1973

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE BARRACKPORE

ANNUAL REPORT

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
BARRACKPORE

ANNUAL REPORT

for the year

1973

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

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DOCUMENTATION SERVICE

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ANNUAL REPORT OF THE CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE, 1973

I. Director's Introduction

History : The Central Inland Fisheries Research Institute was established in March, 1947 in Calcutta, under the Ministry of Food and Agriculture, Government of India. Its present headquarters has been functioning in its own buildings at Barrackpore in West Bengal since June, 1959. The administrative control of the Institute was taken over by the Indian Council of Agricultural Research on October 1, 1967.

Object : The prime objective of the investigations conducted at the Institute is to study and elucidate the scientific principles towards maximising the utilisation of inland waters available in India for optimum production of fish for food. Such an objective entails evolving suitable fish cultural techniques, investigation on the biology of the food fishes, studies on hydrobiology and ecology of different types of fishery waters, research on the fish populations in natural waters and fishery management problems concerning both fresh and brackish water environments. While work on long-range research projects continues, in consideration of the great consumer demand of fish in the country, 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 and increased yield of fish in the country.

Organisational structure : The research projects of the Institute are grouped under two major heads; *viz.*, central scheme and centrally sponsored scheme. Under the former, there are 22 production-oriented priority-laid research projects each with several time-bound research problems, and a few ancillary projects. For implementing the projects under the central scheme, three divisions; *viz.*, Freshwater Fish Culture Division at Cuttack, Riverine and Lacustrine Fisheries Division at Allahabad and Estuarine Fisheries Division at Barrackpore with their units; *viz.*, Reservoir Fisheries Unit at Hazaribagh, Small Reservoirs Unit at Rewa, Tank Fisheries Unit at Bangalore, Lower Ganga Unit at Bhagalpur, Cold Water Fisheries Unit at Srinagar, Krishna-Godavari Unit at Rajahmundry, Brahmaputra Survey Unit at Gauhati, Sunderbans Survey and

Brackish Water Fish Farm Units at Kakdwip and Pulicat Lake Fisheries Research Unit in Madras, have continued to function during the year. Soil Chemistry and Weed Control Unit in Calcutta, Library and Documentation Section, Fisheries Extension Unit, Administrative, Accounts and Audit and Stores Sections at Barrackpore functioned under the direct control of the Director during the year. The centrally sponsored scheme comprises five institute-based All India Co-ordinated Research Projects; *viz.*, (i) Ecology and Fisheries of Freshwater Reservoirs (with main centre at Hazaribagh and subcentres at Bhavanisagar, Nagarjunasagar, Rihand, Ranchi and Bilaspur), (ii) Composite Culture of Indian and Exotic Fishes (with main centre at Barrackpore and subcentres at Kurnool, Bhavanisagar, Kalyani, Jaunpur, Karnal and Poona), (iii) Propagation and Stocking of Seed of Air-breathing Fishes for Culture in Swamps (with main centre at Darbhanga and subcentres at Bhadra and Gauhati), (iv) Riverine Carp Spawn Prospecting and Collection Technique (with main centre at Allahabad and subcentres at Barrackpore, Gauhati and Patna) and (v) Brackish Water Fish Farming (with main centre at Barrackpore and subcentres at Orissa and Tamil Nadu). The first four Co-ordinated Projects began functioning in mid-1971 while the fifth was initiated on October 1, 1973.

Library and Documentation : During the year under report, 216 books, 60 reprints, 107 miscellaneous publications and 1,124 issues of periodicals were added to the library of the Institute. 36 Indian and 44 foreign journals were continued to be subscribed. The Institute obtained, either as gift or in exchange, 160 Indian and foreign journals. The present library holdings, inclusive of year's arrivals, comprise 2,846 books, 1,657 bound periodicals, 3,235 reprints and 1,497 miscellaneous publications, excluding the stock of loose issues of journals, pamphlets, maps, departmental publications etc. Besides maintaining exchange relationship with 284 institutions and organisations, 15 new exchange relationships were established during the year. Accession lists for the period July-December, 1972 and for the months January to December, 1973 were brought out and circulated for the benefit of the staff of the Institute.

45 technical and non-technical enquiries from India and abroad were attended to by the Documentation Unit. The Institute supplied a number of publications to the Secretary, National Committee on Environmental Planning and Co-ordination (Department of Science and Technology), Yojana Bhavan, New Delhi; Zoologist, Zoological Survey of India, Western Regional Station, Poona; College of Basic Sciences, Andhra Pradesh Agricultural University, Hyderabad; Director, Zoological Survey of India, Calcutta; Department of Geology, Andhra University, Waltair; Member Secretary, State Fisheries Development Corporation Ltd., Calcutta; Fisheries Development Officer, Kota, Rajasthan; and the Institute of Library Information Service, Calcutta on inter library loan basis.

During the year, 64 reports on progress of research were compiled and sent to the Indian Council of Agricultural Research. "Bibliography of Indian Fisheries" Vol. 11 (3 & 4), 1972 and Vol. 12 (1 & 2), 1973; "CIFRI Bulletin No. 19" entitled "Fishery Resources of the Hooghly-Matlah Estuarine System"; the Half-yearly Technical Progress Reports for July-December, 1972 and January-June, 1973; and *ad-hoc* publications; *viz.*, "Central Inland Fisheries Research Institute—Projects and Results" and "Report of the Achievement Audit Committee 1971-72 on the Central Inland Fisheries Research Institute, Barrackpore" were mimeographed and brought out. The 1972 Annual Report of the Institute was published in printed form. Besides the above, 450 sketches/diagrams, 70 posters/charts, 1,200 photographs and 200 ammonia prints on research activities and other achievements were prepared.

Honours, Awards etc. : At the 15th Session of the Indo-Pacific Fisheries Council held in Wellington, New Zealand during October 18-27, 1972, Dr. V. G. Jhingran, Director, CIFRI, was elected as the convener of a FAO Working Party to organise the symposium on "Development and Utilisation of Inland Fisheries Resources", to be held in 1976 in conjunction with the 17th Session of the Council. Dr. V. G. Jhingran had earlier been nominated from India to attend the third meeting of the Indo-Pacific Fisheries Council Working Party on "Economics of Aquaculture" held in Bangkok during April 2-5, 1973 and "Aquaculture Seminar for South East Asian Countries" held under the auspices of International Development Research Centre, Canada at the Freshwater Fishery Research Station of the Malaysian Agriculture Research and Development Institute, Batu Berendam, Malacca, West Malaysia during April 17-25, 1973. He was also nominated to participate in the meeting of the "Working Group on Aquaculture", set up by the technical advisory committee of International Agricultural Research, held at Spoleto, Italy during July 10-19, 1973. Dr. H. Chaudhuri, Senior Fishery Scientist, has been selected as a member of Scientific Panel of the ICAR for three years. Shri P. M. Mathew, Senior Research Assistant, has been awarded Ph.D. Degree.

Sarvasrri M. K. Mukhopadhaya and S. Srinivasagam, Research Assistants and Shri N. C. Basu, Senior Research Assistant, have been awarded Junior Fellowships of the ICAR for prosecuting post-graduate studies and Shri S. K. Mukhopadhaya, Assistant Fishery Scientist, has been awarded Senior Fellowship of the ICAR for Doctoral Research.

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

Mr. Abdel Aziz Mohmed Kamel:	Under Secretary of State, Ministry of Agriculture, Egypt.
Mrs. Hidaza Abd-El-Kerim and : Dr. Mostafa Hafez	Academy of Scientific Research and Technology, Cairo, Egypt.

Shri C. K. Varshney and Shri Ashok Khosla	:	Secretary and Senior Specialist, National Committee on Environmental Planning and Co-ordination, Yojana Bhavan, New Delhi.
Mr. Herbert E. Allen	:	School of Public Health, University of Michigan Ann Arbor, Michigan, U.S.A.
Shri H. Nanjundiah	:	Secretary to the Govt. of Maharashtra.
Shri A. M. Mehesanewala and Shri S. K. Pradhan	:	Deputy Managing Director and Officer Maharashtra Fisheries Development Corporation, Bombay.
Mr. Anthony F. Cassides and Mr. P. N. Hortan	:	British Deputy High Commissioner and Assistant Educational Advisor, British High Commission, New Delhi.
Shri S. K. Srivastav	:	Special Secretary, Agriculture and Animal Husbandry Department (Fisheries), New Secretariat, Patna.
Mr. Tadasu Yamamoto	:	Tokyo World Bank, Washington D.C., U.S.A.
Mr. Leif E. Andren	:	Fishery Resources Division, FAO, Rome, Italy.
Dr. V. Sundaram	:	Director, Cotton Technological Research Laboratory, Bombay.
Dr. C. M. Singh	:	Director, Indian Veterinary Research Institute, Izatnagar.
Dr. K. Kanungo	:	Dean, Indian Agricultural Research Institute, New Delhi.
Dr. L. S. Negi	:	Vice-Chancellor, Assam Agricultural University, Jorhat.
Mr. D. D. Topiador	:	Regional Secretary, Indo-Pacific Fisheries Council, Bangkok, Thailand.
Shri T. Padmanabhan	:	Director of Fisheries, Andhra Pradesh.
Mr. U. Khin B. Bang	:	Johns Hopkins Centre for Medical Research, Calcutta.
Mr. U. Khin Maung	:	General Manager (Research), Agriculture Corporation, Rangoon, Burma.
Mr. W. Than Maung	:	Consul-General of Burma, Calcutta.
Dr. W. H. L. Allsopp	:	Assistant Director (Fisheries), International Development Research Centre, Canada.
Dr. Edward M. Donaldson	:	Fisheries Research Board of Canada, West Vancouver B. C., Canada.

Mr. Gabrial Perin	:	Trade Commissioner for France, Park Mansion, Calcutta.
Dr. C. M. Fernando	:	Professor, University of Waterloo, Canada.
Shri B. Sivaraman	:	Chairman, Agricultural Commission and Member, Planning Comraission, New Delhi.
Dr. M. S. Swaminathan, Dr. B. K. Soni and Dr. R. Raghu Prasad	:	Director General, Deputy Director General and Assistant Director General, Indian Council of Agricultural Research, Krishi Bhavan, New Delhi.
Dr. Yusuf	:	Director of Fisheries, Bangladesh.
Shri Kulwant Singh	:	Secretary to the Fisheries Co-operation Department, Haryana.
Shri Jain	:	Under Secretary, Fisheries Department, Haryana.
Shri Maha Singh	:	Minister for Fisheries, Haryana.
Dr. N. K. Panikkar	:	Member, National Commission on Agriculture, New Delhi.
Dr. H. C. Kewalramani	:	Expert, National Commission on Agriculture, New Delhi.
Shri T. Rathod	:	Minister for Fisheries, Karnataka.
Shri K. Venkatesh	:	Deputy Director of Fisheries, Karnataka.
Prof. P. C. George	:	Joint Commissioner for Fisheries, Ministry of Food and Agriculture, New Delhi.

Important events of the year : Significant events and achievements during the year 1973 were :

New Project on Brackish Water Fish Farming :

An All-India Co-ordinated Research Project on brackish water fish farming has been initiated since October 1, 1973 with its main centre at Barrackpore and subcentres in Orissa and Tamil Nadu. At the brackish water fish farm of the main centre at Kakdwip experiments on culture of *Mugil tade*, *Mugil parsia* and *Penaeus monodon* and *P. indicus* were initiated.

Additional subcentres of the All-India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs :

Two additional subcentres under the All-India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs have been established at Ranchi and Bilaspur as a part of rapid developmental programme.

Intensive fish culture :

A break through in freshwater aquaculture was achieved with the recording of extraordinarily high productions of marketable fish (average 1 kg each) in the experimental ponds at the Cuttack Substation. By judicious manipulation of stocking density and species ratio and adopting pond management techniques developed at the Institute, record gross and net productions of 8,854 and 8,631 kg per hectare in 9½ months were obtained. The species used were silver carp, catla, rohu, grass carp, mrigal and common carp in the ratio of 2.5 : 1 : 2.5 : 1 : 1 : 2 at a stocking rate of 7,500/ha alongwith a few miscellaneous fishes; like, *Notopterus chitala,* hybrids of male catla × female rohu and *Mugil cephalus.* The featherback, a minor predator, was introduced for consuming insects, minnows, trash fishes and molluscs which usually compete for food with carps. In a number of cases, the production figures obtained were about 7,500 kg/ha which is a great advancement over the traditional output of 600 kg/ha in India.

High fish growth in composite culture :

In composite fish culture, gross fish productions as high as 3,174 and 6,521 kg/ha/yr were obtained during 1972-73 through culture of Indian major carps alone and in combination with exotic carps respectively. High growth of different carps were recorded in various trials of composite fish culture. Catla grew to 1.923 kg in 9 months and common carp, 1.125 kg in 5 months at Poona centre; silver carp, 1,705 kg in 6 months at Karnal centre; and rohu, 1.2 kg in 8 months at Bhavanisagar centre of the All-India Co-ordinated Research Project on Composite Culture of Indian and Exotic Fishes. An unprecedented high growth of 5.04 kg of grass carp in one year was obtained at Kalyani centre.

Improvement in fry raising :

The introduction of growth promoting trace element cobalt chloride has shown phenomenal increase in fry production from fish nurseries. The spawn fed on 0.01 mg/day/fish of cobalt chloride mixed with artificial feed showed survival rates of 87, 74 and 60% at stocking rates of 2.5, 3.75 and 6.25 million/ha respectively—an improvement of 27% at the lowest stocking rate and 15% at the highest. Latest experiments with a stocking density of 10 million/ha in 0.04 ha nurseries, with the treatment have given numerical yield of 6.6 million fry/ha. This is the most significant achievement standing in contrast with the conventional production of 20 to 40 thousand fry/ha—showing a twenty-fold increase.

Boost in fingerling production :

In trials to raise fingerlings from fry stocked at the rate of 1,25,000/ha in 2-4 carp species combination, a survival of 97% and a production of 3,486

kg/ha in 3 months were obtained. Eventhough the survival rate was lower (70%) in the recent trials where stocking density was raised to 2,13,000/ha, the overall yield of carp fingerlings was much higher keeping the time span and water bodies constant.

Research collaboration with institutes, universities, colleges and other institutions at national level: With a view to meeting the great demand of the seed of major carps for fish culture in the country, the Institute in collaboration with the State Governments continued to locate through an All-India Co-ordinated Research Project "Investigations on Riverine Carp Spawn Prospecting and Collection Technique", new spawn collection centres for the nineth year in succession. Before the onset of monsoon, thirteen sites in a 170 Km long stretch of the river Brahmaputra from Behali Steamerghat in Kurua in Darang district in Assam; twelve sites in a 140 Km stretches of different rivers in Malda and Murshidabad districts of West Bengal; and seventeen sites in a 160 Km long stretch of the river Ganga between Sultangunj and Rajmahal in Bihar were surveyed. For detailed spawn availability study, Shomoragurighat in Assam, Suksenaghat in Bihar, Manikchakghat on the river Ganga, Khandua on the river Padma, Nurpurghat on the river Kalindri and Shahpur on the river Mohanada in West Bengal were selected. Krishanpur on the river Yamuna in Fatehpur district was also prospected for spawn where the index of spawn quality was found to be 64-86%. The indices of spawn quantity and quality were 84 ml and 97.5% at Shomoragurighat and 880 ml and 79.9% at Suksenaghat. In Assam, Chakkighat on the river Jaibherulu and Satkhuli on the river Luit and in West Bengal, Nurpurghat and Shahpur were found to be suitable for spawn collection.

Under the All-India Co-ordinated Research Project on Culture of Air breathing Fishes in Swamps, basic information has been collected in regard to food and feeding habits, sexual dimorphism, reproductive processes, induced breeding and rearing of fry of *Anabas testudineus*, *Clarias batrachus*, *Heteropneustes fossilis* and *Channa* spp. Ecology of different types of swamps in Assam, Bihar and Karnataka was studied. This enabled the project to take up production-oriented experiments jointly with the State Governments. The assessment of the growing stock has indicated substantial yield of *Anabas testudineus*, *Heteropneustes fossilis* and *Channa striatus*, raised through monoculture from derelict swampy waters. In view of the difficulties in retrieval of stocked fish from weed-infested swampy waters, preliminary trials to culture singhi (*H. fossilis*) and magur (*C. batrachus*) in cages were conducted near Gauhati with promising results.

In joint investigations with the State Governments under the All-India Co-ordinated Research Project on Composite Culture of Indian and Exotic Fishes, fish ponds stocked in 1972 at four subcentres were harvested. At Kalyani, a set of two ponds stocked with Indian major carps alone and the

third pond in combination with exotic carps, gave productions of 2,275, 3,174 and 6,521 kg/ha in one year except in the case of the first pond which was harvested after 11 months of stocking. At Poona, fish yields from a set of two ponds stocked with Indian major carps and common carp and another set of two ponds stocked with Indian and exotic species of fish were : 3,135, 3,802, 5,136 and 5,596 kg/ha/yr respectively. The production at Karnal and Bhavanisagar was found to vary from 1,676 to 4,128 kg/ha/yr, and 2,570 to 3,499 kg/ha/yr respectively. Breeding of mrigal (*C. mrigala*) and exotic carps was also taken up at Kalyani, Gujartal and Karnal and 27.5 lakhs spawn of common carp, 1.25 lakhs spawn of grass carp, 3 lakhs spawn of silver carp and 6.13 lakhs spawn of mrigal were produced.

The All-India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs had within its purview five reservoirs; *viz.*, Bhavanisagar, Nagarjunasagar, Getalsud, Rihand and Bhakra. Of these, Getalsud and Bhakra were taken up for collaborative research investigation with the State Governments during 1973 itself. Considerable progress has been made in the study of the ecological principles that operate in these reservoirs. Bhavanisagar and Nagarjunasagar showed higher values of PO_4-P (0.02 mg/1), and NO_3-N (0.404 mg/1) respectively, while these two reservoirs together had more or less similar values of alkalinity (83-93 mg/1), calcium (19-21 mg/1) and magnesium (5-7 mg/1). Rihand showed only half the value of alkalinity in comparison to the above two reservoirs though in phosphate and nitrate it is close to Nagarjunasagar. Bhavanisagar showed higher values of net primary production (616 mg C/m^3/12 hr). Higher value of dissolved organic matter (4.70 mg/1) showed a positive correlation with plankton biomass (2.68 ml/m^3) in Rihand. Correlation between low value of dissolved organic matter and low plankton biomass was found in Nagarjunasagar. If further studies confirm the above trend, it may provide much needed limno-chemical index for quick assessment of production potential of reservoirs. The fish yield was estimated to be 126.5 t (*i.e.*, 32.24 kg/ha) at Bhavanisagar, 41.7 t (*i.e.*, 2.26 kg/ha) at Nagarjunasagar and 206.3 t (*i.e.*, 6.84 kg/ha) at Rihand. Catch properties and dynamics of fish stocks indicate that stocking densities at Nagarjunasagar and Rihand were 1/4 and 1/8 respectively of the level obtaining at Bhavanisagar. Studies have indicated the necessity to stock Nagarjunasagar with *C. catla*, Rihand with *L. calbasu* and *C. carpio* and Bhavanisagar with *C. cirrhosa*, *C. catla* and *L. fimbriatus*.

Research collaboration at international level with FAO, Ford Foundation etc.: Salient observations on culture fisheries investigations conducted at the Institute were regularly communicated to Food and Agricultural Organisation of the UN, Rome for publication in the quarterly publication entitled "FAO Aquaculture Bulletin".

With a view to exchange research publications, new exchange relationships have been established with fifteen foreign and Indian organisations. Among these, collaboration at international level was established with Institute Nacional De Tecnologia Industrial, Argentine; the Fish Section of British Museum, London; Shrimp Culture Research Centre, Indonesia; the Institute of Scientific Information, U.S.S.R.; Agriculture Corporation, Burma; and Centre for Great Lakes Studies, University of Wisconsin-Milwankee, U.S.A.

A write-up on modern technique of pisciculture was sent to the Government Agricultural Farm, Kalikhola, Bhutan to enable them to initiate profitable fish farming.

Research Associations : Scientists and technical staff of the Institute continued to take initiative in the organisation and management of the "Inland Fisheries Society of India". Vol. **V** 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 Association of Water and Water Pollution Control, Nagpur.
3. Indian Science Congress Association, Calcutta.
4. Inland Fisheries Society of India, Barrackpore.
5. Marine Biological Association of India, Cochin.

Foreign :

1. The Fisheries Society of the British Isles, Huntingdon, England.
2. Societies Internationalis Limnologiae, Michigan, U.S.A.

Advisory services received and provided : Information on various aspects of inland fisheries such as relative toxicity of some chemicals to freshwater fishes; feeding, breeding and culture of frog; fish and fisheries of the Sundarbans; control of aquatic weeds; nursery pond management; breeding of common carp; detoxification of endrin-treated pond water; fish diseases and their control; and modern techniques of composite fish culture and pond management were provided to various private organisations and individuals.

Information on "induced breeding of *L. calcarifer*", "use of green manure in ponds", merits and demerits of "tilapia culture" and "intensive fish farming" were provided to the Department of Fisheries, Maharashtra; State Fisheries Corporation, Calcutta; Department of Fisheries, West Bengal and National

Dairy Research Institute, Karnal (Haryana), respectively.

Ministry of Agriculture, Government of India, New Delhi was furnished with a catalogue of published articles and details about the research work conducted by the Institute. Suggestions on measures for recycling organic wastes were sent to the ICAR. Information on "application of statistics to science and technology", "environmental problem in Indian waters and facilities and measures for abatement" and "fisheries education" was supplied to National Committee on Science and Technology, Technology Bhavan, New Delhi; National Committee on Environmental Planning and Co-ordination, Department of Science and Technology, Technology Bhavan, New Delhi and National Commission on Agriculture, Vigyan Bhavan Annexe, New Delhi, respectively.

Information on water pollution aspects; fish landing statistics; control of acquatic weeds; modern techniques of composite fish culture; biological control of molluscs in fish ponds and fish pond management was furnished to Science Today, The Times of India Buildings, Bombay; Marine Products Export Development Authority, Cochin; Bokaro Steel City Administration, Bokaro; State Bank of India, Bihar; Dandakarayna Project; Agricultural Finance Corporation, Calcutta; Multi Anchal Panchyat, Mograhat, 24-Parganas; Hindusthan Steel Ltd., Bhilai; and Fertiliser Corporation of India, respectively.

Information on water quality and ecological factors controlling aquatic production and ecology and distribution of Indian animals was supplied to various educational institutions.

Information supplied to foreigners included material in connection with Ecology Newsletter to Division of Ecology, School of Biological Sciences, University of Malay, Kuala Lumpur, Malaysia; Bibliography of Indian Fisheries and departmental bulletins for Ulrich's International Periodical Directory; Irregular serials and Annuals to R. R. Bowker Co., New York; Aspects of water quality to Prof. M. B. Peseod, Chairman, Environmental Engineering Division, Asian Institute of Technology, Bangkok, Thailand; Biology and culture of eel and frog and problems in utilisation of freshwater fish to Mr. Domingo D. Tapiador, Regional Fisheries Office and Indo-Pacific Fisheries Council, FAO, Bangkok, Thailand; Reports on underwater survey in India to Mr. E. Memmott, Havering Technical College, Essox, London; information on *Myxosoma cerebralis* to Marshall M. Halliday, Ambulatory Clinic, Royal Veterinary and Agricultural University, Copenhagen V, Denmark; Details of fish breeding and fish meal to Mr. Alibhai Essa, Director, Nyali Stores Ltd., Mombasa, Kenya; Availability of prawns in the Chilka lake to Wm. Macnae, Department of Zoology, University of Witwarterrand, Jan Smuts Avenue, Johannesberg, South Africa; On the use of cobalt chloride to Prof. A. J. Matty, Department of Biological Sciences, University of Aston, Birmingham, U.K.; Aspects of biology of *H. fossilis* to Dr. T. Y. Aldoori, Scientific Research

Foundation, Biological Research Centre, Adhamiya, Bagdad, Iraq; supply of seed/plant of *Aldrovanda vasiculosa* to Mr. J. Pietropasto, Chairman, Science Department, Genera School, New York; Various projects undertaken at CIFRI and their results to Dr. hab. Zofia Fischer, Department of Bioenergetics and Bioproductivity, Nencki Institute of Experimental Biology, 3 Pasteur Street, Warszawa, Poland; Prawn catch statistics of the Ganga-Brahmaputra estuarine system to Dr. Georgean Happ, Lousiana State University, Lousiana, U.S.A.; Write-up on the Institute and its activities to Mr. Peter Ajul, Editor, Fish Farming International, 110, Fleet Street; London; Techniques of breeding and rearing of *M. rosenbergii* to Dr. Alfred Fox, C 4. Bonne Terre, Vacoas, Mauritius; and a write-up on modern technique of pisciculture to the Government Agricultural Farm, Kalikhola, Bhutan.

Extension and nation building activity: With a view to ensuring that the results of practical value emerging from the research activities of the Institute are speedily transmitted to the fish farmers, an extension pamphlet entitled "Technique of carp pituitary gland removal and ampouling for setting up pituitary banks" was published and distributed to the State Fisheries Departments and the interested fish farmers. Pamphlets on other fish culture activities; *viz.*, (i) Intensive fish farming; (ii) Techniques of nursery management; (iii) Breeding of common carp and (iv) Induced breeding of major carps are in press.

For demonstrating the practicability of Composite Fish Culture as a sound commercial proposition to introduce aquaculture in a big way in the country, two national demonstration centres, one at Mirhati and the other at Nilgunj in the district of 24-Parganas, West Bengal, were initiated during the year. Modern techniques of composite culture were demonstrated step by step to the fish farmers at these centres.

A field demonstration displaying high fish yields through composite fish culture was organised on September 30, 1973 at the Operational Research Centre on Composite Fish Culture of the Institute at Anjana Fish Farm, Krishnanagore in West Bengal. Representatives of the Press Bureau and State Fisheries Department (West Bengal), members of the Planning Commission, District Magistrate of Nadia and others attended the demonstration. The news was flashed through All-India Radio, Calcutta on October 1, 1973 and a write-up under the caption "Krishnanagore machchash" (meaning, Fish Culture in Krishnanagore) as well as a protograph of fish catch appeared in a Bengali weekly Satyaprakash on October 7 and 21, 1973 respectively.

Copies of the article entitled "Fish culture : India on verge of break through" by Dr. V. G. Jhingran, Director of the Institute which was published in the Financial Express on December 25, 1972, were distributed to many visitors.

Three handouts entitled "Composite fish culture"—giving the details about notable growth of grass carp at the Kulia Fish Farm, "CIFRI makes yet another endeavour to boost fish production in West Bengal"—describing the successful composite culture in larger sheets of water such as Anjana Fish Farm at Krishnanagore and "*Aquaplosion* through intensive polyculture in freshwater ponds"—recording high fish yield of about 7,500 kg/ha obtained at Cuttack Substation, were distributed among the representatives of Press and All-India Radio on May 10, September 30 and October 19, 1973 to apprise them of the latest achievements of the Institute.

A scheme on Operational Research Project, to be financed by the International Developmental Research Centre, Canada, to promote aquaculture in a few villages in Bengal and Orissa was prepared.

With a view to promoting and facilitating wide and extensive adoption of the techniques of induced breeding for the production of quality fish seed for fish culture, 79 ampoules of 40 mg/ml strength of carp pituitary gland extracts were supplied to various state agencies, agricultural universities and private pisciculturists including two to the scientists of International Developmental Research Centre, Canada.

Laboratory and library facilities, field demonstrations and training in different aspects of culture and capture fisheries including frog farming were provided to 39 trainees of 1973-74 session (during June to December) of Inland Fisheries Training Unit of the Central Institute of Fisheries Education, Barrackpore; 22 and 40 trainees of the Regional Training Centres for Inland Fisheries Operatives, Hyderabad and Agra respectively and 34 trainees of the Central Institute of Fisheries Education, Bombay. The field officers of the Cuttack Municipality and Orissa State Fisheries Department were trained in various methods of controlling unwanted aquatic vegetation and the technical officers of the Kerala State Fisheries Department in methods of frog breeding and rearing.

Fish seed of Indian and Chinese carps were distributed to a large number of organisations, individuals and state fisheries departments in pursuit of the objective of popularising fish culture. The details of spawn, fry, fingerlings and table sized carps sold or supplied are given in table 1.

Finance : The provision of funds for the Institute for the financial year April, 1973 to March, 1974 was :

Non-Plan	Rs.	28,00,000
Plan	Rs.	29,75,000
Total . .	Rs.	57,75,000

Against the above provision, the expenditure during April 1, 1973 to December 31, 1973 was as follows :

Non-Plan	Rs.	20,46,668
Plan	Rs.	10,54,373
Total ..	Rs.	31,01,041

Table 1. Spawn, fry and fingerfings of Indian and exotic carps supplied to various agencies

Agencies	Spawn (Lakh)				Fry & Fingerlings (Lakh)				Large fish (Kg)
	Silver carp	Grass carp	Common carp	Indian major carps	Silver carp	Grass carp	Common carp	Indian major carps	
Orissa Fisheries Dept.	...	...	1.00000	132.90000	0.00200	0.00600	...	11.32926	7,780
West Bengal Fisheries Dept.	...	...	...	...	0.02535	0.02678	...	...	
Kerala Fisheries Dept.	...	...	...	...	0.01050	0.1020	...	...	
Andhra Pradesh Fisheries Dept.	...	...	...	...	0.02100	0.0051	...	...	
Bokaro Steel Plant	...	...	...	...	...	0.02080	...	...	
Fertiliser Corp. of India	...	...	...	...	0.01008	0.00480	...	...	
Agri. Univ., Pantnagar	...	...	...	...	0.00540	0.00220	...	...	
Fish. College. Mangalore	...	...	...	...	...	0.00300	...	...	
All-India Coord. Prój. on Composite Culture	...	...	...	...	0.16600	0.10050	...	...	
All-India Coord. Proj. on Reservoirs	...	...	...	...	0.05000	...	...	...	
Extn. Unit of CIFRI	...	...	...	...	0.02850	0.00870	...	...	
Sunderbans Survey of CIFRI	...	...	.	...	0.01500		...	...	
CIFR Substation, Cuttack	3.29000	1.99500	1.50000	30.00000	0.18000	0.12000	0.18600	1.57000	
Public/Fish Culturists	...	...	...	5 75000	0.02630	0.01228	0.07450	0 65474	
TOTAL	3.29000	1.99500	2.50000	168.65000	0.54013	0.41216	0.26050	13.55400	7,780

2. Progress of Research

As per the Project Programme for 1973, research investigations on a number of problems under 20 projects were carried out while investigations on "*Murrel and Live Fish Culture (Project-7)*" and "*Fisheries of River Basin (Project-21)*" were suspended. Studies on problems and sub-problems were carried out on priority basis and researches on quite a few problems were completed.

