वार्षिक प्रतिवेदन
ANNUAL REPORT
2002-2003

राष्ट्रीय शीतजल मात्स्यिकी अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

भीमताल-263 136, जिला-नैनीताल (उत्तरांचल)

National Research Centre on Coldwater Fisheries

(Indian Council of Agricultural Research)

Bhimtal-263 136, Distt: Nainital (Uttaranchal)

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NATIONAL RESEARCH CENTRE ON COLDWATER FISHERIES

(Indian Council of Agricultural Research)

BHIMTAL - 263136, District - Nainital (Uttaranchal)

NRCCWF Annual Report 2002 – 2003

Compiling and editing
Kuldeep K. Vass
C.B. Joshi
Yasmeen Basade

Computer composing
Yasmeen Basade

Graphics & Cover designing
A.K. Nayak

Hindi summary
C.B. Joshi
Amit Joshi

Published by
Dr. K.K.Vass
Director, NRCCWF

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- The activities and achievements reflected in this report covers the period from April 2002 to March 2003.
- The material in this report contains the semi-processed and analyzed data of different projects, which will form the basis for the publications of the Centre. Therefore, material may not be used for any publication without written permission of the Centre.
- NRCCWF Annual Report is not a priced publication. Recipients of complimentary copies should use it for scientific purposes only.

CONTENTS

1. PREFACE

During the year 2002-2003 the National Research Centre on Coldwater Fisheries continued its research and extension activities to promote Hill Aquaculture in Uttaranchal and generated valuable database-on Hill Aquatic Resources. Apart from our focus on research activities, the overall growth of the institute in-terms of infrastructure creation, human resource development and outreach to different States was also addressed.

The most important event of the year was organizing a National Seminar on "Aquatic Resource Management in Hills" at ATI, Nainital, on 4-5 October 2002. Shri Mantri Prasad Naithani, Hon'ble Minister of Animal Husbandry, Dairying, Cooperative and Fisheries, Govt. of Uttaranchal, inaugurated the seminar. The Chief Guest while delivering the keynote speech appreciated the role of scientists in developing technologies suited to hill region. The institute was encouraged by participation in the seminar of very eminent people in fishery research, development and policy formulation in the country. The institute is grateful to them for guiding the deliberations and giving valuable inputs in formulating recommendations. The delegates from all hill states and other parts of the country participated and presented their work.

The centre during the year worked on seven projects apart from one NATP on mahseer and one adhoc project on rainbow trout. The institute based projects were focused on Himalayan lakes investigations, biodiversity in hill river systems, nutrition and feed development in coldwater fishes, advancing induce maturation and breeding in exotic carps at high altitudes, mahseer population trait studies from lakes and rivers, technology demonstration in farmer's ponds and computer applications in hill fishery management. The efforts at our farm continued to produce golden mahseer seed for our clients and ranching purposes. For the first time successful rearing of rainbow trout was achieved at the eco-climate of Bhimtal. The breeding activity of rainbow trout was carried out second year in succession at Chirapani experimental farm.

Our interaction and close cooperation with Govt. of Uttaranchal grew from strength to strength. The NRCCWF was intimately involved by the State authorities in drafting the Fishery Policy and Act, which after discussion and examination at various levels in the government has been approved in the State legislature. It has now become a guide for fishery development activity in the State.

One of our achievements under the NATP was successful development of a new conservation site – Shyamlatal Lake in Champawat district for Mahseer, the fishery has established in the lake. The Northeastern region was of special focus, during the year a survey of high mountain lakes in Dibang valley in Arunachal Pradesh was carried out and also State Fishery staff were trained in trout culture at their hatchery in Bomdilla.

Many dignitaries paid a visit to NRCCWF during the year, and the notable among them was the inspection visit on June 18, 2002 of Shri Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture, Government of India to the institute headquarters at Bhimtal. In his remarks Hon'ble Minister stressed to develop simple technologies for poor farmers. Similarly the visits of Shri Nav Prabhat Ji, Hon'ble Minister of State for Forest & Environment, Govt. of Uttaranchal and Shri J.M.Lingdoh, the Chief Election Commissioner, Govt. of India to our experimental farm at Chirapani in Champwat District were notable events.

With regard to awareness activities, during the year institute participated in many exhibitions including KISAN SAMMAN DIVAS, organized both at national and local level for the benefit of farmers and other clients in coldwater sector. We made special efforts during the year to extend our consultancy efforts to the Southern States as well.

All the mandatory meetings of Research Advisory Committee, Staff Research Council, Management Committee, Institute Joint Staff Council, Official Languages Committee, were held as per schedule and actions were taken as per their suggestions for the research and institute management.

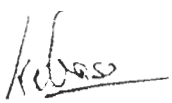
The scientists, technical and administrative staff were provided adequate opportunities for professional participation and manpower development programmes. The construction of NRCCWF complex at Bhimtal is progressing well. Some more facilities were added at mahseer hatchery

I would like to express my sincere thanks to Dr. Panjab Singh the former D.G.ICAR & the Secretary DARE and Dr. Mangla Rai the present Secretary DARE & D.G. ICAR for their support and encouragement extended to NRCCWF. I am grateful to Dr.K.Gopakumar, former DDG(Fy) and Dr.S.Ayyappan the present DDG (Fy) ICAR, for their guidance and support in promoting the institute activities. Time to time support extended to the research and development activities of this centre from SMD by Dr.B.N.Singh, former ADG (IFy) the present ADG (IFy) Dr. V.R. Chitranshi, Dr.A.D. Diwan, ADG (MFy), and Dr.Anil Agarwal is thankfully acknowledged.

All members of NRCCWF family worked in the spirit of unity, integrity and commitment to achieve the overall progress highlighted in this report.

I hope that persons and organizations interested in hill aquaculture and aquatic resource management will find the information presented in the report useful and informative.

I am thankful to Dr.C.B.Joshi, Principal Scientist and Dr. Yasmeen Basade, Scientist (Senior Scale) for their efforts in compiling the basic draft of this report and to all other colleagues who have contributed to this effort. The help rendered by Shri Ashok Nayak, Scientist and Smt. Susheela Tewari, Steno, in computer processing is thankfully acknowledged. Shri Amit Kumar Joshi has rendered his assistance in Hindi Translation of the summary, which is dully acknowledged.



Bhimtal (Nainital)
July 03, 2003

K.K.Vass
Director.

2. EXECUTIVE SUMMARY

The National Research Centre on Coldwater Fisheries (NRCCWF) was established in September 1987 by Indian Council of Agricultural Research (ICAR) entrusting the responsibilities of conducting and promoting research on coldwater fisheries, aquaculture and aquatic resource management in the hill regions of the country. The Centre is located at Bhimtal, district Nainital in the State of Uttaranchal. The Centre at present has ten scientists, eleven technicians, nine administrative and fifteen supporting personnel. The Institute had a total budget of Rs. 176.00 Lakh for the year 2002-2003.

The Institute veered its research priorities as per the guidelines of the high level Research Advisory Committee (RAC) comprising mostly of eminent professionals from the field of fisheries keeping in view vision 2020 and recommendations of QRT. The Centre also has a Management Committee. A number of internal committees such as Staff Research Council, Institute Joint Staff Council, Official Language Committee, Consultancy Processing Cell, etc. are for institute management

Since its inception, NRCCWF, inspite of limited scientific and technical manpower and meager facilities has made significant contribution for proper appraisal of coldwater fishery resources and evolved suitable technologies to propagate important coldwater fish species in hills. Continuing its efforts, the Institute during the year focused its attention on overall performance which involved research, transfer of technology, human resource development, public awareness programmes, establishment of linkages and institutional building activities.

The research programmes are designed with major thrust on Openwater Fisheries, Aquaculture and Transfer of Technology. During the year the Institute worked on seven research programmes apart from a NATP project for which this institute is a nodal centre.

Openwater fisheries:

Ecological modeling and fishery enhancement in Himalayan wetlands

Detailed investigation of central Himalayan lakes in Kumaon and Garhwal regions have already been made during previous years and data on physico-chemical characteristics, primary production and biological status of Kumaon lakes have been analysed to workout the relationship between the biological productivity and sustainable fish yields in these wetland of Kumaon. "Winter Fish Kill" in Kumaon lakes has emerged as a specific problem killing number of fish species during the severe winters when mercury falls below 5^0C. To assess the problem, the investigations on some limnological parameters and fish life were made and it has been concluded that the impaired environment is basically the factor behind this mass killing of fishes. Since there is no surface run off and no renewal of the lake water, the organic waste deposited in lake bottom triggers many physiological changes such as depletion in oxygen level, releasing of toxic substances like ammonia and hydrogen sulphide which ultimately stress the fish population, consequently results in mortality. Like Nainital lake, the Naukuchiatal lake has also been subjected to such intense biotic pressure with heavy nutrient loading resulting in anoxic conditions unwarranted for fish population sustaining in the system.

Resource assessment and aquatic biodiversity characteristics in central Himalayan river systems

Fish habitat structure and species richness in Ganga & Yamuna river stretches located in Garhwal region of Uttaranchal State in Central Himalayas, covering seven main streams and their tributaries have been investigated. Changes in the structure of habitats, current velocity, and biotic communities were studied for evaluating aquatic biodiversity. In all fifteen sampling sites located at different tributaries of Ganga river system *viz.* Ganga, Bhagirathi, Bhilangna, Mandakini, Alaknanda and Pinder were investigated. Numerous factors contribute to biodiversity status in upland streams ranging from bio-geographical or historical events to the variability of the physical habitats and corresponding germplasm inhabiting these resources. This belt of the Himalaya is generally subject to large disturbances (floods and droughts), and is less stable ecosystem, with

lower biodiversity than its counter part in plains. A few natural sanctuaries and reserve areas act as refugee for many species.

