removed alongwith the cages and 80% of the newly released larvae escaped into the pond which helped to control the mortality due to cannibalism.

6.6 A total of 17,176 prawn seed were produced, out of which 12,372 were distributed to governmental agencies and private farmers.

440 prawn seed (10-15 mm) fed on Tapioca and foot of apple snail yielded 709 kg/ha in 6 months with a survival of 68.8%.

6.7 In yard experiment, green water culture with *Chlorella Chaetoceros* and *Navicula* could be successfully maintained in 20 to 30% sea water enriched with KNO_3, KH_2PO_4 Na_2SiO_3 (N:P : Si—7 : 2 : 5) and EDTA. The rotifers (*Brachinus* sp) could be successfully cultured in green water containing fertilizers with organic wastes like paddy husk soaked in water, straw extract and rice bran upto a density of 15-20,000 nos/l. Fresh water shrimps *(Streptocephalus dishotomus)* were also successfully reared on weed compost and soil base for a period of 5 months producing viable eggs.

Project 8 :

8.1 Prawn and fish seed prospecting was carried out at different centres on Ichhamati, Matlah and Thakuran estuaries.

8.7 Histochemical studies of the gonads of *Silago panijus, Glossogobius giuris* and *Liza parsia* are being conducted.

Project 9 :

9.4 Hypophysation of mature F_1 catla-rohu hybrid yielded 0.75 lakh spawn. The F_2 hybrids grew to a size of 339 mm/504 g in one year. Chromosome studies on the F_2 hybrids are being conducted.

9.6 Brood stock of Indian major carps is maintained.

9.7 'Shoot carps' of both the species when reared alongwith normal ones for 6 months did not show any difference in their growth pattern.

9.7.1 Hybrids of grass carp × silver carp looked more like grass carp and have grown to 750 g in the course of about 12 months and the single silver carp × catla hybrid attained a size of one kg in ponds.

9.8 Hybrids of catla × common carp ; catla × silver carp, and rohu × common carp were produced and a few surviving ones are being reared. Rohu × common carp hybrids produced in 1977 had attained 142 mm/ 32 g in 7 months.

Project 10 :

10 2 Seepage in newly dug ponds at Dhauli was observed to be maximum (21.1 cm) during the month of November when the canal water flow was stopped. In other months it was negligible.

Project 11 :

11 8 The size of unit investiments and cost benefit analysis for a project life (in air-breathing fish culture) of 20 years duration has been w o rked out.

Project 12 :

12 5 Recirculation and aeration of water in brood fish ponds proved highly effective in maintaining the brood fish stock of silver and grass carps. The prolongation of receptivity period of silver carp up to first week of November has been achieved. Incidental to various experiments 5.23 lakhs of silver carps and 1.25 lakhs of grass carp spwan was produced.

12.6 Studies on compatibility and competition indicated that the growth of rohu suffered only slightly when raised with silver carp as compared to its rearing with catle.

12.7 Fingerling rearin of exotic carps in a ratio of Sc. 3.5 : Gc. 1 : Cc 2.5 at a stocking density of 2 lakhs/ha is in progress.

12.8 3 rearing ponds each were stocked @ 10 females : 5 males (av. wt. 1.2 kg) and the fish were fed with Napier grass in one case and *Hydrilla* in the second @ 7 kg/day and pulse waste @ 0·5 kg/day in the third case. The effect of these feed on maturity of grass carp could not be ascertained. The brood fish did not respond to hypophysation possibly due to delayed monsoon.

12.2 Estimated productions of 189 24 kg/ha/2 months and 221.87 kg/ha/2 months in the two ponds were achieved in short term (3 months) culture of exotic carps in two ponds at a stocking density of 10,000/ha under intensive feeding and fertilization.

Project 13 :

13.14 Mass culture of *Daphnia* sp. was done using different nutrient media like silk worm pupae extract @ 2 g/1 and cowdung @ 1 kg m^2. Biology of *Brachionus* sp., *Scapholebris* sp. and *Gammarus* sp. was studied.

13.16 *Schizothorax niger* was successfully bred by artificial fecundation using 'dry' method of stripping. Percentege of fertilisation ranged from 76.0-87.0. Survival rate from egg to fry stage was 80%. Fry of *S. niger* stocked @ 40 fry/m^2 attained a size of 31-47 mm in 45 days, while fingerlings (75-130mm 8-12 g) stocked @ 20 fingerlings/m^2 attained a size of 95-145 mm/12-20 g in 80 days with cent per cent survival.

In cage rearing of fry and fingerlings of *Schizothorax* spp., better growth was recorded with fishes fed on supplementary feed consisting of mustard oil-cake and wheat bran as compared to the control.

13.20 Of the various feeds tried for rearing brown trout fingerlings, best conversion ratio of 1.9 was given by the commercial diet.

13.21 Hypophysation of mahseer was tried with pituitary gland extract of mahseer, *Schizothorax* spp. and major carps with dosages ranging from 4 to 6 mg/kg body weight without any success.

Project 14 :

14.1 Total landings from middle stretch of the river Ganga was estimated to be 167.10 t whereas in the lower stretch it was 87.08 and 24.19 t respectively at Bhagalpur and Lalgola. Species-wise landing at Sadiapur, Daraganj and Buxar were estimated. Ecological observations of the Ganga at Bagalpur were made.

Project 16 :

16.3.1 Chronic infestations of *Nymphea, Nymphoides Ottelia* were eliminated by a single application of 2,4-D soaked brick pellets @ 5 kg a.i./ha and the regeneration was controlled by a second application which considerably reduced the problem of reinfestation. Treatment with commercial 2, 4-D granules showed desirable effects on *Ceratophyllum* but was costlier than the former.

Diuron @ 5 kg a.i./ha was effective on all submerged weeds and grasses at all stages of growth and @ 2.5 kg a.i./ha it was very effective in clearance of heavy mats of algae and *Ottelia* as well. The treatment did not hamper the growth of plankton and bottom biota, on the contrary, the kill increased their production.

16.3.2 Paraquat @ 3 ppm cleared *Hydrilla* in 18 days and @ 5 ppm cleared *Vallisneria* and *Ceratophyllum* in 10 days.

16.5 Rooted vegetation *viz., Vallisneria, Hydrilla, Nymphoides* & *Lagorosiphon* and floating plants like *Azolla* & *Spirodela* could be effectively controlled with urea applied @ 400 kg/ha in solution. $CuSO_4$ solution could effectively kill 95% of *Salvinia* plants.

16.6 Absorption of P and Cu by different aquatic plants is being studied.

16.10 The cowshed washings from 16 cows provided fertilisation for 0.3 ha pond stocked @ 5000 fingerlings/ha. The fish have grown well and catla has attained more than one kg in one year without any other fertilizer or feed.

16.12 Plankton and bottom biota were found to be very scarce in ponds infested with *Pithophora*. But these made their appearance in considerable number subsequent to the gradual kill of the weed with treatment with diuron.

2,4-D up to 30 ppm. and Diuron upto 5 ppm were not lethal to fish fry. But theydied with 0·6ppm paraquat.

