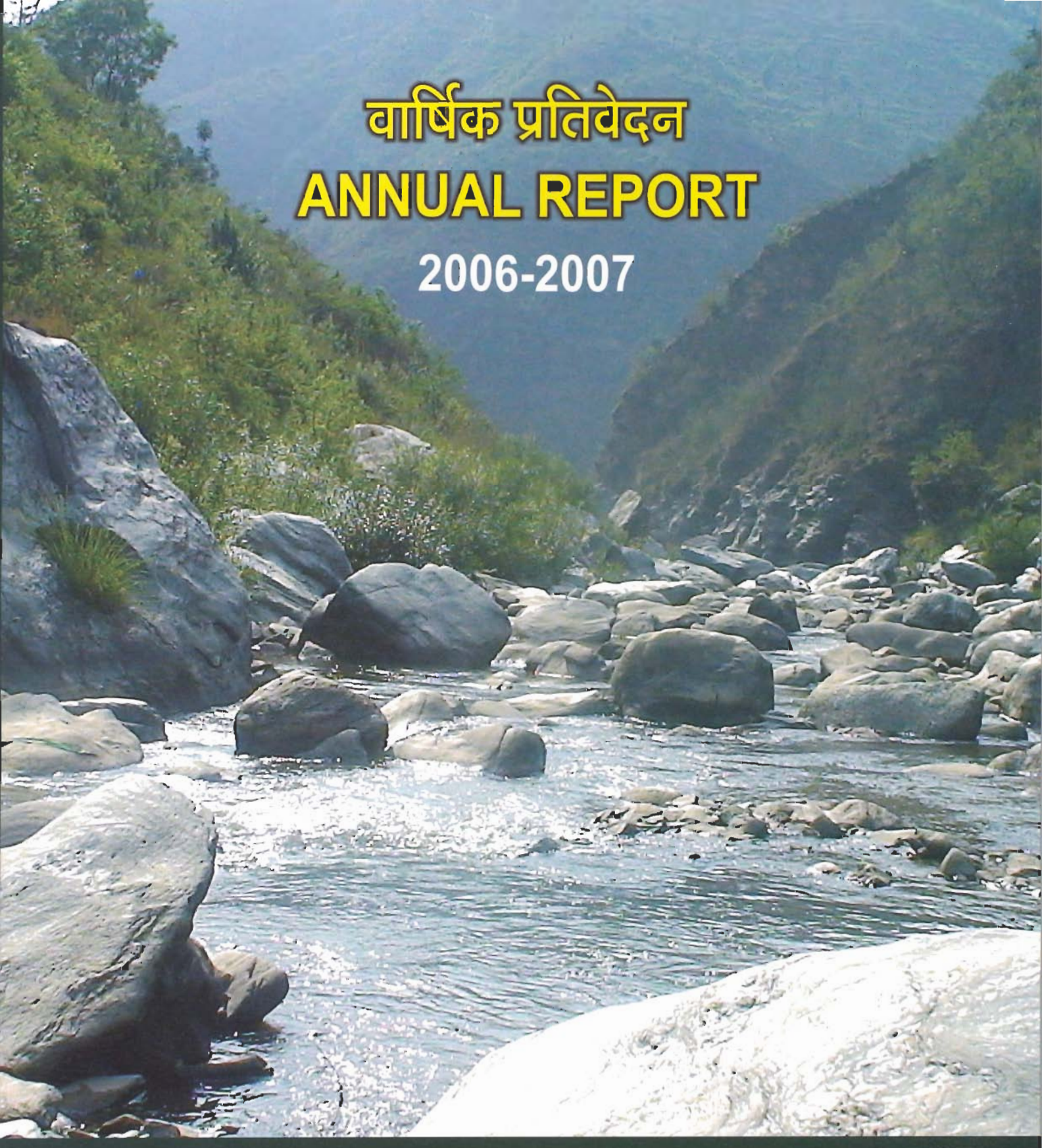

वार्षिक प्रतिवेदन
ANNUAL REPORT
2006-2007

भाकृअनुप
ICAR

NATIONAL RESEARCH CENTRE ON COLDWATER FISHERIES
(Indian Council of Agricultural Research)
Bhimtal - 263136, District - Nainital (Uttarakhand)

NRC CWF
BHIMTAL
ICAR
राष्ट्रीय शीतजल मात्स्यिकी अनुसंधान केन्द्र

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ANNUAL REPORT
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NATIONAL RESEARCH CENTRE ON COLDWATER FISHERIES
(Indian Council of Agricultural Research)
Bhimtal - 263136, District - Nainital (Uttarakhand)

Published by
Dr. P.C. Mahanta
Director

Editors
Dr. Rajeev Kapila
Dr. A. Barat
Mr. A.K. Nayak

Hindi Translation
Mr. Amit Joshi

Photographic and Secretarial Assistance
Mr. Vijoy Kumar Singh
Mr. Amit Kumar Saxena

Assistance
Smt. Susheela Tiwari

Printed at Army Printing Press, 33 Nehru Road, Cant Sadar, Lucknow-226 002 Tel : 0522-2481164

PREFACE

In recent times high mountain areas covering coldwater resources gaining a substantial momentum in the field of aquaculture production. Gradually, responsibilities of NRCCWF also increased manifolds in enhancing sustainable fish production and to achieve a commendable place in the National Gross Fish production. During the year under report, the research was conducted through five institutional projects and one adhoc scheme. Some of the research projects were completed successfully during the year.

For the preliminary database on hill fishery resources of Uttarkhand using GIS and remote sensing system, was a remarkable initiation during previous year. Institute has also initiated a package of practice for cage culture of Mahseer and snow trout. The scientists of this institute also tried to develop cost effective feeds for the indigenous coldwater fishes. NRCCWF tried to extend the research activities and training programme in some North Eastern Hill areas under NEH programme and gained remarkable achievement in mid altitude carp culture in Arunachal Pradesh and Manipur. Morever, successful installation of a hatchery to breed Chocolate Mahseer has inspired to establish two Mahseer hatcheries in Assam and Sikkim. The institute is also associated as a consortium member with VPKAS, Almora in conducting culture technologies in water harvesting tanks in Almora and Champawat Districts.

During the year the institute prepared the vision 2025 document in tune with the emerging trends in fisheries science to address new priorities within the inland fisheries sector. NRCCWF also initiated the preparation of XIth Five Year plan document.

A meeting of all Directors of ICAR Fisheries Institutes was held at this institute during 15-16 April, 2006 to discuss the priorities in biotechnology research in fisheries and aquaculture during XIth plan. A Biotechnology meet was also held during 22-23, September, 2006. Scientists from different fisheries institutes of ICAR and the experts in the field were present during the deliberations. During the meeting prestigious awards were given to the Scientists and staff members for their contributions in this field. Through constant efforts of the scientists and staff it was possible to achieve these landmarks. The generous support, guidance and encouragement received from Dr. Mangala Rai, Secretary DARE & Director General, ICAR and Dr. S Ayyappan, Dy. Director General (Fisheries), Dr. V.V. Sugunan, ADG, (Inland Fisheries) is recorded with sincere thanks and gratitude.

Thanks are also due to Dr. R. Kapila, Senior Scientist, Dr. A. Barat, Senior Scientist and Mr. A.K. Nayak, Scientist, SS in bringing out the Annual Report. The efforts made by Shri Amit Joshi for Hindi version of the report is also acknowledged. Assistance rendered by Mrs. Susheela Tewari, PA to Director is recorded with appreciation.

October, 2007
Bhimtal

P.C. Mahanta
Director

CONTENTS

EXECUTIVE SUMMARY

The National Research Centre on Coldwater Fisheries (NRCCWF) was established in 1987 by the Indian Council of Agricultural Research (ICAR) for providing research inputs towards aquaculture and aquatic resource management in the hill

regions of the country. The mandate of the Institute includes assessment of the hill fishery resources in Indian upland regions for formulating ecological management plans to achieve sustainable fish production, including sport fishery. Besides, the Centre also has a mandate to develop aquaculture technologies for major coldwater fish species with particular reference to trouts, mahseers, snow trouts and carps specific to different altitudinal zones. The Institute is also involved in conducting frontline demonstration programmes and educational training in hill aquaculture and aquatic resource management in co-ordination with other organizations. During the year under report, the research was conducted through five institutional projects and one adhoc scheme.

In open water fisheries, coldwater fishery resources of Uttarakhand were characterized using GIS and Remote Sensing. Based on satellite imageries the perimeter and area of reservoirs were ascertained. This year about twelve lakes in Garhwal region were analyzed by field surveys as well through GPS or digitization from the related topomaps. Moreover, detailed studies on spatial database on fisheries resources of Sarda Sagar Reservoir were also conducted and attempts were made to link the physicochemical parameters of lake with the respective satellite images that would be useful in analyses of the productive/nutritive zone of the reservoir.

In order to develop computerized data base on coldwater fishes of India, a programme has been developed with various structural database formats based on the data available with the Instiute and

secondary data from books, literatures etc. Database systems were designed in such a way to manage large amount of information. Microsoft Visual Basic 6.0 software was used in order to develop the forms as front-end tool and Microsoft Access 2000 for tables as back-end tool. The database has been designed for access in two different ways i.e. for general user and administrative user. The general user can only see the data available with the database and generate reports whereas the administrative user having password can modify and add additional information. The database can provide the facilities to search a species through its scientific/common name, family or its characters. It can also provide information to readers, researchers and anglers along with details of principal game fishes, role of sport fishery in development of tourism etc. Another additional module for the list of institutions/ persons working in the species has also been developed in this programme.

Under aquaculture, cage culture of fishes (golden mahseer and snow trout) were carried in floating raft type wooden frame cages having high density polyethylene webbing in subtropical Himalayan lake of Bhimtal. Experiments were carried out on two sizes of *Tor putitora* and *Schizothorax richardsonii*. It was observed that survival percent of fish increased to 67.1% and 70.3% respectively in cages fed with artificial diets having bigger sized fishes than smaller fish in 90 days feeding trials. Similarly average weight achieved was recorded to be 19.3 gm and 8.9 gms respectively in two coldwater species from initial weight of 6.1 and 5.3 gms.

With the aim to develop cost-effective feeds for indigenous upland fishes, the nutritive value of locally available ingredients was evaluated for feed formulation and to access their suitability for fish feeds. The net weight gain, percent weight gain and SGR increased significantly with increase in inclusion levels of black soybean and horse gram protein in the diet with a peak at 30% and 10% levels followed by decreased growth on further increase in their respective contents. On the other hand, survival percentage was more or less similar for all the treatments and exhibited no such significant effect of the treatments. Further it was observed that wheat flour as carbohydrate source gave better growth performance and feed efficiency than indigenous carbohydrate sources viz., mandua, ramdana and ugal.

Under multivariate statistical analysis of water quality data obtained from secondary sources, factor analysis is able to identify significant sources of water quality inputs to Narmada River. The largest source of variation (27%) appeared to be from water quality parameters associated with sewage discharges. Additional inputs were from the

second factor accounting for about 22% of animal wastes discharges. The third factor, accounting for 8% appeared to be industrial waste is discharged. In other words, we can conclude that factor analysis of water quality data from Narmada River shows that sewage discharge, animal waste discharge and industrial waste discharge are the main causes of variations in water quality in Hoshangabad region of this river system. Thus, three variables namely Bicarbonate Alkalinity, Chloride and pH may be considered as the key parameters of this river section. As we detected some of input sources leading to pollute the river, appropriate measures may be taken up to control it according to the nature of the pollution sources. Similarly results have been obtained when factor analysis is applied to the same water quality data using principal component of extraction method, other conditions remain unchanged.

Under the ICAR Mega Seed Project under the title, Seed production in Agricultural Crops and Fisheries, the Institute produced ten lakh spawn and three lakh fry of common carp as well as 25000 seed of golden mahseer. Moreover, a training programme on seed production of golden mahseer was also organized for the officials of Tehri Hydro Development Corporation Tehri, Uttarakhand from 4-7th September 2006 that may help in conserving endangered Golden mahseer in newly constructed Tehri reservoir.

Efforts are on in developing close liaison with the Universities, State Fisheries Departments, agencies, authorities and users in North Eastern Hill (NEH) region of the country, who have common interest and stake in coldwater fisheries development. The aim is to prepare a blue print for coldwater fisheries development activities in this area. For demonstration of carp farming technology developed by NRCCWF for hill region fourteen sites (ponds / farmers) were selected in the Districts of Ziro, West Siang, and PapumPare of Arunachal Pradesh and seven sites in Ukhrul district of Manipur. The fish production ranged 0.32-0.60 kg / m^2 for all the ponds in Arunachal and 0.28-0.37 kg/m^2 in ponds located in Ukhrul area of Manipur State. The performance of the grass carp was found better in terms of growth and feed conversion ratio followed by common carp. Rohu also grown well comparatively at lower altitude but did not grow in ponds at Ukhrul. Moreover, the ecological habitats, seed availability in Dibang Valley, culture, growth, survival and maturity of chocolate mahseer in pond environment were also studied in Arunachal Pradesh.

In order to understand the biochemical mechanism of cold tolerance in a coldwater fish, snow trout, the protocols were standardized for spectrophotometric estimation and physical visualization of isozymes on Native PAGE gels for

glycolytic enzymes (Lactate dehydrogenase and Pyruvate kinase) and pentose phosphate pathway enzyme (Glucose 6-phosphate dehydrogenase) and esterases. Results obtained clearly depicted that the activity of enzymes increased significantly on cold exposure of fish at cold temperature of 5^0C as compared to control group maintained at 20^0C. The data were further supported by native PAGE gel profiles and measuring inorganic osmolytes concentration of ions in blood plasma which further support the fact that fishes increased their catabolic metabolic pathways during cold exposure to generate energy in order to combat cold.

The scientific, technical and administrative staff were deputed for various training programmes to improve their skill about the new developments in their respective fields. Scientists of the Institute were also participated in various seminars, symposia, workshops and conferences and presented their scientific achievements. The Institute imparted training to fish farmers of the Uttarakhand state and NEH personnel on the different aspects such as coldwater fish culture, breeding, disease management, the crafts and gears used in coldwater fisheries, etc. In the mass awareness programme of the Institute, the scientists apprised the local masses, visiting students, dignitaries, etc about the different aspects of coldwater fish and fisheries.