Trait and gender of upland endangered mahseer, *Tor putitora*

The populations of mahseer, *Tor putitora* in rivers and lakes have been remarkably imperiled on account of the ruthless exploitation, habitat loss and wanton killing of this prized fish of uplands. Further, significant environmental pressure emanating from illegal fishing through dynamiting, poisoning and also due to change in drainage, gravel extraction, canalization of large rivers and damming result in population decline. This elegant mighty mahseer fish is being affected in terms of poor catches and also for loss of certain traits, which are important for domestication of this fish. Besides there is a significant variation in the sex ratio with males dominating in most of the populations. This phenomenon itself appears to be a constraint in self-recruitment of this endangered fish in nature. To address the issue we studied various traits viz., the differential growth rates, maturity stages and sex ratio in the riverine as well as lacustrine populations for determining the stocks with the potential performance for sustainable reproductive management. Further, efforts were also made to scrutinize the sex-linked biochemical parameters in different stocks for using them as markers in sex identification.

Aquaculture:

Nutrition and feed development for indigenous upland fish species

Feeding trial with the test diets: trout feed, NRCCWF-II diet and NRCCWF-III diet on growth performance, feed efficiency and survival of golden mahseer juveniles indicates that fish fed with trout feed had significantly ($P<0.05$) higher net weight gain, percent weight gain, SGR, FCE and better FCR compared to fish fed with NRCCWF-II and NRCCWF-III diets. Suggesting that trout feed is advantageous over NRCCWF-II and NRCCWF-III diet for the growth of golden mahseer juveniles.

Fish fed with practical diet (NRCCWF-III) having 40% dietary protein level exhibited significantly better growth performance and feed efficiency compared to fish fed with the semi-purified diets viz., NRCCWF-I and NRCCWF-II having dietary protein level of 50% and 45%, respectively.

Moreover, the cost of NRCCWF-III diet was lower than the cost of NRCCWF-I diet and NRCCWF-II diet. The expensive ingredients of NRCCWF-I diet viz., casein, cod liver oil, yeast extract and chitin, which were responsible for price escalation, were completely replaced by less expensive ingredients in NRCCWF-III diet like fish meal and vegetable oil. Hence, fishmeal based practical diet was found to be advantageous over the semi-purified (NRCCWF-I, NRCCWF-II and Trout feed) diets for rearing of golden mahseer juveniles.

Induced ovarian development, maturation and spawning of exotic carps in uplands

Water temperature was found to be limiting factor for maturation and embryonic development of grass carp and silver carp. Grass carp and silver carp females under normal circumstances at high altitude (1620 m asl) with 5.3-27.2^{0}C water temperature range and 9-11hrs photoperiod attain maturity in 7th year. While male fishes of these species attain maturity a year ahead of the females. To advance the maturation period, the maturity inducing hormones like HCG @ 250-300IU and PG extract plus ovaprime in 3:1 ratio @ 3ml/kg were found to be effective in advancing maturation period by 1-2years when water temperature was raised to 18.0-26.2^{0}C by erecting poly house.

In grass carp ovaprime was found to be more effective agent when injected at a dose of 1.4-2.0ml/kg in 3 fractional doses in females within 10-16hrs and 0.5-0.8ml/kg in males when injected within 8hrs. At a temperature of 23^{0}C fish spawned naturally while at lower temperature of 17.2^{0}C fish were hand stripped.

The critical temperature for the embryonic development was found to be 22.2-26.0^{0}C and stage of twitching movement was observed after 29hrs at this temperature. At water temperature below 21.5^{0}C, heavy mortality of developing eggs and hatchlings in both flowing water and stagnant water conditions occurred.

Hence, by applying maturity inducing hormone and raising water temperature through poly house in coldwater areas, the maturation period of these species can be shortened.

NATP programme

The NATP programme with three co-operating centres located at Srinagar (Jammu and Kashmir), Palampur (Himachal Pradesh) and Pantnagar (Uttaranchal) is functioning as per schedule and has generated significant information on resources of mahseer and developed technology for its culture under different agro-climatic regions.

To conserve this important germplasm, the data collected from the mahseer resources on eco-biological parameters and fisheries unfolded the scientific information on ecological status and catch statistics of mahseer streams including its migration, spawning, seed resources, sanctuaries and sport fisheries awareness, etc. Based on the data on species availability, natural food availability and productivity status, the streams have been characterised for mahseer sport as well as commercial fishing.

As a conservation and rehabilitation measure, the mahseer are being grown in a natural lake-Shyamlatal in Kumaon hill. The netting operations carried out during the year revealed that the mahseer stocked in the lake in the first phase of the study, has established itself well in the lake and now constitutes a good fishery of golden mahseer in this lake with 97.62% return (120-700 g in weight). With the development of brood stock in the lake the availability of mature spawners for artificial propagation will be ensured, which will open new vistas for conservation and revival of endangered mahseer in himalayan waters. Moreover, the raising of mahseer in the fish ponds in confinement or under running water facilities in hill areas will be helpful to assess its growth performance and survivability in different eco-climatic zones, as well as its compatibility with other fishes like common carp, grass carp and silver carp, which have proved themselves as candidate species in hill farming. With the fabrication and installation of a mahseer hatchery at all the co-ordinating centers the seed production programme for mahseer will get a boost in the region.

Information technology:

Computer application in coldwater fisheries assessment and management

Uttaranchal state was constituted, as the 27th state of Indian Republic on 9th Nov. 2000 comprises 13 districts. As a new state, there is need to collect the information about the fisheries resources in this coldwater

region. This computerized database contains formats and menus, which were designed in Microsoft Visual Basic 6.0 and the relative tables were designed in Microsoft Access for developing a fully computerized databank for coldwater fisheries resource & management. Different forms for data entry on lakes, rivers, reservoirs, ponds etc. were developed. These database formats contains different type of data entry fields. The primary data is being collected to feed on the form for the databank creation. Initially the data for lakes were fed to the format.

Extension activities:

Demonstration of exotic carp farming in upland coldwaters

The demonstration of exotic carp farming popularly known as mixed carp culture involving grass carp, silver carp and common carp with the provision of supplementary feeding and fertilization was continued in the 24 ponds located at different altitude (800-1740m asl) in the district of Champawat and Nainital. One of the fish farmer named Shri. Pitamber Datt Gahtodi village Toli, achieved highest fish production of 8100kg/ha/14 month (6942kg/ha/yr) by producing 162kg fish and sold it @ 70/= per kg. For all the ponds the average fish production was calculated 3508 kg (n=23) being highest 8100kg/ha and lowest 1200kg/ha depending on the culture practices adopted by the farmers. Production rate varied and found linked with the management practices. Among the species grass carp attain the highest weight of 960-1020g when fed well during one growing season. In general, it attained the weight of 372-560g. Common carp also attained the marketable size but silver carp performed averagely as the farmer did not adhere to fertilization schedule.

The programme has motivated more and more farmers especially in district Champawat and Bhimtal area. About 11 more fish farmers may join the programme. On site training programme and resolving the problems of the farmers at their door step have encouraged the other farmers to adopt the fish culture for additional farm income. Self help group has been organized in village Toli to conduct TOT programme.

Seminar organized

The National Seminar on Aquatic Resource Management in Hills was organized by NRCCWF in collaboration with the Society of Biosciences, Muzaffarnagar; UTDASP, Government of Uttaranchal and National Institute of Ecology, Jaipur at the Administrative Training Institute, Nainital from October 4-5, 2002. Shri Mantri Prasad Naithani Ji, Minister of Animal Husbandry, Dairying, Co-operatives and Fisheries, Government of Uttaranchal was the Chief Guest at the inaugural function. Dr. S.N. Dwivedi Ex-Director General, MPCS&T, Bhopal; Ex-Director, CIFE, Mumbai; Ex-Additional Secretary, Government of India presided over the function. Other guests of honour at the function were Dr. S.A.H. Abidi, Member ASRB, New Delhi; Dr. P.V. Dehadari, Former DDG (Fy), ICAR, New Delhi; Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi and Dr. V.P. Agarwal, Secretary General, Society of Biosciences, Muzaffarnagar.

HRD activities:

The scientists, technical and administrative staff members of the Institute were deputed for various training programmes from time to time to upgrade their working skills in their specific work sphere. Many of the scientists of the Institute participated in seminars, symposia, workshops and conferences organized by different scientific agencies and presented their research achievements. The Institute also imparted training to the officials of Nagaland State Fisheries Department on various aspects of coldwater fish culture, breeding and management. The scientists of the Institute appraised the local masses, visiting students, dignitaries, etc. about the different aspects of coldwater fisheries.

Other activities:

The meetings of Research Advisory Committee, Staff Research Council, Official Language and Institute Joint Staff Council were held as per schedule. The various agenda items concerning the respective committees were discussed and guidelines were provided for 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 with genuine spirit of communal and cultural harmony.

3. INTRODUCTION

Establishment and growth

Indian Council of agricultural Research (ICAR) established the National Research Centre on Coldwater Fisheries (NRCCWF) on September 24, 1987 after carving it out from the then Central Inland Fisheries Research institute (CIFRI). The main objective of its establishment was to strengthen fishery research in Coldwater sector, encompassing the Himalayan and Penninsular parts of the country. At present the Centre is operating from rented buildings at Bhimtal, located in the state of Uttaranchal. The Institute has a field centre located at Chirapani in the district Champawat of Uttaranchal state which is operating from January, 1992.

Mandate

- Evaluate and assess the coldwater fishery resources in upland regions
- Develop strategies for their conservation and management
- Conduct research leading to development of suitable technology for farming of indigenous and exotic fish species in uplands
- Study the impact of environmental changes on the aquatic bio-diversity in upland openwaters
- Undertake transfer of technology through training, education and extension programmes
- Consultancy services in different areas like coldwater fisheries development, aquatic ecology and environmental impact assessment

Location

The headquarters of NRCCWF is located at Bhimtal at an altitude of 1470 m asl in the district of Nainital of Uttaranchal 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 Chirapani in Champawat district of Uttaranchal State is about 150 km from Bhimtal.

Faculty

The Institute has eleven scientists including the Director. There are five Principal Scientists (two as per sanctioned cadre and three from career advancement scheme), one Senior Scientist and four Scientists. Nearly 50% of the sanctioned scientist posts are vacant.