(a) *Research completed* :

Since the initiation of project programmes in 1967, investigations on fifty-six problems have so far been completed. One problem was completed in 1969, seven in 1970, five in 1971, twenty in 1972 and twenty-three in 1973. Brief reports, on the problems completed during 1973 are given below :

Project 1 : *Optimum per hectare production of fry, fingerlings and fish in culture fishery operations* :

Problem :	1. 7	Culture of fish food organisms in the laboratory and field for feeding fish
Personnel :		K. K. Vass and (Smt.) K. K. Bhanot
Duration :		Three years (extended by 3 years)

A simple and inexpensive method has been developed to mass culture *Chlorella vulgaris*. Experiments using different ratios of NPK fertilizers have indicated that the 8 : 4 : 5 ratio at 1 ppt gives the maximum production, a rich growth of *Chlorella vulgaris* (2 to 3 million cells per ml) being produced within 3 to 7 days. The diatoms, *Navicula* sp., *Nitzschia* sp. and *Pinnularia* sp. could be produced in partitioned enamel trays and glass aquaria with Miquel's solution and enriched low salinity pond water as the culture media.

Mass culture of *Daphnia similis* was also done successfully, the culture media being an organic source (bone meal or poultry manure) at 0.5 to 1% concentration. *Daphnia* were fed with *Chlorella* (freshly cultured) at 0.2 to 0.5 ml/individual/day. The production was estimated at 10 ml of packed volume per 10 litres of culture solution. The population was harvested every 3rd day.

Controlled feeding experiments with *Chlorella vulgaris* were also carried out. The doses tried were : 2, 4, 8 and 12 ml of *Chlorella* suspension in 20-litre jars. The fingerlings of rohu (*L. rohita*), mrigal (*C. mrigala*) and catla (*C. catla*) were used as the experimental material. An examination of the gut contents and excreta of the fishes showed cells of *Chlorella vulgaris* in various stages of disintegration and most of the cells were partly or entirely

devoid of contents. In experiments with *Chlorella,* fed at concentrations of 8 and 12 ml, there was a definite increase in weight of fingerlings (ranging from 2 to 3% over the control). When fingerlings of catla were fed with a mixture of *Daphnia* and *Chlorella,* it was observed that the increase in the weight was 2 to 4.5%.

Field trials are envisaged in near future.

Problem :	1.12	Evaluation of indigenous plants as fish poisons
Personnel :		H. Chaudhuri and S. Jena
Duration :		6½ years

Laboratory experiments conducted during 1968 with the seed powder of *Barringtonia acutangula* and the unripe fruits of *Randia dumetorum* indicated that the former at 15-20 ppm and the latter at 12 ppm killed tilapia, the test fish, within 4-6 hr. An increase in the dose of the latter to 15-20 ppm reduced the time taken from ½ to 3 hr. Oilcake of 'Mahua' (*Bassia latifolia*) at 200-250 ppm cleared unwanted fishes from nursery ponds; it, however, killed tilapia at 75 ppm in laboratory experiments.

In a field experiment conducted in April, 1970, in a 0.04 ha/1.5 m deep nursery pond, stocked one week in advance with Indian and exotic carps (105 nos.) and miscellaneous fishes (62 nos.), the seed powder of *B. acutangula at* 15 ppm killed all varieties of fish within ½ to 1½ hr. Fishes coming to the surface in distress were netted out and transferred to freshwater, but only *Channa striatus* could recover. It was also observed that the back-swimmer, *Anisops,* which occurred in large numbers in the pond were affected by the poison within about one hour and could be netted out in bulk from the surface water with a cloth. Plankters were not affected by the treatment.

In laboratory trials with alcoholic extracts of stem bark powder of *B. acutangula* during 1971, 2 ppm was found sufficient to kill tilapia within 2 hr.

A few experiments carried out during 1972 with 'Mahua' flower residue (dried and powdered) indicated that it was not toxic to murrel (*Channa marulius*) even upto 100 ppm.

In laboratory jar experiments, stem bark powder of *Cassaris graveolens* at 30 ppm killed the fishes after 6 hr while no effect was observed at 10 & 20 ppm even after 24 hr. Another set of experiments was carried out with *B. acutangula* bark (fibrous portion left after powdering) soaked in water for 48 hr and the solution applied at different doses. In a field experiment, all the fishes were found to be in distress, losing their balance and subsequently dying within 2 hr when *B. acutangula* bark powder was used at 20 ppm.

Experiments with *Euphorbia tirucalli* (whole plant soaked in water for 3 days) were carried out in the laboratory with murrels at different doses. The fishes died within 1-2 hr.

Residual effect of various poisons and the economics of the use of each poison are proposed to be studied.

Problem : 1.19 Conversion ratio of selected carp feed into fish flesh

Personnel : R. D. Chakrabarty, P. R. Sen, N. G. S. Rao and D. K. Chatterjee

Duration : 4 years

Experiments were conducted to find out the comparative usefulness of some easily available items that may be used as feed for carp spawn and fry. The feeds tried were mixtures of mustard oilcake and rice bran, ground-nut oilcake and wheat bran, silkworm pupae (tasar silkworm), soyabean and prawn waste, and the performance of the test animals were compared with those reared on the natural fish food; *viz.*, zooplankton. The highest survival and maximum length and weight increments were obtained with zooplankton in spawn of all the three species of major carps, catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*). Of the feeds tried, soyabeen gave the maximum increment in *C. catla*, and silkworm pupae and the ground-nut oilcake plus wheat bran mixture were found to be better utilized by *L. rohita* and *C. mrigala*. In case of fry, zooplankton proved to be the best food for *C. catla*, but *L. rohita* and *C. mrigala* thrived well with silkworm pupae. Soyabean may not be economical but the ground-nut oilcake plus wheat bran mixture and silkworm pupae can be considered as cheap and well accepted feed.

Five feed mixtures having varying degrees of protein and carbohydrates were used as feed in experiments conducted with spawn of catla, rohu and mrigal. While catla, performed well with a higher content (32.7%) both rohu and mrigal showed good results with feed having 25.2% protein content. The food mixture with 17.7% protein gave the poorest performance in case of all the species. Utilization of the feed as revealed in growth increments was found to be the best in mrigal followed by rohu.

A new programme laying stress on the nutritional requirement of fry and fingerlings of major carps which is somewhat basic to formulation of effective feed mixtures is proposed to be taken up.

Project 4 : *Riverine carp spawn prospecting and collection techniques* :

Problem : 4. 4 Comparative growth rate of spawn from different sources

Personnel : J. C. Malhotra and G. N. Mukherji

Duration : 4 years

Spawn procured from river Sone in Bihar, river Yamuna at Allahabad and from the 'dry bundh' at Nowgong in Madhya Pradesh, were reared under identical conditions up to fry stage in plastic pools and thereafter upto fingerling stage in nursery ponds. The spawn from river Sone exhibited better rate of growth (10-40 mm T.L., av. 23.5 mm) in plastic pools than the spawn from other sources; *viz.*, dry bundh (10-27 mm T.L., av. 16.8 mm) and river Yamuna (12-33 mm T.L., av. 23.7 mm).

The resultant fry from the Sone-and 'bundh'-spawn were reared in nursery ponds for a period of 147 days, and it was observed that catla from the Sone-spawn exhibited better rate of growth (av. T.L., 149.1 mm), while rohu from the bundh had a comparatively better growth (av. T.L., 124.1 mm).

Further observations on spawn from the bundh at Nowgong, induced bred ones at Taraon Fish Farm, from the Ganga at Buxar and from the Yamuna at Allahabad reared for 110 days indicated that induced bred mrigal-spawn grew to an average length of 90 mm, Ganga-mrigal to 117 mm and the Yamuna-mrigal to 103 mm. Catla from the bundh grew to an average length of 80 mm in 80 days of rearing while catla from the Yamuna and the Ganga grew to an average lengths of 56 and 57 mm respectively. Rohu from the bundh attained an average length of 66 mm in 52 days against 71 mm by the rohu in the Yamuna-and Ganga-spawn.

Kosi-spawn had a better rate of growth than the Ganga-spawn. Further the spawn from the second flood in the Ganga showed a better rate of growth than that of the first.

When fry, raised from the spawn from the river Kosi, were reared up to fingerling stage in a known combination of catla 4 : mrigal 3 : rohu 3, it was observed that mrigal showed the maximum growth followed by catla and rohu. With the combination of catla 1 mrigal 1 rohu 1, mrigal again showed the maximum growth followed by rohu and catla. However, when the fry from spawn collected from different spurts in the river Ganga were reared in the same combination, it was established that mrigal maintained its maximum growth followed by catla and rohu in the first spurt, while catla showed the maximum growth followed by mrigal and rohu in the third spurt.

Of the river Kosi and Sone the spawn from the latter river was of a better quality as regards its growth rate.

Project 5 : *Brackish water fish farming*

Problem : 5. 2 Detailed survey of islands in lower Sunderbans for designing brackish water fish farm (400 ha)

Personnel : S. Sengupta, A. B. Mukherjee and P. N. Bhattacharya

Duration : 2½ years

Prismatic compass traverse survey of 600 ha of Mahisani Island has been completed. Detailed contour survey of 280 ha on Mahisani Island has been completed and layout plan of a 200 ha fish farm prepared. The layout plan of a fish farm covering 85 ha on Henry's Island has also been prepared. A common characteristic of both the islands is that the coastal regions are at a a lower level than the interior areas. The average tide water level during March to May at a point of reduced level of 2.55 m is 0.6 m approximately. The outer fringes being at an average reduced level of 2.40 m, excavation to a depth of 0.25 m is to be made to take tidal water up to a depth of 1 m in the brackish water ponds.

As the forest islands of the lower Sunderbans are overgrown with thick and thorny vegetation, it was very difficult to conduct the detailed contour survey. The problem was solved by clearing parallel lines, 120 m apart, through the island and taking spot levels at every 120 m.

Problem : 5. 7 Culture of brackish water fish food organisms

Personnel : K. K. Bhanot, A. N. Ghosh, K. K. Vass, K. M. Das and G. N. Chatterjee

Duration : 6 years

The brackish water fish ponds at Kakdwip have been found to be rich in the periphytic communities, dominant forms being *Pinnularia* sp., *Nitzschia* sp., *Rhizosolenia* sp., and *Navicula* sp. It has been observed that plankton and benthos are to a large extent antagonistic; *i.e.*, when plankton develop and produce turbidity, the benthos are shaded out and when benthos develop, they leave little nutrient material for the plankton. The biomass production records show that periphyton produce between 0.84-2.372 gm/m^2/day ash free dry weight.

The dominant benthic community; *viz.*, the diatoms were mass cultured in plastic bags and partitioned trays, etc., in Miquel's solution.

Based on the preliminary observations a follow up project for mass culture of *Nitzschia* sp., *Pinnularia* sp., *Gyrosigma* sp., and *Navicula* sp., has been proposed to be taken up in the field.

Problem : 5. 9 Response of different fertilizers (both inorganic and organic) on fish productivity

Personnel : R. K. Banerjee, B. B. Pakrasi and N. C. Basu

Duration : 1 year

Preliminary laboratory studies on the effects of compost made of leaves of common mangrove plant *Avicinnia officinalis*, paddy straw, cattle-dung, cattle-urine and superphosphate on the nutritional levels, plankton production and growth of fish were made. The PO_4-P and NO_3-N in treated pond rose from traces to 0.36 mg/1 and 0.12 mg/1 respectively, whereas in untreated pond they ranged between 0.04-0.08 and 0.04-0.05 mg/1. Similarly, in soil phase, the available nitrogen and phosphorus increased to an appreciable extent. The primary productivity and the growth and survival of fish were also encouraging.

Based on these findings, yard experiments were taken up with slight change in the composition of the compost ingredients.

410 kg of compost was obtained from a bulk charge with common mangrove (*Avicinnia officinalis*)—400 kg, paddy straw—360 kg, raw cow-dung—400 kg, and mahua oilcake—30 kg.

The compost's nutrient composition was : total nitrogen 1.176% and organic carbon 10.86%.

Plastic pools were set in situ and compost was charged in two replications each at 10,000 and 5,000 kg/ha and another with 500 kg/ha of compost and superphosphate at 5 kg/1,000 kg of compost.

Both the doses (10,000 kg/ha and 5,000 kg/ha) showed an increase in the nutrient level (PO_4-P and NO_3-N of water being 0.6-10.0 and 0.6-0.8 ppm respectively) and phytoplankton production (dominant forms being *Euglena, Trachelomonas, Oscillatoria, Melosira, Navicula* and *Nitzschia*).

As the maintenance of high nutrient level in water phase and the plankton concentration were encouraging, the use of compost as fertiliser in fish pond is suggested.

Project 8 : *Estuarine and brackish water lake fisheries*

Problem : 8. 2 Prawn seed resources of Hooghly-Matlah estuarine system

Personnel : M. Subrahmanyam, R. K. Chakraborty and D. K. De

Duration : 5 years 9 months

Brackish water prawn seed investigations were conducted at Kolaghat on the Roopnarayan river (December, 1968—November, 1969), Nurpur and Uluberia on the Hooghly river (March, 1970—February, 1971 and January—December, 1972) and Balughata on the Haldia river (January, 1973—

December, 1973). The postlarvae of *Penaeus monodon* and *P. indicus* were abundant in March-April at Kolaghat, in June at Nurpur, in February/March —July at Uluberia and in June-July at Balughata. The seed was available both during high and low tides. Generally the collections included many miscellaneous and uneconomic varieties of fishes and prawns and often the seed were entanglad with organic matter.

The distinguishing features of the important varieties of prawn seed— *Penaeus monodon, Penaeus indicus, Metapenaeus monoceros, M. brevicornis* and *Macrobrachium rude* were determined.

The larvae of *Macrobrachium rosenbergii* were reared upto IV stage at Barrackpore in the estuarine water brought from Namkhana (lower stretches of the estuary) and in the estuarine water at the field laboratory at Uluberia. Further experiments were conducted at Jaunput, employing sea-water and the zoeae could be reared up to IX stage. Due to lack of controls for temperature and dissolved oxygen, complete success could not be achieved.

Further work on the rearing of larvae of *Macrobrachium* spp. would be undertaken at Kakinada (Andhra Pradesh).

Problem :	8. 3	Fisheries of the Pulicat Lake
Personnel :		K. Raman, K. V. Ramakrishna, R. D. Prasadam, S. Radhakrishnan, G. R. M. Rao, M. Kaliyamurthy, C. P. Rangaswamy, K. Gopinathan, R. Ganapathy, S. Srinivasagam and K. Janardhana Rao
Duration :		Five years (extended by 9 months)

The recruitment of postlarvae and juveniles of the important fishes and prawns in the lake showed a declining trend. Polychaetes and planarians were in abundance in the southern sector of the lake while bivalves and chironomid larvae dominated the northern sector. The highest phytoplankton concentration was observed during February and that of zooplankton during May at Lake-mouth. The rate of primary productivity ranged from 0.54 to 1.44 gm C/m^2/day. The minimum density of bottom vegetation in the lake was recorded during monsoon and the maximum during summer and post-monsoon. Pariphyton on flora showed a preponderance of diatoms.

Prawns injected with an indigenous stain did not thrive though the gills were stained well. Crabs when reared in plastic tubs moulted on or near full or new moon days. *M. parsia* injected with carp pituitary extract released eggs but they died after 10-12 hours. In the culture of fish food organisms, plankton increased with increasing doses of NPK, but declined when the dose exceeded 2.0 gm/1.

Of the pelleted feed mixtures tried on mullet fry, ragi + Bengal gram + pea-nut gave better growth increment (110%) and ground-nut oilcake + prawn powder + sago gave better survival (63%). Yeast as growth promoter showed encouraging results.

A detailed report recommending the measures for the development of fisheries of the Pulicat lake is being finalized.

Project 9: *Selective breeding and hybridisation*

Problem :	9. 1	Biological and genetical features of some Indian carp hybrids
Personnel :		H. Chaudhuri and R. M. Bhowmick
Duration :		6 years

During the first four years hybrids; *viz.*, mrigal × catla, catla × mrigal, calbasu × catla were produced and through rearing the growth and biological aspects of those progenies were studied. In 1972, a large number of inter-specific, inter-generic and F_2 generation were produced. Hybrid between common carp and catla, which was produced for the first time, died within 20 days. Of the hybrids produced so far catla × rohu, rohu × catla and calbasu × catla have shown encouraging results. Studies on the food and feeding habits of hybrids were conducted. 5,000 calbasu × rohu hybrids and 1,500 catla × rohu hybrids were produced and reared during 1973. The growth rate and morphological features of the hybrids were under study. Attempts to hybridise rohu with silver carp succeeded, but the hybrid hatchlings produced were mostly deformed and died within a week.

The selected hybrids are being cultured along with other carps with a view to studying their growth and biology.

Project 11 : *Economics in fishery investigations*

Problem :	11. 3	Economic evaluation of different weed control methods
Personnel :		M. Ranadhir
Duration :		3 years

Studies on the economics of weed control by treatment of the pond bottom of sewage-fed fish farms around Calcutta with copper sulphate in mud pellets have indicated that the total expenditure involved in the removal of various types of weeds (*Vallisneria, Hydrilla, Eichhornia, Cyperus* etc.) varied from Rs. 1,278-4,158/ha of weed infested area, the average being Rs. 2,810/ha.

A clear case of benefits of weed control was obtained in the sewage-fed pond (312 sq.m) at Bantola near Calcutta where fish production rose from 27 to 697 kg.

Project 12 : *Exotic Fish Culture*

Problem : 12. 1	Standardisation of techniques of breeding of grass and silver carps
Personnel :	H. Chaudhuri, D. S. Murty, R. K. Dey and P. V. G. K. Reddy
Duration :	6 years

During 1968, adoption of field modifications in stripping and hatching yielded 9.01 lakh of silver carp and 4.0 lakh of grass carp spawn. Investigations carried out, during 1969 onwards, confirmed that conducive weather conditions; *i.e.*, sufficient accumulation of rain water, intermittent rains on the day of the experiment and water temperature between 27°-29°C, played an important role in inducing silver carp and grass carp to breed. In rearing the brooders, a stocking density between 1,500-2,000 kg/ha and adequate feeding of grass carp were found to be important factors. Prolonged drought or extended rainy season with long spells of draught resulted in loss in condition of brooders. A catheter has been found to be very useful in proper selection of female brooders of both the species.

Fish pituitary glands injected at 9-15 mg/kg body weight of female brooders and 2.5 mg/kg body weight of males were found effective. The results were encouraging when the breeding *hapas* were fixed in running water or water sprayed over them. Frequent mortality of developing embryos and hatchlings of both the species observed in hatching *hapas* was overcome to certain extent by using thin *hapas*. The percentage of hatching was quite high when hatching was done in the glass jar hatchery complex. A detailed report is being prepared.

Production of the seed of grass carp and silver carp by employing the techniques standardised is proposed to be taken up on a commercial scale as a follow up programme.

Problelm 12. 2	Mono-culture of silver carp
Personnel :	D. S. Murty, R. K. Dey and P. V. G. K. Reddy
Duration :	5 years

To assess the productive potential of the fast growing silver carp, monoculture experiments were conducted. The experiment initiated in 1968

indicated slow rate of growth (average increment in weight for fish was only 175 and 140 gm in 2 ponds respectively during 5 months) at a stocking density of 5,000/ha. Hence this experiment was given up after six months and a fresh experiment was initiated in March, 1969 with a lower stocking rate of 4,000/ha. The fish (46 gm initial weight) attained an average size of 700.0 and 458.5 gm in the two ponds in one year, the gross/net productions of fish/ha/yr being 1,558/1,374 kg and 1,923/1,739 kg respectively. Another experiment conducted during 1971-72 at 3,000/ha yielded net and gross productions of 248 and 320 kg/ha/yr. The low productions recorded might be due to heavy infestation of *Pithophora* in the pond.

A fresh experiment of one year duration was initiated during April, 1973 and the growth recorded in six months was 280 gm and 365 gm respectively in two ponds.

The data collected so far, indicate that mono-culture of silver carp stocked at the rate 3,000-5,000/ha may result in poor growth of the species.

Project 14: *Riverine and estuarine fish catch statistics*

Problem : 14. 5	Fish catch statistics of the Pulicat lake
Personnel :	K. Raman, K. Gopinathan and S. Srinivasagam
Duration :	Six years (extended by 9 months)

The total estimated landings for the lake varied from 926.89 t (1968) to 1,371.4 t (1972) with an average of 1,152.86 t during the 6-year period from 1967 through 1972 showing a decrease in 1968 and an increasing trend upto 1972. Prawns dominated catches, ranging from 378 t (1968) to 634 t (1967). Though the prawn catches showed a steep decline during 1968, it improved during the following year. *Penaeus indicus* was the most dominant species followed by *P. semisulcatus, P. monodon, Metapenaeus monoceros* and *M. dobsoni.* In order of importance, mullets formed the next group with *Mugil cephalus* as the dominant species. Perches, clupeids, catfishes and crabs were the other important groups landed in order of abundance. *Gerres* spp. and *Sillago sihama* among perches, *Nematalosa nasus* and *Chanos chanos* among clupeids, *Plotosus canius* and *Tachysurus* spp. among catfishes and *Scylla serrata* and *Neptunus pelagicus* among the crabs were the commercially important species.

Of the gears generally operated, stake nets landed the major share followed by drag nets, shore seines and hook and line. Catch per unit of effort of the more important gears have not revealed any definite trend.

In 1973, the total landings from the lake were estimated at 11,42,028 t registering a fall of 229.42 t (16.72%) over that of the last year. This may

be attributed to the early closure of the lake-mouth. All the important groups have shown a fall in landings and this was very significant in the case of crabs (79.0%), perches (43.1%), mullets (25.3%) and prawns (2.5%). The maximum catch was landed in February (154.367 t) and the lowest in October (53.862).

The detailed report on fish catch statistics of the Pulicat lake is being finalised.

Project 16 : *Weed control*

Problem	: 16. 1	Standardisation of methods of control of emergent and floating weeds with hormone weedicides
Personnel	:	V. Ramachandran, S. Patnaik, T. Ramaprabhu and K. M. Das
Duration	:	5 years

2,4-D sodium salt, the hormone weedicide easily available in India at a comparatively fair price has been found to be the most effective chemical weedicide for control of most of the major aquatic weeds; *viz.*, water-hyacinth, lotus, lilies, *Cyperus, Typha, Ipomoea aquatica* and *I. carnea* and *Jussiatea.*

Another hormone weedicide 'Dalapon' (2,2,dichloropropionic acid) has been found effective against young stands of the aquatic grass *Panicum* sp.

A rationale for prescription of dosage of weedicides has been worked out based on the average plant weight and density of infestation. In case of water-hyacinth, 3 such size categories; *viz.*, 100 gm, 100-500 gm and more than 500 gm have been delineated and the 2,4-D dosages necessary for complete kill have been found to be 10, 20 and 30 mg per kg of plant weight respectively.

A field technique for approaching the interior areas of vast dense water-hyacinth infestations has been worked out involving use of a few bamboo poles. A special large droplet size high volume spray nozzle has been designed to increase the reach and accuracy of the spray jet.

The high manurial value of the decomposing water-hyacinth, treated with 2,4-D, has been indicated in yard and filed trials.

Control of young sedges (*Cyperus* sp.) in field infestation has been achieved by treating with 2,4-D @ 6 kg a.i./ha. *Typha* was also found susceptible to 2,4-D @ 8 kg a.i./ha.

Successful field treatments have been carried out to control infestations

of lotus and lilies with 2,4-D @ 10 kg a.i./ha. However, the deep underground rhizomes of lotus were not affected which resulted in the regeneration of plants. Control of lilies was most effective. Control of *Nymphoides* was incomplete.

Ipomoea carnea has been identified as a major shallow water and shore weed problem but could be easily killed and controlled by 2,4-D foliar spray @ 2 kg a.i./ha.

All these methods have been demonstrated to the Cuttack Municipality, the Central Rice Research Institute and to several private fish farmers.

Field estimates of the cost and efficacy of manual labour for physical removal of these weeds proved to be very expensive and short-lived.

Problem : 16. 4 Standardisation and evaluation of the use of ammonia as an aquatic weedicide/fertilizer

Personnel : V. Ramachandran, T. Ramaprabhu and K. M. Das

Duration : 6 years

Aqueous ammonia applied as a foliar spray caused only foliar damage to water-hyacinth infestations in field trials. However, when applied in the water in the root zone of the plants, at 40 ppm, it affected the growth, but the plants were not killed.

Aqueous ammonia at 1-1.5% with 0.25% detergent killed *Pistia* sp. infestations when applied as a foliar spray. At concentrations 1.5% and above with 0.25% detergent, aqueous ammonia killed *Salvinia* sp. infestations also.

The efficacy of ammonia as a fertilizer and fish poison was also proved in yard and field trials. In natural ponds it is found to kill all the species of fish present, including *Channa striatus* and *C. gachua*, prawns, tadpoles and plankton when applied @ 20 ppm N in the bottom zone. Within a week or two, however, the water became non-toxic and dense populations of phyto followed by zooplankton reappeared. The fish could also be stocked at this stage.

The procedural difficulties of procuring ammonia from the Fertilizer Corporation of India, though very great, have been solved.

Ammonia has great potentialities for use in fish culture provided procurement and usage are taken up on a large scale in a fish farm. Till such time, the use of ammonia is not attractive enough to use it as a substitute for other weedicides. Investigations are necessary to explore possibilities of its other uses in fish culture.

Project 17 : *Frog farming*

Problem : 17. 1	Induced breeding of commercially important species of Indian frogs
Personnel :	A. K. Mondal, C. R. Das, P. L. N. Rao and S. N. Mohanty
Duration :	6 years

Of the 19, 37, 22, 21 and 12 sets of experiments with *Rana tigrina* conducted during their pre-breeding and breeding seasons in 1968, 1969, 1970, 1971, 1972 and 1973 using homo-and heteroplastic pituitary gland extract injections, the success recorded was 73.7, 97.3, 100, 100, 100 and 100% respectively. In similar experiments with *R. hexadactyla,* all the 7, 2, 5, 10, 2 and 4 sets were respectively bred during the above years. In this species extra-seasonal breeding in two more sets was also obtained during 1971. 4, 1 and 4 sets of *R. crassa* were bred during 1971, 1972 and 1973 respectively and 1 set of *R. limnocharis* during 1972 and 4 sets of *R. cyanophlyctis* during 1973. The pituitary of *Bufo* has been found to be effective in *R. tigrina*, *R. crassa* and *R. cyanophlyctis* at high doses. A single sub-cutaneous injection of 2 to 3 mg of dried frog pituitary gland extract for the recipient female only irrespective of its body size and weight has been recommended for general adoption. The technique has been properly developed and standardised.

The time lag between injection and final stripping has been further reduced from 18 to 3-4 hrs in *R. tigrina* and *R. crassa* and 6-7 hrs in *R. hexadactyla.* Artificial fertilisation of eggs with sperm suspension yielded 100% success.

Fecundity of 25, 19, and 8 specimens of *R. tigrina*, *R. hexadactyla* and *R. crassa* respectively revealed that it varied from 2,939 to 19,864 within a length range of 83-148 mm in *R. tigrina*; from 1,102 to 7,649 in *R. hexadactyla* (size : 92-125 mm); and from 1,869 to 6,323 in *R. crassa* (size : 68-99 mm).

14 out of 15 sets of *R. tigrina* during 1969-1970 and 3 sets of *R. hexadactyla* in 1970 were bred with progesterone alone and in combination with pituitary extract. In 3 sets of the former species follicular rupture could be induced with chorionic gonadotropin.

Employing the induced breeding technique, commercial seed production of frogs will be taken up as a follow up programme and a frog hatchery designed for the same.

Problem : 17. 2	Raising and rearing of tadpoles to early frogs of indigenous commercial species

Personnel : A. K. Mondal, P. L. N. Rao, C. R. Das, and S. N. Mohanty

Duration : 7 years

Fertilised eggs of *Rana tigrina, R. crassa* and *R. hexadactyla* developed well in pond water where more than 80% hatching could be obtained. Post-hatching mortality in the former two species has been checked by improving upon the hygienic condition. Tadpoles of *R. tigrina* and *R. crassa* prefer zoo-plankton, tubificid worms and earthworms to other food items including mosquito larvae and those of *R. hexadactyla* are herbivorous. Tadpoles of the former two species have cannibalistic habits. Metamorphosis is completed in 5-6 weeks in *R. hexadactyla* and 3-4 weeks in *R. tigrina.*

As against the comparatively low survival of the early stages of *R. tigrina* and *R. crassa, R. hexadactyla* tadpoles could be easily reared upto early frog stage in plastic pools/cement cisterns with about 90% survival by provisions of *Spirogyra* sp., *Oedogonium* sp., *Lemna* sp. and *Hydrilla* sp. In a yard experiment conducted in a plastic pool with 5-day old tadpoles of *R. tigrina* stocked at 750 tadpoles/200 litres of water and regularly fed with frog meat, about 72% survival of early frogs was obtained.

It is observed that high rate of cannibalism is prevalent amongst tadpoles of *R. tigrina* and *R. crassa.* This habit was found to be very much reduced in the hybrid tadpoles resulting from hybridisation between these two species. Provision of frog meat, fish meal and shark meat as food checks cannibalism to a great extent.