16.13 Growth of Pistia and Salvinia was more during post-monsoon months (August to October).

Project 17 :

17.7 The frog hatchery technique has been evolved and standardised. 16 experiments were conducted with *Rana tigrina* and *R. crassa* and nearly one lakh hatchlings were produced. Experiments show that even without the pectinase treatment, good hatching of eggs can be obtained with sodium chloride and urea solutions under proper circulation of water.

17.8(a) Out of 1.05 lakh hatchlings/tadpoles of *R. tigrina*, *R. crassa* and *R. hexadactyla* produced, about 35,000 were reared to early frog stage in the laboratory and field. Of the various feeds tried, silkworm pupae not only induced phenomenal growth but also gave excellent survival to earloy frg stage. There was virtual absence of cannibalism in tadpoles of *R. tigrina* and *R. crassa* due to high quality protein diet during their developmental stages.

17.8(b) Tadpoles of *R. tigrina* fed with fish meal and minced goat meat metamorphosed in 25-59 days with 56% survival ; those fed with pelleted feed metamorphosed in 21-41 days with 60.5% survival as against 22-29 days with 16% survival in control.

17.9 (No progress during the year)

17.10 *Pheretima* sp. when cultured for 30 days, showed a multiplication rate of 25 times in yard and 20 times in the field. Cowdung, rotton leaves and compost manure in 1 : 1 : 1 ratio were applied at fortnightly intervals.

17.11 *R. tigrina* showed nocturnal feeding migration and breeding migrations to shallow water areas duridg early monsoon. The egg masses were found to adhere to the submerged weeds at a depth of 3.5 cm.

17.12 The brown plant hopper showed a three fold multiplication rate in wooden cages but the rate decreased during summer months.

17.13 At stocking densities of 10,000/ha and 20,000/ha, 85% and 60% *R. hexadactyla* metamorphosed in to early frogs respectively. The early frogs stpcked @ 25000/ha and 100,000/ha, recorded a production of 300 kg/ha and 1,225 kg/ha and a survival of 55% and 25% respectively in 8 months. The juveniles at a stocking density of 6000/ha grew to 67 mm/73.3 g in 7 months.

Project 18 :

18.1.5 Tilapia stocked @ 20,000/ha in a 0.076 ha pond and fertilised with damestic sewage yielded a remarkably high production of 9,534 kg/ha in 14 months.

18.1.6 Composite culture of catla, rohu, mrigal, silver carp and common carp at a stocking density of 10,000/ha in a 0.17 ha pond fertilised periodically with domestic sewage yielded aproduction of 5,402 kg/ha/yr.

18.1.11 A new system of paddy cum fish culture has been developed wherein a production of 5000 kg of paddy (in 2 crops) and 708 kg of fish has been achieved. A 1.102 ha paddy plot with a perimeter canal of 1.2 m deep and 0·27 ha in area was used for paddy and fish culture. Major carps stocked @ 6000/ha were reared in the canal except from July-November when the field was flooded and the fishes could be reared in the paddy field also. Jaladhi-II and Jaya varieties of paddy were cultivated during kharif and Rabi seasons respectively.

Project 19 :

19.8 Artificial fecundation of fluviatile stock of hilsa from River Narmada was successfully achieved through 'wet' method of stripping. The percentage of fertilisation ranged from 60 to 90. The low rate of hatching and total mortality of hatchlings in ponds at Attlai and Bharbut was attibuted to high iron and low calcium ions concentrations in the wates. Fertilised eggs and spawn of hilsa could be successfully transported under oxygen packing to distances ranging 6-8 hours journey by road with only 5-10% mortality.

The hatchlings could be reared to a size range of 72 to 82 mm in about 80 days in nursery ponds fertilised with organic and inorganic fertilisers.

Success has also been achieved in artificial fecundation of hilsa at Farakka on the river Ganga.

19.9 Studies were carried out to delimit the breeding ground of hilsa and the season of availability of larvae in the Hooghly Estuary.

Project 20 :

20.5 Studies have revealed that the city sewage effluents affect the aquatic biomass in the river Ganga and Yamuna primarily through Oxygen depletion

20.8 Bioassy studies on *Cyprinus carpio* and *Cirrhinus mrigala* indicated that Y-BHC is more toxic than DDT and Malathion.

20.9 The exposure of *L. rohita* to 0.02 ppm ethyl perathion increased the SMR from 75 to 116 and 125 mg/kg/hr for 24 hours and 48 hours exposures respectively at 20°C.

20.10 In Rihand reservoir. the effect of industrial effluent was observed upto 100 m from the confluence during pre-monsoon upto 30 m during monsoon and upto 50 m during post-monsoon month.

20.11 Zinc content in the effluents of rayon, paints, varnish and rubber industries and in the bottom sediment near outfall areas of these effluents was estimated.

20.12 The productivity of the bottom sediment, with respect to plankton production, collected from 5 different sites around the discherge point of tissue mill was studied.

20.13 The physico-chemical parameters and plankton biomass were estimated in 2 centres located in Kulti estuary.

Project 21 :

21.1 Preliminary survey of Mans has been completed and Sikandarpur and Manika have been selected for detailed studies.

Project 22 :

22.2 A 10 km stretch in River Ganga near Allahabad was surveyed. 25 breeding pits of *M. seenghala* were located and 8,000 hatchlings/fry were collected. Cage culture of *M. seenghala* fry, providing chironomid egg mass, was conducted in the river Ganga. Laboratary experiments conducted to findout a substitute for chironomid egg mass revealed that

'Isabgol' soaked in water for a minimum period of 12 hours was acceptable to the fry/fingerlings. Fry of *M. seenghala* could be successfully transported from Allahabad to Cuttack under oxygen packing.

22.3 Cage culture of carps in Jari tank was conducted at a stocking density of 300 fish/cage (2×1.5×1.5 m) providing artificial feed. During the shifting from Jari tank to Gularya reservoir heavy mortality was observed. Growth of fishes during winter months was found very poor. Catla and rohu attained average weight of 1,030 and 188.5 g respectively in about 22 months rearing.

22.4 Penculture of common carp has been initiated in the pens installed in Dhighalmari beel. The fingerlings are provided with artificial feed@ 4% of their body weight. Hydrological observations of the beel are being made.

Project 23 :

23.1(a) Due to nonavailability of water in the canal, the canal breeding experiment could not be conducted.

23.1(b) Successful breeding of Indian major carps was achieved in Nain dry bundh. The total yield of hatchlings was estimated to be 120 lakhs. Partial breeding was observed in Alipura dry bundh and there was no breeding in Chhatrasal dry bundh. The physico-chemical conditions of the bundhs were studied.

Project 24 :

24.1 Circulatory-filter system has been installed in a set of two ponds. Culture of *Catla catla* and *Labeo rohita* fingerlings has been initiated in these ponds with the provision of artificial feed. The experiments are in progress.