Management

A high-powered Research Advisory Committee (RAC) guides the Centre on research planning 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, Institute Joint Staff Council are in place for decentralized management.

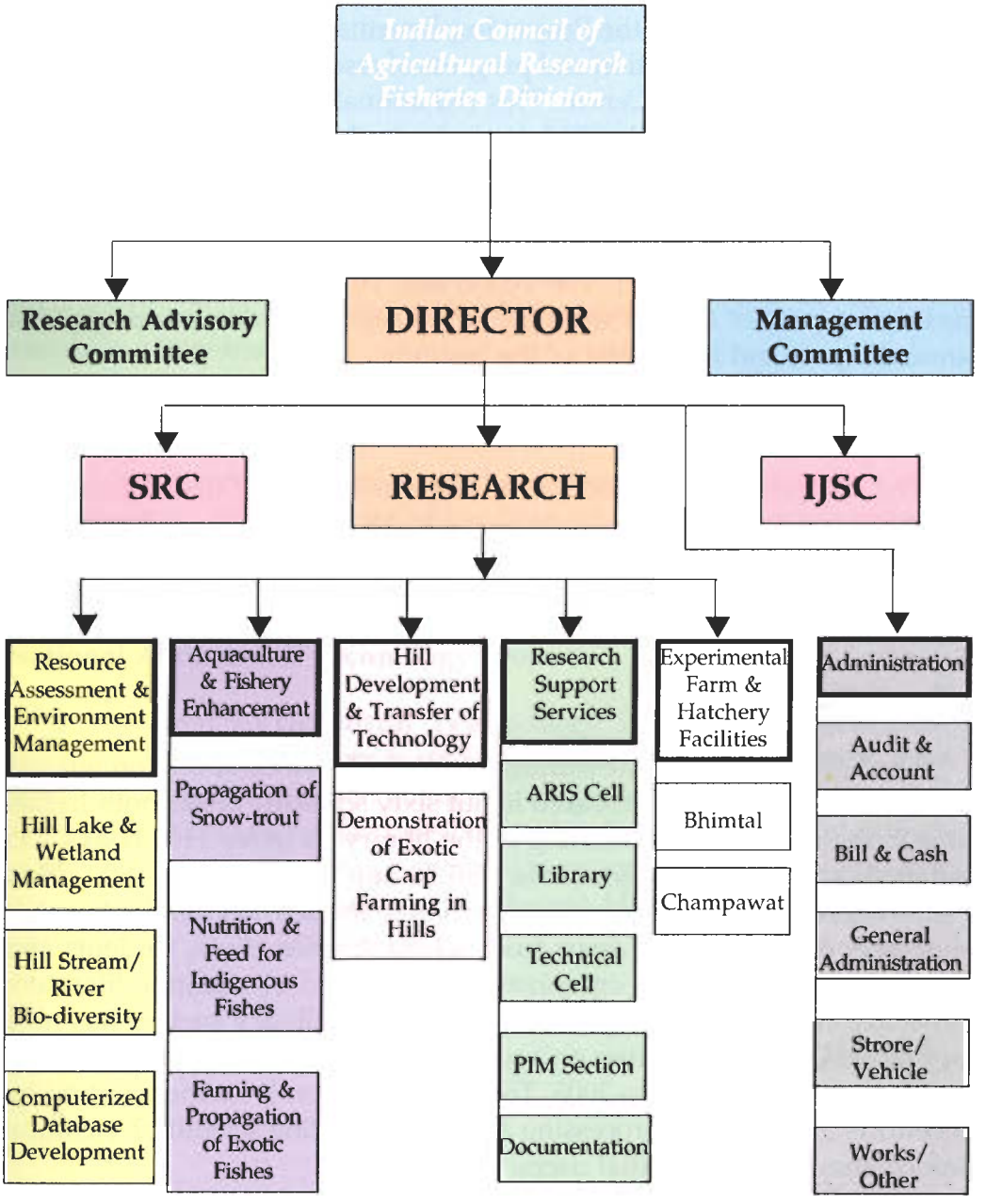
Research Support Facilities

Infrastructure

Building and Farm

The Institute at present is housed in three rented buildings at Bhimtal. A pilot scale mahseer seed production unit is also operating at Bhimtal on the land belonging to the State Fisheries Department, which in addition to the mahseer hatchery houses a laboratory which provides backup facilities to seed production activities of the Centre. The Centre has an experimental fish farm facility at Chirapani in Champawat district of Uttaranchal state which has trout hatchery, cemented raceways for nursery and brood stock rearing, few circular iron tanks for conducting yard trials on various culture aspects of the indigenous and exotic fish species. During the last year the Centre has made a significant headway to create own building facilities at Bhimtal, which includes Lab-cum-Office Complex in Phase-I.

ORGANOGRAM


Indian Council of Agricultural Research Fisheries Division
Research Advisory Committee
DIRECTOR
Management Committee
SRC
RESEARCH
IJSC
Resource Assessment & Environment Management
Hill Lake & Wetland Management
Hill Stream/ River Bio-diversity
Computerized Database Development
Aquaculture & Fishery Enhancement
Propagation of Snow-trout
Nutrition & Feed for Indigenous Fishes
Farming & Propagation of Exotic Fishes
Hill Development & Transfer of Technology
Demonstration of Exotic Carp Farming in Hills
Research Support Services
ARIS Cell
Library
Technical Cell
PIM Section
Documentation
Experimental Farm & Hatchery Facilities
Bhimtal
Champawat
Administration
Audit & Account
Bill & Cash
General Administration
Strore/ Vehicle
Works/ Other

Support Services

Project Implementation and Monitoring Cell

A separate cell called the Project Implementation and Monitoring 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.

Technical Cell

The technical cell shoulders the responsibilities of dealing with all technical matters within and outside the ICAR system. This cell takes care of the training programmes, deputations, participation of scientists in seminars, symposia, workshops, meetings, organizing conferences and HRD activities.

Library Section

The library of the Centre during the year subscribed seven foreign and ten Indian journals and procured about sixty scientific books both Indian and foreign. The current holding of the library includes 1150 books, 215 rulebooks, 1485 foreign journals, 850 Indian journals and 1800 other publications. The library 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 CD-ROM facilities on aquaculture, fisheries and aquatic science for the years from 1971 to 2003. The library section is further continuing its efforts in collection, processing and disseminating scientific/ technical information to the potential users.

Documentation Section

This section is entrusted with the responsibility of publication of scientific bulletins, brochures and pamphlets. During the current year this section published three bulletins and three pamphlets.

ARIS Cell

The computer related facilities are provided to the scientists and other staff members of the Institute by this cell. This cell has made a stride in developing formats to computerize the on-going research project achievements. This cell also shoulders the responsibilities of providing Internet facilities, basic and advanced computer training to the staff members of the Institute.

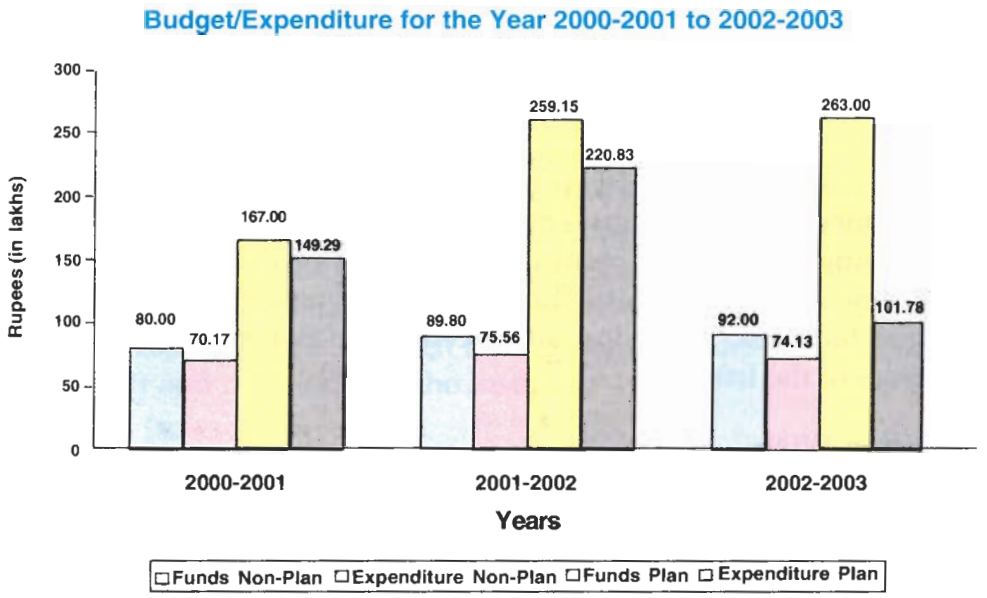
Extension Wing

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

National Agricultural Technology Project

A National Agricultural Technology Project on Aquaculture Management in Coldwaters is under operation at the Institute as a lead centre covering the Kumaon Himalayan region for assessing the mahseer fishery potentials and culture possibilities. Implementation of the approved technical programme of the project and monitoring the progress made by the other cooperating centre in different Himalayan regions is the responsibility of the lead centre.

Financial Statement



Abstract

(Rupees in Lakhs)

Year	Funds Non-Plan	Expenditure Non-Plan	Funds Plan	Expenditure Plan
2000 – 2001	80.00	70.17	167.00	149.29
2001 - 2002	89.80	75.56	259.15	220.83
2002 - 2003	92.00	74.13	263.00	101.78

Budget Statement for the year 2002-2003

(Rupees in Lakhs)

Code	Head of Account	Budget (R.E.)		Expenditure	
		Plan	Non-Plan	Plan	Non-Plan
02	Pay & Allowances	-	75.60	-	63.54
06	Overtime Allowances	-	-	-	-
10	T. A.	3.00	1.00	3.00	1.00
15	Other Charges Including Equipments	70.00	10.50	30.16	7.36
20	Works & Land	185.00	4.40	66.09	2.23
25	Other items Fellowship/ Scholarship/ Awards/NEH Information Technology	5.00	0.50	2.53	-
	Grand Total	**263.00**	**92.00**	**101.78**	**74.13**

Staff Position as on 31-03-2002

S. No.	Category	Post Sanctioned	In Position
1.	Director (RMP)	01	01
2.	Scientific	20	10
3.	Technical	13	11
4.	Administrative	14	09
5.	Supporting	17	15
	Total	**65**	**46**

4. RESEARCH ACHIEVEMENTS

Research achievements during the year under major programme areas of NRCCWF are given below.

