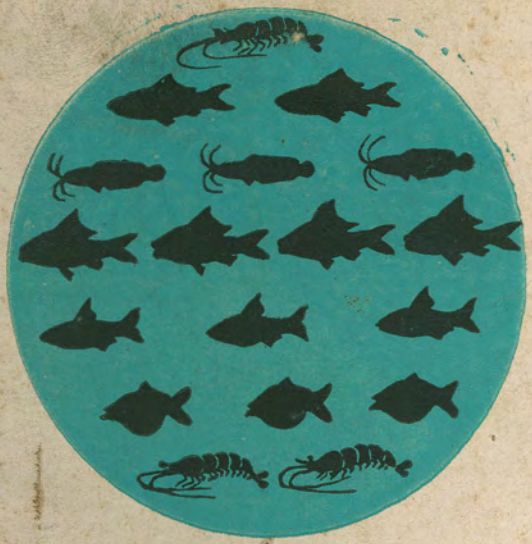

1977
ANNUAL REPORT

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE

BARRACKPORE

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

ANNUAL REPORT

for the year

1977

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

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This report includes unprocessed or semiprocessed data which would form the basis ef scientific papers in due course. The material contained in the report, therefore, may not be made use of without the permission of this Institute, except for quoting it for scientific reference.

ANNUAL REPORT 1977
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 Barrackopre 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 management 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, 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 & 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, Bakkhali, 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. Besides, 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 subcentres at Bhavanisagar, Bilaspur, Kangsabati, Nagarjunasagar, Ranchi, Rihand and Ukai); (ii) Composite Fish Culture & Fish Seed Production of Indian & Exotic Fishes (with main centre at Bhubaneswar and subcentres at Badampudi, Barrackpore, Bhavanisagar, Coimbatore, Durg, Gauhati, Godhra, Jaunpur, Kalyani, Karnal, Kausalyagang, Pune and Ranchi); (iii) Propagation & Stocking Seed of Air-breathing Fishes for Culture in Swamps (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 & Documentation :

During the year under report, 305 books, 124 reprints, 95 miscellaneous publications and 1,102 issues of periodicals were added to the library of the Institute. 34 foreign and 42 Indian journals were subscribed. The library obtained either as free gift or in exchange additional 135 Indian and foreign journals. The present library holdings inclusive of the year's arrivals comprise 3,676 books, 3,654 reprints, 1,784 miscellaneous publications , excluding the stock of journals, pamphlets, maps, deprtmental publications, etc. Besides maintaining exchange relationship with 364 Institutions and organizations, 20 new exchange relationships were established during the year. "Accession Lists" for the period September-December, 1976 and January — September, 1977 and Current Awareness List for July — December, 1976 and January — May 1977 were brought out and circulated for the benefit of the scientists of the Institute. 45 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 Department of Zoology, Vikram Deb College, Joypore, Koraput Dist., Orissa; Indian Council of Agricultural Research; ICAR Research Complex for NEH Region, Tripura Centre, West Tripura; The Central Fisheries Corporation, Howrah; Research Institute, Mithapur, Patna, Bihar; British Council Division, British High Commission, Calcutta; The Registry of Toxicology, Industrial Toxicology Research Centre, Lucknow, U. P. ; Dacca University, Dacca, Bangladesh; The N. E. C. Sponsored

Fishery Research Project, Zoology Department, Gauhati University, Gauhati, Assam The Institute of Agricultural Research Statistics, Indian Council of Agricultural Research, New Delhi; The National Environmental Engineering Research Institute, Nehru Marg, Nagpur; Indian National Scientific Documentation Centre, New Delhi and to the, Department of Botany, St. Andrew's College, Gorakhpur, Uttar Pradesh on inter-library loan service.

During the year, 61 reports on progress of research were compiled and sent to the ICAR. Bibliography of Indian Fisheries, Vol. **16** (1-2), 1977; "CIFRI Newsletter" Vol. **1** (3-4) and **2** (1—2) and a special issue dated January, 1977; Bulletin Nos. 24 and 25 entitled "Report on Dal lake, Srinagar, Kashmir with suggestions for development of its fishery" and "Potentials and problems of composite fish culture technology in West Bengal"; Miscellaneous Contribution No. 13 entitled "A revised note on the methodology for culture of *Penaeus monodon*" and Survey Report No. 6 entitled "Report on fish culture prospects in the Collair lake" were brought out. The 1976 Annual Report was also brought out in printed form during the year. Ninetyone scientific papers emanating as a result of research investigations conducted at this Institute were published in different Indian as well as foreign journals. Besides the above, 300 sketches/diagrams, 50 posters & charts, 3,000 photographs, 300 slides, 50 cover designs and 500 miscellaneous reprographic themes on various research activities and achievements of the Institute were prepared.

Honours, Awards, etc. :

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute, Barrackpore was awarded Padma Shri on the Republic Day, (26th January, 1977) for his outstanding contributions in the field of inland fisheries.

Shri B. N. Saigal, $Scientist_1$, was deputed to undergo a short training course in Documentation and Information Services held in Calcutta from March 28 to April 30, 1977 organised by the Documentation and Training Centre, Bangalore; the Indian National Scientific Documentation Centre, New Delhi and Jadavpur University, Calcutta.

Shri M. V. Gupta, $Scientist_1$ had joined UN/ESCAP assignment at Lao PDR on deputation for a period of 1 year commencing from 12.4.77.

Sarvashri R. D. Chakraborty, $Scientist_2$, S. D. Tripathi, $Scientist_2$ and R. M. Bhowmick (Junior Fisheries Scientist) of the Institute participated in the Second Session of the 5-month Aquaculture Training Programme

offered by the Auburn University (Alabama), USA. The training programme included lectures, laboratory and field works, special assignments and supervised travel. The three scientists visited several Aquaculture Centres in the United States such as Fish Hatcheries, Fish Feed Mills, Fish Processing Plants, Shrimp Culture Facilities and Extension Agencies.

While Shri R. M. Bhowmick visited Fish Breeding Stations and Hatcheries in Hawaii (USA) and Vancouver (Canada), Sarvashri R. D. Chakraborty and S. D. Tripathi visited Fisheries Research Institutes, Fish Farms, Fish Breeding Stations and Hatcheries in Malaysia, Singapore, Federal Republic Germany and Hungary.

Shri M. A. V. Lakshmanan, Junior Fishery Scientist, left India on June 22, 1977 for a visit to Singapore, Indonesia, Thailand and Philippines, to acquaint himself with intensive aquaculture practices in these countries, and returned to India on August 9, 1977.

Dr. P. V. Dehadrai, $Scientist_3$ visited aquaculture centres in Singapore, Djakarta, Manila and Bangkok for a duration of $1\frac{1}{2}$ months from September 1, to October 19, 1977, under Fellowship Programme of the CIFRI/IDRC Project on Rural Aquaculture in India.

Shri Chandidas Saha, $Scientist_1$ was deputed to Singapore, USA and Hungery for studies in fish farm engineering under the same programme for a period of 5 weeks from September, 1977.

Dr. V. G. Jhingran, Director, on an assignment as a Consultant to the World Bank, Mission II, visited Indonesia during December 1-27, 1977.

Shri A. N. Ghosh, $Scientist_2$ has been deputed to join as Project Director, State Fisheries Development Corporation, Government of West Bengal for a period of three years.

Shri A. V. P. Rao, $Scientist_1$ has been deputed to join as Deputy Director, Brackishwater Fish Farm under Andhra Pradesh Agricultural University, Kakinada.

Shri Arabinda Sen, $Scientist_1$ and Shri A. V. Natarajan, $Scientist_3$ were awarded Ph. D. degree during the year.

Distinguished visitors :

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

Dr. Joseph H. Hulse	International Development Research Centre, Agriculture, Food and Nutrition Sciences Division, Box 500, Ottawa, Canda
Dr. A. G. Coche	Fishery Resources Officer, FIRI/FAO, 00100 Rome, Italy
Mrs. Elisabeth Mann Borgose	Chairman, Planning Council, International Ocean Institute, Malta
Mr. Yoshio Notsu	Japan Overseas Co-operation Volunteers 1342 Paz St., Paco, Manila, Philippines
Mr. Alexander Arnaud	Director, UN Programme, Drug Abuse Control, Vientaine, B. P. 743, Laos
Dr. D. D. Tapiador	Secretary, Indo-Pacific Fisheries Council, Bangkok, Thailand
Mr. Olatunji Bakare	Chief Fisheries Officer, Ministry of Agriculture. Lagos, State of Nigeria
Mr. Ducksoo Lee	World Bank, Washington D. C., U S A
Mr. Lucian Mspregne	World Bank, Washington D. C., U S A
Mr. Barrla Mecke	World Bank, Washington D. C., U S A
Mr. Richard Redinger	World Bank, Washington D. C., U S A
Mr. Kim Yong Nok	662-29 Bong Chondong, Seoul, Korea
Dr. Jose Eusobio	Research Director, SEAFDEC, Iloilo, Philippines
Dr. Rufino Ignacio	Director, External Affairs, SEAFDEC, Iloilo, Philippines
Dr. Benjamin Gabrial	Programme Leader, Freshwater Aquaculture Project, SEAFDEC. Iloilo, Philippines
Dr. D. K. Villaluz	Dean, Agriculture Department, SEAFDEC, Iloilo, Philippines
Dr. Noguro Soshinu	SEAFDEC, Iloilo, Philippines

Dr. Tang & team	FAO Mission on Fish Seed Production, Rome, Itally
Mr. M. W. Bailey	Hatchery Biologist, Irrigation Project Fisheries, Bangladesh
Mr. A. Q. Chowdhury	Project Director, Irrigation Project Fisheries, Bangladesh
Dr. R. P. Osborn	FAO Expert, Rome, Itally
Dr. F. Brian Davy	International Development Research Centre, Ottawa. Canada
Dr. A. Ahmed	Director, Scientific Policy & Management of Research, Administrative Staff College, Hyderabad, A.P
Shri Baldev Rai	Director (Accounts & Audit), ICAR, New Delhi
Dr. Salim Ali	President, Bombay Natural History Society, Bombay, Maharastra
Shri Duleep Matthai	World Wildlife Fund India, Bombay, Maharashtra
Shri Sanju Raju Mukhiya	Tribal Chief of Orangal, Vill. & P. O. Dakla, Dist. Orangal, Andhra Pradesh
Dr. A. N. Bose	Vice Chancellor, Jadavpur University, Jadavpur, Calcutta, West Bengal
Major General B. Bhattacharya	Managing Director, Central Fisheries Corporation, Calcutta, West Bengal
Shri P. Basu, IAS	Commissoner of Fisheries, Gujarat State, Ahmedabad, Gujarat
Dr. N. P. Patil	Director of Research, Agricultural University, Bangalore, Karnataka
Shri S. G. Gholop	State Minister for Fisheries, Government of Maharashtra, Bombay
Shri A. G. Kalawar	Director of Fisheries, State Fisheries Department, Maharashtra, Bombay, Maharashtra.
Shri A. K. Sengupta	Joint Director of Fisheries, State Fisheries Department, Calcutta, West Bengal
Shri Sundarajan	Joint Director of Fisheries, Madras Tamil Nadu

Shri R. M. Dhawan	Director of Fisheries, Goa, Daman & Diu, Panaji
Shri V. V. Naidu	Commissioner & Secretary, Government of Karnataka, Bangalore
Smt. K. Chatterjee	Additional Secretary, ICAR, New Delhi
Shri Pritam Singh	Member, National Food Commission, New Delhi
Shri M. Patnaik	Member, National Food Commission, New Delhi
Shri R. Ramachandra Nair, IAS	Secretary to the Government of Kerala, Government Secretariat, Trivandrum, Kerala
Capt. P. K. R. Nair	Director of Ports & Marine Advisers to the Government of Kerala, Trivandrum, Kerala
Shri R. N. Kushwaha	Member of Parliament, New Delhi
Shri Vithalrao Ganpatrao Hande	-do-
Shri Hari Shankar Mohale	-do-
Shri Raghubir Singh Machhand	-do-
Shri Gangadhar Appa Burande	-do-
Shri Ram Sevak Hazari	-do-
Shri P. G. Samantashinhora	-do-
Shri K. H. Jain	-do-
Shri R. S. Verma	-do-
Shri H. N. Yadav	-do-
Shri P. A. P. Rao	-do-
Shri R. K. Sharma	-do-
Shri E. Yeeda	Union Carbide, Vizag, Andhra Pradesh
Shri S. K. Datta	-do-
Shri Saharai Oram	Minister of State, Rural Development & Fisheries, Orissa, Bhubaneswar
Shri E. John Jacob	Minister for Food & Civil Supplies, Government of Kerala, Karala
Shri K. Sankaracharyan	Minister for Agriculture & Community Development, Government of Kerala, Kerala
Dr. M. J. Sebastian	Head, Fisheries Department, Kerala Agriculture University, Cochin, Kerala

Dr. M. S. Swaminathan	Director General, ICAR, New Delhi
Secretary (Agriculture), accompanied by	Government of Assam. Gauhati, Assam
Dr. A. K. Mondal & Dr. P. Mukerjee	Jute Agricultural Research Institute, Nilganj, Barrackpore, West Bengal
Shri R. M. Senapati	Director of Fisheries, Orissa, Bhubaneswar
Dr. G. P. Dubey	Director of Fisheries, Madhya Pradesh, Bhopal, M. P.
Dr. Y. R. Tripathi	Director of Fisheries, Uttar Pradesh, Lucknow, U. P.
Dr. J. C. Daniel	Curator, Bombay Natural History Society, Bombay, Maharashtra
Dr. A. R. Wani	Director of Fisheries, Jammu & Kashmir, Srinagar, J & K
Dr. Sane	Deputy Director of Fisheries, Maharashtra, Bombay, Maharashtra
Dr. R. Raghu Prasad	Assistant Director General (F), ICAR, New Delhi
Prof. K. Hanumantha	Head, Department of Zoology, Andhra University, Waltair, Andhra Pradesh
Dr. M. S. Prabhu	Senior Scientist, Central Marine Fisheries Research Institute, Cochin, Kerala
Dr. T. A. Mammen	Director, Marine Product Export Development Authority, Cochin, Kerala

Important events

Foundation-stone laying of the Freshwater Aquaculture Research and Training Centre, Dhauli, Orissa :

The foundation stone of the Freshwater Aquaculture Research and Training Centre, Dhauli, Orissa was laid by Sm. Indira Gandhi, the then Prime Minister, on January 3, 1977. The proposed farm, with an area of 144 ha will have about 800 experimental ponds of different sizes wherein statistically designed experiments on fish production, fish hybridisation and selective breeding, fish genetics, fish nutrition, etc., to improve

the stock of fish would become possible. These limitations have hitherto hampered further progress in aquacultural research along productive and significant direction. It is hoped that this Central Fish Farm would gradually grow into a big complex as the principal national and an international centre for developmental research, training and extension in freshwater fish culture.

Parliament members visit CIFRI :

Members of the Parliamentary Consultative Committee (1977-78) on Agriculture and Irrigation visited the Central Inland Fisheries Research Institute, Barrackpore, the centres of the All India Co-ordinated Research Projects on "Composite Fish Culture and Fish Seed Production" and "Air-breathing Fish Culture" at Kalyani and that of the Operational Research Project at Krishnanagar in West Bengal on October 10-11, 1977. In Orissa, the members of the Parliamentary Consultative Committee visited Freshwater Aquaculture Research & Training Centre at Dhauli, Trainers' Training Centre & Krishi Vigyan Kendra at Kaushalyagang, the Cuttack Research Centre of the Freshwater Aquaculture Division and Puri Centre of the CIFRI/IDRC Rural Aquaculture Project on October 13-14, 1977.

Dr. V. G. Jhingran, Director, while welcoming the honourable Members at the Institute, briefly explained the organisational set-up, objectives and the pioneering research accomplishments of the Institute. The Members of the Committee discussed individually with scientists about the progress of research on specific problems alloted to them. On the eve of their departure from the Institute, Shri R. N. Kushwaha, MP, on behalf of the team, thanked the Director, the scientists and the Staff of the Institute for the efficient conduct of their tour.

The Committee Members were highly impressed by the efforts made at the Central Inland Fisheries Research Institute in developing labour intensive, low cost and high yielding technologies of fish farming for development of inland fish farming in India. The text of the note submitted by the Committee to the Hon'ble Minister for Agriculture and Irrigation, Government of India, Shri S. S. Barnala, is as follows :

a) A system of intensive fish culture in freshwater ponds and tanks called composite fish culture. This combines Indian major carps, rohu, catla and mrigal and the Chinese carps, silver carp, grass carp and common carp.

Photograph 1 : Dr. V. G. Jhingran, Director CIFRI (back towards the camera) in discourse with Members of the Parliament.

Photograph 2 : Shri R. N. Kushwaha, MP addressing the staff members of the CIFRI.

b) A system of the air-breathing fish culture in derelict waters such as those of swamps and marshes. This involves culture of magur, singhi, koi and murrels.

c) A system of brackishwater fish and prawn culture. This involves culture of shrimps, mullets and bhetki. Shrimps are highly priced export commodity.

d) A system of integrated rural development especially combining pond fish culture with duck, pig and poultry rearing; further integrating it with agriculture, horticulture and sericulture, also involving use of treated sewage.

e) A system of fish breeding by pituitary hormone injection. This imparts a measure of control on fish reproduction. The Institute has received several awards including a first international award for a film based on this technology.

2. The technology of composite fish culture has been applied by 91 private fish culturists of Bengal with revealingly outstanding results. Senior State Government officials of the State and staff of CIFRI have brought out a joint publication on this work. The Institute has also brought out a bulletin on 138 case studies of composite fish culture in different agro-climatic zones of India.

3. While the Committee is pleased to note that great strides have been made in inland fisheries research and results of great developmental values have been obtained, it is disappointed to note that the application of research by the Department of Agriculture, Government of India, and the States has greatly lagged behind. The effort of West Bengal Government in promoting the spread of freshwater aquaculture in their State is in the right direction. The great gulf between the progress of research on the one hand and of development of inland fisheries on the other deprived the country of the benefits of research in inland fisheries. This situation is untenable and must be immediately removed.

4. The Ministry of Agriculture, Government of India and the State Governments should immediately develop programmes for spread of freshwater fish culture in different States of the country. Since the technology of composite fish culture is fully tried and time tested and is revolutionising in its potential, failures in achieving targets laid down should not go unpunished.

5. The following steps may be adopted for giving the country the benefits of research in the field of inland fish culture :

a) Every existing State Government fish farm in each State of the country should be brought under intensive fish culture system.

b) Additionally atleast one modern freshwater fish farm, about 500 acres in area, be established in each State wherein fish seed and table-size fish production should be integrated with animal husbandry, poultry and horticulture. For this purpose, the Central Fisheries Corporation, which hitherto is merely a marketing corporation should be converted into a production corporation. These farms will in addition to producing stocking material and fish, help in extending pisciculture in each State.

c) Each maritime State should additionally have atleast one brackish-water fish farm, about 250 acres in area, on the same pattern as the freshwater fish farm.

d) The infrastructure required for such a massive development such as establishment of seed production centres in the form of hatcheries, assured supply of fertilisers and feeds should be safeguarded against.

e) Each State should survey to locate wetlands, low-lying areas, swamps and marshes where fish farms provided with protective embankment should be constructed and fish farming carried out along scientific lines.

f) A Krishi Vigyan Kendra for inland aquaculture set up in each State at the sites of the Central Fisheries Corporation fish farms.

g) The country has an extensive network of canals. A system of fish culture to utilise running water fish culture, like the one existing in Japan, should be developed.

h) The irrigation command areas should be linked with freshwater fish culture specially fish seed production.

i) The ditches on either side of the railway lines and highways throughout the country should be developed for fish culture. The Railway Ministry and the Central and State Public Works Departments may take immediate steps in this regard.

j) The fish farmers' development agency should be made much more purposeful and be effectively instrumental to bring home the technology of composite fish culture to the fish farmers.

k) Inland Fisheries is a labour intensive rural occupation and offers tremendous scope for integrated countryside development which can generate wealth in villages and improve the nutritional status of the protein starved people of India. It is, therefore, essential that the Ministry of Agriculture has full fledged Commissioner exclusively for inland fisheries.

l) The Planning Commission has no Consultant for inland fisheries development and it is essential that the body has subject matter specialist as a Consultant for inland fisheries.

m) In view of the revolutioning role of inland fisheries in India's rural development, the Central Exchequer should allot substantial sums of money to the State Governments for their scientific inland fish culture development.

n) The Centre and States should greatly strengthen their inland fisheries extension activities.

Important achievements :

Successful pond culture of Macrobrachium rosenbergii :

The Kakinada Research Centre of the Institute conducting investigations on the standardisation of prawn culture techniques, has succeded in raising notable crops of giant freshwater prawn, *Macrobrachium rosenbergii*, in two successive experiments from the laboratory raised second generation seed. In one of the experiments, a freshwater pond (0.02 ha) at Balabhadrapuram (A. P.) stocked with 319 specimens (i.e., @ 15,590/ha) of *M. rosenbergii* (av. size : 85.90 mm/6.14 g) yielded gross and net productions to the tune of 11.55 (c. 577.7 kg/ha) and 9.59 kg (c. 479.7 kg/ha) respectively in 4 months with remarkably high survival rate (89%). 284 prawns recovered at the end of the experiment showed an average size of 157.8 mm/40.7 g. The management measures included pre-stocking fertilisation of pond with 480 kg of cattle shed manure followed by liming and supplementary feeding with minced foot of *Pila*, rice-bran and tapioca separately @ 500-1,000 g/day. To avoid wastage of feed, an important cost factor, quantum of supply was restricted depending upon the magnitude of unutilised feed left on the planks and earthen pots installed in the shallower zones of the pond as food containers. The coefficient of the body weight gained was highly encouraging (1 : 9.57). A few milkfish (*Chanos chanos* : 2-3 cm) introduced in the pond after one month of prawn stocking showed encouraging growth (av. 18.7 cm/50.0 g).

In the subsequent experiment, the gross and net productions obtained from the adjoining pond on stocking 303 seeds of the same species (av. size : 67.05 mm/2.64 g) were 12.04 (c. 602.05 kg/ha) and 11.21 kg (c. 560.55 kg/ha) respectively in $4\frac{1}{2}$ months with equally high rate of survival (81.12%). Management measures remaining the same, artificial feeding was switched on mainly to vegetarian diet comprising coconut oilcake, broken rice, tapioca and sweet potato without any variation in the feeding procedure.

The productions thus obtained in very short periods significantly enlight the possibilities of achieving a target of 4,000 kg/ha under higher stocking densities with further improvement in the culture technique, efforts for which are under way.

Paddy-cum-fish culture :

Culture of fish alongwith deep water paddy is likely to yield better return to the agriculturists since incidental to paddy some fish can also be produced. An experiment along this direction was initiated by the CIFRI to establish a system of paddy-cum-fish culture by renovating a paddy plot (0.75 ha) at Khardah, West Bengal. In this experiment, the waterway for fish culture is of the shape of a trapozoid canal (9.27 ha) running all along the perimeter of the agriculture field. The canal thus constructed may enable to extend the rearing period of stocked fishes to a desired period. The other advantage of the canal is the use of its water for irrigating the paddy plot for raising additional crop of paddy or pulses during summer months. A deep water pest resistant hybrid paddy ('JALADHI-II') was sown and the Indian major carps (catla, rohu and mrigal) were stocked @ 6,000 fingerlings/ha. On the basis of sampling done after six months of rearing, when stocked fishes attained average weights of 220, 120 and 100 g in respect of catla, rohu and mrigal, an estimated production of 1,200 kg/ha/8 months of fish is expected besides, a production of 1,000 kg/ha/6 months of paddy already obtained.

Murrel production from derelict pond :

Trial on murrel culture in a 0.1 ha derelict, swampy pond in Lalbagh gardens at Bangalore, Karnataka yielded a production at the rate of 4,041 kg/ha/7 months. The culture operation was conducted under the All India Co-ordinated Research Project on Air-breathing Fish Culture of the Central Inland Fisheries Research Institute in collaboration with the Directorate of Fisheries and Horticulture, Government of Karnataka. The harvested fish

was sold to the public at the rate of Rs. 8/- per kg. The operation registered a net profit at the rate of Rs. 14,000/ha in seven months from a pond which was not suitable for conventional fish culture.

On April 22, 1977 Hon'ble Minister of Fisheries and Horticulture, Government of Karnatka, Shri K. T. Rathod declared that the soundness of culture techniques for murrel has been conclusively proved in Karnataka. While highlighting the successful production of murrels at Lalbagh garden pond in Bangalore, he emphasised that murrel culture could be taken up in other places in the city.

Domestic sewage—an aid in fish culture :

In view of the present day shortage of conventional fertilisers generally used in fish culture operations, attainment of high fish yields through maximum utilisation of available nutritive ingredients of waste waters is a step forward towards the rapid development of inland aquaculture. This has been made feasible by the investigations being conducted by the Institute at Rahara, West Bengal on the exploitation of sewage-fed ponds as a lucrative source of pisciculture.

In a recent trial, a noteworthy production of 7,200 kg/ha/yr could be achieved from a 0. 17 ha sewage-fed pond by adopting five species culture of Indian and exotic carps. While the pond was stocked with fingerlings of catla, rohu and mrigal in July 1976, exotic carps (common carp and silver carp) were introduced in August and September 1976 respectively. A high stocking density of 15,000 fingerlings/ha in the ratio of 1.0 : 2.5 : 2.5 : 2. 0 : 2.0 in the order of the species mentioned above was adopted. No management measures was employed except for pre-stocking fertilisation of the pond with 6,80,000 litres of primarily treated domestic sewage drained from the Titagarh Sewage Treatment Plant and post-stocking fertilisation with 25,85,000 litres of sewage effluent at periodic intervals.

This achievement not only highlights the important role of domestic sewage in enhancing per hectare fish production but also leads to the possibilities of minimising the cost of fish culture operations in doing away with the conventional fertilizers where such facilities are available.

Canal breeding—a new technique for carp seed production :

The major carps generally breed in running waters in rivers during monsoon

months. Their breeding in captivity in ponds has been made feasible by hypophysation technique. The dry and wet bundhs are also known as good sources for carp seed production, particularly in the States of West Bengal and Madhya Pradesh. For bundh breeding, the velocity of water current required is largely dependent on the gradient of the inlet, the topography and expanse of the catchment area and also on incidence of rainfall.

Recently, spawning of the Indian major carp was successfully attained for the first time by the Riverine and Lacustrine Fisheries Division of the Institute in the plains in a shallow depression, by flooding it from an irrigation canal. The canal water was rushed by gravity. This has led to establishing a new technique being termed as "Canal breeding technique".

A shallow grassy depression (about 4-5 m wide) by the side of a distributary of Balan canal near Basehra (75 km from Allahabad) was selected for the purpose. The depression between the natural bundh of the canal and the field was converted into a rectangular pool by erecting suitable bundhs on the other two sides across the length. The main flow of the canal water was diverted through this chamber having sieves guarding the inlet and the outlet of the same. The depth of water in the pool was maintained at 30 to 120 cm.

In the evening of July 30, 1977 at about 18.00 hr, two sets of *Cirrhinus mrigala* (2 ♀ + 4 ♂) and one set of *Ctenopharyngodon idella* (1 ♀ + 2 ♂) were introduced into the chamber. It was a rainy day and the pool water temperature was 26° C. Only one set of mrigal bred while partial spawning of grass carp was noticed within an hour of their release into the breeding pool.

"Canal breeding technique" opens up a new avenue for boosting quality fish seed production in the country with a vast net work of irrigation canals.

Culture of fish food organisms :

Mass culture of *Artemia* sp. a basic diet for prawn larvae : Brine shrimp, *Artemia* sp., a prime requirement for successful prawn culture operations, involves considerable inconvenience and expenditure towards the import of the sun dried eggs of the species. With a view to deracinating the constraint and sustained culture of the species, laboratory and yard experiments have been in progress at this Institute During initial experiments, in the laboratory, both the reproductive phases ; i. e., viviparous and oviparous, were

noticed in the life history of the same individual of *Artemia* sp. Each female bred 4-5 times in batches, producing 500 nauplii in a span of 15 days. The optimum salinity and temperature of the ambient water for successful hatching of *Artemia* eggs were found to be 45 ppt and 26° ± 2°C respectively. Eggs collected from subsequent reproduction were sun dried and preserved for future use. Test on the viability of these sun dried eggs showed highly promising results thereby pin-pointing the tremendous possibilities of attaining self sufficiency in the procurement of *Artemia* eggs, without involving foreign exchange.

Mass culture of the phytoplankter, Pinnularia gibba :

Pinnularia gibba, a freshwater diatom, has been successfully cultured in laboratory and yard trials at the Barrackpore Estuarine Section of the Institute. The technique employed, included the use of urea, single superphosphate and sodium silicate in the ratio of 100 : 10 : 5 as nutrients in the ambient medium @ 385 ppm. Pure culture of *Pinnularia gibba* maintained on agar plates and slants in the laboratory was used to inoculate the nutrient medium @ 48,524 cells/ml which resulted in a cell density of 1.3 million/ml within a period of 10 days. *Pinnularia gibba* is one of the major natural food items of carps in polyculture.

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), Durg (Madhya Pradesh), Pune (Maharashtra), Kausalyagang (Orissa), Bhavanisagar & Coimbatore (Tamil Nadu), Jaunpur (Uttar Pradesh) and Kalyani (West Bengal).

At Karnal, while with six species combination the gross productions obtained ranged from 3,222-5,909 kg/ha/6 months, the same with five species combination was 2,778 kg/ha/6 months.

At Jaunpur Centre, with six species combination, gross productions recorded (per ha/yr) were, 5,100 and 5,887 kg in ponds I and II which were treated with fertilizers and provided with artificial feed. In ponds III and IV, where fertilisation alone was done, gross productions of the order of 2,745 and 1,681 kg/ha/yr were obtained. In pond nos. V & VI, gross productions to the tune of 4,330 and 3,612 kg/ha/yr were achieved with artificial feed alone. In the control pond, without fertilisation and feeding, the gross production, however, was only 1,422 kg/ha/yr.

Photograph 3 : Shri M. Sinha, Scientist-in-Charge, showing the MPs a grass carp raised in the composite fish culture pond at Kalyani (West Bengal)

At Kalyani Sub-centre, West Bengal, six species combination of Indian and exotic carps yielded gross productions of 3,177 and 4,250 kg/ha/yr from two ponds even when no feeding and fertilisation were done for seven months. At Badampudi Sub-centre, six species combination yielded gross productions @ 4,314 and 4,437 kg/ha/yr in two ponds while with 5 species combination, without grass carp but with *Macrobrachium malcolmsonii*, gross production @ 2,078 kg/ha/16 months was recorded of which the prawn contributed 98 kg/ha/9 months. With six species and five species combinations at Bhavanisagar Sub-centre, gross productions @ 3,782 and 2,957 kg/ha/yr respectively were obtained. At Gauhati Sub-centre, Assam, gross and net productions ranging from 6,145—6,537 and 6,015.8—6,238.8

kg/ha/yr respectively were obtained. With six species combination at Ranchi Sub-centre, the gross production recorded was 1,990 kg/ha/11 months while at Pune sub-centre a gross production @ 5,726 kg/ha/yr was recorded.

Indian major carps and exotic carps were successfully induced bred at different centres of the project during the year producing a total of 224.12 lakhs of spawn. Double spawning of rohu in the same season was successfully achieved at the Gauhati Sub-centre. Breeding of grass carp was achieved for the first time at the Ranchi Sub-centre. *Puntius gonionotus* which was imported from Indonesia has been successfully bred at the Kalyani Sub-centre, West Bengal.

The All India Co-ordinated Research Project on Air-breathing Fishes in its joint investigations formulated with the State Fisheries at different centres continued to tackle several production oriented schemes. In Assam, a production of 9 kg/m^2 of cage area/yr could be achieved in cage culture in weed infested impoundments. Short term *Clarias* culture with supplementary feeding yielded a production of 5,000 kg/ha/6 months in West Bengal while in Karnataka murrel culture operation with supplementary feed recorded a production to the tune fo 4,041 kg/ha/7 months.

Photograph 4 : MPs being demonstrated netting of air-breathing fishes at Dhakordah Fish Farm, Kalyani (West Bengal)

At the Kalyani Sub-centre of the project, 11,000 magur fry could be produced in specially designed paddy plots (3×2m) from 3 sets of brood fish.

Investigations on the protein requirements of magur showed a maximum growth with diet containing 55% protein. Cellulase and high amylase activities were detected in the intestine of *C. batrachus*, indicating the capability of the species to assimilate carbohydrates from food of plant origin.

The All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs in collaboration with the State Fisheries Departments continued its various research activities on the physico-chemical characteristics of soil and water, organic production, fish food resources, fish yields and dynamics of fish stocks in Bhavanisagar, Nagarjunasagar, Rihand, Getalsud and Govindsagar reservoirs.

The soundness of ecology-based management principles adopted for Bhavanisagar reservoir is reflected by the continuing high yield. The estimated yield from the reservoir could be raised to 77 kg/ha/yr in 1977 as against 19 kg/ha/yr in 1971. *L. rohita* occupied second place in the fishery forming 14% *i.* e., 40 tonnes of the total catch in 1977. In Govindsagar in Himachal Pradesh, the increase in mesh bar (from 65 mm to 200 mm) as well as increase in fishing effort (1973 as base) have led to remarkable increase in fish yield of 61.5 kg/ha in 1977. *H. molitrix* recorded 4—6 kg in weight (which escaped into the reservoir in 1971) and indicated successful breeding in the reservoir.

At Rihand, the studies in 1977 confirmed earlier observations regarding the existence of 3 sub-species of *C. catla*. The sub-species distinguished by medium and short pectorals show definite feeding preferences to *Microcystis*, a niche hardly utilised by any other indigenous fish.

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 one each in Andhra Pradesh, Goa, Kerala, Orissa, Tamil Nadu and Maharashtra continued to persue the investigations on brackishwater shell- and fin-fish farming.

Initial success has been achieved in breeding penaeid prawn, *P. indicus* in the laboratory at Madras Centre. 17 sets were successfully bred and the resultant larval stages were reared. A production of 301.8 kg was achieved from a 1.24 ha pond after 130 days of rearing at a stocking

rate of 70,000/ha. In polyculture of *Chanos chanos* and *Penaeus monodon*, a total production of 1,125.0 kg/ha/140 days was obtained in which the contribution of prawn was 445.0 kg in 80 days rearing.

At Kakdwip Centre, *P. monodon* registered a total production of 1,054.81 kg/ha/320 days in three crops, while long term rearing yielded 871.75 kg/ha/320 days. In polyculture, *Chanos*, mullets and prawn, stocked @ 8,000/ha in the ratio of 6 : 1 (fish & prawn) gave a total production of 2,579.8 kg/ha/9 months with supplementary feeding.

In order to strengthen exchange of research publications, new exchange relationships were established with thirteen organisations; *viz.*, Officer-in-Charge, Fisheries Research Station, Hesaraghatta Lake, Karnataka; Managing Editor, the Balwant Vidyapeeth Journal of Agricultural and Scientific Research, Bichpuri, Agra ; The Director, Seva-Bharati Krishi Vigyan Kendra, Kapgari, Midnapore, West Bengal ; The Junior Scientific Officer, Education and Youth Services Deparment, Science and Technology Cell, Mantralaya Annexe, Bombay ; The Head, Department of Zoology, Government Post Graduate College, Gopeshwar (Chamoli), Uttar Pradesh; Associate Project Director, CPCRI, Regional Station, ICAR Research Complex Goa, Margao; Dr S. M. Das, Chief Investigator, M. A. B. Project, D. S. B. College, Kumaun University, Nainital, Uttar Pradesh ; The Professor and Head, Department of Aquatic Biology and Fisheries, Aquarium, University of Kerala, Trivandrum, Kerala ; Professor and Head, Department of Fisheries, Veterinary College, Kerala Agricultural University, Mannuthy, Trichur ; President, Indian National Science Academy, Bahadur Shah Zafar Marg, New Delhi; Professor and Head of the Zoology Department, D. A. V. Post Graduate College, Dehra Dun, U. P.; The Fisheries Development Officer, Office of the Fisheries Development Officer (Forest Department), Government of Sikkim, Gangtok ; and The Director, ICAR Reserch Complex, N. E. H. Region, Amrit Bhavan, Shillong, Meghalaya.

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

Outstanding results of the investigations on culture fisheries conducted at this Institute were regularly communicated to the Food and Agricultural Organisation of the United Nations, Rome for publication in the "FAO Aquaculture Bulletin".

In order to further strengthen exchange of research publications, new exchange relationships at international level were established with seven additional organisations ; *viz.*, Librarian, International Development Research Centre, Relc Building, 30, Orange Grove Road, Tanglin, Singapore ; Librarian, International Development Research Centre, Ottawa, Canada ; Librarian, International Development Research Centre, University of British Columbia, Vancouver, B. C., Canada; Librarian, Library Acquisitions Group, Chemical Abstracts Service, Ohio State University, Columbus, Ohio, U. S. A.; Director, Department of Agriculture, Commercial Fisheries Laboratory, Mayaguez, Puerto Rico, U. S. A. ; Head, Fish Research and Breeding Department, State Fisheries Company, Zaafaraniyah, Iraq ; and Director, Fisheries Research Institute, Szarvas, Hungary.

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

West Bengal Centres :

At Hanspukur Centre in West Bengal, 32 ponds (5.02 ha) in 10 villages were utilised for the purpose of demonstration of techniques of carp fry/fingerlings production, magur culture and composite fish culture. 4,35,000 spawn of Indian major carps was produced during demonstation of fish breeding techniques. Besides utilising the seed for stocking the project ponds at the new centre at Burdwan, 68,300 fry and 4,600 fingerlings were distributed to 116 fish farmers and Burdwan University. 28,000 fry of common carp were also distributed to 30 fish farmers in Amtala Block, 16,000 fingerlings to fish farmers and Extension Division of Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani. Over 500 kg of brood fish was also supplied to 7 fish breeders for fish seed production. An average production of 1,317 kg/ha/6 months of magur was demonstrated in the same ponds where an average production of 810 kg/ha/3 months of carp fingerlings was demonstrated in the monsoon season.

An average production of 4,588 kg/ha/10 months was demonstrated in large ponds by adopting composite fish culture techniques. A total of 25.35 tonnes of fish was produced at this centre.

A 'Fish Farmers' Day' was organised and a production of 5,415 kg/ha/yr was recorded. The demonstration was witnessed by over 100 fish farmers besides, officials of the State Goverment and ICAR.

A training programme was organised for fish farmers, entreprenuers, educated unemployed youth and social workers and 43 persons trained in fish breeding and fish culture.

At Khasimari Centre in North Bengal, composite fish culture techniques were demonstrated in 11 ponds covering an area of 5.7 ha. An average production of 5,975 kg/ha/9 months was demonstrated. A total of 34 tonnes of fish was produced at this centre.

The two centres in West Bengal were shifted respectively to Burdwan in West Bengal and Jalpaiguri in North Bengal.

Orissa Centres :

The project continued to function at Biraharekrishnapur (Puri Dist.) and Aska (Ganjam Dist.) in Orissa. A total of 17 ponds (5.72 ha) in six villages at Puri Centre and 10 ponds (5.92 ha) in 10 villages at Aska Centre were utilised for the demonstration of composite fish culture technology to individual farmers and village Panchayats.

An average production of 3,046 kg/ha/yr was demonstrated at the Bira-Harekrishnapur Centre and 3,084 kg/ha/yr at Aska Centre. Harvesting from the project ponds provided a continuous supply of fish to the rural population for their own consumption. The income derived from the sale of the fish by the Panchayats was utilised for the purpose of construction of school buildings and roads and also for the electrification of villages.

Fellowship and Studentship :

The undermentioned ARS Probationers joined the Institute during the year and are undergoing training :—

Sarvashri B. Venkatesh, Kuldwip Singh, P. K. Chakrabarti, V. K. Bali, Bimalendu Roy, Babuji R. Shirsat, S. Pal, P. M. Sherif and Smt. G. K. Vinci.

Following Research Scholars who joined the Institute in various disciplines are now posted at different Research Centres of the Institute to carry out investigations on the problems alloted to them :—

Shri R. V. Badre	Fish and Fisheries
Km. Santoshini Panigrahi	,,
Km. Neelima Sharma	,,
Shri Ashis Prasad Mukherjee	Agricultural Chemistry
Shri Salil Kumar Barua	Agricultural Economics

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. 9 of the journal was published by the Society.

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

Indian :

1. The 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 Fisheries Association, Bombay
6. Indian Society of Ichthyologists, ZSI, Madras
7. Association of Agricultural Librarians & Documentalists of India, New Delhi
8. 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.*, techniques of composite fish culture, fish breeding and hybridisation, weed control, prawn culture, water pollution, etc. were communicated to various scientific personnel and to a number of institutions in public and private sectors in India and abroad.

Questionaires on "Air and water pollution monitoring programme", "Marine environmental monitoring & marine living resource assessment for the Indian Ocean region", and "Directory on Food and technology (current research programme of the Institute)" were attended to and relevent information passed on to Dr. J.M. Dave, Project Leader, UNDP Project No. 1301/74/005 (S-47), NEERI, Nagpur ; Dr. S.Z. Quasim, Director, National Institute of Oceanography ; and Mr E.V Araullo, Senior Programme Officer, Agriculture, Food and Nutrition Sciences, IDRC, Tanglin, Singapore respectively.

Mr. Robin Hallam, Liaison Officer, Food and Nutrition Sciences Division IDRC, Singapore was informed about the availability of information and reference services at the Central Library of the Institute (CIFRI). Duly filled in proformae partaining to Library activities were sent to Sri S. N. Dutta, INSDOC, New Delhi. A list of books on fish culture, a write up on "Advances in inland fisheries research", a note "On the activities of the Institute and management of its division", a list of fisheries research institutes, and two coloured photographs of fishes were sent to Sri A. Chatterjee, a private pisciculturist of Malda, West Bengal ; Dr. D.V. Bal, Gokhale Road, South Bombay ; Indian Council of Agricultural Research, New Delhi ; Manager, Bhandari Crossfield Limited, Indore ; and publication and information Directorate, CSIR, New Delhi respectively.

Replies of questionaries on "the Projects on Environmental Research undertaken by CIFRI", "Current Research Project Programmes" of the Institute and information in respect of "studies on toxicity of pesticides to fish and fish food organisms determined by static bioassay studies" conducted at the CIFRI laboratories were furnished to the Scientist & Head, TILE Division, NEERI, Nagpore ; Sri A. Lahiri, Principal Scientific Officer, Govt. of India, Technology Bhavan. New Delhi and Sri Dilip Biswas, Senior Specialist and Secretary, National Committee on Environmental Planning and Coordination, Dept. of Science and Technology, Govt. of India, New Delhi respectively.

Technical information on 'induced breeding technique', "biology of *Glossogobius giuris* and larval development of *Barilius* spp.", "hybrid of *C. mrigala* and *C. cirrhosa*", "use of sewage in aquaculture", "occurrence of sting rays in the river Ganga" etc., were supplied to Sri Indar Pal Singh of M/s Antowap India, Visakhapatnam ; Smt. A.R. Sheela, University College, Trivandrum, Kerala ; Dr. K.C. Jayram, Dy. Director, Zoological Survey of India, Calcutta ; Dr. D.D. Tapiador, Secretary IPFC, FAO Research Office, Bangkok, Thailand ; and Mr. T. B. Thorson, University of Nebraska-Lincoln, School of Life Sciences, Nebraska respectively. Information of Current Research Projects of the Institute, Projects successfully completed, and Projects kept in abeyance were sent to the Additional Secretary, ICAR, Krishi Bhavan, New Delhi.

Suggestions were given to Dr. N.R. Ranade, Associate Dean, Kankan Krishi Vidyapith, regarding the possibilities of air-breathing fish culture in integrated rural development programmes. Dr. H. M. Singh, Dy. Director, Agricultural Research, Rajendra Agricultural University, Bihar was suitably suggested regarding the preparation of a scheme on Inland fisheries.

Dr. I. Prakash, Coordinator, ICAR coordination and monitoring centres, CAZRI, Rajasthan ; Asstt. Director of Fisheries, Koraput, Joypore ; Sri P.R.G. Menon, Director of Fisheries, Andaman and Nicobor Administration ; Sri K.M. Kewalramani, Asstt. Director of Fisheries, Gujarat, and Director of Fisheries, Karala were informed about the rodent pest management; name of farms supplying 2-4, D ; Weed control by grass carp and other fishes and bundh breeding of carps, rearing and culture of *M. rosenbergii* and possibilities of dry bundh breeding respectively.

Information regarding supply of pituitary gland of fishes ; toxicity of pesticides on aquatic biota including fish, and glass jar hatchery were passed on to the General Administrator, Makunda Christian Medical Agricultural Joint Seva Mondal, Assam ; Dr. P. Goyal, Manager, Business Developments, Industrial Consulting Bureau Ltd., Bombay and Dr. J.N. Barua, Dy. Director, Regional Research Laboratory, CSIR, Jorhat, Assam respectively.

A note on 'Inland Fisheries Research during 5th Five Year Plan and an approach to 6th Five Year Plan' was sent to Dr. A.C. Mathur, Assistant Director General (AH), ICAR, New Delhi. Information on "Social, economic and political aspects of aquaculture in India" was supplied to Dr. Y. Matusda, Marine Policy and Ocean Management, Massachusetts, U.S.A.

A note highlighting the significant achievements of the Institute and "Research highlights 1977" were sent to Sri K. E. Sankaran, Chief Publicity Officer and Dr. C. Kempanna, Assistant Director General (CC), ICAR, New Delhi respectively.

Extension And Nation Building Activities :

Integration of aquaculture and live stock :

The Operational Research Project on Composite Fish Culture has since its inception in March 1973 at Krishnanagar, West Bengal proved and demonstrated beyond doubt the high production potential of large sheets of water bodies (1 ha and above) through composite fish culture and the economic viability of the technology. In experiments conducted during the year 1973-74 and 1975-76, the productions obtained from three ponds with water spread areas of 1.48, 1.93 and 2.15 ha ranged from 2,654 — 4,290 kg/ha/yr and 3,552 — 4,080 kg/ha/yr showing thereby as many as ten fold increase from the average production of 462 kg/ha/yr previously

obtained from these ponds. The cost of production of fish ranged from Rs. 2.94 to Rs. 3.03 per kg. The path-breaking researches initiated under the project in the third set of experiments (1976-77) with an accent to integrate fish culture with live stock have unvailed a new horizon of high fish production at remarkably low costs. Considerable progress has been achieved in integrating aquaculture with duckery, piggery and poultry with outstanding results.