Preliminary screening of a few chemicals like turpentine, liquid paraffin, benzene, etc. and of various plant parts of *Barringtonia acutangula, Randia dumetorum, Strychnos nux-vomica, Milletia auriculata* etc. was done in the laboratory in order to develop a suitable method for assessing survival of various life history stages in the nursery ponds. Of these, only stem bark of *Milletia* has been found useful in assessing survival of early tadpoles of *R. tigrina* and *R. hexadactyla.* Assessment of survival of *R. tigrina* tadpoles was not found possible in a field nursery through treatment with ammonia at 20 ppm.

Three pre-prepared field nurseries were stocked with 3 to 5-day old tadpoles of *R. tigrina* @ 2.0 and 3.0 lakhs/ha. The survival and growth of advanced tadpoles and metamorphic stages were found to be fairly satisfactory.

No adverse effects on the tadpoles of *R. hexadactyla* (16-23 mm) and common carp spawn (6-7 mm) were noticed when reared together with/ without food for 16 days even at high stocking densities.

Consequent to various induced breeding experiments 0.320, 0.960, 1,400, 1.000, 0.325 and 0.325 lakh tadpoles of the above species were produced during

1968, 1969, 1970, 1971, 1972 and 1973 respectively. An additional 1,000 hybrid tadpoles resulting from crosses between *R. tigrina*, *R. crassa* and *R. limnocharis* were also produced during 1972.

Investigations on nursery management practices for Indian commercial frog species are proposed to be taken up with a view to building up stocking material for frog culture operations.

Problem : 17. 3	Culture of frogs and study of productivity in frog farming
Personnel :	A. K. Mondal and S. N. Mohanty
Duration :	7 years

In two experiments on frog farming conducted during 1968, a production of 259 kg/ha of *Rana tigrina* and 236 kg/ha of *R. hexadactyla* was obtained after 11 and 8½ months' rearing respectively when stocked at 2,000/ha. Similar experiments were also conducted during 1969 with small frogs stocked at 6,000/ha. While a production of 665 kg/ha of *R. hexadactyla* was obtained in 10 months in one experiment, the other experiment with *R. tigrina* had to be abandoned after six months' rearing since the survival and growth of frogs suffered heavily due to non-availability of sufficient quantity of insect food as was earlier suggested to be provided through light trapping device. The highest production of 772 kg/ha/yr of *R. hexadactyla* was obtained in a weed infested pond during 1970-71 at a stocking density of 6,000/ha.

Two more experiments were carried out during 1971-72 with small frogs of *R. hexadactyla* stocked at 6,500/ha and *R. tigrina* at 4,000/ha. A production of 685 kg/ha of the former and 214 kg/ha of the latter species was obtained after one year of rearing.

The recent discovery of the phytophagous habit of *R. hexadactyla* is a major break-through in the field of frog culture, since this helps eliminating the crucial problem of feeding the frogs in confinement with live worms and insects.

Investigations on mono-culture of *R. hexadactyla* will be taken up as a follow up programme in view of its phytophagus habits.

Problem : 17. 4	Fish-cum-frog culture
Personnel :	A. K. Mondal, C. R. Das, P. L. N. Rao, D. K. Chatterjee and S. N. Mohanty
Duration :	7 years

Five experiments on the possibilities of joint rearing of frog and fish have been carried out so far. 235 and 1,611 kg/ha respectively of *Rana tigrina* and Indian major carps and 218 and 1,092 kg/ha of *R. hexadactyla* and fish were produced in the first combined culture experiment conducted for 8½ months during 1968. Frogs and fingerlings were stocked at 2,000 and 3,705/ha respectively. During 1969, *R. hexadactyla* was stocked at 6,000/ha along with Indian major carps at 4,000/ha. The final production of frog and fish was 422 and 1,502 kg/ha respectively. The second experiment was repeated during 1970 with the same stocking density but different ratio and a production of 284 and 1,419 kg/ha of frog and fish was obtained. In the fourth experiment, small frogs (av. 45 mm/9 gm) of *R. hexadactyla* were stocked @ 6,500/ha, along with fingerlings of major Indian and exotic carps at 4,500/ha. The final production of frog and fish was 418 and 3,145 kg/ha/yr respectively. In rearing *R. hexadactyla* and grass carp stocked at 2,000 and 4,000/ha, a production of 920 kg fish/ha/yr of grass carp and 127 kg/ha/yr of frog was obtained.

Project 19 : *Hilsa fisheries*

Problem	: 19. 4	Hilsa fisheries of the Hooghly-Matlah estuarine system
Personnel	:	Apurba Ghosh, V. Gopalakrishnan and L. H. Rao
Duration	:	5 years

During the 1970 monsoon season, collections were made between Dhatrigram and Tribeni covering about 40 km and the two downstream centres were dropped due to the poor availability of larvae. Collections were made in June at Balagarh centre contained newly hatched prolarvae (4-6 mm) in appreciable numbers indicating early commencement of hilsa breeding in that year. Collections were, however, moderate at Dhatrigram, the uppermost centre in the selected stretch.

In 1971, observations were made between Balagarh and Dhatrigram centres dropping out Tribeni, the lowermost centre. Due to heavy monsoon, the water discharge in Hooghly river increased tremendously and flood conditions prevailed in August and September. The concentration of larvae also increased manifold as compared to previous years. The peak breeding was encountered in October.

During 1972, studies were continued between Balagarh and Dhatrigram centres. Hilsa larvae were encountered in poor numbers at all the centres of the stretch. The failure of monsoon seemed to influence the migration and

breeding of hilsa as very few mature hilsa were recorded in commercial catches in the stretch.

During 1973, monsoon migration of hilsa started very late and so also the breeding. Though there was moderate rain in West Bengal, scanty rains in the upper Ganga area probably resulted in decreased water discharge in the Hooghly during flood period. Peak period of larval abundance was observed in early November. Pre-larvae were very common in the collections in both shooting and tow nets. Hydrological data of the stretch during the years of investigations were recorded. Total water discharge data of monsoon months for the years 1969-71 at Kalna point of the river Hooghly, provided by the Ganga Survey Department of the Government of India furnish some positive evidence in support of the hypothesis that water discharge and its velocity have some influence on the migration and spawning of *H. ilisha*.

In view of the commissioning of the Farakka Barrage on the river Ganga, follow up investigations to assess the factors responsible for the decline of hilsa catches will be continued.

Problem : 19. 5 Artificial propagation of *Hilsa ilisha* (Ham.)

Personnel : J. C. Malhotra, P. K. Mathur, K. L. Shah and D. Nath

Duration : 5 years

Success in the artificial fecundation of hilsa (*Hilsa ilisha*) in the Ganga near Allahabad was achieved during 1969. The resultant hatchlings were reared first in river water for 7-20 days and thereafter in freshwater ponds for durations ranging from 23 to 45 days. Hilsa hatchlings, produced through stripping in 1969 lived for more than 2 years and grew to an average length of 322 mm. The average length of 322 mm attained by hilsa in ponds at the end of two years compares favourably with the 336 mm length estimated for + 2-year old hilsa. Fertilised eggs of hilsa hatched successfully in *hapas* fixed in pools, left behind by the receding floods, in the sandy bed of the Ganga and in freshwater ponds. In subsequent experiments the percentage of hatching in ponds increased from 15-30% to 80% by treating the ponds with lime (CaO). Spawn of hilsa were successfully transported under oxygen in sealed containers, @ 75,000 per 18.4 litre polythene bag containing 1/3 water and the rest oxygen, to distances covering a journey of 4½ hr. After 1 week of rearing in nursery ponds treated with mahua oilcake @ 150 ppm and inoculated with Co, Mn and Zn, the survival was estimated to be 80 to 90%. The hatchlings produced during October, 1971 and reared in ponds grew to an average length of 33.7 mm in 75 days of pond life, while those produced in October, 1972 attained an average length of 46.5 mm in 56 days of rearing

and continued to grow satisfactorily. Hatchlings stocked in 1969 attained an average length of 345 mm in the range of 320-370 mm in 2 years, 3 months and 14 days of rearing in ponds by February, 1972. The hatchlings of *Hilsa ilisha* produced through stripping during October, 1972 and reared in ponds grew to an average length of 54.00 mg in 85 days of pond rearing. During March, 1973 total mortality of the hatchlings stocked in freshwater ponds was observed. In October, 1973, investigations were carried out at Khandua on the river Padma and at Sirsa and Varanasi on the river Ganga. At Khandua, hilsa females suitable for stripping were not available in the commercial catches, the latter were also affected by the cyclonic weather during the investigation period. It may also be added that because of the change in the river course sometimes in September, the main hilsa fishing grounds shifted along the north bank in Bangladesh. Suitable females were not available at Sirsa and Varanasi also because the hilsa run during the post-monsoon season was of very low magnitude.

On the basis of the know-how developed, investigations on the culture of *Hilsa ilisha* in confined waters are proposed to be taken up.

Project 20 : *Water pollution investigations*

Problem : 20. 1	Pollution in Hooghly-Matlah estuarine system
Personnel :	B. B. Ghosh, V. Gopalakrishnan and M. M. Bagchi
Duration :	6 years

Detailed investigations on the domestic, municipal and industrial wastes discharged into a 92 km stretch of the Hooghly estuary between Dumurdaha and Birlapore and their pollutional effects on the aquatic biomass were carried out. The major sources of pollutants reaching the estuary are mostly the untreated domestic sewage from townships and estate wastes of jute mills, industial wastes of diverse characters and hot water from power stations. The study reveals that there are 95 factories comprising 6 pulp and paper, 5 textile, 2 distilleries, 1 each of yeast, tennery and rubber, 3 oil, 6 power, 55 jute and 15 miscellaneous industries situated on or very near the banks and 80% of these are discharging their wastes directly into the estuary almost in an untreated manner.

Average daily flow of the waste waters is 252.35 mgd of which 77.35 mgd is contributed by the industrial wastes. The maximum quantity of waste waters (39.29 mgd) having the highest pollution load (28.59 tonnes/day as B.O.D. and 299.20 tonnes/day as suspended solids) is discharged from pulp and paper mills alone. Daily average pollution load with respect to B.O.D. and total suspended and dissolved solids contributed by the industrial wastes

are : 66.03, 894.08, 411.93 and 482.15 tonnes respectively and the corresponding values for domestic and municipal wastes are 40.08, 1,424.36, 645.40 and 778.96 tonnes respectively. The treatment measures adopted at present by the industries are inadequate. The biological wastes discharged from distillary, yeast, cotton textile, tannery and pulp and paper together with highly acidic and toxic wastes discharged from rayon textile deserve adequate treatment. The pollution is more of organic nature.

Extent of pollution with reference to the hydrobiological conditions around the outfall regions of the more important industries like Tribeni tissue (soda process), pulp and paper (sulphite process), distillery and yeast, Dunlop rubber, rayon textile and Bandel thermal plant have been studied in detail in relation to the adverse effects produced on the fishery resources of the estuarine waters. The existence of a poor biological condition in the outfall regions as well as in the main estuary during the summer months indicates the existence of pollutants in sublethal level which are not detectable easily but are injurious to organisms due to their cumulative effects.

A follow up project has been drawn on the basis of the findings of this project.

(b) *Research in hand*

Researches on 20 projects were continued during the year under report. The progress achieved under each project, during 1973, is outlined in the following pages.

Project 1 : *Optimum per hectare production of fry, fingerlings and fish in culture fishery operations*

Problem : 1. 1 Composite culture of Indian and exotic species

Personnel : H. Chaudhuri, R. D. Chakrabarty, M. A. V. Lakshmanan, P. R. Sen, D. S. Murty, N. G. S. Rao, M. Rout, D. K. Chatterjee, R. K. Dey, S. Jena, K. J. Ram, D. R. Kanaujia and P. V. G. K. Reddy

Duration : Continuing

Four 0.08 ha ponds were stocked with fry of catla 3 : rohu 3 : mrigal 3 : grass carp 1 @ 2.5 lakh/ha. After three months of rearing average sizes reached by individual species were : catla 124.4 mm/30.03 gm; rohu 102.0 mm/12.41 gm; mrigal 186.4 mm/35.71 gm and grass carp 281.2 mm/41.09 gm.

In two 0.08 ha ponds, fry of silver carp 4 : grass carp 3 : common carp 3 were stocked @ 2.5 lakh/ha and reared for a period of six months (August-February). The percentage survival and average growth was as under :

Name of species	Survival (%)	Average growth (mm/gm)
Silver carp	65. 2	172.38/ 48.25
Grass carp	44.56	180.88/ 68.25
Common carp	10.75	228.76/563.59

Over all survival was 42.2%. Another experiment of three months' duration at 2 lakhs/ha with silver carp 5 : grass carp 1.25 : common carp 3.75 is in progress.

In a composite culture experiment stocked @ 5,000 fingerlings/ha with silver carp 2 : catla 1 : rohu 3 : grass carp 1 : common carp 1.5 : mrigal 1.5, gross and net productions of 4,223.4/4,089.13 and 4,468.96/4,334.72 kg/ha/yr with an aggregate survival of 82.4 per cent respectively in two replicate ponds were recorded. A similar experiment in two 0.14 ha ponds was initiated in April, 1973 by adopting the same stocking density with silver carp 2 : catla 1 : rohu 2 : grass carp 2 : mrigal 1 : common carp 2. Supplemental feeding was resorted to only in one of the ponds. An estimated production of 3,526 kg/ha in 7 months with supplemental feeding and 1,660.5 kg/ha in control pond was obtained.

In order to avoid poaching, two ponds under composite culture were harvested after 286 and 287 days. Gross and net productions of 8,845/8,631 kg/ha obtained in one of the ponds, is an All-India record. In the other pond, the gross and net productions were 7,410/7,187 kg/ha. In the remaining two ponds, stocked at a density of 7,500 fingerlings per hectare, production of 8,069 kg/ha/10 months in one and over 7,000 kg/ha/9 months in other was estimated. The contributions of different species in the ponds which were harvested after 286 and 287 days were as follows : silver carp, 28.8 and 29.6%; rohu, 18.8 and 15.6%; grass carp, 18.3 and 10.4%; catla, 7.8 and 11.4%; and mrigal, 8.9 and 8.2%.

In experiments in 4 ponds at Kausalyaganga, initiated in 1971 and concluded in 1973 and stocked @ 4,250/ha, the growth rate of carps was much lower in the second year than in the first year. In treated ponds, the growth rate was three times more in the first year and four to five times more in the second year than that in the control.

Intensive fish culture experiments in the adjacent ponds, stocked @ 10,540/ha with catla, rohu, mrigal, silver carp, grass carp and common carp in the ratio of 1 : 3 : 1 : 2 : 1 : 2 and 544/ha of miscellaneous fish, gave gross and net productions of 7,500/7,343 kg/ha/yr and 5,734/5,652 kg/ha/yr respectively. Over one-third of the total production was made up by rohu

(2,638.6 and 2,261.6 kg/ha in two ponds). Performances of silver carp, catla and grass carp were also good. The miscellaneous species like, *Notopterus chitala, Ompok bimaculatus, Mystus seenghala* and *Pangasius pangasius* stocked in the ponds helped in maintaining check on the population of insects, weed fish, molluscs, etc.

In trials to manipulate stocks for improved growth, fingerlings were stocked in ponds @ 5,700/ha and in the ratio of silver carp 3.75 : catla 2.5 : rohu 2.5 : mrigal 2 : common carp 2 : grass carp 1.5. As growth rates of catla and rohu did not reach anticipated level, their densities were reduced. Though rohu gave a positive response, the condition of catla remained unchanged. As such, a reduction in the density of silver carp has been brought about. The experiment will continue till 1974.

Problem :	1. 2	Evolving a balanced fish diet and to improve feeding techniques
Personnel :		M. A. V. Lakshmanan, M. Rout and D. R. Kanaujia
Duration :		4 years, extended by two years

Two experiments were completed with seven feed mixtures comprising two to eight items and varying protein content from 13-25%. Each experiment was of 30 days duration and feeding was based on consumption basis. Of the mixtures tried, 4 with protein : Carbohydrate as 35:46; 30:53; 26:52 and 26:56 were found to be better utilised in order of preference. The studies are being continued.

Problem :	1. 3 & 1. 4	(Research completed in 1972)
Problem :	1. 5	(Research completed in 1970)
Problem :	1. 6	(Research suspended)
Problem :	1. 7	(Research completed in 1973)
Problem :	1. 8	(Research completed in 1971)
Problem :	1. 9, 1.10 & 1.11	(Research completed in 1972)
Problem :	1.12	(Research completed in 1973)
Problem :	1.13	(Research completed in 1972)
Problem :	1.14	Qualitative segregation of fish seed
Personnel :		R. D. Chakrabarty, K. J. Ram and D. K. Chatterjee
Duration :		2 years

Spawn of catla, rohu, mrigal and the minor carp reba were tried. A

temperature gradient of 20°C was created with admixture of ice water and boiling water. A minimum of 1.08 ppm dissolved oxygen was noticed. However, no distinct response was shown by any of the species introduced.

Problem : 1.15 Selective capture of predators from carp culture ponds

Personnel : A. David and P. K. Sukumaran

Duration : Five years

Special types of bamboo traps ("Mavulu") were introduced for capture of murrels and other predatory and unwanted fishes. These traps were operated in Madaga, Milghatta and Nidige tanks. Four big traps with and without baits and five small traps with baits were operated for 24 hrs in each tank. The baits used were pieces of small fishes, guts and air bladders, small dead frogs and crabs.

In Madaga tank, smaller traps proved to be more efficient than the bigger ones. *Mystus cavasius* (173-182 mm in total length/40-45 gm) and one *Channa striatus* (197 mm/65 gm) were caught.

In Milghatta tank, bigger traps without baits were found to be more efficient than the smaller ones. The fishes caught on these traps were *Channa striatus* (217-327 mm/80-0.329 gm). Smaller traps, with baits, recorded *Channa punctatus* (133 mm/30 gm) and *Notopterus notopterus* (85-196 mm).

In Nidige tank, all the traps were operated with baits. One big trap recorded *Channa striatus* (189 mm/60 gm) and one smaller trap had *Puntius chola* (75 mm).

Problem : 1.16 (Research completed in 1971)

Problem : 1.17 Effect of irradiation on fish

Personnel : R. D. Chakrabarty and P. R. Sen

Duration : 3 years

Fertilised eggs and newly hatched larvae of common carp were subjected to soft Gamma and Neutron irradiation. The post-larvae were reared in glass jars on zooplankton initially and later fed on a mixture of ground-nut oilcake and rice bran. Treatment in which fry appeared to exhibit somewhat better growth were transferred to plastic pools for further growth. Untreated fish were also kept in a pool as control. Maturity has been attained in both treated and untreated fish. Work is being continued.

Problem : 1.18 Role of some trace elements in pond fertilization

Personnel : G. N. Saha, D. K. Chatterjee and K. Raman

Duration : 5 years

Two yard experiments were conducted with low nutrient acid soil. Survival and growth of fish were taken as indices of response. B, Co, Mo and Zn were applied @ 0.05 ppm. In one experiment the trace elements were also used in combination with fertilizer (N+P). The pools were stocked with advanced common carp fry @ 0.15 million/ha and reared for a month. Water qualities did not vary much under various treatments. The maximum primary productivity was recorded with cobalt (0.28 mg O_2/1/hr) as against 0.08 mg/1/hr in the control. Survival and growth of common carp fry was better in Co (100%; 43.8 mm/1.35 gm) as against 100%; 41.0 mm/1.15 gm in molybdenum and 96%; 44 mm/1.25 gm in the control.

In the second experiment the trace elements were applied @ 0.05 ppm and advanced fry of rohu and mrigal stocked @ 5 in each pool. No significant differences could be recorded with responses in the control pool.

Problem : 1.19 (Research completed in 1973)

Problem : 1.20 Carp culture with periodic replenishment with freshwater

Personnel : H. Chaudhuri, M. A. V. Lakshmanan, M. Rout, N. G. S. Rao and G. N. Saha

Duration : Initially one year

Two ponds of 0.15 ha were stocked with Indian and exotic carps @ 13,200/ha in the ratio of C1 : R3 : M1 : Sc2 : Gc1 Cc2. Periodic inorganic fertilization and feeding with a mixture of ground-nut oilcake, mustard oilcake and rice bran was done. The ponds were replenished six times with freshwater during the year and then harvested finally.

The productions registered were 7,720 kg/ha/yr in the pond where all fish were recorded and 7,548 kg/ha/yr in the replicate which was not completely harvested. The survival of fish in the ponds appeared to have been adversely affected due to the inadvertant entry of *Wallago attu*.

Problem : 1.27 Carp fry rearing for optimum survival and growth under high stocking density

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

Duration : 3 years

Spawn of rohu were stocked @ 10 million/ha and fed with artificial feed containing cobalt chloride @ 0.01 mg/day/fish. Average survival of fry at the end of 12 days was 66.62% in the treated ponds as against 53.5% in the control.

Problem : 1.22 Biology of fish food organisms—*Cladocera*

Personnel : R. D. Chakrabarty

Duration : 2 years

The study of the biology of the commonly occurring cladoceran of fish ponds, *Moina* sp., has been initiated. Mahua oilcake, cow-dung and poultry manure at 400, 600 and 750 ppm respectively have been tried as culture media of these animalcules. The studies are in progress.

Problem : 1.23 Evolving efficient method for sampling of bottom-dwelling fishes in ponds

Personnel : M. Rout, M. A. V. Lakshmanan and D. R. Kanaujia

Duration : 2 years

Two types of nets made of cotton yarn were designed and prepared, one a sinker net with a row of pockets and the other a stake net. The former has a mesh size of 6-7 mm, each piece being 15 metres long, 3 metres wide and with 30-45 cm pockets at the bottom. Iron sinkers (6-8 gm each) were fixed on the bottom rope. The stake net was 20 metres long and 4 metres wide with a mesh size of 25 mm. Both head and foot ropes were joined by stakes of 1.5 to 2 metres.

The results obtained so far indicate that 90% of the bottom dwelling fishes (mrigal and common carp) could be collected by the sinker net while 70-75% were caught with stake net compared to as low as 10% catch by an ordinary drag net. The reduction of man power requirement to an extent of 75% is a notable advantage.

Problem : 1.24 Studies on the effect of chemical fertilizers like ureaformaldehyde, ammonia liquor, sodium nitrate and calcium cyanamide in relation to pond productivity

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

Duration : 5 years

Laboratory and yard experiments were conducted with fertilizers; *viz.*,

urea-form, sodium nitrate and liquor ammonia, using near neutral soil type. In laboratory, out of two doses (50 kg and 80 kg N/ha), the higher dose of urea-form gave higher survival and growth of rohu fry (90%; 15.63 mm/51 mg/20 days) as compared to the control (73%; 13.2 mm/45 mg/20 days). In yard, however, sodium nitrate at the same rate showed better results in respect of survival and growth of advanced rohu fry, while liquor ammonia gave the maximum growth of mrigal fry (100%; 74.2 mm/3.97 gm/month) as against control (94.4%; 51.5 mm/1.36 gm/month). All these fertilizers enhanced plankton production.

Problem : 1.25-1.29 (Research contemplated)

Project 2 : *Induced fish breeding*

Problem : 2. 1 (Research completed in 1970)

Problem : 2. 2 Use of various hormones for inducing spawning in carps

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

Duration : 4 years

Pituitary glands extracts of the marine fishes : *Trichiurus* sp; *Caranx* sp; *Pampus* sp; M. *cephalus*; *Scoliodon* sp; *Saurida* sp; *Triachanthus* sp; *Leiognathus* sp, failed to elicit spawning in *Labeo rohita* as against the controls injected with carp pituitary extract. Similar negative results were obtained with pituitary extracts of *Channa* sp. and other catfish species.

Problem : 2. 3 (Research completed in 1972)

Problem : 2. 4 Hatching of eggs of major carps in newly designed hatching jars under controlled conditions

Personnel : R. M. Bhowmick, R. K. Jana and S. D. Gupta

Duration : 5 years

Utilising the new glass jar hatchery complex, 5 million carp spawn valued at Rs. 6,000/- were produced in thirteen experiments, without involving any recurring expenditure. The hatching and survival was superior to controls. Silver carp eggs which failed to hatch in the pond hatchery were successfully hatched in the glass jar hatchery. Out of 2 experiments 242.5 thousand fry were produced.

Besides the above experiments, a set of calbasu could be successfully

induced-bred in the hatchery, late in the season producing 0.75 lakh spawn. Common carp eggs could also be successfully incubated in the hatchery after degumming the eggs.

Problem : 2. 5 (Research suspended)

Problem : 2. 6 Experiment on the production of multiple crops from the same individual of major carp in the course of one year

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

Duration : 3 years

Inspite of late monsoons two ♀ rohu could be matured for the second time after 34 days and as much as 1.45 lakh spawn was produced.

Problem : 2. 7 Isolation of fish gonadotropin for hypophysation of carps in large scale

Personnel : V. R. P. Sinha

Duration : 3 years

Pituitary glands were collected from the Calcutta fish markets and fractionated in the laboratory without the help of UV-cord recorder. The separated second fraction was injected to 8 pairs of *Cirrhinus mrigala* and all the pairs bred successfully.

Problem : 2. 8 & 2. 9 (Research contemplated)

Project 3 : *Reservoir Fisheries*

Problem : 3. 1 - 3. 5 (Research completed in 1972)

Problem : 3. 6 Fisheries of Peninsular tanks: Assessment of biological productive potentialities

Personnel : A. David, P. K. Sukumaran and S. L. Raghavan

Duration : 3 years

Bio-mass production—plankton : The plankton density ranged between 15 and 1,704 units/litre in all the water sheets. Diatom concentration was more in tanks in semi-malnad area where silicate concentration was higher than tanks in Mysore and Mandya districts. The phytoplankters encountered were : *Microcystis* sp., *Nostoc* sp., *Anabaena* sp., *Spirulina* sp., *Coelastrum* sp., *Actidesminum* sp., *Pediastrum* sp., *Pachycladon* sp., *Closteridium* sp., *Micras-*

terias sp., *Cosmarium* sp., *Arthrodesmus* sp., *Desmidium* sp., *Spirogyra* sp., *Ulothrix* sp., *Oedogonium* sp., *Ceratium* sp., *Campylodiscus* sp., *Pinnularia* sp., *Navicula* sp., *Amphora* sp. and *Rhizosolenia* sp. Among zooplankters, *Arcella* sp., *Difflugia* sp., *Frontonia* sp., *Keratella* sp., *Testudinella* sp., *Daphnia* sp., *Cypridopsis* sp., nauplii, copepods (Calanoids, *Cyclops*) and nematods were encountered.

Settled organisms: Plankton density on weeds ranged between 558 and 2,620 units on 100 gm weeds. The phytoplankters encountered were *Microcystis* sp., *Nostoc* sp., *Anabaena* sp., *Spirulina* sp., *Tetraspora* sp., *Chlorococcum* sp., *Coelastrum* sp., *Pediastrum* sp., *Quadricula* sp., *Pleurotaenium* sp., *Cosmarium* sp., *Arthrodesmus* sp., *Desmidium* sp., *Spirogyra* sp., *Mougeotia* sp., *Rhaphidionema* sp., *Ulothrix* sp., *Chaetophora* sp., *Oedogonium* sp., *Cladophora* sp., *Tabellaria* sp., *Fragillaria* sp., *Camphylodiscus* sp., *Gyrosigma* sp., *Frustulia* sp., *Pinnularia* sp., *Caloneis* sp., *Navicula* sp., *Amphora* sp., and *Cymbella* sp. The zooplankters included *Arcella* sp., *Difflugia* sp. and copepods (calanoids, *Cyclops*).

Littoral and benthic organisms: The organisms encountered in the littoral and benthic zones in the tanks were gastropods (*Amnicola* sp., *Gyraulus* sp., *Lymnaea* sp., *Melanoides* sp. and *Viviparus* sp.), bivalves, represented by freshwater mussel *Corbicula* spp., insects (*Laccotrephes* sp., *Ranatra* sp., *Notonecta* sp., *Belostoma* sp., mayflies and dragonflies), prawns (*Macrobrachium ideae*, *M. scabriculum*, *Caridina* spp.) and tadpoles. The density of organisms in these zones ranged from 1 to 635 units/m^2.

Fish stocking: 50,000 fingerlings of *Channa leucopunctatus* (19-56 mm) were collected from tanks near Shimoga and stocked for studies on growth, prey-predator relationship and production with cultivable carps in the tanks as shown below:

Tanks	District	Nos. stocked
Settykere	(Mysore district)	5,000
Megalpura	(Mandya district)	3,000
Yeliyur	(Mandya district)	7,000
Yeswanthpur tank	(Bangalore district)	14,500

Besides 15,000 fry/fingerlings of *C. leucopunctatus* were supplied to the Department of Fisheries, Andhra Pradesh for stocking the Mottur fish farm, Vijayawada.

200 fry of *C. marulius* were also stocked in Settykere and Yeliyur tanks.

Fish production: Fishing with 'Kille-kethas' was done in Madaga tank fish species; *viz.*, *Puntius sarana*, *Notopterus notopterus*, *Ompok bimaculatus*, *Channa striatus*, *C. gachua* and *Puntius pulchellus* were caught. Average catch

was reported to be 5 kg/day.