The NRCCWF Scientists bagged prestigious awards; Dr. P.C. Mahanta, Director, NRCCWF, Bhimtal (Nainital) has been awarded Dr. R.C. Dalela "Oration-2006" by the Academy of Environmental Biology and Dr. Madan Mohan, Principal Scientist was conferred "Fellowship of the Year-2005 Award" by National Environmental Science Academy, New Delhi.

The meetings of the various committees of the Institute viz., Research Advisory Committee, Staff Research Council, Official language, Management Committee, Institute Joint Staff Council were conducted as per schedule. The respective committees discussed the various agenda items and provided guidelines for the proper management and smooth functioning of the institute and research activities.

The NRCCWF family is representative of the diverse cultures of the country and each member participated in celebration of various national days, events and genuine spirit of communal and cultural harmony.

INTRODUCTION

Indian Council of Agricultural Research (ICAR) established the National Research Centre on Coldwater Fisheries (NRCCWF) on September 24, 1987. The main objective of its establishment was to strengthen fishery research in coldwater sector, encompassing the Himalayan and Peninsular parts of the country. The Centre was shifted to its own campus at Bhimtal Industrial area w.e.f. September 05, 2003. The Institute has a field centre located at Chhirapani in district Champawat of Uttarakhand state that came into existence in 1992.

Location

The headquarters of NRCCWF is located at Bhimtal at an altitude of 1470 msl in the district of Nainital of Uttarakhand State. It is about 25 km away from the famous tourist place of Nainital. The nearest railway station is Kathgodam, which is about 280 km from Delhi. The nearest airport is Indira Gandhi International Airport, New Delhi. The experimental field station of the Institute at Chhirapani in Champawat district of Uttarakhand State is about 160 km from Bhimtal.

Faculty

The Institute has nine scientists. There are three Principal Scientists (one as per sanctioned cadre and two from career advancement scheme), two Senior Scientists, two Scientists (Senior Scale) and one Scientist. More than 50% of the sanctioned posts scientists are vacant.

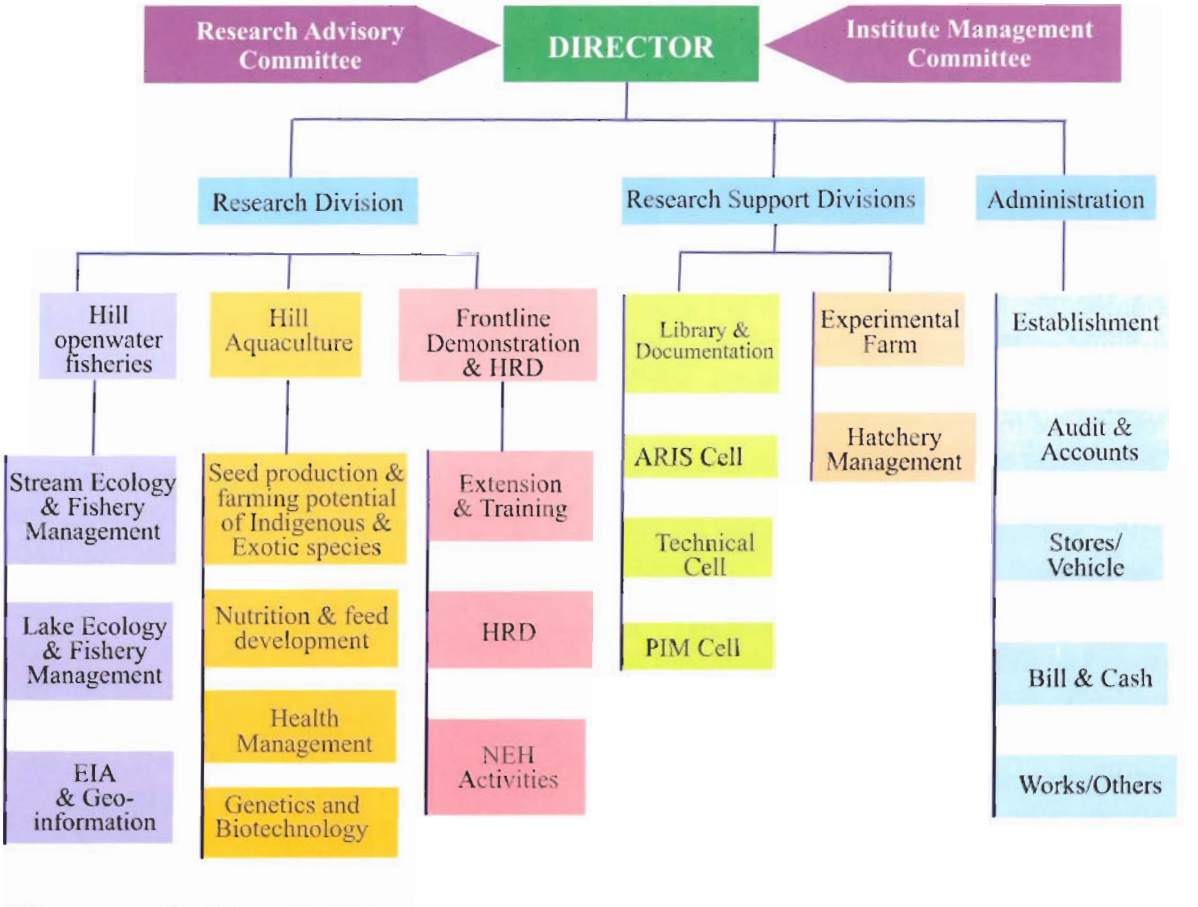
Management

A high-powered Research Advisory Committee (RAC) guides the Centre on planning research thrust areas and new initiatives. The RAC also evaluates and monitors the progress of research activities. The Management Committee (MC) constituted and mandated by the Indian Council of Agricultural Research under the chairmanship of the Director, supervises the Centre. A number of internal committees, such as Staff Research Council, Official Language Committee, and Institute Joint Staff Council are in place for decentralized management.

Mandate

- To conduct basic, strategic and applied research in coldwater fisheries and aquaculture
- To develop stock management models and culture technologies for major coldwater fish species
- To create awareness and provide training and consultancy

Organogram



The organizational set-up

The institute is now functioning from its own new complex constructed at the Bhimtal Industrial Area. A Pilot Cell mahseer seed production unit is being operated at Bhimtal on the land belonging to the State Fisheries Department, that included of mahseer hatchery houses and a laboratory, which provides back-up facilities to seed production activities of the Centre. The Centre has an experimental fish farm facility at Chhirapani in Champawat district of Uttarakhand State which has trout hatchery, cemented raceways for nursery and brood stock rearing and few circular iron tanks for conducting yard trials on various culture aspects of the indigenous and exotic fish species.

Project Implementation and Monitoring (PIM) Cell monitors the implementation and progress of research project programmes being conducted by the Centre. This cell annually organizes the meeting of Staff Research Council (SRC) to evaluate the progress made in each research project and accordingly approves the work programmes for the current year. The new proposals are also approved by the SRC after thorough evaluation of the objectives, practical utility, manpower support and financial involvement. The cell is also responsible for maintaining records of project reports through RPF system, besides compilation of annual report and newsletter of the Institute.

Staff strength as on 31.03.2007

Category	Sanctioned	Filled	Vacant
Director (RMP)	01	01	-
Scientific	30	09	21
Technical	13	13	-
Administrative	11	12*	-
Supporting	15	13	2
Total	70	48	23

* Transferred along with post from IVRI, Mukteswar for a period of one year.

The technical cell has given the responsibilities of dealing with all technical matters within and outside the ICAR system. This cell takes care of the training programmes, deputation, participation of scientists in seminars, symposia, workshops, meetings, etc., and organizing of conferences.

The library of the Centre during the year subscribed to 25 National and International journals. Current holdings are 1512 books, 1581 foreign journals, 657 Indian journals and 3000 other publications. It provides services to the scientists and other staff members of the Institute apart from scholars, researchers, students and other persons from local organizations interested in scientific literature on coldwater fisheries and allied subjects. The library section has now upgraded with CD ROM facilities on aquaculture, fisheries and aquatic science by procuring CD ROM. The library section is further continuing its efforts in collection, processing and disseminating scientific/ technical information to the potential users. The library automation has also been completed. Five online journals have also been subscribed by this institute for the year 2006-07.

The documentation section is entrusted with the responsibility of publication of scientific bulletins, brochures and pamphlets. During the current year this section published two booklets and two pamphlets.

The ARIS Cell of the Institute is established and providing the VSAT Internet / email facilities, scanner, printers etc. for official use of scientist/ staff of this institute. The Internet facilities were provided to all scientists, AAO, AF&AO, Library and Director Cell in their respective rooms for its efficient use. The LAN connectivity has also been installed. The Institute is also well equipped with modern plasma display/ LCD projection facilities required for the meetings and conferences.

The website of this institute has been upgraded regularly. It contains relevant information about the Institute, photographs of the Institute's complex, various laboratories, experimental fish farm/ hatchery at Bhimtal and field station Champawat, the mandate of the institute with organizational structure and manpower. The website also contains the information about the institutional projects and externally aided projects and their achievements. The major

achievements of the Centre, the technology generated, consultancy services and angling information is also being incorporated in the site. Further, for the ongoing and forthcoming training programmes, seminar / symposia to be conducted by the Institute, tender notice will be reflected in the website. The NRCCWF's website finds a place in the Indian Council of Agricultural Research (ICAR) website with the address: http://www.icar.org.in/nrccf

The Extension wing carries out the various extension activities of the Institute such as transfer of technology programmes, organizing the exhibitions, training programmes and other activities related to farmers.

BUDGET 2006-2007

Financial Statement Abstract **(Rupees in Lakhs)**

Year	Funds Non-Plan	Expenditure Non-Plan	Funds Plan	Expenditure Plan
2002 - 2003	92.00	74.13	100.50	100.40
2003 - 2004	110.00	95.89	90.00	88.09
2004 - 2005	113.81	98.41	136.00	134.80
2005 - 2006	124.03	117.68	235.98	235.90
2006-2007	124.50	116.21	192.91	186.26

Budget Statement for the Year 2006 - 2007 **(Rupees in Lakhs)**

02	Pay & Allow.	91.60	84.64	-	-
10	T. A.	2.20	2.20	5.35	5.35
15	Other Charges including Equipments	16.20	14.91	139.23	133.71
18	Information Technology	-	-	3.75	3.71
20	Works & Land	14.50	14.46	14.68	14.68
25	Other items	-		24.50	24.48
	Fellowship/ Scholarship/ Awards				
28	NEH	-		5.00	4.93
	Grand Total	124.50	116.21	192.91	186.86

Research Achievements

OPEN WATER FISHERIES

PROJECT CODE	RAEM/B/0018
PROJECT TITLE	Characterization of Coldwater Fishery resources of Uttarakhand through Geoinformatics and development of computerized database on Coldwater Fishes of India
SCIENTISTS	Prem Kumar, Ashok Kumar Nayak, N.Okendro Singh

A. Characterization of Cold-water Fisheries resources

(i) Enlisting the lakes in Garhwal region:

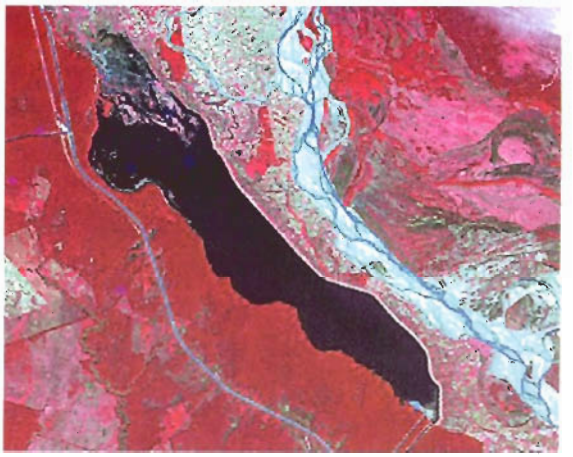
The lakes in Garhwal are numerous but they are not as big as that of Kumaon region and it was difficult to assess their depiction on the LISS III image. Therefore, field truths were collected for some of the lakes in Garhwal region. The area of the lakes either was analyzed through GPS or digitization from the related topomap. Area and perimeter of major lakes in the Garhwal region is given in the table.

(ii) Studies on Spatial database on Fisheries resources of Sarda Sagar Reservoir

Physicochemical parameters are such as temperature pH, TDS, transparency, dissolved oxygen, free CO_2, Alkalinity and nutrients. These parameters would be linked with the respective satellite image and would be useful to analyze the productive/ nutritive zone of the reservoir. Efforts are on to collect the information regarding fish biodiversity and fishing methods of the Sarda Sagar Reservoir.

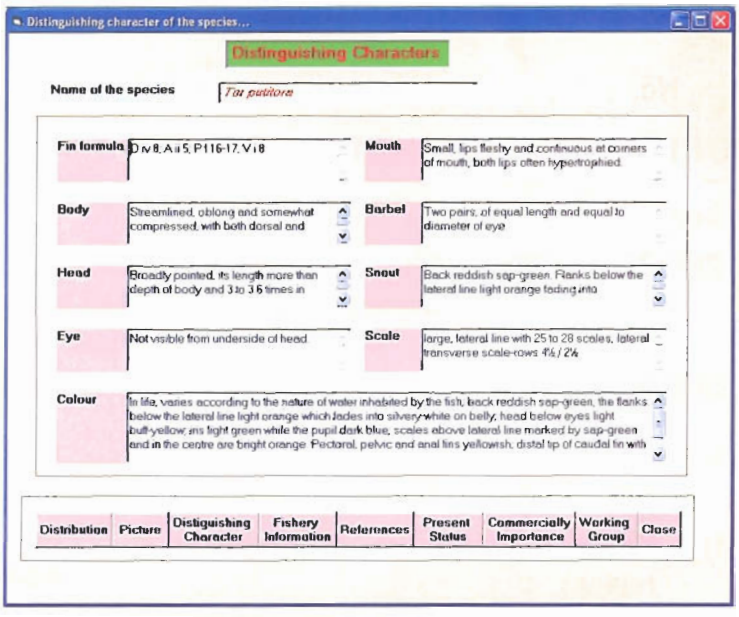
B. Development or computerized data base on Coldwater Fishes of India

- The database on coldwater fishes of India has been developed in Microsoft Visual Basic 6.0 software. Microsoft Access 2000 has been used for tables as back-end tool. An attempt has been made to store information about all 258 coldwater fishes of Indian uplands and programme has been developed with various structural database formats. The database system is designed in such a way to manage large amount of information. The database in consolidated form is based on the secondary available data together with NRCCWF's work. Information



on species belonging to different sub-families has been computerized in the form of database. This database will be efficient in retrieving and storing information related to the coldwater fish species of India.