Sustainable fishery development in Kumaon and Garhwal lakes

K.K. Vass, H.S. Raina, C.B. Joshi, Yasmeen Basade and A.K. Nayak

During the period under report special emphasis was given to study some important controlling physico-chemical and biological characteristics to assess present status and scope to improve fishery of Nainital lake. Some of the main findings are as under:

Thermal structure of Nainital Lake

Thermal structure of the Nainital lake indicates that the lake falls under *warm-monomictic* type remaining thermally stratified from March to November every year, dividing the whole mass of water into an upper epilimnion and lower hypolimnion. Two markedly separated by a transitional zone called metalimnion or thermocline, the lake becomes homothermal during winter period (from late November to early March). Surface water temperature fluctuated between 7.0 to 23.5^{0}C, with highest and lowest occurring during July and December, respectively. The seasonal profile records indicate that lake starts circulating in December at 11^{0}C but it maintains a temperature difference of 1-2^{0}C in a depth column of 25 m. This temperature profile drops to 8.5^{0}C at surface and 7^{0}C at 25 m in February. By May, a very stable stratification is set-in with surface temperature at 20^{0}C, which drops to 11.5^{0}C at 10 m depth zone and subsequently remains at 10.5^{0}C till 25 m depth zone. In post monsoon months of October and November the surface temperature drops from 17^{0}C to 12^{0}C but the hypolimnion temperature remains around 9^{0}C with stable thermocline. Therefore, lake would in fact circulate only for short period.

The Nainital lake in March records a vertical temperature gradient of 4.0°C between surface and bottom waters, against the gradient of 12.0°C in May. The air temperature during summer did not exhibit marked diurnal fluctuation, whereas during spring it becomes very low at night. Thus, a considerable amount of heat loss occurred during spring from superficial layers, resulting in low vertical gradients compared to the summers. Since upper waters are influenced by the input of radiant heat, the temperature of deep waters did not fluctuate widely but remained between 11.0–12.3°C during the warm period. The gross primary production of this lake ranged between 30.0-85.0 mg C m^{-3} hr^{-1} in summer and 10.0-50.0 mg C m^{-3} hr^{-1} in winters.

Water quality profile

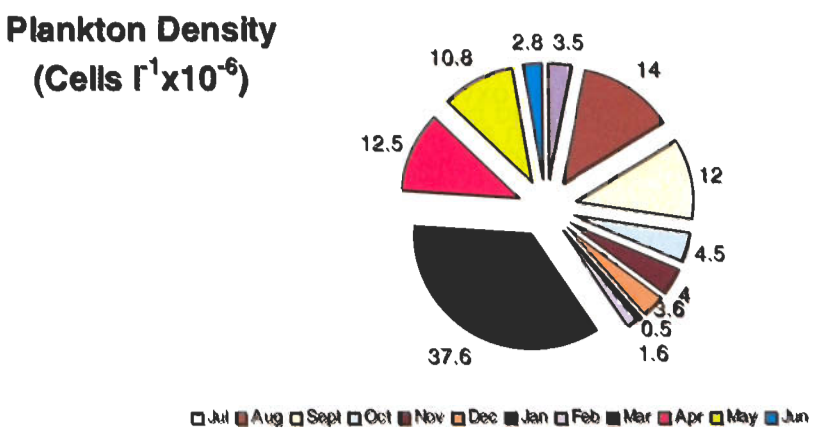
The water remained in alkaline range with seasonal variations, recording high value during June – August and low in winter. The variation ranged from 7.2 – 9.0 in surface to 7.5-8.6 in zones below 5 m depth. However, the difference in pH between surface and 10 m depth zone in summer period was insignificant (0.5 units), while in other months it was slightly higher 1.0 unit. The dissolved oxygen data indicated low concentration at surface ranging between 0.5- 4.2 mg/l. Even these values further drop below 3.0 mg/l in winters. However, with warming of the lake the values sharply increase to 9.0 mg/l at surface but remained constant at 2.0 mg/l at bottom.

The seasonal oxygen profile of lake indicate that in December the surface to 10 m depth column has oxygen in the range of 4.4 to 4.3 mg/l thereafter it drops gradually when at 19 m depth zone anoxic condition exist. The entire column from 10 m down is under oxygen stress. The situation slightly improves in February when after circulation an oxygen profile of 4.3 to 2.48 mg/l is recorded between surface to 25 m depth zone, but these values are also critical for majority of biological communities. In summer during May the surface is well oxygenated at 9.04 mg/l but it drops to 3.2 mg/l by 5 m depth zone and thereafter till 25 m the concentration range between 2.1-1.0 mg/l. During post-monsoon period between October and November, the epilimnion oxygen range between 7.0-6.0 mg/l, which drops near to anoxic conditions by 10 m depth zone. This indicates that in majority of months large volume of lake water is under oxygen stress. Both temperature and oxygen profiles in the lake to a large extent control distribution of fish species and their potential production.

Biological profile

The lake supports a massive growth of algal phytoplankton often forming blooms except during winter. The algal density varied from $2.4x10^{-6}$ to $37.6x10^{-6}$ cells l^{-1} with two peaks, a major of $37.6x10^{-6}$ cells l^{-1} in March and a minor of $14x10^{-6}$ cells l^{-1} in August. The spring peak mainly constituted by chlorococcales and dominated by *Chlorella vulgaris* population. The dominant population change from chlorococcales to volvocales during rainy season, when a massive bloom of *Chlamydomonas spp.*, is recorded which persists till mid-autumn. The algal populations decline in the winter season to low levels. Among Chlorophycae, *Closterium acerosum, Eudorina elegans, Cosmarium, Zygnema* were the chief species. Among different groups, green algae was most dominant with high density of *Closterium acerosum* and *Chlamydomonas spp.*, among Cyanophyceae. *Microcystis spp.* peaked during mid-November recording a maximum density of 52,480 col. l^{-1}. The phytoplankton were more abundant in the surface waters, the vertical difference was highest during summer and rainy seasons. The most marked vertical gradient in plankton density existed in August (14×10^{-4} l^{-1}).

Monthly average Phytoplankton density in Nainital Lake



The percent contribution of diatoms to total phytoplankton density remains high for a short period during January (78%). The annual mean percent values were: Green algae 83.4; Diatoms 9.4; and Blue-green algae 5.9. Although, the massive blooms of blue-green algae (*Microcystis* spp.) are reported in the lake during autumn and early winter season, they do not form a sizeable part of the phytoplankton density (because whole colony being counted as single unit). However, when cell count data was converted into biomass (cell volume or fresh weight), the contribution of blue-green algae becomes more important. On this basis, the mean annual percentage composition amounts to green algae (51.5), blue-green algae (34.7), and diatoms (13.0). Therefore, in terms of biomass the phytoplankton population exhibited a major peak in October, which was at variance to cell count peak. This peak was contributed by dominance of blue-green algae, thus the phytoplankton community in Nainital is truly characterized by blooms of blue-green algae.

Table 1: Depth-wise yearly mean algal biomass.

Depth of water column	Range in g m^{-3} (fresh weight)
Surface	>5.0 – 56 .0
01 m	>5.0 – 40.0
03 m	>5.0 – 30.0
05 m	>5.0 – 25.0
10 m	<5.0 – 15.0
20 m	<5.0 – 10.0

The profile of algal biomass reflects that upper column from surface to 5 m is the main productive zone while the biomass beyond 10 m could be constituted by the algal forms which are physiologically inactive. This high biomass positively leads to bloom formation because some of the populations of chlorophyceae and cyanophyceae do not find favour with the fish species available in the lake. This huge biomass upon death and decay add to the nutrient load resulting in oxygen stress.

The zooplankton population in Nainital lake exhibited only a single peak of ($4.8x10^{-5}$ m^{-3}) during October. Although the seasonal pattern was similar to that of the phytoplankton, low zooplankton population (0.1 x 10^{-5} m^{-3}) was recorded during January to March. The population was dominated by Copepods contributing about 84.2% (28.3% cyclopoids; 55.9% diaptomids), whereas rotifers and Cladocerans contributed only 10.5% and 5.3%, respectively, to the total plankton population.

Table 2: Average biomass (mg m^{-3}) and species diversity.

Seasons	Zooplankton biomass (mg m^{-3})(Average / range)	Species diversity	Remarks
Spring	89.3* (2.0 –260.0)	2.08 (2.0-2.25)	* Low values recorded in March and high values in May
Summer	306.6* (250.0-370.0)	1.9 (1.8-2.1)	* Biomass values recorded were fairly well represented.
Autumn	446.6* (220.0-650.0)	0.4 (0.2-0.7)	* Low values recorded in Nov. and high in Oct.
Winter	134.5* (3.0-300.0)	1.6 (1.25-1.85)	* High values recorded in Feb. and low values in Jan.

Among the rotifers the most important species recorded were *Horaella brehmi, Filinia seta, Keratella tropica,* and *Asplanchna brightwelli,* while *Diaphanosoma excisum* was the only dominant cladocera. The Cyclopoids were represented by two permanent species, namely *Mesocyclops leuckarti* and *Eucyclops serrulatus* contributing above 12.0 % in the population.

Phyllodiaptomus blancei, a Diaptomid, constituted the largest zooplankton population (56.3%). Zooplankton population at littoral zones of the lake due to presence of submerged weed (*Potamogeton pectinatus)* is comparatively high as compared to limnetic zones. The Nainital Lake, typical warm sub-tropical ecosystem, has typical sub- tropical species like *Mesocyclops leuckarti, Eucyclops serrulatus, Tropocyclops prasinus, Diaphanosoma excisum, Alona affinis,* among the important components of zooplankton community .