Physico-chemical conditions of water and soil: The physico-chemical conditions of water and soil in the tanks during the period were as follows:

A. WATER PHASE

Physical factors

Temperature (C°)		24° - 30°
Turbidity (ppm)		100

Chemical factors

pH		6.8 - 9.5
Dissolved Oxygen	(ppm)	3.6 - 9.82
Alkalinity	(ppm)	32.0 - 510.0
Hardness	(ppm)	28.0 - 188.0
Specific conductivity	($\times 10^{-6}$ mhos)	104 - 808
Nitrate	(ppm)	Tr - 0.540
Phosphate	(ppm)	Tr - 1.78
Silicate	(ppm)	16.1 - 47.7
Iron	(ppm)	0.02 - 0.52

B. SOIL PHASE

pH		7.5 - 8.5
Calcium	(ppm)	400 - 1200
Magnesium	(ppm)	8 - 25
Phosphorus	(ppm)	5 - 15
Ammonia	(ppm)	3 - 25

The water was clear in all the tanks even during monsoon months, turbidity being less than 100 ppm. Higher values of nutrients noticed during April-May were due to evaporation and concentration. Dilution of nutrients was noticed with the influx of rain water from July to September. An increase in the concentration of nutrients was in evidence from October, 1973 onwards. Arsikere tank exhibited higher values of alkalinity, pH, hardness, specific conductivity, nitrate and silicate while iron was in low concentration. Nidige, Madaga and Anjanapur reservoir (Semi-malnad area) showed higher values of silicate (17.9-247.7 ppm) than the Megalpura, Settykere, Yeliyur and Yeswanthpur tanks (16.1-28.5 ppm) which is also reflected in diatom concentrations. Tanks in Mysore and Mandya districts exhibited higher values of alkalinity, hardness, specific conductivity and phosphate than the tanks in semi-malnad area, with low concentration of silicate and iron. Free carbon dioxide was present up to 36 ppm in Nidige, Madaga and Anjanapur while it

was absent in other tanks. Higher concentration of phosphate (0.38-1.78 ppm) was observed in Yeliyur, Settykere and Yeswanthpur tanks where considerable quantity of *Microcystis* was present.

Bottom soils of these tanks were alkaline in nature with pH ranging from 7.5 to 8.5. Magnesium was present in low to moderate quantities in all the tanks whereas calcium was present in moderately high concentration. Low to moderate quantities of phosphorus were observed in semi-malnad tanks while in others it ranged from moderate to high in concentration. The same trend was noticed in case of ammonia also.

Problem :	3. 7	(Research completed in 1970)
Problem :	3. 8	Fisheries of Peninsular tanks : Introduction and propagation of cultivable spacies
Personnel :		A. David, P. K. Sukumaran and Shri S. L. Raghavan
Duration :		3 years

250 fingerlings of *Puntius pulchellus* collected from the Tunga river were stocked in Nugu reservoir/fish farm.

Feeding experiments of about five weeks' duration with *P. pulchellus* yearlings (186-252 mm) were conducted in cement cisterns using equal number of specimens in each replicate and four types of weeds; *viz.*, *Hydrilla* sp., *Vallisneria* sp., *Aponogeton* sp., grass and *Eichhornia* sp. The studies have indicated that in almost all cases *Hydrilla* is completely consumed followed by *Vallisneria* sp. and *Aponogeton* sp., grass and *Eichhornia* sp. are consumed least.

The studies have led to the tentative conclusion that one year old *P. pulchellus* (212.2 mm/123.0 gm) consumes about 33.5 to 36.3 gm of soft weeds per day. The conversion ratio varying between 1:79.6-1:86.2. An average increase in length by 10.7 mm and 16 gm in weight was observed. Studies on feeding of *P. pulchellus* yearlings (209.6 mm) on *Eichhornia* sp. were continued.

Commercial sources of Mahseer fry were located at the tail-end of the Bhadra reservoir. 10,000 fry were collected of which 8,000 and 1,000 fry were stocked in Vanivilaspura fish farm and Hessarghatta fish farm respectively for follow up studies.

Problem :	3. 9	Development of fisheries of the Loni reservoir
Personnel :		S. J. Karamchandani, D. V. Pahwa, S. N. Mehrotra, B. Singh and R. K. Saxena
Duration :		3 years

Hydrology : Water temperature ranged between 26.4° and 31.4°C. The transparency of water ranged from 29.7 (June) to 64.2 cm (November). pH varied from 7.7-8.1 with carbonate and bicarbonate ions ranging from 0.5-6.75 ppm and 67.75-151.5 ppm respectively. Free CO_2 was present only during July to November and varied from 2.2 to 2.7 ppm. The concentration of calcium varied from 19.5 to 32.25 ppm while that of magnesium fluctuated between 3.55 and 4.9 ppm. DO was maximum (9.57 ppm) in January and minimum (6.35 ppm) in July. Of the inorganic nutrients, phosphate-P ranged from 0.072 to 0.170 ppm and nitrate-N from 0.117 to 0.140 ppm. The concentration of nitrate was more than the phosphate except on one occasion. Silicates ranged between 7.4 and 14.5 ppm.

Plankton : The average plankton population during January through October fluctuated between 837 u/l in July and 103 u/l in September. Phytoplankton (70.8%) dominated over zooplankton during the entire period, Bacillariophyceae (64.2%) contributing the maximum amongst the phytoplankton. The numerical increase in plankton quantity during Jan.-Oct., 1973 as compared to the corresponding period in 1972 was mainly due to the diatom bloom (*Navicula* spp.) which appeared in March and continued till July, 1973. The other phytoplankton species; *viz.*, *Pediastrum* spp., *Glenodinium* spp. and *Merismopedia* spp. also indicated a rising trend. Chlorophyceae was mainly represented by *Pediastrum simplex, Scenedesmus quadricanbis* and *Cosmarium ornatus.* Only *Glenodinium* occurred amongst the Dinophyceae. Zooplankton comprised mainly Rotifers (*Brachionus* spp., *Filinia* spp. *Monostyla* sp. and *Polyarthra* sp.), copepods (Cyclops sp., *Diaptomus* sp. and different stages of nauplii) and Cladocera (*Moina* sp., *Bosmina* spp. and *Diaphanosoma* spp.).

As regards zonal distribution, zone IV showed the maximum concentration stages of nauplii) and cladocera (*Moina* sp., *Bosmina* spp. *and Diaphanosoma* tive.

Fishing operations : Drag nets (1/16" mesh) and cast nets (½" mesh) were operated. No specimens with clipped fins were encountered in the catches. The total catch amounted to 54.350 kg and comprised *L. calbasu, L. gonius, L. bata, C. reba, G. chapra, N. notopterus, A. mola, O. cotio, R. daniconius, L. laubuca, P. sarana, Chela* spp., *Ompok* spp., *Mystus* spp., *X. cancila, Ambassis* spp., *G. giuris* and *Channa* spp. *Chela* spp., *O. cotio* and *Ambassis* spp. dominated the catches. These fishing operations served to reduce the population of unwanted fishes.

Biological data of fishes caught in the Loni reservoir by commercial fishing party from 17.2.73 to 19.2.73 were recorded. A total of 214.90 kg of fishes were caught in 3 days by gill nets. Cast nets were also operated and a total of 61.600 kg of fishes were caught. In all a total of 276.500 kg of fishes were caught by 12 fishermen using 6 boats. The species composition of the catches

is presented below.

Species caught (gill nets)	*Total wt.* (kg)	*Length range* (mm)
1. *L. rohita*	127.150	351-635
2. *C. mrigala*	46.000	434-680
3. *L. calbasu*	18.300	357-424
4. *C. catla*	14.750	487-890
5. *W. attu*	8.700	805-891

Fishing operation by the commercial fishermen was undertaken again from 1.11.1973 to 4.11.1973. The total catch by the gill nets amounted to 52.050 kg and comprised *C. mrigala* (24.100 kg), *L. rohita* (13.300 kg), *W. attu* (7.400 kg), *M. seenghala* (3.000 kg), *C. catla* (2.950 kg), *P. sarana* (0.750 kg) and *L. calbasu* (0.550 kg).

Problem : 3.10 & 3.11 (Research suspended as per suggestions of the Achievement Audit Committee)

Project 4 : *Riverine carp spawn prospecting and collection techniques*

Problem : 4. 1 & 4. 2 (The work is being done under a Co-ordinated Project)

Problem : 4. 3 (Research completed in 1971)

Problem : 4. 4 (Research completed in 1973)

Problem : 4. 5 Yearly variation in quality and quantity of spawn in the river Ganga

Personnel : K. L. Shah and G. N. Mukherjee

Duration : 5 years

Investigations were carried out at two centres; *viz.*, Jhusi near Allahabad and Bharauli near Buxar only. At Jhusi, a total of 1,421 ml of spawn was collected in two floods. Flood I contributed 1,326 ml of spawn in the rising phase while Flood II contributed 95 ml of the spawn in the receding phase. The index of quantity was calculated to be 263.1 ml. The quality of major carp spawn according to spawn analysis was 63.65% and according to nursery rearing 19.33%.

At Bharauli 3,790 ml of spawn was collected in the receding phase. The index of quantity was calculated to be 303.2 ml. The quality of major carp spawn according to spawn analysis was 49.47% and according to nursery rearing 33.61%.

Project 5 : Brackish water fish farming

Problem : 5. 1 Productive potential of polyculture in lower Sunderbans and behaviour of pond dykes

Personnel : A. V. P. Rao, B. B. Pakrasi, A. Sengupta, P. Roy, N. C. Basu, R. K. Banerjee and P. N. Bhattacharya

Duration : 5 years

Although the rainfall during 1972 was less than in 1971, the polyculture pond 'K' (0.25 ha, depth 1.5 m) retained sufficient rainwater till the harvesting of fish in July, 1973. The water and soil salinity ranged from 2.7 to 0.77‰ and 0.2 to 0.05% respectively. Prior to harvesting in July the soil characteristics observed were: nitrogen, 6.16-6.72 mg/100 gm, phosphorus 10.32-27.24 mg/100 gm and organic carbon as 0.15-0.31%. In the water phase, NO_3-N, PO_4-P and pH ranged from 0.30-0.70 ppm, 0.12-0.60 ppm and 8.0-8.4 respectively. The primary productivity ranged from 270-603 mg C/m^3/hr.

Under conditions of regular manuring with N : P : K (18 : 8 : 0) fertilizers @ 600 kg/ha, raw cow-dung @ 3,000 kg/ha and poultry manure @ 1,500 kg/ha and supplementary feeding with mustard oilcake and rice bran @ 1% of the body weight, the average sizes (length/weight) attained by various fishes and prawns stocked @ 10,220 per ha after eight months of rearing were : silver carp 407.2 mm/649.1 gm, catla 250.2 mm/223.0 gm, rohu 335.0 mm/433.0 gm, mrigal 288.1 mm/230.1 gm, common carp 322.0 mm/602.2 gm, *Mugil cephalus* 382.6 mm/663.8 gm, *M. tade* 280.1 mm/237.3 gm, *M. parsia* 160.3 mm/49.9 gm and *Penaeus monodon* 224.8 mm/103.1 gm, with an overall survival of 52.37%. The gross and net productions were 1,867 and 1,686 kg/ha/8 months respectively.

The pond was completely dewatered and its bed dried. The soil composition was 38.2% sand, 21.0% silt and 40.3% clay with a nearly neutral pH. The C/N ratio was 5.4. The available nitrogen, P_2O_5 and specific conductivity were : 15.1 mg/100 gm soil, 7.1 mg/100 gm soil and 1,389 $\times$ 10^{-6} mhos respectively. After a mild application of 25 kg lime, a basal dose of raw cow-dung and mustard oilcake was applied @ 1,800 and 360 kg/ha respectively. Followup manuring with N : P : K (12 : 8 : 0) fertilizers @ 600 kg/ha and raw cow-dung @ 10,000 kg/ha was done at fortnightly intervals. The pond was stocked in September, 1973 with silver carp, catla, rohu, common carp, *Mugil cephalus, M. tade, M. parsia, Chanos chanos* and *Penaeus monodon* @ 7,810/ha in the proportion of 41.1% freshwater fishes, 36.8% brackish water fishes and 12.1% brackish water prawns. The estimated gross and net productions for a period of three months were 424.32 and 239.544 kg/ha with the average sizes (length/weight) being : silver carp 193.2 mm/59.9 gm, catla 207.3 mm/117.1 gm, rohu 158.2 mm/46.15 gm, *M. cephalus* 174.0

mm/50.0 gm, *M. tade* 156.0 mm/38.6 gm, *M. parsia* 104.1/15.9 gm, *Chanos chanos* 150.3 mm/29.0 gm and *P. monodon* 184.3 mm/46.5 gm.

In another pond 'R' (0.25 ha, depth 1 m), the soil characteristics were: clay 45%, silt 41.67% and sand 13.33%, pH 7.2, C/N ratio 2.5, available nitrogen 17.6 mg/100 gm, available phosphorus 3.6 mg/100 gm, organic carbon 2.1% and specific conductivity 3,968 $\times$ 10^{-6} mhos. Based on the above analysis, manuring with inorganic fertilizers N P : K (10 : 10 : 0) @ 600 kg/ha was done at fortnightly intervals. Fertilizatios with organic manures was similar to that in pond 'K'. Turbidity (200-300 units), during and after the monsoons, had brought down the primary productivity from 562 mg C/m^3/hr to a very low level. The pond was stocked @ 8,560 per ha in October, 1973 with silver carp, catla, rohu, mrigal, common carp, *Chanos chanos*, *M. cephalus*, *M. tade*, *M. parsia* and *P. monodon* in the proportion of 47.9% freshwater fishes, 41.2% brackish water fishes and 10.9% brackish water prawns. The estimated gross and net productions at the end of 2 months were 325.088 kg and 231.132 kg/ha respectively.

Studies on phreatic line indicated an average hydraulic gradient of 1 in 3.5.

Problem : 5. 2 (Research completed in 1973)

Problem : 5. 3 (Research suspended as per suggestions of the Achievement Audit Committee)

Problem : 5. 4 - 5. 6 (Research completed in 1972)

Problem : 5. 7 (Research completed in 1973)

Problem : 5. 8 Induced breeding of grey mullet, *Mugil cephalus*

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

Duration : 6 years

Of the 13 sets of experiments conducted near the Chilka lake mouth 9 sets gave positive results while 3 sets yielded nearly 20,000 hatchlings. These were successfully reared in plastic pools and tanks and fed with plankton (veligers and trochophores of molluscs, nauplii of copepods, rotifers and diatoms). The larvae were gradually accilimatised to freshwater and reared in plastic pools at Cuttack. Two survived for 159 days reaching a size of 72 mm/6 gm and one for 325 days (100 mm/12 gm) which may be said to be the first record in India.

Problem : 5. 9 (Research completed in 1973)

Problem : 5.10 Detailed survey of Mahisani island for designing brackish water fish farms

Personnel : A. Sengupta, B. B. Pakrasi, A. B. Mukherjee, S. C. Banerjee and P. N. Bhattacharya

Duration : 1½ years

Contour survey of 300 acres of forest island was done during the year. Based on the area surveyed so far, a contour map has been prepared.

Problem : 5.11 Quantitative assessment of brackish water fish and prawn seed in Bakkhali region

Personnel : N. C. Basu, B. B. Pakrasi and A. V. P. Rao

Duration : Three years

Based on the work done during 1970-72, a good collection centre was selected in the Bakkhali creek for the quantitative assessment of brackish water fish and prawn seed in connection with the proposed 200 ha semi-commercial brackish water fish farm. Three shooting nets were operated at the site so that the cross section of the creek was covered during spring tides. A total of 99,948.11 ml (15, 26, 665 no.) of seed was collected in 222 hrs during the period April-June. The percentage of economically important prawns and fishes in this collection was : *P. indicus* 26.9, *P. monodon* 0.8, *M. brevicornis* 2.8, *M. monoceros* 0.27, *Palaemon styliferus* 0.24, *M. cephalus* 0.03, *M. parsia* 1.7, *M. cunnesius* 0.12, *Chanos chanos* 0.09, *Elops saurus* 0.04 and *E. tetradactyla* 0.08. The species-wise abundance was as follows :

P. monodon : A total of 116.82 ml (12,378 no.) was collected with a peak [1.44 ml (181.53 no.)/net/hour] during the fullmoon phase in May.

P. indicus : A total of 31,313.06 ml (4,09,785 no.) was collected with a major peak [287.52 ml (5528.93 no.)/net/hour] during the new moon phase in April.

M. brevicornis : The total catch was 8,453.11 ml (42,408 no.) with a peak [142.17 ml. (603.39 no.)/net/hour] during the fullmoon phase in June.

M. monoceros : The total catch was 351.27 ml (4,196 no.) with a peak [6.85 ml (85.92 no.)/net/hour] during the new moon phase in June.

Palaemon styliferus : The total catch was 939.08 ml (3,677 no.) with peak [13.02 ml (46 no.)/net/hour] during the fullmoon phase in June.

M. cephalus : The total catch was 109.22 ml (450 no.) with a peak [1.20 ml (7.05 no.)/net/hour] during the new moon phase in April.

M. parsia : The total catch was 4,565.8 ml (26,251 fry) with a peak [84.20 ml (473.4 no.)/net/hour] during the new moon phase in April.

Chanos chanos : The total catch was 13.11 ml/(1,448 larvae) with a peak [0.27 ml/(26.61 no.)/net/hour] during the fullmoon phase in May.

Elops saurus : The total catch was 54.67 ml (541 no.) with a peak [1.34 ml (8.25 no.)/net/hour] during the fullmoon phase in June.

Eleutheronema tetradactyla : The total catch was 2,193.03 ml (11,195.5 no.) with a peak during the new moon phase in April [21.84 ml (123.74 no.)/net/hour].

The ranges of the different physico-chemical parameters during the period of study were : water temperature of 25.5°-35.2°C, velocity of water 1.55-3.25 km/hr, transparency (Secchi disc) 3.4-22.9 cm and salinity 29.43-35.64‰.

Problem :	5.12	Methods of silt control and experimental trials on sluices
Personnel :		A. B. Mukherjee, A. Sengupta and P. N. Bhattacharjee
Duration :		3 years

A gauge was fixed in the canal bed to determine the monthly rate of silt deposition. The annual rate of silt deposition in the feeder canal of the Bakkhali Farm was about 30 cm. A silt trap was designed to prevent the entry of silt into the ponds. The total length of the silt trap would be 174 m and it would store 2,500 Cu m of water at the maximum tide water level.

Silt cage : A rectangular silt cage (15.4 m × 7.8 m) was constructed by driving straight wooden poles ('garan' and 'keora') in the ground at a selected spot on the upstream face of the earthen dyke of the Bakkhali Farm. The silt would now accumulate on the bed and side of the dyke to make it strong and durablel

Sluices : Design and estimates of a wooden rectangular type sluice box (1.22 m × 0.9 m × 12.2 m long) were prepared to work as a substitute for the main C. I. sluice which has become unserviceable at the Kakdwip Farm.

Hume pipe sluices (30 cm diameter) to serve as secondary sluices with 'sal' wood shutters have been designed, constructed and fitted in two brackish water ponds. Each sluice structure consists of rectangular vertical wooden frames of 'sal' wood, securely fitted at the socket end of the hume pipe with the help of a circular wooden beam tightened with a M. S. circular clamp. Vertical shutter to act as the sluice gate would operate in the grooves left in the frames. The hume pipes were laid horizontally on a hard base surrounded

with 45 cm thick layer of black clay soil to prevent the possibility of burrowing by crabs. Mean velocity of flow as observed at the inlet of the sluice was 0.24 m/sec and the corresponding discharge was 0.017 cu m/sec (0.6 cusec). Since the discharge was maximum when the wetted perimeter was minimum, maximum discharge through the sluice could be obtained when the maximum depth of water flowing through it occupied a height of 0.95 times diameter of the circular section.

Observations made so far on the workability and efficacy of the sluices have proved that these are quite durable, sufficiently strong to withstand the horizontal pressure of water and are free from leakages.

Problem :	5.13	Selective culture of *Mugil parsia* and *Mugil tade*
Personnel :		A. N. Ghosh, K. M. Das, G. N. Chatterjee, H. C. Karmakar and M. K. Mukhopadhyaya
Duration :		3 years

The relative efficiency of (1) fertilization, (2) fertilization and supplementary feeding and (3) fertilization, supplementary feeding and periodic replenishment of impounded water with fresh tidal water to increase the survival and growth rates of fish in the nursery ponds was investigated. The ponds were fertilized with superphosphate and cow-dung at uniform rates and were stocked with *Mugil parsia* @ 1,25,00/ha (average size 17 mm). The third method was found to be the most efficient. During 90 days of rearing the average net gain in weight per fry was 5.815 gm with more than 82% survival.

Growth of *M. parsia* was studied in three ponds: (1) fertilized with inorganic fertilizer (Superphosphate), (2) with inorganic fertilizer combined with organic manure (cowdung) and (3) without any fertilizer (control), each stocked at 5,000/ha. It was observed that the maximum growth was attained in pond fertilized with superphosphate, being 15 gm in 120 days. The control exhibited a growth of 11.4 gm during the same period.

In a laboratory experiment, direct relationship between the availability of added phosphorus and the water salinity was found. Although about 40% of the added phosphorus was lost from the water phase within 10 days of application and only 16% remained after a period of 100 days, comparatively more phosphorus was available in higher salinities (58.92% at 3‰ as against 44.4% at trace salinity on the 10th day).

Different feed mixtures, rice bran + fish meal (1 : 1); rice bran + mustard oilcake + fish meal (4:3:3); rice bran + silk worm pupae (1:1) and rice bran + mustard oilcake + silk worm pupae (4:3:3) were fed to *M. parsia* fry in a well designed laboratory experiment to find out the most efficient

feed mixture. Both in terms of survival and conversion ratio into fish flesh the last mixture was found to be significantly different from the others at 1% level with the survival ratio as 0.700 and the conversion ratio as 3.62 : 1. The crude protein and carbohydrate contents of the mixture were approximately 36.6 and 37.15% respectively. With the same feed mixture a low conversion of 14.5 : 1 was obtained at low temperature (range 23°-24.4°C) and salinity (6.91-10‰). Addition of minerals and Cobalt chloride with the feed, however, increased the conversion to 4,773 : 1 at the same temperature and salinity.

By judicious stock manipulation through repeated stocking and periodical partial harvesting a net estimated production of 2,670.92 kg/ha/yr could be obtained in selective culture of *M. parsia* and prawn. While a total of 32,500 nos./ha of *Mugil parsia* were stocked, the prawn seed was let in with the tidal water after straining it through a closely woven bamboo grating.

In order to determine the optimal stocking density, the fry of *M. tade*, @ 1,92,300/ha (average size 22 mm), 1,53,840/ha (average size 20 mm) and 76,920/ha (average size 21 mm) were stocked in different morphometrically identical nursery ponds. They were fed daily with powdered mustard oilcake and maize mixed together in equal proportion, at the rate of 1/16 of the total fish fry weight. The average sizes attained (length/weight) after three months at the above stocking densities were 54 mm/2.6 gm, 63 mm/4.6 gm and 72 mm/4.9 gm respectively.

Selective culture of advanced fry of *Mugil tade* was done at two stocking densities; *viz.*, 40,000/ha (average size 67 mm) and 30,000/ha (average size 53 mm). Supplementary feeding with a mixture of rice bran and fish meal (1:1) @ 1/10 of body weight of the stocked fish was done on alternate days. The length and weight achieved after six months were : 141 mm/26.36 gm and 151 mm/30.0 gm respectively.

In culture operations at a stocking density of 4,000/ha (average size 149 mm/32.5 gm) the fish recorded a growth of 184 mm/73.7 gm in five months when fed with a mixture of mustard oilcake and maize powder in the proportion of 1 : 1.5 given daily @ 16% of the total weight of the fish.

Problem : 5.14 Culture of *Penaeus monodon*

Personnel : P. U. Verghese, A. N. Ghosh, G. N. Chatterjee, H. C. Karmakar and P. B. Das

Duration : 3 years

Preliminary rearing experiments with different size groups of *Penaeus monodon* were initiated to develop a suitable and effective culture technique. Post-larvae of *P. monodon* were available at the farm site at Kakdwip for nearly

9 months during the year with a peak during June-August. In jar experiments, post-larvae (average size 12 mm) were found to attained 40 mm/0.5 gm in 50 days. Artificial pelleted feed prepared out of fish meal, wheat flour, algal powder, molluscan shell powder and yeast mixed at 40 : 40 : 15 : 4 : 1 ratio by weight was tried in a series of randomised block design experiments to test the efficacy of feed on the growth of juvenile prawns (30-40 mm). The monthly growth rate was 10 to 21.8 mm/0.40 to 0.95 gm when salinity and temperature ranged from 14.8 to 22.7‰ and 28.5° to 30.5°C respectively. The survival rate with different experiments ranged from 46.6 to 66.7%. When reared in cages kept in the farm canal with low salinity (1.8 to 4.7‰) and low temperature (19° to 26°C) juvenile *P. monodon* (size range-35 to 56 mm) exhibited monthly growth rate ranging from 3.8 to 6.3 mm/0.38 to 0.57 gm with survival rate ranging from 74 to 94%. Studies on moulting frequency indicated that small prawns (20-40 mm) and juveniles (60-90 mm) moulted on an average at 3 days and 10 days interval. The increase in size per moult varied from 2 to 4 mm in both size groups at temperatures from 27° to 32°C and salinity from 12 to 28‰.

In a rearing experiment in a pond with water spread of 0.01 ha, without supplementary feed or manuring, employing 35-50 mm size *P. monodon* at a stocking density of 30,000/ha, a production of 403.2 kg/ha/8 months of marketable prawns (average weight 27.28 gm) was obtained. The over all survival being 55.57%. Besides the cultured species, miscellaneous fish and prawn, which entered as larvae while taking in tidal water through bamboo screens for replenishment of pond water, formed an additional production of 358.4 kg/ha/8 months.

Problem : 5.15 Culture of *Penaeus indicus*

Personnel : M. K. Bandyopadhyay, A. N. Ghosh, P. U. Verghese, H. C. Karmakar and G. N. Chatterjee

Duration : 3 years

Shooting net (1/8" mesh) was used during spring tides in the canals and drag net (1/16" mesh) was operated in the main river during neap tides to procure the post larvae and juveniles of *P. indicus*. Post larvae and juveniles of *P. indicus* entering the farm area with the tidal water, were found to adjust to the lentic environment and yielded 25.280 kg and 0.007 kg of *P. indicus* in two identical ponds of 0.13 ha in 127 and 40 days respectively.

Post larvae of *P. indicus* (size range 15-40 mm) were stocked in nursery ponds @ 5 million/ha. The mortality rate was very high (90-95%) immediately after stocking. Post larvae and juveniles (15-56 mm, av. size 32 mm) cultured in a pond (0.02 ha) were observed to attain 37 to 72 mm (average 56 mm) within a period of 58 days. During the same period, *P. indicus* (size

range 17-38 mm, average 30 mm) stocked in another pond, grew to 49-76 mm (average size 68 mm).

Some experiments on suitable size at stocking and stocking density were conducted by stocking three size groups of *P. indicus; viz.*, 60-80 mm, 81-100 mm and 101-140 mm @ 50,000, 40,000 and 30,000/ha respectively in 0.02 ha ponds. Within 50 days the respective average length/weight increments were 39.04 mm/4.38 gm, 19.23 mm/4.57 gm and 11.41 mm/6.60 gm when the salinity, temperature and dissolved oxygen varied from 17.01 to 28.20‰, 30.6° to 33.0°C and 6.3 to 9.24 ppm respectively.

Studies on feeding habits and preference for different food items in different size groups of *P. indicus* have shown that the advanced post larvae (20-40 mm) mostly fed upon diatoms and rotifers while the juveniles (40-60 mm) preferred algae.

Problem : 5.16 Culture of *Lates calcarifer*

Personnel : A. N. Ghosh, M. K. Bandopadhyay, H. C. Karmakar and P. K. Pandit

Duration : 3 years

Lates calcarifer fry (8 mm and above) were available locally during the period from late April to early September with a peak (555 no./ha) during early June.

Fry of *Lates* (110 no.) were acclimatized to low saline water and were transported to Cuttack Sub-station of CIFRI under oxygen packing for culture in freshwater.

L. calcarifer fry were stocked in two separate ponds @ 1,500 and 2,000/ha. Almost identical quantities (2.6 kg and 2.7 kg) of live prawns and gobids were given as supplementary feed. With former rate of stocking an average length/weight increase of 88.5 mm/173.78 gm was obtained during a period of 7 months, the survival being 80%, while with the latter rate of stocking, the average increase was 91.8 mm/156.3 gm with 75% survival.

These fishes were later transferred to the main inlet canal after closing the ends with bamboo grating which prevented the escape of fish but allowed the entry of forage fish and prawn with tidal ingress. The continuous supply of food organisms and the available space in the long canal contributed to a further growth of 111 mm/617 gm during 170 days.

Problem : 5.17 Brackish water prawn culture in Madras region

Personnel : K. Raman, K. Gopinathan and K. J. Rao

Duration : Five years (initiated in April, 1973)

Post larvae and juveniles of prawns were reared in glass jars, earthen hundies, rectangular plastic troughs and round plastic pools providing aeration and artificial feed to study their salinity and food preferences.

In an experiment, *Penaeus indicus* juveniles (range 25-30 mm, average 27.5 mm/0.196 gm) were reared in rectangular plastic troughs with artificial feeds (fish meal, prawn meal, rice bran, weed powder and tapioca powder in different combinations). The mixture: prawn meal + weed powder + tapioca gave the best results (average increment 17.95 mm/0.343 gm in 40 days) with 100% survival. However, the prawns showed slightly retarded growth (average increment 10.01 mm/0.331 gm) with 90% survival when the experiment was further extended for a period of 42 days.

When powdered prawn head alone was used as artificial feed *P. indicus* juveniles (23.7 mm/0.103 gm) showed growth increment of 8.1 mm/0.173 gm with 58% survival in 30 days.

In another experiment four feed mixtures; *viz.*, (1) prawn powder + tapioca + gram powder (2 : 2 : 1); (2) prawn powder + tapioca + weed powder (2 : 2 : 1) (3) fish meal + tapioca + gram powder (2 : 2 : 1) and (4) fish meal + weed powder + gram powder + tapioca (2 : 2 : 1 : 1) were tried as artificial feeds for *P. indicus* (26 mm/0.237 gm). Feed No. 1 gave best survival (100%) and percentage growth increment (123.4% in length and 412.6 % in weight) followed by the other three during a rearing period of 30 days.

Feed mixtures were tried on *Metapenaeus monoceros* and *M. dobsoni.* In all the three species there was retardation in growth, after reaching a length of 55-60 mm.

The survival of prawn juveniles was good between 5 and 9‰ salinity.

Two 0.08 ha nursery ponds in the Adyar fish farm were cleared with a velon net and one of them stocked with prawns (27-56 mm) and mullet fry (24-50 mm).