24.2 Six feeding trials with artificial feed were conducted to find out the feeding capacity and utilisation of feed by *L. rohita* and *Clarias batrachus*. Pellets of 5.0 to 8.0 mm size were made and applied @ 5-7% of the body weight of the fish. Out of 5%, 6% and 7%, *L. rohita* and *C. batrachus* consumed 3.6, 4.2 and 4.1% ; and 3.8, 4.5 and 4.7% of body weight respectively.

Project 25 :

25.1 Studies on the hydrobiology of a selected beel in Assam have been initiated.

Project : CFCSP

1.1 At Pune centre, a record production of 10,194 kg/ha/yr was achieved with 6 species combination of Indian and exotic carps. Production to the tune of 5,909 kg/ha/6 months, 7,371, 6537 and 3,526 kg/ha/yr could be achieved at Karnal, Jaunpur, Gauhati and Ranchi Centres respectively. *M. malcolmsonii* tried as a component in composite fish culture was found not compatible with grass carp. Induced breeding of Indian and exotic carps was carried out at different centres and silver carp was, for the first time, induced bred at Badampudi centre. Incidental to induced breeding experiments a total of 363.0 lakhs spawn was produced.

1.2 At centrally sponsored centres of the project encouraging rate of production was achieved. The production figures were 4,107 kg/ha/6 months *c* 4000 kg/ha/14 months, *c* 3,300 kg/ha/yr and 1,600/kg/ha/7 months—3,578 kg/ha/9 months at Kausalyagang, Godhra, Khutelabhata and Coimbatore respectively. Induced breeding of Indian and exotic carps were conducted successfully at all the centres.

CFCSP 2 (Research work completed in 1977)

CFCSP 3 Female carp spawners were found to lose weight on capture. Pituitary extract injection induced hydration in them. Sum total of gain and loss of weight indicated the success of hypophysation. Those fishes which do not show increase in weight before the second injection should be put back in the pond.

CFCSP 4 Experiments to findout the efficacy of Brahmaputra silt as a fertiliser in composite fish culture ponds indicated that the riverine silt increased the pH and nutrient level of the water. Data on other aspects are being analysed.

CFCSP 5 (Research work suspended since 1975)

CFCSP 6 (No progress of work during the year)

CFCSP 7 & 8 (Research work completed in 1978)

CFCSP 9 (No progress during the year)

CFCSP 10 In pig-cum-fish culture, six species combination of Indian and exotic carps yielded a production of 7,300 kg/ha/yr. Two lots of pigs, reared during this period produced 1,095 kg of pig flesh. In fish-cum-duck rearing a total of 6,397 kg of fish could be produced in one year from a 1.48 ha pond. In addition to fish 1,835 duck eggs were also collected.

CFCSP 11 Studies on the developmental stages of silver carp have been completed. Studies on the biology of the species are being continued.

CFCSP 12 (No progress during the year)

CFCSP 13 A production of 3,841.5 kg/ha/13 months was achieved from a demonstration pond.

CFCSP 14 (Research work suspended in 1978)

CFCSP 15 (Research work completed in 1977)

CFCSP 16 (Research work suspended in 1978)

CFCSP 17 (Research work completed in 1977)

CFCSP 18 Experiments conducted with fry and fingerlings of mrigal as test fish indicated greater role ofproteins and vitamins in their growth. Test diet containing 48% protein and vitamins A, B_1, B_2 and D_2 enhanced the growth of mrigal fry by almost double than those offered with diet containing 32% protein and devoid of vitamins.

CFCSP 19 Zooplankters were found to survive when exposed even to 50 ppm of latex extracted from *E. verifolia*, *E. antiquorum* after 24 hrs.

CFCSP 20 Different media of extension were used for the purpose of popularising aquaculture techniques.

Project ABF :

ABF 1. Induced breeding of singhi, koi, murrels and magur was successfully demonstrated. Mixed culture of *O. striatus* and *Anabas* yielded a production of 914 kg/ha/6 months. Semi-intensive and intensive culture of magur gave production ranging from 3-7 tons/ha/6 months and 55 tons/ha/7 months respectively whereas singhi yielded 4 tons/ha/4 months and 35 tons/ha/7 months respetively.

ABF 2 It has been estimated that with each raking 2 kg of available $P_2O_5$5/ha out of 1,727 kg of available P_2O_5/ha, and 9.3 kg of available nitrogen/ha out of 2386 kg of available nitrogen per hectare will be released into the water.

ABF 3 The work could not be initiated due to some technical difficulties.

ABF 4 (Research work completed in 1977)

ABF 5 (Research work completed in 1977)

ABF 6 Haematological studies on *C. batrachus* jn relation to circodian rhythem has been carried out.

ABF 7, 8, 9 (Research work completed in 1977)

ABF 10 (Research work merged with problem ABF 3)

ABF 11 Size-group wise price data and the seasonal variations in arrival of the air-breathing fishes have been collected.

ABF 12 (Research work completed in 1977)

ABF 13 Malathion exposure at concentration of 1.0 ppm enhanced the activity of the drug metabolising system in liver and gills in magur. There was significant inhibition of protein synthesis when the fish were exposed to malathion (0.5 ppm) for forty days.

ABF 14 Fifty percent of the protein in the diet of magur and singhi could be replaced by urea supplying equivalent nitrogen without any adverse effect on growth and survival.

Project R :

R 1 : Investigations on the physico-chemical and biological conditions and fish population dynamics in Bhavanisagar, Nagarjunsagar, Getalsud Govindsagar and Rih and reservoirs were continued.

In Bhavanisagar a production of 45.3 kg/ha/yr was obtained. *Labeo calbasu* was found to be the prime contributor (52.10%) in the total catch foliowed by *Mystus aor* (14.80%). Total fish yield in Nagarjunsagar was higher

than that of the previous year, catfishes being the major contributors. In Getalsud and Rihand bulk of the total landing was constituted by *Catla catla* (91.16% and 90.6% respectively). In Govindsagar *Labeo dero* was the prime contributor followed by *Labeo rohita*, *Cyprinus carplo* and *Catla catla*.

Project : CIFRI/IDRC/WB

CIFRI/IDRC/WB 1 & 2 (Research work completed in 1978)

CIFRI/IDRC/WB 3 : Diet containing 30% protein showed 71% degestibility in grass carp. Out of 5 test diets, maximum growth of grass carp fingerlings was recorded with diet containing 26% protein. Cellulase and considerable lipase activity was observed in the hepatopancreas of the fish. Cellulase activity was also recorded in the intestinal bulb and intentine of the fish.

CIFRI/IDRC/WB 4 : (Research work suspended)

CIFRI/IDRC/WB 5 : Unidentified diseases in silver carp and magur have been recorded. Reddish lesions on the body of these fishes could be cured by administering terramycin alongwith feed @ 300 mg/kg of feed in a 7-days course.

CIFRI/IDRC/WB 6 (Research work suspended in 1976)

CIFRI/IDRC/WB 7 (No progress during the year)

CIFRI/IDRC/WB 8 Experiments on nutritional requirements of silver carp have been initiaten.

CIFRI/IDRC/WB 9 Village response survey of rural aquculture has been intiated and a proforma has been devised and tested in the Hanspukur area.