Fish diversity in Lake

In Uttaranchal state, especially lakes are bestowed with valuable fish germplasm . These systems hold large population of both indigenous and exotic cultivable and non-cultivable fish species. The major components of capture fisheries in the state are snow-trout and mahseers. Minor carps and loaches also contribute to the fish biodiversity of the region. The group-wise details are presented in the table below:

Table 3: Group-wise Fish diversity in the lake.

Group/ Subfamily	Indigenous fauna	Transplanted within India	Introduction exotic	Present Status	
				Indigenous*	Exotic**
Cyprininae	05	06	05	02	03
Rasborinae	03	-	-	-	-
Schizothoracinae	02	-	-	01	-
Garrinae	03	-	-	-	-
Nemacheilinae	06	-	-	-	-
Pocciliidae	-	-	01	-	01
Total	**19**	**06**	**06**	**03**	**04**

* *Puntius conchonius* and *Puntius ticto* dominant at littoral zones and *Schizothorax richardsonii* recorded on rare occasion that too from clear parts of the lake.

** *Cyprinus carpio, Ctenopharyngodon idellus* and *Hypophthalmichthys molitrix* recorded in clear and limnetic zones. While *Gambusia affinis* recorded densely on the margins of the lake, does not invade profundal zones.

Problem of *Gambusia affinis* (Mosquito fish)

Kumaon lakes including Nainital lake, about a decade back were stocked with *Gambusia affinis* at the instructions of authorities in Malaria Control Organization with an objective to control malaria in the region. Besides withstanding wide environmental conditions of temperature, oxygen and nutrients it is a typical larvicidal fish and also known to feed voraciously on zooplankton. In Nainital lake it forms dense population towards littoral zones and avoid invading limnetic zones. It is a prolific breeder and reproduces young ones many a times a year.

The population of *G. affinis* in Nainital lake, presently dominates the highly enriched margins of the lake thus impacting the previously dominant fish species of *Puntius* alongwith juveniles of other species. Its superior ability has lead to competitive displacement of other small fishes inhabiting the margins of the lake. This fish as such, does not invade the limnetic zones of the lake has therefore very little impact on important fishes like *Schizothorax richardsonii*, Chinese carps and *Cyprinus carpio*. These fishes normally remain clear in limnetic zones and avoid littoral zones. A general contention among the scientists is that since Nainital lake has developed large population of *G. affinis*, this has contributed to the decline in zooplankton population, consequently the blooms of phytoplankton have increased, but this hypothesis needs to be experimentally evaluated.

It is abundantly clear that stocks of native fishes (*Tor* and *Schizothorax*) in Nainital lake have declined drastically. The reasons for this decline are many but the most significant one being rapid ecological degradation of lake especially its water quality while presence of introduced fish species has marginally contributed to this situation. Some of the native species appear to compete with or survive in the presence of alien species.

Potential yield

The actual fish yield estimation from the lake is difficult due to paucity of required catch data. However, an attempt has been made to indirectly estimate the potential on the basis of food-chain energy available in the system. Based on the energy conversions of the total primary net productivity data as per the published work on the lake, it is estimated that contribution of phytoplankton productivity is 2.9×10^{-6} g cal $m^{-2}y^{-1}$

while macrophytes contribute additional $1.1x10^{-6}$ g cal m^{-2} y^{-1} totaling to $4.0x10^{-6}$g cal $m^{-2}y^{-1}$ as energy source for secondary and tertiary food-chain. Since the fish species in the system mainly feed on primary and detritus chain, this cumulative energy is available to them for sustenance and growth. If we assume all the energy losses through different pathways operating in the lake and with known conversions from the published records, it is estimated that at 0.5% conversion efficiency between total primary productivity and fish, the Nainital lake has a potential to a fish yield of 167.5 kg $h^{-1}y^{-1}$ but on a conservative conversion of only 0.1% the potential will drop to 34 kg $h^{-1}y^{-1}$. Since we are resorting to outside stocking higher potential is expected as estimates of allocthonous energy is not available. On the other hand when we apply the morpho-edaphic- index (MEI) model for potential estimation the production falls in between 0.5 to 0.1% conversion efficiency.

Production enhancement

As per the primary production estimates of the lake and the pattern of food chain, biologically the system is quite rich and this energy can be converted into fish biomass provided scientific management is applied. The production enhancement is quite possible to the tune of 35-70 kg ha^{-1} which will give us an anticipated biomass of more that 2 tonnes from the lake. The right sized fingerlings for the lake stocking can be produced through cage culture of seed at suitable places on the lake. Assuming to achieve a yield of 70 kg $h^{-1}y^{-1}$ and expecting an average growth rate of 250 g per fish per year due to climatic constraints and allowing 20% additional stock for losses the fingerling stocking should be 340 per hectare. This can be executed in two phases. In phase-I it should have a ratio of 40:60 common carp and silver carp and after the water quality improves during phase-II the stocking ratio should be 30:50:10:10 common carp, silver-carp, snow-trout and mahseer. But the existing biological productivity cannot be effectively transformed into fish biomass unless the water quality and nutrient load is reduced to the desirable levels. It is clearly observed that any fish rehabilitation programme will not prove a success unless the acceptable standards are met with. The fishery development and enhancement in the lake will accrue social benefits to the local population. In a tourist place like Nainital the fish produced from the lake will help to establish fast-food joints based on fish products for the tourists, this will help generate local self-employment also.

Establishment of baseline information with respect to aquatic resources and biodiversity with application of GIS

H.S. Raina, Shyam Sunder and A.K. Singh

During the period under report fifteen sampling sites located in different tributaries of Ganga river system were studied *viz.* Ganga, Bhagirathi, Bhilangna, Mandakini, Alaknanda and Pinder. Numerous factors contribute to biodiversity variations in upland streams ranging from biogeographical situation to the variability of the physical habitat and the germplasm inhabiting in these resources. Main findings accomplished during the period under report from these systems are as under:

General Ecology of Garhwal streams

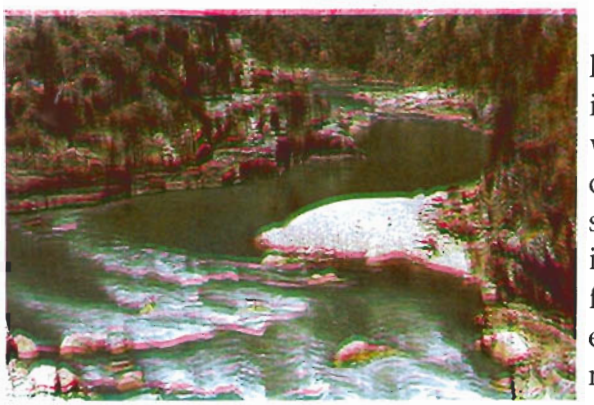
Most of the riverine resources in Garhwal Himalayas are perennial and typical mountain river systems, having glacial or spring origin; while a few have their catchments in the high reaches without snow. Garhwal Himalayas is largely a rugged mountainous belt where the altitude fluctuates between 300 m to 7000 m. Habitat structure in the representative tributaries in Ganga river system, like other systems have substrata consisting of boulders, stones and sand mixed with pebbles in the upper reaches, while at lower it is generally mixture of mud and sand. The flow of these rivers range between 0.8 m/sec. to 4.0 m/sec. with maximum flow in higher reaches and particularly in peak monsoon periods. The catchments of these tributaries are predominately forest, grassland and agricultural land with low population density, thus still free from major nutrient influx or industrial waste. The data on various parameters in different tributaries is depicted in the table 4. The pH in these tributaries is normally alkaline and water highly oxygenated (dissolved oxygen above 8.5 mg/l.) with specific conductivity in the range of 35.0 (Bhilangna) - 100.0 (Bhagirathi) μ mhos (at 25^0C). The carbonate alkalinity was low ranging from 36 mg /l (Nandakini) to 110 mg/l (Bhagirathi).

Table 4: Physico—chemical characteristics of various study sites in Garhwal region.

Characters	Ganga	Bhagirarthi	Bhilangna	Alaknanda	Pinder	Nandakini	Ram Ganga
Air temperature (°C) .	8.5 – 27.0	10.0 – 26.2	12.0-19.0	12.0-27.0	14.0-23.0	12.0-19.0	14.0-6.0
Water temperature (°C)	10.0-18.0	7.0-19.0	9.5-18.0	9.5-15.0	11.0-17.5	9.0- 18.0	11.0-7.5
Water flow (m/Sec.)	1.5-3.0	1.0-2.5	0.9-1.7	1.4-2.2	1.0-2.1	1.3- 2.2	1.0-2.4
pH	7.0-7.5	7.5- 8.0	6.8-7.8	7.0-7.6	7.2-7 .6	7.3-7.8	7.3- 8.0
Total hardness (mg/l)	40.0-47	37.0-48.0	20.0-23.0	28.0-37.0	36.0-45.0	18.0-23.0	22.0-1.0
Alkalinity (mg/l)	40.0-56.0	40.0-110.0	65.0-78.0	41.0-49.0	38.0-47.0	60.0-75.0	34.0-6.0
Conductivity) (μ mhos at 25°C)	65.0-72.0	80.0-100.0	35.0-62.0	62.0-96.0	45.0-76.0	57.0-92.0	72.0-5.0
Calcium (mg/l)	9.0-12.0	12.0-17.0	7.5-10.0	5.9-8.6	7.2-11.0	16.5-21.0	7.2-11.0
Magnesium (mg/l)	0.5- 1.5	1.1-4.3	0.3- 4.3	2.5-3.2	3.2-3.4	2.0- 3.1	1.4-1.8
Chlorides (mg/l)	13.0	9.5	15.2	15.0	17.5	8.7	9.0

Biological profile

Benthic microbiota (Epiphytic)



A Garhwal Himalayan river

The benthic micro-biota in highland waters play a key role in dispersal of insects and fishes which rasp the algae and other organisms growing on bottom stones and forms very important food component of fishes inhabiting these ecosystems. The benthic microbiota studied in these river systems included organisms which grow over the bottom stones as epiphytic organisms in fast flowing streams. The population density of micro-biota was in the range of 0.02 to 1.24 million units/sq.cm. Bacillariophyceae (55.9-92.0%) dominated the bulk of the population in all the rivers and their tributaries. While other groups green algae (Chlorophyceae) contributed 1.2-9.2% followed by blue green algae (Cyanophyceae) 0.5 –13.5%. The population of benthic protozoan and rotifers was negligible. In these waters the periphyton communities comprise *Gomphonema/Cocconeis* association with *Gomphonema* contributing more than 75.0% in upper reaches, particularly in winter months. The *Mastogloia* was the dominat epiphytic form at lower reaches. The principal forms recorded at all the sampling stations were *Gomphonema, Cocconeis, Cymbella, Amphora, Diatoma, Mastogloia, Nitzschia, Microspora, Scenedesmus, Oscillatoria, Centrophyxis, Arcella, Difflugia, Lecane, Trichocerca, Keratella*. The study on microbiota revealed that benthic algae exhibited seasonal periodicity recording a sharp decline with the increased water flow rate.