Photograph 5 : Netting demonstration at Operational Research Project pond at Krishnanagar (West Bengal). The visiting MPs are also seen in the picture

In duck-cum-fish culture experiments still in progress in a large sheet of water body (1.48 ha), six species culture of Indian and exotic carps stocked @ 6,000 fingerlings/ha alongwith 100 ducklings (Bengal runner and cross bred of Bengal runner & Khaki Campble) reared simultaneously on floating duck houses (50×3 ft) constructed on the pond, yielded 3,027 kg of fish in a partial harvesting during Cctober, 1977 besides, 850 duck eggs collected as additional output. Management measures adopted included no external fertilisation of the pond or feeding of fish but for the duck droppings which go directly into the pond at an estimated rate of 10 t/100 birds/yr and automatically recycled. Based on the standing crop, another 5,190 kg of fish is estimated from the pond. The ducks have also exhibited notable growth increment.

Photograph 6 : Fishing operation in a duck-cum-fish culture pond at Anjana Fish Farm Krishnanagar

Results of the experiments on pig-cum-fish culture are outstanding as both the fish and pigs have shown excellent growth. Under a heavy stocking density (8,500 nos/ha) and without the provision of supplementary feeding, silver carp and grass carp have grown to over 2 kg in 10 months from their initial average weights of 9 & 5 g respectively. Catla, rohu, mrigal and common carp have recorded weights of 1.3, 1.0, 0.9 and 0·6 kg respectively from respective initial average weights of 48, 28, 23 and 3 g. Another interesting and notable feature of the experiment is the feeding of the grass carp purely on cattle fodder such as *barseem* and hybrid napier grass. No aquatic vegetation was used for feeding the grass carp. The present estimated per hectare standing crop of the pond is 8,500 kg. The pigs have attained average weight of 95.4 kg from their initial av. weight of 22·5 kg on January, 1977.

It is hoped that the final results will give a great boost to the idea of rural development through integration of fish culture and animal husbandry and will open a new vista for rural employment as well.

Harvesting demonstration at Hanspukur :

A harvesting demonstration was organised on March 24, 1977 at Hanspukur in a 0·55 ha pond. The pond was stocked with the Indian

Photograph 7 . Visitors being taken round the pigsties of the pig-cum-fish culture centre Krishnanagar.

major carps and exotic carps in the proportion of silver carp 30, catla 10, grass carp 5, rohu 20, mrigal 15, common carp 20 @ 5,000 fingerlings/ha in March, 1976. A total of 2,718.5 kg of fish was harvested during the netting demonstration, giving a production rate of 5,034.3 kg/ha/yr.

The harvesting demonstration was presided over by Dr. V.G. Jhingran, Director, Central Inland Fisheries Research Institute and was attended by several fish farmers, pond owners, fishery officials and private entrepreneurs. Shri S.N. Roy, Director of Fisheries, Government of West Bengal, was the Chief Guest.

On this occasion, 200 kg of brood fish, mainly silver carp and grass carp, were supplied to two private entrepreneurs, Messrs. Spandan Enterprises, Narendrapur and Socio-Economic Development Project, Keorapukur, who propose to undertake a massive fish breeding programme during the coming monsoon season. The catch was sold to the consumers at site and over 1.5 tonnes of fish was handed over by the pond owner to the Central Fisheries Corporation.

Photograph 8 : Fish netting demonstration at Hanspukur fish pond under CIFRI/IDRC Rural Aquaculture Project

Photograph.9 : Fish catch from Hanspukur pond being handed over to the pond owner

Photograph 10 : Sale of harvested fish at the pond site in the village Hanspukur, 24 Parganas, West Bengal

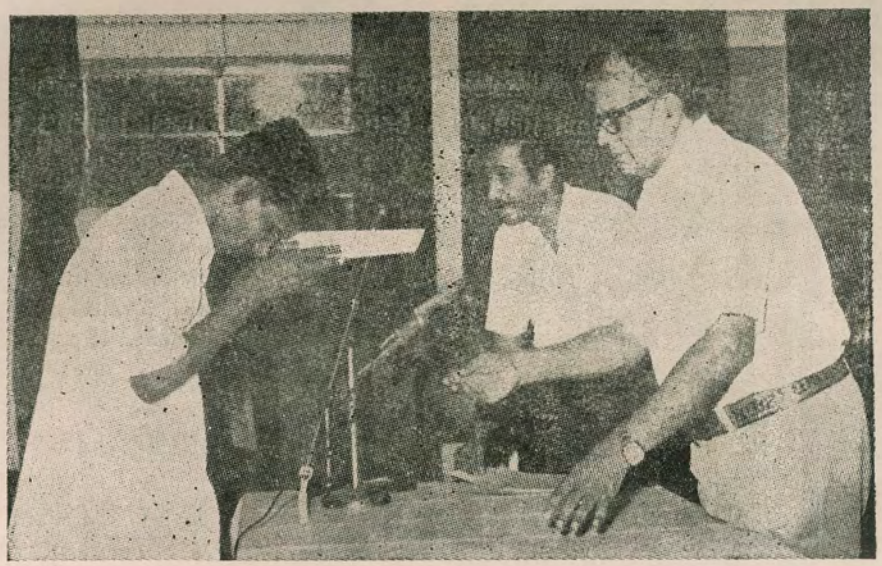
Training programme :

A six-day training programme was arranged under the Rular Aquaculture Project at Hanspukur from April 11-16, 1977. A group of 43 trainees, including fish farmers, pond owners, educated unemployed youths and school teachers participated in the training programme. Under the programme, 14 lectures on different aspects and activities of fish culture were delivered to the participants.

A netting demonstration and practical field trainings were also arranged during this programme. The educated unemployed youths showed a special interest in collection of fish pituitary glands which, according to them, is a ready source of income.

The trainees visited the laboratories of the CIFRI and two films "Composite Fish Culture" and "Induced breeding" were also screened to provide them a visual reality of the entire technology of fish culture. The trainees also went round an exhibition depicting the activities and achievements of the Institute.

Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute distributed certificates to the trainees on May 9, 1977 in the auditorium of the CIFRI, Dr. R, Raghu Prasad, Assistant Director General (Fisheries), ICAR, was the Chief Guest on the occasion.



Photograph 11 : A trainee receiving certificate from Dr. V. G. Jhingran, Director Central Inland Fisheries Research Institute

Dr. V.R.P. Sinha, Project Co-ordinator, Composite Fish Culture and Fish Seed Production delivered a series of informative lectures to the ARS Probationers at the Central Staff College for Agriculture (ICAR), Hyderabad on August 23, 1977. The topics of his lectures were "ICAR Research Support on Fisheries Development in India", "Status, Scope and Planning of Agriculture in India" and "Managment of Aquaculture Research and Training Centre".

Shri P. Das, Scientist Extension, delivered a lecture on "Modern techniques of fish farming" to the participants of Orientation Training Course for the Development Officers of United Commercial Bank at Calcutta on August 18, 1977.

Shri V. Ramachandran, Fishery Scientist and Officer-in-Charge, Weed Control Unit, conducted an intensive practical training including lectures for a week's duration on weed control and utilisation to fishery officers of North Eastern States at Sibsagar Fish Farm in Assam.

Shri V. Ramachandran, Fishery Scientist and Officer-In-charge of the weed Control Unit was engaged as a part-time consultant by the N.E.C.

for studying the enormous aquatic weed problem of the N.E. States and to work out demonstration-cum-pilot projects for the control.

Shri V. Ramachandran, and Dr. S. B. Singh, Fishery Scientists carried out a survey of the weed problem in Chiklod lake, a commercial freshwater fishery near Bhopal, on Institutional consultancy basis and submitted the report.

The Second Workshop of the All India Co-ordinted Research Project on Brackishwater Fish Farming was held at Madras from January 31 to February 1, 1977. Dr. V.G. Jhingran, Director, CIFRI, welcoming the delegates explained the potentialities that exist in the field of brackishwater fish farming. He emphasised that the area available for brackishwater fish farming is about 2 million hectares and is more than what is available for freshwater fisheries in the country. He also expressed that less inputs like fertilizers and artificial feeds are needed in brackishwater fish farming and a better production of a variety of exportable fishes can be obtained. Inaugurating the workshop, Shri P.K. Dave, Adviser to the Governor of Tamil Nadu, observed that there is ample scope for accelerating the pace of development of inland fisheries in India. He pointed out that the State of Tamil Nadu has yet to become self sustaining in fish seed. Shri Dave stressed the importance of brackishwater fishery as an export-oriented venture and suggested that along with co-operative and private agencies the State Corporation should also enter the field. He also emphasised the need of providing fish to rural population at a reasonable cost. Delegates from various State Fisheries Departments, Universities, Colleges and a number of fishery industrialists participated in the workshop. At the Adyar Fish Farm, demonstrations of prawn and fish production under mono- and polyculture operations were made by the Tamil Nadu Fisheries Department under the project.

The Fifth Workshop of the All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs was held at Ukai, Gujarat on September 7 and 8, 1977. Welcoming the participants at the workshop, Dr. R. Raghu Prasad, Assistant Director General (Fisheries) stressed the need of reservoir fisheries research in the country. He also appraised the participants about the contribution of the ICAR and that of the participating States in the joint research programmes on reservoir fisheries.

The first two sessions of the workshop were chaired by Shri K.V. Navate, Deputy Commissioner of Fisheries, Gujarat and the third, *i.e.*, the finalisation of technical programme was presided by Dr. V.G. Jhingran, Director Central Inland Fisheries Research Institute, Barrackpore.

Dr. O.P. Kathuria, Professor of Zoology, Government College, Ratlam, Madhya Pradesh and a private fish culturist from West Bengal have been given intensive training with special emphasis on induced breeding of fish.

On 19th July, 1977, Dr. V.G. Jhingran, Director, CIFRI, in a discourse with the students and staff of G.B. Pant Agricultural University, Uttar Pradesh, highlighted the recent advances in freshwater aquaculture in India and laid stress on new approach of integration of fish culture alongwith compatible combination of horticulture, agriculture, poultry, piggery, duckery, etc., involving the principles of nutrient utilisation by recycling of wastes.

The Calcutta Station of the All India Radio included in its programme 'Vigyan Bichitra' of August 18, 1977, a series of talks delivered by the scientists of this Institute. While Shri P. Das, Scientist Extension highlighted the role of CIFRI in the rapid development of the inland freshwater aquaculture, Shri K.K. Ghosh, Scientist$_1$, focussed the noteworthy achievements of the Institute in the field of brackishwater fish and prawn farming. 'Diseases in fish and their control' was the other aspect covered by Shri Ajoy Kumar Ghosh, Scientist$_1$.

To generate interest among the children in the aquatic wealth of the country with particular reference to fish, a talk on 'Local Aquatics' summarised by Shri P. Das, Scientist Extension, was broadcast by the All India Radio, Calcutta in their English Programme 'Calling All Children' on August 28, 1977.

Finance :

The provision of funds for the financial year April, 1977 to March, 1978 was as under :—

Non-Plan	Rs.	60,87,000.00
Plan	Rs.	1,08,12,000.00
Total	Rs.	1,68,99,000.00

Against the above provision, the expenditure from 1.4.77 to 31.12.77 was as follows :

Non-Plan	Rs.	46,39,179.00
Plan	Rs.	68,63,580.00
Total	Rs.	1,15,02,759.00

Table I : Spawn fry and fingerlings supplied to various agencies in 1977

Agencies	Indian major carps		Exotic carps		Common carp	
	Spawn (lakh)	Fry & fingerlings (No.)	Silver carp fry & fingerlings (No.)	Grass carp fry & fingerlings (No.)	Spawn (lakhs)	Fry & fingerlings (No.)
1. I.D.R.C.	—	9,910	3,515	2,978	—	2,450
2. Orissa Fisheries Dept.	5.55	44,280	5,000	5,000	—	—
3. Operational Research Project	5.62	—	—	—	—	—
4. Co-ordinated Project, Dhauli	—	6,099	100	16	—	—
5. CIFR Sub-station (Departmental stocking)	28.65	68,885	5,222	1 500	—	4,586
6. Private party	10.03	47,610	2,091	5,098	—	2,075
TOTAL	49.85	1,76,784	15,928	10,002	—	9,111

Table 2 — The details of problems under various research projects completed, suspended and transferred to other projects during 1973—77

	Year	Code numbers										Total
Problems completed	1973	1.7	1.12	1.19	4.4	5.2	5.7	5.9	8.2	9.1		
		11.3	12.1	12.2	14.5	16.1	16.4	17.1	17.2	17.3		
		17.4	19.1	19.4							—	24
	1974	1.20	5.11	11.1	11.2	19.2					—	5
	1975	1.18	1.22	5.1	5.8	5.10	5.13	5.14	5.15	5.16		
		17.6	20.2								—	11
	1976	1.23	1.27	2.2	3.9	3.12	5.20	6.1	5.85	8.5		
		11.4	11.5	12.4	13.18	15.1	16.8	17.9 (b)			—	16
	1977	1.24	1.26	1.30	1.32	5.21	5 29	5.44	8.6	10.1		
		11.6	11.7	13.2	13.8	13.13	13.17	13.19	14.7	14.10		
		14.12	16.7	17.9 (c)	20.3	20.4	20.6	CFCSP 2	ABF 4			
		ABF 5	ABF 7								—	28
											TOTAL	84
Problems suspended	1973	1.15	2.5	3.10	3.11	5.3	9.3	19.3	19.6	21.1		
		21.2									—	10
	1974	14.9									—	1
	1975	1.2	1.14	1.17	5.25	13.11	13.12	14.8	CFCSP-5		—	8
	1976	1.28	3.6	5.12	13.10	ABF-6	IDRC-6				—	6
	1977	1.36	1.38	5.12	17.8(b)	22.1 (a)					—	5
											TOTAL	30
Problems transferred to other projects	1973-77	5.19	5.24	5.32	5.35	5.43	6.3	8.4	14.12	16.2		
		19.7									—	10

2. PROGRESS OF RESEARCH

Research investigations on twentythree research projects (excluding project 7) of the Institute, thirty research problems of the Institute based All India Co-ordinated Research Projects and five research problems of the CIFRI/IDRC/WB Project were continued during the year 1977 as per scheduled programme. Each project has several problems to be handled on priority basis. Due to practical difficulties, investigations on the research problems "**I·36** — Snail control in ponds under fish culture", "**I·38**—Biology of some bloom forming blue-green algae of fish ponds" had to be suspended in 1977. Moreover, research work on "Project **7**—Murrel and live fish cultures" was discontinued as the investigations are being conducted under the Institute based All India Co-ordinated Research Project on Air-breathing Fish Culture (Table 2).

(a) Research completed :

Since the Institute embarked on time bound project programme in 1967, investigations on 118 problems ; *i.e.*, one problem in the year 1969, seven in 1970, four in 1971, nineteen in 1972, twenty four in 1973, five in in 1974, eleven in 1975, sixteen 1976 and twenty eight in 1977 were completed. Brief reports of the problems completed during 1977 are presented below :

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

Problem : 1.24 (Research completed in 1977. Final report is being prepared)

Problem : 1.26 Nutritional requirements of fry and fingerlings of carps

Personnel : P.R. Sen, N. G. S. Rao and S.R. Ghosh

Duration : Three years

Five test diets with casein levels of 0, 15, 30, 45 and 60 per cent with corresponding carbohydrate levels of 71, 56, 41, 26 and 11

per cent respectively were tried. Based on the results obtained, test diets with casein levels of 0, 15, 30, 40, 45, 50, 55, 60 and 70 per cent and carbohydrate levels of 71, 56, 41, 31, 26, 21, 16, 11, and 1 per cent respectively were tried to narrow down range of casein level required for optimum growth.

The feed, in terms of a proportion of the total initial body weight of the fish (spawn 100%, fry 25.50%, fingerlings 5%), were provided daily in containers.

Growth of carp spawn, fry and fingerlings was optimum with diets having 45% protein (Casein) and 26% carbohydrate (Dextrin) in the temperature range of 24° to 32°C. This suggests that under tropical conditions, protein in excess of 45% in carp feed will not perhaps be utilised by carps and hence is not desirable. It has also been observed that 26% carbohydrate in the diet yielded the best growth in carps. The optimum growth of carps at gross energy level of 492 cal/100 g might be due to maximum metabolisable energy of feed having 45% casein and 26% dextrin.

Problem : 1.30 (Research completed in 1977. Final report is being prepared)

Problem : 1.32 Bionomics and culture of tendipedid larvae, a favoured fish food organism

Personnel : N.G.S. Rao

Duration : Three years

Screening of organic and inorganic fertilisers, for mass culture of tendipedid larvae, was done and their efficiency tested at concentrations ranging between 50 and 250 ppm. Organic manures favoured better production of tendipedid larvae. Cow dung, poultry droppings, mahua oilcake, milk powder, etc. were the organic bases and tripple superphosphate & urea were the inorganic bases tried.

By adopting controlled spawning technique using organic base (200-250 ppm), the production of larvae could be enhanced to 780 2,800/m^2/20—25 days as against 1,000/m^2 obtained in natural spawning. Adult emergence

and larval densities were found maximum during May—June and minimum during monsoon and post monsoon months. Production of tendipedid larvae on a large scale would assure the supply of this natural food to fishes cultured under high stocking density in ponds.

Project 5 : Brackishwater fish farming

Problem	: 5.21	Fish and prawn seed resources of Pulicat lake
Personnel	:	K. Raman, K.V. Ramakrishna, R.D. Prasadam, G.R.M. Rao, S. Radhakrishnan, C.P. Rangaswamy, M. Kaliyamurthy, K.O. Joseph and S. Srinivasagam
Duration	:	Five years

Studies on abundance and ingress of fish and prawn larvae into the lake Pulicat were continued. Collections made by operating Vellon nets indicated that *Elops saurus* appeared in good numbers during February (21.5/net/hr) and June (43.2/net/hr) and *Silago sihama* (15.0/net/hr) in February. The other fish species encountered were : *Ambassis* sp., *Anchoviella* sp., *Aplochilus* sp., *Chanos* sp., *Gerres* sp., *Hemirhamphus* sp. *Mugil* sp., *Mystus* sp., *Nematalosa* sp., *Tylosurus* sp.. *Therapon* sp., gobiids, etc. Among prawns *Penaeus indicus, P. semisulcatus, M. monoceros, M. dobsonii, Acetes* sp. were encountered besides, mysids and crabs. The investigations under this project have been transferred to project 5.50 entitled "Location, collection and assessment of resources, acclimatisation and transport of brackishwater fish and prawn seed".

Problem	: 5.29	Role of silt load in the Hooghly estuary on nutrient balance of the environment and its effect on primary production processes
Personnel	:	S.C. Banerjee, B.B. Pakrasi and N.C. Basu
Duration	:	Two years

The important point noticed was that the nutrient status of the silt was quite significant (average value 11.2—19.6 mg/100 g for N_2 and 1.88 — 9.99 mg/100 g for P) during highest water level of spring tide. The ranges of hydrological parameters in tide water were : pH—7.3 to 8 1 and 7 5 to 8.1 ; silt load—0.19 to 0.90 mg/100 g and 0·55 to 1.04 mg/100 g ; N_2—0.10 to 0.12 and 0.3 to 0·55 ppm ; phosphate—0.06 to .12 and 0.22 to 0.45 ppm ; salinity—0.034 to 0.06‰ and 19.3 to 15.8‰ ; sp. conductivity– 563 to 578 and 16,734 to 27,317 $\times 10^{-6}$ mhos at Barrackpore and Kakdwip respectively. The studies have indicated that the silt may be well utilised for replenishment of the nutrients' level in brackishwater impoundments and the nutrients in the settled silt may be utilised by suitable mineralisation.

Problem : 5.44 (Research work completed in 1977. Final report is being prepared)

Project 8 : Estuarine and brackishwater lake fisheries

Problem : 8.6 Standardisatian of brackishwater seed prospecting, collection and transporting techniques

Personnel : N C. Basu, R.N. Dey, A.R. Paul, S P. Ghosh and N.N. Mazumdar

Duration : Three years

Observations, made with standard Midnapore type and modified Midnapore type shooting nets, revealed that modified net was 125.92% more efficient than the standard one. The catch per net hour of *P. monodon* ranged from nil to 1,521 ; *P. indicus.* nil to 664.00 ; *M. brevicornis* 10.33 to 3,210.67 ; *M. monoceros* 57.33 to 2,918.67 ; and *P. styliferus* nil to 5,1 30.67. The major peaks occurred in June (first fortnight), August (second fortnight) and March (first fortnight) and in full moon phases only.

Project 10 : Fish firm designing

Problem : 10.1 Designing fish farm under the soil conditions of Orissa

Personnel : C. Saha, N.K. Tripathy, M.D. Mantri and C.D. Sahoo

Duration : Four years

Studies on dyke slopes, conducted at Dhauli, have indicated that the dykes steeper than $1\frac{1}{2} : 1$ ($1\frac{1}{2}$ horizontal; 1 vertical) would have excessive erosion. Considering the water supply, topography, soil type, etc., of Dhauli suitable design has been worked out for the construction of a freshwater experimental fish farm over an area of about 145 hectares. The designed layout consists of 66 stocking ponds, 84 rearing ponds, 253 nursery ponds and 253 small experimental ponds.

The water supply system by gravity from the Kanas Branch Canal flowing adjacent to the farm boundary has been designed. During the lean period when the irrigation canal (Kanas Branch Canal) will not have any supply, the water supply would be maintained from open wells. The drainage arrangement of the ponds has been designed in such a way so as to flow the water through underground conduit system into a collection sump for final outfall by pumping.

Project 11 : Economics in fishery investigations

Problem : 11.6 Economics of intensive fish farming in freshwater ponds of West Bengal and Orissa

Personnel : M. Ranadhir, S.D. Tripathi and M.A.V. Lakshmanan

Duration : Two years

&

Problem : 11.7 Economics of composite fish culture technology in India

Personnel : M. Ranadhir

Duration : One year

(As the nature of problems 11.6 and 11.7 were more or less identical, the final reports of these two problems are presented together)

The total cash variable expenses and the per hectare production levels showed great variation from region to region and from place to place within a region. These variations were attributable to the degree of application of composite fish culture technology in different parts of the country as regards feed, availability of weeds and species composition. The average expenditure per hectare of cultivable water area varied from Rs. 6,904 per annum in southern region to Rs. 15,067 per annum in western region. These variations in cash variable expenses did not reflect the agro-climatic and ecological needs of the region towards adoption of the new fish culture technology but seem to indicate only the extraneous factors like non-availabilily of input factors etc. In West Bengal, during 1975-76 the average cash variable expenses from 91 demonstration centres laid out in farmars' ponds on physical inputs alone was Rs. 11,44[illegible]/ha/annum. These did not include imputed wages of owner labour and own capital expenditure. Including these imputed wages, the application of composite fish culture technology at appropriate levels may involve a total expenditure of about Rs. 15,000 per hectare per annum.

The average input cost structure showed a dominating expenditure on feeds at an average level of 65 to 70% on total cost. In physical terms, an application of feed of about 11,000 kg yielded a fish production of about 5,500 kg in western region whereas a feed of about 7,000 kg yielded 3,500 kg in the eastern region. Considering the economics of feed application an additional one rupee investment on account of feed has brought about an additional revenue of Rs. 1.50. The returns to scale could not be determined with the data presently available. From the fish culture demonstration centres in West Bengal. an average gross profit of about Rs. 16,500 per hectare of cultivable water area has been obtained at 1975-76 price level. The improved fish culture technology has the potentiality of providing an additional employment to one farm labour per one hectare of cultivable water area due to various additional fish culture operations to be undertaken. The average cost of production per kg of fish varied from Rs. 2.38 to Rs. 2.93 whereas it's disposable price at site is around Rs. 6 to Rs. 8 a kg thus assuring a minimum profit margin of Rs. 3 to Rs. 4 per kg of fish produced.

Project 13 : Cold water fish culture

Problem :	13.2	Artificial feeds and trout nutrition
Personnel :		G.N. Bhat and Shyam Sunder
Duration :		Three years

Investigations were undertaken to evolve a cheaper, nutritive and balanced feed for trout. Dry, compound and pelletized feeds were prepared, and their nutritive and cost factors were determined. The feeding trials conducted have indicated that feeds containing 28.0, 35.0 and 39.0% of crude protein when fed to brown trout, gave conversion ratios of 2.0, 1.9, and 1.4 respectively. The test animals in these trials ranged from 15/kg to 10,000/kg and duration of trials from 49 to 180 days. In case of rainbow trout, feeds containing 28.0, 35.0, 37.6, and 39.0% crude protein gave the conversion ratios of 1.8, 1.5. 2.1, and 1.7 respectively. Per kg cost of pellets prepared in the laboratory ranged between Rs. 5 50 and Rs. 6 00. Subsequently a commercial firm formulated the feeds at almost half the cost.

The feed containing fish meal 600 g, soyabean meal 100 g, wheat midlings 150 g, Brewer's yeast 100 g, shark liver oil 30 g and vitamin mix 20 g (having crude protein 39.16%, crude fibre 2.15%, ash 37.20%, ether extract 5.34%, nitrogen free extract 13 33% and moisture 2.82%) proved to be the best.

Problem :	13.8	Standardisation of trout hatchery practices
Personnel :		H.B. Singh, R.K. Langer, and Sirajuddin & G.N. Gazi (Dept. of Fisheries, J & K State)
Duration :		Three years

It has been observed that segregation of brown trout spawners, 3 months prior to stripping, and feeding them on meat balls of partially boiled common carp, enhanced the average number of eggs/kg body weight to 1,808 as against 1,340 in unsegregated spawners fed on raw fish. The rate of fertilisation ranged between 93.3—99.2%. Use of malachite green @ 1 : 2,00,000 for 30 minutes, twice a week as a prophylactic against common hatchery diseases, thinning of ova and alevins in the hatching trays (at temperature ranging between 2.9 and 5.8°C, and DO between

9.8—10.3 ppm), etc. enhanced the cumulative survival rate to 88.8% as against 53.9% under control.

Problem	: 13.13	Studies on the biological indicators in an eutrophic lake (Dal lake)
Personnel	:	K.K. Vass, Shyam Sunder, H.B. Singh and R.K. Langer
Duration	:	Two years

Various biological and physico-chemical parameters of Dal lake, Kashmir were studied with a view to finding out biological indicators which could reflect the pollutional impact due to discharge of raw sewage and other effluents from the house boats, run-off from the floating gradens, etc. The analysis of data revealed that Myxophycean forms, like *Spirulina* and *Oscillatoria* occurred at Dalgate indicating pollution due to raw sewage discharge from house boats located at this station. The effect of pollution at Nishat and Charchinari was characterised by a bloom of Euglenophyceae. Hazaratbal centre depicted a tendency of high eutrophication due to the abundance of *Fragillaria* and *Gomphonema*. Maximum abundance of chironomid and oligocheate worms at these centres substantiated the plankton study. Increased nutrient status and primary productivity values provided further support to rapid eutrophication of this ecosystem, although intensity varied from station to station.

Physico-chemical studies have shown that water temperature of Dal lake ranged from 4.1—28.7°C and transparency between 20—150 cm. DO content at Brein and Hazaratbal centres was invariably high (8.5—10.5 ppm) whereas it was low (1.5—7.6 ppm) at Nowpora and Dalgate. pH indicated more or less alkaline water at all the centres. Total alkalinity ranged between 40 and 165 ppm, being more during winter months. Silicates ranged between nil and 0.4 ppm. Dissolved organic matter was more in the polluted zones (Nowpora and Brein). Primary production ranged between 24 and 122 mg $C/m^3/hr$. A negative production, in which respiration was more than photosynthesis, was also recorded in the polluted zone.

Problem : 13.17 Some biological aspects of common carp, *Cyprinus carpio* var. *specularis* to assess its role in decline of endemic carp fishery in Dal lake

Personnel : Shyam Sunder, Siraj-ud-din (Dept. of Fisheries, J & K State) and H.B. Singh

Duration : Two years

Gut analysis of 309 specimens of *Cyprinus carpio* var. *specularis* (23—460 mm/12—1,540 g) showed that the fish is a detritus feeder. Food comprised detritus 75.15%, phytoplankton 19.25% and zooplankton 1.89%. Very small quantities of paddy and maize seeds, husk, fish scales, insect larvae, oligochaetes and nematodes were observed. Stray specimens of *Gambusia affinis* and *Crossocheilis latius* were also observed in the gut of the species. The study also revealed a close similarity in the feeding habits of mirror carp and *Schizothorax* spp. The average number of eggs in mature specimens of mirror carp (360—491 mm/709—1,312 g) ranged between 27,488 and 4,07,072. Scales, examined for age and growth, indicated that the annulii were formed sometimes between late December and February and appeared as dark circular bands in close proximity. The age and growth study by scale method was also supplemented by length frequency data.

The mirror carp was found to breed from 1st week of March to 1st week of June in Dal lake near Shalimar, Nishat, Hazaratbal snd Pishpow nullah. Eggs were laid in the weed infested areas, especially on *Ceratophyllum, Myriophyllum, Potamogeton* and *Hydrilla*. Eggs were also found attached to fine roots of floating plants and willow trees.

Endemic species of *Schizothorax* was observed to migrate in Arh stream for spawning.

Studies have indicated a keen compitition for food between the mirror carps and *Schizothorax* spp. Due to higher fecundity and simple spawning habits, mirror carp appeared to have an edge over the endemic *Schizothorax* spp. of the Dal lake.

Problem : 13.19 Breeding of brown trout at Uttarkashi (U.P.)

Personnel : C.B. Joshi and R.C. Joshi

Duration : One year six months

The investigation on the breeding of brown trout *(Salmo trutta fario)* were carried out during the breeding season of 1975-76 and 1976-77 amongst the pre-existing primitive conditions at Kaldhyani trout hatchery at Uttarkashi (U.P.).

The average number of green eggs produced in 1975-76 was 1,130/ kg of body weight against 1,491 during 1976-77, when the ratio of the animal protein and vitamins was increased in the trout diet.

Cumulative percentage of survival of fry was 57 9% during 1975-76 and 23.8% during 1976-77.

The mortality of green eggs, eyed ova, alevin and fry was due to non-viable eggs, fungus, white spot, soft egg, blue sac, whirling, body deformities, pin head and silt. Heavy silt load and cement particles were responsible for the mass mortalities of eyed ova and elevin during 1976-77 resulting in a poor survival of fry.

The incubation period for the brown trout eggs at Kaldhyani hatchery was observed to be 78—105 days during 1975-76 at 2.0—17.5°C and 75—105 days at 2.0—13.5°C during 1976-77.

The use of malachite green as fungicide was found to be very effective in controlling spreading of fungus in the hatching trays. Picking up of the dead ova from the hatching trays on every alternate day and the weekly treatment with malachite green reduced the mortality during incubation of brown trout eggs.

The monthly average values of the dissolved oxygen showed its peak during December—January in the year 1975 and 1976 while the lowest values were recorded during April—May in 1976 and 1977. The values of free CO_2 were the highest during January—February and the lowest during April and March in both the breeding seasons. The ranges of DO and free CO_2 were 9.2—10.8 ppm and nil—4.0 ppm in 1975-76 and 8.4—12.0 ppm and nil—2.4 ppm in 1976-77 respectively.

Project 14 : Riverine and estuarine fish catch statistics

Problem	: 14.7	Fisheries of Brahmaputra River
Personnel	:	Ravish Chandra, H.P. Singh, M. Choudhury and V. Kolekar
Duration	:	Five years

Rapid survey of 600 km stretch of the river Brahmaputra between Biswanath Charali and Dhubri was carried out in 1972. 42 important fish landing centres were located in Dibrugarh, Sibsagar, Nowgong, Kamrup, Goalpara and Dahrang districts.

Data collected on fishing inventory indicated that there were 140 fishing villages. Nomadic fishermen also formed sizeable percentage. Principal gears comprised gill nets (1/2 — 10" mesh), drag nets (1/2 — 8" mesh), bag nets, cast nets and dip nets (1/2 — 1½" mesh), long lines, traps, and clap nets made of cotton/nylon/Assam silk.

Information on the production and abundance of commercial fisheries of the Brahmaputra river was collected from 1972 to 1977 at two centres, *viz.*, Uzanbazar and Fancybazar, and from 1974 to 1976 at four centres *viz.*, Tezpur, Uzanbazar, Fancybazar and Dhubri. Estimations indicated maximum landings at Fancybazar (396 t), followed by Uzanbazar (336 t) in the years 1972 to 1977. Total market arrivals during the period 1974-77 were estimated at 221 t and 201 t at Dhubri and Tezpur respectively. The commercia landings were mainly represented by major carps, minor carps catfishes, hilsa, prawn and miscellaneous fishes.

The overall average annual landing at the four centres for the period under study was estimated at 56 92 t in which the miscellaneous group contributed maximum (26.79%), followed by catfishes (23.74%), major carps (18.70%), minor carps (14.39%), hilsa (11.73%), and prawn (4.65%).

Amongst major carps, *L. rohita* was the dominant species at all the centres and amongst the catfishes *W. attu* contributed maximum (8 20%) to the total landings. Fancybazar received maximum quantity of hilsa every year. However, the landings showed declining trends from a maximum of 15.97 t in 1974 to 11.51 t in 1977. Dhubri ranked second in receiving hilsa, Uzanbazar and Tezpur ranked third and fourth respectively. A declining trend in abundance of hilsa was noticed at all the centres.

Observations on the physico-chemical conditions of the river water were also made. No marked variations in the total alkalinity (50—240 ppm) free CO_2 (1—10 ppm), DO (3.6—10.4 ppm), nitrate (0.01—0.07 ppm), and phosphate (0.05—0.32 ppm) were noticed between the centres.

Gross and net primary production at Gauhati were estimated at 15.6—31.25 mg C/m³/hr and 12.3—19.36 mg C/m³/hr respectively.

The average monthly plankton density varied from 14—81 u/l at different centres with winter and summer peaks. Phytoplankton, represented by *Spirogyra* sp., *Ulothrix* sp., *Zygnema* sp., *Tabellaria* sp., *Gomphonema* sp., *Navicula* sp., and *Oscillatoria* sp., dominated over zooplanton, mainly represented by *Filinia* sp., *Lecane* sp., *Brachionus* sp., *Cyclops* sp., *Eudorina* sp., *Bosmina* sp., *Daphnia* and copepod nauplii. Chlorophyceae dominated in 1974 (in 1976 at Gauhati) and Bacillariophyceae in 1975, 1976 and 1977 among the phytoplankters.

Problem	: 14.10	Ecological changes in the Hooghly estuary in the context of freshwater release from Farakka Barrage into the system
Personnel	:	A.C. Nandy, K.K. Ghosh, P M. Mitra, M.M. Bagchi, R.K. Chakraborty, S K. Mazumdar, P.R. Das, B.K. Saha, R.N. De, N.D. Sarkar, A.R. Paul, N C. Mandal and S.P. Ghosh
Duration	:	Two years eight months

To study the effects of flushing of freshwater into the system, regularly, fortnightly collection of hydrological data, plankton, benthos, primary production and tow net collections were made from 8 sampling stations, 5 along the Hooghly, one each on Rupnarain, Matlah and Mani rivers. Additional freshwater to the Hooghly was put by the Farakka Barrage at a low rate. The Farakka discharges raised the freshwater flow into the Hooghly estuary and changed the ecology of the system significantly. A sizeable drop in salinity of the estuary was observed. The earlier recognised gradient-transient zone has largely become the freshwater zone while the marine zone has become largely transient-gradient zone. With the lowering of the estuarine salinity and higher water flow, the general habitat has considerably improved The higher freshwater discharge has stabilised the temperature regimes thus at most centres of Hooghly the winter water temperature were slightly higher while the summer high water temperature

were lower. The plankton populations have shown most significant improvements. The plankton densities have been recorded 3-5 times in the different zones of Hooghly-Matlah estuarine system as compared to those reported by earlier workers.

Problem	: 14.12	Robustness of estimators of population size and efficiency of mortality rate estimators by Monte - carlo methods
Personnel	:	K.K. Ghosh
Duration	:	Two years nine months

The estimation techniques available in literature for finite and assumed infinite populations have been examined. The geometric, logistic and modified logistic models of population growth with poison or geometric models of mortality are being theoretically examined for the estimation procedures.

Project 16 : Weed control

Problem	: 16.7	Studies on the algal population of fresh-water ponds with special reference to their utility for fish culture and control when in excess
Personnel	:	S. Patnaik and K.M. Das
Duration	:	Five years

In some ponds at Killa and Kausalyagang temporary abundance of *Pediastrum simplex, Panderina morum, Coelastrum microforum* and *Euglena acus* occurred after rains when there was slight rise of total alkalinity, phosphate and nitrate in the water. Similarly during winter months, abundance of *Euglena tuba, Selesoastrum gracile* and *Trachelomonas* sp., was observed when water pH was 7.6 - 7.9, total alkalinity 144 - 158 ppm, nitrate 0.05 - 0.12 ppm and phosphate 0.04 - 0.22 ppm.

Bloom of *Microcystis* (density 1.45 ml/l) could be cleared by application of 0.75 ppm copper sulphate in two doses at 15 days interval. The bloom, however, reappeared after 7 months. The fish or the fish food organisms of the pond were not affected by the treatment.

Project 17 : Frog farming

Problem : 17.9(c) (Studies under this problem have been completed and the final report is under preparation)

Project 20 : Water pollution investigations

Problem : 20.3 Studies on estuarine pollution with reference to pulp and paper and tannery wastes

Personnel : B.B. Ghosh, S.K. Mazumder and M.M. Bagchi

Duration : Four years

Assessment of the pollutional status of the Hooghly estuary in the context of polluted and unpolluted zones was made. The stretches of the Hooghly near Kalna, Diamond Harbour and Kakdwip, located beyond the industrial belt of the estuary as well as the stretches near Kolaghat and Port Canning along Rupnarain and Matlah respectively, which virtually do not receive any industrial effluent, showed high gross primary production and plankton abundance and more favourable physico-chemical environment as compared to those of the stretches of the Hooghly near the outfall of pulp and paper (Average : 6.7 mg $C/m^3/hr$) and tanneries (Average : 9.8 mg $C/m^3/hr$) investigated earlier. Annual average gross primary production in the Matlah (65.5 mg $C/m^3/hr$) was more in comparison to that of the Rupnarain (56.8 mg $C/m^3/hr$) and the selected stretches of the non-polluted zones of the Hooghly (59.8 mg $C/m^3/hr$). Mostly a low primary production accompanied by low biotic abundance was obtained during summer (March—June) under neap tidal phase as compared to that obtained during rainy season (July—October) and winter (November—February) under spring/bore tidal phase.

Problem : 20 4 (Research work completed in 1977. Final report is being prepared)

Problem : 20.6 The effects of biocides on the physiological activities of aquatic animals

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

Duration : Three years

Experiments were conducted to study the standard metabolism (mg/kg/hr) of *C. mrigala* (av. wt. 3.1 g), *L. rohita* (av. wt. 1.9 g), *C. fasciata* (av. wt. 1.9 g) and *C. catla* (av. wt. 4.8 g), at selected temperatures (20°, 25°, 30° and 35°C) in sublethal concentrations of DDT (0.01 and 0.02 ppm), Ethyl parathion (0.02 ppm), Gammaxene (0.005 ppm), Endrin (0.005 ppm) and Malathion (0.01 ppm). Control experiments were also conducted with the fishes for the comparative study.

It was found that the sublethal concentration of DDT (0.02 ppm) at 20°C affects the standard matabolism of *C. mrigala* by 25, 46 and 134% ; of *L rohita* by 8, 33 and 76% ; and of *C. fasciata* by 22, 43 and 77%, when (1) tested in 0.02 ppm DDT, (2) short-term (24 hr) exposure and tested in 0 02 ppm DDT and (3) short-term (48 hr) exposure and tested in 0.02 ppm DDT, respectively.

Observations on the effects of sublethal Ethyl parathion (0.02 ppm) on the activity and metabolism of *C. fasciata* (av. wt. 1.9 g) at 20 and 30°C have been made. The values of standard metabolic rate ranged from 68.3 to 163.8 mg/kg/hr at 20°C and 202.0 to 366.5 mg/kg/hr at 30°C under various experimental conditions.

Upper temperature tolerance limits in *C. mrigala* and *C. fasciata* were studied. It was found that *C. fasciata* (av. length : 6.2 cm) can tolarate temperature upto 42.0°C and fish of the same size in 0.005 ppm BHC can tolerate temperature upto 39.5°C, and *C. mrigala* (av. wt. 2.3 g) can tolerate upto 40.1°C in control water.

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production

Problem : CFCSP 2 Bundh breeding of silver carp, *Hypophthalmichthys molitrix*, and grass carp, *Ctenopharyngodon idella*

Personnel : V.R.P. Sinha, M.V. Gupta, B. K. Sharma and M. Sinha

Duration : Two years and five months

Experiments on the bundh breeding of exotic silver carp *(Hypophthalmichthys molitrix)* and grass carp *(Ctenopharyngodon idella)* were taken up in the Bankura district of West Bengal during 1975-77 to develop and standardise the techniques of breeding of exotic carps in dry bundhs and to at the spot demonstrate the technique, so developed, to the pisciculturist of the adjoining villages for its extensive application.

To initiate the experiment in 1975, anaesthesized breeders of silver carp were transported to Simlapal (Bankura) from Kalyani and Krishnanagar centres. Due to delayed and scanty monsoon, the experiment could not be started in time and the fishes lost the appropriate condition for breeding. However, attempts were made to breed the fishes with the aid of pituitary gland extract injection. Silver carp, though in regressing stage, bred profusely and 72 litres of eggs could be collected. Grass carp did not respond. During 1976, three sets of silver carp were bred in bundhs by administrating the pituitary glands @ 12—15 mg/kg to females and 5—8 mg/kg to males. Hatching was carried out in double walled *hapas*, in 'chabas' and in 'chabas' fitted with inner *hapa*. Hatching in the double walled *hapas* yielded better results, and 6,000 fingerlings produced on rearing the hatchlings were distributed free to local fish farmers.

In 1977, 5 sets of silver carp and grass carp were successfully bred in bundhs, by injecting the ptuitary glands @ 10—15 mg/kg to females (in 2 instalments), and 8—10 mg/kg to males (single instalment . 30,000 silver carp and 20,000 grass carp hatchlings were obtained and the fingerlings (15,000 of each species) were distributed free to local fish farmers.

Successful results, obtained repeatedly in different years, reveal the possibility of breeding silver carp and grass carp in bundhs.

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

Problem : ABF 4 Digestive physiology of air-breathing fishes with particular reference to enzymes

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

Duration : Two years

Investigations on the specific activities of amylase, cellulase, protease and lipase in the intestine of the air-breathing catfish *Clarias batrachus* were carried out. pH optima of all the enzymes were found between 6.9 and 7.9. The activity of lipase and cellulase showed very little change with change in the nutritional status of the diets. Isolation and purification of alkaline protease from intestine of *Clarias batrachus* could be done and two enzymes, trypsin and chymotrypsin, were characterised and their activities assessed under different diet treatments.

Cellulase and high amylase activities, as observed in the intestine of *C batrachus*, indicated the species as capable of assimilating carbohydrates from plant sources.

Problem : ABF 5 Culture of air-breathing fishes in derelict water

Personnel : P.V. Dehadrai, S.M. Banerjee and R.N. Pal

Duration : Three years

In 1976, two ponds (0.03 and 0.04 ha) were stocked with magur, *Clarias batrachus*, fingerlings @ 20,000 and 40,000 nos/ha respectively. Fishes of both the ponds were fed with artificial feed comprising dried marine trash fish (80%) and rice bran (20%) at the rate of 5% of the body weight. Gross productions of 36 kg in 5 months and 80 kg in 6 months could be achieved from the respective ponds when only 50% of the stocked fishes were retrieved.

In 1977, a production to the tune of 3,750 kg/ha/6 months of magur was obtained from a 0.1 ha pond when 75% of the stocked fishes was recovered.

The experiments have shown that high production of air-breathing fishes can be obtained from the derelict swampy water bodies abounding in the different agro-climatic conditions of the country by systematic culture of commercially important species of air-breathing fishes and also without involving input towards reclamation of such water bodies unsuitable for carp culture. The results, thus achieved, lay the foundation for a production oriented programme for utilization of derelict and swampy water areas.

Problem :	ABF 7	Biochemical, nutritional and toxicological investigations on the culture prospect of air-breathing catfish, *Clarias* and *Heteropneustes* in partially saline water
Personnel :		P. V. Dehadrai, Ansuman Hajra, B. R. Balurkar and Gouri Chakraborty (upto November 1977)
Duration :		Three years

Results of the experiments indicated that *C. batrachus* and *H. fossilis* can tolerate partially saline water with LD values at 14 ppt. It was further observed that growth of both the species when cultured in partly saline water (upto 8 ppt) was normal when they required approximately 50% protein in their diet compared to 55% protein requirement when cultured in freshwaters. Further investigations have been kept in abeyance.

(b) Research in hand

Researches on different problems under 23 Projects operating at the Institute, 5 problems under CIFRI/IDRC Project and 19, 12 and 1 problems of the All India Co-ordinated Projects on — "Composite Fish Culture & Fish Seed Production", "Air-breathing Fish Culture in Swamps" and "Reservoir Fisheries" respectively were continued during the year 1977. 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. Dutta, S. Jena, D.R. Kanujia and S.L. Kar
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 (1,600 kg/ha of cow dung) and artificial feeding (660 kg/ha of ground-nut oilcake+rice bran) were provided. All the species had registered satisfactory growth at the end of 3 months culture and average weights recorded being catla 14.0 g, rohu 25.5 g, mrigal 22.5 g in one pond and 29.0 g, 65.0 g and 33.5 g respectively in the other.

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

Personnel : R.D. Chakraborty, P.R. Sen, N.G.S. Rao, S. Jena, S.R. Ghosh, and D.R. Kaunjia

Duration : Three years

The experiment on composite culture of Indian and exotic carps at a stocking density of 10,000 fish/ha and species ratio of silver carp 2.5: catla 1.0: rohu 2.0: mrigal 1.0: grass carp 1.5: common carp 2.0 is being concluded early as poaching apperared to have adversely affected fish production. However, gross productions estimated at the end of 9 and 10 months of rearing, based on average weights, were 6,021 kg/ha and 4.437 kg/ha. Management measures included use of lesser quantities of feed and fertilisers and mineralisation of bottom deposits by periodical addition of lime.