7. PERSONNEL

Retirement

Dr. V. Gopalakrishnan, S-3 voluntarily retired w.e.f. 31.12.1976.

Dr. K. H. Ibrahim, Scientist-2 voluntarily retired from the service on 31.10.1978.

Promotion :

The following persons were promoted to next higher grade during the the year.

Shri M. Ranadhir	:	Scientist 1	to	Scientist 2
Dr. G. N. Mukherjee	:	Scientist 1	to	Scientist 2
Shri Ch. Gopalakrishnaya	:	Scientist 1	to	Scientist 2
Shri G. K. Bhatnagar	:	Scientist 1	to	Scientist 2
Shri M. Y. Kamal	:	Scientist 1	to	Scientist 2
Shri K. V. Ramakrishna	:	Scientist 1	to	Scientist 2
Shri C. Saha	:	Scientist 1	to	Scientist 2
Shri R. S. Panwar	:	Scientist 1	to	Scientist 2
Shri M. K. Mukhopadhyay	:	Scientist	to	Scientist 1
Shri G. N. Srivastava	:	Scientist	to	Scientist 1
Shri Anup Kumar Datta	:	Scientist	to	Scientist 1
Shri Dina Nath Singh	:	Scientist	to	Scientist 1
Shri Dhirendra Kumar	:	Scientist	to	Scientist 1
Shri Kusamadhab Das	:	Scientist	to	Scientist 1
Shri P. Kumariah	:	Scientist	to	Scientist 1
Shri V. K. Murugesan	:	Scientist	to	Scientist 1
Dr. Harbhajan Singh	:	Scientist	to	Scientist 1
Shri V. V. Sugunan	:	Scientist	to	Scientist 1
Shri K. Gopinathan	:	Scientist	to	Scientist 1
Shri B. K. Mishra	:	Scientist	to	Scientist 1
Dr. Mathew Abraham	:	Scientist	to	Scientist 1

Smt. G. K. Vinci	:	Scientist	to	Scientist 1
Shri P. K. Chakraborti	:	Scientist	to	Scientist 1
Shri Bimalendu Roy	:	Scientist	to	Scientist 1
Shri K. V. Rao	:	Scientist	to	Scientist 1
Shri Ardhendu Mukherjee	:	Scientist	to	Scientist 1
Smt K. K. Bhanot	:	Scientist	to	Scientist 1
Shri P M. Mitra	:	Scientist	to	Scientist 1
Shri R. A. Gupta	:	Scientist	to	Scientist 1
Shri B. C. Jha	:	Scientist	to	Scientist 1
Dr. Brijhata Prasad Gupta	:	Scientist	to	Scientist 1
Shri Dibakar Nath	:	Scientist	to	Scientist 1
Shri S. K. Saha	:	Scientist	to	Scientist 1
Shri Hansila Prasad Singh	:	Scientist	to	Scientist 1
Shri G. N. Chatterjee	:	Scientist	to	Scientist 1
Shri R. K. Das	:	Scientist	to	Scientist 1
Dr. Prakash Rai	:	Scientist	to	Scientist 1
Shri P. K. Mukhopadhyay	:	Scientist	to	Scientist 1
Shri M. M. Bagchi	:	Scientist	to	Scientist 1
Shri M D. Pisolkar	:	Scientist	to	Scientist 1
Shri P. K. Sthanapathy	:	Superintendent	to	Assistant Administrative Officer
Shri A. K. Sengupta	:	Assistant	to	Superintendent

Grant of Advance Increments :

The undermentioned scientists of the Institute have been granted advance increments as mentioned against their names :

	Name	Increment
1.	Shri D. R Kanaujia	Three
2.	,, Radha Kanta Dey	Three
3.	,, S. K. Majumder	Two
4.	,, B. K. Singh	Two
5.	,, Narbada Prasad Srivastava	Two
6.	,, Surendra Narain Singh	One
7.	,, M. P. Singh Kohli	Three
8.	,, P. C. Mahanta	Two
9.	,, D. K. Kaushal	One
10.	,, Vijay Kumar Sharma	Two
11.	,, Vijay Kolekar	Two

	Name	Increment
12.	,, P. K. Sukumaran	Two
13.	,, P. K. Ghosh	Two
14.	,, N. M. Chakraborty	Two
15.	,, Amitabha Ghosh	Three
16.	,, R. Ganapathy	Two
17.	,, B. K. Banerjee	One
18.	,, R. K. Dwivedi	Three
19.	,, Dilip Kumar De	Three
20.	,, V. Pathak	Three
21.	,, J. N. Pal	One
22.	,, R. K. Singh	Two

Appointment :

Following appointments were made during the year :

Name	Designation	Place of posting
Shri J. C. Malhotra S-2	Scientist-3	Allahabad
,, R. D. Chakraborty S-2	do	Cuttack
Dr. S. B. Singh S-2	do	Cuttack
Dr. A. G. Jhingran S-2	do	Allahabad
Shri S. D. Tripathi S-2	do	Barrackpore
,, D. D. Halder S-1	do	Kakdwip
,, M. A. Khan	Scientist-1	Barrackpore
,, J. P. Verma	Sr Training Asstt.	Kausalyagang
,, S. L. Kar	do	Kausalyagang
,, B. B. Satpathy	do	Kausalyagang
,, Bhailal	LFA (T-1)	Allahabad
,, T. P. Ghosh	Launch Driver (T-1)	Kakdwip
,, Kishan Manjhi	Jr. Clerk	Bilaspur
,, R. N. Mahato	do	Barrackpore
,, R. K. Ghosh	do	Barrackpore
,, S. K. Tikadar	do	Kakdwip
,, Chottey Lal	do	Allahabad
,, Swapan Kumar Deb	Plumber	Barrackpore
,, Rabindra Tarai	Driver	Cuttack
,, Balaram Das	Watchman	Cuttack
,, Debahari Behera	do	Cuttack
,, K. C. Naik	do	Cuttack
,, J. Paira	do	Kalyani

Name	Designation	Place of posting
,, G, C. Mallick	do	Kalyani
,, H. C. Banik	do	Barrackpore
,, N. K. Das	do	Barrackpore
,, R. K. Bhoi	do	Dhauli
,, Parsuram Das	Fisherman	Cuttack
,, Rijaya Bhoi	do	Cuttack
,, Ramesh Chandra Swain	do	Cuttack
,, Jatadhari Swain	do	Cuttack
,, Sudarsan Naik	do	Cuttack
,, Yusuf Dar	do	Harwan
,, M. C. Das	do	Gauhati
,, S. K. Venkatachalam	do	Pune
,, K. P, Ram	do	Ranchi
,, Govind Lal	do	Allahabad
,, Sudama Behera	do	Dhauli
,, Ramesh Ghadei	do	Dhauli
,, N. Jena	do	Dhauli
,, B. Patnaik	do	Dhauli
,, P. K. Nayak	do	Dhauli
,, Rajan Swain	do	Dhauli
,, Pitambar Swain	do	Dhauli
,, Dhanu Behera	do	Dhauli
,, Shripati Nayak	do	Dhauli
,, B. C. Sardar	Khansama	Barrackpore
,, Chaki Behera	Mali	Cuttack
,, Pasupati Ghosh	Mali	Barrackpore
,, P Nageswar Rao	Safaiwala	Tadepalligudem
,, J. Balmiki	Safaiwala	Allahabad

Transfer :

Inter Institutional :

Shri D. Narayanswami, S-1 has joined this Institute on Inter-Institutional transfer from Central Potato Research Institute on 1.6.1978.