- The database has been designed for access in two different ways. The general user only see the data available with the database and generate reports whereas the administrative user with password can also modify and add additional information. After entering into the database the user can search a species through its scientific name, common name, and family or identify the species through its characters. This database contains different modules for each species viz. classification, morphological characters, habitat distribution, biological features, breeding period and behaviour, present status, economic importance, photographs and bibliography.



- In this database, an attempt is made to store the information of commercially important species of Upland Himalayas and make available to the readers, researchers and anglers along with details of principal game fishes, role of fishery sports in the development of tourism and principal fishing sites in different riverine ecosystems. The generation of database on the biological wealth of various ecosystems of this state would ultimately help in developing strategies for the proper management and conservation of upland fish germplasm. Another module for the list of institutions/person working in the species has been developed. This will display the name of the person/ organization, their address with email and species on which they are working or worked previously.

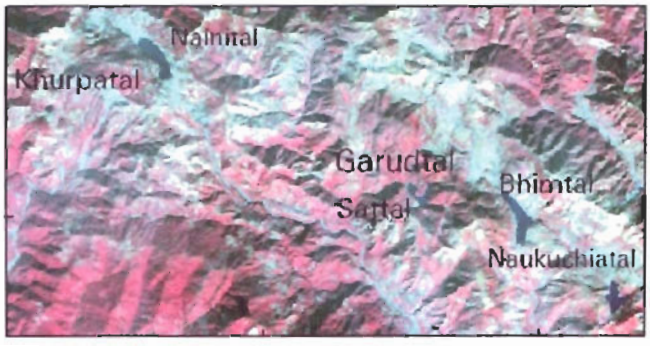


Table : Area and perimeter of major Lakes in the Garhwal region :

Sl. No.	Name of the Lake	Area (ha)	Perimeter (kms)
1.	Arwatal	4.25	1.01
2.	Bajwarital	1.06	0.39
3.	Gandhi Sarovar	1.61	0.49
4.	Hemkund	9.30	1.42
5.	Kashnital	2.51	0.60
6.	Kholiyatal	2.32	0.79
7.	Lamatal (comprises five small lakes)	0.56	0.28
		1.49	0.49
		1.05	0.38
		0.52	0.28
		0.63	0.35
	Total	4.25	1.78
8.	Nandikund	6.63	1.10
9.	Panyatal	2.53	0.65
10.	Sastrutal (comprises seven small lakes)	0.47	0.27
		0.95	0.37
		0.99	0.39
		1.83	0.55
		3.68	0.74
		3.90	0.76
		5.34	0.88
	Total	17.16	3.96
11.	Satratal	0.99	0.39
12.	Vasukital	5.60	1.05

AQUACULTURE

PROJECT CODE	AFE/A/0021
PROJECT TITLE	Cage culture of fishes in floating cages in subtropical Himalayan lake- Bhimtal
SCIENTISTS	Madan Mohan, Shyam Sunder, B.C. Tyagi, Yasmeen Basade

To build up technology for cage culture in open waters, lay out design for the cages was prepared and got fabricated. Each unit comprised of four cages (3 m x 3 m x 3 m each) made of HDPE net (4-15 mm mesh size) fitted with a wooden frames and suspended with angle iron poles at suitable site in lake Bhimtal. All the sides of cages have been provided with working wooden platform.

Four different experiments were conducted with golden mahseer (*Tor putitora*) and snow-trout (*Schizothorax richardsonii*) with varied fish sizes each having a replica for a period of about three months. One set for each experiment was kept as control whereas in treated, artificial diet was given regularly.

Golden mahseer (*Tor putitora*) specimens having a weight range of 3.1- 3.9 g (av.3.5 g) were stocked @ 350 no./ cage in two sets. The initial biomass of the fish stocked was 1225 g in each cage. Barring control, the fishes in the second set were fed with formulated artificial feed twice a day @ 5-10% body weight. Experiment lasted for 93 days and harvesting of fish showed survival rate of 43.4% in control while 61.1% in treated cage. The respective values of total final biomass, individual fish weight, weight increase/ fish, growth increment / day were recorded as 1029 g, 6.1-7.5 g (av. 6.9 g), 3.4 g and 0.04 g in control and 2953 g 12.4-16.1 g (av. 13.8 g), 10.3 g and 0.11 g in treated cages.

In another experiment, golden mahseer stocking was done with a weight range of 5.8-6.5 g (6.1 g) in two cages @ 350 fish/ each cage with an initial biomass of 2135 g and the fishes in the treated cage were fed twice daily. After a rearing period of about three months, the rate of survival was observed 49.7% and 67.1% in control and fed cages. The respective values of final biomass, individual fish weight, weight increase/ fish, growth increment / day

in control and treated cages were worked out as 1810 g and 4536 g, 8.3-11.9 g (av. 10.4) and 18.2-21.3 g (19.3 g), 4.3 and 13.2 g, and 0.05 g and 0.14 g.

Two experiments were conducted for rearing of different sized snow-trout (*Schizothorax richardsonii*) in anchored impoundments. In first trial, snow-trout specimens weighing 2.7- 3.8 g (3.2 g) were stocked in two cages @ 350 fish / cage having an initial biomass of 1120 g in each cage. In the experimental cage, artificially compounded diet was given two times a day 5-10% body weight. After a rearing period of about three months, the total fish biomass was recorded 869 and 1428 g in control and experimental cages. The respective values of survival rate, final fish weight, weight increase/ fish and growth increment/ day in control and experimental cages were observed to be 51.7% and 69.1%, 4.1-5.2 g (4.8 g) and 4.7-6.3 g (5.9 g), 1.6 g and 2.7 g and 0.02 g and 0.03 g.

Another experimental trial was made with slightly bigger snow- trout specimens weighing 4.8-6.7g (5.3 g) and stocked in two cages @ 350 fish/ cage with an initial fish biomass of 1855 g each cage. Fish in experimental cage were fed twice a day with formulated feed. Experiment lasted for 91 days with a harvesting weight of 6.4-7.8 g (7.1 g) in control and 7 .8-9.7g (8.9 g) in fed cages. Respective rate of survival, final fish biomass, weight increase/ fish and growth increment/ day in control and experimental cages were recorded as: 53.7% and 70.3%; 1335 g and 2189 g; 1.8 g and 3.6 g and 0.02 g and 0.04 g.

The practical diet used in cage culture rearing trials contains crude protein (40.65%), lipid (16.84%), crude fibre (6.97%), NFE (25.14%), Ash (10.40%). Though a fixed ration was set as per body weight for the experimental fish stocks twice a day, however, it was assessed periodically depending upon the water temperature, turbidity and acceptability etc.

The respective important water quality parameters in Bhimtal lake assessed for inside and outside the cages ranged as: water temperature, 21.2-26.4^{0}C and 20.1-26.2^{0}C; transparency, 1.71- 2.24 m and 1.71-2.00; pH, 6.9 –8.7 and 6.5-8.7; dissolved oxygen, 5.2-7.6 mg/l and 5.2-7.2 mg/l; free carbondioxide, 0.9-2.10 mg/l and 0.9-3.12 mg/l, alkalinity, 69-116 mg/l and 69-109 mg/l and conductivity, 251-342 µ mhos and 251-378 µ mhos.

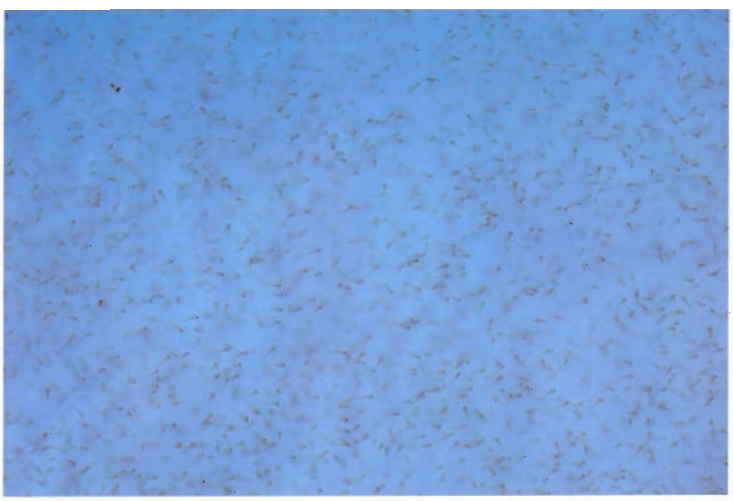
As natural food, the total plankton assemblages comprised 2.7 – 7.2 x 104 units/l inside the cages whereas 2.6 – 6.8 x 104 units/l in the open lake. Phytoplankton mostly included Bacillariophyceae (28.11-40.02%, av. 33.76%), Dinophyceae (21.78-31.47%,av.25.91%),Chlorophyceae(29.12-42.97%, av. 36.34%) and Cyanophyceae (1.99-6.38%, av. 3.99%). Zooplankton mainly comprised Protozoa (9.07- 21.51%, av. 16.54%), Cladocera (58.93- 73.14%, av. 66.32%), Copepoda (5.10- 12.43%, av. 8.42%) and Rotifera (7.13- 12.43%, av. 8.72%).

The abiotic and biotic parameters such as water quality and plankton were recorded and analysed inside and outside the cages. The water quality parameters inside and outside as recorded are given below.

Parameters	Inside cages	Outside cages
Water temp. (°C)	21.2-26.4	20.1-26.2
Transparency	1.71-2.24	1.71-2.00
pH	6.9-8.7	6.5-8.7
Dissolved oxygen (mg/l)	5.2-7.6	5.20-7.2
Free carbon dioxide (mg/l)	0.9-2.10	0.9-3.12
Alkalinity	69-116	69-109
Conductivity umhos	251-342	251-378

PROJECT CODE	ICAR-Mega Seed Project
PROJECT TITLE	Seed production in agricultural crops and fisheries
SCIENTISTS	Madan Mohan, Prem Kumar

In the Inception Meeting at CIFA, Bhubaneshwar on 6-7th April 2006 on ICAR Mega seed project, NRC on Coldwater Fisheries Center has been entrusted with the job of production of carp seeds with special emphasis on coldwater fishes. The seed production technology for coldwater fishes is quite different from carp seed technology used in hills. However there is an urgent need of fish seeds in hills for growing fish for consumption, fish seed for rivers and lake ranching, for river stocking for sport fishery etc. Hence, decision was taken that maximum quantity of common carp seed may also be produced along with the other coldwater fish seed.



Seed production of golden mahseer (*Tor putitora*)

- Brooders of golden mahseer (T.L 490-560 mm and 1000-1500 g in weight) were collected through overnight operating gill nets in Bhimtal lake.
- The ripe eggs were stripped and fertilized with oozing milt from male specimen (T.L 370-390 mm and 400-500 g in weight) by "dry method". The rates of fertilization varied between 85.0-90.0% and eggs were fertilized.
- The fertilized eggs were kept in hatching trays having flow-through facilities (water flow of 2-3 l/min) for incubation. The incubation period ranged between 118-120 hours depending upon the water temperature fluctuating between 16.5-24.5°C and the yolk-sac absorption was completed within 10-12 days at the water temperature of 17.5-25.0°C.
- The hatching rate was 88.0-90.0% and swim-up fry were produced.
- The newly emerged swim-up fry were stocked in flow-through nursery tanks (100 x 100 x 45 cm) having continuous water

flow of 2-3 l/min and fed initially with Goat's liver for about a fortnight and finally shifted to laboratory prepared artificial pelletized dry feed.

- During the hatching operation and rearing phase, all necessary and possible precautions were taken for better survival of eggs, hatchlings as well as fry with reference to the use of disinfectants in overhead water storage tanks, hatching trays/troughs and rearing tanks periodically; arrangements of fertilized eggs in specially designed flow-through hatching trays/ troughs in optimum densities, daily removal of non-viable eggs and egg shells, proper stocking of nursery and rearing tanks/ troughs with fry, initial feeding, regulation of required water flow rate etc.
- About 25000 seed of endangered golden mahseer was produced by using existing hatchery facilities and stocked in Bhimtal lake. Hatchery is being fully renovated, and full target will be achieved during next season. Mahseer lays about four thousand eggs per kg of its body weight unlike fishes in plains mainly carps which produce about one lakh eggs per kg of its body weight. Therefore egg production is of very low magnitude. Hence, it is very important to save this germplasm by indulging in its good quality seed production, which can be stocked in lakes and rivers and may be mixed with Chinese carps in pond fish production.
- About thirty numbers of golden mahseer and twenty numbers of Common carp brooders are being reared at the mahseer hatchery complex in 12x5m size earthen pond for seed production in future.

Fish Seed production at NRC on Coldwater Fisheries, Bhimtal

Particulars	Targets	Production	Remarks
Carp seed production	250 lakh spawn 100 lakh fry	10 lakh spawn & 3 lakh fry of common carp, 25000 seed of golden mahseer	1. Hatchery installation nearing completion 2. Broodstock of rainbow trout will breed only next year. 3. Broodstock of common carp being raised 4. Broodstock of mahseer raised in pond. 5. Seed production will be much higher during 2007-08 as hatchery production will start.
Hatchery installation		Various components of hatchery got fabricated, procured and being installed.	Hatchery for coldwater fishes is different compared to warmwater (in plains) fishes.
Training for seed production of mahseer-		A training programme in seed production of golden mahseer was organized for officials of Tehri Hydro Development Corporation Tehri, Uttarakhand from 4-7th September 2006.	This will help Tehri Development Hydro Corporation to produce seed of endangered Golden mahseer and conserve them in newly constructed Tehri reservoir.

Seed production of rainbow trout

Establishment and rearing of rainbow trout at a comparatively lower altitudes and higher temperature regimes of Kumaon region is a very recent phenomenon. The fast growing rainbow trout stock was brought two years back by NRC on Coldwater Fisheries from Kokernag Fish Farm of Department of Fisheries, Jammu and Kashmir to raise brood stock at its fish farm for seed production. Rainbow trout normally starts breeding at 2 + years age but good quality eggs are obtained from three years old females. Keeping these points in view, about 1000 brooders of rainbow trout have been separated from rest of the stock during the year and transferred in a separate raceways for rearing. They were provided

highly nutritious diet during 5-6 months so that very good quality eggs may be obtained from females. The brood stock is likely to breed in January-February 2008.