1.1.2.3 Intensive culture of Indian major carps

Personnel : R.D. Chakraborty, P.R. Sen, N.G.S. Rao, S. Jena, S.R. Ghosh and D.R. Kanujia

Duration : Three years

Stocked @ 6,000/ha and in the species ratio of 4:3:3 catla, rohu and mrigal, in two ponds of 0.17 ha and 0.19 ha, yielded 1,458.8 kg and 2,027 kg/ha respectively at the end of 10 months culture with the recovery of only 23 and 37% of the stocked fishes respectively. Management measures envisaged included periodic fertilisation of the ponds, daily provision of supplementary feeding and multiple harvesting.

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

Personnel : N.G.S Rao, P.R. Sen, S.N. Dutta, S. Jena and S.R. Ghosh

Duration : Three years

Experiments were initiated in two ponds of 0.16 ha area each, in January, 1977. The ponds were stocked with fingerlings of catla, rohu, mrigal, silver carp and common carp at a combined density of 6,000/ha in the ratio of 1.5: 2 0: 1.5: 2 5: 2.5. Management measures included periodic fertilisation of ponds with both organic and chemical fertilisers.

In view of largescale poaching of fishes in the ponds, the experiment had to be prematurely concluded and is to be restarted in 1978. Gross productions of 2,170 kg and 2,011 kg/ha were recorded with 66 and 51% recovery of fishes respectively. The results of experiments cou'd find immediate application as these are designed to suit low-investment fish culture programmes.

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	:	1.13	(Research work completed in 1972)
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	(Researeh 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 higher stocking density

Personnel : P.R. Sen and D.K. Chatterjee

Duration : Two years

Two sets of experiments were conducted in 1977, one set with catla spawn stocked @ 4.5 million/ha and the second with rohu spawn stocked @ 2.5 million/ha. Cobalt chloride and manganese @ 0.01 mg/day/fish were supplied to catla and rohu spawn respectively alongwith the feed.

In case of catla, 42% survival was obtained with cobalt chloride treatment as against 22%recorded in the controls which indicated that cobalt choride was very much effective in enhancing the survival of catla fry when stocked at a very high density.

In the second set of experiments where manganese was provided, rohu spawn recorded 46% survival in the treatment as against 35% in the untreated control, which indicates that manganese is less effective in enhancing survival and growth of carp fry than that of cobalt chloride,

Problem : 1.22 (Research work completed in 1975)

Problem : 1.22.1 Culture and life history of Cladocera from fish ponds

Personnel : D.R. Kanaujia

Duration : Three years

Plankton samples were collected from different ponds of Killa Fish Farm and zooplankton identified. In most of the ponds where plankton concentration was more, cladocerans dominated whereas in ponds where plankton concentration was low copepods dominated. The dominant forms of Cladocera encountered were *Moina* sp. and *Daphnia* sp. These were collected from ponds and inoculated in 10 l of pond water kept in jars into which powdered mahua oilcake, triple superphosphate and cow dung were added in different concentrations. The growth rate and multiplication of cladocerans are being studied.

Problem : 1.23 (Research work completed in 1976)

Problem : 1.24 Studies on the effect of chemical fertilisers in relation to pond productivity

Personnel : G. N. Saha, D.K. Chatterjee and K.C. Pani

Duration : Five years

A field experiment was conducted in two ponds (0.25 ha each) stocked with fingerlings of silver carp, catla, rohu, mrigal and common carp @ 7,000/ha. In one pond, treated with chemical fertilisers @ 590 kg/ha/yr (urea 530 kg+Potasssium chloride 60 kg in combination with small quantity of cow dung), the net yield of fish was 3,431 kg/ha/yr as compared to that of 1,043 kg/ha/yr in control.

A comparative study on the efficiency of chemical fertilisers (N-urea) alone and in combination with organic manure (cattle manure) on enhancing fish production has been initiated in two ponds (0.25 ha each) stocked with fingerlings of major carps and exotic carps (except grass carp) @ 7,500/ha.

Efficiency of phosphatic fertilisers *viz.*, single and triple superphosphate at three rates (25, 50 & 80 kg P_2O_5/ha) were studied in the laboratory using soil with low available phosphorus (2.0 mg/100 g). Each treatment was replicated thrice. Triple superphosphate maintained higher level of dissolved inorganic phosphate (1.25, 1.94 and 3.10 ppm) in water compared to single superphosphate (1.09, 1.87 and 2.86) at respective rate of treatments. Single superphosphate showed higher soil available phosphorus.

In the yard, with the same soil type, both these fertilisers at 25 kg P_2O_5/ha showed similar trend. Single superphosphate recorded slightly higher primary production (0 175 mg O_2/l/hr), whereas triple superphosphate showed higher plankton production (0.21cc/5 l).

Problem : 1.25 Mass culture of phyto-and zooplankton in field to feed fish

Personnel : A.C. Nandy, S.K. Mazumder and R.K. Chakraborty

Duration : Six years

Culture of zooplankters : Laboratory and yard experiments were carried out to culture *Cyclops* sp. with different feeds such as dried Brewer's yeast and freshly cultured *Chlorella vulgaris* as feed. The algae were introduced in suspension @ 0.25cc/individual/day. The density of *Cyclops* sp. could be raised to 8,500 u/l from an initial inoculum of 10 cc/l within a culture period of 15 days. Trials were made on the mass culture of *Daphnia lumholtzi* under field conditions using dried Brewer's yeast as feed. The stocking at 10 u/l resulted in multiplication to the tune of 15,000 u/l in a period of seven days. Mahua oilcake at 740 ppm was found suitable to obtain sustained culture of *Brachionus mulleri.*

Culture of phytoplankters : Mass culture of one species of chlorococoales, *Scenedesmus obliquus* and two species of diatoms, *Navicula cuspidata* and *Pinnularia gibba* have been achieved in the laboratory and yard. Culture of *Scenedesmus obliquus* has been achieved in modified Bristol solution. A density of 57×10^3 cells/ml could be obtained in 20 days from an initial inoculum of 260 u/ml. Sustained growth of *Nevicula cuspidata* and *Pinnularia gibba* was obtained by using urea, single superphosphate and sodium silicate in the ratio of 100:10:5 (N:P:S). Maximum cell density was observed on the 5th day of inoculation. The cell density per ml increased as 1.2 and 1.5 million from an initial inoculum of 24,620 & 29,000/ ml respectively. Growth kinetics of *C. vulgaris* cells in culture by direct observation on growth of individual algal cells by measuring the variations of size distribution at 24 hours intervals is also being studied.

Problem	: 1.26	(Research work completed in 1977)
Problem	: 1.27	(Research work completed in 1976)
Problem	: 1.28	(Work could not be initiated 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.L. Kar
Duration	:	Three years

Ponds were treated with mahua oilcake (as a fish poison) in routine fish culture operations. Data on effective dose, the fish killed,

effects on plankton and other biota were collected and are being analysed.

Problem	1.30	Operational research on fish culture
Personnel		C. Selvaraj, M.A.V. Lakshmanan and D.R. Kanujia
Duration		Four years

Three ponds in Pahala Panchayet and six ponds in Kandarpur Panchayet were prepared and stocked with induced bred spawn of catla, rohu and mrigal. Submerging of the ponds or cutting of the bundhs to drain out excess water during monsoon months, helped entry of murrels from the adjoining low-lying areas causing damage to the fry reared in the ponds. However, 14,300 fry of catla, rohu and mrigal could be harvested from a pond (0.02 ha) in Pahala Panchayet and 26,000 rohu fry from another pond (0.027 ha) in Kandarpur Panchayet.

Composite fish culture conducted in a village pond (0.08 ha) in Korapada has demonstrated that inspite of limited management measures adopted by the villagers, a gross production of 3,499 kg/ha/13 months could be obtained.

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

Chemical anaesthetics, Tertiary amyl alcohol, was tried at different concentrations on the fingerlings of catla, rohu and mrigal to find out the narcotic effect, if any, on them. With a view to finding out the rate of metabolism, D.O., free CO_2, free NH_3 and pH of the ambient water were recorded in all the experiments.

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 (from Sept., 1977), P.K. Chakraborty (upto Sept., 1977) and K.S. Banerjee

Duration : Four years

Observations on the digestive enzymes of Indian major carps ; *Channa striatus*, and *M. gulio* were continued. Detection of the digestive enzymes of *Pangasius pangasius* was initiated during October, 1977. Preliminary observations have indicated the presence of amylase and invertase in the G I. tract of the fish. Invertase, however, was either absent or very faintly present in the liver. The average pH of stomach, intestine and liver was 6.2, 5.6 and 6.4 respectively. Investigations on *H. molitrix* has been taken up.

Problem : 1.34 Observations on the cultural possibilities of fish in jute-retted pond water

Personnel : B.N. Saigal, Amitabha Ghosh (from Sept., 1977), P.K. Chakraborty (upto Sept., 1977) and S.K. Saha

Duration : Three years

(No progress of work due to ıransfer of staff to other projects.)

Problem : 1.35 Culture of fish alongwith deep water paddy

Personnel : S.N. Dutta, S.L Kar, S. Jena, R.P. Singh, P.K. Pati and R.K. Nigam

Duration : Three years

During the first quarter of the year, rearing of *Cyprinus carpio* fingerlings alongwith 'China 1039' variety (a hybrid) of paddy, at Dhauli, gave 88% recovery and a net production of 127.6 kg/ha in 99 days of rearing. The average size and weight increments were 36.0 mm and 12.4 g respectively.

In Kharif season, one paddy plot of 0.16 ha at C.R.R.I., Cuttack was stocked with *Cyprinus carpio* fingerlings @ 12,000/ha, the variety of paddy cultivated was 'C.R. 1009'. Stocked in September, 1977, fishes had shown good growth in three months time.

Problem	:	1 36	(Research work suspended in 1977)
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 ranging from 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, man power, floats, etc , on sampling system were studied by repeated netting to reduce the sampling error. Estimates for mean values of length and weight from successive samples collected from different hauls did not differ significantly. The unbiased estimate of different variance calculated through subsampling was of maximum accuracy when compared against other sampling procedures. With a view to finding out the optimum sample size, the fishes were sampled from 10 to 25% of the total fish stock. Standard errors were calculated for sample means of different sample sizes which did not show any significant variation.

During the course of sampling, the hourly loss in weight of fish was observed which affected the estimated production by about 2.50% and 1.08% in summer and winter respectively.

Problem	:	1.38	(Research work suspended in 1977)
Problem	:	1.39	Effect of lime in pond soils
Personnel	:		D.K. Chatterjee and G.N. Saha
Duration	:		Four years

Calcium carbonate at higher rate showed maximum increase in soil pH (6.9) and available phosphorus (4 4 mg/100 g) 60 days after treatment compared to calcium oxide and calcium hydroxide when applied to slightly acid soil (pH 6.2) at 250, 500 and 1,000 kg/ha on equivalent calcium oxide basis.

In neutral soil (pH 7.0), all the liming materials effected a gradual fall in total alkalinity, according to the increased rate of treatment, the maximum being calcium hydroxide (96.0 ppm) followed by calcium oxide (102.1 ppm) and calcium carbonate (129 ppm).

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

Organic manures, namely, cow dung, mustard oilcake poultry manure and compost of water hyacinth and *Pistia* were applied in pond soils with low organic matters (0.45%) on equivalent carbon basis (300, 600 and 1,200 kg carbon/ha).

Cow dung maintained higher phosphate level in water while mohua oilcake maintained high nitrogen level. *Pistia* compost showed faster mineralisation and enriched the water with higher concentration of dissolved phosphates and nitrogen. Cow dung and water hyacinth compost gave maximum survival of fry at 1,200 kg C/ha (70 & 65% respectively).

Problem : 1.41 Effects 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

(No progress of work during the year due to technical difficulties)

Problem : 1.42 Statistical relationship between the inputs and fish production in composite fish culture

Personnel : M.G. Rout

Duration : Two years

Data on inputs and productions, collected from various experiments of composite fish culture showed that profit ratio to operating cost was maximum (173%) for the eastern region (West Bengal, Assam and Orissa) and minimum (83%) for western region (Maharashtra and Haryana). It was also revealed that the cost of production increases with increase in water area. A model of second degree polynominal has been tried to fit the data of variables *i*,e., fish production and inputs.

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

(No progress during the year due to technical difficulties)

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

Newly dug-out ponds (0.02 ha) at Dhauli with low nutrient status did not show much improvement in nutrient levels and biological production when treated with chemical fertilisers (N.P.K.) and organic manure (Cow dung) alone and in combination after three doses.

Problem	:	1.45	Culture of *Mystus seenghala* and *M. aor*
Personnel	:		V.R.P. Sinha and N.G.S. Rao
Duration	:		Two years (Work is being initiated)
Problem	:	1.46	Culture of tubificid and tendipedid worms
Personnel	:		K.L. Sehgal
Duration	:		Two years

Culture of tubificid, *Nais obtusa* and tendepedid, *Tendipes* sp. have been successfully done in stagnant water in rectangular glass jars of 0.65 m^2 area. Sterilised garden soil (4 cm thick layer) was spread at the bottom of each glass jar to help the worms in preparing tubes.

Nais obtusa yielded an average crop of 5,875 units from an initial inoculum of 250 units in a period of 13 days. The worms were maintained on emulsified Brewer's yeast. The artificial feeding was done on every alternate days @ 500 mg./1,000 units. The cultures were maintained at 20.5°—30.3°C.

Successful rearing of tendipedid, *Tendipes* sp., from larvae to the fly stage and subsequent egg-laying on used up X-ray film strips and sides of glass jars, hatching and emergence of fly occurred in the laboratory. The larval period was the longest (12—15 days) at 20.5°—27.2°C. The fly died immediately after egg-laying in a period of 24—32 hours. The ratio of male to female flies was 3:1. The eggs are laid in a saucer-shaped gelatinous mass. The average number of eggs ranged from 675—775 per gelatinous mass. At 25.5°—27.3°C, the period of incubation ranged from 20—27 hours, while percentage of hatching ranged between 50 and 60. The culture of tendipedids was maintained on 1—2% emulsified Brewer's yeast given on alternate days.

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

A total of 14 experiments, with major carp eggs, were conducted in the hatchery yielding about 2.7 million spawn. In all the cases, the glass jar hatchery showed relatively better hatching of eggs and survival of spawn than those of controls (cloth *hapas* fixed in ponds).

Besides the eggs of Indian major carps, 5 experiments were conducted with silver and grass carp eggs and a total of 0.675 million spawn were obtained.

Problem	: 2.5	(Research work suspended since 1973)
Problem	: 2.6	Production of multiple broods from the same individual of major carps in the course of one year

Personnel : R,M. Bhowmick, G.V. Kowtal, R.K. Jena and S D. Gupta

Duration : Six years six months

No progress of work due to technical difficulties.

Problem : 2.7 (Research work kept in abeyance)

Problem : 2.8 Induced breeding of important cultivated fishes (other than carps)

Personnel : R.M. Bhowmick, K.H. Ibrahim, G.V. Kowtal, R.K. Jena 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. Jena, S.D. Gupta and K.H. Ibrahim

Duration : Six years

Morpho-histological studies of ovary of *Labeo rohita* revealed that the ova in Stage-I were oval, transparent with a large nucleus and many nucleolii. They measured 0.145 mm on an average and were dominant during November and February. They underwent development during February– May and reached the Vth stage. The fully mature ova were spherical, fully yolk laden, translucent with a clear perivitelline space and had an average diameter of 0.956 mm.

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

Pituitary glands and gonads of common carp and Indian major carps have been collected at regular interval from ponds as well as riverine sources. Histological studies of these materials have been initiated.

Problem :	2.11	Effect of hormones, vitamins and feeds on the maturity of carps
Personnel :		S.D. Gupta, H.A. Khan and R.M. Bhowmick
Duration :		Four years

Two ponds of Kausalyagang were stocked with catla and rohu. The brood fishes were fed regularly with artificial feed consisting of ground-nut oilcake and rice bran @ 2–3% of the body weight. In one pond, along with the feed, Vitamin E (Ephynal tablets) was given @ 5 mg/kg weight of the stocked fishes. Fish from both ponds were successfully induced bred and spawn obtained. No conclusive evidence, showing the effect of Vitamin E on the maturity and spawning of these fishes could be drawn.

Consequent to induced breeding of Indian major carps, a total of 41.285 lakhs of spawn was produced at Killa Fish Farm.

Project 3 : Reservoir Fisheries

Problem :	3.1 to 3.5	(Research work completed in 1972)
Problem :	3 6	(Research work suspended in 1976)
Problem :	3.7	(Research work completed in 1970)
Problem :	3.8	Fisheries of Peninsular tanks: Introduction and propagation of less known cultivable species
Personnel :		B.V. Govind, P.K. Sukumaran and S.L. Raghavan
Duration :		Four years

Puntius pulchellus recorded an average weight increment of 1,101.81 g in the Vanivilassagar Fish Farm. The fish were stocked in the earlier part of the year. The follow up studies are in progress.

Problem	:	3.9	(Research work suspended since '976)
Problem	:	3.10	(Research work 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 and S.L. Raghavan
Duration	:		Three years

The second composite fish culture experiment in freshwater irrigational tanks was initiated in February, 1977 with the stocking of Indian and exotic carps in ASC (South) tank in Bangalore. Catla, rohu, mrigal, common carp, grass carp and silver carp were stocked at a combined density of 4,095/ha in a phased manner. No management measure other than manuring the pond with cow dung was adopted.

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 : Water temperature of the reservoir ranged between 17.5°C (January) and 31.0°C (May). Transparency indicated higher water clarity during winter (46.0 cm) and lower in winter and monsoon (11.0 cm). pH values fluctuated from 7.4 to 8.4. Alkalinity varied between 24.0 and 80.0 ppm, whereas hardness ranged between 12.0 and 40.0 ppm. Ca^{++} ion concentration showed an increasing trend from January to June (12.0—26.0 ppm) but declined in monsoon, increasing gradually thereafter. Nitrates (0.08—0.13 ppm) and phosphates (0.05—0.12 ppm) were poorly represented till June but showed a sharp increase during monsoon months and thereafter the values declined. Silicates, indicating a rising trend upto June (12.4 to 15.0 ppm) declined in monsoon (4.6—6.8 ppm) and remained steady there-

after. The DO values ranged between 4.6 and 8.4 ppm while the free CO_2 fluctuated in the range of 2.0 to 5.2 ppm. Gross production ranged between 62.5 and 150 mg $C/m^3/hr$ and net production ranged from 50.0 to 125.0 mg $C/m^3/hr$ while the respiration rate remained at 12.5 mg $C/m^3/hr$.

Plankton : The planktonic biomass ranged between 0.3 ml/m^3 and 2.14 ml/m^3 (245 to 4,060 u/l), the maximum being in June and minimum in November. Phytoplankton (56.7 to 99.2%) invariably dominated over zooplankton.

The phyto-and zooplankters were represented by the following genera.

Phytoplankton

Zygnema, Crucigenia, Ulothrix, Spirogyra, Scenedesmus, Pediastrum, Staurastrum, Microspora, Tetraspora, Cosmarium, Gonatozygon, Genicularia Microsterias, Navicula, Nitzschia, Synedra, Gomphonema, Diatoma, Achnathes, Gyrosigma, Cyclotella, Fragillaria, Oscillatoria, Microcystis, Merismopedia and *Chlrococcus.*

Zooplankton

Nauplii, *Cyclops, Diaptomus, Bosmina, Daphnia, Filinia, Keratella, Asplancha* and *Collothecca* sp.

Macrobenthic fauna : The bottom fauna represented by chironomid larvae, oligochaetes and Coleoptera larvae fluctuated within a range of 95 to 4.769 u/m^2, indicating a rising trend from winter to summer months. During monsoon months, the number varied between 150 and 283 u/m^2 and thereafter again showed a rising trend reaching 440 u/m^2 in November.

Observations on breeding of major carps : With the onset of monsoon, spawning grounds of major carps were located in the reservoir in the second week of July and some eggs were collected from the marginal shallow areas above the waste weir, near the confluence of Koilha nullah and the reservoir. Before and after the water attained full storage level at 390.0 MSL, a good number of hatchlings and approximately 10,000 fry of major carps were collected at the waste weir which comprised 70% *L. calbasu* and 30% *L. rohita*. The salvaged fry were reared and stocked into the reservoir.

Stocking : Fingerlings numbering 29,450 were stocked in Gulariya reservoir till 10th December, 1977. The stocking of the reservoir is being continued.

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	(Rresearch work suspended since 1972)
Problem	:	4.4	(Rresearch work completed in 1973)
Problem	:	4.5	Yearly variation in quality and quantity of spawn in rivers Ganga and Yamuna
Personnel	:		K.P. Srivastava, N.K. Srivastava, Shree Prakash and D.P. Verma
Duration	:		Four years

Mundhuka on the river Yamuna about 3 km upstream of Mahewapatti in the district of Allahabad was selected for detailed studies. Round the clock observations were recorded to assess the availability and abundance of fish spawn and the effects of various meteorological, hydrological & hydrobiological factors affecting the quality and quantity of spawn.

The observations commenced on 8th of July and lasted till 20th August. Three floods were observed in the river and a total of 13,010 ml (c. 65,05,000) of spawn was collected by operating five 1/8" mesh standard Midnapore type of shooting nets. The first, second, third fourth and fifth spurts yielded 190, 7,860, 935, 3,850 and 175 ml of spawn respectively, contributing 1.46, 60.42, 7.19, 29.59 and 1.34% in the seasons' total catch. The durations of the five spurts occuring between 15th and 16th July, 18th to 21st July, 26th to 28th July and 2nd to 6th August were 18,74, 60, 108 and 26 hours and the catch/net/hour was estimated to be 1.6, 21.2. 3.1, 7.1 and 1.3 ml respectively. Mandhuka centre was found to be more suitable than Mahewapatti as it yielded about 6 times more spawn.

Microscopic examination of the spawn samples of I, II, III, IV & V spurts revealed the average percentage of the desirable spawn to be 3.2, 5.7, 16.9, 43.6 and 75.0 respectively.

Spawn of different spurts were reared in *chetty pots* and plastic pools at the collection site and 1,800 ml of hatchlings were stocked for rearing

in the Naini Jail nursery pond. A total of 250 ml spawn was handed over for work under Project Problem 22.3.

The average major carp content in the pond was estimated to be 80% comprising *C. catla* 20%, *L. rohita* 10%, *C. mrigala* 50% and minor carps (*C, reba.*) 20%.

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 Experimental 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 in 1976)
Problem	:	5.13	(Research work completed in 1975)
Problem	:	5.14 to 5.16	(Research work completed in 1975)
Problem	:	5.17	Brackishwater prawn culture in Madras region
Personnel	:		K. Raman, and P.M.A. Kadir
Duration	:		Five years

In a field trial on the rearing of *P. indicus* (38 mm/0.3 g) stocked @ 20,000/ha in a 0.01 ha pond at Adyar fish farm, a production of 610 g could be obtained in six months. The production was adversely affected due to shallowness of the water which facilitated predation by birds.

in another experiment in a small pond (0.01 ha), *P. indicus* and *P. monodon* at a combined stocking density of 14,000/ha registered average increments of 95.7 mm/11.8 g and 130 mm/24.9 g respectively in 7 months.

Problem	: 5.18	Culture of the edible oyster in Pulicat lake
Personnel	:	K.V. Ramakrishna
Duration	:	Five years

Oysters kept on trays and asbestos sheets showed a height ranging from 45.0—100 mm and 40.0—85.0 mm respectively. Periodic observations of oyster trays for cleaning showed presence of forage fish in appreciable numbers.

Problem	: 5.19	(Work programme transferred to Problem 5.26)
Problem	: 5.20	(Research work completed in 1976)
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 and M. Kaliyamurthy
Duration	:	Five years

Mullet fry (21 mm/146 mg) at a stocking rate of 30,000/ha, showed an average increment of 63 mm/730 mg in 140 days without any artificial feed.

In nylon *hapa*, fixed in a stocking pond, mullet fry (13.95 mm/20.58 mg) showed an increment of 51.5 mm/371.8 mg in 76 days.

Mullet fry (23 mm/120 mg) reared in a plastic pool and fed with yeast showed an increment of 15.21 mm/638 mg in about one month.

Fingerlings of *L. macrolepis, L. parsia, M. cunnesius* and *E. vaigiensis* were stocked @ 30,000/ha in a 0.01 ha pond. The growth rates of *L. macrolepis* were 3.2 mm and 5.9 mm/month, *L. parsia* 1.6 mm/month, *M.*

cunnesius 7.0 and 3.8 mm/month and *E. vaigiensis* 10.8 and 41.1 mm/month with a combined 55.3% survival.

Experiment on culture of *Chanos* recorded an average increment of 83.8 mm/17.7 g in 7 months with a survival rate of 56.2%. In other two experiments, one without any artificial feed, an average increment of 162.1 mm/49.2 g with a survival rate of 69.2%was recorded and in the other with artificial feed (@ 10% body weight on alternate days', an average growth of 23.3 mm/3.67 g/month was recorded.

Of the six commercially important perches of the Pulicat lake cultured in plastic pools, two were also cultured in velon cages *(hapa)*. The growth rates exhib ted by the species are given below :

Species	Velon cage	Plastic pool	
	(mm/month)	(mm/month)	Survival (%)
Sillago sihama	—	4.1	53.3
Therapon jarbua	4.6	3.6	90.0
Gerres spp.	4.4	2.3	16.0
Etroplus suratensis	—	12.4	100.0
Tilapia mossambica (male)	—	10.0	100.0
Tilapia mossambica (female)	—	7.0	100.0

Whereas in a pond culture, *Sillago sihama* recorded a growth of 9.0 mm/month, *Therapon jarbua* 5.5 mm/month, and *Gerres* fingerlings 5.5-10.9 mm/month.

In another experiment, a production of 1,433.3 kg/ha/6½ months was obtained in mixed culture of *Chanos* & prawns, with 66.2 and 16.0% survival respectively.

Problem : 5.23 Experimental culture of brackishwater fish food organisms in the laboratory and field

Personnel : A.C. Nandy, A.N. Ghosh (upto February, 1977), S.K. Mazumder, R.K. Chakraborty and P.R. Das (on study leave)

Duration : Three years

Mass culture of *Navicula lenceolata* was carried out in glass jars using urea, single superphosphate and sodium silicate in the ratio of 100: 10: 5 as nutrients. The peak density (5 million cells/ml from an initial inoculam of 29,000/ml) was attained in 13 days. Laboratory and yard experiments were also conducted to raise stock of viable eggs of *Artemia salina*. Each female produced about 500 nauplii in batches (4-5) in a span of 20 days. The optimum salinity and temperature of ambient water for successful hatching of *Artemia* eggs of California type have been found to be 45 ppt and 26° ± 2°C respectively. Viability of sundried eggs, produced in the laboratory, has been found to be 100%.

Problem	:	5.24 (a)	Effect of hormones on the growth and photosynthetic behaviour of plankters
Personnel	:		R.K. Chakraborty, A.C. Nandy and S.K. Mazumder
Duration	:		Two years

Effect of indol acetic acid on the multiplication of *Navicula lanceolata* was studied. The multiplication of the species was observed to be 24 folds in 8 days and 52 folds in 17 days of inoculation in 1 mg IAA/L than the control.

Problem	:	5 25	(Research work suspended since 1975)
Problem	:	5.26	Transformation of nitrogen and phosphorus in water - logged saline soils relative to different grades of water salinity
Personnel	:		G.N. Chattopadhyay, A.N. Ghosh (upto February, 1977) and M.K. Mukhopadhyay
Duration	:		Three years

Investigation was carried out to study the nature of transformation of applied nitrogen in the form of ammonium nitrate under different water salinity regimes. The study showed a general trend of higher water salinities to maintain comparatively higher amounts of water soluble nitrogen which ranged from 1.3 to 10.4 ppm under trace to 3‰ water salinity levels within 30 days of incubation. In another study, amounts of water soluble

phosphorus, when added in the form of single superphosphate, were observed to be comparatively less under higher water salinities. While 3.0‰ water salinity level maintained 0.5 ppm of water soluble phosphorus at 24‰ water salinity regime, corresponding values of water soluble P were 0.1 ppm only. Concentrations of calcium ions were found to increase from 64.0 to 320.0 ppm with the increase in water salinity from 4.7 to 27.8‰ and this behaviour could be attributed to the low availability of phosphorus under higher water salinity regime.

Problem : 5.27 (Research work kept in abeyance since 1976)

Problem : 5.28 Behaviour of lake-mouth bar and its bearing on the fishery of lake Pulicat

Personnel : K. Raman, K.V. Ramakrishna, S. Radhakrishnan, K. O. Joseph, S. Srinivasagam and P.M. Abdul Kadir

Duration : Three years

Two minor connections with the sea were established to the north of the original lake mouth during the monsoon. Due to accretion from the southern side the mouth shifted northward.

Hydrobiological data collected from the sea, lake-mouth and a few centres inside the lake ranged as follows:

Parameters	*Sea*	*Lake-mouth*	*Other centres*
Water temp (°C)	27.0-33.0	24.5-36.0	25.0-36.8
Salinity (ppt)	30.0-36.0	22.0-43.0	1.0-59.0
D.O. (ppm)	6.4-12.8	4.0-13.6	5.2-13.2
Phosphate (ppm)	0.03-0.35	0.03-0.40	0.024-0.60
Silicate (ppm)	7.0-8.8	4.8-14.0	4.0-23.0
Transparency (cm)	—	8.0-70.0	10.0-40.0
Phytoplankton (no/haul)	—	45-120	37-120
Zooplankton (no/haul)	—	70-130	40-113

The total landing from the lake for the period was estimated at 1,019.246 t. Prawns were found to be the dominant group (41.56%) in the whole lake and the southern sector. Other groups in order of abundance

were mullets (22.13%), clupeids (15.02%), perches (7.15%), Beloniformes (3.58%), catfishes (2.89%), and crabs (2.68%).

Problem	:	5.29	(Research work completed in 1977)
Problem	:	5.30	(Research work kept in abeyance since 1976)
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
Duration	:		Three years

The dominant bottom macrophytes were *Cymodocea* sp. and *Halophila* sp., and their respective biomass ranged from 0.075-12.5 kg/m^2 and 0.05-0.6 kg/m^2. *Hypnea* sp. and *Chaetomorpha* sp. were available in the southern sector and their biomass ranged between 0.125 and 12.5 kg/m^2. Attempts were also made to culture *Hypnea* sp. in the lake water using rope method. In the experiment, six fragments of algae (weighing 2.0 g) registered an increase in weight by 19.0 g after 22 days on a coir rope (30.0 cm).

Periphyton consisted mostly of diatoms and their density on glass panels varied from 2,420—38,720 u/cm^2, on plastic sheets 4,840—89,540 u/cm^2, on asbestos 4,840—1,37,940 u/cm^2, and on wooden panels from 4,840—1.28, 260 u/cm^2.

In experiment using lab-lab powder, ground-nut oilcake and *Salicornia* sp. as fish feed, mullet fry registered an average increase in weight by 7.5 mg, 15.0 mg and 45.0 mg respectively in 20 days, while in 30 days average increments of 54 2 mg and 36.7 mg were observed with *Salicornia* sp. and ground-nut oilcake respectively.

In another experiment with bottom microphytes used as fish feed, mullet fry registered average increment in weight by 200.0 mg with *Hypnea* sp., 113.5 mg with *Halophila* sp., and 72 mg with *Chaetomorpha* sp.

Problem	: 5.32	Culture of edible portunid crabs
Personnel	:	S. Srinivasagam and K. Raman
Duration	:	Three years

While juveniles of *Thalamita crenata* (17—46 mm) reared in earthenware tubs registered an average growth of 4.06 mm/month, *Portunus pelagicus* reared together showed an average growth of 10.6 mm/month during a rearing period of 60 days.

In rearing experiment with three species combination (*Scylla serrata:* 40-60 mm, *P. pelagicus* : 48-87 mm, *T. crenata* : 17-46 mm), the crabs showed average gain in growth (per month) and survival rate of 9.3 mm & 33.3%, 10.2 mm & 33.3% and 3.5 mm & 100% respectively in 60 days.

In 60 days rearing in plastic cages, *Portunus pelagicus* (26—30 mm) registered an average growth rate of 12.66 mm/month with 66.6% survival. In another experiment the crab (33-48 mm), when reared in glass jars for 60 days, exhibited a growth rate of 11.68 mm per month with 80% survival. *S serrata* (40-60 mm) cultured in cages registered an average growth of 10.61 mm/month with 54 55% survival in 60 days.

Problem	: 5.33	Nursery management for the culture of *Eleutheronema tetradactylum*
Personnel	:	A.V.P. Rao (upto 14 9.77) A.N. Ghosh (upto February 1977) and P.K. Ghosh
Duration	:	Two years

Seed of *Eleutheronema tetradactylum* were usually available in plenty from the new moon phase of May, 1977 and continued to appear in sufficient numbers till late August.

Experiments on the culture of *E. tetradactylum* were conducted in two ponds of 0 02 ha each. The ponds were stocked @ 50,000 and 1,00,000 nos/ha ; the average size of stocking material being 10 mm. The growths obtained at the above stocking densities were 65.7 mm in 38 days and 84.2 mm in 55 days respecti.ely whereas the percentage of survival was 51 at the lower stocking density. The same could not be worked out due to inadvertent entry of *Lates calcarifer* into the pond with higher stocking density of fish.

The physico-chemical conditions were as under :

	Pond I		Pond II	
	Max.	Min.	Max.	Min.
Water temp. (°C)	36.6	22.3	36.6	23.5
Water depth (cm)	94.0	40.0	118.0	40.0
Salinity (‰.)	17.36	1.83	12.0	6.0
DO (ppm)	12.0	6.0	12.0	6.0

Studies on predator-prey relationship indicated that *E. tetradactylum* (TL 8 mm) ingested copepods of an average size of 0.73 mm whereas, at 12 mm length, copepods of 0.95 mm size were taken. In fishes of 45 to 89 mm average length, 73-132 numbers of post larvae of *Metapenaeus* sp. (measuring 5-6 mm) per fish were encountered. Polychaetes constituted the dominant item in this size group.

E. tetradactylum seed gradually started declining from August onwards and as such sufficient numbers for conducting investigations on cultural aspects could not be procured during rest of the period.

The species has been observed to be very sensitive to handling in-spite of great care, resulting in rapid and high mortality.

Problem : 5 34 Stock manipulation in polyculture of Indian and exotic carps, mullets, chanos & prawns in low saline ponds in the Sunderbans

Personnel : A.V.P Rao (upto 14.9.77), P.K. Ghosh (from 14.7.77), A.N. Ghosh (upto February, 1977), R.K. Banerjee (upto March, 1977), T. Rajyalakshmi (from 14.9.77), S.M. Pillai (from 26.9.77) and A.K. Roy

Duration : Two years six months

A 0.25 ha low saline rain-fed pond was stocked @ 8,000/ha with fingerlings of Indian major carps, catla, rohu and mrigal and exotic carps, *viz.*, common carp and silver carp, mullets *Liza tade, L. parsia, Mugil cephalus* ; milkfish *Chanos chanos* and prawn, *Penaeus monodon* during August-September, 1976 under the repeated stocking and harvesting programme for brackishwater fishes and prawns ; and single stocking and harvesting for freshwater fishes. The

species combination were : Indian and exotic carps — 65%, brackishwater fishes 25% and *P. manodon* 10%.

The pond was fertilised with urea @ 480 kg/ha, superphosphate @ 480 kg/ha and cow dung @ 5,000 kg/ha. Supplementary feeding with mustard oil cake and maize powder @ 1.0 to 1.5% of the body weight of the stocked fish, was resorted to during the course of experiment.

Plankton analysis revealed that phytoplankton ranged from 110 to 580 u/l and zooplankton ranged as 1,100 to 2,914 u/l with peaks during March and April for phyto- and February and July for zooplankton. Phytoplankters were principally represented by *Spirulina* sp., *Anabaena* sp., *Spirogyra* sp., *Ankistrodesmus* sp , and *Chlorella* sp., *etc.*, whereas zooplankters encountered were mysids, nauplii of copepods, Cladocera (*Moina* sp.) *etc.* The plankton volume ranged between 0.1 and 1.25 ml/l.

Final harvesting was done after treatment with mohua oil cake @ 200 ppm. The average size (length/weight) attained (initial sizes given in paranthesis) by various fishes and prawns after one year of rearing was : catla 304.6 mm/368.7 g (103.8 mm/12.46 g), rohu 272.9 mm/266.5 g (59.2 mm/3.0 g), mrigal 356.8 mm/295.0 g (58.1 mm/2.35 g), silver carp 348.4 mm/404.4 g (Gr. I : 166.2 mm/39.6 g) and (Gr. II : 240.7 mm/131,7 g,) common carp 344.2 mm/594.7 g (74.6 mm/7.50 g); *Mugil cephalus* 404.3 mm/809.2 g (181.2 mm/78.5 g), *Liza tade* 318.0 mm/245.2 g (197,9 mm/71.3 g), *L. parsia* 174.6 mm/47.6 g (37.5 mm/1.6 g), *Chanos chanos* 344.7 mm/286.7 g (183.4 mm/54.3 g) and *P. monodon* 198.0 mm, 74.6 g (77.6 mm/4.11 g).

An overall survival of 54.8% could be achieved. Cent percent survival of *Mugil cephalus* was an interesting feature of the experiment. *L. parsia* and *C. chanos* were found to have low survival rate with little contribution to the overall yield. Due to short term rearing, it was possible to recover 37.5% of *P. monodon*.

Turbid condition of water and wild breeding of common carp caused hindrance to achieve higher production. Though water hyacinth was introduced in the pond water to remove the egg masses of *C. carpio*, 33.5 kg common carp fry was harvested during the period under report.

Problem : 5.35 Culture of *Chanos chanos*

Personnel : P.K. Ghosh, T. Rajyalakshmi (from 14.9.77), A.K. Roy and M.K. Mukhopadhyay

Duration : Three years six months

Efforts were made to collect *Chanos chanos* fry and fingerlings from all possible sources at Kakdwip and Bakkhali area. However, the number of fry collected so far (April-June) was not sufficient for experimental purposes.

A consignment of 921 *Chanos* fry was received from State Fisheries Department, Government of Tamil Nadu in last week of June, of which 815 survived. These were in the average sizes of 38, 56 and 58 mm and three ponds (0.02 ha area each) were stocked @ 13,000, 16,000 and 12,000 fry/ha respectively. The growth and survival achieved after 100 days rearing were 126.8, 211.8 and 163.6 mm and 74.01, 3.9 and 42.2% respectively with fertilisation alone in the first pond and fertilisation+artificial feeding in the second and third ponds. The poor survival rate in the second pond might have been due to high stocking density.

In these experiments fertilisation with poultry manure @ 2,000 kg/ha and inorganic fertiliser @ 240 kg urea & superphosphate each per hectare was done. Feeding with maize powder and rice bran (1 : 1) @ 5% of body weight of stocked fish was also resorted.

Two ponds of 0.02 ha area each, were stocked with advanced fingerlings (163.6 mm/32.4 g) @ 2,500 and 3,000/ha. After 90 days of rearing, the average sizes of 233.0 mm/91.6 g and 183.6 mm/55.0 g in the first pond with fertilisation only and 179.2 mm/43.6 g and 224.8 mm/79.0 g with fertilisation+artificial feed in the second pond were obtained. The concentration of phyto—and zooplankton ranged between 100 & 400 and 500 & 1,300 u/l respectively. *Anabaena* sp., *Navicula* sp., *Nitzschia* sp., *Ankistrodesmus* sp., *Gyrosigma* sp., *Spirulina* sp., and *Oscillatoria* sp., etc., among the phytoplankters and copepods, nauplii, *Brachionus* sp., and *Keratella* sp., etc., among the zooplankters were the common forms observed.

The physico-chemical factors *viz.*, DO and salinity were observed to be between 6.4 and 12.8 ppm & 1.47 and 10.49‰ respectively. Estimated standing crops in the two ponds were 175 kg/ha and 155 kg/ha respectively during 190 days of rearing.

Problem : 5.36 Collection and rearing of *Penaeus monodon* seed for stocking and supply

Personnel : P.U. Verghese, P. Ravichandran (from 26.9.77) and H.C. Karmakar

Duration : Three years

Collections of *P. monodon* seed were made by operating shooting nets in the tidal estuary adjacent to the Kakdwip farm. The nets were operated during the spring tides when the velocity of the current was sufficient to keep the net in position. A total of 1,10,993 *P. monodon* post - larvae (10-15 mm) was segregated by employing 254.5 manhours, compared to the last years' collection of 48,450 nos/128.25 manhr.

The ingress of *P. monodon* postlarvae was at the peak during April (1,406.8) to May (1,344.1) and minimum in January (1.2). Observations made during this year confirmed the findings of the last year. During the peak period of abundance, the salinity of the water ranged from 14.83 to 19.5‰. With the onset of rain, the magnitude of availability of the post-larvae decreased and the salinity dropped to 1.11‰ during the first week of July. Though the saliny increased to 7.94‰ by the end of December, the catch per manhour remained low. During the peak period, the maximum catch/hour was observed at the time of spring tide associated with the new moon.

The postlarvae were reared under different salinity levels and temperature conditions. The stocking rate could be increased to 28.5 nos/l (28,500/m^3) with 85.5% survival upto 10 days at controlled salinity of 10-12‰ and temperature of 28° to 30°C. From the reared post-larvae, 1,500 were supplied to IDRC project at Hanspukur and 3,000 were supplied to Bakkhali Farm for rearing in low saline ponds.

Experiments on long distance transportation (16 to 48 hours) of the prawn seed under oxygen packing were conducted. In case of juveniles (20—25 mm), 16 to 45% mortality was encountered at a packing density of 40 to 200 nos/l. At 20 nos/l, 100% survival was observed. The mortality was mainly due to cannibalism. Further experiments are in progress.

Problem : 5.37 Crop rotation under prawn-cum-fish culture

Personnel : P.U. Verghese, T. Rajyalakshmi (from 14.9.77), P. Ravichandran (from 26.9.77) and H.C. Karmakar

Duration : Three years

Prawn-cum-fish culture experiments, with the objectives of raising three short-term crops from the same pond, were conducted in 4 ponds of 0.02 ha each. In monoculture, *P. monodon* (av. size. 20-40 mm) stocked @ 20,000/ha attained average size of 150-170 mm/28.8 g in 90 days resulting in a production of 304.8 kg/ha. The rate of survival was 54.5%. Subsequently during May-October, another crop of 209.5 kg/ha/180 days could be raised from the same pond. The rate of growth and survival of *P. monodon* in the second crop has been poor which may be attributed to the unstable ecology in the brackishwater ponds due to heavy rainfall, bringing down the salinity to almost near freshwater condition. The production from second crop in other ponds ranged from 95 0 to 263.7 kg/ha/200 days. The survival rate of *P. monodon* in these experiments varied from 1.2 to 31.6%. The lowest survival recorded from one of the ponds was due to accidental entry of *Lates calcarifer*.

Third stocking has been done at the rates of 20,000 to 25,000 nos/ha of *P. monodon* juveniles in the first week of November and the growth attained in 45 days ranged between 53.3 to 69.4 mm. The experiments are being continued.

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

Personnel : M.K. Mukhopadhyay, A.N. Ghosh (upto February, 1977), H.C. Karmakar and B. Basak

Duration : Two years

Culture of L. calcarifer : For stocking purpose the postlarvae of the species, appearing in the last week ef March in the Muriganga estuary adjacent to the Brackishwater Fish Farm, were collected by employing shooting nets and hapa nets and a total of 920 nos of fry in the size range of 4.5 to 25.0 mm were collected during April, May and June.

Two ponds of 0.02 ha area each were stocked with *L. calcarifer* fry (20-25 mm) @ 10,000/ha. In one of the ponds regular interchange of the tidal water was carried out, whereas the second pond was manured with organic

and inorganic fertilisers to encourage the growth of mysids. The rate of growth of *L. calcarifer* fry was 1.0 mm/day in the fertilised pond whereas in the ponds receiving tidal water, the growth was 1.6 mm/day. To minimise cannibalism, frequent netting was done and the bigger size groups were removed and stocked in separate ponds. Rates of survival in the above treatments were 86 and 90% respectively.

In yard experiments, the effect of food and apace on the growth and survival of *L. calcarifer* post-larvae was determined and best result obtained when the fry were fed @ 15% of the body weight and stocked @ 3 nos/l of water. Similarly the food intake, growth, food conversion efficiency in relation to different salinities have also been studied for the juveniles of the species. At 10‰ concentration, the food intake was observed to be maximum followed by maximum growth and highest conversion efficiency. Diurnal variation in the feeding of juveniles of *L. calcarifer* was also determined.

Under the principle of repeated stocking and partial harvesting, two sets of experiments were conducted. In one experiment, a 0.06 ha pond was stocked with 2 size groups of juveniles, (a) 255.77 mm/208.61 g, (b) 173.2 mm/71.42 g) at the rate of 2,500/ha. They attained average sizes of 317.77 mm/375.55 g and 251.45 mm/189.09 g respectively by August, 1977. The first size group from this rearing was separated and the remaining population grew to 268.4 mm/240.0 g by December.

The second experiment, was conducted in a 0 12 ha impoundment at a stocking density of 2,500/ha. The size groups stocked had average size of 315.1 mm/375.5 g an 251.95 mm/168.23 g. About 80.00 kg of *L. calcarifer* (446.72 mm/986.81 g) was harvested during June to August. The harvested stock was replaced by the smaller size group (average 317.65 mm/364.28 g) in the month of August. The final size attained by the three respective size groups were 572.50 mm/1,900 g, 442.00 mm/800.00 g and 340.72 mm/467.77 g in December, 1977. The estimated production was 2,670.00 kg/ha/yr.

Problem	: 5.39	Intensive culture of *Penaeus indicus* in association with other penaeid prawns
Personnel	:	N.K. Das, N.M. Chakrabarti and A.K. Roy
Duration	:	Three years

Four ponds of 0.02 ha each and one pond of 0.06 ha were utilised for short term and long term culture of estuarine prawns.

In short term culture, two experiments, each of 75 days duration, without artificial feeding, and another experiment of 120 days with provision of supplementary feeding, were carried out in ponds of 0.02 ha.

Prawns, *Penaeus indicus* (18-47 mm), *Palaemon styliferus* (19-30 mm), *Penaeus monodon* (12-39 mm), *Metapenaeus monoceros* (6-18 mm) and *M. brevicornis* (16-40 mm) were stocked at a combined stocking density of 2 lakhs/ha and the production achieved from 3 crops ranged from 660.0 kg/ha—850.0 kg/ha for prawn alone and 891 kg/ha, 997.0 kg/ha for prawn and fish in 270 days as against the targetted production of 400 kg/ha/yr for the year. Overall survival of prawns was 6%.