Intra Departmental :

Following transfers were made during the year :

Name	Designation	From	To
Shri Balbir Singh	S-1	Kalyani	Allahabad

Name	Designation	From	To
Dr. K. G. Rao	S-1	Gauhati	Bhubaneswar
Shri A. K. Laal	S-1	Kalyani	Barrackpore
,, P. L. N. Rao	S-1	Puri	Bhubaneswar
,, C. B. Joshi	S-1	Uttar Kashi	Dehradun
,, V. R. Chitransi	S-1	Buxar	Muzaffarpur
,, A. K. Laal	S-1	Barrackpore	Bhagalpur
,, Kuldip Singh	S-1	Barrackpote	Kakdwip
,, P. K. Chakraborty	S-1	Barrackpore	Kakdwip
,, V. K. Bali	S-1	Barrackpore	Harwan
,, B. R. Sirsat	S-1	Barrackpore	Bhubaneswar
Smt. G. K. Vinci	S-1	Barrackpore	Nagarjunsagar
Shri P. M. Sherief	S-1	Barrackpore	Allahabad
,, D. Narayanswami	S-1	Kakinada	Barrackpore
,, A. Halim	Sr. Clerk	Bhubaneswar	Allahabad
,, Wilson Giria	Jr. Clerk	Ranchi	Bhubaneswar
,, Pasupati Lall	Driver	Barrackpore	Burdwan
,, A. M. Patra	Lab. Boy	Burdwan	Jalpaiguri
,, S C. Balmiki	Lab. Boy	Barrackpore	Nagarjunsagar
,, C. K. Pandey	Lab. Boy	Allahabad	Bhagalpur
,, H. K. Burman	Boatman	Allahabad	Barrackpore
,, Bhim Bahadur		Cuttack	Barrackpore
Dr. S. P. Rai	S-1	Puri	Cuttack
Shri J. P. Mishra	LFA (T-1)	Rihand	Tadepalligudem
,, D. Kapoor	SRA	Allahabad	Muzaffarpur
,, A. R. Choudhury	T-4	Barrackpore	Calcutta
,, Dr (Mrs) T. Rajyalakshmi	S-2	Kakdwip	Barrackpora
Shri M. P. Singh	LFA (T-1)	Bhagalpur	Patna

Staff :

The following staff rendered their services to the Institute during the year :

DIRECTOR

Dr. V. G. Jhingran

S-3

Chakraborty, R. D. Dehadrai, P. V.

S-3 (Contd.)

Gopalakrishnan, V. (on FAO assignment)
Ghosh, A N. (on deputation to SFDC,WB)
Halder, D. D
Jhingran, A.G.
Malhotra, J. C.
Natarajan, A V.
Pakrasi, B. B.
Sinha, V. R. P.
Singh, S. B.
Tripathi, S. D.

S-2

Ayar, S. P.
Bhatnagar, G. K.
Chandra, Ravish
Das, P.
Ghosh, Apurba
Ghosh, K. K.
Gopalakrishnayya, Ch.
Givind, B V.
Gupta, M. V. (on FAO assignment)
Ibrahim, K. H.
Kamal, M. Y.
Khan, H. A.
Mitra, Eva
Mukherjee. G. N.
Pahwa, D. V.
Panwar, R. S.
Pal, R N.
Pathaik, S.
Ramakrishna, K. V.
Ramaprabhu, T.
Rajyalakshmi, T.
Raman, K.
Rao, N. G. S.
Rama Rao, Y.
Ranadhir, M.
Saha C.
Saha, G. N.
Salgal, B. N.
Sehgal, K L.
Sen, R. R.
Subrahmanyam, M.
Sukumaran, K. K.

FISHERY SCIENTIST

Ramachandran, V.
Mondal, A. K.

SCIENTIST-1

Abraham Mathew
Arabindrakshan, P. K.
Bagchi, M. M.
Bali, Usha
Banerjee, R. K.
Banerjee, S. C.
Bhanot, Kailash, K.
Bhanot, Kuljeet, K.
Bhatnagar, G. K.
Bhowmick, M.
Bhowmick, U.
Chakraborty, D. P.
Chakraborty, R. K.
Chakraborty, P. K.
Chandra, J.
Chatterjee, D. K.
Chatterjee, G. N.
Chitransi, V. R.
Des, C. R.
Das, K. M.
Das, M. K.
Das, N. K.

SCIENTIST-1 (Contd.)

Das, R. C.
Das, R. K.
Das, S. R.
Desai V. R.
Datta, A. K.
Dutta, S. N.
Ghosh, Ajoy K.
Ghosh, B. B.
Ghosh, S. R.
Gopinathan, K.
Gupta, B. P.
Gupta, R. A.
Gupta, S. D.
Jena, R. K.
Jha, B. C.
Joshi, C. B.
Joshi, H. C.
Kalimurthy, M.
Khan, M. A.
Kowtal, G. V.
Krishnamurthy, K. N.
Kumar, Dhirendra
Kumar, Dilip
Kumar, Kuldip
Kumariah P.
Laal, A. K.
Laal, Babu
Mathew, P. M.
Mehrotra S. N.
Mitra, P. M.
Mishra, B. K.
Mishra, D. N.
Mohanti, S. N.
Md. M Peer
Mukherjee, A.
Mukhopadhyay, M. K.
Mukhopadhyay, P. K.
Mukhopadhyay, S. K.
Murugesan, V. K.
Munnet, S.
Nandi, A. C.
Nath, D.
Pandey, B. L.
Pandit, P. K.
Pathak S. C.
Paul, S.
Pillai, S. N.
Pisolkar, M. D.
Pravakaran, V. T.
Prasadam, R. D.
Radhakrishnan, S.
Rai, Prakash
Rai, S. P.
Raj, Paul
Ram, K. J.
Ramamohan, G.
Rangaswami, C. P.
Rao, A.V.P. (on deputation)
Rao, J. B.
Rao, K. G.
Rao, K. J.
Rao, K. V.
Rao, L. H.
Rao, P. L. N.
Rao, R. M.
Ravichandran, P.
Rout, M. D.
Roy, B.
Saha, A. K.
Saha, S. B.
Saha, S. K.
Saxena, R. K.
Selvarai, C.
Sen, A.
Sengupta, A.
Shah, K. L.
Sherif P. M.
Singh, B.
Singh, B. N.
Singh, D. N.
Singh, H.
Singh, H. P.
Singh, K.
Singh, S. B.

SCIENTIST-1 (Contd.)