Problem : 5.18 Culture of the edible oysters in lake Pulicat

Personnel : K. V. Ramakrishna and R. Ganapathy

Duration : 5 years (initiated in April, 1973)

Empty oyster shells with attached spat were restrung on a new raft. An average monthly growth of 15.49 mm in length and 14.32 mm in breadth was observed during the first two months. A thick growth of *Balanus* sp. on the

cultch impaired the growth and survival of oysters causing 68% mortality. Later, nylon ropes were cut by crabs and the cultch with the oysters dropped to the bottom, most of the growing oysters dying due to silting. The surviving ones and a few from the old raft were restrung with galvanised wire, their size range being 23-83 mm in length and 18-80 mm in width. At the end of 5 months, the size ranged between 50-92 mm and 39-82 mm in length and breadth respectively.

Juvenile oysters ranging from 31-108 mm and 22-80 mm in length and breadth were collected from lake mouth during late August and were kept in wooden trays suspended in midwater. After three months their size range was 38-109 mm (length) and 29-95 mm (width). The oyster trays were found to harbour a variety of animal life including fishes such as *Scatophagus argus, Lutianus johnii, Sparus* sp. *and Synagris* sp.

Fresh spat fall was noticed on asbestos sheet cultch material in September. Their size ranged from 6-30 mm in length and 6-28 mm in breadth. At the end of two months their size range was found to be 18-40 mm (length) and 21-38 mm (width).

Observations on the physico-chemical and biological conditions of the area were continued. Veliger larvae were, however, not encountered in the plankton.

Problem : 5.19 - 5.24 (Research work contemplated)

Project 6 : Freshwater prawn culture

Problem : 6. 1 Freshwater prawn culture techniques

Personnel : S. K. Mukhopadhyaya

Duration : 6 years 6 months

Macrobrachium malcolmsonii was successfully bred in the laboratory and the larvae could be reared upto 3 days in artificial saline water.

Culture of *M. Malcolmsonii* is being tried in prepared nursery ponds with two size groups (71.69 mm and 52.95 mm) of the fingerlings of the prawn @ 20,000/ha and fed with a mixture of rice bran and ground-nut oilcake + fish meal in the ratio of 1:1:0.5 at the rate of 25% of their body weight. Average sizes of 109.88 and 100 mm were attained in three ponds respectively after five months.

Among the artificial feeds, rice, bran with prawn powder and tubificid worms gave better results than rice bran and ground-nut oilcake.

Problem : 6. 2 Propagation and culture of *Macrobrachium malcolmsonii*

Personnel : T. Rajyalakshmi, Y. Ramarao, T. S. Ramaraju, K. S. Rao and D. R. Rao

Duration : 5 years

Four ponds (0.05 ha each in Kadiam Fish Farm were manured with cow-dung @ 10,000 kg/ha/yr at monthly intervals and were stocked with juveniles of *M. malcolmsonii* during December, 1972 at a stocking density of 75,000/ha. The production ranged from 14 to 256 kg/ha in the 4 ponds as against 43 to 228 kg in 1972. With the reduction in the stocking rate to 75,000/ha, a progressive increase in survival percentage (3.5 to 22.2% as against 1.5 to 7.5% in 1972) was observed. The fall in production rate could be due to low water level in the ponds and on account of prevailing adverse conditions. The size of prawns at the time of harvesting ranged between 67.7 mm/3.4 gm and 111.8 mm/19.9 gm. The primary production and DO values during the months December '72 to May '73 in the above ponds ranged between 325 and 3.50 mg C/m^2/6 hr and 2.95 and 13.44 ppm respectively.

In the Katheru Fish Farm, 6 ponds (0.005 ha each) were manured with cow-dung @ 5,000 kg/ha/yr and lime @ 150 kg/ha yr at monthly intervals and were stocked with juveniles of *M. malcolmsonii* @ 75,000/ha where breeders of major carps were also released. The production ranged from 32.6 to 104.5 kg/ha in 3 ponds as against 63 to 414 kg/ha in 1972. The other 3 ponds dried up due to adverse water conditions. The size of prawns at the time of harvesting ranged between 61.3 mm/2.0 gm and 110.0 mm/17.6 gm. The primary production and DO values during the months of December, 1972 to April, 1973 were between 700 and 3,700 mg C/m^3/6 hr and 4.47 and 17.42 ppm respectively. The volume of standing plankton ranged from 0.0066 to 0.0396 ml/1 of pond water during the above period.

Tagging : For the second season, 3,605 prawns, *M. malcolmsonii* were tagged with double disc tags at Seeranagaram on the river Godavari. All the recoveries were within 15 km of release spot. 91.13% of recoveries were within 30 days from the day of release, 6.97% within 60 days and 0.13% were at large beyond 60 days. The tagging mortality was 6.3% only.

The growth rate was found to be very low probably due to the fact that the tagging was conducted in the pre-breeding months when the gonads begin to ripen. Within 10 days, the growth (in length) increment was 4.28 mm without any perceptible change in weight. After 40 to 50 days the growth increment was 1.62 mm (length) and 1.83 gm (weight).

Survey of juvenile resources : The survey of larval and juvenile prawns in the estuary was continued at Yanam, Kotipalli, Kapileswarapuram and

Narasapur. *Cheerameenuvala* (cloth drag net) collections indicated that the post-larvel stages of *M. malcolmsonii* and *M. rude* were abundant in October at Yanam and Narasapur. Juveniles were abundant in October at all the centres. The collections ranged from 30 to 8,150 no./net/hr (Yanam) and 6,150 no./net/hr at Narasapur.

The size of the juvenile prawn increased towards upstream. The carapace lengths being 3-5 mm at Yanam and 6-8 mm at Dowlaiswaram. Per night collection at Dowlaiswaram during late October, November and December ranged from 1 to 45 kg *i.e.* from 67,000 to about 30 lakhs of juveniles.

10,000 juvenile prawns were transported to Kovvali fish farm (West Godavari Dt., A.P.) in oxygenated containers without any mortality.

Problem : 6. 3 Freshwater prawn fishery of the middle stretch of the Ganga

Personnel : D. V. Pahwa, Shree Prakash and N. K. Srivastava

Duration : 4 years

Survey of 232 villages, of north and south banks of R. Ganga, between Varanasi and Ballia was conducted to assess the potential prawn landing grounds, fishermen population activity engaged in prawn fishing and to determine the prawn assembly centres. Seven assembly centres, four on the north bank; *viz.*, Varanasi, Saidpur, Gazipur and Ballia and three on the south bank; *viz.*, Buxar, Chausa and Zamania were established. Prawn landings at these centres were recorded for six days in a month, three days consecutively in each fortnight. However, at Buxar the landings were recorded for 20 to 25 days in a month. The estimated landings during June-September are given in the following table.

Table 2 : Month-wise prawn catch (in kg) from the middle stretch of the river Ganga

	Jun.	Jul.	Aug. (Weight in kg)	Sept.	Total	Total (in %)
Varanasi	1460.00	1256.31	85.31	Nil	2801.60	20.1
Saidpur	355.00	Nil	...		355.00	2.6
Gazipur	172.50	62.04	25.85	Nil	260.39	1.9
Ballia	2197.50	560.40	188.94	Nil	2946.84	21.1
Buxar	860.00	986.34	17.55	Nil	1860.89	13.3
Chausa	3385.00	253.07	Nil	Nil	3638.07	26.1
Zamania	1580.00	497.61	Nil	Nil	2077.61	14.9
	10010.00	3615.77	317.65		13,940.40	

The prawn landing season has been observed to be very short, lasting only

two or three months *i.e.* from June to August.

Culture experiments : About 1,000 specimens of *Macrobrachium lamarrei* collected on 18th July, 1973 from Loni reservoir by means of small sized drag net (1/16″ mesh), were transported under oxygen packing and kept in two plastic pools at the rate of 500 specimens per pool. After 40 hrs all the prawns in one plastic pool died probably due to oxygen depletion. In the other pool, the entire stock survived for about four months. This pool was provided with a 4″ layer of sand at the bottom and *Hydrilla* sp. and *Vallisneria* sp. for maintaining the oxygen level.

Berried females of M. *lamarrei* collected from the river Ganga on 19th September, 1973 were kept in three round glass jars with thoroughly washed sand at the bottom. They were fed with plant matter and plankton. After 4 days all the berried females in one of the glass jar died, the reason for which could not be ascertained. In the other two jars, berried females (four in each jar) released their young larvae, mysis stages, on 6th and 7th October, 1973 respectively. The DO content of the jars was maintained between 6.5 and 7.5 ppm by aerating the water daily for about 2 hours in four equal instalments. The females were then removed and the young ones were allowed to feed upon the algal mass and diatom paste. In 14 days (on 21st October, 1973) the larvae attained all the adult characters. The various stages of development have been preserved and permanently mounted. After 32 days of their survival in glass jars, the young ones died within 18 hours when fresh dechlorinated water was added into the jars. No definite cause of mortality could be ascertained.

Project 7 : *Murrel and live fish culture*

Problem : 7.1 & 7.2 (Research suspended)

Project 8 : *Estuarine and brackish water lake fisheries*

Problem :	8. 1	Brackish water fish seed prospecting
Personnel :		V. Gopalakrishnan, Apurba Ghosh, K. K. Bhanot, L. H. Rao and P. R. Das
Duration :		5 years 9 months

Brackish water fish seed prospecting was conducted at Geokhali, Lot No. 8 and Namkhana in the Hooghly estuary during April, May and June and at Port Canning in the Matlah estuary, throughout the year. The per net per hour abundance of various species of fish and prawn seed obtained from Lot No. 8 are given in table 3.

Table 3 : Abundance of brackish water fish seed (Nos./net/hr) around Kakdwip from the Hooghly estuary during 1973.

H. T.	*April*		*May*		*June*	
	I. F. N.	II. F. N.	I. F. N.	II. F. N.	I. F. N.	II. F. N.
P. indicus	61.8	162.1	50.3	96.2	210.5	319.5
P. sculptilis	4.2	4.4	13.5	0.4	0.5	0.4
M. brevicornis	48.3	117.8	116.3	42.4	138.3	111.0
M. rude	5.0	22.9	15.4	57.2	720.0	185.0
P. styliferus	15.9	12.8	0.5	2.0	178.0	68.5
P. monodon	46.9	101.2	189.5	576.6	4789.5	3840.0
M. affinis	4.7	6.4	0	2.8	0	0
M. monoceros	1.5	6.6	142.3	125.8	858.0	478.5
Sciaenids	2.1	3.7	2.8	4.0	1.0	16.1
S. phasa	1.3	1.7	0	0	0	0
E. tetradactyla	0.5	1.7	15.0	97.9	31.5	28.5
I. elongata	0	0	0	0	350.5	42.5
Mullets	41.8	68.9	11.5	26.1	605.5	498.5

H.T. = High tide I F.N. = First fortnight II F.N. = Second fortnight

An appreciable number of mullet seed could be collected in the initial half-an-hour to forty-five minutes of the high tide. Transportation of the mullet fry was also done. The fry (*M. parsia* and *M. tade*) were collected by scooping the pits and low-lying areas adjoining the main river and small canals at Kakdwip and Jorapul. A total number of 300 mullet seed (2-4 cm) were collected for transportation during the second fortnight of May and conditioned in freshwater for 72 hours without mortality. They were transported to Barrackpore in 5 polythene bags filled with oxygen each containing 20, 40, 60, 80 and 100 fry within a period of about 5 hours. Mortality recorded was only 3%.

In another experiment during June, 150 mullet fry (2 cm) were collected and conditioned in freshwater for 24 hours and transported to Barrackpore in 2 polythene bags with oxygen, each containing 50 and 100 fry. The mortality was 20%.

At Namkhana, prawn seed dominated over fish seed. The abundance of prawn and fish seed (no./net/hr) is given below :—

	April	*May*	*June*
P. indicus	36	49	1533
P. monodon	9	28	0

	April	*May*	*June*
M. *brevicornis*	5	7	23
P. *sculptilis*	9	8	7
M. *parsia*	1	1	3
P. *pama*	16	4	4

P. monodon numbering 40, collected from a canal near Namkhana were acclimatized gradually to freshwater conditions. After 24 hours, 12 prawns died. The remaining prawns were brought to Barrackpore by keeping them in 3 liters of water. After 6 hours of journey all the prawns were observed in living condition.

The abundance of seed (no./net/hr) at Geokhali was as under :—

	April	*May*	*June*
P. *indicus*	3.7	3.6	2.8
M. *brevicornis*	1.2	2.5	1.8
P. *sculptilis*	2.5	1.8	2.4
P. *styliferus*	1.8	2.8	1.9
M. *rude*	0.3	0.3	0.1
P. *monodon*	1.9	0	20.8
M. *monoceros*	0.4	0.3	1.3
Mullet	0.2	0.3	0.2

In the Matlah estuary, observations were made at three centres; *viz.*, Kumrakhali, Bhangankhali and Port Canning Jetty. The availability of seed in order of abundance of the various species was as under : M. *brevicornis* (17-50 mm), P. *styliferus* (16-42 mm), P. *indicus* (13-49 mm), P. *sculptilis* (18-25 mm), M. *monoceros* (20-43 mm), P. *monodon* (11-25 mm), E. *tetradactyla* and *Mugil* spp.

Problem : 8.2 & 8.3 (Research completed in 1973)

Project 9 : Selective breeding and hybridisation

Problem : 9. 1 (Research completed in 1973)

Problem : 9. 2 (Research completed in 1972)

Problem : 9. 3 (Research suspended)

Problem : 9. 4 (Research contemplated)

Project 10 : *Fish farm designing*

Problem : 10. 1 Formulation of fish farm designing under the soil conditions of Orissa

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

Duration : 4 years

A comparative study of the soil conditions, water source, shape and design of Killa and Kausalyaganga fish farms has been made.

Project 11 : *Economics in fishery investigations*

Problem : 11. 1 Economic evaluation of fish culture operations

Personnel : M. Ranadhir

Duration : 3 years

A total of 34 fish farms were covered, of which 8 were owned by the Government and 26 by the private parties. This sample reflected the variation in farm sizes adequately. On an average the rate of profit over operating costs was relatively high (25%) in many private farms. The characteristic feature of the cost structure of private farms in comparison with public sector fish farms was that the stocking material constituted a relatively high percentage of total costs ranging from 20 to 40 per cent. Other dominant constituents of recurring costs comprised labour wages (30 to 60%) and fertilizer and feeds (5 to 10 %). The commercial fish production ranged from 750 to 3,000 kg/ha in sewage fed fish farms (22-60 ha) around Calcutta.

Problem : 11. 2 Economic evaluation of various spawn production methods

Personnel : M. Ranadhir

Duration : 4 years

A total of 66 units belonging to private parties were covered for economic evaluation of spawn production methods, of which 11 relate to bundh breeding, 5 to induced breeding and 50 to riverine source. Bundhs varying from 0.08 to 12.15 ha in area were covered. The average cost of production per lakh of spawn through bundh breeding was Rs. 112/- and the average production per hectare of water area was 215 lakh. The average cost of production

was Rs. 150/lakh through induced breeding, while it was Rs. 90/lakh through riverine source.

Problem : 11. 3 (Research completed in 1973)

Problem : 11. 4 Assessment of marketable size for fish culture enterprises in West Bengal

Personnel : M. Ranadhir

Duration : Two years

Six fish markets; *viz.*, Uttarpara, Serampore, Pati Pukur, Lake market, Khardah and College Street Fish markets were covered each month during the year, for collection of data on fish prices and the size groups marketed. The retail rate of fish weighing from 500 gm to 1 kg varied from Rs. 7 to Rs. 9, whereas the average rate of fish weighing more than one kg was Rs. 12 per kg. Fish weighing less than 500 gm were sold at Rs. 5 to Rs. 6 per kg. No appreciable differences were noticed in the price structure among the six different fish markets. A difference of Rs. 2-4 in price structure was noticed between the early and later parts of the year. This might be due to the overall increase in the price index. The average weight of fish in the supplies marketed ranged from 1 to 1.5 kg in all the fish markets.

Project 12 : *Exotic fish culture*

Problem : 12. 1 & 12. 2 (Research completed in 1973)

Problem : 12. 3 (Research completed in 1972)

Problem : 12. 4 Suitable supplementary feeds for grass carp fry and fingerlings

Personnel : D. S. Murty, R. K. Dey and P. V. G. K. Reddy

Duration : 3 years

Three sets of laboratory experiments of 15 days duration in glass jars were conducted with fry of grass carp (size range 21.33-24.45 mm).

The feeds given were *Wolffia*, rice bran, ground-nut oilcake and plankton individually and a mixture of ground-nut oilcake and rice bran in equal ratio by weight. In these preliminary trials both plankton and ground-nut oilcake indicated almost equally good growth whereas *Wolffia* as a feed showed poor growth of fry.

Problem : 12. 5 & 12. 6 (Research contemplated)

Project 13 : *Cold water fish culture*

Problem : 13. 1 (Research completed in 1970)

Problem : 13. 2 (Research suspended)

Problem : 13. 3 (Research completed in 1971)

Problem : 13. 4 & 13. 5 (Research completed in 1970)

Problem : 13. 6 (Research completed in 1972)

Problem : 13. 7 (Research completed in 1970)

Problem : 13. 8 & 13. 9 (Research suspended)

Problem : 13.10 Food of *Salmo trutta fario* in natural streams

Personnel : K. L. Sehgal, Shyam Sundar and K. Kumar

Duration : 3 years

The analysis of gut contents of the specimens from individual streams; *viz.*, Lidder, Erin and Bringhi has shown that Trichoptera larvae ranged as first grade food (55.6-67.7%) of trout in these streams followed by nymphs of Ephemeroptera (8.8-13.2%) and *Gammarus pulex* (3.9-7.7%). The corresponding figures for the abundance of major groups of animals in the streams were : Trichoptera larvae (32.7-62.1%); Ephemeroptera nymphs (4.8-44.8%) and *Gammarus pulex* 6.0-0.32.1% respectively. The size of 123 specimens of *Salmo trutta fario* examined ranged from 188-335 mm, 220-370 mm and 190-460 mm from the Lidder, Erin and Bringhi streams respectively.

Problem : 13.11 Biological studies of *Orienus plagiostomus*

Personnel : M. J. Bhagat and Shyam Sundar

Duration : 3 years

In all 33 specimens were collected at Doda, Chenani, Udhampur and Reasi which ranged in the size from 11-386 mm/110-420 gm. The analysis of gut contents showed Bacillariophyceae, 61.65%; detritus, 24.38%; algae, 7.22% and others 6.75%. The studies were initiated during the year and are being continued.

Problem : 13.12 Biological studies of mahseer *Tor putitora*

Personnel : Kuldip Kumar and D. B. Joshi

Duration : 3 years

In all 43 specimens were collected at Udhampur, Jhajjarkotli and Reasi. The fish ranged from 115-307 mm in total length and 14-200 gm in weight. Gut contents study indicated that detritus constituted 34.50% followed by Bacillariophyceae, 31.49%; aquatic vegetation, 30.53% and others 3.48%. The studies initiated during the year are being continued.

Project 14 : *Riverine and estuarine fish catch statistics*

Problem : 14. 1 Fish catch statistics of the middle stretch of the Ganga river system

Personnel : R. K. Tyagi, R. K. Sexana, Shree Prakash, P. N. Jaitly, N. K. Srivastava, R. K. Dwivedi and S. N. Mehrotra

Duration : 4 years

Fish landings: Estimated fish landings at Sadiapur, Daragang, at Allahabad and a Buxar during January to November, 1973 were 65.16, 19.96 and 14.85 t respectively. Species-wise fish landings at the respective centres are given in the table 4.

Table 4. Species-wise fish landings (kg) at different assembly centres in the middle stretch of the Ganga river system

Centres	*C. mrigala*	*C. catla*	*L. rohita*	*L. calbasu*	*M. aor*	*M. seenghala*	*W. attu*	*H. ilisha*	Misc.	Total
Sadiapur	8649	3550	2962	12299	7408	5156	4544	2982	24969	
Daraganj	1579	192	433	343	2364	2118	454	250	10799	
Buxar	395	1335	1540	37	2584	1721	557	1966	4710	14845

The mean lengths in respect of four species; *viz., C. mrigala, L. calbasu, M. aor* and *H. ilisha were* calculated to be 525, 470, 485 and 362 mm respectively.

Hydrological studies of the Ganga river system :

Alkalinity of the Yamuna (91.0-270.0 ppm) was more than that of the

Ganga (44.0-241.0 ppm). The Yamuna water was harder (35-72 ppm) than that of the Ganga (37.5-67.5 ppm). Chloride concentration was more in the Yamuna (15-60 ppm) as compared to that of the Ganga (6.7-20.0 ppm). Dissolved oxygen in the Ganga ranged from 5.6 to 9.8 ppm and in the Yamuna from 5.0 to 9.6 ppm. Phosphates were found to be more in the Ganga (0.135-0.28 ppm) as compared to the Yamuna (0.08-0.28 ppm); silicate ranged from 2.4 to 20 ppm and 6.25 to 20 ppm in the Ganga and the Yamuna respectively. Primary productivity of the Ganga (12.5-212.5 $mgC/m^3/hr$) was more than that of the Yamuna (12.5-100 $mgC/m^3/hr$).

Plankton studies: Fortnightly observations on the plankton were made from April to December, 1973.

The total plankton population of the river Ganga was 968 units/litre (average of 9 months) as against 223 units/litre of the Yamuna. The phytoplankton (921 units/litre) exhibited clear dominance over zooplankton (47 units/litre) in the river Ganga. *Peridinium* sp. among dinoflagellates, *Melosira* sp. and *Synedra* sp. among diatoms, *Anabaena* sp. among Myxophyceae and *Pediastrum* sp. among Chlorophyceae were dominant forms of phytoplankton. *Brachionus* spp. among Rotifers, *Cyclops* spp. among copepods and different nauplii stages formed the bulk of zooplankton.

Problem : 14. 2 Fish catch statistics of the lower stretch of the Ganga river system

Personnel : G. N. Mukherji, S. N. Sar, R. C. Singh and B. L. Pandey

Duration : 4 years

(a) *Fish catch statistics*

The estimated total fish landings at the six assembly centres were 600.98 t, showing an increase by 33.15% over the production of 1972 (451.36 t). The increase was due to heavy landings of *H. ilisha* at Lalgola and miscellaneous species at a few centres. Species-wise fish landings at different centres with the related details are presented in table 5.

Table 5 : Contribution of various species (in t) at different assembly centres in the lower stretch of the Ganga river system

Species	Bhagalpur	Sahibganj	Rajmahal	Dhulian	Farakka	Lalgola	Total	% in total
C. mrigala	1.67	1.37	1.00	1.52	1.34	...	6.90	1.15
C. catla	3.81	2.60	2.19	2.47	2.27	...	13.34	2.12
L. rohita	1.51	1.02	1.19	1.56	1.14	0.05	6.47	1.08
L. calbasu	0.31	0.30	0.48	0.30	0.34	...	1.73	0.29
M. aor	3.71	1.96	2.02	1.56	1.39	...	10.64	1.78
M. seenghala	4.13	2.27	1.80	2.25	1.67	...	12.12	2.08
W attu	10.65	7.21	4.15	4.84	4.01	0.09	30.95	5.16
H. ilisha	1.41	1.41	8.02	35.48	37.07	227.85	361.20	60.10
Misc	34.38	24.36	24.57	35.44	22 27	16.57	157.63	26.24
Total	61.58	42.50	45.42	85.42	71.50	294.56	600.98	
(% in total)	10.25	7.07	7.56	14.21	11.90	49.01		100.00

Percental contribution of different species at various assembly centres is presented in table 6.

Table 6. Percentage contribution of various species at different assembly centres in the lower stretch of the Ganga river system

Species	Bhagalpur	Sahibganj	Rajmahal	Dhulian	Farakka	Lalgola
C. mrigala	2.71	3.32		1.78	1.87	...
C. catla	6.19	6.13	4.82	2.90	3.17	...
L. rohita	2.45	2.40	2.62	1.83	1.59	...
L. calbasu	0.50	0.71	1.06		0.48	...
M. aor	6.02	4.61	4.44	1.83	1 94	...
M. seenghala	6.72	5.34	3.96	2.63	2.35	...
W attu	17.29	16.96	9.14	5.67	5.61	
Misc.	55.82	57.31	54.10	41.48	31.14	5.63
H. ilisha	2.30	3.32	17.66	41.53	51.85	94.33

(b) Primary productivity

The maximum abundance of phytoplankton (4,004 u/l) was in May and the minimum (126 u/l) in August. Over the corresponding period of 1972, the phytoplankton density indicated an increase by 21.30%. Phytoplankton mainly comprised *Gonatozygon* sp., *Microcystis* sp., *Navicula* sp., *Meris-*

mopedia sp., *Anabaena* sp., *Oscillatoria* sp., *Padiastrum* sp., *Ankistrodesmus* sp., *Eudorina* sp., *Pandorina* sp., *Scenedesmus* sp., *Spirogyra* sp., *Characiopsis* sp., *Synedra* sp. *and Nitzschia* sp.

The density of zooplankton varied between 4 (July) and 169 u/l (October) and registered an increase by 28.34% over the corresponding figures of 1972. It comprised rotifers (*Keratella* sp., *Notius* sp., *Brachionus* sp., *Polyarthra* sp., *Trichocerca* sp., *Ploesoma* sp. and *Asplanchna* sp.), protozoans (*Actinophrys* sp.) and glochidium larvae of molluscs. Phytoplankton : zooplankton ratio was 1:0.04 for the period of observation and it variad from 1:0.01 in June and September to 1:0.27 (October).

The average gross and net primary productivity and respiration during the year were 43.99, 24.29 and 23.51 mgC/m^3/hr respectively. These values shows an increase of 26.99, 56.70 and 25% over the corresponding values of the previous year. Primary productivity was the maximum (83.76 mgC/m^3/hr) in May and the minimum (14.38 mgC/m^3/hr) in August. The maximum net primary productivity (49.07 mgC/m^3/hr) was in March and the minimum (5.63 mgC/m^3/hr) in June. Maximum and minimum rates of respiration were observed in May (46.50 mgC/m^3/hr) and August (7.13 mgC/m^3/hr) respectively.

DO was the maximum (7.97 ppm) in March when average water temperature was 23.0°C and the minimum (3.94 ppm) in August with average water temperature being 29.0°C. The pH varied from 8.00 (July) to 8.75 (April). Air temperature was the maximum (31.0°C) and minimum (12.50°C) during June and January respectively.

Problem : 14. 3 (Research completed in 1969)

Problem : 14. 4 (Research completed in 1971)

Problem : 14. 5 (Research completed in 1973)

Problem : 14. 6 Effect of major environmental changes on the fisheries of commercially important stocks of the Hooghly-Matlah estuary

Personnel : V. Gopalakrishnan, A. Chowdhury, G. C. Laha, P. M. Mitra, A. R. Chowdhury, D. K. De, H. S. Mazumdar, R. N. De, P. K. Pandit and B. K. Saha

Duration : 3 years

The data from October, 1972 to September, 1973 were processed during the period. A total of 13,226.5 tonnes of fish was landed from the Hooghly-Matlah estuarine system during this period. Zone III (*i.e.*, lower Sunderbans) contributed about 86.5% of the total catch while zones I, II, IV and V contri-

buted about 7.6, 2.5, 2.3 and 1.0% of the total catch respectively.

The species which dominated the catches were *H. nehereus* (2610.0 tonnes, 19.74% of the total catch), S. *phasa* and S. *taty* (1633.3 tonnes, 12.35% of the total catch), *T. jella* (1616.2 tonnes, 12.22% of the total catch), prawns (1323.8 tonnes, 10,01% of the total catch) and *H. ilisha* (1241.5 tonnes, 9.39% of the total catch).

The gears which dominated the catches were bag-net, drift-net and large seines. Gear-wise contributions were: bag-net (7,547.7 tonnes (57.07% of the total catch); drift-net 2,332.5 tonnes (17.64% of the total catch) and large seine 1,965.3 tonnes (14.86% of the total catch).

Problem : 14. 7 Fisheries of the Brahmaputra river

Personnel : Ravish Chandra, H. P. Singh, S. N. Upadhyaya and Mahadeo Choudhury

Duration : 4 years

Catch statistics: During the year under report 239.2 t of fish were landed at Fancy Bazar and Uzan Bazar. The bulk of the landings came during post-monsoon and winter months. The maximum landings (average/day) were observed during October and November. Details of fish landings are presented in table 7.

Table 7. Monthly landings (kg) and average landing per day from the river Brahmaputra

Months	Uzan Bazar		Fancy Bazar	
	Total landing (kg)	Av. landing /day	Total landing (kg)	Av. landing /day
December(1972)	7,432	239.7	16,181	521.9
January	6,359	205.1	13,174	423.7
February	5,827	208.1	8,163.5	291.5
March	3,814	123.0	7,222	232.9
April	6,093.5	203.1	9,698	323.9
May	6,549.5	211.3	8,234	265.6
June	2,653	88.4	8,017	267.2
July	6,575	212.1	6,892	222.3
August	8,722	281.3	7,243	233.6
September	17,389	579.6	13,627	454.2
October	20,756	669.5	15,786	599.2
November	18,893	629.8	13,900	463.3
Total	111,063		128,137.5	

Miscellaneous fishes dominated the catches, followed by major carps at Fancy Bazar and catfishes at Uzan Bazar as shown below :

	Uzan Bazar (%)	*Fancy Bazar* (%)
Major carps	12.15	29.18
Catfishes	24.78	25.59
Hilsa	6.21	11.95
Prawns	3.68	2.53
Miscellaneous	53.18	30.75

Hydrological observations : The surface water temperature at Uzan Bazar Ghat varied from 21.0° to 30.5°C. The pH fluctuated between 7.4 and 7.5 except in the month of April (6.6). The turbidity fluctuated between 30.0 and 150.0 ppm. The alkalinity varied from 62.0 to 92.0 ppm. Free CO_2 ranged from 2.0 to 4.0 ppm. The dissolved oxygen varied from 3.6 to 6.0 ppm. The nitrate concentration varied from 0.04 to 0.07 ppm except in the second fortnight of June (0.012 ppm). Phosphate content varied from 0.05 to 0.14 ppm.