The growth of prawns, observed in 75 days of culture, ranged from 96 mm/7.0 g—140 mm/20.0 g for *P. indicus*, 62 mm/2 5 g—83 mm/3 5 g for *P. styliferus*, 120 mm/12.0 g - 140 mm/27.0 g for *p. monodon*, 93 mm/7.0 g—104 mm/8.0 g for *M. brevicornis* and 97 mm/7.0—135 mm/13.4 g for *M. monoceros* in the salinity, oxygen and temperature ranges of 9.23—18.07‰, 8.2—9 8 ppm and 24.3-33.1°C respectively.

No significant increase in growth was observed in the third experiment of longer duration (120 days) even with provision of wheat powder @ 5% body weight of the prawns since the average salinity was observed to be very low (2.92‰).

Long term culture experiments on the principle of multiple stocking and partial harvesting (ponds of 0.02 ha and 0.06 ha) and single stocking and partial harvesting (pond of 0 02 ha) were carried out. *P. indicus* (23—27 mm), *P. styliferus* (19 —23 mm), *M. monoceros* (17— 31 mm), *M. brevicornis* (18—21 mm) and *P. monodon* (30—70 mm) were stocked at a combined stocking density of 4 lakhs/ha.

The production achieved from first method of culture ranged from 333 3— 365.0 kg/ha/270 days for prawn alone and 420.5— 519.95 kg/ha for prawn and fish in the same period of culture.

In the second method of culture, the yield was 237.0 kg/ha for prawn alone and 344.25 kg/ha for prawn and fish in the same culture period of 270 days.

The bottom fauna available in the ponds were gammarids (162.95- 859 25

nos/m^2), tanaids (111.10-3762.91 nos/m^2) and polychaetes (103.69—333.25 nos/m^2) in temperature, salinity, and oxygen conditions of 24.3°-33.1°C, 9.23-18.07‰ and 8.2-9.8 ppm respectively.

A statistically designed experiment was carried out in laboratory on *P. indicus* (size range 30-33 mm) to test the response of the species to artificial feeds. Prawn meal alone, prawn meal+maize powder (1:1), prawn meal+wheat powder (1:1) and wheat powder+maize powder (1:1) were fed at 5%, 10%, 15%, and 20% level of body weight for a period of 8 weeks. Prawn meal+maize powder gave the best result at 10% level of application with 90% survival.

Problem :	5 40	Stock manipulation in intensive farming for mullets in monoculture and in association with penaeid prawn
Personnel :		N M. Chakrabarti, N.K. Das and H.C. Karmakar
Duration :		Three years

In three ponds (0.02 ha each) *Liza parsia* fry, stkocked @ 1,25,000; 2,50,000 and 5,00,000 nos/ha to rear upto stockable sizes without supplementary feeding, attained an average size of 44.32 mm (initial average size 29.12 mm), 49 88 mm (initial average size 25 73 mm) and 52.29 mm (average size 18.93 mm) in a period of 45 days with survival rates of 53.68, 45.47 and 41.79% respectively.

Mixed culture of *Liza tade* and *Penaeus monodon* was taken up in two ponds of 0.08 ha and 0.12 ha. In 0.08 ha pond, stocked with *L. tade* and *P. monodon* (average size of 223 33 mm/117.36 g and 105 65 mm/10 69 g respectively) at a combined stocking density of 7,450 nos/ha, *L. tade* and *P. monodon* attained the average sizes of 313.9 mm/357.5 g and 158.2 mm/39.5 g with a survival of 90 and 54.2% respectively in 270 days. A smaller group of *L. tade* (average size 116 6 mm/15.7 g) was also introduced in the pond which attained 222.8 mm/103.9 g in 180 days.

Chanos chanos fry stocked @ 500 nos/ha (average size 132.0 mm/16.0 g) attained 186.2 mm/58.8 g in 60 days. A total production of 2,049.5 kg/ha/yr of mullets, *Chanos* and penaeid prawns could be achieved from the pond. The other pond of 0.12 ha was stocked with fry of *L. parsia* (av. size 31.5

mm) and *P. monodon* (av. size 17.3 mm) @ 50,000 nos/ha and in 200 days, the average sizes attained by *L. parsia* was 122.5 mm/19.0 g and *P. monodon* 132.7 mm/27.5 g. In addition to the mullets and prawn, fry of *Chanos chanos* was introduced in the pond @ 500 nos/ha (av initial size : 126.8mm/15.1 g) They attained the size of 187.8 mm/60.0 g in a culture period of 60 days. The standing crop was estimated to be 1,825 kg/ha/yr.

The range of physico-chemical factors was : water temperature—24.2°—35.0°C ; water depth—65.5 to 115 cm ; salinity: 8.33—15.19‰ ; DO : 7.6—12 2 ppm ; alkalinity: 64.170 ppm ; pH: 8.9—9.2 and turibidity: 155—340 mm

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 : H.C. Karmakar, T. Rajayalakshmi (from 14.9.77), G.N. Chattopadhyay, M.K. Mukhopadhyay and P.K. Ghosh

Duration : Three years

A total of 30,405 fry of *L. parsia* was collected by scoop net by spending 136.5 manhour and the average month-wise collection were : 191.5 nos/man/hour in January ; 292.1 nos/man/hour in February ; 326.7 nos/man/hour in March ; 320.8 nos/man/hour in April ; 203.5 nos/man/hour in May ; 78.4 nos/man/hour in June.

A total of 4,82,715 nos of commercially important fish and prawn seed was collected by shooting net spending 262.00 manhour from river Muriganga. Statistical analysis made separately with the catch (nos) per net per hour of commercially important fish and prawn ; viz., *P. monodon* ; *P. indicus* ; mullets ; and *E. tetradactylum* indicated that the total collection did not differ significantly in different months. High tide collection was found to be significantly different at 5% level and better than the low tide collection.

Collection of *P. monodon* seed was found to be equally better in the month of April, May and June and the same significantly differed from other monthly collections at 1% level. Collection of *P. monodon* during high

tide was also found better and significantly different than that of low tide af 5% level.

Collection of *P. indicus* seed was found equaliy better in the month of February, March, April, June, Jnly, October and November and sigificantly different than other months at 5% level. High tide catch of the species was found better than low tide catch (at 1% level).

L. parsia and *L. tade* fry were available during December—May and June—October respectively, and no significant difference was observed between the period, of their availability.

March and August were found to be the best periods for collection of *E. tetradactylum* fry which significantly differed from other months at 5% level.

Relative catch efficiency of three types of shooting nets having different diameter of the mouth (1st net : 3.5 m ; 2nd net : 3.0 m; and 3rd net : 2.5 m) was studied. It was found that the catching efficiency was better in the 1st & the 2nd net than that of the 3rd net at 1% level.

Three ponds (0.02 ha each) fertilised with cow dung @ 1,000 kg/ha and superphosphate+urea (1:1) @ 500 kg/ha were stocked with *L. parsia* fry @ 1,25,000, 2,50,000 and 5,00,000/ha and reared upto stockable size. The survival rates were found to be 53.68, 45.44 and 41.79% respectively after 45 days.

Problem :	5.42	Specified protein levels in supplementary feeds for enhancing growth of brackishwater fishes and prawns
Personnel :		B.B. Pakrasi and S C. Banerjee
Duration :		Two years

Experiments on specified protein level in supplementary feeds for enhancing growth of brackishwater fish and prawns showed that *P. monodon* (30-40 mm) attained an average length/weight of 4.0 mm/0.3 g in one month when fed on pelleted feeds containing 25% animal protein. When fed on soyabean powder having 25% vegetable protein average growth of 15.0 mm/0.32 g was achieved in the same period. The experiment will be continued for a further period of 2 years to standardise feeds prepared from various protein source.

Problem : 5.43 (Work programme transferred to project 20.3)

Problem : 5.44 Role of trace elements in the mineralisation of organic nitrogen

Personnel : S.C. Banerjee, R.K. Banerjee and B.R. Dutta (upto May 1977)

Duration : Two years

Investigations on the effect of trace elements on the mineralisation of organic matters were conducted using cotton seed oilcake and mahua oilcake as organic substrates. Mineralisation of organic nitrogen was more effective when treated with molybdenum than with cobalt. The release of nitrogen was 28·0 & 65.3 ppm in saline water (15—20‰ salinity) and 24.1 & 57.1 ppm in freshwater (NH_3—N level) with cobalt and molybdenum respectively. It was observed that the nitrogen release was higher in slightly acidic water (pH 6.7—6.9) as compared to alkaline water (pH 7.3—7.5).

Problem : 5.45 Nutrient status of brackishwater ponds in Madras region

Personnel : K.O. Joseph, K. Raman, S. Radhakrishnan and P.M. Abdul Kader

Duration : Three years

The physico—chemical characteristics of Adyar and Pulicat lakes were as follows :

Parameters		Adyar	Pulicat
WATER			
Dissolved oxygen	(ppm)	5.6—10.8	7.6—9.6
Salinity	(ppt)	33.0—42.0	3 0—47.0
Transparency	(cm)	10.0—25.0	10 5—27.0
Water temperature	(°C)	27.5—34.1	26.3—33 0
Free CO_2	(ppm)	nil—1.4	nil—1.2
Total alkalinity	(ppm)	160.0—210.0	130.0—210 0
Phosphate	(ppm)	0.09 · 0.82	0.02—0.8
Silicate	(ppm)	18.0—32.0	8.0—21.0
pH		8.0—8.6	8.2—8.5
SOIL			
Available phosphate	(ppm)	2.5—6.5	2.0—5.9
pH		8.1—8.35	8.35—8.45

Trace elements like Mn, Co and B in higher doses resulted in maximum survival and maximum average increase in length and weight of mullet fry. But Zn in lower dose gave maximum survival and average increase in length and weight of mullet fry when compared to control (basal treatment of cow dung and urea only).

Problem :	5.46	Floculating colloidal soil suspensions in impounded waters of low salinity
Personnel :		R.K. Banerjee, B.B. Pakrasi, A.V.P. Rao and S.C. Banerjee
Duration :		Three years

Experiments were conducted with compost alone @ 15,000 kg/ha, compost @ 15,000 kg/ha+5 Kg N as urea+5 Kg P as superphosphate, N+P+K @ 500 kg/ha and saline water just to raise the sp. conductivity by 2 to 3 mhos/cm, in nursery ponds of 0.02 ha area, with an average annual water level of 40 to 100 cm.

The typical natural condition hinders in evaluating the efficacy of any of the treatments in floculating the suspensoids and none could control the turbidity permanently. The huge amount of silt carried in by the wind covered the organic matter added and the rain water lowered the conductivity which caused the turbidity to develop.

Problem :	5.47	Acceleration of the rate of mineralisation of organic reference by microbe inoculation
Personnel :		R.K. Banerjee, B.R. Dutta (upto May, 1977) and N.N. Majumder
Duration :		Three years

Straw and *Eichhornea* pieces, 20—25 mm size, of C/N ratio 43 and 30 respectively, were compost separately in wooden boxes (55×35×35 cm). Initially straw was mixed with sewage sludge of C/N ratio 4 in requisite proportion to reduce its C/N ratio to 30.

Strains of cellulose decomposing micro-organisms (*Aspergillus* sp. @ 1%) was inoculated to accelarate the decomposition rate. The moisture content was maintained between 57 and 69%.

At the end of 60 days the C/N ratio of straw came down to 19.6 and that of *Eichhornea* to 8.7. It was calculated that in 60 days the microbes could bring about 26% more decomposition over the control.

Problem :	5.48	Ablation of eye-stalk of female penaeid prawns for induced maturation
Personnel :		B.B. Pakrasi and B.R. Dutta (upto May 1977)
Duration :		Three years

Experiment on eye ablation of female penaeid prawn, for induced maturation, were carried out in split bamboo cages in brackishwater impoundments at Taldi. Ecdysis of the ablated prawns was rapid. The prawns were transferred from the original pond as the water was polluted because of large scale decomposition of weeds. All of them died due to change of environment. The programme has been merged with project 5.57.

Problem :	5.49	Evaluation of different supplementary feeds used in mullet farming
Personnel :		A.K. Roy, T. Rajyalakshmi (from 14.9.77), N.M. Chakrabarti and and G.N. Chattopadhyay
Duration :		Three years

To find out the effects of artificial feeding on growth and survival of *L. tade* (39.29 mm/1.37 g) at nursery stage, experiments were conducted in 4 ponds (0.02 ha each) with a stocking density of 36,250/ha for 74 days. Artificial feed @ 6% of body weight of fry was given in 3 ponds in varying proportions of carbohydrate, protein and fat. One pond was kept as control.

Another experiment was conducted with *L. tade* (60 mm and above) at a stocking density of 10,000/ha and feed was given @ 5% of body weight for 55 days. Feed containing fish meal : wheat powder (1:2) showed better growth with an average increment of 5.87 g. Artificial feeding of the fish in nursery and production ponds indicated better growth and survival compared to the control.

An experiment based on the principle of randomised complete block

design was laid out in the laboratory and conducted for 22 days with six feed mixtures having varying protein, carbohydrate and fat contents, to assess the relative efficiency of the feed mixtures on growth and survival of *L. tade* fry. Statistical analysis of results showed that feed containing fish meal alone, differs significantly at 5% level of significance than other treatments indicating maximum growth. However, the feed containing fish meal : rice bran in equal proportion showed best survival (92%).

In another experiment carried out in plastic pools, *L. tade* fry recorded maximum survival of 51.6% when fed with wheat powder : rice bran (2:1)

Qualitative and quantitative analyses of plankton indicated significant differences of zooplankton and phytoplankton in different months. Concentration of phytoplankton was maximum in October and minimum in August, while maximum and minimum zooplankton concentration was observed in September and July respectively.

The range of salinity, DO and pH were observed to be 8.0—12.0 ppt, 2.91—9.05 ppm and 7.6—9.2 respectively.

Problem	: 5.50	Location, collection, and acclimatisation of fingerlings of cultivable fish species
Personnel	:	G.R.M. Rao and R.D. Prasadam
Duration	:	Three years

A total of 261 fingerlings of *Chanos* were collected with a commercial drag net *(Konda vala)* from Kovalam. During the first week of December, 150 juveniles of *Mystus gulio* (45.0 mm/1.0 g) were collected with velon net from the mouth region of Ennore back-waters.

Problem	: 5.51	Studies on the ecology of commercial brackishwater bheries of variant productivity
Personnel	:	B.B. Pakrasi, N.C. Basu and B.R. Dutta (upto May, 1977)
Duration	:	Three years

Experiments in 5 commercial brackishwater *bheries*, 2. at Porer Dhapa and 2 at Bauchandi (C 15 ha) and one at Taldi (C 20 ha). The brackishwater *bheries* at Porer Dhapa & Bauchandi are replenished by tide water mixed

with supernatant municipal effluents whereas, the bheries at Taldi was filled up only with tide water. The bheries at northern zone showed productivity range of 128.1 to 422.0 mg C/m^3/hr and in southern zone 291.2—626 mg C/m^3/hr. Salinity range in the northern region was 1.04—10.3‰ and in the southern zone was 4.03—9.5‰. pH varied from 7.3 to 8.2 and 8.1 to 8.5 in northern and southern zones respectively.

Project 6 : Freshwater Prawn Culture

Problem	: 6 1	(Research work completed in 1976)
Problem	: 6.2	Culture of *Macrobrachium malcolmsonii*
Personnel	:	K V. Rao, T.S R. Raju, K.S Rao, D.R Rao and P.S.C. Bose
Duration	:	Three years

Experiments on the culture of *Macrobrachium malcolmsonii* in the four ponds at Badampudi fish farm in West Godavari District of Andhra Pradesh were continued

Regular monthly manuring of the ponds with cattle dung @ 5,000 kg/ha, after having given half of the total requirement as initial dose during November, 1976, was done. Besides, urea @ 75 kg/ha was given every month alternating with cattle dung application Liming was done @ 75 kg/ha, after an initial dose of 200 kg/ha, during November, 1976. While the fish were fed with rice bran, groundnut oilcake and fish meal in the ratio of 10:10:1 and @ 2% of the body weight, grass carp was supplied with the aquatic weed, *Hydrilla*, @ 20% of body weight The same feed was given to prawns @ 10% of body weight. In pond IV, branches and twigs of trees were placed for the prawns to settle on them, thereby reducing the congestion at the bottom. Shelters for the moulted prawns were provided in the form of small brick houses and shrubs planted at different places in each pond

In general, the plankton production was higher during the months of January and May 1977. The quantity of plankton was less than 0.5 ml/50 l during all the months under observation and in all the ponds excepting that 0.8 ml/50 l recorded in pond IV at 16 00 hrs on 19.1.77 and 0.9 ml/50 l in pond III at 10.00 hrs on 2.2.77. The number of plankters per litre

ranged from 20.88—6,291.00 in pond I, 742.86—6,047.00 in pond II, 427.52—2,977.00 in pond III and 200.74—7,494.00 in pond IV during January to May, 1977. Phytoplankton dominated over the zooplankton during all the months in all the ponds. The zooplankton was mainly represented by nauplii ot copepods, *Cyclops* sp., *Diaptomus* sp., cladocerans *(Daphnia* sp. and *Bosmina* sp.) ; rotifers *(Keratella* sp., *Brachionus* sp., *Noteus* sp., *Triarthra* sp., *Polyarthra* sp. and *Filinia* sp.) and water mites. Euglenoids were the dominant constituents of phytoplankton causing blooms of varied magnitudes throughout the period in all the ponds. Besides, *Oscillatoria* sp. *Pediastrum* sp. and *Cosmerium* sp. were frequently recorded.

Dissolved oxygen ranged from 6.6—9.9 ppm being higher during winter months. The average primary production was the maximum during February to April (1,375—2,875 mg C/m^3/6 hr).

The details of the growth of different species of fish taken up under mixed culture with prawns during different month as revealed in the monthly sampling of the stocks are presented in Table— 3

The growth of *Macrobrachium malcolmsonii* ni different ponds during a period of five months by the beginning of the second week of May is presented below :

Pond No.	Av. total length (mm)	Av. wt. (g)	Per hectare production (Kg)	Survival (%)
I	103.9	15.5	38.5	3.69
II	103.5	19.3	208.9	19 02
III	102.4	19.9	168.4	14.6
Iv	92.4	11.3	58.1	14.3

The investigations are being continued.

Problem : 6.3 (Work programme transferred to project programme 14.1)

Problem : 6.4 To study the biology and production of prawn in the lower stretch of the Ganga

Personnel : J. C. Malhotra, Shree Prakash, K. Chandra and D. P. Verma

Duration : Three years

Table 3— Stocking and harvesting details of fish in ponds in mixed culture of prawns and fishes

Pond No.	CATLA				SILVER CARP				GRASS CARP			
	At the time of stocking		At the time of harvesting		At the time of stocking		At the time of harvesting		At the time of stocking		At the time of harvesting	
	Lenght (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
I	101.1	13.3	290.0	300.0	90.0	6.7	301.1	294.0	114.5	13.5	378.0	712.0
Survival			20.0%				100 /.				91.4%	
II	101.1	13.3	201.3	123.0	90.0	6.7	241.5	144.9	114.5	13.5	375.5	802.0
Survival			47.6%				97.1%				61.9%	
III	77.5	2.8	209.3	132.5	85.9	5.6	245.6	193.4	100.5	9.7	369.0	686.0
Survival			87.8 /.				63 4				100%	

An estimated total production of 5.37 t of prawns was recorded from Bhagalpur and Lalgola centres in which large sized prawns contributed 9.68%. The total prawn production showed an increase by 52.56% over that of the last year.

Six species of prawns, five belonging to the genus *Macrobrachium* and one to the genus *Caridina*, have so far been collected from Bhagalpur, Sahibganj, Rajmahal, Farakka and Dhulian regions. Three large sized berried live female prawns were procured and bred successfully under laboratory conditions. Larvae released by the species survived upto 8, 9 and 14 days respectively after which total mortality occured. The causes of mortality could not be ascertained immediately and are being looked into.

Problem	: 6.5	Culture of *Macrobrachium birmanicum choprai* in ponds
Personnel	:	Shree Prakash and D.P. Verma
Duration	:	Five years

Post larvae of *Macrobrachium birmanicum choprai* stocked in August 1976 were reared till March, 1977 during which period they attained an average size of 72 mm. However, there was total mortality probably due to high temperature, low water level, high turbidity, low plankton productivity and cannibalism.

To begin the experiments afresh during the next season, the pond was dried and 30 cm thick layer of earth from the bottom of the pond was removed in order to reduce turbidity thus increasing plankton production. Lime (25 kg) was applied immediately after the pond was filled up *i.e.*, 15 days before stocking. Due to non-availability of berried females of *M. birmanicum choprai* in and around Buxar, they were procured from Sinkaghat (Arrah), about 50 km downstream of Buxar, 54 berried famales were transported during a period of 9 days, of these only 21 could survive and were stocked in the pond. The stocking was done with a mixture of mohua oilcake and rice polish in the ratio of 1:2 and @ 10% of body weight. The hatching was successful and the survival was satisfactory. The pond (area 15×10 m) was stocked with an estimated number of 20,000 hatchlings, laid by 20 berried females of *M. birmanicum choprai* having an average fecundity of 10,000.

The growing juveniles attained an average size of 66 mm (av. wt. 1.65 g) during a period of 125 days. Feeding of the juveniles is being continued @ 10% of body weight. Liming of the pond is being done at monthly intervals @ 350 kg/ha. *Microcystis* sp. bloom was checked by stopping supplementary feeding, using liquid cow dung/5 ppm $CuSO_4$ solution. The management procedure increased transparency of pond water from 4—5 cm to 57—58 cm and plankton productivity to 3,839 u/l.

The physico—chemical factors ranged as : temperature 19°—34°C, DO 8—10 ppm, total alkalinity 320—340 ppm and free CO_2 nil to traces, transparency 11.5 to 17.5 cm and hardness 25-30 ppm

Breeding experiments—The breeding of *M. birmanicum choprai* in captivity was done successfully with 3 pairs. All the females died after laying the eggs. The probable cause for the same could be low oxygen content, some toxic effect of the water medium and heavy exertion by the males. Moulting took place before copulation in all these cases.

The culture experiment is continuing.

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

A total of 2,588 seed of *Macrobrachium rosenbergii* was produced from the 1st generation and 2nd generation adults. Most of the seed were produced in 4′×2′ F.R.P. tanks.

Two ponds (0.02 ha each) were stocked with second generation seed at Freshwater Fish Farm, Balabhadrapuram (A.P.). Before stocking, each pond was fertilised with 480 kg dried cattle shed manure and lime.

In one pond (stocking rates 15,950/ha) pieces of *Pila* foot, broken rice & tapioca were supplied daily in the afternoon @ 500—1,000 g. The gross and net productions of prawn were 11.554 g. (577.7 kg/ha) and 9.594 kg (479.7 kg/ha) with 89% survival. The coefficient of the body weight gain was 1 : 9.57.

In the other pond the prawn seed were stocked @ 15,150/ha and fed mainly on vegetarian diet (coconut oilcake, broken rice, tapioca and sweet potato)

at the above rate. The gross and net productions of 12.041 kg (606.05 kg/ha) and 11.211 kg (560.55 kg/ha) were obtained with 81.12% survival after $4\frac{1}{2}$ months. The coefficient of the body weight gain was 1:10.09.

In laboratory and yard experiments, *Chlorella*, diatoms (*Navicula, Cyclotella, Gyrosigma, Chaetoceros*, etc.) and zooplankters (rotifers like *Brachionus* and copepods) were cultured in 30-40% aged sea-water, using inorganic nutrients (potassium nitrate potassium dihydrogen phosphate, sodium silicate in the ratio of 100:10:5 and Titriplex III), fertilisers (ammonium sulphate, single superphosphate and potash) and organic wastes (straw, paddy husk and oilcakes) in order to develop a simple and economic method for the culture of food organisms. Natural inoculum present in seawater or derived from brackishwater was used.

Mass culture of *Chlorella, Chaetoceros* and rotifers was achieved in cement tubs of 70 to 100 litres capacity using 20–30% seawater enriched with inorganic nutrients (potassium nitrate, potassium dihydrogen phosphate, sodium silicate in the ratio of 7:2:5+Titriplex III 0.05 ml/l). The cultures developed (*Chlorella* and *Chaetoceros* 225×10^3/l and rotifers--1500/l) in about 2 weeks with the application of straw extract, fertilisers (Urea, ammonium phosphate at 200 ppm) and oilcakes (groundnut or coconut oilcake at 5 to 10 ppm). In another trial *Chaetoceros* and rotifers developed in about 4 weeks with the application of urea, ammonium phosphate (93 ppm), single superphosphate (1,000 ppm), Potash (77 ppm) and straw extract.

In plastic tub (30 l capacity) 500—1,000 freshly hatched zoeae of *M. rosenbergii* when fed with *Chlorella, Chaetoceros* and rotifers survived upto 10–15 days.

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 : 8.1 Brackishwater fish and prawn seed prospecting of the Hooghly-Matlah estuarine system

Personnel : K.K. Bhanot, D.K. De, P.B. Das, R.N. De. N.D. Sarkar, B.K. Saha, A.R. Paul, S.P. Ghosh and N.C Mondal

Duration : Ten years

Studies on the abundance and procurement of brackishwater fish and prawn seed resources in the estuarine complex of the Lower Sunderbans were carried out. The observations were made with a modified type of standard spawn collection net, both during high and low tides, fortnightly and on the day of highest spring tide. Two observation sites, one each at Itindaghat and Hasnabad on river Ichhamoti, were established. The other sites consisted of Kakdwip, Port Canning and Raidighi.

Ichhamati Estuary :

Studies conducted in a part of this estuary have revealed that a variety of prawn species exist e.g., *Penaeus monodon, P. indicus, Metapenaeus brevicornis, M. monoceros, Macrobrachium rude, M. mirabilis, Palaemon fluminicola* etc. *P. monodon* was obtained only during May and June while *M mirabilis* and *P. fluminicola* were absent during the same period. *M. monoceros* was not available during September and October. The rest of the species were encountered from both the centres in varying concentrations throughout the year. Fish seed, represented by *Eleutheronema tetradactylum* and *Liza parsia,* was obtained in negligible number during May and June respectively.

Thakuran Estuary :

The fish seed resources around Raidighi were studied which indicated a mixed quality being represented chiefly by *Palaemon styliferus. Parapenaeopsis sculptilis, Penaeus monodon, Macrobrachium rude,* etc. amongst prawns and sciaenids, *Mugil cephalus, Ilisha elongata, Mystus gulio, E. tetradactylum* etc. amongst fishes.

Matlah estuary :

The common species obtained were *M. rude, M. brevicornis, P. indicus P. monodon L. parsia, Plotosus canius, M. gulio, S. argus* and *E. tetradactylum.*

Hooghly estuary :

Seed prospecting work was carried out around Kakdwip. The species

were represented principally by mullets, *E. tetradactylum*, *Sciaena miles*, *Elops sourus* and all commercially important prawns.

The peak periods of abundance of prawn and fish seed of different centres (Thakuran, Matlah and Hooghly estuary) are given in the following table :

Table 4 : Estuary-wise peak abundance (per net/hr)

Species	Thakuran	Matlah	Hooghly
Penaeus monodon	June—660	July—113	June—850
P. indicus	June—150	July—121	July — 92
Metapenaeus brevicornis	May—284	October 145	June—116
Palaemon styliferus	April—408	—	October 215
Parapenaeopsis sculptilis	May—1,400	—	—
Liza parsia	April—75	March—19	March—293
L. tade	—	—	August—316
Mugil cephalus	June—96	—	—
M. cunnesuis	July—35	—	—
Polynemus pardiseus	July—224	—	—
Elutheronema tetradactylum	—	August—174	July—163

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

Specimens of adult *Sillago panijus*, *Scatophagus argus* and *Glossogobius giuris* were collected from Port Canning, Kakdwip and Barrackpore to study the various developmental stages of the gonads in varying salinities. Female *S. panijus* was obtained upto 5–6 stages of egg maturation around Kakdwip during January, May and August. *G. giuris* was found upto 5—6 stages from all the three places during April, May and August. Mature specimens

of *S. argus* could not be obtained. The larvae of these species were collected and their abundance were : *S. argus*—Kakdwip (June) and Port Canning (July/August) ; *G. giuris*—Port Canning (July) and Raidighi (August, October and November) ; *S. panijus*—Raidighi (July/August).

Problem : 8—8.10 (Research work kept in abeyance)

Project 9 : Selective breeding and Hybridisation

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	Selective breeding and hybridisation of carps and other cultivated fishes with special reference to cytogenetical features of the hybrids
Personnel	:		R.M. Bhowmick, R.K. Jena and S.D. Gupta
Duration	:		Six years

Catla-rohu hybrids attained first maturity in three years and one set of these hybrids was induced bred. No stripping was necessary. Rearing of F_2 generation offsprings is in progress.

Rohu-calbasu hybrids produced in 1976, were stocked in a pond. An average size of 115 mm/17.3 g of hybrid fish was recorded in 210 days. Studies on the maturity of catla-rohu hybrid (F_1) and production of F_2 generation are in progress.

Problem	:	9.5	Studies on maturity of Catla-rohu hybrid (F_1) and production of F_2 generation
Personnel	:		R.K. Jena, H.A. Khan and K.H. Ibrahim
Duration	:		Three years

The matured catla-rohu (F_1) hybrid was injected with carp pituitary gland extract and yielded 0.75 lakh of spawn. 4-day-old (F_2) spawn were stocked in 0.04 ha pond for raising fry and fingerlings. The F_2 offsprings have grown to an average size of 137 mm/26 g after 98 days of rearing. The problem has been merged with the 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. Khan
Duration :	Three years

A stock of brood fishes of Indian major carps is being raised. Further work will be taken up during the next breeding season.

Problem : 9.7	Breeding of selected stock of grass carp and silver carp
Personnel :	S.N. Singh & R.K. Dey
Duration :	Five years

Tagging of the induced bred females of grass carp and silver carp has been done and the stocks are being maintained for observations during the next fish breeding season. Use of tertiary amyl alcohol as anaesthetic was tried at the time of stripping and tagging the brood fishes. Studies on 'shoot carps' obtained from induced-bred progeny of 1977 are being continued. Along with above studies, hybridisation between grass carp female and silver carp male was successfully done and the viable progeny produced is being reared in glass jars, plastic pools, nursery and rearing ponds. Active feeding by the hybrids (as small as 20 mm) on *Wolffia* and mosquito larvae was interesting to note. Another hybrid between silver carp female and catla male was produced and the only surviving specimen is being reared in a plastic pool.

Problem : 9.8	Hybridisation between *Labeo rohita* X *Cyprinus carpio* and *C. catla* X *Hypophthalmichthys molitrix*
Personnel :	K.H. Ibrahim and G.V. Kowtal
Duration :	Four years

Rohu x common carp and catla x silver carp hybrids were produced. Among both hybrids, during embryonic and larval phase, large scale mortality was recorded. At larval stages incidence of deformity at caudal peduncle was very high. Details of embryonic/larval stages have been worked out

in both hybrids and a few surviving ones are being studied for various biological, morphological and genetical features. The following average growth rate has been recorded in the laboratory cisterns *viz.*, *C. catla* X *H. molitrix* 105 mm in $3\frac{1}{2}$ months and *L. rohita* X *C. carpio* 61 mm in 3 months.

Project 10 : Fish Farm Designing

Problem	:	10.1	(Research work completed in 1977)
Problem	:	10.2	Studying seepage losses in ponds
Personnel	:		C. Saha, G.N Saha, C.D. Sahoo and M.D. Mantri
Duration			Five years

Seepage loss studies were conducted in 18 newly constructed nursery ponds at Dhauli. It was observed that the irrigation canal flowing nearby was keeping the water table high and as a result, the seepage loss in these ponds appeared to be negligible when the canal was having flow. But during the period when the canal water flow was stopped it had recorded an average loss of 16 cm in a month (April). During monsoon months water levels of ponds were increased and average increase of pond water level was about 40 cm. Again during November and December, when the canal water flow was stopped the average loss was recorded as 23 cm per month.

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 1977)
Problem	:	11.7	(Research work completed in 1977)

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
Duration	:	Four years six months

Usefulness of recirculation and aeration of water in the brood fish ponds was further substantiated. The response to hypophysation was highly encouraging after the conducive environmental conditions set in. During favourable ecological conditions, out of 28 sets of grass carp and 29 sets of silver carp, as many as 17 sets of grass carp and 23 sets of silver carp were either properly stripped or naturally spawned inside the *hapa*. Differences in response to hypophysation by brood stock of both the species from the same pond in different breeding environments *viz.* pond, adjacent moat and river were studied. The sets kept in the moat and river responded positively whereas, those in the pond did not. Also the differential response to induced breeding in the same breeding environment by brood stocks, maintained in two different ponds, was observed.

Receptivity period in the case of grass carp females was found to be much shorter as compared to silver carp as was also observed in the previous years.

A characteristic spawning reflex was observed in the females of grass carp and silver carp before stripping them. The observation is of direct applied value.

Altogether 4.35 lakhs of grass carp and 3.05 lakhs of silver carp spawn were produced.

Problem	: 12.6	Compatibility and competition between silver carp and Indian major carps
Personnel	:	R.K. Dey, S.R. Ghosh and P.V.G.K. Reddy

Duration : Five years

A field experiment of 6 months duration to study the compatibility and competition between silver carp and Indian major carp (rohu) initiated in December, 1976 was concluded in June, 1977. The experiment was conducted in two rearing ponds (0.08 ha each) and four nursery ponds (0.04 ha each) with stocking density of 5,000/ha (in two rearing ponds and two nursery ponds) and 3,000/ha (in two nursery ponds) and species combination of Sc 2 : R 3 (two replicates) and C 2 : R 3 (two replicates). At both the stocking densities the growth of rohu suffered only slightly in the presence of silver carp as compared to catla. The study is being continued.

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

Personnel : S.B. Singh, R.K. Dey, S.R. Ghosh and P.V.G K. Reddy

Duration : Four years

Fingerling rearing : An experiment of 3 months duration on rearing of fingerlings of silver carp, grass carp and common carp was initiated in two rearing ponds (0.08 ha each), but it got vitiated due to flooding and so, it was reset in two nursery ponds (0.04 ha each) in October, 1977 at a stocking density of 2.5 lakhs/ha and species combination of Sc 4 : Gc 3 : Cc 3. The study is in progress.

Large fish culture : A field experiment of one year duration on composite culture of silver carp, grass carp and common carp, initiated in two rearing ponds (0.08 ha each) in December, 1976 with a stocking density of 5,000/ha and species ratio of Sc 4 : Gc 3 : Cc 3 without any supplementary feeding except supply of weeds to grass carp, was concluded in December, 1977. The experiment in one of the ponds (RP 3) was vitiated due to mass poaching of the fish. The average survival in the other pond was 89% and the gross and net productions were 1,969 kg and 1,925 37 kg/ha/yr respectively.

Project 13 : Cold Water 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	Crude culture of fish food organisms under temperate climate
Personnel	:		K.K. Vass and H.B. Singh
Duration	:		Two years

Zooplankton culture : Different media *viz.*, mustard oil cake, cowdung extract, sheep manure, urea and yeast were screened for the growth of *Daphnia* spp. Best result was obtained in cowdung extract when 3,176 organisms/l were raised as compared to 2,100 in sheep manure ; 1,527 in urea ; 1,433 in yeast and 1,310 per litre in mustard oil cake within a period of 12 days with an initial stocking of 50 organisms/l.

Problem	:	13.15 & 16	(Research work kept in abeyance)
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	(Research work kept in abeyance)
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

Only six females and ten males were found suitable for hypophysation & stripping at Baitawali Mandi farm. The length & weight of the brood fish ranged from 453 to 630 mm and 575 to 1,350 g. Before injection they were fed on artificial pelleted feed containing 35% crude protein.

While the males were administered with 2 mg/kg body weight of Indian major carp pituitary extract, the females were injected @ 4 mg/kg at an interval of 12 hours. Though the males were oozing freely the females were not in proper condition of maturation. So the final dose was injected @ 8 mg/kg to the females only. Only one female (570 mm/1,250 g) responded to partial stripping and about 1,200 eggs were produced by dry method. The eggs were incubated in spring water at 20.5°—22.3°C in wooden trays and 65—70% hatchlings were obtained after 76—90 hours but none could survive due to *Saprolegnia* infection.

The ovary of the stripped female revealed three sizes of eggs (0.5—0.7 mm, 1.2—1.9 mm & 2.7—3.2 mm) indicating that the eggs matured in succession.

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, R.K. Tyagi, R.A. Gupta, R.K. Dwivedi, N.K. Srivastava (middle stretch), B.L. Pandey, S.A.K. Nasar, R.C. Singh and A. Sarkar (lower stretch)

Duration : Continuing

The total fish landings at Sadiapur, Daraganj, Buxar, Bhagalpur and Lalgola centres were estimated to be 102.70, 27.91, 18.73, 76.09 and 43.27 t respectively during the period December 1976 to November 1977 for the first two centres and January 1977 to November 1977 for rest of the three centres. Details of species-wise landings are given in Table. 5

Table — 5 Estimated landings of various species (in tonnes)

		C. mrigala	*C. catla*	*L. rohita*	*L. calbasu*	Major carps Total	*M. aor*	*M. seenghala*	*W. attu*	Catfishes Total	*H. ilisha*	Others	Total
Sadiapur	t	9.82	3.15	2.11	16.13	31.21	14.45	8.36	2.18	24.99	0.24	46.26	102.70
	%	9.6	3.1	2.1	15.7	-	14.1	8.1	2.1	-	0.2	45. 0	
Daraganj	t	2 48	1.24	0.32	1.04	5.08	0.75	6.65	1.63	9.03	0.08	13.72	27.91
	%	8.9	4.4	1.1	3.7	-	2.7	23. 8	5.8	-	0. 3	49. 3	
Buxar	t	0.90	0.93	1 39	0.36	3.58	3.13	0.71	1.11	4.95	0.25	9.95	18.73
	%	4.8	5.0	7.4	1.9	-	16.7	3.8	5. 9	-	1. 3	53. 1	
Bhagalpur	t	2.13	3.57	1.85	0.55	8.10	3.85	4.55	12.90	21.30	0.37	46.32	76.09
	%	2.8	4.7	2.4	0.7	-	5.1	6.0	16. 9	-	0. 5	60. 9	
Lalgola	t	0.02	0.14	0.12	nil	0.28	0.25	nii	nil	0.25	25.25	17.49	43.27
	%	0.1	0.3	0.3	-	-	0.6	-	-	-	58. 3	40. 4	

At Sadiapur the total landings showed an increase by 22.58% and 5.49% over the landings of the years 1975 (83.78 t) and 1976 (97.35 t) respectively. Maximum abundance was recorded in the landings of the miscellaneous fishes. At Daraganj centre a decrease by 16.09 and 6.22% over the landings of the years 1975 (33.26 t) and 1976 (29.76 t) respectively were observed This pronounced decline in the landings was due to poor representation of miscellaneous fishes. *H. ilisha* landings were almost of the same magnitude as in the preceeding three years at Sadiapur and Daraganj. Data on length frequency of eight commercially important species were collected from Sadiapur fish landing centre. The mean length of these species during the year 1977 are presented in table 6 and compared with the respective mean lengths during the years 1967, 1974 and 1975.

Table— 6 Mean length (mm) of different species in various years

Species	1977	1975	1974	1967
C mrigala	587	692	586	483
C. catla	691	805	750	595
L. rohita	530	694	614	567
L. calbasu	456	454	466	403
M. aor	481	434	517	512
M. seenghala	473	452	523	533
W. attu	565	464	574	599
H. ilisha	381	473	353	328

A total of 177 scales of *C. mrigala* were collected and studied for aging. The mean length as calculated at ages from I to VI year were estimated to be as follows :

Age in year	I	II	III	IV	V	VI
Mean length (mm)	282	421	584	722	822	897

Von-Bertalanffy's growth equation was fitted to the data on growth (in length). The asymptotic length was estimated at 1,475 mm and the values of K at 0.149 which on further analysis yielded the value of t_0 at 0.39 and hence Von-Bertalanffy's growth equation for mrigal can be expressed as :

$$l_t = 1475\ 1 - e^{-0.149\ (t+0.39)}$$

The length measurements of *M. seenghala* and *M. aor*, collected during the period of 1972-77, were used for estimating the length at ages with the help of probability method. The maximum length were 1,137 mm and 1,080 mm respectively for *M. seenghala* and *M. aor*. The average length at ages determined for the above species were as follows :

Table :— 7 Length at ages for *M. seenghala* and *M. aor*

Age in years	Average length in mm	
	M. seenghala	*M. aor*
I	310	290
II	545	495
III	675	655
IV	755	750
V	815	825
VI	857	860

Problem : 14.2 (Research Programme 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 Ecological changes in the Hooghly estuary in the context of freshwater release from Farakka Barrage into the system

Personnel : A.C. Nandy, K.K. Ghosh, P.M. Mitra, M.M. Bagchi, R.K. Chakraborty, S.K. Mazumder, P.R. Das (on study leave), B.K. Saha, R.N. De, N.D. Sarkar, A.R. Paul, N.C. Mondal and S.P. Ghosh

Duration : Two years

To study the effects of flushing of freshwater into the system, regularly, fortnightly collection of hydrological data, plankton, benthos, primary production and tow net collections were made from 8 sampling stations, 5 along the Hooghly, one each on Rupnarain, Matlah and Mani rivers. Additional freshwaters to the Hooghly was put by the Farakka Barrage at a low rate. The Farakka discharges raised the freshwater flow into the Hooghly estuary and changed the ecology of the system significantly. A sizable drop in salinity of the estuary was observed. The earlier recognised gradient-transient zone has largely become the freshwater zone whereas the marine zone has become largely transient-gradient zone. With the lowering of the estuarine salinity and higher water flow, the general habitat has considerably improved. The higher freshwater discharge has stabilised the temperature regimes thus at most centres of Hooghly the winter water temperature were slightly higher while the summer high water temperature were lower. The plankton populations have shown most significant improvements. The plankton densities have been recorded about 3—5 times more in the different zones of Hooghly-Matlah estuarine system as compared to those reported by earlier workers.

Problem : 14.11 Statistical evaluation of sampling and estimation techniques of plankton

Personnel : K.K. Ghosh, B.N. Saigal, K.K. Bhanot and R.K. Chakraborty

Duration : Two years eight months

Effect of sample size on surface plankton collected by the plankton net collection method showed high degree of variation repeated samples both qualitatively and quantitatively for 12, 15 and 20 litre samples. Large size samples showed higher representation of less abundant forms and higher concentration of zooplankton *viz.*, *Moina* sp., *Brachionus* sp., *Cyclops* sp. and nauplii of copepods and the smaller samples were dominant in phytoplankton *viz.*, *Euglena* sp. *Phacus* sp., *Oscillatoria* sp., *Microcystis* sp., *Anabaena* sp. and *Navicula* sp. Repeated estimations of primary productivity using 250 ml light and dark bottle technique have shown high degree of variation ranging from 226 to 544 mg $C/m^3/hr$.

Problem	:	14.12	Robustness of estimators of population size and efficiency of mortality rate estimators by Monte—carlo method
Personnel	:		K.K. Ghosh
Duration	:		Two years eight months

The estimation techniques available in literature for finite and assumed infinite populations have been examined. The geometric logistic and modified logistic models of population growth with poisson or geometric models of mortality are being theoretically examined for the estimation procedures.

Problem	:	14.13	The analysis of catch and effort statistics of commercially important species of the Hooghly—Matlah Estuarine system
Personnel	:		P.M. Mitra and K.K. Ghosh
Duration	:		Two years

Trends of yields, total and its principal components, from the Hooghly-Matlah estuarine system, were estimated by fitting second degree curves. The trends showed about 6% rise/annum in total catch. The residual analysis showed random series except in the case of the trend of total catches less *Hilsa* and migratory bagnet catches.

Seasonal indices of total landings have been constructed. The indices attain peak during the winter months *i.e.*, November-January.

Problem	:	14.14	Comparative fishery and ecological studies of River Ganga at Bhagalpur and Farakka sites
Personnel	:		J.C. Malhotra, S.A.K. Nasar and A. Sarkar
Duration	:		Two years

Average gross and net carbon assimilation during 1977 was recorded to be 47.31 and 31.69 mg $C/m^3/hr$ respectively. The community respiration was 18.46 mg $C/m^3/hr$. The average gross and net carbon assimilation decreased by 25.02% and 7.07% respectively. The community respiration also decreased by 47.01%.

The gross primary productivity was maximum in the month of April (72.19 mg C/m^3/hr) and the minimum in August (20.00 mg C/m^3/hr). The net primary production was maximum in the month of November (51.25 mg C/m^3/hr) and the minimum in July (6.88 mg C/m^3/hr.). The maximum community respiration was recorded in the month of June (52.50 mg C/m^3/hr) and the minimum in August (7.50 mg C/m^3/hr).

The minimum air temperature (16.2°C) was in December and the maximum (29.8°C) in July.

The minimum water temperature (17.6°C) was recorded in January and the maximum (30.15°C) in September. Transparency was maximum in April (34.4 cm) and minimum in October (4.5 cm).

Among the chemical factors, pH varied between 6.0 and 8.25 Dissolved oxygen ranged from 4.98 ppm (August) to 7.61 ppm (December) showing inverse relation with the water temperature, though, it was not so with free CO_2 which was the maximum in November (14.50 ppm) and the minimum in December (3.0 ppm). Total alkalinity was the maximum in December (169.2 ppm) and the minimum in October (133.5 ppm).

A preliminary study of physico-chemical aspects of the River Ganga at Farakka was made during November, 1977. Water temperature was found to range between 26° and 27°C during the first fortnight and it gradually came down in the range of 23°—24°C. Transparency ranged between 10.3 and 23.0 cm during the month. Chemical parameters like pH, D.O., free CO_2 and total alkalinity were in the range of 7.6—7.8, 8.4—9.9 ppm, nil and 124.2—127.3 ppm respectively.

The maximum abundance of phytoplankton was observed in June, when the total number was 22,824 u/l while the minimum, 412 u/l, in September The average yearly production decreased by 25.39% when compared with the preceeding year. The dominant genera encountered were as follows :

Chlorophyceae	:	*Oedogonium* (dominated in June), *Hydrodictyon*, *Spirogyra*, *Ulothrix*, *Tribenema*, *Pediastrum*.
Myxophyceae	:	*Oscillatoria*, (dominated in June), *Merismopedia*, *Microcystis*, *Spirulina* and *Phormidium*.
Desmidiaceae	:	*Closterium*, *Desmidium*, *Genicularia*, (dominated throughout the year), *Gonatozygon* and *Docidium*.