Sinha, M.
Sirsat, B. R.
Sivakami, S.
Srinivasagam, S.
Srivastava, G. N.
Srivastava, K. P.
Sugunan, V. V
Sukumaran, K. K.
Sultana, M.
Sundar, Shyam
Thakur, N. K.
Thakurta, S. C.
Tyagi, B. C.
Vass, K. K.
Venkatesh, B.
Verghese, P.U.(on deputation)
Vinci, G. K.
Wishard, S. K.
Yadav, Y. S.

JUNIOR FISHERY SCIENTIST

Bhowmick, R. M.
Karamchandani, S. J.
Laksmanan, M. A. V.
Murthy, D.S.(on deputation)
Ray, P.

JUNIOR SCIENTIST EXTENSION

Sharma, B. K.

ARS PROBATIONERS (SCIENTIST-1)

George John
Ayyappan, S.
Reddy, N. A.
Suresh. K.
Unnithan, V. K.
Purushothaman, C. S.
Mandal, S. K.
Naskar, K. R.
Dilip Kumar

LIASION OFFICER

Tripathi, N. K.

ASSISTANT ENGINEFR

Mukherjee, A. B.

SCIENTIST - S

Banerjee, B. K.
Chakraborty, N, M.
Chaudhuri, M.
De, D. K.
Dey R. K.
Dwivedi, R. K.
Ganapati, R.
Ghosh, Amitabha
Ghosh, P. K.
Ghosh, P. K.
Jaitly, P. N.
Joseph, K. O.
Hajra, A.
Kanujia, D. R.
Karmakar, H. C.
Kaushal, D. K.
Kholi, M. P. Singh
Kolekar, Vijay
Laha, G. C.
Mazumdar, S. K.
Mahanta, P. C.
Pal, J. N.
Pathak, V.
Prakash, Shree
Roy, A. K.
Saha, P. K.
Seth, R. N.
Sharma, V. K.
Srivastava, N. P.
Singh, B. K.
Singh, H. P.
Singh, R. K.
Singh, S. N.
Sukumaran, P. K.

SENIOR RESEARCH ASSISTANT

Banerjee, A. C.
Bhhgat, M J.
Chaudhury, A.
Kapoor, D.
Sar, S. N.

SENIOR ARTIST T-5

Ghosh, J

SENIOR LIBRARY ASSISTANT T-5

De, Anjali

OVERSEER T-4

Bhattacharjee, P. N.

ARTIST PHOTOGRAPHER T-4

Mazumdar, A. R.

DEMONSTRATOR T-4

Dutta, B. R.
Kumar, Kuldeep
Radheshyam
Sarkar, S. K.

TECHNICAL ASSISTANT T-4

Chowdhury, A. R.
Das, P. B.
Das, P. R.
De, R. N.
Kar, S. L.
Mazumdar, H. S.
Raghavan, S. L.
Ramaraju, T. S.
Rao, D. R.
Rao, K. S.
Reddy, P, V. G. K.
Saha, B. K.
Sarkar, S. K.
Singh, R. C.

TECHNICAL ASSISTANT T-II-3

Abdul Kadir, P. M.
Agarwal, K. K.
Basak, B.
Bhattacharjee, G. P.
Bose, P. S. C.
Chandra, Ram
Das. K. M.
Ghosh, Bhaskar
Panigrahi, V.
Rahman, F.
Roy, A. K.
Sarkat, N. D.
Satpathy, R. C.
Srivastava, D. N.
Srivastava, N. K.

ARTIST T-II-3

Das, S. K.

SENIOR LIBRARY ASSISTANT T-II-3

Das, Sukla

PHOTOGRAPHIC ASSISTANT T-II-3

Ghosh, P. K.

ESTIMATOR

Sahoo, Chakradhar

DRAFTSMAN

Mantri, Muralidhar

TECHNICAL ASSISTANT T-I-3

Banerjee, K. S.
Ekka, A. K.
Ghosh, S. P.
Mazumder, N. N.
Mondal, N. C.
Paul, A. R.
Sarkar, Aloke
Saroj, B. D.
Sen, H. K.
Verma, D. P.

TECHNICAL T-2

Krishnan, S.
Lakra, Camil
Langer, R. K.
Mishra, J. P.
Mohanty, A. N.
Muduli, H. K.
Sahu, G. C.
Sarkar, N. N.
Serangi, N.
Singh, M. P.

ARTIST T-2

Dasgupta, P.

ELECTRICIAN T-2

Chatterjee, S. K.
Guin Narsing
Sadhukhan, B. N.

MECHANIC T-II-3

Sathpati, R. C.

MECHANIC T-2

Singh, Donald

LABORATORY AND FIELD ASSISTANT T-1

Chatterjee, Swapan Kumar
Das, B. B.
Jain, Aloke Kumar
Krishnan, S.
Langer, R. K.
Mohanti, A. N.
Mondal, S. C.
Mishra, J. P.
Pani, K. C.
Saha, Sukumar
Sahoo, G. C.
Saful, Debashis
Sarengi, N.
Singh, K. P.
Singh, M. P.
Tiwari, Ranjit

SAMPLE SORTER T-1

Banerjee, A. K.
Gupta, S. K.
Moitra, S. C.
Nath, A. K.
Saha, K. P.
Saha, N. P.
Saha, R. D.

SENIOR GESTETNER OPERATOR T-1

Bhowmick, S. C.

SENIOR BINDER T-1

Das, M. M

DRIVER/ENGINE DRIVER/LAUNCH DRIVER/MINI BUS DRIVER VEHICLE DRIVER T-2

Basmedaya
Das, S. C.
Negi, R. S.
Roy, R. M.
Saha, J. C.
Sothi, B. B.
Singh, R. N.
Tarai, D.

DRIVER/ENGINE DRIVER/LAUNCH DRIVER/MINI BUS DRIVER/ VEHICLE DRIVER T-1

Bahadur, Suraj
Balmiki, R. L.
Biswas, N. C.
Chatterjee, U. K.
Das, K. L.
Deb, K. R.
Deo, Kishen
Dutta, K K.
Das, Harihar
Ganesh, K.
Ghosh, T. P.
Kahall, B.
Lal, Pasupati
Mazumder, A. K.
Nath, C. K.
Roy, B. B.
Singh, Badal Lal
Subramani, M. G.

CARPENTER T-2

Bhattacharjee, S.

PLUMBER

Deb, S. K.

PUMPMAN T-1

Das, C. R.

Roy, N.

Technical Supporting :

BOOK BINDER

Saha, N. K.

GESTETNER OPERATOR

Naik, D.

DARK ROOM ASSISTANT

Halder, R. K.

AQUARIUM ATTENDENT

Bose, M. R.

Routh, H. K.

LABORATORY BOY

Bahadur, Budhi
Bahadur, Hari
Barik, N.
Behera, N.
Bhoi,B.
Bhuyan, U.
Biswas, D. N.
Biswas, R. C.
Bose, J. L.
Burman, M. S.
Chakraborty, S. K.
Chand, Salek
Das, K. K.
Das, Musa
Das S. K.
Dutta. S. K.
Iruthiraj, M.
Kujur, J. M.
Mishra, P.
Mondal, A. K.
Majhi, B.
Panda, L.
Pandey, C. K.
Patra, A. M.
Prakash, B.
Ram, Bokshi
Saha, R. N.
Sahu, D.
Samal, D. R.
Sasmal, B.
Singh, Chattar
Verghese, P. V.