Primary production : The gross primary productivity fluctuated between 18.75 and 31.25 mgC/m^3/hr. The net production varied from 12.5 to 14.45 mgC/m^3/hr.

Plankton studies : Plankton samples were taken fortnightly from June, 1973 and analysed. Diatoms were found to be the dominating group of phytoplankton (43.2 to 75.4%) followed by green algae (12.1 to 24.5%) and blue-green algae (9.8 to 21.2%). Zooplankton was very poor during the entire period of observation (5.2 to 27.2%).

Problem : 14. 8 & 14. 9 (Research contemplated)

Project 15 : *Fish pathology*

Problem : 15. 1 Etiology and control of parasitic diseases of cultured warm-wetar fishes

Personnel : A. K. Ghosh

Duration : 4 years

Argulus, bred in the laboratory, showed on an average 260 eggs per batch

during April-December. The eggs hatched in 12 days and could be reared upto 21 days. They could be controlled by 0.5 ppm BHC. Eggs deposited on planks and tin sheets supplied in the pond having *Argulus* infection were destroyed. The same method was found to be useful in collecting and destroying parasitic leeches. *Placobdella emydae* Harding and *Glossiphonia weberi* Blanchard. The former bred in the laboratory in August. A few young ones kept with the host (major carp fingerlings) are thriving well in the laboratory.

Malachite green at concentrations of 2 ppm and above was lethal to major carp fry but effectively controlled the infections of Myxosporidia and monogenetic trematodes at 1 ppm.

Project 16 : *Weed Control*

Problem : 16. 1 (Research completed in 1973)

Problem : 16. 2 (Research suspended)

Problem : 16. 3 Evolution and evaluation of weedicide formulations

Personnel : V. Ramachandran, S. Patnaik, T. Ramaprabhu and K. M. Das

Duration : Continuing

A dense field infestation (0.18 ha) of *Pisti stratiotes* and *Jussiaea* sp. was successfully controlled by treating with Gramoxone (a.i. 20% Paraquat) at the rate of 0.4 kg/ha. The rotting of weeds, though resulted in pollution and severe depletion of oxygen initially, did not cause any fish mortality and was followed by a steady level of high phosphate concentration in water (0.6 ppm) and development of *Spirodela* and *Wolffia* which was utilized for feeding grass carp. Stocking of Indian major carps and exotic carp fingerlings was possible after 3-4 weeks.

Gramoxone was also found effective against *Selvinia* sp. at 0.9 kg a.i./ha in field trials.

'Asulox', a new experimental commercial weedicide formulation, was effective against *Panicum* sp. and *Leptochloa* sp. @ 5-6 kg a.i./ha and also adversely affected *Cyperus* sp., *Phragmites* sp. and *Enhydra* sp. in small scale field trials.

'Dedenol' was found more effective than 'Surf' as a wetting agent.

Problem : 16. 4 (Research completed in 1973)

Problem : 16. 5 Eradication of weeds by chemical treatments

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

Duration : 2 years for each field trial

A pond 656 sq. metre in area and choked with *Eichhornia* sp. was selected for treatment with superphosphate (16%) solution. The first dose was applied on the plants and the later intermittent doses were applied in water. After the first dose the phsophate concentration of water increased from 0.2-0.3 ppm to 61 ppm, later treatments mainained the phosphate concentration between 15-20 ppm. 80% *Eichhornia* sp. plants were destroyed and the remaining decaying 20% were cleared by manual labour. The treatment was successful as it could destroy and check the regrowth of *Eichhornia* sp.

Another pond, choked with *Nymphoides cristatum* and scattered growth of *Vallisneria spiralis*, was treated with superphosphate (16%) solution in 5 intermittent doses (total dose being 1,350 kg/ha). The plants showed a gradual decline and within 5 months they died. There was no regrowth of weeds. With the treatment both zooplankton and phytoplankton showed an increase in abundance.

Fernoxone was applied in solution form at doses 50, 100, 150, 200 and 250 kg/ha in laboratory experiments to kill *Vallisneria* sp., *Hydrilla* sp. and *Ceratophyllum* sp.

All the doses could destroy the plants but regrowth was observed at 50 and 100 kg/ha. Regrowth was nil in other doses. Since the cost of the chemical is too high, the experiments were given up.

Problem : 16. 6 Autecology of aquatic weeds

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

Duration : 4 years

Collection of plants, soil and water from each pond from different localities have been made. Analysis of plant parts, soil and water are in progress.

Problem : 16. 7 Studies on the algal population of freshwater ponds with special reference to their utility for fish culture and control when in excess

Personnel : S. Patnaik

Duration : 4 years

Wide ranges of pH, total alkalinity and algal population were observed in 3 ponds at Cuttack, Barang and Angul, the algal populations were dense at Cuttack (250-19,700 u/1).

Microcystis sp. blooms could be effectively cleared by application of simazine @ 2.26 and 3 ppm in two ponds.

Problem : 16. 8	Investigation on the biodegradation, persistance and the effects of 2,4-D and Simazine weedicides on the productivity and fish life in culturable waters
Personnel :	V. Ramachandran, S. Patnak, T. Ramaprabhu and K. M. Das
Duration :	3 years

Yard experiments in plastic pools with 0.2 and 0.5 ppm simazine showed that the survival and growth of fish (*Cyprinus carpio* fry) is affected. However, 2,4-D (5 and 10 ppm) did not have any such effect.

Suppression of *Potamogeton nodosus* was observed in a pond treated with 11 kg/ha of simazine even after 5 months. Rohu spawn stocked in a pond treated with 5 kg/ha simazine were not affected adversely.

Problem 16. 9 (Research contemplated)

Project 17 : *Frog farming*

Problem : 17. 1-17. 4	(Research completed in 1973)
Problem : 17. 5	(Research suspended)
Problem : 17. 6	Culture of frog food organisms
Personnel :	C. R. Das, P. L. N. Rao, A. K. Mondal and one chemist
Duration :	3 years

Tubificid worm samples from natural resources consisted mainly of *Limnodrilus socialis* (Steph) and *Tubifex tubifex* (Muller). Pond soil + organic manure was found to be a suitable medium. Infusion of rice bran seemed to hasten their multiplication. Addition of used tea leaves, dried *Spirodela* and leaves of guaav (*Psidum guava*) respectively enhanced multiplication of the order of 35, 26 and 19 times in the case of *Tubifex tubifex* and 12, 8 and 4 times in case of *Limnodrilus socialis.* Paper pulp and ground-nut oilcake on pond soil base also enhance their multiplication. However, cowdung, urea and ammonium nitrate did not help in their multiplication in laboratory studies.

Problem : 17. 7-17. 9 (Research contemplated)

Project 18 : *Sewage-fed fisheries*

Problem : 18. 1 Ecology of sewage-fed fisheries

Personnel : Apurba Ghosh, S. C. Banerjee and L. H. Rao

Duration : 2 years

Ecological studies in two sewage-fed ponds at Khardah were continued. Plankton and bottom biota samples were collected at fortnightly intervals. The plankton showed three peaks in January/February (8.45 cc/50 l), May (8.9 cc/50 l) and July (12.4 cc/50 l). The concentration of plankton coincided with the release of sewage effluent into the pond. The dilution rate of sewage : water was 1 : 2. Phytoplankton was represented by *Oscillatoria* sp., *Spirulina* sp., *Merismopedia* sp., *Nostoc* sp., *Ankistrodesmus* sp., *Scenedesmus* sp., *Chlorella* sp., *Navicula* sp. and *Synedra* sp. and the zooplankton was represented by *Moina* sp., *Cyclops* (?), *Diaptomus* (?), *Branchionus* sp., *Keratella* sp., *Asplanchna* sp., *Filinia* sp. and eggs and nauplii of copepods and cladocerans and larval stage of ostracods and molluscs.

Bottom biota comprised molluscs, annelid worms and chironomids. Among molluscs, gastropods were in abundance.

The gross primary productivity for the period January-November varied from 120.03 mgC/m^3/hr in September to 796.87 mgC/m^3/hr in May.

Dissolved oxygen values varied from 2.60 to 6.70 ppm and the water temperature ranged from 22.0° to 32.75°C.

Vijayawada.

To study the survival and growth of silver carp *H. molitrix,* fingerlings (average size 110 mm and weight 8 gm) were introduced into the sewage-fed stocking pond. The stocking pond had a standing crop of Indian major carps in the ratio of 2 rohu : 5 catla : 3 mrigal at a stocking density of 50,000 fingerlings/ha. The silver carp constituted 0.02% of the total stocking density and grew to approximately 1 kg in 5 months. During the same period of rearing, average weights attained by rohu, catla and mrigal were 188.3, 155.0 and 142.5 gm respectively. The total fish harvest from the sewage-fed pond was estimated to be 7,676 kg/ha in a period of 7 months.

Pond No. 2 which was stocked with major carps in the ratio of 50 rohu : 15 catla : 15 mrigal : 20 bata @ 2,00,000 fingerlings/ha (size 20-25 mm/ 0.3 gm) by the fish farmer has been taken up for the assessment of primary and secondary biomass production.

Project 19 : *Hilsa fisheries*

Problem : 19. 1	(Research completed in 1972)
Problem : 19. 2	Hilsa fisheries of the lower stretch of the Ganga river system
Personnel :	B. L. Pandey, G. N. Mukerji, S. N. Sar, R. C. Singh
Duration :	7 years

Appraisal of the fishery : The estimated landings from the lower stretch of the Ganga river system were recorded to be 361.63 t against 207.94 t of the preceding year thereby registering an incrase of 73.91%. Farakka (37.41 t) and Dhulian (35.44 t) on the river Ganga and Lalgola on the river Padma (277.82 t) were highly productive, contributing 96.97% of the total landings. The production of *H. ilisha* at Bhagalpur, Sahibganj and Rajmahal was 1.41, 1.53 and 8.02 t respectively.

A comparison between tre years 1972 and 1973 indicated that the production decreased at Bhagalpur, Sahibganj, Rajmahal and Farakka by 17.54, 29 61, 16.07 and 20.63% respectively and increased at Dhulian and Lalgola by 5.15 and 144.44% respectively.

The month-wise production at individual centres during June to October accounted for the bulk of catches from the entire stretch. Hilsa measuring less than 180 mm were conspicuous by their absence in catches at Lalgola. The production in the month of May and June (100.00%) at Bhagalpur, June (72.19%) at Sahibganj, May and June (84.52 and 69.57% respectively) at Rajmahal, April (0.02%) at Farakka and April (2.00%) at Dhulian comprised juveniles mainly.

Among the three sub-populations the 'slender' variety dominated at Bhagalpur, Sahibganj, Rajmahal and Dhulian forming 58.80, 67.56, 54.93 and 33 74% respectively by weight, while 'broader' variety dominated at Farakka (40.12%) and 'broad' variety at Lalgola centre contributing 40.57% of the total catch there. The 'broad' variety at Lalgola contributed its minimum at Rajmahal (9.34%) and at Bhagalpur (20.65%).

The distributional pattern of the individual variety in the fishery at these centres during different months revealed that the 'slender' variety dominated over the other two varieties throughout the year at Bhagalpur, Sahibganj and Rajmahal except in the month of Ocober at Bhagalpur and June at Sahibganj when 'border' variety dominated the catches. At Farakka the 'slender' variety dominated in the month of January-February, May and September to October, the 'broad' variety in November (39.40%) and the 'broader' during March-

April and June-August. At Dhulian centre, the 'slender' variety dominated the catches during January and March and 'broader' during April-July and September. At Lalgola centre the 'broad' variety dominated in catches during March-May and November while during rest of the months the catches were dominated by the 'broader' variety.

Delimitation of spawning grounds : Independent spawning activity of *H. ilisha* was observed at Bhagalpur, Rajmahal and Dhulian sectors. Two separate spawning seasons in these sectors, one during the post-winter months of March and April and the other during the monsoon months July-October as evidenced by the availability of spawn (4 mm) in the 1/16" mesh shooting net and 0.5 m organdie tow net collections, were observed. The intensity of spawning as adjudged by concentration of spawn per 1,000 m^3 water was found to be higher during the post-winter months at Bhagalpur and monsoon months at Rajmahal and Dhulian. The number of spawn per 1,000 m^3 water varied between 121.28 in May and 1,612.14 in March at Bhagalpur, 1.20 in May and 87.01 in April at Rajmahal, and 1.70 in May and 160.58 in April at Dhulian. The spawning activity was of low magnitude at Bhagalpur during the monsoon months, the numbers of larvae per 1,000 m^3 water varied between 0.38 in October and 26.25 in September. At Rajmahal and Dhulian centres the spawning activity during monsoon months was high, the number of larvae per 1,000 m^3 water varied between 132.24 in September and nil in October at Rajmahal, and 175.45 in August and nil in October at Dhulian. At Lalgola centre, no hilsa larvae were encountered in the tow net collections. At Sahibganj, the *H. ilisha* larvae were observed in the month of April. At Farakka centre, the *H. ilisha* larvae were observed during March, April and July, there number being 1.41, 2.90 and 2.10/1000 m^3 of water. Two distinct spawning peaks were observed at Bhagalpur, Rajmahal and Dhulian during the months of March and September, April and September, and April and August respectively.

Problem : 19. 3	Artificial propagation of Godavari hilsa
Personnel :	T. Rajyalakshmi, Y. Ramarao, T. S. Ramaraju, K. S. Rao and D. Ramakrishnarao
Duration :	5 years

Age-group composition : Sampling for length/age distribution in the catches, for stages of ovarian maturity was conducted in all the branches of the river Godavari both in estuarine and freshwater centres. Though the overies were observed in IV and V stage of maturity throughout the year, as

in previous years, no oozing females were observed. Induced breeding attempts were unsuccessful.

No larvae or eggs were encountered in tow net and fry net collections at any of the sampling centres, confirming that breeding activity is poor in natural environment in freshwaters. Continued absence of *H. ilisha* juveniles in freshwaters also confirms scanty spawning of the species.

Ovary weight : The mean ovary weight/kg body weight since 1969-1973 was 100.7, 137.4, 111.6, 78.6 and 86.7 gm respectively. With the mean size of 479.1 mm and weight 1,356.0 gm mean ovary weight recorded was 116.0 gm.

Fecundity : For groups IV and V average fecundity was observed to be 9.63 and 13.90 lakhs respectively.

Size of ova : The average ova diameter during the months August to November in the samples from Rajahmundry and Dummagudem ranged between 0.416 and 0.666 mm, the ovaries being in IV and V stages of maturity. In two oozing females, the average ova size was observed to be 0.766 mm.

Sex ratio : The sex ratio showed an increase in the proportion of females in the IV age group. The dominance of males in III age group and females in V age group was observed during this year also. The percentages of ♂ / ♀ in the groups III, IV and V were 100.0/nil, 31.6/68.4, and nil/100.0 in July; 100/nil, 31.5/68.5 and nil/100.0 in August; 100/nil, 43.0/57.0 and nil/100.0 in September; 100/nil, 41.0/59.0 and nil/100 in October and 96.2/3.8, 20.7/79.3 and nil/100.0 in November.

Problem : 19. 4 & 19. 5 (Research completed in 1973)

Problem : 19. 6 (Research suspended)

Problem : 19. 7 - 19. 9 (Research contemplated)

Project 20 : *Water pollution investigation*

Problem :	20. 1	(Research completed in 1973)
Problem :	20. 2	Pollution study in different river systems of India caused by various sources with reference to aquatic bio-mass
Personnel :		R. S. Panwar, H. C. Joshi and D. Kapoor
Duration :		3 years

Short (24 hrs) and long (96 hrs) term bioassay experiments were carried out by using biocides like Gammexane (BHC), Folidol (Ethyl parathion), Endrin, Malalthion and Rogor. Chironomids, oligocheates, gastropods (*Viviparus bengalensis*), bivalves (*Parreysia favidens*) weed fishes (*Trichogaster fasciatus, Puntius sophore*) and spawn and late fry of major carps (*Labeo rohita* and *Cirrbina mrigala*), zooplankton (*Daphnia* sp.) were used as test animals for experiments in flowing and static waters.

Gammexane (BHC)-20EC, In BHC, Tlm 24 hr for chironomid larvae was 0.027 ppm in static condition, for *V. bengalensis* (size 23-25 mm) Tlm 96 hr was 1.4 ppm in flowing system, while for *P. favidens* (30-45 mm) Tlm 96 hr was 1.9 ppm. Tlm 24 hr for spawn of *C. mrigala* (size 11-13 mm) and *L. rohita* (size 11-14 mm) were 0.033 and 0.034 ppm respectively.

Ethyl parathion-50EC. In Ethyl parathion (Folidol) Tlm 24 hr for for chironomid larvae was 1×10^{-7} ppm and for *Daphnia* sp. it was 4×10^{-7} ppm in static condition. *Puntius sophore* showed 1.15 ppm Tlm for 48 hr. In continuous flow system, Tlm 96 hr for *V. bengalensis* and Tlm 72 hr for *P. favidens* were 3.8 and 3.7 ppm respectively.

Endrin-20 *EC.* Tlm 24 hr for chironomid larvae and oligochaetes were 0.013 and 0.0034 ppm respectively in static condition. The Tlm 96 hr for *V. bengalensis* was 0.563 ppm and Tlm 72 hr for *P. sophore* was 0.0025 ppm sn continuous water flow system.

Malathion-50*EC.* Tlm 24 hr for chironomid larvae was 0.038 ppm in static condition for late fry of *C. mrigala* (size 32-46 mm), Tlm 24 hr was 2.0 ppm and for *T. fasciatus* (size 30-50 mm) Tlm 96 hr was 2.75 ppm in continuous water flow system.

Rogor-30*EC.* Tlm 24 hr for chironomid larvae was 0.0014 ppm in static condition.

Esomus danricus showed 70% survival in 13 and 22 days at 0.001 and 0.0005 ppm respectively in sublethal concentration of Endrin-20EC. *T. fasciatus* and *E. danrica* showed 10 and 20% mortality in 196 hr respectively when they were exposed to water collected from Amreeha fish pond treated with 110 kg DDT and 55 kg BHC for protection of trapa. *Daphnia* sp. and *Cyclops* sp. died (100%) in each case within 24 hours.

Problem : 20. 3 - 20. 5 (Research contemplated)

Project 21 : *Fisheries of river basin*

Problem : 21. 1 & 21. 2 (Research suspended)

Project 22 : *Fish Culture in running water*

Problem : 22. 1 — Cage culture in running water in the river Yamuna near Mahewa

Personnel : — R. K. Saxena, Balbir Singh, Dhirendra Kapoor and S. N. Mehrotra

Duration : — 3 years

415 fingerlings of *L. rohita* and 86 of *C. mrigala* were stocked in a bamboo cage (2 × 1 × 1 m). Due to *Saprolegnia* infection heavy mortality occurred. Again 298 fingerlings of *L. rohita* and 85 of *C. mrigala* treated with 3% sodium chloride and 1 ppm of $KMnO_4$ were stocked in the cage. After 111 days of rearing, *L. rohita* recorded an average growth of 37.3 mm/6.6 gm and *C. mrigala* 62.5 mm/6.9 gm.

Nutrient level of poultry feed provided was calculated to be 24% crude protein and 6.6% fat. Zinc sulphate and Oxytetracycline were added to the feed with a view to promoting growth and as preventive for any possible infection. Protein and fat contents of the feeds were raised to 29 and 8.7% respectively by addition of fish meal to the feed. The feed was further fortified with vitamin B complex and mustard oilcake was replaced with ground-nut oil-cake. This feed was provided during May and growth of fingerlings was the maximum during this period.

Fingerlings of *M. seenghala* (468 no. in the size range 22-30 mm and 320 no. in the size range 35-66 mm) were collected from the river Ganga during April and May and kept in plastic pools. The fingerlings started feeding on plankton and boiled potato with fish meal after 6 to 8 days in the plastic pools. Heavy parasitic infection and fin rot resulted in total mortality.

Problem : 22. 2 (Research contemplated)

Project 23 : *Bundh breeding*

Problem : 23. 1 & 23. 2 (Research contemplated)

(c) *Research contemplated*

Quite a few of the problems on which investigations were undertaken during 1973, are required to be continued in the next year for achieving the target. In addition to these, some of the problems which could not be dealt with during the year under report for paucity of staff facilities and resources or which need confirmation are also envisaged to be taken up alongwith the

new problems during 1974. The details of problems contemplated are given below :

Project 1 : *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. 2	Evolving a balanced fish diet and to improve feeding techniques (Old programme will continue)
Problem :	1.14	Qualitative segregation of fish seed (Old programme will continue)
Problem :	1.17	Effect of irradiation on fish (Old programme will continue)
Problem :	1.18	Role of some trace elements in pond fertilization (Old programme will continue)
Problem :	1.20	Carp culture with periodic replenishment of fresh-water (Old programme will continue)
Problem :	1.21	Carp fry rearing for optimum survival and growth under high stocking density (Old programme will continue)
Problem :	1.22	Biology of fish food organisms-*Cladocera* (water-fless) (Old programme will continue)
Problem :	1.23	Evolving efficient method for sampling of bottom dwelling fishes in ponds (Old programme will continue)
Problem :	1.24	Studies on the effect of chemical fertilizers like urea-formaldehyde, ammonia liquor, sodium nitrate and calcium cyanamide in relation to pond productivity (Old programme will continue)
Problem :	1.25	Mass culture of *Chlorella, Navicula, Nitzschia, Daphnia, Moina* and rotifers in field to feed the fish

Techniques for mass culture of plankton are to be tested under field conditions and studies on growth of fishes with cultured plankton are to be undertaken.

Problem : 1.26 Nutritional requirements of fry and fingerlings of carps

The optimum levels of protein and carbohydrate required by carp fry and fingerlings for growth are to be found out.

Problem : 1.27 Comparative study of the structure of the gill apparatus of the Indian major carps catla, rohu and mrigala and its development with age and correlation with feeding

The relative filtering capability of the gill apparatus and consequently the types of feed items that might be ingested by the Indian major carps are to be determined.

Problem : 1.28 Commercial production of carps through composite culture in large sized ponds

Techniques for the management and exploitation of carps in large sized ponds are to be evolved.

Problem : 1.29 Comparative study of the efficacy and economics of available fish poisons and their residual effects on the fish pond ecosystem

The suitability of the available fish poisons under different pond situations with due consideration to their long-term and short-term side effects on the ecosystem is to be assessed and the overall economics of each poison worked out on a long term basis.

Project 2 : *Induced fish breeding*

Problem : 2. 2 Use of various hormones for inducing spawning in carps
(Old programme will continue)

Problem : 2. 4 Hatching of eggs of major carps in newly designed hatching jars under controlled conditions
(Old programme will continue)

Problem : 2. 6 Experiments on the production of multiple broods from the same individual of major carp in the course of one year
(Old programme will continue)

Problem : 2. 7 Isolation of fish gonadotropin for hypophysation of carps in large scale
(Old programme will continue)

Problem : 2. 8 Induced beeding of important cultivated fishes (other than carps)

Seed of cultivated fishes for augmenting fish yield in ponds is to be produced in large scale.

Problem : 2. 9 Studies of the process of maturation, ovulation and resorption in gonads in Indian major carps

Morphological and cytological changes in the gonads of Indian major carps during the process of maturation, ovulation and resorption are to be elucidated.

Project 3 : *Reservoir fisheries*

Problem : 3. 6 Fisheries of peninsular tanks : Assessment of biological productive potentialities
(Old programme will continue)

Problem : 3. 8 Fisheries of peninsular tanks : Introduction and propagation of cultivable species
(Old programme will continue)

Problem : 3. 9 Development of fisheries of the Loni reservoir
(Old programme will continue)

Project 4 : *Riverine carp spawn prospecting and collection techniques*

Problem : 4. 5 Yearly variation of quality and quantity of spawn in the river Ganga
(Old programme will continue)

Project 5 : *Brackish water fish farming*

Problem : 5. 1 Productive potential of polyculture in lower Sunderbans and behaviour of pond dykes
(Old programme will continue)

Problem : 5. 8 Induced breeding of grey mullet, *Mugil cephalus*
(Old programme will continue)

Problem : 5.10 Detailed survey of Lothian and Prentice islands for designing brackish water fisr farms
(Old programme will continue)

Problem : 5.11 Quantitataive assessment of brackish water fish and prawn seed in Bakkhali region
(Old programme will continue)

Problem : 5.12 Methods of silt control and experimental trials on sluices
(Old programme will continue)

Problem : 5.13 Selective culture of *Mugil parsia* and *Mugil tade*
(Old programme will continue)

Problem : 5.14 Culture of *Penaeus monodon*
(Old programme will continue)

Problem : 5.15 Culture of *Penaeus indicus*
(Old programme will continue)

Problem : 5.16 Culture of *Lates calcarifer*
(Old programme will continue)

Problem : 5.17 Brackish water prawn culture in Madras region
(Old programme will continue)

Problem : 5.18 Culture of edible oysters in the lake Pulicat
(Old programme will continue)

Problem : 5.19 Studies on the optimum salinity in brackish water ponds for increased fish production

The optimum salinity for the maximum release of nutrients to enhance plankton and fish production in coastal ponds is to be studied.

Problem : 5.20 Use of compost as fertilizer in coastal fish ponds

The effect of manuring with compost, made of cheap ingredients available in the lower Sunderbans area, is to be studied.

Problem : 5.21 Fish and prawn seed resources of the Pulicat Lake

With increasing interest in brackish water farming especially that of

prawns, a quantitative assessment of the stocking material available in the area is essential. Investigations are also to be proposed to be carried out on the production of brackish water fish and prawn seed under controlled conditions.

Problem : 5.22 Rearing of fry of brackish water fishes

Suitable rearing techniques and artificial feeds for the important brackish water fish fry are to be evolved in Madras region.

Problem : 5.23 Mass culture of *Nitzschia*, *Pinnularia*, *Gyrosigma* and *Navicula* for feeding in brackish water fish ponds

The dominant periphytic forms usually present in brackish water ponds are to be cultured on a mass scale in field conditions for feeding fish and prawns.

Problem : 5.24 Effect of hormones on the growth and photosynthetic behaviour of plankters

Dense population of desired plankton for use as fish food is to be produced within the shortest possible time by the application of hormones for quick conversion of nutrients into organic matter.

Project 6 : *Freshwater prawn culture*

Problem : 6. 1 Freshwater prawn culture techniques
(Old programme will continue)

Problem : 6. 2 Propagation and culture of *Macrobrachium malcolmsonii*
(Old programme will continue)

Problem : 6. 3 Freshwater prawn fishery of the middle stretch of the Ganga
(Old programme will continue)

Project 8 : *Estuarine and brackish water lake fisheries*

Problem : 8. 1 Brackish water fish seed prospecting
(Old programme will continue)

Problem : 8. 4 Quantitative assessment of the prawn seed resources of the Rupnarayan estuary

The quantum of prawn seed available in the Rupnarayan estuary is to be determined and economic method for transportation of prawn seed is to be developed.

Problem : 8. 5 Breeding and rearing of the palaemonid prawn, *Macrobrachium rosenbergii*

Macrobrachium rosenbergii, the giant Indian prawn is to be bred and the larvae are to be reared upto the postlarval stage to open the possibility of culturing this prawn in Indian waters.

Project 9 : *Selective breeding and hybridisation*

Problem : 9. 4 Selective breeding and hybridisation of carps and other cultivated fishes with special reference to cytogenetical features of the hybrids

Strains and hybrids of superior cultural qualities are to be developed with a view to have improved stock for high fish production.

Project 10 : *Fish farms designing*

Problem : 10. 1 Formulation of fish farm designs under the soil conditions of Orissa
(Old programme will continue)

Project 11 : *Economics in fishery investigations*

Problem : 11. 1 Economic evaluation of fish culture operations in West Bengal and Orissa
(Old programme will continue)

Problem : 11. 2 Economic evaluation of various spawn production methods
(Old programme will continue)

Problem : 11. 4 Assessment of marketable size for fish culture enterprises in West Bengal
(Old programme will continue)

Project 12 : *Exotic fish culture*

Problem : 12. 4 Suitable supplementary feeds for grass carp fry and fingerlings
(Old programme will continue)

Problem : 12. 5 Techniques for commercial production of grass carp and silver carp seed

To meet the great demand for silver carp and grass carp for composite culture in achieving high per hectare production, the seed of the Chinese carps are to be produced in large scale.

Problem : 12. 6 Compatibility and competition between silver carp and Indian major carps

The extent of competition between silver carp and Indian major carps and the possibility of evolving suitable ratio for stocking which may lead to optimum production are to be studied.

Project 13 : *Cold water fish culture*

Problem : 13.10 Food of *Salmo trutta fario* in natural stream
(Old programme will continue)

Problem : 13.11 Biological studies of *Orienus plagiostomus*
(Old programme will continue)

Problem : 13.12 Biological studies of mahseer, *Tor putitora*
(Old programme will continue)

Project 14 : *Riverine and estuarine fish catch statistics*

Problem : 14. 1 Fish catch statistics of the middle stretch of the Ganga river system
(Old programme will continue)

Problem : 14. 2 Fish catch statistics of the lower stretch of the Ganga river system
(Old programme will continue)

Problem : 14. 6 Effect of major environmental changes on the fisheries of commercially important stocks of the Hooghly-Matlah estuary
(Old programme will continue)

Problem : 14. 7 Fisheries of the Brahmaputra river
(Old programme will continue)

Problem : 14. 8 Fish catch statistics of the upper stretch of the Ganga river system

To understand the trends in variations, if any, in species-wise total fish landings from the Yamuna at Agra and from the Ganga at Kanpur, information is to be obtained so as compare with that obtained during 1949-69.

Problem : 14. 9 Fishery resources of the entire Pulicat lake including areas both in Tamil Nadu and Andhra Pradesh

The fish catches of the entire Pulicat lake are to be assessed zone-wise, species-wise, gear-wise and size-wise for estimating total landings and following the fishery trend.