Bacillariophyceae : *Navicula* & *Nitzschia* (dominated throughout the year) *Diatoma, Surirella, Asterionella, Fragilaria* and *Synedra.*

The zooplankton population varied from 128 u/l in September to 6,889 u/l in June. The average yearly zooplankton population increased by 533.33% when compared with that of the preceeding year. The following zooplankton genera were encountered :

Rotifers : *Brachionus* (dominated throughout the year), *Keratella, Polyarthra, Filinia,* and *Asplanchna.*

Cladocera : *Daphnia* (dominated throughout the year), *Bosmina, Moina* and *Sida.*

Copepods : Nauplius, *Cyclops* & *Diaptomus*

Protozoa : *Arcella, Mallomonas, Ceratium, Volvox*

The ratio between phyto-and zooplankton was recorded to be 1 : 0.03 during the period under report.

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 (Work being done under Project 16.7)

Problem : 16.3 Evolution and evaluation of herbicide formulations

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

Duration : Ten years Nine months

a) In a field trial in a pond infestation, rooted weeds *viz., Ottellia* sp. and *Nymphoides* sp. ware completely controlled after three

instalments of treatment with brick pellets soaked in 2,4—D aqueous solution (@ 12 kg a.i./ha.), There has been no regeneration of weeds so far.

In connection with a consultancy assignment referred to the Institute by a commercial fish culture enterprise of Bhopal, the yard experiments carried out at the Cuttack Research Centre with the weed samples (mainly *Scirpus* sp.) brought from the site at Bhopal indicated that the weed which had grown over a large area of the fishery lake near Bhopal could be killed by either foliar application or root-zone application of 2,4—D @ about 5 kg a.i./ha and above.

Commercial granular formulation of 2,4—D @ 5 kg a.i./ha had only slight initial effect upon rooted weeds *viz.*, *Lin nophyllum* sp., *Nelumbo* sp., *Nymphoides* sp. etc.

b) Diuron herbicide has been found to be effective on submerged weeds and the aquatic grass *Panicun* sp. at a low dose of 4 kg/ha. The submerged weed *Ottelia* sp. started distintegrating in the water from about the 2nd week after the treatment.

In a nursery pond, fishes were not affected even when a high concentration of 4 ppm a.i. of diuron was applied for clearing *Microcystis* sp. blooms.

Foliar spray of herbicide formulation of 3,4-dichloropropionanilide @ 2 kg a.i./ha was found fairly effective for the control of aquatic grasses (*Panicum* sp.) in the early stage of their growth.

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 continued to ascertain the optimum dosage of chemicals *viz.*, copper sulphate, superphosphate and urea required for eradicating weed infestations in fish ponds, caused by floating and submerged vegetations, without adversely affecting the prevailing environment for fish culture.

Treatment with Coppersulphate ($CuSO_4$) :

In the laboratory, experiments were conducted in a number of earthen tubs with *Pistia* and *Salvinia* as test plants. In the first set of experiments, two intermittent doses of coppersulphate solution (@ 35 kg/ha) were applied in tubs having infestations of *Pistia* and *Salvinia* plants separately. The result of the treatment was apparent on 22nd day when 75 and 50% of *Pistia* and *Salvinia* plants died respectively. However, complete extermination of the plants could be achieved on the 53rd day of the experiment with the application of an additional dose of $CuSO_4$ solution @ 35 kg/ha on 23rd day. The maximum copper ion concentration of the treated water varied between 0.36 and 0.40 ppm as against .01 ppm of the control tub containing mixed population of *Salvinia, Pistia, Azolla, Vallisneria,* and *Lagarosiphon* plants.

In another set of experiments, attempts were made to study the effect of $CuSO_4$ solution on *Salvinia* plants at a lower dose of 20 kg/ha —— 3 doses applied within 7 days, followed by 4th on 12th day, 5th on 19th day, and the last dose on 26th day. While the majority of the plants died after the 5th dose was applied the rest which showed signs of regrowth, could be destroyed completely with the application of 6th dose. No regrowth of *Salvinia* in the treated tub has been observed for the last 9 months.

Treatment with Superphosphate :

It has already been observed that excess growth of rooted and floating aquatic vegetations can be controlled by the treatment of superphosphate in intermittent doses to a total dose varying from 1,500—2,000 kg/ha. The draw back with the treatment of superphosphate solution is that the portion of the solution precipitates and settles in the bottom mud. As such experiments were conducted in the laboratory in glass jars to explore the feasibility of checking the precipitation of superphosphate solution by its combined application with mustard oilcake powder. In one set of experiment, superphosphate was applied @ 1,000, 1,250 & 1,500 kg/ha in combination with mustard oilcake powder @ 1,500 kg/ha in each dose. Best result was obtained with the dose @ 1,500 kg/ha of superphosphate. The maximum phosphate concentration of the jar treated with the dose of 1,500 kg/ha was observed to be 28.9 ppm and was retained for a longer period, showing lesser precipitation than that of the other two doses.

In second sets of experiments, the dose of 1,500 kg/ha of superphosphate was applied in different manners in combination with mustard oilcake @ 1,500 kg/ha. Though the maximum concentration of phosphate (100 ppm) was observed in the jar treated with mustard oilcake (1,500 kg/ha) + two intermittent doses (@ 75 kg/ha each) of superphosphate, the maximum affectation of weeds was noticed in the jar treated with superphosphate + mustard oilcake each @ 1,500 kg/ha.

In the third set of experiments enhanced doses of superphosphate showed higher phosphate concentration (115—130 ppm) in the treated water with low intensity of affectation of plants (25—30%).

In the fourth set of experiments, jars having dense population of *Hydrilla* and *Vallisneria* plants were treated initially at a dose of 500 kg/ha each of superphosphate and mustard oilcake followed by intermittent doses of superphosphate + mustard oilcake (@ 100 kg/ha each) on 3rd, 8th, 13th and 19th day of the treatment. Though the vegetative reproduction of both the plants could be completely checked within a month from the application of initial dose, 90% of the *Hydrilla* sp. was destroyed within 3 months. *Vallisneria* sp. showed less affectation during the same period. The phosphate concentration of the treated water (initially 0.6 ppm) was the maximum (100 ppm) on 7th day from the 1st dose but gradually came down to 12.54 ppm on 20th day of the experiment.

In the fifth set of experiment, in a samll aquarium, *Hydrilla* sp., *Vallisneria* sp. and *Chara* sp. were treated with superphosphate in combination with mohua oilcake in variable doses of 500 kg/ha each on 1st day followed by a dose of 100 kg/ha each on 2nd day, only superphosphate @ 100 kg/ha on 4th day, and doses of 50 kg/ha each on 6th and 7th day. The results of the treatment indicated 25% affectation of *Hydrilla* sp. and *Chara* sp. whereas 20% of the *Vallisneria* sp. were dead and decayed in $2\frac{1}{2}$ months time. However, vegetative reproduction of all the plants was completely checked. Phosphate concentration (initialy 0.3 ppm) was observed to be the maximum (81.5 ppm) 4 hrs after the application of 3rd dose and was finally 1.5 ppm after $2\frac{1}{2}$ months from the 1st dose.

Treatment with Urea :

In repeated laboratory experiments, it was observed that *Hydrilla* sp., when treated with urea @ 400 kg/ha were completely destroyed within a period of $1\frac{1}{2}$ to 2 months from the date of treatment. Urea when applied

on *Vallisneria* sp. infestation, checked the vegetative reproduction of the plants within $1\frac{1}{2}$ months. Later gradually the plants decayed.

Problem	:	16.5	Autecology of aquatic weeds
Personnel	:		E. Mitra (Miss), S.C. Banerjee and A.C. Banerjee
Duration	:		Four years

Collection of weeds, water and soil samples made from the ponds located in different areas of West Bengal are being analysed to find out the ecological conditions required for the healthy growth of the specific plants which generally grow and multiply in ponds.

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

Samples of cattle shed washing, which are proposed to be used as the sole nutrient inputs in experimental fish ponds, were found to contain about 2.3 mg phosphorus and nearly 467 mg N per litre.

Problem	:	16.11	Turnover of major nutrients such as nitrogen, phosphorus and potassium in fish production
Personnel	:		V. Ramachandran, V.R.P. Sinha, M. Rout and S.L. Kar
Duration	:		Three years
			(Research work could not be initiated due to technical difficulties)

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* could be achieved in the newly developed hatchery complex. Treatment of eggs with sodium chloride (4 g/l) and urea (3 g/l) solutions in the proportion of 2 : 1 for about 2 hr. followed by a treatment with 250 ppm pectinase helped in complete degumming. The period of incubation of eggs could also be reduced by the use of the hatchery. A production of over 42,000 hatlings was obtained during the experimental process.

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

About 5,000 tadpoles of *Rana hexadactyla* were produced and reared to early frog stage. Incidental to induced breeding and development of hatchery complex 42,000 hatchlings of *R. tigrina* were produced. In a field experiment on the rearing of tadpoles to early frog stage *R. hexadactyla* 81% survival could be achieved when tadpoles were stocked @ 450 nos/400 l (c. 11.25 million/ha/m depth) and fed with fresh *Hydrilla* twigs.

Problem	:	17.8 (b)	(Research work suspended since 1977)
Problem	:	17.9 (a)	Mono-culture 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)	Rearing of the tadpoles of *Rana hexadactyla* upto the adult stage
Personnel	:	C.R. Das and V. Panigrahi
Duration	:	Two years

Consequent to spring and monsoon breeding 2,500 and 3,000 tadpoles of *Rana hexadactyla* were produced which confirmed the earlier findings that the species has two prolonged breeding phases.

Three species of aquatic plants *viz., Spirogyra* sp., *Lemna* sp. and *Hydrilla* sp. were tried as feed in rearing experiments. Optimum rate of survival and growth were recorded with *Hydrilla* sp. followed by *Spirogyra* sp. and *Lemna* sp.

In a rearing experiment *R. hexadactyla* juveniles with an av. l/av. wt of 67.5 mm/40 g and a stocking density of 6,000/ha attained an av. l/av. wt of 86.5 mm/97 g size in 14 months time. A production of 370 kg/ha was recorded (total period of rearing = 24 months). Heteromorphic growth were recorded amongst them. Males were found to grow to smaller size than females.

In another rearing experiment of early frogs (av. l/av. wt of 15mm/.5 g) with a stocking density of 10,000/ha an av. l/av. wt of 35 mm/6.5 g was attained in four months time.

Problem	: 17.10	Culture of earthworms for feeding frogs
Personnel	:	C.R. Das, S.N. Mohanty and V. Panigrahi
Duration	:	Three years

Two common species of earthworms *Pheretima* sp. and *Megascolex* sp. were tried for culture. Field experiments recorded upto 25 times multiplication in *Pheretima* sp. when compost manure together with cowdung and rotten leaves were applied at a regular interval of 15 days in the ratio of 1 : 1 : 1 in one months' duration.

Project 18 : Sewage-fed fisheries

Problem	: 18.1	Fish culture in sewage-fed ponds
Personnel	:	Apurba Ghosh, L H. Rao, S.K. Saha and K K. Bhanot (Smt.) from Sept., 1977
Duration	:	Five years six months

Culture of Tilapia mossambica in sewage fed pond : Culture of *Tilapia mossambica* in a sewage-fed pond (0.076 ha) located at the out yard of the Titagarh sewage treatment plant, Rahara, West Bengal was continued. The pond was renovated in January, 1977 and was initially fertilized with 17,80,000 litre of domestic waste water in March, 1977. The pond was stocked with *T. mossambica* @ 20,000/ha in the sex ratio of 6 males : 4 females in April, 1977. Sewage effluents ranging from 21,000 litres to 2,08,00 litres per month within a period of one month stocking, were taken into the pond at weekly/fortnightly intervals. *Tilapia* started breeding and by mid August large numbers of different size groups were available in the pond. Periodic harvesting of the fish was resorted to from August and within a period of 7 months 304.6 kg (estimated 4,077 kg/ha) of tilapia was harvested from the pond.

Mixed culture of carps with damestic sewage effluent : Mixed culture of carps in a pond (0.17 ha) with five species *i.e*, rohu, catla, mrigal, silver carp and common carp, initiated in July, 1976 at a stocking density of 15,000/ha was completed in June, 1977. Initial manuring of the pond was done with 6,80,000 litres of primarily treated sewage effluent prior to stocking and about 25,85,000 litres of sewage effluent was utilised for fertilising the pond at periodic intervals during post stocking phase from October 1976 to May 1977. No supplementary feeding was resorted to except irrigating the pond with domestic sewage effluents. The fishes were harvested periodically after seven months of rearing and final harvesting was done after 12 months. A total production of 1,224 kg *i.e.*, 7,200 kg/ha/yr (gross) and 6,971 kg/ha/yr (net) was obtained.

Another experiment on mixed culture of carps was initiated from September 1977. The pond was initially fertilized with 8,50,000 litres of domestic sewage effluent diluted with freshwater (Sewage : water : : 1 : 2) during July-August, 1977. The pond was stocked with major carps, common carp and silver carp. The stocking ratio and density of the species stocked

were catla 1 : rohu 2.5 : mrigal 2.5 : common carp 2 : silver carp 2 @ 10,000 fingerlings/ha. The major carps were stocked during September, while fingerlings of common carp and silver carp were stocked in October, 1977. No supplementary feed or fertilizer was given to the fishes except for fertilising the pond with domestic sewage effluent ranging from 17,000 litres to 51,000 litres/month during the rearing period from October to December, 1977. The average length/weight of fishes at the time of stocking were catla 172.3 mm/82.7 g, rohu 164.9 mm/31.2 g, mrigal 163.3 mm/23.0 g, common carp 115.2 mm/52.9 g and silver carp 124.5 mm/10.0 g. It was observed that catla had grown to 354.5, rohu 150.0 and mrigal 106.0 g in 3 months. Common carp and silver carp attained average weights of 183.0 and 190.0 g respectively in two months.

Analysis of the bottom soil : pH 6.4—6.9, organic carbon 6.2—11.0%, available nitrogen 26.3—49.4 mg/100 g of soil, total nitrogen 0.40—0.58%, available phosphate 21.6—36 mg/100 g of soil. The percentage of sand, silt and clay were 58, 23.6 and 19.4 respectively.

Bio-chemical and bacteriological studies on fishes reared in ponds fertilised with domestic waste water : Bio-chemical analysis for protein content of rohu and mrigal were carried out and found to be 7.46 and 2.78% respectively.

Paddy-cum-fish culture in freshwater at Rahara Centre : Rearing of fish along with deep water paddy is likely to yield better returns to the agriculturists since along with paddy some fish will also be produced. With this idea an eperiment has been initiated to establish a system of paddy-cum-fish culture by renovating a paddy plot (1.02 ha) at Rahara, Khardha. In the culture operation the waterway (0.27 ha) for fish culture is of the shape of a trapozoidal canal which runs all along the perimeter of the agricultural field. The water way thus constructed may enable to extend the rearing period of the fish. The water from the canal can be used for irrigating paddy field and help produce a second crop of paddy or pulses in the same plot during summer months.

A deep water pest resistant hybrid paddy, "Jaladhi-2" was directly sown in an area of 0.75 ha in May, 1977 and three species of Indian major carp fry *i.e.*, catla, rohu and mrigal were stocked @ 6,000/ha in July, 1977.

Provision has been made to keep the water of the canal 4 feet deep from the level of agricultural land. Within a period of 3 months the paddy

had grown to about 5 high. Among the stocked fishes 'catla registered a growth of 105 g, rohu 60 g and mrigal 55 g in four months. The stocked fishes were fed @ 5% of the body weight, with rice bran and mustard oil cake in the ratio of 1 : 1 upto November, 1977.

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 & 19.5	(Research work completed in 1973)
Problem	:	19.6	(Research work suspended since 1973)
Problem	:	19.7	(Work merged with project problem 14.1)
Problem	:	19.8	Culture of *Hilsa* in confined freshwater
Personnel	:		J.C. Malhotra, K.L. Shah, K.P. Srivastava and G.N. Srivastava
Duration	:		Five years

Intensive search in and around hilsa fishing grounds at Farakka was made between 2nd and 27th November, 1977. No mature oozing female hilsa specimen could be obtained for conducting stripping experiments. The fish were found to be in III/V stages of maturity only. Analysis of physico-chemical conditions of water was also made during the period of study. As the water temperature became considerably low (23°—24°C) in the later part of November and there was no fishing in and around Farakka, the chances of obtaining mature hilsa specimens were almost nil and as such further work was suspended.

Problem	:	19.9	Fluc'uations in the hilsa fisheries of the Hooghly estuary
Personnel	:		D.K. De, B.K. Saha and G.P. Bhattacharya
Duration	:		Five years six months

An estimated catch of 42,392 kg of *Hilsa* was landed in the freshwater zone of the Hooghly estuary from February to July. Hilsa larvae were also not available at Monirampore and Palta centres during August-October. Random samples of maturing gonads covering stages I to V were collected and preserved for further study on maturity and fecundity of the fish.

Project 20 : Water pollution investigations

Problem	:	20.1	(Research work completed in 1973)
Problem	:	20.2	(Research work completed in 1975)
Problem	:	20.3	Studies on estuarine pollution with reference to pulp and paper and tannery wastes
Personnel	:		B.B. Ghosh, S.K. Mazumdar and M.M. Bagchi
Duration	:		Four years

Assessment of the pollutional status of the Hooghly estuary in the context of polluted and unpolluted zones was made. The stretches of the Hooghly near Kalna, Diamond Harbour and Kakdwip, located beyond the industrial belt of the estuary, as well as the stretches near Kolaghat and Port Canning along Rupnarain and Matlah respectively, which virtually do not receive any industrial effluent, showed high gross primary production and planktonic abundance and more favourable physico-chemical environment as compared to those of the stretches of the Hooghly near the outfall of pulp and paper (average : 6.7 mg C/m^3/hr) and tanneries (average : 9.8 mg C/m^3/hr) investigated earlier. Annual average gross primary production in the Matlah (65.5 mg C/m^3/hr) was more in comparison to that of the Rupnarain (53.8 mg C/m^3/hr) and the selected stretches of the non-polluted zones of the Hooghly (59.8 mg C/m^3/hr). Mostly a low primary production accompanied with low biotic abundance was obtained during summer (March-June) under neap tidal phase as compared with that obtained during rainy season (July-October) and winter (November-February) under spring/bore tidal phase.

Problem	:	20.4	Investigation on Hooghly estuarine ecosystem to determine biological indicators of the water quality

Personnel : S.B. Saha

Duration : Two years

Plankton distribution was observed to be poor at Titagarh Paper Mill compared to Titagarh Municipality Sewage which comprises, *Spirogyra* sp., *Oscillatoria* sp., *Microcystis* sp., *Malosurea* sp., *Coscinodiscus* sp. *Synedra ulna* etc. and *Diaptomus* sp., *Cyclops* sp., *Brachionus* sp., nauplii, lamellibranch, etc. Benthos distribution at Titagarh Paper Mill outfall area was almost nil compared to that of Titagarh Municipality Sewage where tubificid worms & megalops larvae dominated (max. no. 355/haul). At Batanagar both plankton & benthos distributions were more compared to that of Titagarh Paper Mill area and there also tubificid worms dominated. Titagarh Municipality sewage area was found to be most productive.

Problem : 20.5 Investigations on the Ganga and the Yamuna River Eco-system at Allahabad to determine the biological indicators of water quality

Personnel : S. N. Mehrotra, S. P. Singh, B. C. Jha, and D. N. Singh

Duration : Four years

The effect of sewage discharge in the Rivers Ganga and Yamuna was studied at three points *viz.*, above the outfall (AOF), at the outfall (OF) and below the outfall (BOF) area. The data revealed no appreciable difference in water temperature at the three points of observation, the range being 17°—32°C. Transparency was found to be less at the outfall (4—30 cm) as compared to other points. Free CO_2 was present (4—30 ppm) at the outfall whereas at other points it was either absent or in low concentrations. Alkalinity and hardness remained high at the outfall area. The organic nutrients like nitrate, phosphate and silicate were fairly rich at the outfall area as compared to that of other points. The outfall area was rich in mineral content especially calcium and magnesium. Free ammonia was abundant (1.6—10.8 ppm) at the outfall area. Dissolved oxygen was low (1.2 ppm) at the outfall. BOD of sewage ranged between 58—118 mg/l at the outfall area.

Amongst the phytoplankton, diatoms (mainly *Synedra* sp. and *Navicula* sp.) dominated in the three zones followed by green algae (*Oedogonium* sp. *Pediastrum* sp. and *Scenedesmus* sp.). Amongst zooplankton rotifers (*Keratella*

sp. and *Lecans* sp.) were the main forms encountered in the Ganga and Yamuna rivers followed by copepods (*Cyclops* sp., *Diaptomus* sp. and nauplii). *Zoogloea* sp. was very prominent at the OF area of the Yamuna.

Bottom biota

The AOF area in both the rivers had gastropods (*Viviparus* sp.) bivalves (*Corbicula striatella*) as dominant forms followed by oligochaets (*Tubifex* sp. & *Nais* sp.). The chironomid larvae were the dominant form at the OF area followed by oligochaets (*Nais* sp. and *Tubifex* sp.). Dead shells of molluscs were also encountered at the OF area. The molluscs reappeared in the BOF area as dominant form followed by chironomid larvae and oligochaets. During monsoon benthic fauna was almost nil.

Fish fauna

The fish species encountered in cast net operations were *Rita rita, Mystus cavasius, Clupisoma garua, Bagarius bagarius, Wallago attu* among catfishes and *Gadusia chapra, Aspidoparia morar, Chela bacaila* among miscellaneous fishes. There was no appreciable difference in their availability in the three regions.

Problem	:	20.6	(No progress of work during the year)
Problem	:	20.7	Bio-assay of selected industrial wastes disposed into the Hooghly Estuary
Personnel	:		P. Roy, B.B. Ghosh, M.M. Bagchi and S.K. Majumdar
Duration	:		Three years

Short term (96 hrs) bioassay studies were conducted with synthetic rayon wastes by continuous flow system using shrimp (*Macrobrachium* sp., *Palaemon* sp.) and *Daphnia similis* as test animals during different seasons. The estimated LC_{50} value was found to range between 31—49% during summer, 52% during monsoon and 33% during winter with shrimp while with *Daphnia* sp. the value was 1.75% during monsoon and 6.5% during winter. During the course of experiments temperature of the media ranged between 28.5—32.5°C in summer, 29.5—31.0°C in monsoon and 20.5—25.0°C during winter. Effluent pH ranged between 2.8—5.4, 4.2—5.2 and 3.2—4.6 during the above mentioned seasons.

Problem : 20.8 Pollution studies in inland waters caused by pesticides

Personnel : R.S. Panwar, M. Peer Mohammed, D. Kapoor, R.A. Gupta, A.P Mukherjee and R.N. Seth

Duration : Four years

Experiments were conducted to study the accumulation of pesticide DDT—25 E. C. using *Labeo rohita* (90—100mm/6.60—6.68 g) as test fish. The concentration of pesticide used was 0 005 ppm (in 10 l of water). The qualitative measurement of DDT was estimated by colorimetric method (Schechter Haller), using spectro-colorimeter (spec 100), at 550 mm wave length the accumulation of DDT was estimated at 1.6464 mg, 1.5037 mg and 4.8120 mg/kg body weight of test fish in the tissues, intenstine and other parts respectively in 60 days exposure time. Experiments were also conducted to study the accumulation of DDT—25 EC in gills and intestine of *Cirrhinus mrigala* (90—102 mm/6.85—8.00 g). The concentration of DDT used was 0.005 ppm in plastic pool (containing 270 l of water). The accumulation of pesticide in gills and intestine of the fish was estimated at 15.162 mg and 14.945 mg/kg body weight of the fish respectively when exposed for 15 days, while the same was 17.624 mg and 17.402 mg/kg body weight of the fish respectively in 30 days exposure period.

Bioassays were made with pesticides *viz.*, γ-BMC-20 E.C., DDT– 25 E.C. and Malathion—50 E.C. using test fish *L. rohita* (av. L./wt 60 mm/ 2 26 g). The effect of DDT and γ-BHC was found more toxic than Malathion as judged by its LC_{50} values. Bioassay studies were also made with oligochaets at 20 $\pm$ 1°C using γ-BHC-20 E.C., DDT-25 E.C. and Malathion-50 E.C. The results revealed that oligochaets were more affected by organochlorine (DDT and BHC) and least by organo phosphorus (Malathion) pesticides.

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

Personnel : M. Peer Mohammed, R.S. Panwar, G.N. Srivastava, R.A. Gupta and D. Kapoor

Duration : Two years

Experiments conducted to study the effect of sub-lethal BHC (Gamm-

oxone 0.005 ppm) on *C. catla* (48 g) at room temperature (24 ± 1°C) indicated that the standard metabolic rate which was 100 mg/kg/hr for *C. catla* shifted to 150 mg/kg/hr when exposed to 0.005 ppm of BHC. The random activity of catla was high (more than 150 counts/hr) as compared to the fish exposed to 0.005 ppm BHC (*c.* 25 counts/hr).

Experiments conducted on *Colisa fasciata* to find out the upper temperature tolerance limit have shown that *C. fasciata* (av. wt. 2.3 g) can tolerate upper temperature upto 40.1°C.

Influence of sub-lethal BHC on the upper temperature tolerance limit on *C. mrigala* (1—6.2 cm) was studied. The sub-lethal concentration (0.005 ppm) was selected for the study and it was observed that the fish could tolerate upto 39.5°C. Earlier experiments showed temperature tolerance upto 42°C in control medium (without biocide).

Problem	: 20.10	Pollutional effect of industrial wastes on aquatic ecosystem
Personnel	:	R.S. Panwar, D.N. Singh, D. Kapoor, K.C. Srivastava, R.N. Seth and R.K. Saxena
Duration	:	Two years

Surface and column samples of water, plankton and bottom samples for benthos were collected at the outfall (O.F.) and at different distances from the O F. *viz.*, 20, 50, 100, 200, 350, and 1,000 m during pre-monsoon and monsoon periods.

Air and water temperatures at different sampling points ranged from 28°—38°C and 28° to 32°C respectively during pre-monsoon, and from 25° to 35°C in monsoon period. pH of the water at outfall ranged from 6.4—7.0 and at 1,000 m away from O.F., it ranged between 7.8.—8.0 during pre-monsoon period. It showed slight increase between 8.2—8.4 at similar distance during monsoon. Free chlorine showed very high value at the outfall zone (60—70 ppm). The values suddenly dropped to 3.9 to 15.0 ppm at station 5 m away from the O.F. area and thereafter decreased to 1—2 ppm at the stations 100 m away from outfall during the pre-monsoon period. In monsoon it ranged from 55.96 to 102.8 ppm at the outfall zone and disappeared at 200 m distance from the outfall onwards probably due to dilution. The specific conductivity of the effluent was estimated at 10,939.09 micro mhos/cm in pre-monsoon and 11,867.68 micro mhos/cm in

monsoon period. While at O.F., it ranged from 346.2 to 1,096.4 micro mhos/cm and 75.62—414.68 micro mhos/cm during pre-monsoon and monsoon seasons, respectively. Specific conductivity of water sample at about 20 and 100 m from O F. varied from 226.0- 507.8 and 190.0—250.0 micro mhos/cm during pre-monsoon and 93.97 - 179.12 micro mhos/cm and 74.62—106.54 micro mhos/cm during monsoon periods. Phosphate ranged from 0.04—0.08 ppm in the O.F. area, in traces at other points during pre-monsoon period. Though NO_3-N was found in traces at all stations during monsoon periods, it ranged from 0.02 to 0.32 ppm during pre-monsoon and 0.11—0.19 ppm during monsoon. Chloride content of the effluent in monsoon and pre-monsoon periods showed 2,000—2,980 ppm and 1,380—1,133 ppm respectively but at other stations, it fluctuated between 8—48 ppm and 8—39 ppm during premonsoon and monsoon periods respectively. Hardness of the effluent ranged between 60—80 ppm during both seasons whereas it varied between 20—60 ppm at other stations. Dissolved oxygen ranged from 6.8—7.2 at outfall whereas 100 m away from O.F. it ranged as 7.0 to 7.6 ppm. Total solids during pre-monsoon and monsoon ranged between 6,140 and 6,180 ppm and 2,140—2,172 ppm at O.F. respectively while at 100 m distance from O.F. it ranged between 260—280 ppm and 180—185 ppm during pre-monsoon and monsoon seasons respectively.

Plankton population was found to be rich on the days when large quantity of the effluent was not discharged into the reservoir. Zooplankters were represented by copepods (*Cyclops* sp., *Diaptomus* sp. and nauplii), rotifers (*Filina* sp. and *Asplanchna* sp) and cladocerans (*Diaphanosoma* sp., *Daphnia* sp., *Sida* sp and *Bosmina* sp.). Phytoplankters comprised diatoms (*Synedra* sp, *Navicula* sp., *Melosira* sp. and *Gyrosigma* sp.) and blue-green algae (*Oscillatoria* sp) during monsoon and pre-monsoon periods. *Microcystis* sp. bloom was observed during monsoon period but the same disappeared after discharge of the effluent.

Plankton population declined from the outfall to 100 m away when the effluent was discharged heavily. Oligochaets (*Chironomid* and *Chaoborus* larvae) were recorded at the bottom at about 100 m from the outfall. Large scale mortality of fish (50 - 250 mm) was observed at the outfall and 100 m away from the outfall during the monsoon period. *Clupisoma garua*, *Catla catla* and *Mystus aor* dominated amongst the dead fishes. Three dead specimens, *viz.*, *C. catla* (2.8 g), *M. aor* (325 g) and *C. garua* (72 g) were recorded even at a distance of 400 m away from the outfall during premonsoon period.

Project 21 : Fisheries of river basins

Problem	:	21.1	Ecology and development of Mans in Gandak basin (Research work kept in abeyance)

Project 22 : Carp culture in running water

Problem	:	22.1 (a)	Carp culture in running water in the Ganga (Investigations suspended)
Problem	:	22.1 (b)	Carp culture in running water in Brahmaputra (Investigations kept in abeyance)
Problem	:	22.1 (c)	Carp culture in running water "Kol" of the Ganga in cages (Investigations kept in abeyance)
Problem	:	22.2	Catfish culture in running water
Personnel	:		A.V. Natarajan, S.P. Singh, K.P. Srivastava, R.N. Seth and K. Chandra
Duration	:		Five years

Assessment of catfish seed : To assess the availability of catfish (*Mystus aor* and *M. seenghala*) seed in time and space, a 45 km stretch of the Ganga from Mehdauri to Sirsa, and 6 km stretch of Yamuna from Madhauka to Arail were surveyed during the period April to June. Breeding pits of *M. seenghala* were encountered only in the 22 km stretch of the Ganga from Mehdauri to Lavain. The maximum number of 'Live' pits (with hatchlings) were observed during May followed by April and June. Breeding pits of *M. aor* were not encountered during the survey.

3,839 hatchlings/fry of *M. seenghala*, 1,164 (T.L. 32—43 mm) during April ; 2,275 (T.L. 10—81 mm) in May and 400 (T.L. 35—48 mm) in June, were collected for rearing in the nylon cages in the river Ganga.

Rearing experiments of M. seenghala : Experiments were carried out to rear the hatchlings of *M. seenghala* in the cages (made of 1/12" meshed

nylon netting) of 1 × 1 × 1 m size and tied to bamboo frames. The cages were kept floating. The hatchlings were stocked after giving a bath in 1 ppm acreflavin. The chironomid egg mass and semiboiled trash fish were given as feed in the beginning. When the hatchlings started accepting and feeding on semi—boiled trash fish, the chironomid egg mass as feed was discontinued. It was observed that fry below 30 mm in total length fed exclusively on chironomid egg mass, and its supply for a minimum period of 7—10 days was essential for the larger size groups to get habituated on semi-boiled fish feed.

In the experiments, carried out during April, fry of *M. seenghala* with an average size of 32 mm attained an average size of 39 mm (size range 36—47 mm) during 15 days of rearing in one experiment, while during 26 days of rearing in another experiment the fry grew to an average size of 52 mm (size range 37—82 mm).

In other experiments initiated in May/June, the fry in the size range of 40—81 mm (av. 50 mm) attained a size range of 162—231 mm (av. 202 mm) during a rearing period of 208 days in one cage. In other two cages the fry of size range 10—48 mm (av. 37 mm) attained 154—195 mm (av. 165 mm) in one of the cages and in the second the fish attained an average size of 137 mm in a rearing period of 183 days.

The semi-boiled trash fish was given as feed twice a day @ 10% of the body weight. Artificial feed comprising semi-boiled trash fish, mustard oil cake and rice bran in the ratio of 2 : 1 : 1 in the form of small balls was tried for a fortnight but it was not accepted. Another trial with pelleted artificial feed also did not meet with success. The fish did not accept pellets even after starving for 10 days. The pellets comprised fish meal, soyabeen and rice bran in two ratios (1 : 1 : 1 and 3 : 1 : 1). Bentonite was added as binder. The non-acceptance of the artificial feed may probably be due to the fishes having more liking for flesh food.

There was no mortality due to infection in any of the cages. However, fishes purchased from the market when given as food, caused mortality which were later found to be contaminated. Stormy conditions, sudden impact of current, flood and erosion of bank etc., caused damage to cages resulting in escapement of the reared fish.

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

The rearing of fishes was further continued at Jari during the period under report. The fishes, kept in 1 m^3 size wire mesh cage, were transferred to a new wooden frame cage (2 × 1.5 × 1.5 m of galvanised $\frac{1}{8}$" iron mesh) on 25.6.77. After the rains the cages were shifted again to the old Jari tank on 5.8.77. A remarkable growth in length and weight of fishes was observed during this period. By December 2, 1977 when last sampling was done, the fishes in cages completed a successful 16 months period of rearing Catla recorded an average length of 375.6 mm (weight 782.0 g) and mrigal an average length of 249.2 mm (weight 169.0 g). An increment of 125.7 mm in length and 592.3 g in weight of catla and 108.1 mm in length and 134.0 g in weight of mrigal was recorded during 186 days of rearing from 30.5.77 to 2.12.77. Catla showed better growth both in terms of length and weight (0.7 mm and 3.2 g/day) as compared to mrigal, which recorded 0.6 mm in length and 0.7 g in weight/fish/day.

The feeding, done @ 10% of the body weight of fish (feed comprising Soyabean powder, ground nut oil cake and rice polish in the ratio of 1 : 1 : 1) was reduced to 4% of the body weight in phases, during winter months.

New set of experiments on rearing of carp spawn in cages (floating nurseries) were initiated in the Gulariya reservoir from August 1977. About 80,000 hatchlings (200 ml) collected at Marawka (Yamuna river) on 4.8.77 were released in floating *hapas* of 1/40" mesh on 10.8.77 after acclimatizing them in plastic pool by feeding on artificial feed. Another batch of 20,000 hatchlings (50 ml) collected from the same source on 12.8.77, was released in another cage on 19.8.77. By September the hatchlings had attained an average size of 32.4 mm in a rearing period of 31 days.

The nylon *hapas* gave way due to rough conditions persistently prevailing in the reservoir, which resulted in escapement of fry. A total of 908 fingerlings (average length 49.8 mm) finally recovered were being reared in cage 1 from 9.12.77.

About 3,000 fingerlings of rohu, mrigal and catla (size range 31—60 mm) netted from Taraon Fish Farm were stocked in another 1/8" mesh

nylon *hapa* on 29.10.77. Only 478 fingerlings were being reared in cage No. 2 from 9.12.77.

The feed comprising soyabean powder, ground nut oilcake and rice polish, given in balls was reduced to 10% of the body weight of fish from December 1977 from 20% of the body weight given earlier. The experiments are in progress.

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 and K. Chandra
Duration	:	Four years

Investigations were initiated with a view to evolving a technique for producing quality fish seed where in the canal water could be utilised for fish breeding purposes instead of depending on the rain waters from the catchment area as practised in bundh breeding of fishes. A site by the side of Belan canal in the village Basehra about 60 km from Allahabad was selected for conducting the experiment. Some construction work was done by raising embankments and fixing meshed screens at the inlet and outlet of a shallow natural depression thus converting the same into a rectangular pool termed as "breeding chamber". The chamber was provided with a trench inbetween the inlet and outlet, a deep pool near the outlet, and a sloping grassy spawning ground situated lengthwise towards one side of the chamber.

During the course of the experiment, the main flow of the Belan canal was diverted through the "breeding chamber" for creating water current and providing conditions conducive for the breeding of major carps. The brood fishes were released into the "breeding chamber" and the depth of the flowing water was maintained at 20 to 30 cm by operating a sluice provided inbetween the main and the distributing canals.

On the evening of 30th July, 1977, two sets of *Cirrhinus mrigala* in the ratio of 2 ♀ : 4 ♂ and one set of *Ctenopharyngodon idella* in the ratio of 1 ♀ : 2 ♂ were introduced into the "breeding chamber". It was a rainy

day and water temperature was 26°C. On subsequent morning, *i.e.*, on 31st July, 1977, eggs of mrigal and grass carp were collected at the spawning ground and from the lower and of the trench respectively. Examination of the brood fishes revealed that one set of mrigal had bred and partial spawning of grass carp had occurred. Similar successful breeding experiment were conducted with mrigal brooders on the nights between 5th and 6th August and between 6th and 7th August, 1977 and their eggs collected at the spawning ground within the "breedlng chamber".

While conducting the experiments, observations were made on the physico-chemical conditions during pre-breeding, breeding and post-breeding periods. During the spawning period the water temperature was usually 26°C (ranging between 24° to 27°C) which was lower when compared to that recorded during pre and post-breeding periods and the current velocity at the inlet of the "breeding chamber" ranged between 3.5 and 13 metres/second. Total alkalinity was found to be comparatively low (70 to 80 ppm) during breeding time, and the pH was 8.0 and the D.O. content ranged from 6.8 to 7.6 ppm.

Successful breeding of mrigal and grass carp was achieved for the first time by this method. The Canal Breeding Technique opens up an altogether new avenue for raising quality fish seed in the country where extensive net-work of canals can be made use of for fish breeding.

Problem : 23.1 (b) Bundh breeding of major carps in Bihar

Personnel : S.K. Wishard and R.C. Singh

Duration : Five years

Experiments were conducted at Chaibasa (South Bihar) to breed major carps in an improvised bundh and study the topographical, meteorological and chemical factors responsible for the spawning of major carps in bundhs.

An abandoned paddy field, 0.05 ha in area, was selected for the aforesaid experiments in the village Tonto and by the side of Roro Canal. Embankments were raised and strengthened to maintain a water level from 20 to 120 cm. The field was ploughed and levelled to have a gradually sloping ground. A small pit (6 × 5 × 2 m) was also dug near the outlet to accommodate the brooders. Riverine conditions were stimulated within the bundh by drawing water from the nearby Roro canal. Both, the inlet and the outlet were screened with iron meshed gates.

Two sets, each of mrigal and rohu, in the ratio of two males to one female, were introduced in the pit immediately after a few heavy showers. The bundh was then flooded with water and a mild current was generated by regulating the inlet and the outlet. The prospective spawners were watched for two consecutive nights but breeding did not take place despite suitable weather conditions (cloudy with intermittant showers), water temperature ranging from 27.0° to 29.5°C, pH 7.2—7.4, transparency 5.6—8.5 cm CO_2 nil to 1 ppm, phosphate 0.01 ppm, silicate 0.2 ppm and nitrate 0.1 ppm. Pituitary gland extract was then administered to one set each of rohu and mrigal @ 2 mg and 4 mg/kg body weight of males and the females respectively, primarily to examine the feasibility to sympathetic breeding. However, only one pair of rohu responded and spawned in the early hours of the subsequent day. Approximately 1,61,000 eggs were collected of which 88% were fertilised. The eggs were allowed to hatch in 4 hatching *hapas* installed in Roro canal and 4.5 *batis*, *i.e.*, over 90,000 hatchlings were handed over to the District Fishery Officer.

Other fishes, however, did not respond favourably because of testes in males being not viable.

Since none among the physico-chemical properties of water and weather conditions appeared repressive for the breeding of carps, the incompatibility of the male spawners was the main reason for the failure of natural spawning in the bundh. It was therefore, felt essential to select and isolate the prospective spawners early in the month of April for their successful breeding in the bundh during monsoon.

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production

Problem : CFCSP 1.1 Composite fish culture and fish seed production

Personnel : V.R.P Sinha, M.V. Gupta (upto 12 4.78), K.K. Sukumaran, R.M. Rao, M.Y. Kamal, K.N. Krishnamurthy, K.K Ghosh, M.R. Sinha, D.V. Pahwa, B.N. Singh, K.G. Rao, P M. Mathew (from 1.9.77), B.C. Tyagi (from 1.9.77), P.K. Aravindakshan (from 1.9.77), J.C. Markandey (from 1.9.77), A. Mukherjee (from 1.9.77), J.B. Rao,

D.P. Chakraborty, Balbir Singh, Dhirendra Kumar, P.K. Saha, D.N. Misra, B.K. Singh, P.C. Mohanta and P.N. Jaitly.

Duration : Four years

Exeriments aimed at obtaining maximum sustained yield of fish through composite culture of conventional Indian (catla, rohu and mrigal) and exotic (silver carp, grass carp and common carp) carps were continued during the year at different sub-centres of the project located under varied agro-climatic conditions of various States of the country.

At Badampudi, *M. malcolmsonii* was tried as an additional component in composite fish culture. In an experiment, six species combination of Indian and exotic carps together with *M. malcolmsonii* (stocked @ 10,000/ha) yielded gross productions ranging from 4,314—4,437 kg/ha/yr. As a result of low survival of the prawn (6.5—10.3%), its contribution to the total production was insignificant. In another experiment, employing five species (eliminating grass carp) and *M. malcolmsonii* (@ 2,500/ha) the gross production obtained was 2,078 kg/ha/16 months, the prawn alone contributed 97.9 kg/ha in 9 months when 84.6% of the stocked prawn could be recovered.

At Jaunpur, gross productions obtained with provision of feed and fertiliser ranged from 5,100—5,866 kg/ha/yr as against 3,612—4,330 kg with supplementary feeding alone; 1,681—2,745 kg with fertiliser alone; and 1,422 kg/ha/yr without feed and fertiliser. This signifies the important role of artificial feeding in composite fish culture.

At Kalyani, gross production ranging from 3,177—4,250 kg/ha/12 months could be raised even when no feeding and fertilisation was adopted till the 8th month of the axperiment.

At Bhavanisagar, six species combination yielded gross production of 3,782 kg/ha/yr as against 2,957 kg/ha/yr obtained with five species combination.

At Gauhati, fish yields from the composite fish culture could be remarkably increased when compared to that of the preceeding year. During the year, the gross productions obtained with six species combination ranged from 6,145—6,537 kg/ha/yr as against 3,731—4,083 kg/ha/yr in 1976.

At Ranchi, six species combination at a lower stocking density

(5,000/ha) resulted in gross productions ranging from 1,990—2,670 kg/ha/11 months.

In an experiment at Pune, gross production receorded was 5,726 kg/ha/yr with six species combination.

At Karnal, while with six species combination the gross productions obtained ranged from 3,222—5,909 kg/ha/6 months, the same with five species combination was 2,778 kg/ha/6 months.

Fish seed production : Breeding of exotic carps was successfully carried out at all the centres, except for grass carp at Bhavanisagar centre and silver carp at Badampudi centre. For the first time, grass carp was successfully induced bred in Bihar at Ranchi and at Kausalyagang in Orissa. A total of approximately 160 lakhs of Indian major carp and Chinese carp spawn could be produced. Another important achievement in the field of fish seed production has been the double spawning of rohu within the same season at Gauhati producing 6.645 lakh of spawn in the second breeding. *Puntius gonionotus*, imported four years ago from Indonesia, has been successfully bred at Kalyani centre.

Problem : CFCSP 1.2 Composite fish culture and fish seed production
(centrally sponsored scheme)

Personnel : V R.P. Sinha, A.R. Munshi (upto June 1977), H.L. Bhatia, N.G. Mazumder, S.K. Mohanty, V. Natarajan, P.E.B Menon (from September, 1977)

Duration : Four years

Based on the outstanding results so far achieved in obtaining sustained high fish yields through composite fish culture in different States of the country and with the increasing popularity of the composite fish culture technology for its tremendous economic viability resulting in high demand of quality fish seed, it was felt imperative to develop formulae to indicate adequate species combination, feeding intensity and fertiliser doses required under different agro-climatic conditions to optimise fish production in pond culture operations. To meet these objectives, experiments have been Initiated at 4 Centrally sponsored centres of the Project one each in the States of Tamil Nadu (Coimbatore), Orissa (Kausalyagang), Madhys Pradesh (Khutal-abhata) and Gujarat (Godhra).

At Coimbatore centre, composite fish culture with six species combination of Indian (Catla, rohu and mrigal) and exotic carps (silver carp, grass carp and common carp) yielded gross productions of 2,365 kg/ha in 262 days and 2,036 kg/ha/264 days from two ponds (0.018 ha each) whereas with five species combination gross yield recorded were 1,600 and 2,005 kg/ha/237 days. These experiments indicated that ponds with soil bottom and sides gave higher yields in comparison to ponds with soil-cement sides. At this centre, 6 5 lakh spawn of Indian major carps and 0.5 lakh of common carp could be produced through induced breeding.

At Kausalyagang centre, experiments have been initiated in two ponds by stocking the fingerlings of Indian and exotic carps and that of milk fish *(Chanos chanos)* @ 6,545 nos/ha. Due to over flooding and erosion of embankments during monsoon, fishes escaped into adjoining inundations. However, the experiments are in progress. Another set of experiments has been initiated in three ponds with and without the provision of supplementary feeding. In these experiments, one pond was stocked with 5 species combination (excluding grass carp) and the remaining two ponds were stocked with 6 species combination of Indian and exotic carps. Successful induced breeding of Indian and exotic carps at this centre resulted in 29.18 lakhs spawn of Indian major carps, 20.10 lakhs spawn of common carp and 0.87 lakhs spawn of silver carp.

At Kutelabhata centre, gross and net productions of 3,338.4 and 3,152.7 kg/ha/yr respectively were obtained with six species combination of Indian and exotic carps and 3,279.2 and 3,095 kg/ha/yr respectively with five species combination (excluding grass carp). Whereas in the control pond stocked with only Indian major carps (catla, rohu and mrigal) gross and net productions of only 185.1 and 174.6 kg/ha/yr respectively were recorded.