LABORATORY-CUM-FIELDMAN

Burman, S. N.
Choudhury, M. S.
Motarah, S.
Naik, B.
Sao, B. Appa

FIELDMAN

Bahadur, C.
Bahadur, Durga
Bahadur, Jit
Bahadur, Lalit
Bahadur, Nar
Barik, S.
Behera, A.
Behera, A. C.
Behera, B. N.
Behera, K. B.
Behera, K. C.
Behera, T.
Bhuyan, N.
Biswas, J. N.
Biswas, T. K.
Burman, G. N.
Chakraborty, K. L.
Dalal, Balaram
Das, A. R.
Das, C.
Das, H. K.
Das, K. P.
Das, P. V. N.
Dey, S. K.
Dosed, R. B.
Gopal, K.
Gangaram
Jally, D.
Jally, H.
Jally, U. N.
Jana, N.
Jana, K. C.
Lal, Bhai
Lal, Hari
Lal, Madan
Lama, H. B.
Mandal, S. L.
Mewalal
Mohanty, N. N.
Moolchand
Munda, B. R.
Naik, J.
Bhuloka, D.
Patnaik, S. R.
Pramanick, H. K.
Prasad, K.
Rahman, A. (Retired voluntarily w.e. from 1.5.78.)
Ralkwar, R. L.
Ramdeo
Ram, Lalu
Ram, Ch. G.
Sahmood
Sahu, D.
Samal, H. K.
Sarkar, A. K.
Setty, P C.
Singh, Desharath
Singh, D. N. Baldev
Sitaram
Sivaraj, M.

BOAT DRIVER

Jally, K. B.

BOATMAN

Balaram, M.
Behara, K.
Burman, H. K.
Das, P. C.
Tiwar, R. N.
Yadav, A. L.

DECK SUKHANI

Chakraborty, S.
Saha, P. C.

KHALASI

Biswas, S. G.

LASKAR

Pugalendhi

CHAINMAN

Das, J. R.
Ranjit, R. B.

FISHERMAN

Anjanappa, M.
Appana K.
Banjara, S. S.
Barik, D.
Barik B. K.
Behara, K.
Behara, K. V.
Behara, M.
Behara, R. K.
Botal, S.
Bez, P. C.
Bhanja, D.
Bhoi, B.
Binda, M. P.
Biswas, A. K.
Biswas, Ananda
Biswas, Jagadish
Biswas, M. N.
Biswas, S. C.
Bondare, S.
Borah, B.
Boro, B.
Burman, B.
Burman, H. S.
Burman, N. C.
Burman, N. K.
Burman, Shatendra
Burman, Sudhanshu
Burman, S. K,
Burman, S. S.
Chaudhury, U.
Das, B. C.
Das, D. C.
Das, Girldhari
Das, Gunadhar
Das, Jahiram
Das, K. M.
Das, M. C.
Das, P. B.

FISHERMAN (Contd.)

Das, Parasuram
Das, S.
Das, Sudhansu
Dhanu, B.
Dhibar, G.
Dukharan
Gangayya, A.
Garate, S. T.
Gtadei, R.
Gharami, Phani
Gowda, K M.
Gowda, M.
Halder, R. K.
Halder, S.
Hazarika, B.
Jally, Barman
Jally, K. C.
Jally L.
Jana, B. K.
Jana, G.
Manickyan, P.
Marappa, V.
Moolchand
Mukhia, J.
Murugesan, A,
Naik, N. B.
Naik, S.
Nayak, P. K.
Nayak, S.
Namasudra, R. K.
Patnai, K. B.
Prasram
Parida, F.
Parida, G.
Parida, S.
Parida, Y.
Pillai, D.
Pitambar, S.
Pradhan, B.
Prasad, R.
Prasad, Sital
Raju, K, D.
Ram, K. P.
Rajen, S.
Ram, L.
Ramalingam, M
Rao, M. C.
Rao, M.
Rao, Subba
Ray, Karam
Runndale, G. J.
Suhani, A.
Sahoo, D.
Sahoo, G.
Sahoo, L.
Samal, K. C.
Samanta, N. C.
Samata, C.
Santra, G.
Santram
Satyanarayana, U.
Sayalu, P.
Seshan
Singh, C. P.
Singh, M.
Singh, Kuldip
Sita
Samulu, L.
Srinivasan, V. K.
Subramani
Subramaniyan, K.
Swine, J.
Swine, R. C.
Vava, C. K.
Venkatachalan
Yesiah, R.
Yusuf, Dar

ADMINISTRATIVE OFFICER

Chatterjee, S. K.

ACCOUNTS OFFICER

Deb, P. C.

ASSISTANT ADMINISTRATIVE OFFICER

Roy, K. C.

Sthanapati, P. K.

P.A. TO DIRECTOR

Lahiri, G.

SUPERINTENDENT

Biswas, M. L.
Chatterjee, N. G.
Das, A. K.
Datta, B. C. (from 3.11.78)
Kanungo, P. C.
Rajani, K. B.
Sengupta, A. K.

ASSISTANT

Bhattacherjee, B. C.
Bose, S. K.
Chatterjea, B. R.
Chatterjee, N. G. (upto 21.9.78)
Das, T. P.
Dasgupta, S.
Dutta, B. C. (upto 2.11 78.)
Mazumder, Sandhya
Roy, Bani
Roy, M. R.
Roy, S. C.
Saha, S. C
Sarkar, A. C.
Sarkar, N. K.
Shastry, S. P.
Zaidi, F. A
Mahesh Prasad
Awadh Sah

STENOGRAPHER

Banerjee, A. K.
Chakladar, H.
Chakraborty, G. M.
Srivastava, R C.

JUNIOR STENOGRAPHER

Bhattacharjee, S.
Chatterjee, T
Das, P. K.
Ghosh, U. K.
Jena, P.
Prasad, P.
Roy, T. K.
Saha, A. K.
Sahoo, D. C.
Sinha, R. C. P.

SENIOR CLERK

Acharjee, D. K.
Baidya, D. N.
Banerjee, D. K.
Banerjee, J. N.
Bose, D. C.
Choudhury, Namita
Das, C. C.
Ghosh, B. K.
Halder, S. R.
Halim, Abdul
Kar, S. K.
Kodandraman, I. N.
Mishra, L. P.
Mitra, N. K.
Mukherjee, B. B.
Nath, H. K.
Neogi, M. M.
Patra, J. C.
Pramanick, S. K.
Pramanick, S. N.
Prasad, Keshaw
Sarkar, H. L.
Sarkar, S, K.
Singh, R. C. P.
Sreedharan, T. K.
Subrahamaniam, M.
Sutur, H. B.