Seed production of common carp

About 125 number of brood stock of common carp measuring 250-350 mm in length and 250-900 gm in weight; and about 280 numbers of yearlings measuring 80-110mm in length and 30-100 gm in weight are being reared at NRCCWF farm. By using existing mahseer hatchery at Bhimtal, about 10 lakhs spawn of common carp from which about 3 lakhs fry during the last week of March, 2007. As mortality stated in fry, the entire stock was stocked in Bhimtal lake.

PROJECT CODE	AFE/B/0019
PROJECT TITLE	Evaluation of indigenous ingredients and feed supplements for feed formulation of indigenous upland fishes of Kumaon region
SCIENTISTS	Yasmeen Basade, Madan Mohan

During the year 2006-07, five experimental trials were carried out to assess dietary requirements for key nutrients viz., protein, lipid and carbohydrate in the indigenous upland fish, evaluation of locally available plant protein sources, suitability of the locally available indigenous dietary carbohydrate sources on the growth performance and feed efficiency of the indigenous upland fish and finally to assess the effect of dietary probiotic and immunostimulants on growth performance and feed efficiency of the indigenous upland fish.

Dietary requirements for key nutrients in golden mahseer

In fish fed diets having different levels of protein, lipid and carbohydrate the net weight gain, percent weight gain and SGR were significantly higher in fish fed dietary levels of 40% protein, 15% lipid and 25% carbohydrate compared to fish fed with all other levels of key nutrients. Survival percentage was not significantly affected with the treatments. Feed conversion ratio and feed conversion efficiency were significantly better in fish fed with dietary levels of 40% protein, 15% lipid and 25% carbohydrate compared to fish fed with all other levels of key nutrients. The apparent digestibility coefficient (ADC) of dry matter was significantly higher in fish receiving dietary levels of 40% protein, 15% lipid and 25% carbohydrate compared to fish fed with all other levels of key nutrients. Hence, the requirements of key nutrients viz., protein, lipid and carbohydrate in the diets of golden mahseer were assessed to be 40%, 15% and 25%, respectively based on their better growth performance, feed efficiency and ADC of dry matter.

Horse gram in the diets of golden mahseer

Horse gram was incorporated in the diets at different levels in raw and heat treated forms. The net weight gain, percent weight gain and SGR increased significantly with increase in inclusion levels of horse gram protein in the diet with a peak at 10% level and then decreased with further increase to 15% and 20% levels in both the raw and heat treated forms. Survival percentage was more or less similar for all the treatments and exhibited as such no significant affect of the treatments. Feed conversion ratio (FCR) and feed conversion efficiency (FCE) were significantly better in fish fed with 10% level of raw and heat treated horse gram protein compared to those fed with higher levels of 15% and 20% and lower levels of 5% and 0% horse gram proteins. Apparent digestibility coefficient (ADC) of dry matter of the test diets in test fish increased with increase in inclusion level of dietary protein source, horse gram (raw and heat treated forms) up to 10% and there onwards decreased with further increase in its inclusion level up to 20% of the dietary protein source, suggesting that the horse gram can be incorporated in the golden mahseer diets up to 10% level. However, it is advantageous to use heat treated horse gram over the raw forms as heat treatment denatures the anti-nutrients present.

Black soybean in the diets of golden mahseer

Black soybean in raw and heat treated form was included in the diets at various levels. The net weight gain, percent weight gain and SGR increased significantly with increase in inclusion levels of black soybean in the diet with a peak at 30% level and then decreased with further increase to 40% levels in both the raw and heat treated forms. Survival percentage was more or less similar for all the treatments and exhibited as such no significant affect of the treatments. FCR and FCE were significantly better in fish fed with 30% level of raw and heat treated black soybean compare to those fed with higher levels of 40% and lower levels of 0%, 10 and 20% black soybean. ADC of dry matter of the test diets in test fish increased with increase in inclusion level of dietary protein source, black soybean (raw and heat treated forms) up to 30% and there onwards decreased with further increase in its inclusion level up to 40% of the dietary protein source. Indicating that the black soybean can be incorporated in the golden mahseer diets up to 30% level. However, it is advantageous to use heat treated black soybean over the raw forms as heat treatment denatures the anti-nutrients present.

Locally available indigenous carbohydrates in the diets of golden mahseer

The locally available indigenous

carbohydrate sources viz., mandua, ramdana and ugal with wheat flour as controls were used to prepare the test diets. The net weight gain, percent weight gain and SGR was significantly higher in the control diet followed by the diet having mandua. While the growth performance of fish fed with ramdana and ugal was almost similar. Survival percentage was more or less similar for all the treatments and exhibited as such no significant affect of the treatments. FCR and FCE were significantly better in fish fed with wheat flour compared to those fed with mandua, ramdana and ugal. ADC of dry matter was significantly higher in fish fed the test diet having wheat flour than the fish fed with diets having mandua, ramdana and ugal. The result indicates that the control diet having wheat flour as carbohydrate source gave better growth performance and feed efficiency. Hence, wheat flour is advantageous over the others.

PROJECT CODE	AFE/B/0020
PROJECT TITLE	Studies on induced maturation and seed Production of Himalayan Mahseer, *Tor putitora* and *Schizothorax richardsonii* in pond Environment
SCIENTISTS	B.C. Tyagi, Shayam Sunder, Rajiv Kapila, Prem Kumar

The species Himalayan Mahseer, *Tor putitora*, and snow trout, *Schizothorax richardsonii* are important indigenous coldwater food and sport fishes generally distributed between 800-1800 and 1500 2800 m asl respectively. Their population in their aquatic habitats is declining fast. Their conservation through culture and breeding in captivity in pond environment seems to be the only alternate. Low fecundity, long breeding period, specific requirement of breeding in ponds are some of the factors compelled to formulate the present project so that their seed production through scientific intervention can be achieved for culture and rehabilate in their aquatic habitats.

The fish stocks of each species of different age group (1+ and 2+ year) were collected from natural waters and are being reared in ponds at Cheerapani Fish Farm

Champawat (*S. richardsonii*) and in 2 hired ponds at Bhimtal (*Tor putitora*) since October 2005. The details of rearing, growth and maturity are given in Table 1.

Table: 1:Rearing, growth and maturity of Mahseer in ponds

Species	Mahseer	Mahseer
Area	100M²	100M²
Density (Fish / M²)	1	1
No & wt. (Oct 2005)	100 , 50	100, 183
No.& wt (Feb 2006)	67 , 55.7	72 , 190
No.& wt (Feb 2007)	89, 103	68, 248
Survival (%)	89	68
Growth / mo (G)	4.4	6.9

The species, *Tor putitora* was stocked @ 1 fish / m ² in ponds having an area of 100 m² each with an average weight of 50g /171mm and 183 g /280 mm size. Fishes are growing well in ponds @ 4.4 g / mo in case of 1+ and 6.9g / mo in case of 2+ year being

attained 103 g and 248 g in February 2007. No growth was recorded during winter months (December-March) owing to low temperature (6.7-16.8°C) and about 37 % stock died due to heavy bacterial and fungal infection. Further loss has been checked and it was replenished. Water temperature ranged 6.7- 26.4 °C. The DO_2, pH, CO_2, Alkalinity were recorded 5.6-7.8 mg/l, 7.9-8.4, nil-1.2 mg/l and 40-68 mg/l respectively. The fishes were fed daily @ 2-3 % of body weight having rice polish 40%, oilcake 30%, wheat bran 20% and fish meal 10%. The vitamin concentrates were also mixed. **No maturity was observed in either sex after attaining the age of 3 years.**

The stock having an age of 3+ year in April 07 will be treated with 17 MT (Across Organic97%) @ 50 mg/ kg, LHRH+ DOM @ 25mg /kg /10th Day and LHRH+ DOM+PG @ 0.2+0.3 ml /Kg/15th Day to induce the maturity in fishes and, on attainment the maturity the fish may be spawned by using LHRH-A +DOM +PG OR Ovaprime. To observe the inducement status in fishes, the gonads will be removed and preserved in Bouins for further studies.

Similarly the fish stock of snow-trout is being reared in 3 nursery ponds (15m²) at Champawat @ 8 (18 g), 11.3(57 g) and 5.3 (85 g) fishes/ m² since October 2005.

POND	I	II	III
Species	Snow trout	Snow trout	Snow trout
Area	15M ³	15M³	15M³
Density (Fish / M²)	8	11.3	5.3
No & wt. (Oct 2005)	120, 18	170, 57	80, 85
No.& Wt (Feb2006)	114, 20	160, 60	76, 89
No.& Wt (Feb2007)	105, 37	153, 79	71, 113
Survival (%)	87.5	88.3	88.7
Growth / mo (g)	1.2	1.3	1.7

After 2 years, fishes have attained 37,79 and 113 g weight being growing 1.2,1.3 and 1.7 g /mo in NP 1,2 and 3 respectively. The fishes may mature in this season. The fishes are being fed on a formulated diet having rice polish 45%, oil cake 25%, fishmeal 10%, wheat bran 20% plus vitamin concentrate necessary for growth and maturation. Ponds are also being fertilized with organic manures @ 1000 kg/ha / dose at 20 days interval. Water quality is being monitored to keep the quality at optimum. Water temperature ranged 3.8-21.4°C whereas pH was 7.2-8.4, DO_2 6.7-8.1 mg/l, CO_2 1.2 mg/l and alkalinity 38-78 mg/l. Growth of fishes is being recorded at monthly intervals and results are quite encouraging at this stage of rearing. Breeding may be attempted in coming months.

PROJECT CODE	RAEM/B/0022
PROJECT TITLE	Multivariate Statistical Analysis of Water Quality Data
SCIENTISTS	N. Okendro Singh

- Water quality data observed by Palharya and Malviya (1988) at monthly intervals during January-December, 1985 at seven different sampling sites of the Narmada River has been used in this study. The sampling sites were selected between Hoshangabad Circuit-House and Hasalpur Village. Hoshangabad is situated on 220, 46' North latitude and 770, 45' East latitude on 303.35 meters above the sea level. Sampling sites I to V were different five important ghats at Hoshangabad while the remaining sites VI and VII were selected near Dongarwara village. The average readings on 11 different physico-chemical parameters noted separately of each month for the said period is further utilized in the present study.

- Factor analysis using a principal axis factoring of extraction method and varimax rotation of physico-chemical parameters of the Narmada River has been conducted. Principal axis factoring of extraction method is generally preferred when the research purpose is to identify latent variables, which contribute to the common variance of the set of measured variables. Also, correlation matrix is chosen because the covariance method has problems when the variables are measured on widely different scales. The Kaiser-Meyer-Olkin measure of sampling adequacy is 0.747, indicating that the present data is suitable for factor analysis. Similarly, Bartlett's test of shpericity is significant ($p < 0.001$), indicating sufficient correlation between the variables to proceed with the analysis (Table 1).
- All the extracted communalities are acceptable except the lower values of Free Carbon Dioxide and Temperature, which indicates that these two variables are not fit for the factor solution (Table 2).
- The first three factors in the initial solution have an Eigen values > 1 that accounts for almost 68% of observed variation in water quality observations (Table 3) and the rest being neglected. According to Kaiser Criterion, only the first three factors should be used because subsequent Eigen values are all < 1. Scree plot shown in Fig 1 is also a useful tool to decide number of factors. The cumulative variance explained by these three factors in the extracted solution is only about 57%, which results a difference of about 11% from the initial solution. This difference is due to some unexplained variability by the factor model to the original variables.
- Factor loadings are used to measure correlation between variables and the factors. A loading close to ± 1 indicates a strong correlation between a variable and the factor, while a loading close to zero indicates weak correlation (Evans et al., 1996). The factors are rotated with the uses of varimax rotation, which is a standard rotation method (Kaiser, 1958). In the present study, only those factor loadings > 0.6 are considered for interpretation purposes.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.747	
Bartlett's Test of Sphericity	Approx. Chi-Square	488.784
	df	55
	Sig.	.000

Table 2:

	Initial	Extraction
Bicarbonate Alkalinity	.659	.616
BOD	.591	.673
Calcium Hardness	.720	.605
Carbonate Alkalinity	.401	.422
Chloride	.598	.618
Dissolved Oxygen	.691	.810
Free Carbon Dioxide	.380	.175
Magnesium Hardness	.730	.580
pH	.329	.542
Temperature	.218	.250
Total Hardness	.891	.967

Table 3: Total Variance Explained

Factor	Initial Eigen-values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Of Variance	Cumu-lative %	Total	% Of Variance	Cumul-ative %	Total	% Of Variance	Cumu-lative %
1	4.646	42.240	42.240	4.314	39.217	39.217	2.924	26.586	26.586
2	1.615	14.686	56.926	1.243	11.298	50.516	2.405	21.860	48.446
3	1.253	11.391	68.317	.701	6.368	56.884	.928	8.438	56.884
4	.950	8.640	76.957						
5	.636	5.780	82.737						
6	.547	4.976	87.712						
7	.470	4.271	91.983						
8	.331	3.009	94.992						
9	.257	2.338	97.330						
10	.222	2.019	99.350						
11	.072	.650	100.000						

Extraction Method: Principal Axis Factoring.

Table 4: Rotated Factor Matrix (a)

	Factor		
	1	2	3
Total Hardness	.941	.284	.003
Bicarbonate Alkalinity	.761	.192	-.014
Magnesium Hardness	.747	.082	-.124
Calcium Hardness	.534	.441	.354
Free Carbon Dioxide	.359	.213	.021
Dissolved Oxygen	-.346	-.829	-.039
BOD	.192	.671	.431
Chloride	.431	.657	-.032
Carbonate Alkalinity	-.301	-.568	-.089
Temperature	-.156	.377	-.290
pH	-.174	.078	.711

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 15 iterations.