At Godhra centre, two ponds stocked @ 5,000 fingerlings/ha with five species combination of Indian and exotic carps (eliminating silver carp) were harvested and gross productions @ 3,948—4,247 kg/ha/14 months were achieved. Induced breeding of cultivated carps was conducted successfully producing 3 lakhs spawn of Indian major carps and 5.89 lakhs spawn of common carp and the resultant fry and fingerlings were supplied to Gujarat State Fisheries Department.

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 : Three years

Preliminary experiments were undertaken during the breeding season to find out relation between hydration and spawning of carps, which showed that following the pituitary injection, the fish gains about 4% increase in their body weight within 4—5 hrs as compared to fishes kept in control.

Problem : CFCSP 4 Efficacy of Brahmaputra silt as a fertilizer in composite fish culture

Personnel : K.G. Rao and P.C. Mohanta

Duration : Two years

The experiment is in progress in two ponds at Gauhati, one pond treated with Brahmaputra silt and the other fertilized with organic and inorganic fertilisers. Both the ponds have been stocked with five species combination of Indian and exotic carps (excluding grass carp).

Problem : CFCSP 5 (Research work suspended since 1975)

Problem : CFCSP 6 Biology and role of grass carp, *Ctenopharyngodon idella* in composite fish culture

Personnel : K.K. Sukumaran and M.V. Gupta (upto 12.4.77.)

Duration : Four years

Breeding of grass carp was successfully carried out at Dhauli. Two ponds were stocked with six species combination @ 4,000 fingerlings/ha. No management measure, such as fertilisation of ponds and supplementary feeding of fishes, has been abopted except for the provision of green fodder for grass carp in one pond. The experiment is in progress.

Problem : CFCSP 7 Effects of oxygen, carbon dioxide and temperature on the metabolism and assimilation of feed in certain Indian and Chinese carps

Personnel : B.N. Singh, V.R.P. Sinha, M.V. Gupta (upto 12.4.77) and D.P. Chakraborty

Duration : Two years eight months

The effects of exygen on the rate of feeding and assimilation of food in rohu fingerlings have been investigated. The effect of temperature on the feeding and utilization of feeds have also been studied. Work on intake and assimilation of feeds by catla fry/fingerlings are in progress.

Problem : CFCSP 8 Composite fish culture without fertilisation and feeding

Personnel : D.N. Misra, H.A. Khan and B.C. Tyagi (from 1.9.77)

Duration : Three years eight months

The experiments concluded in early 1977 at Jaunpur centre revealed that the artificial feeding contributes more towards enhancing fish production than fertilizing the ponds with both organic and inorganic fertilizers. With feeds and fertilizers gross productions per ha per yr ranged from 5,100—5,886 kg as compared to 3,612—4,330 kg with supplementary feed alone; 1,681—2,745 kg with fertilizers alone; and 1,422 kg when no feed and fertilizer was provided. Further investigations are in progress.

Problem : CFCSP 9 Composite fish culture in running water

Personnel : K.N. Krishnamurthy and P.K. Aravindakshan (from 1.9.1977)

Duration : Four years

The experiment initiated in a 0.03 ha pond had to be furled up due to accidental entry of tilapia and their subsequent prolific breeding.

Problem : CFCSP 10 Operational Research Project on composite fish culture

Personnel : B.K. Sharma, V.R.P. Sinha, Dilip Kumar, Amitabha Ghosh (upto 23.9.77), M. K. Das & S.K. Das (From Sept, 1977)

Duration : Three years

The Operational Research Project on Composite Fish Culture has since

its inception in March 1973 at Krishnagar, West Bengal proved and demonstrated beyond doubt the high production potential of large sheets of water bodies (1 ha and above) through composite fish culture and the economic viability of the technology in the earlier two sets of experiments conducted during the years 1973-74 and 1975-76.

The path-breaking research initiated under the project in the third set of experiments (1976-77) with an accent to integrate fish culture with live stock has unveiled a new horizon of high fish production at remarkably low costs. Considerable progress has been achieved in integrating aquaculture with duckery, piggery, and poultry with outstanding results.

In duck-cum-fish culture experiments, still in progress, in a large sheet of water body (1.48 ha), six species culture of Indian and exotic carps stocked @ 6,000 fingerlings/ha alongwith 100 ducklings (Bengal runner and cross breed of Bengal runner & Khaki Campble) reared simultaneously on floating duck houses (50×3 ft) constructed on the pond, yielded 3,027 kg of fish in a partial harvesting during October, 1977 besides, 850 duck eggs collected as additional output. Management measures adopted included no external fertilisation of the pond or feeding of fish but for the duck droppings which go directly into the pond at an estimated rate of 10 t/100 birds/yr and automatically recycled. Based on the standing crop, another 5,190 kg of fish is estimated from the pond. The ducks have also exhibited notable growth increment.

Results of the experiments on pig-cum-fish culture are outstanding as both the fish and pigs have shown excellent growth. Under a heavy stocking density (8,500 nos/ha) and without the provision of supplementary feeding, silver carp and grass carp have grown to over 2 kg in 10 months from their initial average weights of 9 & 5 g respectively. Catla, rohu, mrigal and common carp have recorded weights of 1.3, 1.0, 0.9 and 0.6 kg respectively from respective initial average weights of 48, 28, 23 and 3 g. Another interesting and notable feature of the experiment is the feeding of the grass carp purely on cattle fodder such as *Barseem* and hybrid napier grass. No aquatic vegetation was used for feeding the grass carp. The present estimated per hectare standing crop of the pond is 8 500 kg. The pigs have attained average weight of 95.4 kg from their initial average weight of 22.5 kg on January, 1977.

Problem : CFCSP 11 Biology of the silver carp, *Hypophthalmichthys molitrix* (C & V) and its performance in composite fish culture

Personnel : B.K. Sharma

Duration : Three years

The studies on the growth and performance of silver carp in composite fish culture and in monoculture were initiated during the year.

Studies on food and feeding habits of the fish during various months of the year were conducted by analysing the gut content of the fish collected from composite fish culture ponds.

Maturity and fecundity studies of the fish were also continued.

Problem : CFCSP 12 The pituitary gonad feed back relationship in *Mystus vittatus* (Bloch)

Personnel : A. Mukherjee and V.R.P. Sinha

Duration : Three years

Due to some technical difficulties, the investigation could not be taken up during 1977. However, the work will be resumed in 1978, at Doranda Fish Farm, Ranchi.

Problem : CFCSP 13 Composite fish culture for demonstration to fish farmers

Personnel : P. Das, M. Sinha and D. Kumar

Duration : One year

One 0.32 ha pond at Jute Agricultural Research Institute, Nilganj was stocked with Indian and exotic carps @ 7,500 fingerlings/ha. A total of 1,225 kg of fish has so far been harvested and about 19% of the stocked fishes is still left in the pond.

Problem : CFCSP 14 Techno-economic and socio-economic aspects of massive fish seed production for composite fish culture

Personnel : K.K. Ghosh

Duration : Two years

Due to technical difficulties further work could not be done during the year.

Problem : CFCSP 15 Statistical evaluation of some growth parameters and their confidence intervals

Due to some technical difficulties the investigation could not be initiated during the year.

Problem : CFCSP 16 Evaluation of fish production and loss due to poaching from cultivated resources

Owing to some technical difficulties the work could not be carried out during the year.

Problem : CFCSP 17 A test on the equal catchability of tagged and non-tagged animals in mark recapture studies

Owing to some technical difficulties the work could not be carried out during the year.

Problem : CFCSP 18 Fish nutrition—protein, carbohydrate and vitamin requirements of certain Indian major carps, in relation to temperature

Personnel : B.N. Singh and V.R.P. Sinha

Duration : Three years

Experiments have been conducted on rohu and mrigal fry and fingerlings using feeds with varying protein contents. The growth of mrigal fry was studied using diets containing vitamins A, B & D. The results obtained have indicated a significant role of protein and vitamins in the growth of mrigal.

Problem : CFCSP 19 Use of some cactii as piscicides

Personnel : Dilip Kumar

Duration : Two years

Under laboratory conditions, the the latex of *Euphorbia neriifolia* and *E.*

antiquorum was found toxic to Indian major carp fingerlings when applied @ 0.5 ppm. 100% mortality of fingerlings occured within 60 minutes of exposure under laboratory conditions. Investigations to determine the exact lethal level are in progress with major carps and other species as well.

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, D.N. Singh, V.K. Murugesan, P. Kumaraiah and M.P.S. Kohli
Duration :		Eight years

Culture systems of air-breathing fishes for extensive utilisation of derelict swampy, shallow water bodies without fertilisation and supplementary feeding have been developed. Short term *Clarias* and murrel culture operations with artificial feeding have indicated productions to the tune of 5,000 kg/ha/6 months and 4,042 kg/ha/7 months respectively in the States of West Bengal and Karnataka. In Assam, a production of 1,687.5 kg/ha/yr could be achieved with the provision of cheap artficial feed, comprising rice bran and slaughter house waste (1 : 1), in murrel culture. In cage culture experiments, a production of 9 kg/m^2 cage area/yr could be achieved in weed infested water.

Induced breeding techniques of commercially important air-breathing fishes have been standardised and murrels could be, for the first time, induced bred in Bangalore. In Kalyani, 11,000 fry of magur *(Clarias batrachus)* could be produced in specially designed paddy plots (3 × 2 m) from three sets of brood fish. Nursery and rearing techniques of spawn and fry of air-breathing fishes with high survival (78%) have been evolved and demonstrated. Ecological studies of the swamps were continued.

Problem :	ABF 2	Nutrient balance of the soil and water in weed infested swamps
Personnel :		R.K. Das, P.V. Dehadrai and B. Roy
Duration :		Four years ten months

Raking of the bottom soil, containing much un-decomposed and semi-decomposed organic matter, helped in rapid mineralisation. Liming followed by raking resulted in rapid mineralisation of the organic matters when phosphate, nitrate, and ammonia increased from 3—120 mg/m^2., 120—360 mg/m^2 and 15—60 mg/l respectively. The mineralisation was also reflected in the change of pH (5.8 to 7.2) and DO (2 to 9 ppm) of water. With the increase of water soluble phosphate, the gross primary production increased from 312 5 to 1,500 mg C/m^3/hr.

Problem : ABF 3 Food conversion among air-breathing fishes

Personnel : R.N. Pal, P.V. Dehadrai, R.K. Das and B. Roy

Duration : Three years

During the year, two sets of experiments were conducted in cement cisterns stocked with magur *(Clarias batrachus)* fry @ 2,00,000 nos/ha. The fish stock was provided with an artificial feed composed of fish meal (34 5% protein) and ground-nut oilcake (34% protein) in the ratio of 4 : 1. Further, yeast was added to the feed @ 1 g/kg of fish. In the first set of experiment, the average gain in the weight of magur was observed to be 18.3 g/fish in $2\frac{1}{2}$ months whereas in the second set of experiment the average growth increment observed was slower and a net average weight gain of 5 g/fish/month was recorded. The gross fish production during the growing period of monsoon months was @ 5,500 kg/ha/2 months whereas, with enhanced photoperiod of 21 hours per day during peak winter months, the fish production registered in the backyard cisterns was to the tune of 4,000 kg/ha/3 months at an average water temperature of 18°—20°C.

Problem : ABF 4 (Research work completed in 1977)

Problem : ABF 5 (Research work completed in 1977)

Problem : ABF 6 Nutritional and bio-chemical studies of the air-breathing catfish, *Clarias batrachus*

Personnel : R.N. Pal, P.K. Mukhopadhyay, P.V. Dehadrai

Duration : Four years

Investigations on the protein requirement of magur, *Clarias batrachus*, were carried out under varying temperature conditions of summer and winter

months. No significant difference on the effect of temperature on the growth could be noted during the investigations. Maximum growth of the species was recorded with diet containing 55% protein. Total protease, trypsin and chymotrypsin—isolated, purified and characterised under different dietary levels of protein, showed maximum activity in fishes fed with diet containing 55% protein. However, higher dietary protein levels indicated no further stimulation of enzyme activity.

Problem :	ABF 7	(Research work completed in 1977)
Problem :	ABF 8	Some aspects of the toxicity metabolism and detoxication of organophosphorus pesticides in fish
Personnel :		P.K. Mukhopadhyay, P.V. Dehadrai and A. Hajra
Duration :		Two years

Air-breathing fishes, *Anabas testudineus* and *Clarias batrachus*, were found to be more resistant than non-air-breathing teleost *Tilapia mossambica*, when exposed to different concentrations of cadmium ion. Both acid and alkaline phosphatases were found to be inhibited significantly when fishes were exposed to cadmium ion (50 ppm).

Investigations are being carried out on the activities of mitcchondrial and lysosomal enzymes in the gill and liver of *C. batrachus* treated with different concentrations of Malathion—an organophosphorus pesticide.

Problem :	ABF 9	(Research work suspended since 1976)
Problem :	ABF 10	Studies on the effect of photo-period and temperature on the gonadal maturity of *Clarias batrachus* (Linn.)
Personnel :		B. Roy, P.V. Dehadrai and R.N. Pal
Duration :		Two years

It was observed that with enhanced photo-period of 21 hours per day during peak winter months, *C. batrachus* grew better at a stocking density of 2,00,000 nos./ha. The stock was daily fed with a supplementary diet, comprising ground-nut oilcake and dried marine trash fish (1 : 4) added with

yeast (1 g/1 kg feed). The treated fish attained an average size of 175.4 mm/ 67.g and showed second stage of gonadal maturity in the month of January when no such development was observed in specimens (155.5 mm/ 48.78 g) kept in control. The average initial length/weight of test animals was 130.6 mm/27.3 g.

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

A 12 ha workable area, out of approximately 20 ha., of Matikhata beel at Kalyani was surveyed for the construction of an air-breathing fish farm. Data were also collected on the total catch arrival of air-breathing fishes at Canning wholesale market. The catch composed of *H. fossilis* (8.67%), *C. batrachus* (11.64%), *A. testudineus* (27.73%), *C. striatus* (30.12%), *C. punctatus* (19.62%) and miscellaneous fishes (2.22%). However, in the lean month of October, 739.kg of air-breathing fishes on an average, arrived daily in the market when 472 kg was available between 9 p.m. and 12 midnight and 267 kg between midnight and 3 a.m. Data on the price index were also collected. The minimal prices for fry upto 7.5 cm in size were *H. fossilis* (Rs.6.2), *C. batrachus* (Rs.6.0), *A. testudineus* (Rs.3.6), *C. striatus* (Rs.3.4) and *C. punctatus* (Rs.3.25) ; however, the cost of table size fishes were Rs. 10, Rs. 11, Rs. 10.25 Rs. 7.75 and Rs. 7.5./kg respectively. The work is in progress.

Problem : ABF 12 Biochemical investigations on blood and tissues of air-breathing catfishes, *Clarias* and *Heteropneustes* in fresh-and partially saline water under different stress conditions of nutrition and toxicity

Personnel : Ansuman Hajra, P.V. Dehadrai and P.K. Mukhopadhyaya

Duration : Two years

Protein requirements of air-breathing catfishes, *C. batrachus* (av. wt. 15.2 g) and *H. fossilis* (av. wt. 10.7 g) were found to be approximately 50%.

During the studies on nutritional requirements of above catfishes, tests were conducted to assess their response to non-protein-nitrogen (N-P-N) in the diet. In a series of experiments, with as high as 50% replacement of animal protein by N-P-N at equivalent nitrogen value, for four weeks indicated 6.7% more gain in weight of experimental fishes over the control. Neither toxicity was apparent nor mortality was recorded during the experimental period. A significant increase in the activity of amino-transferase for both GOT & GPT levels was also observed in response to the addition of N-P-N in the diet. This indicates the possible pathway of N-P-N assimilation by the catfishes.

Project R : All India coordinated Research Project on Reservoir Fisheries

Problem	: R 1	Ecology and fisheries of freshwater reservoir
Personnel	:	A.V. Natarajan, G.K. Bhatnagar, Ch. Gopalakrishnayya, V.R. Desai, Y. Rama Rao, M. Ramakrishniah, A. Mathew, B.P. Gupta, V.V. Sugunan, R.K. Singh, V. Pathak, N.P. Srivastava, D.K. Kaushal, S N. Singh, G.K. Vinci (Smt) and V.T. Prabhakaran
Duration	:	Eight years

Bhavanisagar (Tamil Nadu) : The soundness of ecology-based management principles adopted for Bhavanisagar reservoir is reflected by the continuing high yield. The estimated annual yield for 1977 being 284 tonnes (*i.e.*, 77 kg/ha) for the same effort (25 units) as in 1976. The species composition of catch was largely made of *L. calbasu, C. mrigala, C. catla, L. rohita, P. dubius, L. fimbriatus, L. bata, M. aor* and *W. attu*. The carp *L. calbasu* continues to form the dominant component of the fishery contributing 38.52%. *L. rohita*, a prime major carp, which formed nil in 1971 occupies second place in fishery forming 14% *i.e.*, 40 tonnes of the total catch in 1977. This is entirely due to uninterrupted stocking of this fish from 1972 onwards. Another fish which benefited from stocking was *C. mrigala* which formed 39 tonnes (13.71%). Enhanced fishing effort has also brought in changes in the stock structure of large catfish populations. Intensive cropping has favoured the productivity of *W. attu* as reflected by the yield which rose from 11 t in 1971 to 28.4 tonnes in 1977. The increase in the productivity of *W. attu* brought in its wake corresponding decline in productivity of *M. aor* indicating inter-population competition. This observation is of

great importance in stock manipulation of *M. aor* and *W. attu* using cropping intensity as a tool. Studies reveal large scale breeding in respect of *L. calbasu* and *L. bata* as reflected by spawn index at Moolathurai in Bhavanisagar reservoir. There are also indications of breeding but on a low scale in respect of *C. catla, C. reba, L. fimbriatus* and *P. carnaticus.*

Nagarjunasagar (A.P.) : Studies in 1977 in Nagarjunasagar confirmed earlier observation that there is hardly any natural breeding or recruitment of Gangetic major carps. Only the indigenous carp *L. fimbriatus* shows indications of breeding and recruitment to some extent. This is also reflected by absence of fry or fingerlings of major carps in dragnet collections except for a stray fingerling of *L. rohita.* Unlike carps, catfishes show signs of breeding. This has tilted carp-catfish ratio in favour of the latter. The annual fish yield from the reservoir was estimated at 132 tonnes and was dominated by catfish fishery. The commercial fishery is constituted of *L. fimbriatus, L. calbasu, C. catla, L. rohita, C. mrigala, T. khudree, M. seenghala, M. aor, S. childrenii, P. taakree, P. pangasius* and *W. attu.* Amongst miscellaneous fishes *P. pulchellus, O. vigorsii, P. kolus, M. punctatus, B. bagarius* and *R. pavimentata* were cncountered.

Rihand (U.P.) : In Rihand the fish yield during January-May (5 months) was of the order of 78.79 tonnes. Closed fishing season was observed between June and November. The catch was dominated by *C. catla.* The studies conducted in 1977 confirmed earlier observations regarding the existence of 3 sub-species of *C. catla.* The sub-species distinguished by medium and short pectorals, show definite feeding preferences to *Microcystis,* a niche hardly utilised by any other indigenous fish. Natural breeding was observed in respect of *C. catla, C. mrigala, L. calbasu* and *L. rohita* as reflected by the spawn quality after rearing. But fry quality index indicated greater recruitment success in *C. catla* (17.6%) than in *C. mrigala* (4.4%), *L. calbasu* (3.5%) and *L. rohita* (2.4%).

Getalsud Reservoir (Chotanagpur Division, Bihar) : The study in Getalsud does not provide any indications of natural breeding or recruitment of major carps. The stocking, being done since 1974 has helped in building up sizeable fish stocks in the reservoir as reflected by departmental fishing just commenced. The studies are in progress.

Govindsagar (H.P.) : In Govindsagar reservoir both increase in mesh bar (from 65 mm to 200 mm) as well as increase in fishing effort (taking the year 1973 as base) have led to further remarkable increase in fish

yield in 1977 *i.e.*, 673 tonnes. This is equivalent to 61.5 kg/ha, an all time record for the reservoir. The yield rose from 21.6 kg in 1974 to 61.5 kg in 1977. The catch composition comprised *C. catla, C. mrigala, L. rohita, L. calbasu, T. putitora, C. corpio, M. seenghala, L. dero, L. bata, L. dyocheilus* and *C. reba*. The Gangetic major carps alone formed 55%. The common carp formed as much as 16.5% *i e.*, 113.7 tonnes. The sustained large scale stocking has firmly established common carp in Govindsagar and the remarkable yield of this fish from 1976 onwards is also attributable to the enlargement of mesh size and enhanced fishing effort. There are strong indications of natural breeding of silver carp (*H. molitrix*) in 1977, 47 adult fish of which escaped into the Govindsagar reservoir in 1971 due to a breach in the pond where they were kept. While the recoveries of silver carp in 1977 generally weighed between 4 and 6 kg, young ones (7 nos.) weighing less than 250 g were also captured for the first time in October this year indicating successful breeding and recruitment. This is the first known case of natural breeding of silver carp in a reservoir in India. Large scale breeding of Gangetic major carps was observed in Lunkhar Khad in lentic zone of the Govindsagar reservoir.

Ukai Reservoir (Gujarat) : In Ukai reservoir, the fishery is made of *C. catla. L. rohita, C. mrigala* and *Tor* sp. The annual fish yield was of the order of 204.239 tonnes in 1976—77. The present stock strength of Ukai is about 13% of Bhavanisagar. The effort density of Ukai is about 2% of Bhavanisagar. The studies indicate further need of stocking the reservoir with *C. catla, C. mrigala, L. rohita* and *L. calbasu* inspite of breeding and recruitment observed.

Kangsabati Reservoir (West Bengal) : In Kangsabati reservoir, the annual fish yield was of the order of 7.259 tonnes of which major carps formed 75.54%. The combined stock densities of Kangsabati reservoir form just about 8% of the level obtaining in Bhavanisagar and effort density about 24%. The study indicates the need for further stocking the reservoir with *C. catla, L. rohita, C. mrigala* and *L. calbasu*.

Project CIFRI/IDRC/WB : Rural aquaculture in India

Problem : CIFRI/IDRC/WB 1 Composite culture of carps and certain air-breathing fishes

Personnel : S.D. Tripathi, A.K. Datta, K.K. Sengupta, M.L. Bhowmick, S. Patra and M.K. Ghosal

Duration : Two years

Hanspukur-Burdwan Research Centre

Composite fish culture experiments were conducted in 15 ponds (0.10 to 1.20 ha), covering a total area of 4.61 ha. Six of the 15 ponds were stocked with grass carp at 2.5% instead of 15% as in other ponds. The stocking density of 13 ponds was 7,500 fingerlings/ha, the species ratio being silver carp 25 : grass carp 15 : common carp 15 : catla 15 : rohu 20 : mrigal 10. One pond (1.2 ha) belonging to the Indian Institute of Management, Jokha, Calcutta, could not be harvested completely during 1976—77 and was further stocked @ 5,000 fingerlings/ha. The other two ponds were stocked @ 5,000 fingerlings/ha (silver carp 30 : catla 10 : rohu 20 : mrigal 15 : common carp 20 : grass carp 5).

Production from these ponds at Hanspukur Centre ranged from 2465.5 kg/ha/9½ months to 5,644.6 kg/ha/year. In these experiments, grass carp (4,200 g) ranked first in terms of growth attained followed by silver carp (2,600 g), common carp (2,200 g), catla (2,000 g), rohu (1,500 g), and mrigal (1,160 g).

Composite culture was also attempted with magur (*Clarias batrachus*) as a component substituting grass carp. In this experiment, one pond (0.09 ha) was stocked with fingerlings of silver carp, common carp, catla, rohu and mrigal @ 7,500 nos./ha and that of magur @ 30,000 nos./ha. A production of 2,342.7 kg/ha/7 months was obtained, silver carp being the prime contributor followed by magur.

Experiments were also designed to explore the feasibility of mixed farming of common carp and magur. Five ponds (0.04—0.06 ha) covering a total area of 0.240 ha were stocked with magur fingerlings (8.9—14.8 g) @ 30,000 nos./ha (Dec. '76—January '77) whereas common carp fingerlings (1.3—3.9 g) were introduced during February—April '77 @ 5,000 nos./ha. Productions from these ponds ranged from 777.5 kg/ha/5½ months to 2,270.0 kg/ha/5⅓ months. The weight attained by both the species was encouraging.

Fish seed production : Experiments to produce seed of Indian major

carps and exotic common carp by hypophysation was the other item of programme taken up by the project during the year being reported upon. The project achieved commendable success in inducing Indian major carps and exotic common carps to breed at its various centres. In phased experiments, a total of 85,000 spawn of mrigal, 3.5 lakh of rohu, and 4.0 lakh spawn of common carp was produced by hypophysation

Common carp spawn, thus obtained, were reared in two (0.04 ha) nursery ponds each stocked @ 5 million per hectare. After 15 days, one pond yielded 86,500 fry (48.3% survival). Of the 86,500 fry, a total of 28,000 was distributed amongst the fish farmers and the rest reared in a 0.02 ha pond to the fingerling stage. Subsequently 16,000 fingerlings were supplied to the Bratacharigram Samity, Bratacharigram ; Bidhan Chandra Krishi Vidyalaya, Kalyani ; and the interested local fish farmers. As a result of accidental entry of predatory and trash fishes from adjoining canal, the experiment suffered a set-back in the second pond which yielded only 6,550 fry.

The spawn of mrigal and rohu were stocked in two nursery ponds @ 2.125 and 7 million per hectare respectively. Management measure, in terms of supplementary feeding with rice bran+ground-nut oilcake+fish meal (1 : 1 : 1), was adopted. After 15 days rearing, a total of 37,176 fry of mrigal and 2,30,000 fry of rohu could be obtained indicating a survival of 43.7 and 66.3% respectively. Of this, 63,000 fry of rohu and 4,500 fry of mrigal were distributed to a considerable number of fish farmers in the project area. In the later phase of the experiment, 4,600 rohu fingerlings were supplied to Burdwan University, Burdwan and Sewage-fed Fisheries Research Unit of CIFRI at Khardah.

Attempts were also made to breed silver carp and grass carp by administration of pituitary extract. In two cases, grass carp though responded to the treatment and produced a few eggs without stripping, total mortality of the hatchlings occurred after five days. However, silver carp did not respond.

Malda—Jalpaiguri Research Centre

Experiments on composite fish culture were carried out in 11 ponds located at different villages under the coverage of the Malda Centre. In 9 to 10 months culture, productions ranging from 4,900—7,550 kg/ha was obtained from 10 ponds. The production recorded from the other pond

was only 1,334 kg/ha/6 months, which was due to sudden fall in the water level of the pond and consistent poaching.

Demonstration of composite fish culture techniques was arranged in 13 ponds (5.07 ha total area) at Jalpaiguri Centre. The technique involving six species combination of Indian and exotic carps was adopted in 3 ponds whereas the remaining 10 ponds were stocked with fingerlings of catla, rohu, mrigal and exotic silver carps (18.75 : 25.0 : 18.75 : 37.50) at 6,000 nos./ha. The growth of the fishes in these experiments suffered considerably on account of the acidic character of soil and water, and due to dense infestation of *Microcystis* blooms. The pH was, however, maintained in the alkaline range by fortnightly application of lime.

Mono-culture of magur was also tried in a 0.058 ha pond at this Centre. Magur fingerlings (103.0mm/6.1 g) were stocked @ 40,000 nos./ha and fed on molluscan meat and oilcake (1 : 1). A production of 310 kg/ha of magur (266 mm/176 g) was obtained in 4 months indicating thereby the feasibility of magur culture in small water spreads unsuitable for carp culture.

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, K.M. Das, M.K. Ghosal and S. Patra

Duration : Two years

Analysis of soil and water samples for physico-chemical and biological charteristics was continued at Hanspukur and Malda Centres till the two centres were shifted to Burdwan and Jalpaiguri respectively. The soil and water characteristics of Malda and Hanspukur ponds were as follows.

SOIL

Pond	pH	Organic C (%)	Total N (%)	Average N (mg/100 gm)	Av. P_2O_5 (mg/100 gm)
Malda	6.6—7.2	1.5—2.5	0.1—0.25	35—65	8—16
Hans—pukur	6.4—7.2	0.8—2.5	0.04—0.18	18—30	3—8

WATER

Pond	pH	Alkalinity (ppm)	Nitrates (ppm)	Phosphates (ppm)	Sp. conductivity (mhos)	Calcium (ppm)
Malda	7.0—7.6	70—140	0.05—0.2	0.2—0.6	300—600	14—30
Hans—pukur	7.8 8.2	130—250	0.08—0.2	0.08—0.2	400—1500	14—65

The ponds at Malda were found to be more productive than those located at Hanspukur probably because of the high nitrogen, phosphorus and organic carbon contents.

Studies on the biological characteristics of the ponds at Hanspukur centre indicated that plankton volume and bottom biota ranged from 1.5—3.8 cc/50 litres and 1,110—2,398 units/sq. m respectively.

Problem : CIFRI/IDRC/WB 3 Effect of different diets on the digestibility and growth of grass carp, *Ctenopharyngodon idella*

Personnel : S.D. Tripathi and K.M. Das

Duration : Two years

Studies on the protein utilization from plant sources by grass carp indicated the rates to be 52, 50.6, 48.6 and 45% respectively with *Lemna*, *Wolffia*, *Hydrilla* and cabbage leaves.

Investigations on the evaluation of the nutritional value of the faecal matters of grass carp were made. Common carp recorded a growth of 4 g in a month subsisting exclusively on the faecal matters of the grass carp reared together (grass carp 2 : common carp 1) later fed with cabbage leaves.

In another experiment grass carp fingerlings, fed with an artificial diet prepared from leaf protein concentrate containing 30% protein, exhibited two times as fast a growth over control reared on *Lemna minor*.

Presence of significant cellulase activity has been noticed in the digestive enzymes of the intestine and hepatopancreas of grass carp fingerlings.

Problem : CIFRI/IDRC/WB 4 Feed-input fish-yield relationship for freshwater fish culture operations

Personnel : S.D. Tripathi, M. Randhir, A.K. Dutta and K.K. Sengupta

Duration : Two years

It was estimated that a feed input of 17.4, 7.5, 8.8 and 9.3 tonnes/ha gave a production of 5.2, 4.2, 5.0 and 5.3 tonnes of fish per hectare in about 10—12 months in four ponds. However, the experiment was discontinued due to the appearance of blooms and irregular feed input.

Problem : CIFRI/IDRC/WB 5 Rural aquaculture in India

Personnel : R.N. Pal and S.D. Tripathi

Duration : Two years

Mass mortality of *Catla catla* due to *Argulus* infection was controlled by treating the pond with 0.2 ppm water dispersal gammexane. Bacterial infection on silver carp was treated through oral application of Terramycin. Infectious dropsy among carps was controlled by treating the pond with 2 ppm potassium permanganate and lime (300 kg/ha). Myxobolid infection on catla was controlled by thinning out the population and supplying sufficient feed (10% of the body weight).

(c) Research contemplated :

Over and above the problems on which investigations are being continued as per the project programmes inforce, a number of problems under different projects have been proposed to be initiated during the year 1978. The details of such problems are presented below :

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

(Old programme will continue)

Problem	:	1.22.1	Culture and life-history of Cladocera from fish ponds (Old programme will continue)
Problem	:	1.25	Mass culture of phyto and zooplankton in field to feed fish (Old programme will continue)
Problem	:	1.29	Comparative study on the efficacy and economics of available fish poisons and their residual effects on the fish pond ecosystem (Old programme will continue)
Problem	:	1.31	Use of anaesthetics in transport of fry and fingerlings under oxygen packing (Old programme will continue)
Problem	:	1.33	Studies on detection of digestive enzyme complex of freshwater culturable food fishes (Old programme will continue)
Problem	:	1.34	Observations on cultural possibilities of fish in jute-retted pond water (Old programme will continue)
Problem	:	1.35	Culture of fish along with deep water paddy (Old programme will continue)
Problem	:	1.37	Devising effective sampling technique for estimating production (Old programme will continue)
Problem	:	1.39	Effect of lime in pond soils (Old programme will continue)
Problem	:	1.40	Comparative efficiency of organic manures

on the fertility of pond soils
(Old programme will continue)

Problem : 1.41 Effects of size of stocking material on production in composite fish culture
(Old programme will continue)

Problem : 1.42 To find out the statistical relationship between the inputs and fish production in composite fish culture
(Old programme will continue)

Problem : 1.43 Seasonal changes in the fat content in flesh of Indian major carps under different ecological conditions
(Old programme will continue)

Problem : 1.44 Studies on eclogical changes in newly constructed ponds and their management
(Old programme will continue)

Problem : 1.45 Culture of *Mystus seenghala* and *Mystus aor*
(Old programme will continue)

Problem : 1.46 Culture of tubificid and tendipedid worms
(Old programme will continue)

Project 2 : Induced fish breeding

Problem : 2.4 Hatching of eggs of major carps in newly designed hatching jars under controlled conditions
(Old programme will continue)

Problem : 2.6 Production of multiple broods from the same individual of major carps in the course of one year
(Old programme will continue)

Problem : 2.8 Induced breeding of important culturable fishes (other than carps)

(Old programme will continue)

Problem : 2.9 Studies of the process of maturation, ovulation and resorption of gonads in Indian major carps

(Old programme will continue)

Problem : 2.10 Pituitary gonad relationship in a free-spawning and non free-spawning carp

(Old programme will continue)

Problem : 2.11 Effect of hormones, vitamins and feeds on maturity of carps

(Old programme will continue)

Problem : 2.12 Activities of interrenal and chromaffin tissues during the process of maturation of gonads of Indian major carps from still and running waters

(Histology and histochemistry of the interrenal and chromaffin tissues for differentiating cellular organisation and their activities in relation to different stages of gonadal maturation of Indian major carps from lotic and lentic environments will be studied)

Problem : 2.13 Studies on the factors responsible for multiple spawning of carps

(Factors responsible for the multiple spawning phenomenon in carps will be elucidated)

Project 3 : Reservoir fisheries

Problem : 3.8 Fisheries of Peninsular tanks : Introduction and propagation of less known cultivable species

(Old programme will continue)

Problem	:	3.13	Composite fish culture of Indian and exotic carps in tanks simulating long seasonal irrigational tanks (Old programme will continue)
Problem	:	3.14	Ecology and fishery development of Gulariya reservoir (Old programme will continue)

Project 4 : Riverine carp spawn prospecting and collection techniques

Problem	:	4.5	Yearly variation in quality and quantity of spawn in the river Ganga (Old programme will continue)

Project 5 : Brackishwater fish farming

Problem	:	5.17	Brackishwater shell fish culture in Madras region (Old programme will continue)
Problem	:	5.18	Culture of the edible oysters in Pulicat Lake (Old programme will continue)
Problem	:	5.22	Rearing of fry of brackishwater fishes (Old programme will continue)
Problem	:	5.28	Behaviour of Lake-mouth bar and its bearing on the fishery of Lake Pulicat (Old programme will continue)
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 (Old programme will continue)

Problem	:	5.34	Stock manipulation in polyculture of Indian and exotic carps, mullets, chanos & prawns in low saline and saline ponds in Bakkhali farm (Old programme will continue)
Problem	:	5.37	Crop rotation under mixed prawn cum fish culture (Old programme will continue)
Problem	:	5.38	Stock manipulation in selective culture of *Lates calcarifer* (Old programme will Continue)
Problem	:	5.40	Stock manipulation in intensive farming for mullets and chanos in association with penaeid prawn (Old programme will continue)
Problem	:	5.41	Development of devices for large scale collection, segregation and rearing of brackishwater fish and prawn fry for stocking for intensive culture (Old programme will continue)
Problem	:	5.42	Supplementary feed for brackishwater fishes and prawns (Old programme will continue)
Problem	:	5.45	Nutrient status of Brackishwater lakes and lagoons in Peninsular region (Old programme will continue)
Problem	:	5.47	Utilisation of industrial, agricultural and municipal wastes in aquaculture (Old programme will continue)
Problem	:	5.50	Location, collection, assessment of resources, acclimatisation and transport of brackishwater fish and prawn seed (Old programme will continue)

Problem : 5.51 Studies on the ecology of commercial brackishwater bheries of variant productivity (Old programme will continue)

Problem : 5.52 Rationalisation of frequency of fertilisation of fish ponds

(The work is aimed at determining the frequency of fertilisation needed for maximum recovery of nutrients and also to correlate the available phosph orus in soil phase with water phase based on different extractants)

Problem : 5.53 Estimation of total biomass in enclosed brackishwater eco-system

(Investigations will be conducted to assess the fertility status of selected brackishwater impoundments and work out the manurial requirements for producing natural fish food organisms of both plant and animal origin for the cultivated species. Seasonal changes in productivity of these water bodies will also be studied for making predictions of rational doses of fertilisers to be used in these impoundments)

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

(The nutrient status and biological production potential of different types of intertidal soils will be determined with a view to utilislng them in the development of brackishwater aquaculture)

Problem : 5.55 Transformation and fate of applied nitrogenous and phosphatic fertilisers in saline soils of brackishwater farms

(Investigations will be taken up to assess the fate of nitrogenous and phosphatic fertilisers in soil and water phases at different salinity levels in relation to the utilisation of N & P by various fish food organisms for their growth and also to standardise the rate of fertilisation for optimum production of fish from brackishwater impoundments)

Problem : 5.56 Development of compounded feeds in relation to the nutritional requirements of *P. monodon* and other prawns

(The study is aimed at formulating the pelletised artificial feed for *P. monodon* and other prawns and also the evalution of the feeds from the point of view of utilisation and economy)

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

(Investigations will be taken up to determine whether *P. monodon* and *P. indicus* can mature and breed in brackishwater environment by eye-stalk ablation technique)

Project 6 : Freshwater prawn culture

Problem : 6.2 Culture of *Macrobrachium malcolmsonii*
(Old programme will continue)

Problem : 6.5 Culture of *Macrobrachium birmanicum choprai* in ponds
(Old programme will continue)

Problem : 6.6 Seed production of the giant freshwater prawn *Macrobrachium rosenbergii*
(Old programme will continue)

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

(Attempts will be made to find out cheap and indigenously available feeds for larval rearing of freshwater prawns *viz., Macrobrachium rosenbergii* and *M. malcolmsonii* and culture of prawn food organisms in the laboratory for rearing of prawn larvae)

Project 8 : Estuarine and brackishwater lake fisheries

Problem : 8.1 Brackishwater fish and prawn seed prospecting of the Hooghly-Matlah estuarine system

(Old programme will continue)

Problem : 8.7 Reproductive biology of culturable brackish-water fishes

(Old programme will continue)

Problem : 8.11 Studies on prawn seed trade in West Bengal based on sample census

(Assessment of the potentialities of cultivable prawn seed, collected from the Hooghly-Matlah estuarine system, will be made to workout the strategy of establishing prawn seed trade for developing commercial brackish-water prawn farming in the country)

Project 9 : Selective breeding and hybridisation

Problem : 9.4 Hybridisation of carps with required reference to cytogenetical features of the hybrids

(Old programme will continue)

Problem : 9.6 To develop suitable strains of Indian major carps

(Old programme will continue)

Problem : 9.7 Breeding of selected stock of grass carp and silver carp

(Old programme will continue)

Problem : 9.7.1 Studies on the morphology, growth and maturity of the hybrid between grass carp female and silver carp male

(Studies on the morphology, growth and maturity of the hybrids will be made for screening the hybrids with improved genetical combination to build up the stock of high yielding varieties)

Problem : 9.8 Hybridisation between *L. rohita* x *C. carpio*; *C. mrigala* x *C. carpio* and *Catla catla* x *H. molitrix*

(For production of improved strains of carp hybrids with better growth potential, attempts on hybridisation of Indian and exotic varities of carps will be made. Efforts will also be made to produce carp hybrids which may freely breed in confinement).

Project 10 : Fish farm designing

Problem : 10.2 Studying seepage losses in ponds
(Old programme will continue)

Project 11 : Economics in fishery investigations

Problem : 11.8 Returns from investment in inland fisheries research

(Studies will be made to determine the quantum of research expenditure and its pay-offs at regional, State and national levels).

Problem : 11.9 The price spread of inland fish

(Studies will be made on the existing market mechanism for fish produced from inland waters to suggest price support measures to sustain producers interest in fish production)

Project 12 : Exotic fish culture

Problem : 12.5 Techniques for large scale production of grass carp and silver carp seed
(Old programme will continue)

Problem : 12.6 Compatibility and competition between silver carp and Indian carps
(Old programme will continue)

Problem : 12.7 Optimum production of fingerlings and fish of exotic species under composite fish culture
(Old programme will continue)

Problem : 12.8 Maturity of grass carp with different feeds

(Screening of suitable feeds (aquatic weeds, fodder grass etc.) for grass carp, which will help in obtaining optimum maturity condition, will be done so as to facilitate and standardize hypophysation of the species)

Problem : 12.9 Short term large fish culture of exotic carps

(The possibilities of culturing exotic carps to raise table size fish, within a short culture period, will be assessed)

Project 13 : Coldwater fish culture

Problem : 13.14 Mass culture of fish food organisms under temperate climate

(Old programme will continue)

Problem : 13.16 Induced breeding and culture of *Schizothorax* spp.

(Old programme will continue)

Problem : 13.20 Standardisation of rearing techniques of brown trout from fry to fingerling stage

(Old programme will continue)

Problem : 13.21 Induced breeding and rearing of mahseer *(Tor putitora)* seed in running water ponds

(Old programme will continue)

Project 14 : Riverine and estuarine fish catch statistics

Problem : 14.1 Riverine fish catch statistics of the middle and lower stretch of the Ganga river system

(Old programme will continue)

Problem : 14.13 The analysis of catch and effort statistics of commercially important species of the

Hooghly-Matlah estuarine system
(Old programme will continue)

Problem : 14.15 Fish population studies of the Brahmaputra river, Gauhati

(Investigations will be conducted to assess the present status of fisheries of river Brahmaputra with a view to suggesting a guide line for its conservation and management on sound scientific principles)

Problem : 14.16 Pilot survey to evolve sampling methodology for estimating inland resources and total catch of fish in West Bengal

(Studies will be undertaken to evolve sampling methodology for estimating the resources and total catch of fish from inland waters, and the prevailing practices in pisciculture)

Project 16 : Weed control

Problem : 16.3.1 Standardisation of preparation and application technique of formulation for long-term control of rooted aquatic and noxious algae
(Old programme will continue)

Problem : 16.3.2 Control of submerged weeds by paraquat formulation
(Old programme will continue)

Problem : 16.5 Eradication of weeds by chemical treatment
(Old programme will continue)

Problem : 16 6 Autecology of aquatic weeds
(Old programme will continue)

Problem : 16.10 Recycling of animal waste and weeds in fish culture
(Old programme will continue)

Problem : 16.11 Turnover of major nutrients such as nitrogen, phosphorus and potassium in fish production
(Old programme will continue)

Problem : 16.12 Effects of herbicidal treatments on the bio-ecology of fish ponds

(Effects of herbicides, used for controlling aquatic weeds, on the aquatic biomass, with special reference to fishes will be evaluated. Residual effects and the process of biodegradation of the herbicides will also be studied)

Problem : 16.13 Studies on aggresive capacity, viability and perenniation of reproductive bodies of noxious aquatic weeds

(The period of active growth, flowering, germination and viability etc. of the reproductive bodies of common aquatic weeds in relation to environmental factors will be studied)

Project 17 : Frog farming

Problem : 17.7 Development of hatchery complex for Indian commercial frog species
(Old progrmme wiil continue)

Problem : 17.8 (a) Nursery management for Indian commrcial frog species
(Old programme will continue)

Problem : 17.9 (a) Mono-culture of *Rana hexadactyla*
(Old programme will continue)

Problem : 17.10 Culture of earthworm for feeding frogs
(Old programme will continue)

Problem : 17.11 Studies on the ecology of *Rana tigrina* Daud and their behaviour in nature

(Ecology and behavior of Indian bull frog, *R. tigrina* in nature will be studied)

Problem : 17.12 Culture possibilities of brown plant hopper, *Nilparuate lugens* for feeding frogs

(Studies will be taken up to evolve techniques of culturing *N. lugens*. Suitability of this insect as frog food will be assessed)

Problem : 17.13 Optimum per hectare production of early frogs juveniles and adults of *Rana hexadactyla*

(Investigations will be conducted to evolve and standardise the techniques of production of early frogs, & juveniles and culture of *R. hexadactyla*)

Project 18 : Sewage-fed fisheries

Problem : 18.1 Fish culture in sewage-fed ponds
(Old programme will continue)

Project 19 : Hilsa fisheries

Problem : 19.8 Culture of *Hilsa ilisha* in confined freshwater
(Old programme will continue)

Problem : 19.9 Fluctuations in the Hilsa fisheries of the Hooghly estuary
(Old programme will continue)

Project 20 : Water pollution investigations

Problem : 20.5 Investigations on the Ganga and Yamuna river ecosystems at Allahabad to determine the biological indicators of water quality
(Old programme will continue)

Probiem : 20.7 Bio-assay of selected industrial wastes disposed into the hooghly estuary
(Old programme will continue)

Problem : 20.8 Pollution studies in inland waters caused by pesticides
(Old programme will continue)

Problem : 20.9 The impact of pesticides on respiratory metabolism and energy utilisation in aquatic animals
(Old programme will continue)

Problem : 20.10 Pollutional effects of industrial wastes on aquatic eco-system
(Old programme will continue)

Problem : 20.11 Environmental pollution in the Hooghly estuary with reference to heavy metals disposed through industrial wastes
(Old programme will continue)

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

Industrial wastes usually contain organic suspensoids which may form toxic complexes with other organic matters and chemicals. Studies will be conducted to assess the effects of such toxic materials on the life processes of aquatic organisms in the estuarine zone)

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

(The study is aimed at evolving proper means of utilizing the calcutta municipal wastes for piscicultural purposes.)

Project 21 : Fisheries of river basins

Problem : 21.1 Ecology and development of Mans in Gandak Basin.
(Old programme will continue)

Project 22 : Fish culture in running water

Problem : 22.2 Cat-fish culture in running water
(Old programme will continue)

Problem : 22.3 Cage culture in lentic waters
(Old programme will continue)

Problem : 22.4 Pen culture in lentic waters

(Production potential of Indian major carps and common carp in floating wooden, bamboo or metal pens will be assessed)

Project 23 : Bundh breeding

Problem : 23.1(a) Breeding of major carps through canal breeding technique
(Old programme will continue)

Problem : 23 1(b) Bundh breeding of major carps
(Old programme will continue)

Project 24 : Freshwater aquaculture in urban and near urban areas

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

(Experiments will be conducted to assess the possibility of achieving maximum yield of Indian major carps from circulating water system when limited quantity of water is available).