Plankton

In the fast flowing riverine systems the phyto-plankton play a very important role as compared to zooplankton. The density of plankton ranged between 28-4112 units/l in upper zones of the rivers to 20-11075 units/l in middle and lower reaches. In terms of population structure Bacillariophyceae contributed 12.5 – 96.0% while green algae and blue

green algae contributed very less and was more of a seasonal occurrence. Green algae were more dominant in summer months while blue green during spring. The dominant phytoplankton taxa were *Cymbella, Amphora, Achnanthes, Nitzschia, Cocooneis, Mastogloia, Gomphonema, Fragillaria, Melosira, Navicula, Oscillatoria*. Population density normally declines during snowmelt period (March/April) and during monsoon in the upper reaches. The contribution of zooplankton ranged between 1.0-3.5 % in total population. Their occurrence was as stray specimens represented by *Keratella, Asplanchna, Polyarthra*. The occurrence of these forms coincides with higher water temperature, more frequently in lower stretches of the rivers.

Benthic macrobiota (Benthos)

A succession trend among the benthic communities was registered in the higher reaches of the tributaries. In this succession, Chironomids play a key role and contribute 60% to total density in upper reaches and only 25% in the lower reaches. Occurrence of Simulidae (Diptera) was generally low than expected, probably on account of the Oligotrophic state of waters and low levels of suspended organic matter. Trichoptera are well-represented at all sampled areas. The other groups of insects become consistent in streams and tributaries in lower reaches where the composition of the community changes considerably and typical rhithral groups such as Plecoptera, Ephemeroptera, Trichoptera, Oligochaeta become well established. These tributaries are at low altitude, have gentle slope, moderate summer temperature, higher conductivity and abundance of mosses. In Garhwal upland streams, two principal variables, temperature and stream stability seems to determine the occurrence of taxa.

The richness of macroinvertebrate population both qualitatively and quantitatively reflects high productive nature of the stream. The wet biomass of these organisms ranged between 0.650 – 31.00 g m^{-3} (27– 616 ind m^{-2}). The benthic macroinvertebrate population was dominated by Ephmeroptera (7.0 - 56.0%) followed by Trichoptera (7.2 - 42.0%); Coleoptera (2.0 – 15.0%); Odonata (nil – 4.5%); and Diptera (nil – 4.7%). The study of benthic invertebrates depicted relatively higher occurrence of juveniles of Plecoptera in the upper reaches; while nymphal stages of Ephemeroptera, Trichoptera in association with molluscs. In all 34 genera of benthic organisms were recorded from the various major groups maximum

recorded in Diptera (9 genera). The list of predominant macroinvertebrate recorded in different tributaries are given in table 5.

Table 5: Main macro-invertebrate recorded in Garhwal upland water.

Benthic groups	
1. Ephemeroptera (7 genera) *Baetis, Ephemerella, Iron, Caenis, Rhithrogena, Epeorus, Ironychea.*	4. Odonata (5 genera) *Gomphus, Agrion, Enallagma, Argia, Octogomphus.*
2. Plecoptera (5 genera) *Nemoura, Perla, Isoperla, Perlinella,Allocapnia.*	5. Coleoptera (4 genera) *Elmis, Gyrius, Hydraecna, Promoresia.*
3. Diptera (9 genera) Chironomus, Simulium, Tabanus, Hexatoma, Atherix, Pedicia, Tanypus, Tendepidae, Pericoma,	6. Trichoptera (4 genera) *Leptocella, Rhyacophila, Philopotamus, Hydro psyche.*

Fish Biodiversity

Using the conventional cast nets covering an approximate 500-m stretch area of the stream at each sampling site, the fish collection was made. Twenty one species belonging to three orders five families ten genera were recorded, of which *Schizothorax richardsonii, Tor putitora, Tor chelynoides, Labeo dero, and Labeo dyocheilus* are important food species while others though smaller in size and of low economic value are significant from diversity view point. It appears that fresh water fishes in Garhwal uplands belong to two groups, native species, which are widely distributed in streams and their tributaries and exotic trout, *Oncorhynchus mykiss* introduced in the beginning of 20th century in a few rivers in Chamoli and Uttarkashi district of Uttaranchal (waters of Pinder river). Studies based on evaluation of biodiversity trends with the overall change in habitat, environment in and around the uplands ecosystems, revealed that majority of species are under pressure due to heavy exploitation through illegal means.

Table 6: Piscine diversity in upland riverine ecosystems of Garhwal Himalayas recorded during 2002-2003.

I. Order Cypriniformes Family: Cyprinidae Subfamily: Cyprininae 1. *Labeo dero* 2. *Labeo dyocheilus* 3. *Tor putitora* 4. *Tor chelynoides* 5. *Tor tor* Subfamily:Raborinae 1. *Barilius barila* 2. *Barilius barna* 3. *Barilius vagra* 4. *Barilius bendelisis* Subfamily: Schizothoracinae 1. *Schizothorax richardsonii* Subfamily : Garrinae 1. *Garra gotyla gotyla* 2. *Garra spp.* Subfamily: Noemachellinae 1. *Noemacheilus beavani* 2. *Noemachelius montanus* 3. *Noemacheilus multifasciatus* 4. *Noemachelius botia*	II. Order: Siluriformes Family : Sisoridae 1. *Glyptothorax conirostre* 2. *Glyptothorax pectinopterus* Family : Salmonidae 1. *Oncorhynchus mykiss* *Family:* Belonidae 1. *Xenentodon cancila* III. Order: Perciformes Sub order: Mastacembeloidei *Family: Mastacembelidae* 1. *Mastacembelus armatus*

Table 7: Detail of dominance of fish species and Av. CPUE of two major fishes in Garhwal waters recorded during 2002-2003.

River stretches	Location	% composition of dominant fish species	Av. CPUE (Biomass g m^2)	
			Schizothorax - richardsoni	*Tor putitora*
Ganga	Rishikesh (1160msl)	*Schizothorax richardsonii (80.0-85.0%),* *Tor putitora* (1.0-3.0%),*Garra gotyla* (3.0-4.0%)	1.08	0.58
Bhagirathi	Tehri Dam- I (2770 m asl)	*S. richardsonii* (95.0-98.0%), *Tor putitora* (0.0-1.0 %) *Garra gotyla* (1-2%),	1.82	0.03
Bhilangna	Tehri Dam –II (Dharasu) (2770m asl)	*S. richardsoni* (85.0- 98.0%), *Barilius bendelisis* (2%)	1.72	0.00
Bhagirathi	Devprayag (2650 m asl)	*S. richardsonii* (90-95%), *Labeo dero* (1.0-2.0%), *Garra gotyla* (1.5-3.5%)	1.92	0.64
Mandakini	Rudraprayag (2770 m asl)	*S. richardsonii* (92-98%), *T. putitora* (3.0-5.0%) *Mastacembelus* (1. 5-2.5%), Noemacheilus spp. (0.0-1%)	2.24	0.98
Alaknanda	Rudraprayag (2600 m asl)	*S. richardsonii* (90-95%), *T. putitora* (1.5-2.5%), *Garra gotyla* (3.0-5.0%), *Glyptothorax pectinopterus* (1.0-2.0%)	1.72	0.00
Alaknanda	Karanprayag (2600 m asl)	*S. richardsonii* (85.0-92.0%), *T. putitora* (5.0-7.0%), *Garra gotyla* (1.0-3.0%), *Noemacheilus* (0..5-1.0%) *Glyptothorax pectinopterus* (1.0-2.0%)	2.03	0.42

River stretches	Location	% composition of dominant fish species	Av. CPUE (Biomass g m^2)	
			Schizothorax - richardsoni	*Tor putitora*
Pinder	Karanprayag (2600 m asl)	*S.richardsonii* (92.0-94.0%), *Onchorhynchus mykiss* (0.0-2.2%),*Labeo dychocheilus* (1.0-3.0%), *Garra gotyla* (2.0-5.0%)	1.86	1.02
Nandakini	Nandprayag (3000 m asl)	*S. richardsonii* (82.0-85.0%),*T. putitora* (1.0-2.0%), *Glyptothorax pectinopterus* (3.0-5.0%), *Garra gotyla* (1.0-2.0%)	0.88	1.08
Alaknanda	Nandprayag (3000 m asl)	*S.richardsonii* (88.0-92.0%),*Labeo dero* (3.0-5.0%), *Garra gotyla* (4.0-5.0%),*Mastacembelus* (1.0-3.0%)	0.82	0.00
Ram Ganga	Mehlchauri	*S.richardsonii* (70.0-80.0%),*T. putitora* 15.0-20.0%, *Labeo dero* (5.0-7.0%), *Xenantodon* sp.(0.0-1.0%)	0.42	2.08
Ram Ganga	Gairsain	*S. richardsonii* (75.0-85.0%), *T. putitora* (0.5 –1.5%), *Barilius* spp. (1.0-1.5%) *Noemacheilus* spp. (0.0-1.0%) *Garra gotyla* (0.0-05 %)	0.34	0.78

Nutrition and feed development for upland fish with a focus on indigenous species

Madan Mohan, Yasmeen Basade and Rajeev Kapila

As per the approved technical programme the work was carried out during the year. The results achieved are highlighted as under:

Trial with trout feed:

Experimental design:

Juveniles of golden mahseer were procured from the Mahseer Seed Production Unit of NRCCWF, Bhimtal. The test fish of 0.15g average weight were stocked randomly in nine experimental tanks having flow through water system at a density of 100-fish/ tank. Feeding was carried out with the experimental diets- Trout feed, NRCCWF-II diet and NRCCWF-III diet @ 10% of the body weight in two split doses, once in morning and evening.