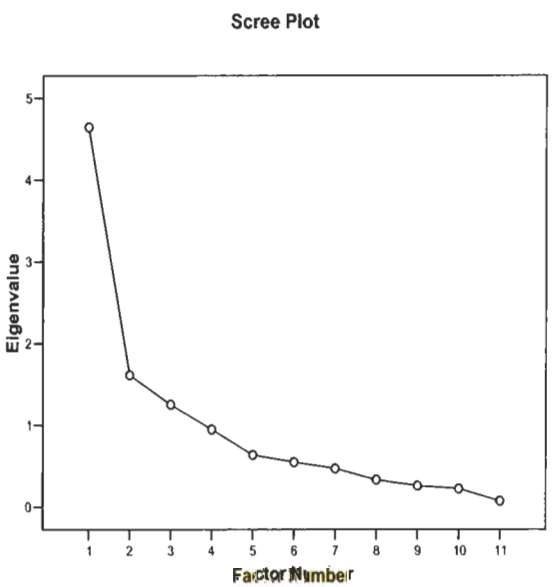


Fig 1

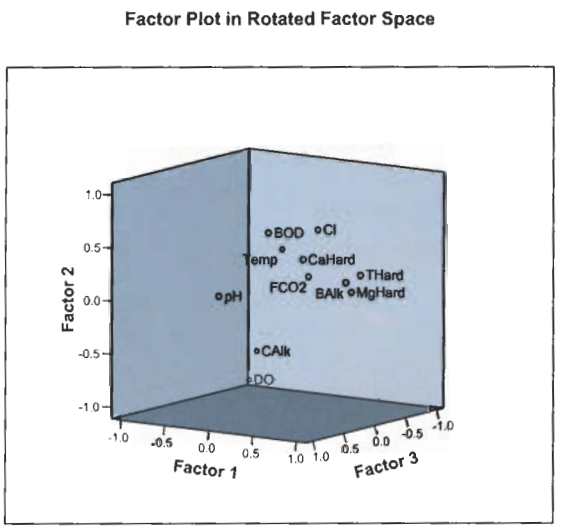


Fig. 2

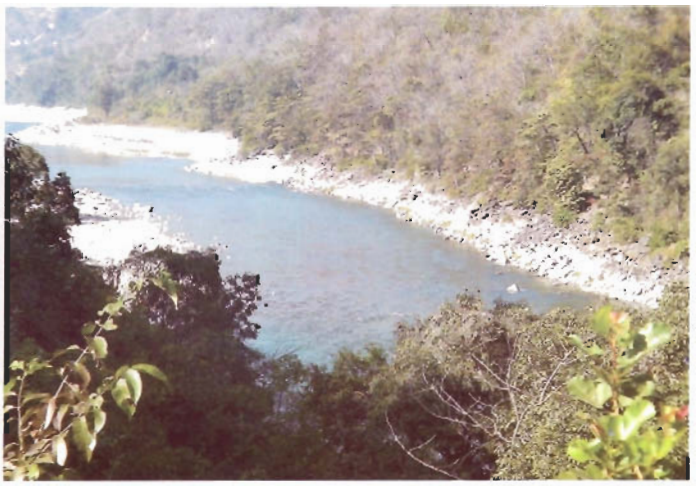
- An interpretation of the rotated three factors in Table 4 is made by examining the factors noting the relationship to the original variables. Further, it is justified with the factor loadings plot shown in Fig 2. The first factor gives information about the variation in total Hardness, Bicarbonate Alkalinity and Magnesium Hardness. Thus, the first factor in this analysis appears to be associated with sewage discharge into the river. The variable Bicarbonate Alkalinity may be considered as an indicator variable since higher concentration of Bicarbonate is found in sewage polluted water (Munawar, 1970). Also, higher concentration of total Hardness and Magnesium Hardness is expected in polluted water. BOD and Chloride exhibited positive loadings on second factor while Dissolved Oxygen had strong negative loading on it. Chloride seems to be the indicator variable of this factor, which reflects animal waste, is discharged into the river as suggested that higher value of Chloride in water is an index of pollution of animal origin (Munawar, 1970). Moreover, in polluted water, BOD is quite high, and it has negative impact on Dissolved Oxygen and Carbonate Alkalinity as shown in Table 4. The third factor has strong loading of pH. Thus, pH represents the indicator variable of this factor, which reflects that an industrial waste is being carried out into the river as claimed by Mazlum et al., (1999).
- Factor analysis is able to identify significant sources of water quality inputs to Narmada River. The largest source of variation (27%) appeared to be from water quality parameters associated with sewage discharges. Additional inputs from the second factor accounting for about 22% of animal waste discharges. The third factor, accounting for 8% appeared to be industrial waste discharged. In other words, we can conclude that factor analysis of water quality data from Narmada River shows that sewage discharge, animal waste discharge and industrial waste discharges are the main causes of variations in water quality in Hoshangabad region of this river system. Thus, three variables namely Bicarbonate Alkalinity, Chloride and pH may be considered as the key parameters of this river section. As we detected some of input sources leading to pollute the river, appropriate measures may be taken up to control it according to the nature of the pollution sources.
- Moreover, similar results have been obtained when factor analysis is applied to the same water quality data using principal component of extraction method, other conditions remain unchanged.

PROJECT CODE	NEH
PROJECT TITLE	Fisheries Research and Development in NEH region
SCIENTIST	B.C. Tyagi

Aquaculture Development

The survey revealed that the people of NEH region like catching fish instead of growing them in ponds. The time, input cost, no availability of fish seed of cultivable species, lacks of knowledge etc. are some of the reasons responsible for poor growth in aquaculture sector. Those who have ponds do rearing of fish for their own consumption and few farmers are doing fish culture on commercial scale. The production is quite low on various counts. Therefore, a decision was taken to identify progressive farmers having ponds for demonstration of carp farming technology developed by NRCCWF for hill region.

Based on the altitude and water temperature, NRC on Coldwater Fisheries has developed different fish culture technology for carps, snow trout, and exotic trout. About 60 per cent area is carp area in Arunachal Pradesh wherein Chinese carps and Mahseer can be cultured together in ponds located at 600 - 1800 m asl. Any shape or size of earthen / RCC ponds can stock @ 4-5 fish m^2 in early March when water temperature is above 15°C with common carp @25%, grass carp 35%, silver carp 20%, rohu 10% and /or Chocolate Mahseer (katli) 10% with the provisions of supplementary feed @ 2-4% of body weight and only organic fertilizers @ 9000kg /ha/ yr and liming @ 5-600kg/ ha/ at a suitable intervals . The technology enable to produce fish @ 0.4-0.8 kg / m^2 after a period of 8 months. Periodical harvest can be done if stocked bigger and assorted size of fingerlings in desired number at appropriate intervals.



To demonstrate the said technology in Arunachal Pradesh, 14 sites (ponds / farmers) were selected in the Districts of Ziro, West Siang, and PapumPare of Arunachal Pradesh and 7 sites in Ukhrul district of Manipur (1400-1600 masl). The ponds were stocked second time in August 06 with the seedlings of Chinese carps along with rohu. The fishes were fed 5 days in a week @ 2-3% of stocked weight on locally

formulated diet consisting of rice polish 45%, mustard oilcake 35%, maize / wheat flour 20%. The grass carp was also fed on banana leaf, terrestrial weeds or left over of vegetables putting on a platform. As the soil is acidic, the ponds were regularly limed on an interval of 10-12 day @ 450 kg/ ha / dose to maintain the pH above 8.0. The ponds were also fertilized with raw cattle dung @ 9000 /kg /ha /yr. No disease was encountered. However, some time low oxygen was reported which was rectified by spraying lime + potassium permanganate solution / splashing / adding more water into the pond. The farmer harvested the fishes for his consumption now and then and harvested completely after 8 -10 months. The fish production ranged 0.32-0.60 kg / m^2 being 0.42 kg / m^2(n=14) average for all the ponds in Arunachal and 0.28-0.37 kg/ m^2 in ponds located in Ukhrul area of Manipur State. The performance of the grass carp was best in terms of growth and feed conversion ratio followed by common carp. Rohu also did well but at lower altitude. It did not grow in ponds at Ukhrul. The fish production was higher in ponds located in Ziro District as the clients have knowledge about fish culture. The availability of fish seed of cultivable carps i.e. grass carp, silver carp and also of common carp was a problem as the seed is available in North Lakheempore (Assam) and to be transported to remote locality of Arunachal Pradesh in Ziro, Along, West Siang and other areas. The departments of fisheries of these states have to make arrangements for timely supply of quality fish seed. In addition to that, farmers have to be trained to adopt the new carp farming system for hills. The production was found directly correlated to management practices adopted by the farmer and their basic knowledge of fish culture. The details are given in tables and figures as follows:

Table: 2: Demonstration of carp farming technology under NEH in West Siang, Ziro, Papumpare districts of Arunachal Predesh (2006-07)

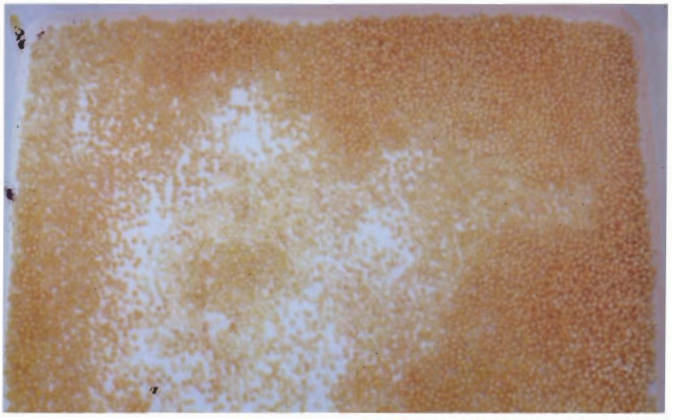
Name &location	No.	Area (m^2)	Period	Species	Density No/m^2	Survival (%)	Production (kg/m^2)	Husbandry practice
K.Bagra, Along	1	800	Aug. 06-Feb. 07	Gc+Sc+Cc+R	5	97	0.57	F+F
Poge Dozi, Along	1	1400	Aug. 06-Feb. 07	Gc+Sc+Cc+R	4	90	0.40	F+F
Gedo Dozi, Along	1	1500	Aug. 06-Feb. 07	Gc+Sc+Cc+R	4	82	0.49	F+F
NeiTapodia, Lekhi	1	1925	Aug. 06-Feb. 07	Gc+Sc+Cc+R	4	90	0387	F+F

Name &location	No.	Area (m^2)	Period	Species	Density No/m^2	Survival (%)	Production (kg/m^2)	Husbandry practice
Marjum Dozi, Along	1	400	Aug. 06-Feb. 07	Gc+Sc+Cc+R	4	857	080	F+F
G.Bagra, Along	1	500	Aug. 06-Feb. 07	Gc+Sc+Cc+R	5	70	030	F+F
Tamkar Dozi Along	1	420	Aug. 06-Feb. 07	Gc+Sc+Cc+R	5	80	0.34	F+F
Hage Ankha Ziro	1	400	Aug. 06-Feb. 07	Gc+Sc+Cc	5	90	0.57	F+F
Hage Tago Ziro	1	400	Aug. 06-Feb. 07	Gc+Sc+Cc	4	100	0.54	F+F
Tailyang Haley Ziro	1	304	Aug. 06-Feb. 07	Gc+Sc+Cc	5	85	0.60	F+F
Millo Tadu Ziro	1	400	Aug. 06-Feb. 07	Gc+Sc+Cc+R	5	90	0.48	F+F
HagedOollo Ziro	1	600	Aug. 06-Feb. 07	Gc+Sc+Cc	5	85	0.58	F+F
HagedPombo Ziro	1	400	Aug. 06-Feb. 07	Gc+Sc+Cc	5	90	0.53	F+F
Taliyang Shanti Ziro	1	700	Aug. 06-Feb. 07	Gc+Sc+Cc	5	80	0.56	F+F
Tilling Tadi Ziro	1	1600	Aug. 06-Feb. 07	Gc+Sc+Cc+R	5	98	0.61	F+F
ASWwungnaorei, Ukhrul	1	398	Aug. 06-Mar.07	Gc+Sc+Cc+R	5	87	0.37	F+F
YLWunzs-hungmil, Ukhrul	1	2172	Aug. 06-Mar.07	Gc+Sc+Cc+R	4	90	0.40	F+F
W.Muirang, Ukhrul	1	520	Aug. 06-Mar.07	Gc+Sc+Cc+R	5	72	0.29	F+F
N. Hongre, Ukhrul	1	588	Aug. 06-Mar.07	Gc+Sc+Cc+R	4	90	0.38	F+F
S. Shaiza, Ukhrul	3	913	Aug. 06-Mar.07	Gc+Sc+Cc+R	6	75	0.28	F+F
Mayo Shaiza, Ukhrul	4	978	Aug. 06-Mar.07	Gc+Sc+Cc+R	5	70	0.30	F+F
H.Makhalei, Ukhrul	1	662	Aug. 06-Mar.07	Gc+Sc+Cc+R	5	80	0.34	F+F

Gc=grass carp, Cc=Commoncarp, Sc=Silvercarp,R= Rohu; F+F=feed Fertilizers as per technology norms

CULTURE AND BREEDING OF MAHSEER IN ARUNACHAL PRADESH

Culture, growth, survival and maturity of Chocolate Mahseer (*N. hexagonolepsis*) in pond environment have been studied. It is a very important food fish. It is benthoplegic omnivorous but also accepts supplementary feed. Fecundity has been recorded 12-13000 eggs/kg in nature and found migrating to breed and laying eggs on gravel / pebbles field during June to August. The species, being important one, was selected to grow, mature and spawn them in pond environment. Iduli fish farm located at Roing, Arunachal Pradesh (Lat.27° 59' 09" N; long.95° 48' 52"; 156 m asl) was selected for the purpose. The fingerlings collected from Shelley Lake, near Roing,



were stocked in two ponds. In total, 140 fishes of 1+ year having 80 g / 274 mm in first pond and 2935 of 19-56 mm fry were stocked in second pond having 110 m^2 area during September 2004. The fry attained a net weight of 110.4-g/ yr and bigger size fishes 119-162 g in 275 days. After 3 years fishes have attained an average weight of 338 g (170-600g).

The fishes were fed on formulated diet @ 3-4 % of their body weight and the water quality were found in normal ranges but during summer months the water temperature was recorded 33.4 °C. Due to water scarcity fish mortality of brood stock occurred. The lost stock has been replenished to some extent and being reared in ponds. The fishes have shown the maturity signs and may breed in coming season (June-August). In January 2007, a flow-through Mahseer hatchery of 2.0-lakh seed production capacity has been installed at Iduli Fish Farm, Roing, Arunachal Pradesh.

The project Rapid Survey Fisheries Resources of Arunachal Pradesh has been completed. The report is under preparation for print.

BIOTECHNOLOGY

PROJECT CODE	AFE/B/0015
PROJECT TITLE	Studies on biochemical mechanism of cold tolerance of coldwater fish *Schizothorax richardsonii* (Gray)
SCIENTISTS	Rajeev Kapila

Visualization of changes in the activities of enzymes/proteins due to cold adaptation.