Problem : 24.2 Estimation of "Satiation rate" and utilisation of pelletized feed by *Labeo rohita* and *Clarias batrachus*

(Investigations will be taken up to estimate the "feeding levels" of *Claries batrachus* and *L. rohita*, when pelletised feed is used in culture fishery operations. The study will help in understanding the "feeding pattern" and "consumption capacity" of these fishes and will help in getting the maximum return of inputs by way of rational utilisation of feed)

Project 25 : Beel fisheries

Problem : 25.1 Ecology and fishery management of a selected beel in Assam

(Observations on the ecology of the beel will be made to evolve a suitable management technique on a scientific basis for the judicial exploitation of the resources)

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture and Fish seed Production

Problem : CFCSP 1 Composite fish culture and fish seed production
(Old programme will continue)

Problem : CFCSP 3 Reproductive physiology of Indian & Chinese carps
(Old programme will continue)

Problem : CFCSP 4 Efficacy of Brahmaputra silt as a fertiliser in composite fish culture
(Old programme will continue)

Problem : CFCSP 6 Biology and role of grass carp, *Ctenopharynogodon idella* in composite fish culture
(Old programme will continue)

Problem : CFCSP 7 Effects of oxygen, carbon di-oxide and temperature on the metabolism and assimilation of feed in certain Indian and Chinese carps
(Old programme will continue)

Problem : CFCSP 8 Composite fish culture without fertilisation and feeding
(Old programme will continue)

Problem : CFCSP 9 Composite fish culture in running water
(Old programme will continue)

Problem : CFCSP 10 Operational Research Project on Composite fish culture
(Old programme will continue)

Problem : CFCSP 11 Biology of the silver carp *Hypophthalmichthys molitrix* (C. & V.) and its performance in composite fish culture
(Old programme will continue)

Problem : CFCSP 12 Pituitary gonad feed back relationship in *Mystus vittatus* (Bloch)
(Old programme will continue)

Problem : CFCSP 13 Composite fish culture for demonstration to the fish farmers
(Old programme will continue)

Problem : CFCSP 18 Fish nutrition 1. Protein, carbohydrate and vitamin requirements of certain Indian major carps in relation to temperature
(Old programme wii continue)

Problem : CFCSP 19 Use of some cactii as piscicide.
(Old programme will continue)

Problem : CFCSP 20 Popularisation of modern aquacultue techniques

(To popularise the modern fish culture technique among the fish farmers, practical demonstratian and other means of extension will be utilised as a tool to augment fish production in the country)

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
(Old programme will continue)

Problem . ABF 2 Nutrient balance of the soil and water in a weed infested swamp
(Old programme will continue)

Problem : ABF 3 Food conversion among air-breathing fishes
(Old programme will continue)

Problem : ABF 6 Nutritional and Bio-chemical studies on the air-breathing cat fish, *Claries batrachus* (Old programme will continue)

Problem : ABF 8 Some aspects of the toxicity metabolism and detoxication of organophosphorus pesticides in fish
(Old programme will continue)

Problem : ABF 11 Economic potential of air-breathing fish culture and plans for its development in certain pockets of West Bengal.
(Old programme will continue)

Problem : ABF 13 Some aspects of toxicity and metabolism of malathion and carbonuron in the air-breathing catfish, *Clarias batrachus* in relation to its culture in paddy fields.

(*In vivo* effects of sublethal concentration of malathion, a pesticide widely used in agricultural fields, on *Clarias batrachus* will be studied)

Problem : ABF 14 Bio-chemical investigations on nutrient utilisation and energy metabolism in blood and tissues of air-breathing cat fish *Clarias batrachus* and *Heteropneustes fossilis*.

(Investigation will be conducted to know the nutrient utilisation and energy metabolism in the blood and tissues of *Clarias batrachus* and *Heteropneustes fossilis*)

Project R : All India Co-ordinated Research Project on Reservoir Fisheries

Problem : R 1 Ecology and fisheries of freshwater reservoir
(Old programme will continue)

Project CIFRI/IDRC/WB : Rural Aquaculture in India

Problem : CIFRI/IDRC/WB 1 Composite culture of carps and certain air-breathing fishes
(Old programme will continue)

Problem : CIFRI/IDRC/WB 2 Chemical and biological characteristics of ponds under semi-intensive fish culture.
(Old programme will continue)

Problem : CIFRI/IDRC/WB 3 Effect of different diets on the digestibility and growth of grass carp, *Ctenopharyngodon idella*
(Old programme will continue)

Problem : CIFRI/IDRC/WB 5 Fish diseases in semi-intensive fish culture and their remidial measures
(Old programme will continue)

Problem : CIFRI/IDRC/WB 6 Assessment of energy inputs in semi-intensive fish culture
(Old programme will continue)

Problem : CIFRI/IDRC/WB 7 Effect of cation and anion exchange capacity, pH, and type of clay minerals on fertility of fish ponds

(Effect of cation and anion exchange capacity of soil on the nutrient availability in relation to pond productivity will be studied).

Problem : CIFRI/IDRC/WB 8 Nutritional requirements of silver carp

(Studies will be conducted to determine the nutritional requirements of silver carp during the different stages of growth—fry, fingerling and adult stages under different temperature conditions throughout the year)

Problem : CIFRI/IDRC/WB 9 Village response survey of the Rural Aquaculture Project and constraints in adoption of scientific techniques for fisn and fish production

(Studies will be taken up on the economic impact of the Rural Aquaculture Porject and constraints in adoption of imporved technologies of fish farming with a view to finding out their solutions)

3. PUBLICATIONS

The following papers were published by the staff of the Institute during the year 1977.

Alagaraja, K. and A. G. Jhingran 1976
Application of von Bertalanffy's growth model to *Setipinna phasa* (Hamilton) when growth is allometric. *Aquaculture,* **9** (2) : 181-186

Alagaraja, K. and M. V. Gupta 1976
A note on clipping experiments to estimate fish production in culture operations. *J. Inland Fish. Soc. India,* **8** : 157-159

Anon, 1977
Report on Dal lake, Srinagar, Kashmir with suggestion for development of its fishery. *Bull. Cent. Inland Fish. Res. Inst.,* Barrackpore., No. 24, 13 p. *(Mimeo.)*

—, 1977
A revised note on the methodology for culture of *Penaeus monodon. Misc. Contr. Cent. Inland Fish. Res. Inst.,* Barrackpore., No. 13, 10 p. *(Mimeo.)*

Banerjee, S. C., R. K. Banerjee, B. B. Pakrasi and A. Moitra 1976
Salinity problem of pond soils in the deltaic region of Lower Sunderbans. *J. Indian Soc. Soil Sci.,* **24** (1): 84-85

Barrackpore, Central Inland Fisheries Research Institute 1976
Annual Report, 1976 : 248 p.

Barrackpore, Central Inland Fisheries Research Institute 1977
Bibliography of Indian Fisheries, **16** (1-2) *(Mimeo.)*

Barrackpore, Central Inland Fisheries Research Institute 1976 & 1977
CIFRI Newsletter, **1** (3-4); **2** (1-2) and a special issue, 1976 and 1977

Basu, N. C. and B. B. Pakrasi 1976
On the occurrence of milk fish, *Chanos chanos* (Forskal) larvae in the Bakkhali region of Lower Sunderbans. *J. Inland. Fish. Soc. India,* **8** : 97-104

Bhanot, Kuljeet K. and K. K. Vass 1976
Mass rearing of *Daphnia carinata* king in the field. *J. Inland Fish. Soc. India,* **8** : 145 148

Bhowmick, R. M. and S. K. Mukhopadhy 1977
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4. EXTENSION

The Extension Section of the Institute continued to provide its services to the public, specially to the fish farmers and to the State Government Agencies.

Demonstration programme : For demonstrating the composite fish culture, with four species combination, a pond at Nilganj was stocked in May, 1976 with catla, rohu, mrigal and common carp @ 7,500 fingerlings/ha in the ratio of 3:3:2:2. The total quantity of fish harvested from the pond was 1,225.2 kg, estimated gross and net production being 3,828.75 and 3,475.7 kg/ha/yr respectively

Two demonstrations, during the course of experiment, were arranged which were attended by 87 and 143 fish farmers respectively.

Khardah Centre : A 0.25 ha demonstration pond in V.C. College Compound, Rahara, Khardah, West Bengal was stocked @ 6000 fingerlings/ha in May '77 with catla, rohu and mrigal in the ratio of 3 : 4 : 3 . After 6 months of rearing the average sizes attained by different species were : catla 773, rohu 447 and mrigal 444 g as against 60, 36 and 25 g initial average weight respectively. The experiment is expected to be completed in May 1978

Six demonstrations on application of mahua oilcake ; liming ; organic manuring ; application of inorganic fertilisers ; stocking of fingerlings ; and supplementary feeding were arranged for the benefit of fish farmers and other interested persons.

Composite fish culture at Izatnagar (U.P.) : An experiment on composite fish culture was initiated in a 0.45 ha pond of the Indian Veterinary Research Institute, Izatnagar. In this experiment no fertilization of pond and artificial feeding of fish was resorted to. The pond was, however, connected by a drain through which cattle-shed washings were allowed to flow into the pond. A total of 6769.85 kg of fish were harvested from this pond after 11 months of rearing, the resultant survival was only 43.96%.

Technical advice on nursery and rearing pond management, induced fish breeding, common carp breeding, fish pathology, weed control, air-breathing fish culture and techniques of brackishwater fish and prawn culture was given to 91 fish farmers who called at the Institute with their respective problems. Inland aquaculture and its profitability (economics) was explained to the Agricultural Officer of the United Bank of India, Calcutta to enable him in recommending loans for fishery operations to the fish farmers.

Extension staff of the Institute visited 16 ponds owned by 10 fish farmers and offered suggestions on fish culture after studying the conditions of the ponds.

Training programmes : Arrangements were made for providing training on intensive fish culture & induced breeding (at Cuttack) and fish pathology (at Barrackpore) to Md. Atwar Rahman, Sita Kundu, Baruipur, 24-Parganas from 20.6.77 to 4.7.77 and 21.9.77 to 26.9.77 respectively.

A 10-week field oriented training course on "Brackishwater Prawn and Fish Farming" was organised at Kakdwip from 26.12.77 to 5.3.78 for the officials from Orissa State, State Fisheries Corporation, West Bengal and a private fish farmer from West Bengal.

Arrangements were made for the training on aquaculture (including induced breeding) for the following foreigners at the Cuttack Research Centre and other research centres of the Institute.

Shri A.M. Jayasekara of Srilanka	from 26.1.77 to 25.7.77
5 Bangladesh trainees (Sarvashri A.Z.M. Obaidul Hoque Bhuiya, Hasan Mahamud, Rafiqul Islam Rezaul Haque, Abdus Sattar)	from 20.7.77 to 20.8.77
Shri C.H. Lugiko of Tanzania	from 22.9.77 to 1.10.77
Shri Budiono Mataosudarmo of Indonesia	from 19.10.77 to 7.11.77
Shri Alie Poernoemo of Indonesia	from 3.12.77 to 9.12.77
Sarvashri S. Chaider & R. Mukeri of Indonesia	from 8.7.77 to 6.10.77
Drs. M.M. Hafik & M.T. Kheir of Egypt	from 14.7.77 to 28.7.77
Shri H.B Abdullah of Malaysia	from 15.7.77 to 15.8.77

Shri P. Das, Scientist Extension, attended the workshop on "Agricultural Information Communication" organised jointly by Directorate of Extension, Ministry of Agriculture and the Bidhan Chandra Krishi Vishwavidyalaya at Kalyani from 28th January-3rd February, 1977.

Shri M. Sinha, Scientist S—1, delivered a lecture on 'Inland fish culture and its economic viability' to the trainees of the Induction Training Course of the United Commercial Bank, Calcutta on 28.2.77.

Shri P. Das, Scientist Extension, participated in discussion on modern fish culture techniques and their production with the fish farmers in a Fish Farmers' Day organised by Bidhan Chandra Krishi Viswa Vidyalaya, West Bengal at Chandirampore, Nadia, West Bengal on 20.3.77. He also attended the Advisory Committee and Implementation committee meetings of Operational Research Project at Nilganj on 21.3.77 and 23.3.77 respectively. Shri Das also participated in the meeting of the implementation committee of the Operational Research Project of the Jute Agricultural Research Institute, Nilganj at Gosaba on 17.5.77. Shri Das delivered a lecture on "Achievements of the Institute specially in fish culture" to the trainees of the Cooperative training College, Kalyani, Nadia on 15.9.77.

Lectures in Bengali were delivered to 11 trainees of the Don Bosco Agriculture Centre, Krishnanagar, Nadia to appraise them of the modern techniques of composite fish culture by Shri Amitabha Ghosh, Scientist working under the Operational Research Project. Krishnanagar, West Bengal

Different aspects of Composite Fish Culture technology, were demonstrated step by step to the local fish farmers of Krishnanagar, Jaynagar and Arangsarisa of Nadia district, West Bengal by Shri B. K. Sharma, Scientist-in-charge, Operational Research Project centre Krishnanagar and his associates.

Miscellaneous activities :

The following visitors were taken round the institute's laboratories and posters depicting the achievements of the Institute were explained to them The films on "Composite fish culture" and "Induced breeding" were also screened.

Thirty farmers of Barasat Block and 15 fish farmers from fisheries Training Institute, Mithapur, Patna on 16.5.77 and 14.6.77 respectively.

Students and Trainees from the following institutes visited the CIFRI Headquarters at Barrackpore. Lectures on various aspects of inland fisheries and field visits were arranged for them.

Students of Master of Engineering of All India Institute of Public Health and Hygiene on 2.2.77; Students of M. Sc. (Zoology), Calcutta University on 6.4.77; Students of M.Sc, (Zoology), Gauhati University on 11.4.77; Students of M. Sc. (Zoology) Jawahar Lal University, Imphal, Manipur from 20.6.77 to 4.7.77; Students of M. Sc. (Zoology), Government Arts and Science College, Raigarh. M. P. on 27.12.77; Students of Higher Secondary Gyan Bharati Bidyamandir, Calcutta on 3.12.77; Trainees from Nowgaon Fisheries Training Centre, Nowgaon, M. P. from 31.10.77 to 1.11.77; Trainees from CIFE Bombay from 30.8.77 to 5.9.77; Trainees from Fisheries Staff Training Institute, Madras from 14.12.77 to 17.12.77; Students of B.F.Sc, Fisheries College, Mangalore from 24.11.77 to 27.11.77; Trainees of Senior and Junior Statistician Course of the Institute of Agriculture Research Statistics, Delhi and the Block Development officers, West Bengal

Field trips to Composite Fish Culture and Fish Seed production Centre, Kulia; Air-breathing Fish Culture centre, Kalyani; Sewage-fed Fish Culture centre, Rahara; Operational Research Project Centre, Krishnanagar and IDRC Centre were arranged by the Extension Section for appraising the distinguished visitors obout the work and achievements of the Institute.

Publicity activities :

Newspaper reports : "Bidagdha" a Bengali fortnightly in its issue dated 1st January, 1977 carried an article on the noteworthy contributions of the CIFRI leading to "fish revolution" in West Bengal.

The Bengali daily "Jugantar" dated 20th March, 1977 published an article entitled "Machher chash Barate" highlighting the role of the CIFRI in increasing inland fish production in the country.

"The Statesman" reported the news of "Demonstration of one year harvest from a composite fish culture pond at Gosaba" on the 14th August, 1977 with a view to popularising fish culture in rural areas.

"Amardesh" a Bengali weekly carried an article on "air-breathing fish culture and its profitability" in their issue dated 16.9.77.

Film shows :

Films on "Induced breeding" and "Composite fish culture" were shown to : Fish farmers at Hanspukur on 16.4.77; Staff members of Gramophone Company of India, Dum Dum on 5.2.77 and Students of La Martiners School, Calcutta on 24.3.77.

Radio programmes :

The Calcutta Station of the All India Radio included in its programme 'Vigyan Bichitra' of August 18, 1977, a series of talks delivered by the Scientists of this Institute. While Shri P. Das, Scientist Extension, highlighted the role of CIFRI in the rapid development of the freshwater aquaculture, Shri K. K. Ghosh, Scientist S-2, focussed the noteworthy achievements of the Institute in the field of brackishwater fish and prawn farming. 'Diseases in fish and their control' was the other aspect covered by Shri Ajoy Kumar Ghosh, Scientist S-1,

To generate interest among the children in the aquatic wealth of the country with particular reference to fish, a talk on 'Local Aquatics' summarised by Shri P. Das, Scientist Extension was broadcast by the All India Radio, Calcutta in their English programme 'Calling All Children' on August 28, 1977

Exhibitions :

The Institute participated with charts, posters, models, specimens, living fishes, blow-up photographs, etc., in the following exhibitions :

Exhibition at Dhauli, Bhubaneswar from January 3 to 7, 1977 on the occasion of foundation stone laying ceremony of Institute's Freshwater Aquaculture Research and Training Centre.

At Seva Bharati, Kapgari (Dist. Midnapore) from February 26 to 28, 1977 on the occasion of inauguration of Krishi vigyan Kendra, Kapgari.

Scottish Church College compound, Calcutta from 9 to 11 March, 1977

"Agri Expo 77" at New Delhi from November 13 to December 14, 1977

Science Exhibition at Allahabad from November 19 to 23, 1977.

CONFERENCES AND SYMPOSIA

A talk on "The fishery resources of India and their utilisation" on the focal theme of Survey, conservation and Utilisation of Resources was delivered by Dr. V.G. Jhingran, Director on January 6, 1977 under the Zoology, Entomology & Fisheries Section at the 64th Session of the Indian Science Congress held at Bhubaneswar, Orissa.

The Weed Science Conference/Workshop in India organised by the Indian Society of Weed Science was held at the Central Plant Protection Research Institute, Rajendranagar, Hyderabad, A.P. during January 17—21, 1977 and the following papers by the Scientists of the Institute were presented.

Ramaprabhu, T. and V. Ramachandran
A review on the effects and persistence of herbicides in aquaculture,

Ramachandran, V. and T. Ramaprabhu
A field technique for preparation of slow release herbicide formulation and results of preliminary experiments on their use for control of rooted aquatic vegetation.

Patnaik, S.
Studies on the autecology of *Utricularia stellaris* L. f.

A paper entitled "The behaviourial patterns of Snake headed fishes (Ophicephalidae) observed in nature" by V.K. Murugesan and P. Kumariah was communicated for presentation at the sixth annual conference of Ichthyological Society of India held in the Department of Zoology, Central College, Bangalore University, Bangalore during 22nd-29th January, 1977.

The Workshop on "Agriculture Information Communication" jointly organised by the Directorate of Extension, Ministry of Agriculture and the Bidhan Chandra Krishi Vishwavidyalaya at Kalyani was held from January 28 to February 3, 1977. Shri P. Das, Scientist (Extension) attended the Workshop.

The Second Workshop on All India Coordinated Research Project on Brackishwater Fish Farming of the CIFRI, Barrackpore was held at Madras during January 31—February 1, 1977. Participants from various State Fisheries Depatments, Universities, Colleges, and other agencies attended the same.

The Fifth FAO/SIDA Workshop on "Aquatic pollution in relation to protection of living resources and scientific basis for management measures" was held in Manila, Philippines during February 17—27, 1977 Dr. P.V. Dehadrai, Scientist S—3 attended as a Resource Speaker besides Shri P. Ray, S—1 & Dr. M. Peer Mohamed S—1 scientists of this Institute who also participated.

The 6th Asian Pacific Weed Science Society Conference and Workshop on Weed Control in Small Scale Farms was held at Djakarta, Indonesia during 11—17th July, 1977. A paper entitled "Aquatic weeds of ponds in Assam, India" by S. Radhakrishnan & B.R. Bhuyan was communicated for presentation at the above conference.

The first working party meeting on "Genetic conservation and Utilisation in Fish" was held at Bhubaneswar in August 1977 and a working paper entitled "Genetic Conservation and utilisation in fish" by V.R.P. Sinha & K.H. Ibrahim was presented at the meeting and Sarvashri V. Ramachandran, K.H. Ibrahim, R.M. Bhowmick and Dr. S.B. Singh, scientists of this Institute participated in the same.

A Seminar on Pisciculture, organised by the Fish Farmer Development Agency, Ganjam, at Berhampur (Orissa), was attended by Dr. S.B. Singh. Sarvashri M.A.V. Lakshmanan & S. Patnaik, scientists of this Insritute. Dr. S.B. Singh acted as Chairman at one of the sessions. The following papers were presented by the Scientists of the Institute.

Chakraborty, R. D.
Intensive fresh water fish culture

Patnaik, S.
Control of algal blooms in fish ponds.

Singh, S. B.
Breeding and culture of silver carp and grass carp in Orissa.

Sen, P. R.
Rearing of carpseed in ponds

The Fifth Workshop of the All India Coordinated Research Project on Ecology and Fisheries of Reservoir was held at Ukai, Gujarat on September 7—8, 1977.

A paper entitled "Ecotoxicological hazards of the inland fisheries of India" by V.G. Jhingran was communicated for the colloquium on 'Biochemistry of fish' held at the Annamalai University during 17—19 September, 1977.

A paper entitled "Biochemical and pathobiological studies on the toxicity of malathion in the air-breathing fish, *Clarias batrachus* (Linn.) by P.K. Mukhopadhyay, P.V. Dehadrai, S.G. Dastidar and S.K. Banerjee was communicated for presentation at the All India Symposium on Metabolism and Disposition of Xenobiotics held at Marathwada University, Aurangabad during November 22—24, 1977.

A paper entitled "Adsorption of formaldihyde by Indian clay minerals in presence of phosphatic fertilisers" by K. Chandra was communicated for presentation at the convention of the Indian Society of Agricultural Chemists held at Calcutta on 27 & 28, November, 1977.

A paper entitled "Some aspects of Capture & culture fisheries of the Inland Waters of India in relation to environmental pollution" by V.G. Jhingran was presented at the INSA/HAU Symposium on Environmental Pollution and Toxicology held at Hissar, Haryana during 28—30, November, 1977.

At the "Seminar on Industrial Wastes" held on 8—9 December, 1977 in Calcutta the following five papers were presented by the Scientists of the Institute.

Ray, P., B. B Ghosh and M. M. Bagchi
The effects of variations in physico-chemical parameters on plankton biomass around the distillery outfall.

Ray, P.
Some considerations on the control and abatement of distillery wastes with special reference to aquaculture.

Ghosh, B. B. *et al.*
Effects on the biotic condition of the Hooghly estuary due to disposal of effluent from sulphite pulp & paper industry.

Banerjee, R. K. and B. B. Pakrasi
Recycling of distillery waste

Panwar, R. S.
Bioassays to determine toxicity of selected pesticides to the bivalve, *Parreysia favidens* (Benson).

A paper entitled "Estimation of fish population in ponds by mark and recapture method" by M. Rout and D.S. Murty was presented at the 31st Annual Conference of the Indian Society of Agricultural Statistics held at the Institute of Agricultural Research Statistics, New Delhi during 16—18 December, 1977.

A 10-week training course on Brackishwater Prawn and Fish Farming was started on December 26, 1977 at the Kakdwip Research Centre of the Institute. Participants from the States of Orissa and West Bengal received the training.

6. SUMMARY

Project 1 :

1.1 Fry of catla, rohu & mrigal (1 : 1 : 1), stocked in two ponds @ 2 lakhs/ha, attained average weights ranging from 14.0—25.5 g in one pond and 29.0—65.0 g in the other in three months.

Six species culture of Indian and exotic carps stocked @ 10,000 fingerlings/ha, yielded gross production of 6,021 and 4,437 kg/ha in two ponds in 9 and 10 months of rearing respectively. Management measures included nominal provision of feed & fertilisers besides periodic liming of the ponds.

Catla, rohu & mrigal (4 : 3 : 3) stocked @ 6,000/ha in two ponds (0.17 and 0.19 ha) yielded 1,458.8 and 2,027 kg/ha respectively when 23 and 27% of the stocked fishes respectively could be retrieved.

Fingerlings of catla, rohu, mrigal, silver carp and common carp (1.5 : 2.0 : 1.5 : 2.5 : 2.5) when stocked @ 6,000/ha in two identically fertilised ponds yielded productions of 2,170 kg and 2,001 kg/ha, the percentage of recovery being 66 and 51 respectively.

1.2 (Research work suspended since 1975)

1.3 & 1.4 (Research work completed in 1972)

1.5 (Research work completed in 1970)

1.6 (Research work completed in 1972)

1.7 (Research work completed in 1973)

1.8 (Research work eompleted in 1971)

1.9 to 1.11 (Research work completed in 1972)

1.12 (Research work completed in 1973)

1.13 (Research work completed in 1972)

1.14 (Research work suspended since 1975)

1.15 (Research work suspended since 1973)

1.16 (Research work completed in 1971)

1.17 (Research work suspended since 1975)

1.18 (Research work completed in 1975)

1.19 (Research work completed in 1973)

1.20 (Research work completed in 1974)

1.21 Catla & rohu spawn were stocked @ 4.5 and 2.5 million/ha respectively. The artificial feed supplied was fortified separately with cobalt chloride and manganese @ 0.01 mg/day/fish. The rate of survival was 42% with cobalt chloride as against 22% with manganese indicating thereby the former to be more effective in enhancing the survival rate.

1.22 (Research work completed in 1975)

1.22.1 Plankton sample from Killa Fish Farm ponds indicated cladocerans in high concentrations where as the copepods were in low concentrations.

1.23 (Research work completed in 1976)

1.24 From a pond fertilised with urea+potassium chloride besides, a little quantity of cowdung (@ 590 kg/ha/yr) and stocked with Indian and

exotic carp fingerlings (silver carp, catla, rohu, mrigal and common carp) @ 7,000/ha, a production of 3,431 kg/ha/yr was obtained.

Comparative studies on the efficiency of chemical fertilisers alone and in combination with organic manure were made. Triple superphosphate maintained higher level of dissolved inorganic phosphate than single superphosphate.

In yard experiments, single superphosphate recorded higher primary production while triple superphosphate gave higher plankton production.

1.25 *Cyclops* sp. population could be raised from 10 u/l to 8,500 u/l in 15 days by using dried Brewer's yeast and freshly cultured *Chlorella vulgaris*.

Daphnia lumholtzi was mass cultured under field conditions and a cell density of 15,000 u/l could be obtained in 7 days from an initial inoculum of 10 u l using dried Brewer's yeast as feed. Culture of *Brachionus mulleri* was successfully achieved with mahua oil cake (at 740 ppm).

In laboratory and yard trials, the density of *S. obliquus* could be raised from 260 u/ml to 57×10^3 cells/ml in 20 days by employing modified Bristol solution.

Sustained population of 1.2 and 1.5 million/ml of *N. cuspidata* and *P. gibba* respectively was obtained in 5 days from their respective initial density of 24,620 and 29,000/ml, by fertilising the ambient medium with urea, single super phosphate and sodium silicate (100 : 10 : 5).

Growth kinetics of *C. vulgaris* was also studied.

1.26 (Research work completed in 1977)

1.27 (Research work completed in 1977)

1.28 (Research work could not be initiated due to technical difficulties)

1.29 Data on the effective dose of mahua oilcake as fish poison and its side effects on plankton and other biota are being analysed.

1.30 Nine ponds in Pahala and Kandarpur Panchayet were prepared & stocked with Indian major carp spawn. A total of 40,300 fry was harvested from 0.047 ha area.

Composite fish culture was conducted at Korapada and a gross production of 3,499 kg/ha/3 months was obtained under limited management facilities.

1.31 To find out the narcotic effect of chemical anaesthetics, tertiary amyl alcohol, was tried at different concentrations on the fingerlings of Indian major carps. The results are being finalised.

1.32 (Research work completed in 1977)

1.33 Amylase and invertase have been detected in the G.I. tract of *Pangasius pangasius*. The average pH of the stomach, intestine & liver of the fish was found to be 6.2, 5.6 and 6.4 respectively.

1.34 (No progress of work during the year)

1.35 *C. carpio* fingerlings when stocked in a paddy plot, under cultivation with China 1034 variety of paddy, yielded a net production of 127.6 kg/ha of fish in 99 days (88% retrieval). In another experiment, *C. carpio* stocked @ 12,000/ha in a plot cultivated with C.R. 1009 variety of paddy, exhibited encouraging growth.

1.36 (Research work suspended since 1976)

1.37 For estimating fish production from a pond, different sampling procedures were adopted and the effect of variables *viz.*, size of net, actual fishing time, man-power, floats, etc., were studied. Standard errors were caloulated for sample means which showed no significant variation.

1.38 (Research work suspended since 1976)

1.39 In acid soil (pH 6.2) calcium carbonate, at higher rate, contributed to maximum increase in soil pH (6.4) and available phosphorus (4.4 mg/100 g) after 60 days. But in neutral soil (pH 7.0), the liming material with increased rates of application inflicted gradual fall in total alkalinity.

1.40 Effect of organic manures and compost were studied on equivalent carbon basis. While higher phosphate concentration was maintained with cowdung, mahua oilcake maintained high nitrogen level. *Pistia* compost caused faster mineralisation and enriched the water with phosphate and nitrogen. Maximum survival rates of carp fry, recorded with cowdung and water hyacinth composts were 70 & 65% respectively.

1.41 (Research work kept in abeyance)

1.42 Composite fish culture experiments in different regions showed that profit ratio to operation cost was maximum (173%) in the eastern region and minimum (83%) in the western region.

1.43 (Research work kept in abeyance)

1.44 No marked improvement in nutrient levels and biological production was noticed at Dhauli ponds when treated with 3 doses of inorganic and organic manures.

1.45 (Research work is being initiated)

1.46 Tubificid and tendepedids were successfully cultured in rectangular jars (0.65 m^2) using sterilized garden soil. From an initial inoculum of 250 units, at 20.5°—30.3°C, *Naias obtusa* produced 5,875 units in 13 days on emulsified Brewer's yeast.

Tendipes larvae were successfully reared in laboratory upto fly stage. The larval period was from 12—15 days at 20.5°-27.2°C. The ratio of male : female was 3 : 1. The eggs were laid in saucershaped gelatinous mass. The culture was maintained in 1-2% emulsified Brewer's yeast.

Project 2 :

2.1 (Research work completed in 1970)

2.2 (Research work completed in 1976)

2.3 (Research work completed in 1972)

2.4 A total of 2.7 million spawn of Indian major carps could be produced from 14 sets of experiments using hatching jars. Five sets of experiments conducted with silver & grass carp, yielded 0.675 million spawn.

2.5 (Research work completed in 1973)

2.6 (No progress during the year)

2.7 (Research work kept in abeyance)

2.8 Though ovulation took place, no fertilised egg could be obtained from the hypophysation experiments conducted with *Pangasius pangasius.*

2.9 Ova of *L. rohita* in stage I were found to be oval, transparent with a large nucleus and many nucleolii where as the mature ova were yolk ladden & translucent with a clear perivitelline space.

2.10 Pituitary glands and gonads of Indian major carp and common carps have been collected for further histological studies.

2.11 No conclusion could be drawn on the effects of vitamin E on the maturity and spawning of catla and rohu. Consequent to the induced breeding experiment, 41.285 lakhs of spawn could be produced.

Project 3 :

3.1 to 3.5 (Research work completed in 1972)

3.6 (Research work suspended in 1976)

3.7 (Research work completed in 1970)

3.8 *P, pulchellus* registered an average increment of 1,101 81 g in one year in Vanivilas sagar fish farm.

3.9 (Research work completed in 1976)

3.10 & 3.11 (Research work suspended in 1973)

3.12 (Research work completed in 1976)

3.13 Second composite fish culture experiment, in ASC Bangalore tank, with Indian and exotic carps is in progress. No management measure is being adopted except for manuring the pond with cowdung.

3.14 Hydro-biological parameters of Gulariya reservoir were studied. The water of the reservoir was found fairly alkaline (pH 7.4—8.4 ; alkalinity 24—80 ppm) ; DO ranged between 4.6 and 8.4 ppm and phytoplankton invariably dominated over zooplankton althrough the year. The reservoir is being stocked with fingerlings since December, 1977.

Project 4 :

4.1 & 4.2 (The research is being done under a Coordinated Project)

4.3 (Research work suspended in 1972)

4.4 (Research work suspended in 1975)

4.5 At Mandhuk on river Yamuna, a total of 13,010 ml of spawn could be collected by Midnapore type of shooting net from three floods. The catch/net/hr was estimated as 1.6, 21.2, 3.1, 7.1 and 1.3 ml in the five spurts studied. The percentage of desirable spawn was maximum in the 5th spurt.

Project 5 :

5.1 (Research work completed in 1975)

5.2 (Research work completed in 1973)

5.3 (Work programme transferred to Brackishwater Experimental Fish Farm Unit, Kakdwip)

5.4 (Research work completed in 1972)

5.5 (Research work completed in 1972)

5.6 (Research work completed in 1972)

5.7 (Research work completed in 1973)

5.8 (Research work completed in 1975)

5.9 (Research work completed in 1973)

5.10 (Research work completed in 1975)

5.11 (Research work completed in 1974)

5.12 (Research work suspended in 1977)

5.13—5.16 (Research work completed in 1975)

5.17 From 0.01 ha pond at Adyar, stocked with *P. indicus* (38.0 mm/0.3 g) @ 20,000/ha, a production of 610 g in six months was obtained.

In another experiment, *P. indicus* and *P. monodon*, stocked together @ 14,000/ha, av. growth increments of 95.7 mm/11.8 g and 1.30 mm/24.9 g respectively in 7 months were recorded.

5.18 Oysters cultured on trays and asbestos sheets registered shell heights of 45—100 and 40—85 mm respectively.

5.19 (Research work transferred to problem 5.26)

5.20 (Research work completed in 1976)

5.21 (Research work completed in 1977)

5.22 Mullet fry, stocked @ 30,000/ha, recorded an average increment of 63 mm/730 mg/140 days in pond as against 51.5 mm 371.8 mg/76 days in nylon *hapa*.

In experiments with mullet fry and *E. vaigiensis*, stocked together @ 30,000/ha, a survival of 55% was achieved. 69% survival of *Chanos* fry was obtained in experiment with no management measure being adopted. A production of 1,433.3 kg/ha/6½ months was obtained in mixed culture of *Chanos* and prawns. Experiments to study the growth rate of commercially important perch species of Pulicat lake are in progress.

5.23 A peak density of 5 million cells/ml of *Navicula lanceolata* (initially 29,000 cells/ml) could be obtained when cultured in medium fertilised with single superphosphate, urea and sodium silicate. Viability of laboratory raised sun-dried eggs of *Artemia salina* was observed to be 100%.

5.24 (a) Multiplication of *N. lanceolata* was observed to be 24 folds in 8 days and 51 folds in 17 days in 1 mg IAA/l as compared to that of the control.

5 25 (Research work suspended since 1975)

5.26 Magnitude of water soluble nitrogen was observed to be high in water with higher salinity levels. Concentration of Ca ion was found to increase with the increase of water salinity, whereas reverse was the finding in case of P.

5.27 (Research work kept in abeyance since 1976)

5.28 Due to southern accretion, lake mouth was shifted northward. Hydrobiological studies were continued. An estimated total landing of 1,019.246 t of prawns and fishes were recorded. Prawns formed the bulk of the catches (41.56%) of the lake including southern sector. Mullets formed the second dominant group (22.13% whereas crabs were least abundant (2.68%).

5.29 (Research work completed in 1977)

5.30 (Research work kept in abeyance)

5.31 *Cymodocea* sp. was the most abundant bottom microphytic (0.075—12.5 kg/m^2) followed by *Halophila* sp. *Hypnea* sp. and *Chaetomorpha* sp. were available in the southern sector of Pulicat Lake. *Hypnea* sp. (2.0 g initially), cultured in lake water in 30 cm coir rope, attained 19.0 g in 22 days. Periphyton was dominated by diatoms which recorded maximum density (4,840—1,37, 940 u/cm^2) on asbestos sheets. Plant and algal powder were tried separately or in combination as feed for mullet fry. The highest average weight increment (200 mg) was observed with *Hypnea* sp. alone as feed and the least (7.5 g) with lab-lab powder.

5.32 Several experiments, each of 60 days duration, on portunid crabs showed that in mixed culture, *P. pelagicus* exhibited higher average growth increment (10.6 mm/month) than *T. crenata* ; in laboratory the average growth increment and survival of *S. serrata*, *P. pelagicus* & *T. crenata* ranged from 3.5—10.2 mm/month and 33.3—100.0% respectively ; *P. pelagicus* showed better growth increment (12.66 mm/month—66.6% survival) in plastic cages than those cultured in glass jars ; and the growth increment of *S. serrata* was 10.61 mm/month in cages.

5.33 Seed of *E. tetradactylum* was available during May-August with peak availability during new moon phase of May. *E. tetradactylum* (10 mm) stocked @ 50,000 and 1,00,000 nos/ha attained 65·7 mm (38 days) and 84.2 mm (55 days) respectively. *E. tetradactylum* (8—11 mm) was found to ingest copepods (0.73—0.95 mm) whereas at increased lengths (45—89 mm) post-larvae of *Metapenaeus* sp. (5—6 mm) was encountered in the gut @ 73—132 nos/fish. Polychaetes dominated the food-spectra of *E. tetradactylum* in the size range of 45—89 mm.

5.34 Under repeated stocking and harvesting programme, a low saline 0.25 ha pond stocked with Indian & exotic carps, brackishwater fishes

and prawn *(P. monodon)* @ 8,000/ha gave an overall survival of 54% after one year. Amongst Indian and exotic carps, *C. mrigala* (356.8 mm/295.0 g) and common carp (344.2 mm/594.7 g) exhibited best growth. Amongst brackishwater fishes, *Mugil cephalus* showed highest growth (404.3 mm/809.2 g). and the prawn *P. monodon* attained an average growth of (198.0 mm/74.6 g). Management measures, such as fertilisation of pond with organic and inorganic fertilisers and artificial feeding @ 1.0—1.5% were adopted. Phytoplankton in the pond ranged between 110 and 580 u/l with peak abundance during March and April as against 1,100—2,914 u/l of zooplankton with peak abundance during February & July.

5.35 Out of 921 Chanos fry procured from State Fisheries Department of Tamil Nadu, 815 fry of 38, 56 and 58 mm average length stocked in three 0 02 ha ponds @ 13,000 ; 16,000 and 12,000 nos/ha respectively, attained (length/survival) 126.8 mm/74.01% (under fertilisation only) ; and 211.8/3.9% and 163.6 mm/42.2% (under fertilisation+artificial feeding) in 100 days respectively. *Chanos* fingerlings (163 mm/32.4 g), stocked @ 2,500 and 3,000 nos/ha in two 0.02 ha ponds, exhibited encouraging growth in pond under fertilisation only over those cultured in the pond under fertilisation + artificial feeding programme. In these ponds, zooplankton (500—1,300 u/l) was found to dominate over phytoplankton (100—400 u/l).

5.36 A total of 1,10,993 post-larvae of *P. monodon* (10—15 mm) was segregated from shooting net collections at Kakdwip employing 254.5 man hour. Peak abundance of larvae was during April (1,406.8 nos/hr)-May (1,344.1 nos/hr) at a salinity range of 14.83—19.5 ppt and the minimum during January (1.2 nos/hr). In 16 days rearing of the post-larvae (@ 28,500 nos/m^3) under controlled conditions (salinity-10-12% ; temperature-28°—30°C), 85.5% survival could be achieved. The rate of mortality of post larvae (20—26 mm packed @ 200 nos/l) transported (16—48 hrs) under oxygen was noted as 16—45%. A reduced rate of packing (20 nos/l) results in 100% survival.

5.37 *P. monodon* (150—170 mm/28.8 g), stocked in a 0.02 pond @ 20,000 nos/ha, yielded 304.8 kg/ha/90 days with 54.5% survival in first crop as against a production of 20 .5 kg/ha/180 days in second crop exhibiting low rates of growth and survival. In other identically stocked pond, similar low trends of production (95 0—263.7 kg/ha/280 days) and survival (1.2—31.6%) were recorded in second crop.

5.38 A total of 920 fry (4.5—25.0 mm) of *L. calcarifer* was collected from Muriganga estuary and stocked in two (0.02 ha) ponds @ 10,000/ha. *L. calcarifer* post-larvae indicated maximum growth when fed @ 15% of body weight at a stocking density of 3 nos/l. 90% survival of fry was achieved from the pond with provision of fertilisation as against 86% from the second pond with arrangements for regular change of tidal water. At 10ppt. salinity level, *bhetki* fry exhibited the maximum food intake and growth with highest conversion ratio.

5.39 In mixed culture of *P. indicus* and other prawns stocked @ 2 00,000/ha, productions achieved in three crops ranged as 666—850 kg/ha/270 days. In experiments with varying stocking density and partial harvesting, *P. indicus* and other prawns stocked jointly @ 4 lakhs/ha yielded productions ranging from 333.3—365.0 kg and 337.0 kg/ha/270 days respectively. Hydrobiological conditions of the ponds were also studied.

5.40 In 45 days rearing of *L. parsia* fry, 53.68, 45.47 and 49.79% survival were achieved. A total production of 2,049.5 kg/ha/yr was achieved in polyculture of mullets, milk-fish and penaeid prawns. Physico-chemical conditions of different experimental ponds were studied.

5.41 Shooting net collection on river Muriganga yielded 30,405 and 4,82,715 nos, fry of *L. parsia* and other commercially important fish & prawns respectively. *P. monodon* seed was abundant during April to June whereas *P. indicus* during February to July and October-November. The maximum abundance of *L. parsia* and *L. tade* fry were recorded during December to May and June to October respectively. Efficiency of shooting nets with 3.5 and 3.0 m diameter were observed to be better than those with 2.5 m diameter.

5.42 *P. monodon* (30—40 mm) fed with 25% animal and plant protein separately attained average growth of 14.0 mm/0.3 g and 15.0 mm/0.32 g respectively.

5.43 (Work programme transferred to problem 20.3)

5.44 Mineralisation of organic nitrogen from cotton seed oilcake and mahua oilcake was best effected when treated with molybdenum. Nitrogen release was observed to be higher in acidic water than in alkaline water.

5.45 Physico-chemical characteristics of soil and water of Adyar and Pulicat lakes were studied.

5.46 Experiments to raise the sp. conductivity of a brackish-water pond by the treatment of compost alone and in combination with urea + superphosphate and with N-P-K were inconclusive.

5.47 In 60 days, the C/N ratio of straw and *Eichhornia* compost could be brought down to 19.6 and 8.7 respectively from respective initial C/N ratio of 43 and 30. Microbes were found to enhance the rate of decomposition by 26% over that of control

5 48 Induced muration and breeding of penaeid prawns by eye-stalk ablation could not be achieved due to large scale mortality of gravid specimens.

5.49 Fish meal + wheat powder (1 : 2) given @ 5% of body weight to *L. tade* fry, stocked @ 10,000/ha, gave encouraging average growth increment (5 87 g/55 days) In statisticarly designed experiments, 92% survival of *L. tade* fry was achieved when fed with fish meal + rice bran (1 : 1), whereas fish meal alone as feed was found to differ significantly at 5% level of significance indicating the maximum growth. Hydo: biological conditions of different ponds were also studied.

5.50 261 *Chanos* fingerlings and 150 *M. qulio* juveniles were collected by drag net and vellon net respectively from Kovalam and Ennore backwaters.

5.51 Productivity of *bheries* of northern zone ranged between 128.1 and 422.0 mg $C/m^3/hr$ and of Southern zone between 291.2 and 626.0 mg $C/m^3/hr$.

Project 6 :

6.1 (Research work completed in 1976)

6.2 Mixed farming of prawn and fish in four ponds were continued. Artificial feeding and fertilization were done. Catla, silver carp and grass carp recorded average weight increments of 286.5, 287.3, 698.5

g in pond I; 109.7, 138.2 and 788.5 in pond II and 129.7, 187.8 and 676.3 g respectively in pond III in 5 months. During the same period. *M. malcalmsonii* registered production' to the tune of 88.5, 208.9 and 168.4 kg/ha in pond I, II & III respectively. In pond IV, where monoculture of the prawn species is in progress, an estimated production of 58.1 kg/ha has been recorded after 5 months culture. The experiments are being continued.

6.3 (Work programme transferred to problem 14.1)

6.4 Total landings of prawns, at Bhagalpur and Lalgola centres, was estimated at 5.37 t showing an increase by more than 52% over that of the last year. Larvae, released by three berried females, could be reared under laboratory conditions for a maximum period of 14 days.

6.5 Twentyone berried females of *M. birmanicum choprai* procured from Sinkaghat, were stocked in a pond bottom soil of which (30 cm thick) was removed in order to reduce turbidity and enhancing productivity of the pond. 2,00,000 hatchlings were produced and stocked in a pond of 150 m^2 area. They attained an average increment of 66 mm/1.65 g in a period of 125 days. The rearing experiment is in progress.

6.6 A total of 2,588 seeds of *M. rosenbergii* could be produced from 1st and 2nd generation adults. Prawn seed when stocked @ 15,590/ha in a 0.02 ha pond and fed with minced foot of *Pila*, broken rice and Tapioca gave net production to the tune of 479.7 kg/ha with 89% survival. In another pond where the seed were fed with vegetation diet a net production of 560.55 kg/ha/41/2 months could be achieved with 81.2% survival. Mass culture of *Chlorella*, *Chaetoceros* and rotifers could be done successfully using 20—30% sea water as the culture medium.

Project 7

7.1 & 7.2 (Research work being conducted under a coordinated project)

Project 8 :

8.1 Fish and prawn seed prospecting conducted with a modified type of standard spawn collection net, revealed that *P. indicus*, *M. brevicornis* and

M. rude were available throughout the year in varying concentration at the centres on the Ichhamati estuary. At Raidhighi on the Thakuran estuary *P. styliferus* was found to be the most dominant amongst prawns while *M. cephalus* and *I. elongata* chiefly represented the fish species. *M. rude* amongst the prawn and *L. parsia* amongst the fishes were found dominant in the Matlah whereas around Kakdwip, on the Hooghly estuary, mullets and *E. tetradactylum* were the principal commercially important species encountered.