Project 15 : *Fish pathology*

Problem : 15. 1 Etiology and control of parasitic diseases of cultured warm water fishes
(Old programme will continue)

Project 16 : *Weed control*

Problem : 16. 3 Evolution and evaluation of weedicide formulations
(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. 7 Studies on the algal population of freshwater ponds with special reference to their utility for fish culture and control when in excess
(Old programme will continue)

Problem : 16. 8 Investigations on the biodegradation, persistance and the effects of the 2,4-D and Simazine weedicides on the productivity and fish life in culturable waters
(Old programme will continue)

Problem : 16. 9 Increasing fish production by conversion of crops of aquatic vegetation into manure *in situ*

A procedure for manuring the fish pond to enrich the ecosystem chemically, bacteriologically and biologically through periodicals and repeated conversion of limited crops of aquatic weeds into organic manure by chemical killing is to be evolved.

Project 17 : *Frog culture*

Problem : 17. 6 Culture of frog food organisms
(Old programme will continue)

Problem : 17. 7 Development of hatchery complex for Indian commercial frog species

The possibility of development of hatchery complex for commercial production of seeds of *Rana tigrina* and *Rana crassa* is to be explored.

Problem : 17. 8 Nursery management of Indian commercial frog species

The maximum production of metamorphic stages and early frogs in frog culture operations are to be obtained.

Problem : 17. 9 Mono-culture of *Rana hexadactyla*

The productive potentialities of the phytophagous *Rana hexadactyla* are to be evaluated.

Project 18 : *Sewage-fed fisheries*

Problem : 18. 1 Ecology of sewage-fed fisheries
(Old programme will continue)

Project 19 : *Hilsa fisheries*

Problem : 19. 2 Hilsa fisheries of the lower stretch of the Ganga river system
(Old programme will continue)

Problem : 19. 7 Appraisal of the present status of fishery of hilsa sub-populations in the lower stretch of the Ganga river system

The magnitude of the three sub-populations of hilsa in the fishery of different sectors of the lower stretch of the Ganga river system is to be assessed.

Problem : 19. 8 Investigation on culture of *Hilsa ilisha* in confined freshwaters

The possibilities of culturing hilsa, *Hilsa ilisha* in confined freshwater is to be assessed.

Problem : 19. 9 Fluctuations in the hilsa fisheries of the Hooghly and Rupnarayan estuaries

The factors responsible for the fluctuation in hilsa fisheries of the Hooghly and Rupnarayan estuaries and the breeding biology of the species are to be studied.

Project 20 : *Water pollution investigation*

Problem : 20. 2 Pollution study in different river systems of India caused by various sources with reference to aquatic biomass
(Old programme will continue)

Problem : 20. 3 Studies on estuarine pollution with reference to pulp and paper, and tannery wastes

The waste water discharged from different sections of plants of the integrated mills of paper and pulp, and tannery on the Hooghly estuary is to be characterised and pollutional loads to pin-point the source of the maximum pollution is to be assessed for suggesting remedial measures. The pollutional status of the estuary with respect to disposal of wastes from pulp and paper, and tannery industries is to be assessed for determining the factors which will help in formulating effluent standards in estuarine environment.

Problem : 20. 4 Investigations on the Hooghly estuarine ecosystem to determine biological indicators of its water quality

The effects of industrial pollution on the biota of the Hooghly estuary to determine biological indicators of its water quality is to be found out.

Problem : 20. 5 Investigations on the Ganga and the Yamuna river ecosystems at Allahabad to determine biological indicators of water quality

The toxicity of the chemical components of the wastes is to be determined and the degree of pollution in the longitudinal segments of the rivers Ganga and Yamuna receiving city's sewage outfalls is to be measured.

The effect of discharges upon the water quality and river communities at various points on the rivers Ganga and Yamuna under varying weather conditions is to be studied. Zones of pollution are to be classified and the pretreatment of the wastes required before they are discharged in the riverine ecosystem is to be decided upon.

The effect of pollution on the biodynamic balance in the ecosystem is to be assessed and the biological indicators of its water quality to represent the degree of pollution numerically as a biotic index is to be defined.

Project 22 : *Fish culture in running water*

Problem : 22. 1 Cage culture in running water in the river Yamuna near Mahewa
(Old programme will continue)

Problem : 22. 2 Catfish culture in running water in the river Ganga

The optimum production of catfish from unit area in running water with artificial feed is to be determined.

Project 23 : *Bundh breeding*

Problem : 23. 1 Bundh breeding of major carps in Uttar Pradesh

The topographical details suitable for establishing 'bundh' for the breeding of major carps the reqiured meteorological, physical, chemical and biological factors influencing the spawning of major carps in such environments are to be determined.

Problem : 23. 2 Bundh breeding of major carps in South Bihar

The topographical details suitable for establishing 'bundh' for the breeding of major carps will be studied. The meteorological, physical, chemical and biological factors influencing the spawniing of major carps in such environments will be investigated.

3. PAPER PUBLISHED

The following papers were published by the staff of the Institute during the year 1973 :

Bhanot, K. K. 1973
Common fishing methods in our country. *Indian Farmers' Digest,* **6** (1) : 15-19

Bhanot, K. K. & V. Gopalakrishnan 1972
Observations on the collection of fry of the mullet *Mugil parsia* Hamilton with standard spawn collection nets. *J. Inland Fish. Soc. India,* **4** : 205-206

Bhatnagar, G. K. 1972
Maturity, fecundity, spawning season and certain related aspects of *Labeo fimbriatus* (Bloch) of river Narmada near Hoshangabad. *Ibid,* **4** : 26-37

Bhimasena Rao, J. & R. K. Dwivedi 1972
On the recovery and growth of silver carp *(Hypophthalmichthys molitrix)* from Kulgarhi reservoir (M.P.) *Ibid,* **4** : 214-215

Chakraborty, R. D. & D. S. Murty 1973
Life history of Indian major carps, *Cirrhinus mrigala* (Ham.) *Catla catla* (Ham.) and *Labeo rohita* (Ham.) *Ibid,* **4** : 132-161

Das, P. R. 1972
Some observations on the macrovegetation in and around 'Bheris' of Sunderbans, West Bengal. *Ibid,* **4** : 210-211

Datta, P., K. Alagaraja, P. M. Mitra & G. C. Laha 1972
Examination of the efficacies of some sampling procedures in the estimation of fish landings *Ibid,* **4** : 194-197

Datta, P. *et al.* 1973
Fishery resources of the Hooghly-Matlah Estuarine System. *Bull. Cent. Inl. Fish. Res. Inst.,* Barrackpore (20) : 24 p. *(Mimeo.)*

David, A., G. C. Panicker & D. P. Chakraborty 1972
Eradication of unwanted air-breathing predatory fish and aquatic insects from nursery ponds by selective poisoning. *J. Inland Fish. Soc. India,* **4** : 189-193

Dehadrai, V. Padmakar & Shyam Ratan Banerji 1973
Culture of air-breathing fishes. *Indian Farmers' Digest,* **6** (1) : 41-43

Ghosh, Amitabha 1973
On some diseases of carps. *Souvenir, 9th Annual Re-Union, Department of Zoology, University of Kalyani,* : 25-26

Gopalakrishnan, V. 1973
The pollution problem in Indian estuaries. *Seafd. Export. J.,* **5** (1) : 83-86

Gopalakrishnan, V., P. Ray & B. B. Ghosh 1973
Present status of pollution in the Hooghly estuary with special reference to the adverse effects observed on the fishery resources. *Proc. Symp. on Environmental Pollution,* 1973 : 1-8

Hanumantha Rao, L. 1972
Observations on the biology of *Parastromateus niger* (Bloch) and *Pampus chinensis* (Euphrasen) from the Godavari estuary. *J. Inland Fish. Soc. India,* **4** : 207-209

Jhingran, V. G. 1972
Recent advances in inland fisheries. *Indian Fmg.,* **22** (6) : 115-117

———— 1973
Fish culture in India. *Indian Farmers' Digest,* **6** (1) : 11-14

———— 1973
Fish culture and nutrition—Inland Fisheries Research Institute's work. *Yojana,* **17** (5) : 228-229

Jhingran, V. G. & V. Gopalakrishnan 1973

Prospects for the development of brackish water fish and shrimp culture in India. *Tech. Conf. Fish. Mgmt. Developm. Canada, Tech. Session* IV, FI : FMD/73/C-1 : 6 p.

Kaliyamurthy, M. 1972
Notes on the brackish water mysid, *Mesopodopsis orientalia* (Tattrrsall) of the Pulicat lake. *J. Inland Fish. Soc. India,* **4** : 198-200

Kaliyamurthy, M. & K. Janardhana Rao 1972
Preliminary observations on the food and feeding habits of some fishes of the Pulicat lake. *Ibid,* **4** : 115-121

Khan, H. A. & S. K. Mukhopadhyay 1972
On the fecundity of climbing perch, *Anabas testudineus* (Bloch). *Ibid,* **4** : 212-213

Lakshmanan, M. A. V. 1972
All about cultivable species of fishes. *Indian Farmers' Digest,* **6** (1) : 25-28

Mukhopadhyay, S. K. 1972
Observations on the extended spawning phase of *Heteropneustes fossilis* (Bloch). *J. Inland Fish. Soc. India,* **4** : 203-204

Natarajan, A. V. 1972
Progress of fisheries research in reservoirs. *Indian Fmg.,* **22** (6) : 120-121

Natarajan, A. V. & S. Patnaik 1972
Embryonic and larval development of Chilka mullet *Liza macrolepis* (Smith). *J. Inland Fish. Soc. India,* **4** : 15-19

Parameswaran, S. 1973
Grow fish for profit and pleasure. *Indian Farmers' Digest,* **6** (1) : 21-24

——————— 1973
Production of quality fish seed by induced breeding—A breakthrough in fish culture. *Ibid*, **6** (1) : 35-39

Parameswaran, S., S. Radhakrishnan, C. Selvaraj & B. R. Bhuyan 1971
Fish yield from Assam ponds kept under different experimental conditions. *Indian J. Fish.*, **18** (1 & 2) : 67-83

Ramachandran, V. & T. Ramaprabhu 1973
Weed control in fish culture. *Indian Farmers' Digest*, **6** (1) : 29-32 contd. on page 34

Ramamohana Rao, G. & L. Hanumantha Rao 1972
On the biology of *Labeo calbasu* (Ham. Buch.) from the river Godavari. *J. Inland Fish. Soc. India*, **4** : 74-86

Rao, N. G. S., P. Ray & K. Gopinathan 1972
Observations on the spawning of *Cirrhina reba* (Hamilton) in the Cauvery and Bhavani rivers. *Ibid*, **4** : 69-73

Saxena, R. K. 1972
Studies on the maturity and fecundity of *Rita rita* (Hamilton) of Ganga river system. *Ibid*, **3** : 169-182

Selvaraj, C., S. Radhakrishnan & S. Parameswaran 1972
Notes on the breeding season, fecundity and life history of a minor carp, *Labeo boggut* (Skyes). *Ibid*, **4** : 87-97

Sen, P. R. 1972
Cytological studies of the pituitary gland of female *Labeo rohita* (Hamilton) during different stages of maturity. *Ibid*, **4** : 20-25

Singh, S. B., K. K. Sukumaran, P. C. Chakrabarti & M. M. Bagchi 1972
Observation on composite culture of exotic carps. *Ibid*, **4** : 38-50

Sinha, M. 1972
Observations on the biology of *Puntius sarana* (Hamilton) of Loni reservoir (M.P.). I. Length-weight relationship, Food and condition factor. *Ibid*, **4** : 122-131

Sinha, V. R. P. 1972
Composite fish culture in India. *Indian Fmg.*, **22** (6) : 118-119

Thakur, Nirmal K. 1970
Observations on the mullet fishery in the Hooghly and Mahanadi estuarine system. *Indian J. Fish.*, **17** (1 & 2) : 1-12

4. Extension

The Fisheries Extension Unit of the Institute continued to provide its services successfully to the Public, specially to the fish farmers.

(a) *Results of immediate practical application* : An extension pamphlet on "Technique of carp pituitary gland removal and ampouling for setting up pituitary banks" was published and distributed to the State Fisheries Departments and other interested fish farmers. Four more extension pamphlets on (i) Intensive fish farming, (ii) Techniques of nursery management, (iii) Breeding of common carp and (iv) Induced breeding of major carps are in press.

(b) *Results likely to be useful to the farmers, but needing further trials* : Nothing to report.

(c) *Publicity activities* : The exhibitions jointly sponsored by the Institute and the Directorate of Fisheries, Government of West Bengal at Bidhan Nagar and Bangaon with a view to making the public concious about the development in inland fisheries as well as the achievements of the Institute towards that end were arranged in December, 1972 and continued till January 10, 1973 and January 1, 1973 respectively. At Bangaon, posters about composite culture, nursery management and induced breeding were mainly displayed as exhibits.

Another exhibition jointly sponsored by the Department of Fisheries, Government of West Bengal and the Institute was held at Calcutta Maidan during January 26 to February 4, 1973. The whole pavilion had the shape of a fish. The exhibits displayed were live specimens of grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and the Indian major carps (*Labeo rohita, Catla catla* and *Cirrhinus mrigala*) which with common carp (*Cyprinus carpio*) formed a high yielding combination of fishes. The hybrids; *viz.*, calbasu × catla, catla × calbasu, catla × rohu, rohu × catla, the carp spawn, fingerlings of Indian and exotic carps, the young ones of *P. pulchellus* and *P. javonicus* and the catfishes were prominantly exhibited in the aquaria. The main themes of the exhibition were composite fish culture and induced fish breeding - two techniques which have the potentiality of revolutionizing fish culture in West Bengal. A model of brackish water fish farm was also displayed. The inside of the pavilion depicted an array of posters detailing achievements of research and development.

Display material like, models, charts, posters, aquaria, transparency boxes etc. were sent from the Institute to the exhibitions at Ranjit Stadium,

Calcutta during May 26 to June 4, 1973 and at Purba Bharat Sanskriti Sanmelan, Calcutta during December 22 to January 1, 1974, while the exhibits from the Institute were also displayed at the exhibition held in June, 1973 at Rabindra Sarobar, Calcutta.

Poster exhibitions were also arranged by the Institute on twenty occasions with a view to apprising the visitors of the activities and achievements of the Institute.

Extension material on various aspects of composite fish culture techniques was supplied to All-India Radio, Calcutta for broadcast under Farmers' programme. A discussion on Intensive Fish Farming by the Senior Extension Officer with the staff of the All-India Radio was also broadcast in July, 1973 in Farmers' programme. Field recordings on the techniques followed and the result achieved at the Kulia Centre of the Co-ordinated Project were also broadcast by the All-India Radio, Calcutta on four occasions on April 16 and 23, and June 18 and 23, 1973.

Several news flashes about the important achievements of the Institute appeared in the leading newspapers of West Bengal. The captions of the news items were : "Something fishy" and "Fishery Institute shows record yield" both reported by the Statesman on January 8, 1973 and May 10, 1973 respectively; "Preliminary steps to raise fish supply" by a staff reporter in the Statesman on July 3, 1973; "*Aquaplosion* to start in West Bengal" by a staff correspondent in the Statesman on October 2, 1973; "State Fish Farms show good work" by a staff reporter in Amrita Bazar Patrika on October 2, 1973; "Ration Carde machh" (meaning fish through ration card) by a staff reporter in Jugantar on October 10, 1973 and "*Machh chashkare uparjjan*" (meaning, earn by fish farming) by a staff reporter on October 3 1973.

Ananda Bazar Patrika, a popular newspaper in Bengali, published more details about inland fisheries development. The issue of the newspaper dated December 13, 1973 contained articles under the captions, "Machher misra chash bakar kamabe" (meaning, composite fisr culture will reduce unemployment) by a special correspondent.

A number of students from different schools, colleges and universities, trainees from the Central Institute of Fisheries Education, Bombay and quite a few Gramsevak trainees from Malda District of West Bengal were taken round the laboratories, aquarium and Museum to give them an overall picture of the work and achievements of the Institute with a view to spreading the beneficial research findings among various sectors of public for fast and wide range practical implementation.

Three delegates from the Institute; Shri B. N. Saigal (Junior Fishery Scientist, Km. A. Ghosh (Senior Library Assistant, Grade I- and Shri P. K. Chakrabarti (Research Assistant) participated in the workship on Library Science jointly sponsored by ICAR and JNKVV at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during the period June 27-29, 1973.

Shri P. Das, Senior Extension Officer, Shri B. K. Sharma, Extension Officer attended the workshop on Fisheries Extension organised by the Ministry of Agriculture, Department of Agriculture, Government of India at the Central Institute of Fisheries Education, Bombay on 19th and 20th October, 1973 and a working paper entitled "Extension activities of the Central Inland Fisheries Research Institute" was presented. Sarvashri S. B. Saha and S. N. Dutta Senior Research Assistants also attended the above workshop.

"Regional Seminar on Noxious Aquatic Vegetation in Tropics and Sub-tropics" organized by National Committee on Environmental Planning and Co-ordination, Technology Bhavan, New Delhi was held at New Delhi during December 12-27, 1973 and the under mentioned papers were presented by the staff of this Institute.

Radhakrishnan, S.

Some aspects of the distribution and seasonal abundanee of macrophytic weeds in lake Pulicat, India.

Mitra, Eva & A. C. Banerjee

Utilisation of higher aquatic plants in fishery waters.

Patnaik, S. & V. Ramachandran

Control of blue green algae blooms with simazine.

Patnaik, S.

Some aspects of the autecology of *Ipomoea aquatica* Forsk.

Ramachandran, V., & T. Ramaprabhu & S. B Singh

A survey of aquatic weed infestations o! Andhra Pradesh.

Ramachandran, V. & T. Ramaprabhu

Use of ammonia for aquatic weed coutrol — a review.

Mitra, Eva

Contributions to our knowledge of Indian freshwater Plants 7 On some aspects of the habit, life history and autecology of *Vallisneria spiralis* L.

The undermentioned paper was presented at the seminar on "Research and Training Needs in Agriculture and Animal Husbandry of the North Eastern Himalayan Region" held in Shillong during October 23-26, 1973 under the auspices of the ICAR. On the basis of the recent resources position of the region, the paper was revised and re-submitted to Shri S. L. Ketyal, Assistant Director General (H), ICAR, New Delhi for publication.

Jhingran, V. G. and P. V. Dehadrai

Inland Fisheries of the North Eastern region of India.

6. Summary

During the year 1973, research investigations were carried out on 20 out of 22 projects. The two projects, work on which was kept in abeyance, were : "Murrel and Live Fish Culture (Project-7)" and "Fisheries of River Basin (Project-21)". Work on 23 research problems under different projects was completed during the year under report.

Project 1 :

1.1 : In mixed rearing of catla, rohu, mrigal and grass carp fry for three months, grass carp showed the maximum growth (41.09 gm) and rohu, the minimum (12.41 gm).

In the mixed rearing of exotic carp fry @ 2.5 lakh/ha, in the ratio silver carp 4 : grass carp 3 : common carp 3, an average survival of 42.2% was recorded, the maximum (65.2%) being of silver carp.

A record production of 8,631 kg/ha/286 days was achieved in experiments conducted in still water ponds.

A trial indicated the growth of carps to be much less in the second year of rearing when compared to that of the first year.

In intensive fish culture experiments, rohu was found to contribute more than 30% of the total net production of 7,343 kg/ha/yr.

In composite culture trials, a reduction in the stocking density of rohu and catla, improved the poor growth of rohu only. The stocking density of silver carp was also lowered to obtain desired growth in catla.

1.2 : Of the seven fish feed mixture tried, four with protein and carbohydrate in the ratios 35 : 46, 30 : 53, 26 : 52 and 26 : 56 gave the best results in the order given.

1.3 & 1.4 : Research completed in 1972.

1.5 : Research completed in 1970

1.6 : Research suspended

1.7 : A simple inexpensive method was evolved to mass culture *Chlorella vulgaris*. Mass culture of *Daphnia similis* was also done successfully. The diatoms, *Navicula* sp., *Nitzschia* sp. and *Pinnularia* sp., could also be produced in trays and aquaria. Growth increments in carp fingerlings with *Chlorella* sp. and *Daphnia* sp. as feeds were investigated.

1.8 : Research completed in 1971

1.9, 1.10 & 1.11 : Research completed in 1972

1.12 : Of the several plant poisons tried, unripe fruit of *Caesaris graveolens* at 30 ppm killed the fish in 6 hours. Bark powder of *Baringtonia acutangula* at 20 ppm was lethal to most of the weed fishes within 2 hours.

1.13 : Research completed in 1972

1.14 : Segregation of spawn of different carps through variation in temperature was not possible.

1.15 : Various kinds of traps (big and small) were tried with and without bait to capture predatory fishes. In these experiments, *Mystus cavasius*, *Channa striatus*, *Channa punctatus*, *Notopterus notopterus*, etc. were effectively trapped.

1.16 : Research completed in 1971

1.17 : To impart beneficial effects on fish, trials with soft irradiations of gamma-rays and neutrons were initiated.

1.18 : In studying the role of trace elements in pond fertilization, the treatments @ 0.05 ppm had no response on fish growth.

1.19 : Five feed mixtures with varying protein, carbohydrate, fat and ash content were tried on spawn of Indian major carps to throw light on the conversion ratio of the feeds into fish flesh.

1.20 : In a pond where freshwater was replenished six times, fish production was as high as 7,720 kg/ha/yr (in completely harvested pond) and 7,548 kg/ha/yr (in incompletely harvested pond) though inadvertent entry of *Wallago attu* had an adverse effect.

1.21 : More than 6 million fry/ha could be raised in 12 days.

1.22 : Study of fish food organisms such as *Moina* sp. has been initiated.

1.23 : Newly designed sinker and stake nets were able to reduce man power requirement for netting by 75%. 90% of the bottom dwellers (mrigal and common carp) by sinker net and 70-75% by stake net against 10% by conventional drag net could be captured.

1.24 : Effects of liquor ammonia, urea-form aldelyde and sodium nitrate as nitrogenous fertilizers were observed at the doses of 50 and 80 kg N/ha.

1.25, 1.26, 1.27, 1.28 & 1.29 : Research work contemplated.

Project 2 :

2.1 : Research completed in 1970

2.2 : Pituitary gland extracts of certain marine fishes; *viz.*, *Caranx* sp., *Mugil cephalus* and *Pampus* sp. and the freshwater fish *Channa* sp. failed to induce spawning in rohu.

2.3 : Research completed in 1972

2.4 : Carp spawn (5 million) was successfully produced through the glass jar hatchery complex where 242.5 thousand fry of silver carp were also obtained. Spawn of common carp was also produced in the hatchery after degumming the eggs.

2.5 : Research suspended.

2.6 : Two rohu female specimens matured for the second time after 34 days and produced 1.45 lakh spawn again.

2.7 : Even without the aid of UV-cord recorder, fish gonadotropin was isolated as the second fraction which was potent enough to induce spawning in mrigal.

2.8 & 2.9 : Research contemplated.

Project 3 :

3.1, 3.2, 3.3, 3.4 & 3.5 : Research completed in 1972

3.6 : Two tanks in Shimoga, one in Mysore and two in Mandya districts have been selected for stocking murrels. Nearly 50,000 fingerlings of *Channa leucopunctata* (19-56 mm) were collected and stocked variously in tanks in Mysore, Mandya and Bangalore districts for studying growth, predator-prey relationship, production with cultivable carps, aspects of acclimatisation, etc. 15,000 fingerlings were given to Andhra Pradesh State Government for stocking Mottur Fish Farm.

Studies on the hydrobiology and fish production estimates in selected tanks were continued.

3.7 : Research completed in 1970

3.8 : Studies on food preferences of the yearlings of *Puntius pulchellus* were continued. The weeds consumed by the fish in order of preference are : *Hydrilla* sp., *Vallisneria* sp., *Aponogeton* sp. and *Eichhornia* sp. The conversion ratio varied between 1 : 79.6 and 1 : 86.2

For the first time in the history of Karnataka, a commercial source of mahseer fry was located at the tail end of the Bhadra reservoir. The fish farms at Vanivilaspura and Hessarghatta were stocked with 8,000 and 1,000 fry of mahseer from the newly discovered source.

3.9 : Studies on hydrology, plankton and fishing operations were continued in the Loni reservoir.

3.10 & 3.11 : Research suspended.

Project 4 :

4.1 & 4.2 : Work is being done under a Co-ordinated project.

4.3 : Research completed in 1971

4.4 : Comparative observations revealed that the spawn from the river Sone was of better quality than that of the Kosi river.

4.5 : Spawn prospecting investigations were conducted at Jhusi and Bharauli on the river Ganga and 1,421 and 3,790 ml of spawn were collected.

Project 5 :

5.1 : A pond at Bakkhali regularly fertilized with organic and inorganic manures and stocked with Indian and exotic carps, mullets and prawns @ 10,220/ha gave a net production of 1,686 kg/ha/8 months with supplementary feeding @ 1%. The water and soil salinity of the pond came down to 2.7-0.77‰ and 0.2-0.05% respectively during the year.

Two ponds were again stocked @ 7,810 and 8,560/ha with carps, mullets, milk fish and prawns in September and October respectively.

Studies on phreatic line indicated an average hydraulic gradient of 1 in 3.5.

5.2 : Detailed surveys of 60 ha in Mahisani and 96 ha in Henry's islands

were completed and the layout plan for fish farms of 2.80 and 87.2 ha respectively were prepared.

5.3 : Research suspended.

5.4, 5.5 & 5.6 : Research completed in 1972

5.7 : Plankton and benthos tended to be antagonistic to one another and the brackish water ponds of Kakdwip were rich in benthic biota. Attempt to mass culture diatoms in Miquel's solution was successful.

5.8 : Nine out of thirteen sets of *Mugil cephalus* were successfully induced bred and the resultant hatchlings were reared in plastic pools providing zooplankton and diatoms as food. A few mullet specimens survived for about 5 months. Only one specimen lasted for about a year attaining a length of 100 mm and a weight of 12 grams.

5.9 : Compost when used alone and in combination with inorganic fertilizer at various doses was found to increase the plankton and nutrient supply.

5.10 : Contour survey of Mahisini Island was continued.

5.11 : Detailed survey of the Brackish water fish and prawn seed resources in the canals surrounding the proposed 200 ha brackish water fish farm was continued to cover all the tidal regimes.

5.12 : Monthly observations on silt deposition in the feeder canal at Bakkhali Fish Farm were made. A silt cage and a sluice box were designed. Secondary sluices for the farm were constructed and fitted in two brackish water ponds.

5.13 : All the three operations; *viz.*, fertilization, supplementary feeding and periodic stock replenishment, when done simultaneously, gave the best results for the growth and survival of *Mugil parsia*. Among the fertilizers, super phosphate gave the best result and more phosphorus was available in the water phase with higher salinity. Among feeds, mixture of rice bran, mustard oilcake, silkworm pupae in the ratio 4 : 3 : 3 gave the best conversion ratio (3.62 : 1). In combined culture of *Mugil parsia* and prawn, a net production of about 2,670 kg/ha/yr was obtained. Optimum stocking density for fry, advance fry and fingerlings of *Mugil tade* was estimated to be about 1,00,000, 40,000 and 5,000/ha respectively.

5.14 : The monthly growth rate (10.0-21.8 mm/0.40-0.95 gm) obtained in various experiments dropped down to 3.8-6.3 mm/0.38-0.57 gm when *Penaeus monodon* was cultured in cages kept in canal with low salinity (1.8-4.7‰) and low water temperature (19°-26°C). A production of 403.2 kg/ha/8 months of *Penaeus monodon* and 358.4 kg/ha/8 months of miscellaneous fishes was obtained by stocking *Penaeus monodon* @ 30,000/ha.

5.15 : Post-larvae of *Penaeus indicus* (15-56 mm) stocked at 50,00,000/ha attained the size of 37-76 mm in 2 months. Juveniles of various size groups in varying number were used to find the optimum stocking size and density for rearing. Feeding trials showed that post-larvae (20-40 mm) preferred diatoms and rotifers and the juveniles (40-60 mm), algae.

5.16 : In culture of *Lates calcarifer* stocked at 1,500 and 2,000/ha, a growth increment of 88.5 mm/173.8 gm and 91.8 mm/156.3 gm and a survival of 80 and 75% respectively were obtained in 7 months. These fish were later released into the feeder canal from farm pond where the continuous supply of food organisms entering with the tidal waters and the available space contributed to the faster further growth increment (111 mm/617 gm in 170 days).

5.17 : In plastic troughs, with artificial feeding juveniles of *Penaeus indicus* (25-30 mm) could be reared to a size of 17.95 mm/0.343 gm in 40 days with 100% survival. The growth rate, however, slowed during further rearing. Among feeds, prawn powder + tapioca + gram powder @ 2 : 2 : 1 gave 100% survival in *Penaeus indicus*. *Metapenaeus monoceros* and *Metapenaeus dobsoni* like *Penaeus indicus* showed growth retardation after attaining a size of 55-60 mm. Highest survival was attained in 5-9‰ salinity.

5.18 : Experiment on culture of the edible oyster were continued in the laks Pulicat.

5.19, 5.20, 5.21, 5.22, 5.23 & 5.24 : Research contemplated.

Project 6 :

6.1 : Rearing of laboratory bred *Macrobrachium malcolmsonii* at a stocking density of 20,000/ha was continued in 3 nursery ponds with artificial feeding. The average size attained by the prawn in 5 months in these ponds varied between 88 and 109 mm. Among feeds, mixture of rice bran, prawn powder and tubificid worms gave the best result.

6.2 : Monoculture and composite culture of *Macrobrachium malcolmsonii* were conducted in the manured ponds of Kadiam and Katheru Farms respectively. The stocking density was 75,000/ha. The production attained was lower (14-256 kg/ha/6 months and 32.6-104.5 kg/ha/4 months respectively) when compared to that attained in 1972. Tagging experiments for the growth estimation of the prawn in nature and the survey of juvenile resources were continued.

6.3 : Estimation of population of prawns and inventory survey of fishermen, craft and gear of the selected stretch of the river Ganga between Varanasi

and Ballia was completed. Successful breeding of *Macrobrachium lamarrei* was achieved in the laboratory and the prawn seed was reared for about 4 months with fair survival.

Project 7 :

7.1 & 7.2 : Research suspended.

Project 8 :

8.1 : Brackish water fish and prawn seed prospecting investigation revealed the dominance of prawn species over fish during April, May and June at Geokhali, Lot No. 8 and Namkhana centres on the Hooghly estuary. At Kumrakhali, Bhangankhali and Port Canning on the Matlah estuary, fortnightly sample surveys were continued to record the abundance of various fish and prawn species.