Acetylcholine esterase (AChE)

The activity of acetylcholine esterase increased in a linear form from 50 to 300µg followed by substrate saturation. At pH 7.5 the activity of enzyme was found to be higher by 1.63, 1.19, 2.01-folds as compared to enzyme assays performed at pH 7.0, 8.6, 9.0 respectively. Similarly, temperature is another important factor that affects the enzyme activity. Acetylcholine esterase was assayed at different temperatures from

10-50°C. It was observed that the activity of enzyme was very stable during incubation from 25-40°C exhibiting 58.3, 52.2, 56.7 IU/min/mg protein activity respectively, and it was 1.31, 3.78 fold more than at 10°C and 50°C. Hence, protocol for AchE estimation was finally standardized in whole fish muscle extracted in 0.9% saline using 300ug acetylcholine as substrate in 100mM phosphate buffer pH 7.5. The decrease in acetylcholine was measured at 490nm by the method of Wolfgong (1974). One unit of enzyme is that which hydrolysis 1nm of

actylcholine per minute at 37°C per mg of protein.

Test fish exposed to cold temperature of 5°C exhibited higher levels of acetylcholine esterase. The activity of ACE appeared to increase by 2.47, 18.34, 78.64, 239.28 and 297.37 % respectively at 12, 24, 48, 72 and 96 hrs of cold exposure at 5°C as compared to control maintained for 96 hrs at 20°C. Except at 24 hrs AChE activity increased significantly ($P \leq 0.01$) as compared to control at all rearing periods.

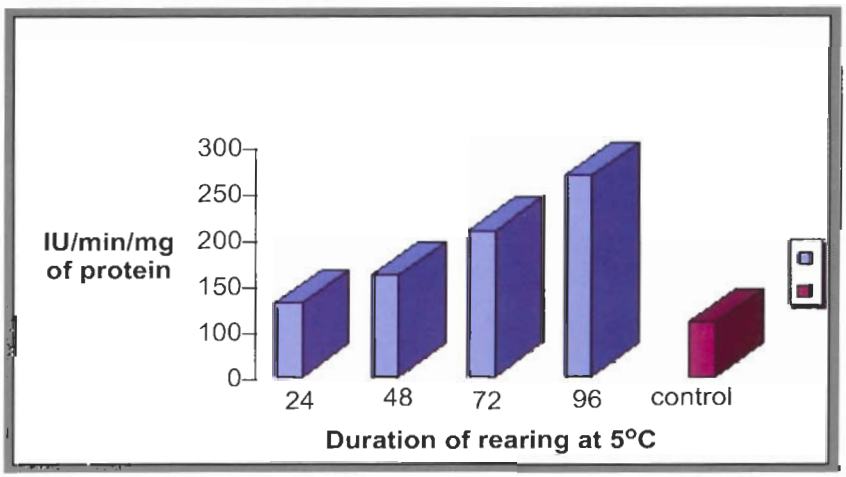
Lactate dehydrogenase (LDH)

The enzyme assays were carried out at pH ranging from 6-10 by using 100mM phosphate buffer. The maximum activity of LDH was observed at pH 8.0 which was 3.54,1.33 and 6.0 fold more than at pH 6, 7.5 and 10 respectively. So further assays for estimating LDH enzyme activity were conducted by using 100mM phosphate buffer of pH 8.0. The assays were also conducted by using substrate concentration ranging from 0.025-0.5 mM of NADH. The activity of LDH increased in a linear form up to 0.3mM. After that exhibited saturation of enzyme with substrate. However, 0.1mM substrate was selected for various assays of LDH to avoid any type of substrate saturation of enzyme. LDH activity was measured in whole muscle fish extracted in 0.9 % saline using 0.1 mM NADH and 69 mM Pyruvate as substrate in 100 mM sodium phosphate buffer pH 8.0. The decrease in $NADH_2$ was measured at 340 nm by method of Bergmeyer and Bernt (1974). One unit of enzyme is that amount of enzyme, which has consumed 1 nM of $NADH_2$ per minute per mg of protein at 14°C.

Test fish exposed to cold temperature of 5°C exhibited higher LDH activity. It has been observed that the activity of this enzyme was increased by 7.61, 28.00, 57.11, and 68.60 % respectively at 24, 48, 72 and 96 hrs of cold exposure at 5°C as compared to control maintained for 96 hrs at 2°0 C. The increase in the activity of this enzyme was found to be statistically insignificant at $P \geq 0.05$ up to 48 hrs when compare to control at 20°C for 96 hrs. However, remarkably significantly increased values ($P \leq 0.01$) of LDH were observed as duration of rearing of fish was increased from 72 hrs to 96 hrs.

Pyruvate kinase (PK)

The activity of PK found to be optimum at pH 8.0 while conducting experiment from pH 6-9 in 100mM Tris HCl buffer. Similarly, the activities of PK increased in a linear order from 4.166-66.64 µM for PEP substrate and 0.25-0.75 mM for ADP. The Pyruvate kinase activity was finally measured in whole fish tissues extracted in 0.9 % saline using 66.64 µM of PEP and 0.75 mM of ADP as a substrate in 100mM Tris buffer pH-7.4. The decrease in $NADH_2$ was measured at 340 nm by method Edwards



and Watts (1981). One unit of enzyme is that amount of enzyme, which utilized 1 nM of $NADH_2$ per minute per mg of protein at 14° C.

Test fish exposed to cold temperature of 5°C exhibited higher levels of Pyruvate Kinase. It has been observed that the activity of this enzyme increased by 35.16, 85.66, 168.68 and 267.91 % respectively at 24, 48, 72 and 96 hrs of cold exposure at 5°C as compared to control maintained for 96 hrs at 20°C. The activity of enzyme was found to be statistically ($P \leq 0.01$) higher at all the durations of fish rearing as compared to control.

Glucose 6 phosphate dehydrogenase

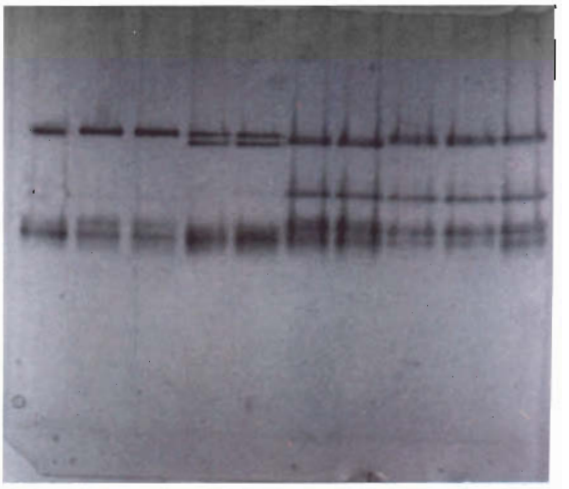
The enzyme assays were conducted at pH ranging from 6-9 using 100mM Tris buffer. At pH 8.0 the activity of enzyme Glucose 6-phosphate dehydrogenase was found to be higher by 11.67, 3.89, 3.89 folds as compared to the assays performed at pH 6.0,7.0 and 9.0 respectively (appendix). So further assays for G6PDH were carried out in 100mM Tis buffer 8.0 pH. The assays were also performed by using substrate concentration ranging from 1-5mM.The activity of glucose 6-phosphate dehydrogenase increased in a linear form up to 3mM and followed by saturation at higher concentration of substrate

The protocol was standardized for measuring Glc -6- P- DH activity in fish tissues extracted in 0.9 % saline using 3 mM Glc 6 phosphate as a substrate in 100mM tris buffer pH-8.0. The increase in $NADPH_2$ was measured at 340 nm by method Kuo and Hsieh (2005). One unit of enzyme is that amount of enzyme, which produces 1 nM of $NADPH_2$ per minute per mg of protein at 30°C.

Test fish exposed to cold temperature of 5°C exhibited higher levels of glucose 6-phosphate dehydrogenase. It has been observed that the activity of this enzyme increased insignificantly ($P \geq 0.05$) by 22.02 % at 24 hrs of rearing at 5°C. However cold exposure of 48 hrs increased the enzyme activity significantly ($P \leq 0.05$) by 24.10% in comparison to control. Further remarkable increase ($P \geq 0.01$) in enzyme activity was found to be 128.87 and 138.09 % at 72 and 96 hrs of cold exposure at 5°C as compared to control maintained for 96 hrs at 20°C respectively.

Visualization of enzymes on Native PAGE

Native gel profiling of Esterase and LDH, Esterases, Pyruvate kinase and Glucose 6-Phosphate dehydrogenase were standardized in 7% polyacrylamide gels and variations in isoforms due to cold adaptation of fish were detected. It was observed that Pyruvate kinase, LDH and Glucose 6 phosphate dehydrogenase exhibited, one, five and one band respectively. The intensity of bands appeared to sharpen in fishes, which were reared for 96hrs at 50°C as, compared control reared at 20°C for same period. On the other hand esterase enzyme exhibited three loci made of 4-6 bands. An



additional esterase band at one of the loci at Rf 0.42 was observed in fishes reared at 5°C as compared to control set.

Measurement of variations in inorganic osmolytes in blood plasma due to cold stress in Schizothorax richardsonii

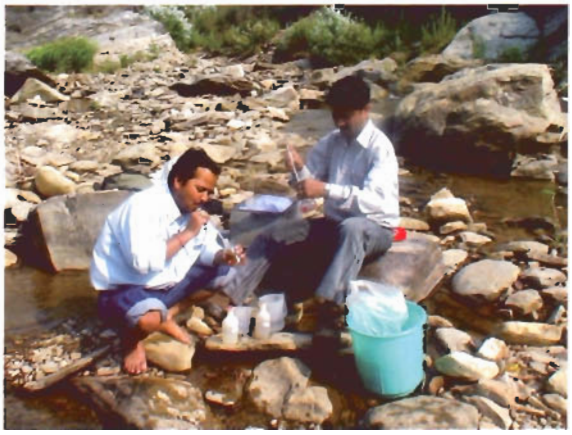
During the period under report test specimens of *Schizothorax richardsonii* were reared for 15 days at 5°C and 20°C respectively in glass aquarium. Blood samples were collected from heart using heparin as anticoagulant. Blood plasma was separated by centrifugation at 3000 rpm for 10 minutes. Conc of Na+, CI-, K+, Ca++ and PO_4- were determined after deproteinising the plasma samples using 20% TCA and reactions were carried out using specific MERK kits for the corresponding ion. The conc. of Na+, Ca++ CI-, K+, and PO_4- were estimated to be 3186.02, 122.64, 2897.1, 69.85 and 32.17, mg/L respectively at 5°C and 2795.23, 109.97, 2541.12, 71.94 and 36.85, mg/L at 20°C reared fish specimens.

TECHNOLOGY ASSESSED & TRANSFERRED

The carp farming technology developed and tested successfully in Kumaon Himalayan region (800-1800 m asl) by NRCCWF is transferred to the farmers of Arunachal Pradesh and Manipur State. In total 21 farmers have adopted Chinese carp based low input and low cost technology and getting fish production ranging 0.32-0.60 kg/m^2 (0.42 kg/m^2 (n=14) average). Many more farmers are eager to join this club. The constraints like seed availability, credit, upgradation of knowledge of the farmers are being addressed.

Extension Activities

Shri Prem Kumar, Scientist (SS) was deputed to ITBP post at Kalapani during 10-15.8.2006 in order to assess the possibility of introduction of fish in the ponds at the origin of the river Kali near China border in



Pithoragarh District. The Place Kalapani is located about 70 km from Mangti Nallah. The said origin of the river Kali comes from the hill, that is passed through the temple there of Goddess Kali. The water is passed through man made ponds of about 570 m^2 and joined with the Pankhagad Tributary of River Kali, which is medium turbulent nallah originated from near the Lipukekh Pass. The water flow was observed to be about 200 L per minute. It was suggested to stock the snow-trout in these ponds.

Training cum demonstration programme on value addition was conducted to the fish farmers of Champawat District in village Toli of Pati block. Pickle preparation from the freshwater fishes was demonstrated to the farmers.

Fish Pickle preparation from freshwater fishes

SPECIAL INFRASTRUCTURE DEVELOPMENT

CPWD has completed the construction work of one block for Scientist (Type-III) residential quarters (4 numbers) at Chherapani Fish Farm, Champawat.

Furnishing of Women Cell, IPR Cell, Training Room and IJSC room in the administrative block of the Institute has been completed.

During the year, library holding of Scientific Books has increased to 1545 and about 23 National and International Journals were subscribed. Library facility has been automated after proper cataloguing and provided to all scientific staff of the Institute through computer networking. Five online journals have also been subscribed by this institute for the year 2006-07.

EDUCATION & TRAINING

Trainings Imparted

Organized Training "Recent Advances in Hill Fisheries in NEH Region" during April 24-26, 2006 at NRCCWF, Bhimtal.

Imparted training to the Fisheries personnel from Arunachal Pradesh State Fisheries Department on "Recent developments in coldwater fisheries" during April 23-30, 2006.

Imparted training to State fishery officials from Manipur on "Brood stock management and seed production of Himalayan mahseer" during July 14-22nd, 2006.

Imparted two-week Training on "SDS-PAGE and Isozyme Profiling of fish tissues" to SRF's and students from College of Fisheries Sciences, G.B. Pant University of Agriculture and Technology, Pantnagar during July-August, 2006.

Imparted training to officials from Tehri Hydro Development Corporation, Tehri (Uttarakhand) on various aspects of mahseer breeding through lectures and practical demonstrations during September 4-7th , 2006.

Organized a Training-cum-Workshop on "Fisheries research & development needs in Manipur state" on March 16-17th, 2007 at NEH Research Complex, ICAR, Imphal (Manipur) and on "Fisheries research & development needs in Arunachal Pradesh state" on March 20th 2007 at Rajeev Gandhi University, Itanagar (Arunachal Pradesh).

Research dissertation work was conducted under the supervision of Dr. Rajeev Kapila , Senior Scientist to M.Sc. students from Department of Biochemistry, College of Basic Sciences and Humanities, G.B. Pant University of Agriculture and Technology on the topics entitled " Impact of exposure to cold temperature on metabolic enzymes/proteins of cold water fish *Barilius bendelisis*," and "Impact of cold temperature on metabolic enzymes/proteins of coldwater *Schizothorax richardsonii*" from January-June 2007.