JUNIOR CLERK

Banerjee, Anita
Banerjee, Narayani
Behara, A, C.
Behera, Kunja
Behera. R. C.
Bala, M. K.
Bhegirathi, S.
Bhowmick, S.
Biswas. A. B.
Biswas, Manjulal
Biswas, P. K.
Bose, Samir Kumar
Chatterjee, Dipankar
Chowdhury, Debesh
Chhotey Lal
Das, B. K.
Das, G. B.
Das, M. K.
Dey Sarkar, D. K.
Dutta, P. K.
Ghosh, P. K.
Ghosh, R. K.
Ghosh, Samar Kumar
Guriah, W.
Kachhap, M.
Kumar, Surendra
Kundu, N. R.
Lahiri, P.
Lal, Ambika
Mahato, R. N.
Mandal, A B.
Mandal, Bulbul
Mandal, S. P.
Manjhi, K.
Mazumder, B. C.
Mazumder, Sikha
Mazumder, T. K.
Moozanappan, S. K.
Mukherjee, R. R,
Mupid, B. S.
Murthy, P. B. V. S.
Neogi, Anjali
Naik, N. C.
Nath, Baij
Panda, R. K.
Radhakrishnan, K.
Rai, Jagadish
Raina, R. L.

JUNIOR CLERK

Roy J.
Roy, Samir Kumar
Roy, S. B
Sarkar, B. K.
Shah, Biswanath
Singh, Kalu
Sinha, S. S.
Srivastava, A. K.
Tikadar, S K.

Administrative Supporting :

FOREST GUARD

Manna, M. L.

DAFTRY

Biswas, Hiralal

PEON

Bahadur, Mina
Baral, S. K.
Behara, M. S
Bhanja, B.
Bose, H. L.
Burman, S. N.
Das, B. B.
Das, N. L.
Ghosh, A. C.
Jangali
Jugalkishore
Maity, S. S.
Mandal, B. N.
Mandal, Kalosashi
Mani, N.
Manna, L. C.
Narasappa, B.
Narendra, G. C.
Panda, Jagadish
Parbat, L. K.
Ram, Rulia
Sahoo, K. M.
Singh, C. P.
Singh, Prahlad
Singh, Ramdeo
Singh, S. S.

MESSENGER

Bain, G C.
Bose, Shankar
Deb Roy, R. L.
Karmakar, S.
Khalko, Joseph
Ram, Rajendra
Saha, M. L.
Salia, M. R.
Sarkar, Sikha
Shetty, P. C.

WATCHMAN

Arumugam, P.
Bahadur, Asta
Bahadur, Bhim
Bahadur, Indra
Bahadur, Lal
Bahadur, Man
Bahadur, Ram
Bahadur, Sitaram
Bahadur, Surja
Bahadur, Tek
Behera, R.
Bhattacharjee, Ashutosh
Bhoi, R. C.
Bhoi, S.
Bhuyan, D.
Bijoli, Amulya
Choudhury, Panchulal
Das, M.
Dhir, K. K.
Kachari, P. C.
Rarketta, Joseph
Kumar, Khasban
Kherra, J.
Krishnappa, B. N.
Mahadeva, M.
Mahendran, S.
Mallah, M. L.
Muchi, R. U.
Naik, B. K.
Naik, B. C.
Painiswami, R.
Paramanick, G. C.
Prakash, Om
Prasad, Lalta
Rajenatham, R.
Rao, G. C.
Roy, P. R.
Saha, P. C.
Sahoo, Gulab
Subbaiyan, K.
Swain, R. N.
Yadav, S. P.

MALI

Bairagi, Suklal
Biswas, A. K.
Chaki, S. N.
Chaki, B.
Ghosh, P.
Mandal, M. G.
Sunder, Ram

SAFAIWALA

Balmiki, J.
Chand, Khem
Das, D.
Dehuri, B.
Dhanuk, Badlu
Dhanuk, Shyamlal
Jena, Panchanna
Lal, Kishan
Nageswara Rao, P.
Parameshwar
Raju, A. E.
Ram, Iswar
Ram, Munsi

APPENDIX I

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(I.C.A.R.)
Barrackpore : West Bengal

Ministry/Department/Office of Central Inland Fisheries Research Institute, Barrackpore, West Bengal, Statement showing the total number of ICAR servants and the number of scheduled castes/tribes amongst them as on 1st January 1979

Class	Permanent Temporary	Total No of employees	Scheduled Castes	Percentage to total employees	Scheduled Tribes	Percentage to total employees	Remarks
Class I	Permanent	69	3	4	-	-	-
	Temporary	94	8	8.51	-	-	-
Class II	Permanent	18	1	6	-	-	-
	Temporary	69	4	6	1	1	-
Class III	Permanent	167	30	18	1	1	-
	Temporary	108	24	22	8	8	-
Class IV	Permanent	184	43	23	1	10	-
	Temporary	140	28	20	3	2	-
Class IV (Excluding sweeper)	Permanent	14	14	100	-	-	-
	Temporary	5	4	80	1	20	-

Appendix—II

ORGANISATION CHART OF
CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

DIRECTOR

JOINT DIRECTOR

FRESHWATER AQUACULTURE DIVISION
624, Saheed Nagar
Bhubaneswar-7

- Pond Culture Section
- Fish Breeding Section
- Exotic Fish Culture Section
- Weed Control Section
- Soil Chemistry Section
- Frog Culture Section
- Fish Farm Engineering Section
- Fish Pathology Section
- Fish Hybridisation & Genetics Sec.

ESTUARINE FISHERIES DIVISION
47/1, Strand Road
Calcutta-7

- Estuarine Fisheries Section
- Hilsa Fisheries Section
- Water Pollution Section
- Statistical Section
- Plankton Culture Section

RIVERINE & LACUSTRINE FISHERIES DIVISION
24 Pannalal Road
Allahabad-2

- Riverine Fisheries Section
- Hilsa Fisheries Section
- Reservoir Fisheries Section
- Statistical Section
- Water Pollution Section

FRESHWATER AQUACULTURE RESEARCH & TRAINING CENTRE (Dhauli)

- Research Centre
- Research Centre
- Kendra (Matsya)
- Training Centre (Fisheries)
- Research Centre
- Research Centre

CALCUTTA RESEARCH CENTRE

- Research Centre
- Research Centre
- Research Centre
- Research Centre

ALLAHABAD RESEARCH CENTRE

- Buxar Research Centre
- Research Centre
- Research Centre
- Research Centre
- Research Centre

ALL INDIA COORDINATED RESEAR

COMPOSITE FISH CULTURE AND FISH SEED PRODUCTION
624, Saheed Nagar,
Bhubaneswar-7

Subcentres

AIR BREATHING FISH CULTURE IN SWAMPS
Barrackpore (W.B.)
Pin-743101

Subcentres

- Gauhati (Assam)
- Patna (Bihar)
- *Bengalore (Karnataka)
- *Palair (Andhra Pradesh)
- *Kalyani (West Bengal)

RESERVOIR FISHERIES
24, Pannalal Roa
Allahabad-2

Subcentres