Growth performance:

Fish fed with trout feed exhibited maximum net weight gain, percent weight gain and SGR to the order of 0.24±0.02g, 157.78±11.76% and 1.58±0.08 %/day, respectively amongest the three test diets attempted. Fish fed with NRCCWF-III diet in turn had values for net weight gain, percent weight gain and SGR to the order of 0.14±0.01g, 95.55±9.69% and 1.0±0.05%/day, respectively while the fish fed with NRCCWF-II diet had the values for these parameters as 0.12±0.01g, 77.78±8.01% and 0.96±0.07%/day, respectively.

Feed efficiency:

FCR and FCE were better in fish fed with trout feed being 2.25±0.10 and 44.62±2.03%, respectively in comparison to the fish fed with NRCCWF-II and NRCCWF-III diets in which the values were 3.26±0.14 and 30.77±1.39%, respectively and 2.97±0.14 and 33.84±1.68%, respectively.

Survival:

Survival percentage was not affected with the treatments and was found to be 99.11±0.44%, 98.22±1.18% and 99.56±0.44% for fish fed with trout feed, NRCCWF-II diet and NRCCWF-III diet, respectively.

Water quality:

The water quality parameters during the experimental period ranged as follows: water temperature 10-20^{0}C, dissolved oxygen 7.4-7.8 mg/l, free carbon dioxide 1.2-1.6 mg/l, pH 7.0-7.2, total alkalinity 70-72 mg/l and water flow rate 0.3-1.0 l/min.

Trial with test diets:

Experimental design:

Golden mahseer juveniles obtained from river Kosi at Gargia near Ramnagar were used for conduct of the trial. Test fish of 0.8-1.1g initial average weight and 41.80-47.20mm initial total length were stocked randomly in nine experimental tanks having flow through water system at a density of 50-fish/ tank. The test diets: NRCCWF-I, NRCCWF-II and NRCCWF-III were fed to fish @ 5% of body weight in two split doses, once in morning and other in evening.

Experimental diets :

The experiments were run with three diets viz., NRCCWF-I, II and III. The NRCCWF-I diet and NRCCWF-II diet were semipurified diets with dietary protein levels of 50% and 45%, respectively and NRCCWF-III diet was a practical diet with dietary protein level of 40%. The NRCCWF-III diet was developed from NRCCWF-II diet after replacement of casein by good quality fish meal.

Growth performance:

Net weight gain, percent weight gain and SGR were highest in the fish fed with NRCCWF-III diet followed by fish fed with NRCCWF-II and NRCCWF-I diets the values being 1.09 ± 0.03g, 0.75 ± 0.01g and 0.61 ± 0.01g respectively for net weight gain; 100.87 ± 7.07%, 81.40 ± 8.54% and

75.89±1.90%, respectively for percent weight gain and 0.77±0.04 %/ day, 0.66±0.55 %/ day and 0.63±0.01 %/ day, respectively for SGR for the three test diets.

Feed efficiency:

FCR and FCE were better in fish fed with NRCCWF-III diet followed by NRCCWF-II and NRCCWF-I diets having values of 2.25±0.08 and 44.55±1.54%; 2.71±0.22 and 37.39±3.28% and 2.96±0.03 and 33.75±0.30%, respectively. Similarly, PER and DEG were highest in fish fed with NRCCWF-III diet followed by fish fed with NRCCWF-II and NRCCWF-I diets. The values for PER and DEG were 0.72±0.01 and 0.87±0.02kJ/fish; 0.97±0.05 and 0.88±0.08kJ/g and 1.20±0.04 and 1.02±0.04kJ/fish, respectively for fish fed with NRCCWF-I, NRCCWF-II and NRCCWF-III diets.

Survival:

Survival percentage exhibited no significant variation between the treatments and was 93.33±3.33%, 90.0±1.15% and 92.0±1.15% for the diets NRCCWF-I, NRCCWF-II and NRCCWF-III, respectively.

Water quality:

The water quality parameters during the experimental period were- water temperature 9.5-21.0^{0}C, dissolved oxygen 7.6-7.8mg/l, free carbon dioxide 1.6-1.8 mg/l, pH 7.1-7.2, total alkalinity 76-78 mg/l and water flow rate 0.5-1.0 l/min.

Conclusions:

The NRCCWF-III diet was found to be advantageous over NRCCWF-I and NRCCWF-II diets and the trout feed for culture of juveniles of golden mahseer.

Table 8: Performance indicators of golden mahseer fed with the experimental diets.

Parameters	NRCCWF-II	NRCCWF-III	Trout Feed
Duration of study (days)	60	60	60
Initial weight (g)	0.15	0.15	0.15
Final weight (g)	0.27±0.01	0.29±0.01	0.39±0.02
Net weight gain (g)	0.12±0.01	0.14±0.01	0.24±0.02
Percent weight gain (%)	77.78±8.01	95.55±9.69	157.78±11.76
SGR (%/day)	0.96±0.07	1.00±0.05	1.58±0.08
FCR	3.26±0.14	2.97±0.14	2.25±0.10
FCE (%)	30.77±1.39	33.84±1.68	44.62±2.03
Survival (%)	98.22±1.18	99.56±0.44	99.11±0.44

Table 9: Range of water quality in the experimental tanks..

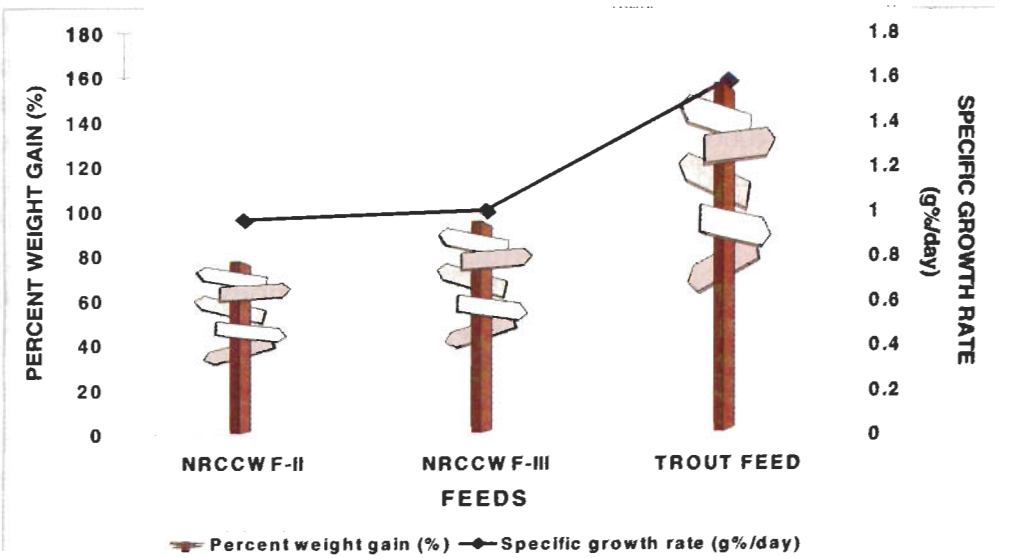
Parameters	Range
Water temperature (°C)	10-20
Dissolved oxygen (mg/l)	7.4-7.8
Free carbon dioxide (mg/l)	1.2-1.6
pH	7.0-7.2
Total alkalinity (mg/l)	70-72
Water flow rate (l/min)	0.3-1.0

Table10: Performance indicators of golden mahseer fed with the experimental diets.

Parameters	NRCCWF-I	NRCCWF-II	NRCCWF-III
Duration of study (days)	90	90	90
Initial length (mm)	41.88±0.53	43.80±2.00	47.20±1.22
Final length (mm)	56.00±1.53	59.33±2.60	68.67±1.20
Initial weight (g)	0.80±0.02	0.94±0.09	1.09±0.04
Final weight (g)	1.41±0.02	1.69±0.09	2.18±0.03
Net weight gain (g)	0.61±0.01	0.75±0.01	1.09±0.03
Percent weight gain (%)	75.89±1.90	81.40±8.54	100.87±7.07
SGR (%/day)	0.63±0.01	0.66±0.55	0.77±0.04
FCR	2.96±0.03	2.71±0.22	2.25±0.08
FCE (%)	33.75±0.30	37.39±3.28	44.55±1.54
PER	0.72±0.01	0.97±0.05	1.20±0.04
DEG (kJ/fish)	0.87±0.02	0.88±0.08	1.02±0.04
Survival (%)	93.33±3.33	90.00±1.15	92.00±1.15

Table 11: Range of water quality in the experimental tanks.