Trainings Attended

Dr. Rajeev Kapila attended a refresher course on " Lab Accreditation by NABL under IS/ISO/IEC 17025:2005" held from May 2-3, 2006 at Consultancy Development Centre (CDC), Ministry of Science and Technology.

Shri Prem Kumar and Shri A.K. Nayak, Scientists (SS) attended a short term course on "Fundamental and Application of Remote Sensing and GIS" held from May 8-12, 2006 at Birla Institute of Applied Sciences, Bhimtal sponsored by Uttaranchal State Council for Science &. Technology, Dehradun.

AWARDS & RECOGNITION

Dr. P.C. Mahanta, Director, NRCCWF, Bhimtal (Nainital) has been awarded Dr. R.C. Dalela Oration-2006 by the Academy of Environmental Biology. He presented lecture on "Conservation and management issues of coldwater fisheries development in India".

Dr. Madan Mohan, Principal Scientist was conferred "Fellowship of the Year-2005 Award" by National Environmental Science Academy, New Delhi conferred at its XIXth Annual Conference at Punjab University Chandigarh during September 16-18, 2006 for his contribution in the field of Fish and Fisheries.

PUBLICATIONS

Research Papers

Basade, Y., Kapila, S., and Kapila R. 2006. Changes in muscle biochemical composition with size in snow trout, *Schizothorax richardsonii* (Gray). Indian J. Fish. 53 (4): 463-467.

Kapila, R. and Mishra, D.P. (2006). Randomly Amplified DNA (RAPD) Fingerprinting of coldwater fish, *Schizothorax richardsonii* (Gray). Indian J. Fish. 53 (2):219-224.

Kapila,R. and Mishra, D.P. (2006) Esterase as molecular marker for identification of genetic variations in coldwater fish, *Schizothorax richardsonii* (Gray). J. Inland Fish. Soc. 38(1):68-71.

Singh, N. O., Bhatia, V.K. and Paul, A.K. 2006. Estimation of Variance Components when Errors are Correlated by Autoregressive of Order One. J. Indian Soc. Agricult. Stat. 60(2): 126-130.

Singh, N.O., Rao. A.R., Wahi, S.D. and Singh, V.P. (2006). Robustness of bootstrap estimates of variance of heritability to master sample in half-sib analysis. Indian J. Anim. Genet. Breed. 27 (1,2):6-11.

Book Chapters

Chauhan, D.P.S., Chauhan R.S., Dehadrai P.V., Kuldip Kumar, Mohan, M., Mahanta P.C. and Sarangi D.N. (2006). Conservation and management of mahseer. In: Resource book ," Art and Science of Mahseer ,Conservation and Management " published by CIFE & Indian Fisheries Association, Mumbai ,June 2006 pp. 5-30.

Keshavanath, P., Mohan M. and Basade, Y. 2006. Nutrition and feeding of mahseer. In: Resource book produced through a participatory writeshop organized by: Indian Fisheries Association, Mumbai, Central Institute of Fisheries Education, Mumbai and Tata power Company, Mumbai; Sponsored by Ministry of Agriculture, New Delhi, NRC on Coldwater Fisheries, Bhimtal; National Bureau of Fish Genetic Resources, Lucknow, Bay of Bengal Programme, Inter-Governmental Organization, Chennai.

Sunder , S. 2006. Trout farming in Indus river region In Fisheries & Aquaculture in Indus river region (Ed. M.P. Singh Kohli). Indian Society of Fisheries Professionals, Mumbai: 49-66.

Sunder, S. 2006. Sheetjal matsyaki vikas evam anusandhan ki aawashaktayen. Jaldhi, CIFT, Cochi: 17-24.

Training Manuals

Tyagi, B.C. 2006, Emerging trends in coldwater fisheries research. A training Manual: NRCCWF, Bhimtal 117p.

Tyagi, B.C. and Singh, N.O. 2006. Brood stock management and seed production of Himalayan mahseer. A training manual: NRCCWF, Bhimtal 98p.

Abstracts/Papers submitted to seminars/Symposia/Workshops

Kapila, R. 2006. Selective expression of myosin isoform and variations in ATPase due to cold adaptation in snow trout (*Schizothorax richardsonii*). In "26th Annual Session of The Academy of Environmental Biology and National Seminar on Environmental Scenario: Challenges and Solutions" held from December 23-25, 2006 at School of Environmental Biology A P S University, Rewa (MP) 023 (22p).

Kapila, R. 2006. Vashwaik Ushmata ka Matsya Kriya Pranali Evam Jeev

Rasayan Vigyan Par Prabhav. In Regional Workshop on " Meedajal Matsaya Vividhta : Uttari Bharat ka Parvatiya Rajyo mai Tikau Matsyaki hatu Sanrakshan and Parvandhan" organized at NBFGR Lucknow on April 24-25,2006.

Kumar P. and Nayak, A. K. 2007. Matsyaki mein bhougolik suchana tantra (GIS) ka upayog. In National Workshop on "Matsyaki Anusandhan evam Vikas – Disayein aur Ayyam" organized at Central Inland Fisheries Research Institute, Barrackpore during March 17-18, 2007.

Mahanta, P.C. and Sunder, S. 2006. Status of exotic fish species in upland waters of India" In : National Workshop on "Fish introduction in India: status, challenges and potentials" Sept. 16-17th,. NBFGR, Lucknow.

Mohan, M. and Basade, Y. 2006. Artificial feeds for coldwater fish culture in India. In: 'International Symposium on Sustainable Fisheries Development for Food and Health Security' organized by College of Fisheries, KVAFSU, Manglore during December 20-21, 2006. pp. 36.

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Nayak, A. K., Haldar, R.S. and Kumar P. 2006. Seetajal Matsyaki Database – ek Upayog. In Regional Workshop on "Meethajal Matasya Vividhata: Uttari Bharat ka Parvatiya Rajyo mein Tikau Matsyaki hetu Sanrakshan and Parvandhan" organized at NBFGR, Lucknow on April 24-25, 2006. p94.

Singh N. O., Alam, M. W. and Paul, A. K. 2006. Length-weight Relationship and Growth Pattern of *Tor putitora* (Hamilton) under Monoculture and Polyculture Systems: A Case Study In: 60th Annual Conference of ISAS, held at IASRI, Pusa Campus, New Delhi, during December 27 – 30, 2006.

Singh, N.O. Kumar, S. and Mahanta, P.C. 2006. Multivariate Statistical Analysis of Water Quality Data in Narmada River In: 60th Annual Conference of ISAS, held at IASRI, Pusa Campus, New Delhi, during December 27 – 30, 2006.

Sunder, S. 2006. Prospectus of mahseer culture in NEH region" In : Workshop on " Fisheries research & development needs in Manipur state" held at NEH Research Complex, ICAR, Imphal (Manipur) organized by NRCCWF on March 16-17th, 2007.

Sunder, S. 2006. Trout culture strategies in Arunachal Pradesh. In: Workshop on " Fisheries research & development needs in Manipur state" held at Rajeev Gandhi University, Itanagar (Arunachal Pradesh) organized by NRCCWF on March 20th, 2007.

Sunder, S. 2006. Culture prospects of mahseers from Indian scenario. In: National Seminar on "Conservation and rehabilitation of golden mahseer in rivers of north east India" organized by Assam (Bhorelli) Angling & Conservation Association at ECO-CAMP village, Potsali, Tejpur (Assam) held during October 26-27th, 2006.

Sunder, S. and Mohan, M. 2006. Uttar-purvi kshetron ki sheet jal matisyaki evam sansadhan. In : Rashtriya Sangoshthi- "Bharat ke Uttar- purvi rajyon ki matisyaki" organised by CIFE, Mumbai at Guwahat during December 6th, 2006.

LIST OF ONGOING PROJECTS

Title of the Project	Project Leaders and Associates	Year of Start	Likely Year of Termination
Institutional Projects			
Characterization of Fishery resources of Uttarakhand by using Geoinformatics and development of computerized database on coldwater fishes of India.	Sh. Prem Kumar Sh. A.K. Nayak Sh. N.O. Singh	2004	2007
Studies on bio-chemical mechanism of cold tolerance in coldwater fish, *Schizothorax* richardsonii.	Dr. R. Kapila	2004	2007
Evaluation of indigenous ingredients and feed supplements for feed formulation of indigenous upland fishes of Kumaon region.	Dr. Y. Basade Dr. M. Mohan	2005	2007
Studies on induced maturation and seed production of Himalayan mahseer, *Tor putitora* and *Schizothorax richardsonii* in pond environment.	Dr. B.C. Tyagi Dr. Shyam Sunder Sh. Prem Kumar Dr. R. Kapila	2005	2008
Cage culture of fishes in floating cages in subtropical Himalayan lake-Bhimtal.	Dr. M. Mohan Dr. S. Sunder Dr. Y. Basade	2005	2008
Externally Funded Project			
Artificial propagation and seed raising of Chocolate mahseer, *Neolissocheilus hexagonolepis* in Arunachal Pradesh.	Dr. B.C. Tyagi Sh. B.M. Laskar Sh. Azen Pujen	2003	2006
ICAR-Mega seed project "Seed Production in Agriculture crops and fisheries".	Dr. Madan Mohan	2006	

PARTICIPATION IN CONFERENCES/ MEETINGS/ SYMPOSIUM/ SEMINARS/ WORKSHOPS

Conferences/Meetings/Symposium/Seminars/Workshops	Participants
Freshwater Fish Diversity: Conservation and Management for Sustainable Fisheries in Hill States of Northern India organized by NBFGR, Lucknow from April24-25, 2006.	Dr. P.C. Mahanta
Meeting of the National Committee on Exotics held at Krishi Bhavan, New Delhi on April 26, 2006.	Dr. P.C. Mahanta
National Consultation on Water Management in Fisheries and Aquaculture at NAAS, NASC Complex, New Delhi on June 23-24, 2006.	Dr. P.C. Mahanta Dr. B.C. Tyagi
Expert consultations meet in Fisheries Sector during XIth Plan period organized by TIFAC at NASC, New Delhi on June 25, 2006.	Dr. P.C. Mahanta
Inauguration function of NFDB at ANG Ranga University, Hyderabad on August 9, 2006.	Dr. P.C. Mahanta
National Seminar " Conservation and rehabilitation of the Golden Mahseer (*Tor putitora*) in the rivers of North East India" at Nameri organized by Assam (Bhorelli) Angling and Conservation Assiciation on October 26 & 27, 2006.	Dr. P.C. Mahanta
Seed Certification Meeting at NASC on November 2, 2006.	Dr. P.C. Mahanta
Zonal Workshop on Policy Issues and HRD in Fisheries and Aquaculture for North Eastern States organized at Guwahati on December 7 - 8, 2006.	Dr. P.C. Mahanta
National Consultation on "Entrepreneurship for Industrial Aquaculture" at Kolkata on December 9, 2006.	Dr. P.C. Mahanta
Awareness-cum-Interface meet on Aquaculture and Fisheries organized by NBFGR, Lucknow in collaboration with Department of Fisheries, Government of U.P. sponsored by NFDB on December 21, 2006	Dr. P.C. Mahanta
Workshop-cum – Training programme at Imphal under NEH component on March 16-17, 2007.	Dr. P.C. Mahanta
Training/ Workshop on "Fisheries research & development needs in Manipur state" on March 16-17th, 2007 at NEH Research Complex, ICAR, Imphal (Manipur).	Dr. Shyam Sunder
Training/ Workshop on "Fisheries research & development needs in Arunachal Pradesh state" on March 20th, 2007 at Rajeev Gandhi University, Itanagar (Arunachal Pradesh).	Dr. Shyam Sunder

Employment awareness programme" organized by District Industrial Centre, Haldwani at Mangoli on May 18, 2006.	Dr. Shyam Sunder
National seminar on "Conservation and rehabilitation of golden mahseer in rivers of north east India" organized by Assam (Bhorelli) Angling & Conservation Association at ECO-CAMP village, Potsali, Tejpur (Assam) on October 26-27th, 2006.	Dr. Shyam Sunder
Meeting on Mega Seed project and Network Project on Fish Feeds and Feed Technology at CIFA Bhubneshwar during April 6-8, 2006.	Dr. Madan Mohan
Workshop on 'Conservation and Management of Mahseer' organized by CIFE Mumbai along with the Indian Fisheries Association and Tata Power Company Ltd. at Lonavala during June 17-21, 2006.	Dr. P.C. Mahanta Dr. Madan Mohan
"Meeting on the National Seed Project" organized by Directorate of Seeds at NASC, New Delhi on June 27, 2006.	Dr. P.C. Mahanta Dr. Madan Mohan
XIXth Annual Conference of the National Environmental Science Academy, organized by Panjab University at Chandigarh during 16-18th Sep. 2006	Dr. Madan Mohan
Meeting on "Prioritization in Biotechnological research in fisheries and aquaculture during XIth plan" under the chairmanship of DDG (Fy), ICAR held at NRCCWF during September 22-23rd, 2006	Dr. P.C. Mahanta Dr. Madan Mohan Dr. Shyam Sunder Dr. B.C. Tyagi Dr. Rajeev Kapila Dr. Yasmeen Basade Sh. Prem Kumar Sh. A.K. Nayak Sh. N. Okendro Singh
National Seminar on "Environmental Scenario: Challenges and Solutions" organized by School of Environmental Biology, Awadhesh Protap Singh University, Rewa and The Acedemy of Environmental Biology, Lucknow from December 23-25, 2006.	Dr. P.C. Mahanta Dr. Rajeev Kapila Sh. Prem Kumar
33rd Annual Conference of the Indian Immunology Society" organized by Department of Biochemistry, All India Institute of Medical Sciences, N. Delhi from 28th-31st January,2007.	Dr. Rajeev Kapila

National Workshop on "Fish Introduction in India: Status, Challenges and Potentials" organized at NBFGR Lucknow on September 16-17, 2006.	Dr. Rajeev Kapila Sh. A.K. Nayak
Regional Workshop on "Meethajal Matasya Vividhata : Uttari Bharat ka Parvatiya Rajyo mein Tikau Matsyaki hetu Sanrakshan and Parvandhan" organized at National Bureau of Fish Genetic Resources, Lucknow on April 24-25, 2006.	Dr. Rajeev Kapila Sh. A.K. Nayak
Workshop for Nodal Officers on Personnel Management Information System Network in ICAR (PERMISnet) organized by Indian Agricultural Statistics Research Institute, New Delhi from July 21-22, 2006.	Sh. A.K. Nayak
Workshop on "Hotspot Geoinformatics" organized by Indian Society of Agricultural Statistics held at Indian Agricultural Statistics Research Institute, New Delhi, India, on 26th December 2006	Sh. N. Okendro Singh
International Conference on "Statistics and Informatics in Agricultural Research" held at Indian Agricultural Statistics Research Institute, New Delhi, India, during 27 – 30 December, 2006.	Sh. N. Okendro Singh
Meeting on "Priorities in Social Sciences Research in Fisheries and Aquaculture during the XIth Plan" held at Fisheries Division, ICAR, New Delhi, during 26 – 27 September, 2006.	Sh. N. Okendro Singh
National Workshop "New Initiative and Fish Germplam Exploration, Cataloguing and Conservation in North East" organized by NBFGR, Lucknow on 5-6 May, 2006.	Dr. B.C. Tyagi
National Workshop on "Hindi use in Science" organized by Rajbhasa Prabandhan avam Vikas Simiti, Delhi at Goa on 8-10 May, 2006.	Dr. B.C. Tyagi
Workshop on "CAPART Schemes and Guidelines" organized by Parvatiya Mahila Gramudyog Sansthan, Bhimtal on 17-18 February, 2007.	Dr. B.C. Tyagi
National Workshop on "Matsyaki Anusandhan evam Vikas – Disayein aur Ayyam" organized at Central Inland Fisheries Research Institute, Barrackpore during March 17-18, 2007.	Sh. A.K. Nayak

RAC, IMC, SRC, QRT MEETINGS

Staff Research Council (SRC)

Annual Staff Research Council meeting of the Institute was held on May 20, 2006 at Bhimtal under the chairmanship of Dr. P.C. Mahanta, the Director. In the meeting the progress of each on-going research project during the year 2005-2006 was critically discussed and evaluated. The work programme for the year 2006-2007 was finalized.