8.2 : Prawn seed investigation was conducted at Balughata on the Haldia river and the maximum quantity of *Penaeus monodon* and *Penaeus indicus* was available in June and December. The zoea of *Macrobrachium rosenbergii* could be reared only up to VI stage during the year as against IX stage attained previously.

8.3 : The recruitment of post-larvae and juveniles of the important fishes and prawns sohwed a declining trend from that observed in the previous year. Studies on feeding of mullets with feed mixtures and growth promoters were continued. Bottom biota, hydrography, plankton and productivity of the lake were studied. Stains made from indigenous herbs were tried on prawns. Rearing of crabs and induced breeding of mullets were attempted. Studies on ecology of estuarine ponds and culture of fish food organisms were continued.

Project 9 :

9.1 : Rearing of 5,000 hybrids of calbasu × rohu and 1,500 of catla × rohu was continued. Hybrids of silver carp × rohu were found to be mostly deformed. These larvae died.

9.2 : Research completed in 1972

9.3 : Research suspended.

9.4 : Research contemplated.

Project 10 :

10.1 : A comparative study of the soil conditions, water source, shape and design of Killa and Kausalyaganga Fish Farms is in progress.

Project 11 :

11.1 : Economics of fish culture in 8 ponds owned by the Government and 26 by the private parties were studied and it was found that the rate of profit over operating cost was relatively higher (25%) in many private ponds.

11.2 : To study the economics of spawn production, 11 private parties were contacted for bundh bred spawn, 5 for induced bred spawn and 50 for river bred spawn. Production cost per lakh was assessed to be Rs. 112, Rs. 150 and Rs. 90 respectively.

11.3 : Clearance cost of weed infestations by *Vallisneria* sp., *Hydrilla* sp., *Eichhornia* sp. and *Cyperus* sp. with the application of copper sulphate mud pellets was estimated to vary between Rs. 1,278-4,158/ha. Fish production in a pond at Bantola increased from 27 to 697 kg after the eradication of weeds.

11.4 : Assessment of size group and price of fish sold at six markets, Uttarpara, Serampore, Patipukur, Khardah, Lake market and College Street (Calcutta), was done.

Project 12 :

12.1 : Pituitary extracts at doses of 10-14 mg/kg of female and 2-4 mg/kg of male were successful for induced breeding of exotic carps and 3.29 lakh of silver carp spawn and 1.99 lakh of grass carp spawn were produced.

12.2 : In a monoculture experiment conducted in two ponds, silver carp recorded a growth of 396 and 531 gm in 10 months.

12.3 : Research completed in 1972

12.4 : Laboratory experiments of 15-day with fry of grass carp indicated that their growth was better with plankton and ground-nut oilcake and poor with *Wolffia* sp.

12.5 & 12.6 : Research contemplated.

Project 13 :

13.1 : Research completed in 1970

13.2 : Research suspended.

13.3 : Research completed in 1971

13.4 & 13.5 : Research completed in 1970

13.6 : Research completed in 1972

13.7 : Research completed in 1970

13.8 & 13.9 : Research suspended.

13.10 : Gut content analysis of *Salmo trutta fario* from the Lidder, Erin and Bringhi st eams of Kashmir revealed that Trichoptera larvae form the prime food followed by nymphs of Ephimeroptera and *Gammarus pulex*.

13.11 : Gut content analysis of *Oreinus plagiostomus* collected from Doda, Chenani, Udhampur and Reasi streams of Kashmir was initiated.

13.12 : Specimens of *Tor putitora* were collected from Udhampur, Jhajjarkotli and Reasi for biological studies.

14.1 : Species-wise landings of fish at Sadiapur, Daraganj and Buxar were estimated on the basis of *arath* arrivals and a steep fall in landing was observed as compared to that of 1972, the most notable fall being in the landings of hilsa.

Studies on plankton from the rivers Ganga and Yamuna in the vicinity of Allahabad were continued.

14.2 : The total fish yield from the river Ganga at Bhagalpur, Sahibganj, Rajmahal, Dhulian, Farakka and Lalgola was estimated to be 600.98 t as against 451.36 t in 1972. The average gross and net carbon assimilation and respiration in the lower stretch of the river were 41.42, 22.04 and 24.15 mg $C/m^3/hr$ respectively.

14.3 : Research completed in 1969

14.4 : Research completed in 1971

14.5 : The early closure in the Pulicat lake-mouth brought down the total landing to 1,142.028 t during the year which means 16.72% less than that in 1972.

14.6 : A total of 13,226.5 t of fish was landed from the Hooghly-Matlah estuarine system during October, 1972 to September, 1973. *Harpodon nehereus* followed by *Setipinna* sp., *Tachysurus jella*, prawns and *Hilsa ilisha* in the catch; and bag net followed by drift net and large seine, among the gears were prime contributors.

14.7 : During the year 1973, 239.2 t of fish were landed at Fancy Bazar and Uzan Bazar. The bulk of the landings came during premonsoon and winter months. Hydrobiological observations of the river Brahmaputra at Uzan Bazar Ghat were continued.

14.8 & 14.9 : Research contemplated.

Project 15 :

15.1 : The carp louse, *Argulus* bred during August-December in the laboratory. The eggs hatched in 12 days and the juveniles which were reared for 21 days could be controlled by 0.5 ppm BHC. Eggs of *Argulus* could also be collected from ponds and destroyed. Method was successfully tested to collect and destroy the leech species *Placobdella emydae* and *Glossiphonia weberi.* The rearing of the hatchlings of the former leach produced in August in laboratory, was continued. *Myxosporidia* and monogenetic trematodes were controlled with Malachite Green at 1 ppm.

Project 16 :

16.1 : 2,4-D sodium salt was effective in controlling water-hyacinth, lotus, lilies, *Cyperus* sp., *Typha* sp., *Ipomoea* spp. and *Jussiaea* sp. and Dalapon in *Panicum* sp. The dose and method for application of the weedicides were standardised. The decomposed weeds had high manurial value.

16.2 : Research suspended.

16.3 : Gramoxone at 0.4 kg a.i./ha successfully controlled *Pistia* sp. and *Jussiaea* sp. without affecting fish. It also affected *Salvinia* sp. Asulox-40, which was effective against *Panicum* sp. and *Leptochloa* sp. at a dose of 5-6 kg a.i./ha, had adverse effect on *Cyperus* sp., *Phragmites* sp. and *Enhydra* sp. Dedenol was found to be a better detergent than Surf.

16.4 : Foliar spray of aqueous ammonia, or its application at the root zone at 40 ppm, could only damage the foliage of water-hyacinth and retard the growth of the plant. At a concentration of 1.5%, with 0.25% detergent, it could kill *Pistia* sp. and *Salvinia* sp. Its application at the bottom zone at 20 ppm N caused mass killing of prawns, tadpoles, plankton and fish including *Channa striatus* and *C. gachua.* The detoxification of ponds occurred within two weeks after the treatment.

16.5 : The application of intermittent doses of superphosphate solution (16%), raised the phosphate level of water to 15-20 ppm killing 80% of *Eichhornia* sp. while the remaining 20% was removed manually and no regrowth of the infestation took place. Similarly, wneh the superphosphate

solution was applied at 1,350 kg/ha in 5 instalments, it caused complete kill of *Eichhornia* sp. It stopped regeneration of *Nymphoides cristatum* and *Vallisneria spiralis*. Fernaxone, though killed *Vallisneria* sp., *Hydrilla* sp. and *Ceratophyllum* sp. at various doses, however, doses higher than 100 kg/ha prevented even the regrowth of the plants.

16.6 : Analysis of plant parts and soil and water samples from a few selected areas are in progress.

16.7 : Studies on the algal population in ponds at Cuttack, Barang and Angul were in progress for selective use as fish feed and for control of excessive weed infestations.

16.8 : 2,4-D (5 and 10 ppm) was not found to affect fish growth in yard experiments in plastic pools.

16.9 : Research contemplated.

Project 17 :

17.1 : Induced breeding of 177 sets of commercially important species of frogs; *viz*; *Rana tigrina, R. hexadactyla, R. crassa* and *R. cyanophlyctis,* was successfully achieved by using homo-and heteroplastic pituitary gland extract injections during the years 1968-73. The pituitary of *Bufo* sp. has been found to be effective in inducing spawning in *R. tigrina, R. crassa* and *R. cyanophlyctis* at high doses only. Fecundity studies in respect of *R. tigrina, R. hexadactyla* and *R. crassa* have also been made.

17.2 : Post-hatching mortality in *Rana tigrina* and *R. crassa* has been checked by improving upon the hygienic conditions. *R. tigrina* and *R. crassa* tadpoles prefer zooplankton while those of *R. hexadactyla* are berbivorous. The tadpoles of the farmer two species have canibalistic habits which could be reduced in the hybrid tadpoles resulting from hybridisation between these species. Provision of frogmeat, fish meat and shark meat as food also checked cannibalism to a great extent. Of the various chemicals and plant parts tried, stem bark of *Milletia auriculata* has been found useful in assessing survival of early tadpoles of *R. tigrina* and *R. hexadactyla.* Against low survival of early stages of *R. tigrina* and *R. crassa,* tadpoles of *R. hexadactyla* could be easily reared up to early frog stages with about 90% survival by providing *Spirogyra* sp., *Oedogonium* sp., *Lemna* sp., and *Hydrilla* sp. No adverse effects on the tadpoles of *R. hexadactyla* and common carp spawn were noticed when reared together with/without food for 16 days even at high stocking densities.

17.3 : In frog farming experiments initiated since 1968 with *Rana tigrina* and *R. hexadactyla,* highest production of 772 kg/ha/yr of *R. hexadactyla* at

a stocking density of 6,000/ha in weed infested ponds was obtained. The discovery of phytophagus habits of *R. hexadactyla* is a major break-through in the field of frog culture. Investigations on mono-culture of *R. hexadactyla* have been taken up in view of its phytophagus habits.

17.4 : Fish-cum-frog culture experiments have been carried out during the past five years. In culture of *Rana hexadactyla* along with fingerlings of Indian and exotic carps, a production of 418 kg of frogs and 3,145 kg of fish/ha/yr was obtained. In rearing *R. hexadactyla* and grass carp, a production of 920 kg of fish and 127 kg of frog/ha/yr was obtained.

17.5 : Research suspended.

17.6 : Pond soil and organic manure were found suitable for the culture of naturally occurring tubificid worms : like, *Limnodrilus socialis* and *Tubifex tubifex* and the infusion of rice bran seemed to hasten their growth and multiplication.

17.7, 17.8 & 17.9 : Research contemplated.

Project 18 :

18.1 : Ecological studies were continued in two sewage-fed ponds at Khardah. In 5 months, silver carp, catla, rohu and mrigal were found to attain average weights of 1,000, 188.3, 255.0 and 142.5 gm respectively. A production of 7,676 kg/ha was obtained during 7 months of rearing.

Project 19 :

19.1 : Research completeed in 1972

19.2 : An estimated total of 361.63 t hilsa was landed from the lower stretch of the Ganga river system. Farakka and Dhulian on the river Ganga and Lalgola on the river Padma were the prime contributers, contributing 96.97% of the total landings. Bulk of catches was accounted during June to October from the entire stretch. 'Slender' variety dominated at Bhagalpur, Sahebganj, Rajmahal and Dhulian while 'broader' and 'broad' dominated at Farakka and Lalgola respectively. Two separate spawning seasons, one during post-winder months (March-April) and other during monsoon months (July-October) were noticed at Bhagalpur, Rajmahal and Dhulian centre, the former centre showed the higher intensity of spawning during post-winter months while the other two in monsoon months. Distributional patern of the individual variety and spawning activity of hilsa at different centres was also noticed during the course of observation.

19.3 : Studies on age group composition, ovary weight, fecundity, ova

size, sex ratio, e.c. of *Hilsa ilisha* from the Godavari river system were conducted. Males in the III age group and the females in the V age group were dominant but no oozing females were observed in catches.

19.4 : Observations on spawning and larval abundance of *Hilsa ilisha* were continued and the volume and velocity of water discharge were found to influence the migration and breeding of the fish in the Hooghly river.

19.5 : Investigation on artificial fecundation and artificial propagation of *Hilsa ilisha* were continued during October 1973 at Khandua, Sirsa and Varanasi. For lack of females in suitable maturity conditions, no spawn was produced at any of the above centres.

19.6 : Research suspended.

19.7, 19.8 & 19.9 : Research contemplated.

Project 20 :

20.1 : Hydrobiological conditions around outfall areas of the Tribeni Tissue (soda process), India Paper & Pulp (sulphate process), Distillary and Yeast, Dunlop Rubber, Rayon Textile and Bandel Thermal Plant were studied to detect the pollutional effect, if any, on the fish life of the Hooghly river.

20.2 : Short (24 hr) and long (96 hr) bioassay experiments were carried out with Gammoxone (BHC), Folidol, Endrin, Malathion and Rogor to test their effect on chironomids, oligocheates, gastropods, bivalves, weed fishes and spawn and late fry of rohu and mrigal along with zooplankton.

20.3, 20.4 & 20.5 : Research contemplated.

Project 21 :

21.1 & 21.2 : Research suspended.

Project 22 :

22.1 : Cage culture of rohu and mrigal in running water of the river Yamuna was taken up at Allahabad. After 111 days rearing the average growth observed was 37.3 mm/6.6 gm for rohu and 62.5 mm/6.9 gm for mrigal.

22.2 : Research contemplated.

Project 23 :

23.1 & 23.2 : Research contemplated.

Retirement : Shri H. N. Mukherjee, Superintendent, retired on 21.10.73

Promotions : The following promotions have been made during the year under report :

Shri P. K. Sthanapati	:	From Assistant to Superintendent (*ad-hoc*)
Shri S. C. Roy	:	From Senior Clerk to Junior Accountant (*ad-hoc*)

Transfers : The following transfers were made during the year under report :

Fishery Scientist		
Shri B. B. Pakrasi	:	Kakdwip to Barrackpore
Junior Fishery Scientist		
Shri R. M. Rao	:	Kurnool to Barrackpore
Shri H. A. Khan	:	Barrackpore to Jaunpur
Shri K. K. Sukumaran	:	Jaunpur to Karnal
Shri K. N. Krishnamurthy	:	Karnal to Bhavanisagar
Shri B. V. Govind	:	Bhavanisagar to Ranchi
Assistant Fishery Scientist		
Shri S. C. Pathak		Allahabad to Jaunpur
Senior Research Assistant		
Shri S. R. Ghosh	:	Nagarjunasagar to Cuttack
Research Assistant		
Shri D. N. Misra	:	Rewa to Rihand
Junior Survey Assistant		
Shri D. P. Verma	:	Rewa to Sankargarh
Laboratory & Field Assistant		
Shri J. P. Mishra	:	Rewa to Hazaribagh
Junior Clerk		
Shri G. B. Das	:	Jaunpur to Barrackpore
Fieldman		
Md. Samood	:	Calcutta to Patna
Peon		
Shri S. S. Maity		Calcutta to Kakdwip
Shri H. L. Bose	:	Kakdwip to Calcutta
Fisherman		
Shri D. Bhanja	:	Allahabad to Kalyani
Shri L. Sahu	:	Kalyani to Cuttack
Shri Mool Chand	:	Allahabad to Bilaspur
Watchman		
Shri Hari Bahadur		Patna to Gauhati

Staff : The following staff rendered their services to the Institute :

Director

DR. V. G. JHINGRAN

1 Freshwater Fish Culture Division (Cuttack)

1.1 Central Inland Fisheries Research Substation, Cuttack (Orissa)

Senior Fishery Scientist	:	Dr. H. Chaudhuri
Fishery Scientist	:	Dr. A. K. Mondal, Sarvashri V. Ramachandran, R. D. Chakraborty and S. B. Singh (on deputation to Tanzania)
Junior Fishery Scientist	:	Sarvashri M. A. V. Lakshmanan, R. M. Bhowmick, N. G. S. Rao, G. N. Saha, G. V. Kowtal, P. R. Sen, D. S. Murthy, S. Patnaik, N. K. Tripathi and Dr. C. R. Das
Junior Engineer	:	Shri C. D. Saha
Assistant Fishery Scientist	:	Sarvashri A. K. Ghosh, R. K. Jana, D. C. Chatterjee, C. Selvaraj, A. Ramaprabhu, S. K. Mukhopadhyay and K. H. Ibrahim (on other duty under Tanzania Government)
Assistant Statistician	:	Shri M. D. Raut
Senior Research Assistant	:	Sarvashri A. K. Banerjee, S. Jana, S. N. Mohanty, R. K. Dey, K. J. Ram, D. R. Kanauja, S. D. Gupta, P. L. N. Rao and S. R. Ghosh (from (7.7.73)
Research Assistant	:	Shri P. V. G. K. Reddy
Draftsman	:	Shri Chakradhar Sahoo
Estimator	:	Shri Muralidhar Mantri
Accountant	:	Shri P. C. Kanungo
Head Clerk	:	Shri A. K. Das

and others

2 Riverine and Lacustrine Fisheries Division (Allahabad)

2.1 Central Inland Fisheries Research Substation, Allahabad (Uttar Pradesh)

Fishery Scientist	:	Shri J. C. Malhotra and Dr. A. G. Jhingram (up to 5.5.73 and then again from 14.12.73)
Junior Fishery Scientist	:	Dr. R. S. Panwar, Sarvashri P. K. Mathur, D. V. Pahwa (*ad-hoc*) and M. Peer Mohamed (from 26.12.73)
Assistant Fishery Scientist	:	Sarvashri S. P. Singh and S. C. Pathak (up to 10.4.73)
Senior Research Assistant	:	Sarvashri S. N. Mehrotra, R. K. Tyagi, P. N. Jaitly, D. Kapoor, Shree Prakash, Balbir Singh, R. N. Seth, H. C. Joshi, D. Nath and K. P. Srivastava

Research Assistant	:	Sarvashri A. C. Nandy (on long leave), R. K. Sexana (on long leave), S. K. Wishard (on long leave), G. N. Srivastava, N. K. Srivastava, K. L. Shah and R. K. Dwivedi
Senior Store Keeper	:	Shdi K. B. Rajani
	and others	

2.2 Central Inland Fisheries Research Unit, Bhagalpur (Bihar)

Junior Fishery Scientist	:	Dr. G. N. Mukherjee
Research Assistant	:	Sarvashri B. L. Pandey, S. N. Sar and R. C. Singh
	and others	

2.3 Small Reservoir Unit, Rewa (Madhya Pradesh)

Junior Fishery Scientist	:	Shri S. J. Karamchandani
Research Assistant	:	Sarvashri M. D. Pisolkar and D. N. Mishra (up to 25.6.73)
	and others	

2.4 Krishna Godavari Unit, Rajahmundry (Andhra Pradesh)

Fishery Scientist	:	Shrimati T. Rajyalakshmi (*ad–hoc*)
Assistant Fishery Scientist	:	Dr. Y. Rama Rao
Research Assistant	:	Sarvashri T. S. Ramaraju, K. S. Rao and D. R. Rao
	and others	

2.5 Reservoir Fisheries Research Unit, Hazaribagh (Bihar)

Fishery Scientist	:	Dr. A. G. Jhingran (from 15.5.73 to 13.12.73)
Senior Research Assistant	:	Shri Ramakrishnaish
Research Assistant	:	Sarvashri S. K. Sarkar, B. Roy, B. K. Banerjee and S. L. Kar
	and others	

2.6 Tank Fisheries Research Unit, Bangalore (Karnataka)

Fishery Scientist	:	Dr. A. David
Senior Research Assistant	:	Shri P. K. Sukumaran
Research Assistant	:	Shri S. Lakshmiraghavan
	and others	

2.7 Cold Water Fisheries Research Unit, Srinagar (Kashmir)

Junior Fishery Scientist	:	Dr. K. L. Sehgal
Senior Research Assistant	:	Sarvashri M. J. Bhagat, Kuldip Kumar, C. B. Joshi and Shyam Sundar
	and others	

2.8 Brahmaputra Survey Unit, Gauhati (Assam)

Junior Fishery Scientist	:	Shri Ravish Chandra
Senior Research Assistant	:	Sarvashri H. P. Singh, M. Chowdhuri and S. N Upadhyaya
	and others	

3 Estuarine Fisheries Research Division (Barrackpore)

3.1 Estuarine Fisheries Research Substation, Barrackpore

Senior Fishery Scientist	:	Dr. V. Gopalakrishnan
Fishery Scientist	:	Shri B. B. Pakrasi (from 7.11.73)
Junior Fishery Scientist	:	Dr. M. Subrahmanyam and Shri Apurba Ghosh
Fishery Economist	:	Shri M. Ranadhir
Assistant Fishery Scientist	:	Sarvashri K. K. Vass and B. B. Ghosh
Senior Research Assistant	:	Sarvashri S. B. Saha, S. N. Dutta, D. D. Halder (*ad-hoc*) (on long leave), A. Chowdhury, K. K. Bhanot, G. C. Laha, L. H. Rao, M. M. Bagchi and Srimati K. K. Bhanot
Research Assistant	:	Sarvashri P. R. Das, B. K. Saha, R. N. De, A. R. Chowdhury, R. K. Chakraborty, D. K. De, H. S. Mazumder and P. M. Mitra
Head Clerk	:	Shri M. L. Biswas
	and others	

3.2 Estuarine Fisheries Research Unit, Kakdwip (West Bengal)

Fishery Scientist	:	Shri A. N. Ghosh
Junior Fishery Scientist	:	Dr. P. U. Varghese
Assistant Fishery Scientist	:	Shri M. K. Bandhyopadhyay
Senior Research Assistant	:	Sarvashri G. N. Chattopadhyay, K. M. Das, and H. C. Karmakar
Research Assistant	:	Sarvashri P. B. Das, P. K. Pandit and M. K. Mukhopadhyay (on long leave)
	and others	

3.3 Pulicat Lake Unit, Madras (Tamil Nadu)

Fishery Scientist	:	Shri K. Raman
Junior Fishery Scientist	:	Shri K. V. Ramakrishna
Assistant Fishery Scientist	:	Shri R. D. Prasadam
Senior Research Assistant	:	Sarvashri S. Radhakrishnan, R. Ganapathy, C. P. Rangaswamy, K. Gopinathan, M. Kaliyamurthy and G. R. M. Rao
Research Assittant	:	Sarvashri K. J. Rao and S. Srinivasagam
	and others	

3.4 Sundarbans Survey Unit, Kakdwip (West Bengal)

Fishery Scientist	:	Shri B. B. Pakrasi (up to 1.11.73)
Junior Fishery Scientist	:	Shri A. V. P. Rao
Fisheries Farm Engineer	:	Shri A. Sengupta

Assistant Engineer	:	Shri A. B. Mukherjee
Senior Research Assistant	:	Shri N. C. Basu
Overseer	:	Shri P. N. Bhattacherjee
	and others	

4 Units under direct control of the Director

4.1 Soil Chemistry and Weed Control Unit, Calcutta (West Bengal)

Junior Fishery Scientist	:	Dr. (Miss) E. Mitra and Shri P. Ray
Senior Research Assistant	:	Sarvashri S. C. Banerjee, A. C. Banerjee, R. K. Banerjee and S. C. Thakurta
	and others	

4.2 Library & Documentation Unit, Barrackpore (West Bengal)

Junior Fishery Scientist	:	Shri B. N. Saigal
Senior Research Assistant	:	Sarvashri A. K. Datta and Amitabha Ghosh
Research Assistant	:	Shri P. K. Chakrabarti
Senior Library Assistant (Gr.I)	:	Kumari Anjali Ghosh
Senior Artist	:	Shri J. Ghosh
Artist Photographer	:	Shri A. R. Mazumder
	and others	

4.3 Fisheries Extension Unit, Barrackpore (West Bengal)

Senior Extension Officer	:	Shri P. Das
Extension Officer	:	Shri B. K. Sharma
Senior Research Assistant	:	Dr. K. G. Rao and Shri A. Mukherjee
Photographic Assistant	:	Shri P. K. Ghosh
Artist	:	Shri S. K. Das
	and others	

4.4 Administrative Section, Barrackpore (West Bengal)

Administrative Officer	:	Shri C. D. Kulkarni
Superintendent	:	Sarvashri H. N. Mukherjee (up to 21.10.73) S. N. Chakraborty and P. K. Sthanapati (*ad–hoc*) (from 22.10.73)
P. A.–cum–Stenographer	:	Shri G. Lahiri
Head Clerk	:	Shri N. G. Chatterjee
Accountant	:	Sarvashri A. K. Sengupta and B. C. Datta
	and others	

4.5 Accounts and Audit Section, Barrackpore (West Bengal)

Accounts Officer	:	Sarvashri B. N. Das (up to 7.12.73) and M. K. Sarkar (from 7.12.73)
Assistant	:	Sarvashri P. K. Sthanapati (up to 21.10.73)
Junior Accountant	:	S. C. Roy (*ad–hoc*) (from 22.11.73)
	and others	

4.6 Stores Section, Barrackpore (West Bengal)

Superintendent	:	Shri S. K. Chatterjee
Assistant	:	Shri K. C. Roy
	and others	

5 Institute Based Co-ordinated Projects

5.1 Co-ordinated Project on Reservoir Fisheries

5.1.1 Main Centre, Hazaribagh (Bihar)

Senior Fishery Scientist	:	Shri A. V. Natarajan
Junior Statistician	:	Dr. K. Algaraja
	and others	

5.1.2 Sub-centre, Nagarjunasagar (Andhra Pradesh)

Junior Fishery Scientist	:	Shri G. K. Bhatnagar
Senior Research Assistant	:	Sarvashri V. V. Sugunan, S. R. Ghosh (up to 3.8.73) and R. K. Das (from 7. 7.73)
	and others	

5.1.3 Sub-centre, Bhavanisagar (Tamil Nadu)

Junior Fishery Scientist	:	Shri Ch. Gopalakrishnayya
Senior Research Assistant	:	Sarvashri A. Mathew and B. P. Gupta
	and others	

5.1.4 Sub-centre, Rihand (Uttar Pradesh)

Junior Fishery Scientist	:	Shri V. R. Desai
Senior Research Assistant	:	Sarvashri M. A. Khan (left on 16.7.73), R. K. Singh and D. N. Mishra (from 2.7.73)
	and others	

5.1.5 Sub-centre, Ranchi (Bihar)

Junior Fishery Scientist	:	Shri B. V. Govind (from 12.9.73)
Senior Research Assistant	:	Shri J. N. Pal (from 16.10.73)
	and others	

5.1.6 Sub-centre, Bilaspur (Himachal Pradesh)

Senior Research Assistant	:	Shri M. P. S. Kohali (from 2.7.73)
	and others	

5.2 Co-ordinated Project on Composite Fish Culture

5.2.1 Main Centre, Barrackpore (West Bengal)

Senior Fishery Scientist	:	Dr. V. R. P. Sinha
Junior Fishery Scientist	:	Sarvashri H. A. Khan (up to 4.8.73) and R. M. Rao (from 4.8.73)

Senior Research Assistant	:	Sarvashri D. P. Chakraborty and P. K. Saha (from 15.6.73)
	and others	

5.2.2 Sub-centre, Kalyani (West Bengal)

Junior Fishery Scientist	:	Shri M. V. Gupta
Senior Research Assistant	:	Shri Dhirendra Kumar
	and others	

5.2.3 Sub-centre, Kurnool (Andhra Pradesh)

Junior Fishery Scientist	:	Shri R. M. Rao (up to 23.7.73)
Senior Research Assistant	:	Shri J. B. Rao
	and others	

5.2.4 Sub-centre, Bhavanisagar (Tamil Nadu)

Junior Fishery Scientist	:	Sarvashri B. V. Govind (up to 30.8.73) and K. N. Krishnamurthy (from 30.8.73)
	and others	

5.2.5 Sub-centre, Jaunpur (Uttar Pradesh)

Junior Fishery Scientist	:	Sarvashri K. K. Sukumaran (up to 14.8.73) and H. A. Khan (from 14.8.73)
Assistant Fishery Scientist	:	Shri S. C. Pathak (from 11.4.73)
Senior Research Assistant	:	Dr. P. M. Mathew
	and others	

5.2.6 Sub-centre, Karnal (Haryana)

Junior Fishery Scientist	:	Sarvashri K. N. Krishnamurthy (up to 23.8.73) and K. K. Sukumaran (from 23.8.73)
Senior Research Assistant	:	Shri B. C. Tyagi
	and others	

5.2.7 Sub-centre, Poona (Maharashtra)

Junior Fishery Scientist	:	Dr. K. P. P. Nambiar
	and others	

5.3 Co-ordinated Project on Air Breathing Fish Culture

5.3.1 Main Centre, Darbhanga (Bihar)

Senior Fishery Scientist	:	Dr. P. V. Dehadrai
Junior Fishery Scientist	:	Shri N. K. Thakur
Senior Research Assistant	:	Shri N. K. Das
	and others	

5.3.2 Sub-centre, Bhadra (Karnataka)

Junior Fishery Scientist	:	Shri S. P. Ayyar
Senior Research Assistant	:	Shri V. K. Murugusan
	and others	

5.3.3 Sub-centre, Gauhati (Assam)

Junior Fishery Scientist : Shri R. N. Pal
Senior Research Assistant : Shri D. N. Singh
and others

5.4 Co-ordinated Project on Spawn Prospecting

5.4.1 Main Centre, Allahabad (Uttar Pradesh)

Junior Statistician : Shri K. K. Ghosh
and others

5.4.2 Sub-centre, Barrackpore (West Bengal)

Junior Fishery Scientist : Shri M. R. Sinha
and others

5.4.3 Sub-centre, Gauhati (Assam)

Junior Fishery Scientist : Shri K. V. Rao
and others

5.4.4 Sub-centre, Patna (Bihar)

Junior Fishery Scientist : Shri M. Y. Kamal
and others

5.5 Co-ordinated Project on Brackish Water Fish Farming

Pending recruitment of technical personnel, the work is being carried by the Staff of the Estuarine Fisheries Research Division under the supervision of the Director.