8.2 & 8.3 (Research work completed in 1973)

8.4 (Research programme merged with problem 8.1)

8.5 (Research work completed in 1976)

8,6 (Research work kept in abeyance)

8.7 Gonads of *S. panijus*, *S. argus* and *G. giuris* have been collected for further studies on various developmental stages. *S. panijus* and *G. giuris* females with eggs in 5th and 6th stage of maturity, could be collected during January, May & August and April to August respectively.

Project 9 :

9.1 (Research work completed in 1973)

9.2 (Research work completed in 1972)

9.3 (Research work suspended since 1973)

9.4 Catla - rohu hybrids, which attained maturity in three years, could be successfully induced bred and rearing of F_2 offsprings is in progress. Studies on the maturity of catla - rohu hybrids are also in progress.

9.5 Catla - rohu hybrid has been induced bred and 0.75 lakh of spawn produced Rearing of the offsprings is in progress.

9.6 To develop suitable strains of Indian major carps a stock of brood fishes is being raised.

9.7 Tagging of induced bred silver carp and grass carp has been done. Hybridisation between grass carp female and silver carp male

could be achieved and the viable progeny produced is being reared. Hybrid between silver carp ♀ and catla ♂ was also produced and the only surviving offspring is being reared.

9.8 Rohu × common carp and catla × silver carp hybrids have been produced. Studies on the embryological, morphological, biological, and genitical features of the hybrids are being made.

Project 10 :

10.1 (Research work c mpleted in 1977)

10.2 Studies on the seepage loss were conducted in 18 newly constructed ponds at Dhauli.

Project 11 :

11.1 & 11.2 (Research work completed in 1974)

11.3 (Research work completed in 1973)

11.4 & 11.6 (Research work completed in 1976)

11.6 & 11.7 (Research work completed in 1977)

Project 12 :

12.1 & 12.2 (Research work completed in 1973)

12.3 (Research work completed in 1972)

12.4 (Research work completed in 1976)

12.5 17 sets of grass carp (*C. idella*) and 23 sets of silver carp (*H. molitrix*) were bred successfully. Response to hypophysation was found to be better in moat and river than in ponds. Altogether 4.35 lakhs of grass carp and 3.05 lakhs silver carp spawn could be produced.

12.6 Studies conducted to determine the compatibility and competition between silver carp and Indian major carps indicated that the

growth of rohu suffered slightly in presence of silver carp as compared to catla.

12.7 Rearing experiment conducted in a 0.05 ha pond at a stocking density of 5,000/ha and with the species ratio Sc 4 : Gc 3 : Cc. 3, yielded a production of 1,925.37 kg/ha/yr when no supplementary feeding was resorted to excepting supplying weeds to grass carp. Experiment on the rearing of exotic carps at a stocking density of 2.5 lakhs/ha is in progress.

Project 13 :

13.1 (Research work completed in 1970)

13.2 (Research work completed in 1977)

13.3 (Research work completed in 1971)

13.4 & 13.5 (Research work completed in 1970)

13.6 (Research work completed in 1972)

13.7 (Research work completed in 1970)

13.8 (Research work completed in 1977)

13.9 (Research work suspended since 1972)

13.10 (Research work suspended since 1976)

13.11 & 13.12 (Research work suspended since 1975)

13.13 (Research work completed in 1977)

13.14 Of the different media tried for crude culture of *Daphnia*, cowdung extract gave the best result followed by sheep manure.

13.15 & 13.16 (Research work kept in abeyance)

13.17 (Research work completed in 1977)

13.18 (Research work completed in 1976)

13.19 (Research work completed in 1977)

13.20 (Research work kept in abeyance)

13.21 While all males responded to hypophysation, one female of *T. putitora* responded partially to hypophysation and on subsequent stripping, produced 1,200 eggs but hatchlings did not survive due to *Saprolegnia* infection. Studies on the maturation of the species indicated that the eggs mature in batches and in succession.

Project 14 :

14 1 The fish landing from the middle and lower stretches of the river Ganga was estimated to be 269.70 t. Species-wise landings at Sadiapur, Daragunj, Buxar, Bhagalpur and Lalgola were estimated.

14.2 (Research programme merged with problem 14.1)

14.3 (Research work completed in 1969)

14.4 (Research work completed in 1971)

14.5 (Research work completed in 1973)

14.6 (Research work kept in abeyance)

14.7 (Research work completed in 1977)

14.8 (Research work suspended since 1975)

14.9 (Research work suspended since 1974)

14.10 Observations on the hydrobiological conditions were made at 8 stations on the Hooghly-Matlah estuarine system. The Salinity level of the estuary dropped down due to freshwater discharge from the Farakka Barrage. The plankton density in the estuary was observed to have increased significantly.

14.11 Statistical evaluation of sampling tachnique of plankton was continued. Repeated estimations of primary productivity have shown high degree of variation.

14.12 Various methods of estimating population sizes and mortality are being examined to find out the robustness ef estimators.

14.13 Studies on the level of exploitation and population dynamics of commercially important fish species of the Hooghly-Matlah estuarine

system indicated 6% rise in the total landing during the year. Seasonal indices of total landings have been constructed

14.14 Hydrobiological studies of the River Ganga were made. The net primary productivity was found to be the maximum during November and the minimum during July. Maximum abundance of phyto-and zooplankton were observed during June

Project 15 :

15.1 (Research work completed in 1973)

Project 16 :

16.1 (Research work completed in 1973)

16.2 (Research is being done under Problem 16.7)

16.3 *Ottelia* and *Nymphoides* infestations were completely controlled when brick pellets soaked in 2—40 were applied @ 12 kg/ha. *Scirpus* sp. infestation could be completely destroyed with foliar application of 2—4D. Diuron has been found to be effective in controlling *Panicum* sp. and *Ottelia* sp. 4 ppm *a.i.* of Diuron effectively cleared *Microcystis* blooms in a nursery pond without affecting the fish. Foliar application of 3—4 dichloropropinanilid @ 2 kg a i./ha effectively controlled *Panicum* sp.

16.4 (Research work completed in 1973)

16.5 (Complete destruction of *Salvinia* and *Pitia* coulds be achieved by two applications of $CuSO_4$ @ 35 kg/ha, at 23 days Super phosphate (1.500 kg/ha) when applied in combination with mustard oilcake powder was found to be effective in controlling the excess growth of rooted & floating aquatic vegetation. *Vallisuerir* showed less affectation than *Hydrilla* when subjected to 500 kg/ha of Super phosphate and mustard oilcake treatment followed by a second application of 100 kg/ha of the same ingredient. Laboratory and field experiments to ascertain the optimum dosage of applications of urea and other weed controlling agents were also continued

16.6 Autecological studies of aquatic plants in relation to water and soil samples were continued.

16.7 (Research work completed in 1977)

16.8 (Research work completed in 1976)

16.9 (Research work completed in 1976)

16.10 Cattle shed washins were found to contain 2.3 mg P and 467 mg N/l.

16.11 (No progress during the year)

Project 17 :

17.1 to 17.4 (Research work completed in 1973)

17.5 (Research work suspended since 1972)

17.6 (Research work completed in 1975)

17.7 Successful hatching of *Rana tigrina* could be achieved in the newly developed hatching jars. The period of incubation of eggs could be reduced. 42,000 hatchlings of the species could be produced during the experiments.

17.8 (a) 5,000 tadpoles of *Rana hexadactyla* and 42,000 hatchlings of *R. tigrina* were produced. 81% survival of *R. hexadactyla* tadpoles could be achieved in rearing experiments when they were stocked @ 450 nos/400 l and fed with *Hydrilla* twigs.

17.8 (b) (Research work suspended since 1977)

17.9 (a) (No progress during the year)

17.9 (b) (Research work completed in 1976)

17.9 (c) *R. hexadactyla* could be bred twice during spring and monsoon and 2,500 and 3,000 tadpoles could be produced respectively. Of the 3 species of aquatic plants tried, *Hydrilla* was proved to be the best for the tadpoles. In rearing experiments with juveniles, heteromorphic growth was observed with males growing to smaller size than females.

17.10 25 times multiplications of *Pheretima* sp. could be achieved when they were reared in a medium comprising compost manure, cowdung and rotten leaves in the ratio of 1 : 1 : 1.

Project 18 :

18.1 *T. mossambica*, when stocked @ 20,000/ha in a sewage fed pond (0.076 ha), recorded a production of 4,077 kg/ha/7 months,

Net production of 6,971 kg/ha/yr could be obtained in five species culture of Indian and exotic carps when stocked @ 15,000/ha, in a 0.17 ha sewage fed pond without feeding and fertilisation. Another experiment with five species combination of Indian and exotic carps has been initiated in September, 1977. The experiment is in progress. Protein content of rohu and mrigal from Sewage fed pond was found to be 7.46 and 8.78% respectively. Paddy-cum-fish culture experiment is in progress in a 1.02 ha paddy plot where a deepwater pest resistant variety of Paddy "Jalachi 2" is being cultivated. The growth of fingrlings of Indian major carps during the first three months has been encouraging.

Project 19 :

19.1	(Research work completed in 1973)
19.2	(Research work completed in 1974)
19.3	(Research work suspended since 1973)
19.4 & 19.5	(Research work completed in 1973)
19.6	(Research work suspended since 1973)
19.7	(The work under this problem has been merged with 14.1)

19.8 No progress of work could be made as no mature female hilsa could be collected from the fishing ground at Farakka.

19.9 Hilsa landing from the freshwater zone of Hooghly estuary during February-July was estimated as 42, 392 kg.

Project 20

20.1 (Research work completed in 1973)

20.2 (Research work completed In 1975)

20.3 The stretches of the Hooghly-Matlah estuary which virtually do not receive any industrial effluents showed high gross primary production and plankton abundance than those stretches which receive the effluents from tanneries and pulp and paper factory.

20.4 Plankton and benthos distribution in Hooghly estuary at the out fall areas of Titagarh Paper Mill, Titagarh municipal Sewage plant and Batanagar area were studied which indicated Titagarh municipal sewage area as the most productive.

20.5 Hydrobiological studies in the Ganga and Yamuna rivers at three points, above, below and at the outfall areas of sewage discharge, were made.

20.6 (No progress of work during the year)

20.7 C 50 values for synthetic rayon wastes on shrimp and *Daphnia* sp. were determined through short term (96 hr) bio-assay studies.

20.8 Experiments were conducted to determine the accumulation of DDT-25 EC in different tissues of *L. rohita* and *C. mrigala*. Bio-assay studies indicated that DDT and Y-BHC were more toxic than malathion to *L. rohita*. Oligochaets were found to be more susceptible to DDT and BHC than malathion.

20.9 Sublethal exposure of BHC at room temperature shifted the SMR of *Catla catla* from 100 mg/kg/hr to 150 mg/kg/hr. Upper temperature tolerance limit of *C. fasciata* (2—3 g) was observed to be 40.1°C. Influence of sublethal BHC on the upper temerature tolerance limit of *C. mrigala* was studied.

20.10 Hydrobiological data were collected from the outfall area of the effluents of an industrial establishment manufacturing bleaching powder, caustic soda, etc., with a view to assessing the load of pollution. *Microcystis* bloom which is normally observed during monsoon disappeared after discharge of the effluents. Large scale mortality of fish was observed at the outfall area.

Project 21 :

21.1 & 21.2 (Research work suspended since 1973)

Project 22 :

22.1 (a) (Investigations suspended)

22.1 (b) & 22.1 (c) (Research work kept in abeyance)

22.2 A 45 km stretch in the Ganga and 6 km stretch in the Yamuna were surveyed. *M. seenghala* fry were encountered only in the Ganga with maximum abundance during May. Fry of *M. seenghala* (below 30 mm), were fed on chironomid egg mass. Semiboiled trash fish ; semiboiled trash fish + mustard oilcake + rice bran etc. were tried as feeds during the rearing experiments and the fishes were found not to accept pelleted feed.

22.3 Carps cultured in wooden frame cages ($2 \times 7.5 \times 1.5$ m) exhibited good growth during June to August in jari tank. Catla registered better growth than mrigal. Soyabean powder + ground nut oilcake + rice polish was tried as feed. New sets of rearing experiments are in progress.

Project 23 :

23.1 (a) Breeding of *C. mrigala* and *C. idella* could be successfully achieved by simulating natural environment by way of rushing in water from the Balan Canal (near Allahabad) into the specially constructed "Breeding chamber". This technique of breeding the fish has been designated as "Canal Breeding Technique".

23.1 (b) Bundh breeding experiments were conducted in an abandoned paddy field by raising embankments and simulating riverine conditions with in the bundh by drawing water from Roro canal. No fish responded even after pituitary extract administration except for one pair of rohu which produced 1,61,000 eggs.

Project CFCSP :

CFCSP 1 Gross productions of 5,909 and 3,222 kg/ha/6 months could be obtained with 6 and 5 species combinations of Indian and exotic

carps at Karnal Centre. At Jaunpur Centre, gross productions of 5,100 and 5,887 kg/ha/yr could be achieved in two ponds by culturing Indian and exotic carps and with provision of fertiliser and feeding. At Kalyani, 6 species combination of Indian and exotic carps yielded gross productions of 3,177 and 4,250 kg/ha/yr from two ponds when no feeding and fertilisation were done for 7 months. At Badampudi, 6 species combination, substituting grass carp by *M. malcolmsonii* recorded gross production of 2,078 kg/ha/16 months. At Gauhati, net productions ranging from 6,015.8 to 6,232.8 kg/ha/yr could be obtained, while at Pune gross production of 5,726 kg/ha/yr was recorded. *Puntius gonionotus* was successfully bred at Kalyani sub-centre West Bengal. Gross productions of 2,365 kg/ha 262 days and 2,036 kg/ha/264 days ; 3,338.4 kg/ha/yr could be obtained at Coimbatore and Kutelabhata centre respectively with 6 species combnation. Spawn of Indian & exotic carps were produced at all the centres excepting Kutelabhata.

CFCSP 2 (Research work completed in 1977)

CFCSP 3 Experiments conducted to find out the relation between hydration and spawning of carps indicated that the fish gains about 4% body weight within 4—5 hr following hypophysation.

CFCSP 4 Experiments to findout the efficacy of Bramhaputra silt have been initiated in two ponds at Gauhati

CFCSP 5 (Research work suspended in 1975)

CFCSP 6 Grass carp was successfully bred at Dhauli. Experiments to evaluate the role of grass carp in composite fish culture are in progress.

CFCSP 7 Effects of oxygen and temperature on the rate of feeding and utilisation of feed in rohu fingerlings are being studied.

CFCSP 8 In composite fish culture using feed and fertiliser, the gross productions ranged between 5,100 and 5,886 kg/ha/yr as compared to 3,612—4 330 kg/ha/yr with supplementary feed alone ; 1,681—2,745 kg with fertiliser alone and 1,422 kg/ha/yr without fertilisation and feeding.

CFCSP 9 (No progress during the year)

CFCSP 10 An estimated production of over 8,200 kg/ha/yr of fish was obtained from the duck-cum-fish culture pond (1.48 ha). In addition to

this 850 duck eggs have also been collected. In pig-cum-fish culture an estimated production of 8,500 kg/ha/yr could be achieved when Indian and exotic carps were cultured at a stocking density of 8,500 fingerlings/ha. Management measures adopted were feeding the grass carp with cattle fodder and fertilising the pond (0.1 ha) periodically with pig dung. The pigs have attained average weight of 95.4 kg from their initial average weight of 22.5 kg during the course of one year.

CFCSP 11 Studies on the biology of silver carp have been initiated.

CFCSP 12 (No progress of work during the year)

CFCSP 13 A total of 1,225 kg of fish could be harvested from a 0.32 ha pond when Indian and exotic carps were cultured at a stocking density of 7,500/ha.

CFCSP 14
CFCSP 15
CFCSP 16
CFCSP 17
(No progress of work during the year)

CFCSP 18 Proteins and vitamins were observed to have significant role in supporting the growth of mrigal.

CFCSP 19 Latex of *Euphorbia* spp. was found toxic to Indian major carp fingerlings.

Project ABF

ABF 1 Short term *Clarias* culture with supplementary feeding yielded a production of 5,000 kg/ha/6 month in West Bengal. A production of 4,041 kg/ha/7 month was obtained from murrel culture in Karnataka. In Assam a production of 9 kg/m^2 could be achieved in cage culture experiments. 11,000 magur fry could be produced in specially designed paddy fields at Kalyani.

ABF 2 Liming followed by raking of bottom soil resulted in rapid mineralisation of the organic matters in a swampy pond at Kalyani.

ABF 3 In cisterns *Clarias* fry stocked @ 2,00,000/haand fed with artificial feed registered significant growth. With enhanced photoperiod during winter months (18—20°C) *Clarias* registered better growth and a production of 4,000 kg/ha/3 months could be achieved during this period.

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

ABF 6 Maximum growth of magur was achieved with diet containing 35% protein. Collulase and amylase activity was detected in the intestine of *Clarias*.

ABF 7 (Research work completed in 1977)

ABF 8 *Anabas* and *Clarias* were found to be more resistant to cadmium ion intoxication than *Tilapia mossambica*.

ABF 9 (Research work suspended in 1976)

ABF 10 *C. batrachus* was observed to grow better when exposed to longer photoperiod and attained gonodal maturity in January when no such maturity was observed in specimens kept as control.

ABF 11 A 12 ha area of Matikatabeel at Kalyani was surveyed. Landing data of air breathing fishes were collected from Canning wholesale market.

ABF 12 Protein requirements of *C. batrachus* and *H. fossilis* were observed to be about 50%. Replacement of 50% animal protein by N-P-N indicated better gain in weight and no toxicity was apparent nor mortality recorded during the experiments.

Project R :

R 1 Investigations on the physico-chemical conditions of soil and water, primary productivity, fish population dynamics etc. were carried out in Bhavanisagar, Nagarjunasagar, Rihand, Getalsud and Govind sagar reservoirs.

In Bhavanisagar and Govindsagar, the fish yield could be raised to 77 and 61.5 kg/ha/yr respectively. The existance of 3 sub-species of catla in Rihand reservoir was confirmed. Fish yield from Nagarjunasagar was estimated at 132 t during the year. Natural breeding of major carps was

not observed in Nagarjunasagar and Getalsud reservoirs. Catla rohu, mrigal and *Tor* spp. were found to be the prime contributors in the fishery of Ukai reservoir. Major carps formed more than 75% of the total catch in Kangsabati reservoir.

Project CIFRI/IDRC/WB :

CIFRI/IDRC/WB 1 A total of 85,000, 3.5 lakhs and 4 lakhs spawn of mrigal, rohu and common carp respectively were produced.

From 15 different ponds, production ranging from 2,465.5 kg/ha/9$\frac{1}{2}$ months—5,644.6 kg/ha/yr were achieved.

A production of 2,342.7 kg/ha/7 months was achieved by culturing magur with carps in a 0.09 ha pond. In 5 ponds magur and common carp were cultured together and the production/ha ranged from 777.5 kg/5$\frac{1}{2}$—2,270 kg/5$\frac{1}{3}$ months. In this experiment average weight gained by magur ranged as 56.1—89.9 g.

At Malda the production ranged from 4,900—7,550 kg/ha/9—10 months from 10 ponds. The production recorded at Jalpaiguri centre was poor.

A production of 310 kg/ha of magur was obtained when fingerlings (103 mm/6.1 g) were stocked @ 4,000/ha and fed with molluscan meat and oil cake (1 : 1).

CIFRI/IDRC/WB 2 The ponds at Malda were found to be more productive than those at Hanspukur.

CIFRI/IDRC/WB 3 Grass carp showed a protein utilisation of 52, 50.6, 48.6 and 45% when fed with *Lemna*, *Wolffia*, *Hydrilla* and cabbage leaves, respectively.

Grass carp fingerlings when fed with leaf protein concentrate, containing 30% protein, recorded two times faster growth then those in control.

Cellulase activity was observed in the intestine and hepatopancreas of grass carp fingerling.

CIFRI/IDRC/WB 4 Fish-yield and supplementary feeding relationship were studied by administrating various diets to the fish.

CIFRI/IDRC/WB 5 *Argulus* infection could be controlled by applying gammoxene @ 0.2 ppm. Bacterial infection on grass carp could be checked by oral application of terramycin. Dropsy was treated by applying potassium permanganate (2ppm) and lime in water.

7. PERSONNEL

Retirement :

Shri M. K. Sarkar. Accounts Officer and Shri S. N. Chakraborty, Assistant Administrative Officer retired during the year under report.

Promotion :

The following promotions took place during the year under report :

Shri B. B. Pakrasi	:	Scientist 2	to	Scientist 3
Dr. K. L. Sehgal	:	Scientist 1	to	Scientist 2
Shri M. V. Gupta	:	Scientist 1	to	Scientist 2
Shri H. A. Khan	:	Scientist 1	to	Scientist 2
Shri B. N. Saigal	:	Scientist 1	to	Scientist 2
Shri A. Ghosh	:	Scientist 1	to	Scientist 2
Dr. S. P. Ayyar		Scientist 1	to	Scientist 2
Shri R. N. Pal	:	Scientist 1	to	Scientist 2
Shri B. V. Govind	:	Scientist 1	to	Scientist 2
Shri P. R. Sen	:	Scientist 1	to	Scientist 2
Shri N. G. S Rao	:	Scientist 1	to	Scientist 2
Dr. M. Subrahmanyam	:	Scientist 1	to	Scientist 2
Shri K. H. Ibrahim	:	Scientist 1	to	Scientist 2
Dr. Y. Rama Rao	:	Scientist 1	to	Scientist 2
Shri Ravish Chandra	:	Scientist 1	to	Scientist 2
Shri D. V. Pahwa	:	Scientist 1	to	Scientist 2
Shri K. K. Ghosh	:	Scientist 1	to	Scientist 2
Dr. K. Alagaraja	:	Scientist 1	to	Scientist 2
Shri G. N. Saha	:	Scientist 1	to	Scientist 2
Dr. (Miss) E. Mitra	:	Scientist 1	to	Scientist 2
Shri S. Patnaik	:	Scientist 1	to	Scientist 2
Shri T. Ramaprabhu	:	Scientist 1	to	Scientist 2

Shri P. L. N. Rao	:	Scientist	to	Scientist 1
Shri L. H. Rao	:	Scientist	to	Scientist 1
Dr. P. M. Mathew	:	Scientist	to	Scientist 1
Shri D. N. Mishra	:	Scientist	to	Scientist 1
Shri Balbir Singh	:	Scientist	to	Scientist 1
Shri M. Kaliyamurthy	:	Scientist	to	Scientist 1
Shri C. B. Joshi	:	Scientist	to	Scientist 1
Shri Shyam Sundar	:	Scientist	to	Scientist 1
Shri S. D. Gupta	:	Scientist	to	Scientist 1
Shri R. K. Saxena	:	Scientist	to	Scientist 1
Shri S. Srinivasagam	:	Scientist	to	Scientist 1
Shri K. J. Rao	:	Scientist	to	Scientist 1
Shri C. P. Rangaswamy	:	Scientist	to	Scientist 1
Shri M. Ramakrishniah	:	Scientist	to	Scientist 1
Shri H. C. Joshi	:	Scientist	to	Scientist 1
Shri D. P. Chakraborty	:	Scientist	to	Scientist 1
Shri S. N. Mehrotra	:	Scientist	to	Scientist 1
Shri S. C. Banerjee	:	Scientist	to	Scientist 1
Shri R. K. Banerjee	:	Scientist	to	Scientist 1
Shri S. C. Thakurta	:	Scientist	to	Scientist 1
Shri S. R. Ghosh	:	Scientist	to	Scientist 1
Shri R. K. Chakraborty	:	Scientist	to	Scietnist 1
Shri S. Radhakrishnan	:	Scientist	to	Scientist 1
Shri Kuldip Kumar	:	Scientist	to	Scientist 1
Shri B. L. Pandey	:	Scientist	to	Scientist 1
Shri M. A. Khan	:	Scientist	to	Scientist 1

The following Technical personnel were promoted to the next higher grade during the year under report.

Shri M. D. Pisolkar	:	Grade T-II-3	to	Grade T-4
Shri T. S. Ramaraju	:	Grade T-II-3	to	Grade T-4
Shri K. S. Rao	:	Grade T-II-3	to	Grade T-4
Shri R. C. Singh	:	Grade T-II-3	to	Grade T-4
Shri S. K. Sarkar	:	Grade T-II-3	to	Grade T-4
Shri B. K. Banerjee	:	Grade T-II-3	to	Grade T-4
Shri P. V. G. K Reddy	:	Grade T-II-3	to	Grade T-4
Shri S. L. Raghavan	:	Grade T-II-3	to	Grade T-4
Shri P. K. Pandit	:	Grade T-II-3	to	Grade T-4
Shri P. R. Das	:	Garde T-II-3	to	Grade T-4
Shri P. B. Das	:	Grade T-II-3	to	Grade T-4
Shri A. R. Chowdhury	:	Grade T-II-3	to	Grade T-4
Shri B. K. Saha	:	Grade T-II-3	to	Grade T-4
Shri R. N. De	:	Grade T-II-3	to	Grade T-4
Shri A. K. Roy	:	Grade T-2	to	Grade T-II-3

Shri G. P. Bhattacharjee		Grade T-2	to	Grade T-II-3
Shri H. K. Sen	:	Grade T-2	to	Grade T-II-3
Shri P. M. Abdul Kadir	:	Grade T-2	to	Grade T-II-3
Shri V. Panigrahi	:	Grade T-2	to	Grade T-II-3
Shri K. M. Das	:	Grade T-2	to	Grade T-II-3
Shri Md. F. Rahman	:	Grade T-2	to	Grade T-II-3
Shri P. S. C. Bose	:	Grade T-2	to	Grade T-II-3
Shri Bhaskar Ghosh	:	Grade T-2	to	Grade T-II-3
Shri D. N. Srivastava	:	Grade T-2	to	Grade T-II-3
Shri Ram Chandra	:	Grade T-2	to	Grade T-II-3
Shri K. K. Agarwal	:	Grade T-2	to	Grade T-II-3
Shri N. D. Sarkar	:	Garde T-2	to	Grade T-II-3
Shri R. C Satpathy	:	Grade T-2	to	Grade T-II-3
Shri Ramji Tiwari	:	Grade T-1	to	Grade T-2
Shri S. Battacharjee	:	Grade T-1	to	Grade T-2
Shri J. C. Saha	:	Grade T-1	to	Grade T-2
Shri R. M. Roy	:	Grade T-1	to	Grade T-2
Shri S. C. Das	:	Grade T-1	to	Grede T-2
Shri Basmadhya	:	Grade T-1	to	Grade T-2
Shri R. N Singh	:	Grade T-1	to	Grade T-2
Shri D. Tarai	:	Grade T-1	to	Grade T-2
Shri B. B. Sethi		Grade T-1	to	Grade T-2
Shri R. S. Negi	:	Grade T-1	to	Grade T-2
Shri S. R. Halder	:	Jr. Clerk	to	Sr. Clerk
Shri Jagannath Banerjee	:	Jr. Clerk	to	Senior Clerk
Shri N. Behera	:	Fieldman	to	Lab. Boy
Shri Lalit Bahadur	:	Watchman	to	Fieldman
Shri S. N. Burman	:	Fisherman	to	Lab-cum-Fieldman
Shri Salekh Chand	:	Sweeper	to	Lab. Boy
Shri R. C. Biswas	:	Fisherman	to	Lab. Boy
Shri H. L. Biswas	:	Mali	to	Daftry

Transfer :

Inter-institutional :

Shri V. T. Prabhakaran, Junior Statistician S-1, has been transferred to the Institute of Agricultural Research Statistcs, New Delhi during the year under report.

Intra-departmental

The following intra-departmental transfers were made during the year under report.

SCIENTIST S-2/FISHERY SCIENTIST

Dr. (Mrs.) T. Rajyalakshmi	:	Barrackpore to Kakdwip

SCIENTIST S-1/JUNIOR FISHERY SCIENTIST

Shri S. K. Wishard	:	Bhagalpur to Allahabad
Shri S. B. Saha	:	Barrackpore to Calcutta
Shri N. K. Thakur	:	Darbhanga to Patna
Shri K. L. Shah	:	Allahabad to Bhagalpur
Dr. M. L. Bhowmick	:	Malda to Jalpaiguri
Shri C. Saha	:	Barrackpore to Bhubaneswar
Shri G. N. Saha	:	Cuttack to Calcutta
Shri S. R. Das	:	Barrackpore to Krishnanagar
Shri A. Sengupta	:	Kakdwip to Barrackpore and Barrackpore to Kakdwip

SCIENTIST S/SR. RESEARCH ASSISTANT

Shri G. C. Laha	:	Barrackpore to Calcutta
Shri M. P. Singh Kohli	:	Darbhanga to Patna
Dr. B. P. Gupta	:	Bhavanisagar to Ranchi
Shri B. C. Jha	:	Allahabad to Gulariya and Gulariya to Ranchi
Shri P. L. N. Rao	:	Cuttack to Puri
Shri D. N. Singh	:	Gauhati to Allahabad
Dr. K, K. Sengupta	:	Hazpukur th Burdwan

RESEARCH ASSISTANT/TECHNICAL ASSISTANT

Shri B. K Banerjee	:	:	Hazaribagh to Bhagalpur
Shri S. K. Sarkar		:	Hazaribagh to Bhagalpur
Shri R. C. Sing		:	Bhagalpur to Buxar
Shri M. D. Pisalkar		:	Allahabad to Bilaspur
Shri P K. Pandit	:	:	Kakdwip to Barrackpore
Shri P. B. Das	:	:	Barrackpore to Calcutta

JUNIOR SURVEY ASSISTANT

Shri N. C. Mondal	:	:	Barrackpore to Calcutta
Shri S. P. Ghosh	:	:	Barrackpore to Calcutta
Shri D. P. Verma	:	:	Hazaribagh to Buxar
Shri A. K. Ekka	:	:	Bilaspur to Ranchi

LABORATORY AND FIELD ASSISTANT

Shri C. Lakra	:	:	Hazaribagh to Ranchi
Shri N. P. Singh	:	:	Buxar to Allahabad

AQUARIUM ATTENDANT

Shri M. R. Bose	:	:	Barrackpore to Calcutta

DRIVER

Shri B. B. Shetty	:	:	Cuttack to Bhubaneswar

STENOGRAPHER

Shri A. K. Banerjee	:	:	Bhubaneswar to Barrackpore

SENIOR CLERK

Shri S. N. Pramanick	:	:	Barrackpore to Calcutta

JUNIOR CLERK

Shri S. S. Sinha	:	:	Darbhanga to Patna

LABORATORY BOY

Shri R.N. Saha	:	Gauhati to Barrackpore
,, C.K. Pandey	:	Bhagalpur to Allahabad

FIELDMAN

Md. Samood	:	Ranchi to Barrackpore
Shri G.J. Raundale	:	Pune to Ranchi
,, Oghar Jally	:	Badampudi to Cuttack
,, Dukharan	:	Bhubaneswar to Ranchi
,, B.R. Munda	:	Darbhanga to Patna
,, R.B. Dosad	:	Bhagalpur to Allahabad

FISHERMAN

Shri Dukhram	:	Pune to Bhubaneswar
„ B.C. Das	:	Gauhati to Hazo
„ A. Sahani	:	Darbhanga to Patna
„ U. Chaudhuri	:	Darbhanga to Patna
„ B.N. Mondal	:	Bhagalpur to Allahabad

MESSENGER

Shri Joesph Khalko	:	Hazaribagh to Ranchi
„ R. Ram	:	Darbhanga to Patna

BOATMAN

Shri P.C. Das	:	Hazaribagh to Bhubaneswar

WATCHMAN

Shri Jadumari Khatwa	:	Cuttack to Ranchi
„ R.U. Moochi	:	Darbhanga to Patna
„ Gulab Shaw	:	Cuttack to Ranchi

SUPERINTENDENT

Shri A.K. Das	:	Cuttack to Bhubaneswar

Staff :

The following staff rendered their services to the Institute during the year :

DIRECTOR

Dr. V.G. Jhingran

Scientific and Technical :

SCIENTIST —3

Dehadrai, P.V.
Gopalakrishnan, V. (on FAO assignment)
Natarajan, A.V,
Pakrashi B.B.
Sinha, V.R.P.

SCIENTIST—2

Ayar, S.P.
Chakraborty, R.D.
Chandra, Ravish
Ghosh, Apurba
Ghosh, A.N.
Ghosh, K.K.
Govind, B.V.
Gupta, M.V.
Ibrahim, K.H.
Jhingran, A.G.
Khan, H.A.
Mitra, Eva
Pahwa, D.V.
Pal, R.N.
Patnaik, S.
Ramaprabhu, T.
Rajyalakshmi, T.
Raman, K.
Rao, N.G.S.
Rama Rao, Y.
Saha, G.N.
Saigal, B.N.
Sehgal, K.L.
Sen, P.R.
Singh, S.B.
Subrahmanyam, M.
Sukumaran, K.K.
Tripathi, S.D.

FISHERY SCIENTIST

Malhotra, J.C.
Ramachandran, V.
Mondal, A. K.

SCIENTIST EXTENSION

Das, P.

SCIENTIST—1

Abraham Mathew
Arabindakshan, P. K.
Bali, Usha
Banerjee, R. K.
Banerjee, S. C.
Bhanot, Kailash, K.
Bhanot, Kuljeet, K.
Bhatnager, G. K.
Bhowmick, M
Bhowmick, U
Chakraborty, D. P.
Chakraborty, R. K.
Chandra, J.
Chatterjee, D. K.
Chitransi, V. R.
Das, C. R.
Das, M. K.
Das, N. K.
Das, R. C.
Das, S. R.
Desai, V. R.
Dutt, S. N.
Ghosh, Ajoy, K.
Ghosh, B. B.
Ghosh, S. R.
Gopalakrishnayya, C. H.

Gupta, S. D.
Halder, D. D.
Jana. R. K.
Jana, S.
Joshi, C. B.
Joshi. H. C.
Kaliamurthyr M.
Kamal, M. Y.
Kowtal, G. V·
Krishnamurthy, K. N.
Kumar Kuldip
Laal, A. K.
Laal, Babu
Mathew, P. M,
Mehrotra, S. N.
Misra, D. N.
Mohanti, S. N.
Md. M. Peer
Mukherjee, A.
MuKhopadhyay, S.K. (on study leave)
Munnet, S.
Nandi, A. C.
Pandey, B L.
Panwar, R. S.
Pathak, S. C.
Pillai, S. N.
Pravakaran, V. T.
Prasadam, R. D.
Radhakrishnan, S.
Raj, Paul
Ram, K. J.
Ramakrishna, K. V.
Ramamohana, G.
Ranadhir, M.
Rangaswami, C. P.
Rao, A. V. P.
Rao, J. B.
Rao, K. G.
Rao, K. J.
Rao, L. H.
Rao, P. L. N.
Rao, R. M.
Ravichaandran, P.
Rout, M. D.
Saha, C.
Saha, S. B.
Saha, A. K.
Saxena, R. K,
Selvaraj, C.
Sen, A.
Sengupta, A
Shah, K. L.
Sharma, B. K.
Singh, B.
Singh, B. N.
Singh, H.
Singh, S. B.
Sinha, M.
Sivakami, S.
Srinivasagam, S
Srivastava, K.P.
Sukumarn, K K.
Sultana, M.
Sundar, Shyam
Thakur, N.K,
Thakurta, S.C.
Tyagi, B C.
Vass, K.K
Verghese, P,U.
Wishard, S.K.
Yadav, Y.S

ARS PROBATIONERS (Scientist-1)

Bali, V.K.
Chakravarty, P.K.
Pal, S.
Roy, Bimalendu
Sherief, P.M.
Shirsat, B.R,
Singh, Kuldip
Venkatesh, B.
Vinci, G.K.

JUNIOR FISHERY SCIENTIST

Bhowmick, R.M.
Karamchandani, S.J.
Lakshmanan, M.A.V.
Murthy, D.S. (on foreign deputation)
Ray, P.

JUNIOR SCIENTISTE-XTENSION

Sharma, B.K.

LIAISON OFFICER

Tripathi, N.K.

ASSISTANT ENGINEER

Mukherjee, A.B.

SCIENTIST S

Bagchi, M.M
Chakraborty, N.M.
Chandra, Krishna
Chattopadhyay, G.N
Choudhuri, Mahadev
Das, R.K.
Das, K.M.
Dutta, A.K.
Dey, R.K
Ghosh, Amitabha
Ghosh, P.K.
Gopinathan, K,
Gupta, B.P.
Gupta, R.A.
Jaitaly, P.N.
Joseph, K.O.
Kanujia, D.R.
Karmakar, H.C.
Kaushal, D,K.
Kumar, Dhirendra
Kumaraiha, P.
Laha, G.C.
Mazumber, S.K.
Mishra, B.K.
Mitra, P.M.
Mohanta, P.C.
Mukhopadhyay, M.K.
Mukhopadhyay, P.K.
Murugesan, V.K.
Nath, D.
Pal, J.N.
Pathak, V.
Prakash Shree
Ramakrishnaiah, M.
Rao, K.V.
Roy, A.K.
Saha, P.K.
Saha, S.K.
Seth, R.N.
Shrivastava, N.P.
Singh, B.K.
Singh D.N.

Singh, Harbhajan
Singh, H.P.
Singh, R.K.
Singh, S.N.
Srivastava, G.N.
Sugunan, V.V.
Sukumaran, P.K.
Tyagi, R.K.

SENIOR RESEARCH ASSISTANT

Banerjee, A.C.
Basu, N.C.
Bhagat, M.J.
Chaudhury, A.
Hazra, A.
Jha, B.C.
Kapoor, D.
Kohali, M.P. Singh
Kolakar, V.
Kumar, D.
Nasar, S.A.K
Rai, S.P.
Sar, S.N. (on study leave)
Sharma, V.K.

SENIOR ARTIST T_5

Ghosh, J.

OVERSEER T—4

Bhattacherjee, P.N.

SENIOR LIBRARY ASSISTANT T—4

De, Anjali

ARTIST PHOTOGRAPHER T—4

Mazumdar, A.R.

DEMONSTRATOR T—4

Dutta, B.R.
Kumar, Kuldeep
Radheshyam
Sarkar, S.K.

TECHNICAL ASSISTANT T—4

Banerjee B.K.
Chowdhury, A.R. (on study leave)
Das P.B.
Das, P.R.
De, R.N.
Kar, S.L.

Mazumder, H.S.
Pandit, P.K.
Pisolkar, M.D.
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 T—II—3

Abdul Kadir, P.M.
Agarwal, K.K.
Basak, B.
Bhattacharjee, G.P.
Bose, P.S.C.
Chakrabarti, P.K. (upto 31 8.77)
Chandra, Ram
Das. K.M.
De, D.K.
Diwedi, R.K.
Ghosh, Bhaskar
Panigrahi, V.
Rahman, F.
Roy, A.K.
Roy, B. (upto 31.8.77)
Sarkar, N.D.
Satpathy, R.C.
Sen, H.K.
Srivastava, D.N.
Srivastava, N.K.
Vinci, G.K. (upto 9.10.77)

ESTIMATOR

Sahoo, Chakradhar

DRAFTSMAN

Mantri, Muralidhar

ARTIST T—II—3

Das, S.K.

SENIOR LIBRARY ASSISTANT T—II—3

Das, Sukla

PHOTOGRAPHIC ASSISTANT T—II—3

Ghosh, P.K.

TECHNICAL ASSISTANT T-1-3

Banerjee, K.S.
Ekka, A.K.
Ghosh, S.P.
Mazumdar, N.N
Mondal, N.C.
Paul, A.R.
Sarkar, Aloke
Saroj, B.D.
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

Cuatterjee, 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.
Lakra, Camil
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 DIRVER/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.
Kahali, B.
Lal, Pasupati
Mazumder, A. K.
Nath, C. K.
Roy, B. B.
Singh, Badal Lal
Subramani, M. G.

CARPENTER T-2

Bhattacherjee, S

PUMPMAN T-1

Das, C. R.

Roy, N,

Technical Supporting

BOOK BINDER

Saha, N. K.

GESTETNER OPERATOR

Naik, D.

DARKROOM ASSISTANT

Halder, R. K.

AQUARIUM ATTENDENT

Bose, M. R.

Routh, H. K.

LABORATORY BOY

Bahadur, Budhi
Bahadur, Hari
Barik, D.
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.
Prakas, 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.
Bhadur, 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.
Dosad, 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.
Newalal
Mohanty, N, N.
Mookhand
Munda, B. R.
Naik, J.
Nhuloka, D.
Patnaik, S. R.
Pramanick, H K.
Prasad, K.
Rahman, A.
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.
Rurman, H. K.
Das, P. C.
Tiwar, R. N.
Yadav, A. L.

DECK SUKHANY

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.
Betal, S,
Bez, P. C.
Bhanja, D.
Binda, M. P.
Biswas, Ananda
Biswas, A. K.
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, Giridhari
Das, Gunadhar
Das, Janiram
Das, K. M.
Das, P. B.
Das, S.
Das, Sudhansu
Dhibar, G.
Dukharan
Gangayya, A.
Garate, S. T.
Gharami, Phani
Gowda, K. N.
Gowda, M.
Halder, R. K.
Halder, S.
Hazarika, B.
Jally, Barman
Jally, K C.
Jally, L.
Jana, B. K.
Jana, G.
Jana, G. M
Japhuram
Jana, N C.
Kallanan, K.
Kamparasha, A.
Khan, R.
Krishnan, M. V.
Lal, Bideshi
Lal, Jawari
Mahalik, A
Mallah, J. N.
Mallah
Mandal, Biswanath
Mandal, B. N.
Mandal, G.C.
Mandal, K
Mandal, N.K.
Mandal, N.N.
Mandal, S C.
Mani. K.
Manickyan, P.
Marappa, V.
Moolchand
Mukhia, J.
Murugesan, A.
Naik N. B
Namasudra, R. K.
Prasram
Parida, F.
Parida, G.
Parida. S.
Parida, Y.
Pillai, D.
Pradhan, B.
Prasad. R.
Prasad, Sital
Raju, K. D.
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
Subramanlyan, K.
Vava, C.K.
Yesiah, R.

ADMINISTRATIVE OFFICER

Sharma, G.C.

ACCOUNTS OFFICER

Deb, P.C.

ASSISTANT ADMINISTRATIVE OFFICER

Chatterjee, S.K.

Sthanapati, P.K.

P.A. TO DIRECTOR

Lahiri, G.

SUPERINTENDENT

Biswas, M.L.
Das, A.K.
Kanungo, P.C.
Rajani, K.B.
Roy, K.C.
Sengupta, A.K.

ASSISTANT

Bhattacherjee, B. C.
Bose, S K.
Chatterjee, B.R. (on deputation)
Chatterjee, N.G.
Das, T P.
Dasgupta, S.
Dutta, B.C.
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.

STENOGRAPHER

Banerjee, A.K.
Chakladar, H.
Chakraborty, G.M.
Srivastava, R.C.

JUNIOR STENOGRAPHER

Bhattacherjee, 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

Acherjee, D.K.
Baidya, D N.
Banerjee, D.K.
Banerjee, J.
Bose, D.C.
Choudhry, 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, Kashab
Prasad, Mahesh
Rai, J.
Sarkar, H.L.
Sarkar, S.K.
Shaw, Awadh
Singh, K.
Singh, R.C.P.
Sreedharan, T.K.
Subrahamanlam, M.
Sutar, H.B.

JUNIOR CLERK

Banerjee, Anita
Banerjee, Narayani
Behara, A.C.
Behara, P.
Behara, R.C.
Bhagirathi, S.
Bhowmick, S.
Biswas, A.B.
Biswas, Manjulal
Biswas P.K.
Bose, Samir Kumar
Chatterjee, D.
Chatterjee, Dipankar
Chowdhury, Debesh
Das, D.K.
Das, G.B.
Das, M.K.
Dey Sarkar, D.K.
Dutta, P.K,
Ghosh, P.K.
Ghosh, Samar K.
Guriah, W.
Hansda, Sreedam
Kachhap, M.
Kumar, Surendra
Kundu, N.R.
Lahiri, P.
Lal, Ambika

Mandal, A.B.
Mandal, Bulbul
Mandal, S.P.
Mazumder, B.C.
Mazumder, P.K.
Mazumder, Sikha,
Mazumder, T.K.
Mukherjee, R.R.
Mupid, B.S.
Murthy, P B.V.S.
Naik, N.C
Nath, Baij
Panda, R.K.
Radhakrishnan, K.
Raina, R.L.
Roy, J.
Roy, Samir
Roy, S.B.
Saha, P.B.
Sarkar, B.K.
Sengupta, A.

Shah, Biswanath
Sinha, S.S.
Sinha, K.B.
Srivastava, A.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.
Halder, C.R.
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.
Raghavana, K.V.
Ram, Rulia
Sahoo, K.M.
Singn, 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.
Bhadur, Asta
Bahadur, Bhim
Bhadur, Indra
Bahadur, Karna
Bahadur, Lal
Bahadur, Man
Bahadur, Ram
Bahadur, Sitaram
Bahadur, Surja
Bahadur, Tek
Behara, R.
Bhattacherjee, Ashutosh
Bhoi, R.C.
Bhoi, S.
Bhuyan, D.
Bijoli Amulya
Choudhury, Panchulal
Das, M.
Dhir, K.K.
Kachari, P.C.
Kerketta, Joseph
Kumar, Khasban
Khetra, J.
Krishnappa, B.N.
Mahato, R.C.
Mahadeva, M.
Mahendran, S.
Mallah, M.L.
Muchi, R.U.
Naik, B.K.
Paik, B.C.
Painiswami, R.
Paramanick, G.C.
Prakash, Om.
Prasad, Lalta
Rajaratnam, 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.
Mandal, M.G.
Sunder, Ram

SWEEPER

Balmiki,
Chand, Khem
Chand, Sir
Das D.
Dehuri, B,
Dhanuk, Badlu
Dhanuk, Shyamlal
Jena, Panchanna
Lal, Kishan
Parameshwar
Raju, A.E.
Ram, Iswar
Ram, Mansi

RESEARCH SCHOLAR

Barua, S.K.
Bedre, R.V.
Mukherjee, A.P.
Panigrahi, S.
Sharma, Neelima

APPENDIX-1

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, 1978

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	82	5	6	—	—	—
Class II	Permanent	18	1	6	—	—	—
	Temporary	69	4	6	1	1	—
Class III	Permanent	167	30	18	1	8	—
	Temporary	101	22	22	8	8	—
Class IV	Permanent	184	43	23	1	2	—
	Temporary	111	26	23	3	3	—
Class IV	Permanent	14	14	100	—	—	—
(Excluding Sweeper)		3	2	67	1	33	—