Research Advisory Committee (RAC)

The third meeting of the present Institute's Research Advisory Committee was convened during March 10, 2007 at Bhimtal. Members of the committee attended the meeting.

At the onset the Director welcomed the Chairman and all the Members of the RAC. After the introductory remarks by the committee members and presentation of the Action Taken Report by the Member Secretary, the progress made under each of the research projects for the year 2006-2007 and the new programmes to be taken up for the year 2007-2008 were discussed in detail. The Chairman and the Memberofthecommittee gave recommendations for improvement of the research activities to be taken up. The meeting ended with vote of thanks proposed by the Member Secretary.

Dr. Brij Gopal	Professor and Head, School of Environmental Sciences, Jawharlal Nehru University, Delhi'	Chairman
Dr. Sarvesh Kumar	Professor and Head, Department of Zoology, Kumaon University, Nainital	Member
Shri. N.A. Quareshi	Director Fisheries, Government of Jammu & Kashmir, Srinagar	Member
Dr. D.N. Das	Senior Lecturer, Aquaculture Unit, Department of Zoology, Arunachal Pradesh University, Itanagar	Member
Dr. V.V. Sugunan	ADG (Inland Fisheries) ICAR, New Delhi	Member
Dr. P.C. Mahanta	Director , NRCCWF, Bhimtal	Member
Dr. Yasmeen Basade	Senior Scientist, NRCCWF, Bhimtal	Member Secretary

Institute Management Committee (IMC)

The 9th meeting of the Management Committee of the institute was held on March 9, 2007 at Bhimtal under the chairmanship of the Director, NRCCWF, Bhimtal and the members of the committee attended the meeting. In addition to the Members of Management Committee the Special invitees from the Institute also attended the meeting.

Dr. P.C. Mahanta, Chairman at the outset extended warm welcome to all the members of the Institute's Management Committee for attending the meeting and described the activities of the Institute highlighting the development of infrastructure facilities like establishment of modern aquafeed mill, equipping the Champawat station for GIS studies, making wetlab functional, completion of Phase-I & II of building complex including furnishing of guest house and auditorium, allotment of land for residential quarters and mahseer hatchery by Govt. of Uttaranchal. Dr. Madan Mohan, Principal Scientist briefed the committee about overall accomplishments of the Institute. The achievements made by the Institute in the research front were highlighted by Dr. Shyam Sunder, Principal Scientist. Dr. H.S. Raina, Principal Scientist appraised about the achievements made under farm activities as well as consultancy services rendered by the Institute. During the meeting various agenda items were discussed critically. The Chairman at the end of the meeting expressed his appreciation on the interest and support provided by the members for the overall development of the Institute and hope to get continued support from the members.

Dr. Mahanta	P.C.	Director, NRCCWF, Bhimtal	Chairman
Dr. Sugunan	V.V	ADG (Inland Fisheries) ICAR, New Delhi	Member
Shri. Quareshi	N.A	Director of Fisheries Government of J&K, Srinagar	Member
Dr. AP. Sharma		Dean, College of Fisheries, G.B. Pant University of Agriculture & Technology, Pantnagar	Member
Dr. RS. Pawar		Head, Riverine Division CIFRI Centre, Allahabad	Member
Dr. AK. Laal		Principal Scientist , CIFRI Centre, Allahabad	Member
Dr. S.P. Singh		Senior Scientist NBFGR, Lucknow	Member
Shri. RL. Raina		AAO , NRCCWF, Bhimtal	Member Secretary

Rajbhasha Committee

The regular quarterly meetings of the Hindi Cell of the Institute were convened under the chairmanship of the Director. In these meetings proposals were discussed and approved to improve the use of Hindi language in day-to-day activities of the Institute by the scientific, technical and the administrative members of staff. The Committee members include the following:

Dr. P.C. Mahanta	Director	Chairman
Smt. Sujata Jethi	Asstt. Director (O.L)	Member Secretary
Sh. A.K. Nayak	Scientist (SS)	Member
Smt. Susheela Tiwari	Steno-grapher	Member
Sh. Harish Ram	Assistant	Member
Sh. Amit Kr. Joshi	Hindi Translator	Member
Sh. Ravinder Kumar	T-3	Member

Institute Joint Staff Council (IJSC)

The Institute Joint Staff Council meetings were held regularly at quarterly intervals under the chairmanship of the Director and was attended by all the members from official and staff side. In the meetings action taken on previous agenda items were reviewed and various new agenda items regarding welfare of the staff were discussed. IJSC comprised of the following members:

Official side

Dr. P.C. Mahanta, Director & Chairman
Dr. Madan Mohan, Principal Scientist
Dr. Yasmeen Basade, Scientist (SS)
Sh. Prem Kumar, Scientist (SS)
Sh. A.K. Nayak, Scientist (SS)
Sh. B.C. Pandey, AF&AO

Staff side

Shri. T.M. Sharma, T-2 & Secretary
Shri. Santosh Kumar, T-3 & Member
Shri. Pratap Singh, LDC & Member CJSC
Shri. J.C. Bhandari, LDC & Member
Shri. Ravinder Kumar, SSG-III & Member
Shri Prakash Akela, SSG-II & Member

WORKSHOP / TRAINING CONDUCTED

A Workshop/Training Programme "Coldwater Fisheries Research and Development Needs in Manipur State" was organized by NRCCWF, ICAR Research Complex and State Fisheries Department on 16-17th March, 2007.

A Workshop/Training on "Coldwater Fisheries Research and Development Needs in Arunachal Pradesh" was organized by NRCCWF, Rajeev Gandhi University, Itanagar and State Fisheries Department on March 20, 2007.

Independence Day Celebration

Independence Day was celebrated by unfurling of the National Flag by the Director Dr.P.C Mahanta. The Director addressed the gathering of the staff member and asked the staff members to work in unity towards the achievement of the goals of the Institute. The function was marked by plantation in the premises of the new complex of the Institute by the Director and staff members of the Institute.

NRCCWF Foundation Day

The Institute's Foundation Day was celebrated on September 25, 2006. The

occasion was graced by Dr. H.S. Gupta, Director, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora as a chief guest. He delivered a lecture on Joint Management Programme in Hill Farming. Dr.P.C. Mahanta, Director welcomed all the dignitaries, local masses, students, farmers and staff members and briefed them about the activities of the institute. The programme was concluded with cultural programme.

World Environment Day

Institute celebrated World Environment Day on June 5, 2006. Dr. P.V. Dehadrai, Ex –Deputy Director General (Fisheries), ICAR was Chief guest on this occasion. He delivered the lecture on environmental pollution and global warming. The function was also attended by Professor A.K. Pant, Director Birla Institute of Applied Sciences, Bhimtal and Sh. S. Paliwal,

Incharge, Regional Tasar Research Institute, Bhimtal who delivered lectures for creating awareness among local people and students about environmental issues.

National Science Day

National Science Day was celebrated on February 28, 2007 in the auditorium of NRCCWF, Bhimtal. On this occasion fisheries officers and fish farmers visited the Institute. The Director and scientists

of this Institute explained the activities and contributions of NRCCWF for the development of coldwater fisheries in hill states.

Hindi Pakhwada

In order to promote Hindi as an Official Language Hindi pakhwada was celebrate by the Institute from September 14-20, 2006. During this weeklong celebrations Hindi essay competition, Hindi quiz competition and Hindi typing competition, etc. were

organized. The winners were awarded during the closing ceremony by Dr. H.S. Gupta, Director, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora and Dr. A.E. Eknath, Chief Scientific Director & Senior Vice President, Genomar, Norway who were also present as distinguished guests on this eve. On this occasion one brief rulebook for implementation of official language was also released. Dr. P.C. Mahanta, Director, addressed the gathering and stressed the need to publish a magazine in Hindi every year.

PERSONNEL

List of staff (As on March 31, 2007)

Research Management

Dr. P.C. Mahanta, Director

Scientific

1. Dr. Madan Mohan, Principal Scientist
2. Dr. H.B. Singh, Principal Scientist (Retired on Superannuation on 30.04.2006)
3. Dr. Shyam Sunder, Principal Scientist
4. Dr. B.C. Tyagi, Principal Scientist
5. Dr. Rajeev Kapila, Senior Scientist
6. Dr. Yasmeen Basade, Senior Scientist
7. Sh. Prem Kumar, Scientist (Senior Scale)
8. Sh. A.K. Nayak , Scientist (Senior Scale) from 27.12.2005
9. Sh. N.O. Singh, Scientist

Technical

1. Sh. R.S. Haldar, T-5
2. Sh. Baldev Singh, T-4
3. Sh. Amit Kumar Joshi, T-4 (Hindi Translator)
4. Sh. Santosh Kumar, T-3
5. Sh. Ravinder Kumar, T-3
6. Sh. Vijoy Kumar Singh, T-3 (Joined on 26.07.06)
7. Sh. Amit Kumar Sexana, T-3 (Joined on 28.07.06)
8. Sh. Gopal, T-2
9. Sh. R.K. Arya, T-2
10. Sh. Hansa Dutt, T-2
11. Sh. T.M.Sharma, T-2
12. Sh. Bhagwan Singh, T-2 (Driver)
13. Sh. Manoj Kumar Yadav, T-1 (Driver) (Joined on 26.07.06)

Administrative

1. Smt. Sujata Jethi, Asstt. Director (O.L.) (Joined on 01.04.06)
2. Smt. Susheela Tewari, P.A.
3. Sh. RL. Raina, Asstt. Admn. Officer
4. Sh. B.C. Pandey, AF&AO (Joined on 29.09.06)
5. Sh. Harish Ram, Assistant
6. Smt. Khilawati Rawat, Assistant
7. Sh. P.C. Tewari, UDC
8. Sh. IC. Bhandari, LDC
9. Sh. Pratap Singh, LDC
10. Smt. Munni Bhakt, LDC
11. Sh. H.S. Chauhan, LDC
12. Sh. H.S. Bhandari, LDC

Supporting

1. Sh. SantRam, SSGr.IV
2. Sh. Ravinder Kumar, SSGr.IV
3. Sh. Om Raj, SSGr.III
4. Sh. Dharam Singh, SSGr.III (from 12.12.06)
5. Sh. Sunder Lal, SSGr.III (from 12.12.06)
6. Sh. Manoj Kumar, SSGr.II
7. Sh. Pooran Chandra, SSGr.II
8. Sh. Prakash Akela, SSGr.II
9. Sh. Kuldeep Kumar, SSGr.II (from 20.02.07)
10. Sh. Bhola Dutt, SSGr.II (from 23.02.07)
11. Sh. Chandra Shekhar, SSGr.I
12. Smt. Basanti Devi, SSGr.I
13. Sh. Mangla Prasad, SSGr.I

DISTINGUISHED VISITORS

- Dr.S. Ayyappan, Deputy Director General (Fy.), Indian Council of Agricultural Research, KAB II, New Delhi
- Dr. P.V. Dehadrai, Former DDG (Fy), Indian Council of Agricultural Research, New Delhi
- Dr. M.V. Gupta, Former ADG (International Relationship) World Fish Center
- Dr.A.E. Eknath, Chief Scientific Director & Senior Vice President, Genomar, Norway
- Dr.A.D. Diwan, Asstt. Director General (MFy), ICAR, New Delhi
- Dr. K. Devadasan, Director, Central Institute of Fisheries Technology, Kochi
- Dr. Dilip Kumar, Director, Central Institute of Fisheries Education, Mumbai
- Dr.K.K. Vass, Director, Central Inland Fisheries Research Institute, Barrackpore
- Dr.N. Sarangi, Director, Central Institute of Freshwater Aquaculture, Bhubaneswar
- Dr.W.S. Lakra, Director, National Bureau of Fish Genetic Resources, Lucknow
- Shri V.P. Kothiyal, Director (Works), ICAR, New Delhi
- Dr. H.S. Gupta, Director, VPKAS, Almora, Uttarakhand
- Dr. P. Ravichandran, Director I/c, Central Institute on Brackishwater Aquaculture, Chennai
- Dr.Krishna Gopal, Head, Aquatic Toxicology Division, Industrial Toxicology Research Centre, Lucknow
- Prof. (Dr.) M. Chandrasekaran, Deptt. of Biotechnology, Cochin Univ. of Science & Technology, Kochi
- Dr. T.J. Rasool, Head, Indian Veterinary Research Institute Reg. Station, Mukteshwar, Uttarakhand
- Dr. C.D. Mayee, Chairman, ASRB, New Delhi

IMPORTANT MEETINGS AT NRCCWF

ACTIVITIES IN NEH REGION

ACTIVITIES IN NEH REGION