Parameters	Range
Water temperature (°C)	9.5-21.0
Dissolved oxygen (mg/l)	7.6-7.8
Free carbon dioxide (mg/l)	1.6-1.8
pH	7.1-7.2
Total alkalinity (mg/l)	76-78
Water flow rate (l/min)	0.5-1.0



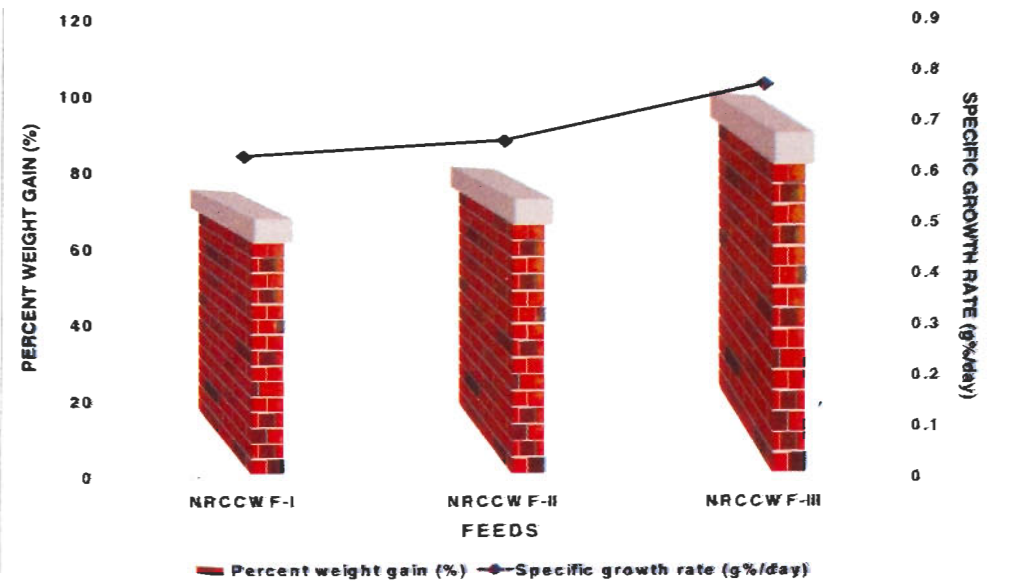


Fig 1. Comparative performance of golden mahseer juveniles fed with the experimental diets.

Estimation of digestive enzymes

Digestive enzyme amylase was estimated in the gut of golden mahseer (*Tor putitora*) before the onset and after completion of feeding experiments. For these studies, intestine of the fish after cutting into small pieces was homogenized at 4000 rmp/min in 0.1 M phosphate buffer (pH 6.9) under chilled conditions and then centrifuged at 5000 rpm to remove the debris. The amylase activity in the supernatant was estimated by incubating 500 microgram starch as substrate. Reducing sugars produced by the action of amylase on starch were estimated by Nelson Somogy method. Protein content of supernatant solutions was determined by Bradford dye binding method-using albumin as the standard.

Amylase enzyme activities were found to increase by 1.25, 1.63 and 1.54 folds after feeding juveniles of mahseer with three formulated diets namely NRCCWF-I, NRC-CWF-II and NRC-CWF-III. The minimum value in case of NRCCWF-I appears to be related to least amount of fiber content. The results are given in the Table 12.

Table 12. Amylase enzyme activity in golden mahseer.

Fish Diets	Amylase activity Before Experiment (U/min/mg of protein)	Amylase activity After Experiment (U/min/mg of protein)	% increase
NRC-CWF-I	0.008± 0.001	0.010± 0.002	25.00
NRC-CWF-II	0.011± 0.002	0.018± 0.003	63.60
NRC-CWF-III	0.014+ 0.002	0.022+ 0.003	57.10

Values are mean ± for ten number of observations.

Induced ovarian development, maturation and spawning of grass carp and silver carp in coldwaters

B.C. Tyagi and K.D. Joshi

The grass carp and silver carp have emerged most favoured cultivable carps in Himalayan uplands. The demand of their seed is on the increase. The studies of last 7 years of this Institute have revealed the maturation and breeding behaviour of these species in coldwaters is different. Normally, at high altitude (1620m asl) the water temperature ranges between 5.3-27.2^{0}C and a photoperiodicity of 9.0-11.0hrs. The species attain maturity in 7th year of their age and responded to ovaprime treatment for spawning. The males of both the species were found oozing one year prior to the females. To advance the maturation period, maturation inducing hormone (MIH) like HCG transplantation @ 250-300IU and PG extract + ovaprime in 3:1 ratio @ 0.3ml/kg at 18.0-26.2^{0}C were found effective to reduce the maturation period by 1-2 years. Better response was recorded in brood stock reared at higher temperature, which was raised by erecting a poly house over the brood stock ponds.

Table 13: Changes in water quality in control and experimental ponds

Parameters	November		December		January		February	
	C	P	C	P	C	P	C	P
Air temp. (^{0}C)	17.7	18.9	11.5	11.9	14.7	14.5	15.2	20.4
Water temp. (^{0}C)	9.8	13.7	5.2	9.3	3.5	8.2	8.8	11.3
Dissolved oxygen (mgl-1)	10.7	11.2	9.4	9.4	10.0	10.4	10.3	10.2
Free carbon dioxide (mgl-1)	2.1	1.9	Nil	1.7	Nil	1.2	Nil	1.6
pH	8.3	8.4	9.0	8.6	8.5	8.7	8.5	8.7

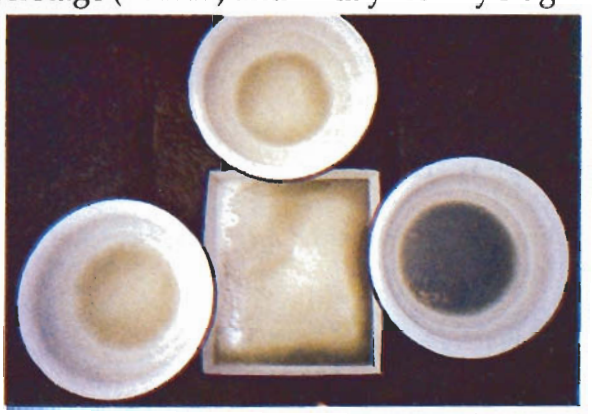
C = Control pond; P = Pond covered with poly house

Matured female grass carp being injected at high altitude

Trapping the solar radiation through poly-house cover to raise the water temperature in ponds located at high altitude is an additional tool along with MIH to advance the maturity of these carps in coldwaters.

Ovaprime (Glaxo, India Ltd.) was found more effective spawning agent when injected at higher doses of 1.4-2.0ml/kg in 3 fractionate doses during 10-16hrs (female) and 0.5-0.8ml/kg in 2 doses within 8hrs (males) in grass carp at 21.5-23.0^{0}C. At lower temperature (17.2^{0}C) fish was hand stripped but spawned naturally at 23.0^{0}C exhibiting vigorous mating behaviour after 8hrs of final injection to both the sexes. The males chased in a row and one male bigger in size caught pectoral fin of the female and pushed its belly against the female. The complete mating took 3.1-3.4hrs having 6-7 spells. The fertilized eggs obtained through natural spawning/ hand stripped were kept in flowing and stagnant water at different temperatures. Critical water temperature for embryonic development was observed to be 22.5-26.0^{0}C and stage of twitching movement was observed after 29hrs at this temperature. Temperature of water below 21.5^{0}C caused heavy mortality of developing eggs and hatchlings in both flowing and stagnant waters. Developing eggs at different stages died quickly at 14.8^{0}C. The fertilized eggs reared at 26^{0}C in stagnent water developed into fish fry (20 mm) and took 114 hrs upto spawn stage (78 mm) and 17 days for fry stage.

The observations recorded under project work indicated that maturity period of these species can be advanced by MIH treatment and raising water temperature by insulating through poly house in coldwater areas. To achieve mass scale seed production of these carps at high altitude coldwaters, further experiments are necessary.



Developing eggs of grass carp at high altitude

Amenability of sex and trait in upland endangered mahseer, *Tor putitora* for sustainable reproductive management

A.K. Singh, K.D. Joshi and Rajeev Kapila

The populations of mahseer, *Tor putitora* in upland rivers and lakes have been imperiled on account of the ruthless exploitation, habitat loss and wanton killings. Further, adverse environmental pressures due to habitat modifications viz., gravel extraction; canalization and damming of rivers have also contributed to population decline. This mighty mahseer apart from poor catches also records loss of certain traits, which are important for its domestication. Besides there is a significant variation in the sex ratio with males dominating in most of the populations. This phenomenon itself appears to be a constraint in self-recruitment of this endangered fish in nature. In this connection studies were initiated on the differential growth rates, maturity stages and sex ratio of the riverine as well as lacustrine populations for determining the stocks with the potential performance and sustainable reproductive management. Further, efforts were also made to scrutinize the sex-linked biochemical parameters in different stocks for using them as markers in sex identification. The whole observations were divided into three groups:

Reproductive polymorphism

Tor putitora of Kumaon lakes is an annual breeder as also in the rivers of Kumaon and Garhwal. It breeds a little earlier than the neighbouring rivers. The examination of the gonads during the spawning and pre-spawning phase depicted the following findings:

i) Resting phase- it occurs during October-November. Ovaries during this stage are light weighing 452±38 mg, thin translucent less vacuolated and whitish in colour.

ii) Maturing phase: This stage is attained during Dec-Feb. The ovary becomes slightly thicker and more translucent than in resting phase. The weight of the ovary becomes 3190±82 mg.

iii) Mature phase: It starts from end of Jan and continues upto end of March. The ovary attains mulberry like structure and its weight further

increases to 9230±36 mg. In later phase of this stage ovary becomes much distended and enlarged. Their colour turns light orange due to increased vasularity.

iv) Pre-spawning phase: It starts from late March . The fish starts shedding nearly mature eggs and ova. The weight of ovary becomes 8020±48 mg with light orange colour.

v) Spawning phase: It starts from late April and lasts upto July or even upto Sept in lakes. At this stage fully ripe ova are shed out and the weight of ovary becomes a little less and becomes 6210± 86 mg in weight.

vi) Post spawning and spent phase: It extends from Aug to Sept. After spawning the ovaries become thin slender and translucent and weighs 180±86 mg.

Table 14: Maturity phases of brood fishes of *Tor putitora*.

Maturity stages	No. of examined specimen	Average length (mm)	Average weight (g)
Resting phase (Oct-Nov)			
Male	7	166(165-180)	210(190-240)
Female	3	210(145-228	330(212-418)
Mature phase (Jan-March)			
Male	9	290-(245-310)	302(260-318)
Female	4	312(290-360)	810(560-1120)
Spawning phase(April-July)			
Male	11	245(234-268)	298(286-322)
Female	5	406(310-480)	870(480-1240)
Post spawning (Aug-Sept)			
Male	12	352(260-398)	510(360-718)
Female	7	432(360-510)	940(662-1380)

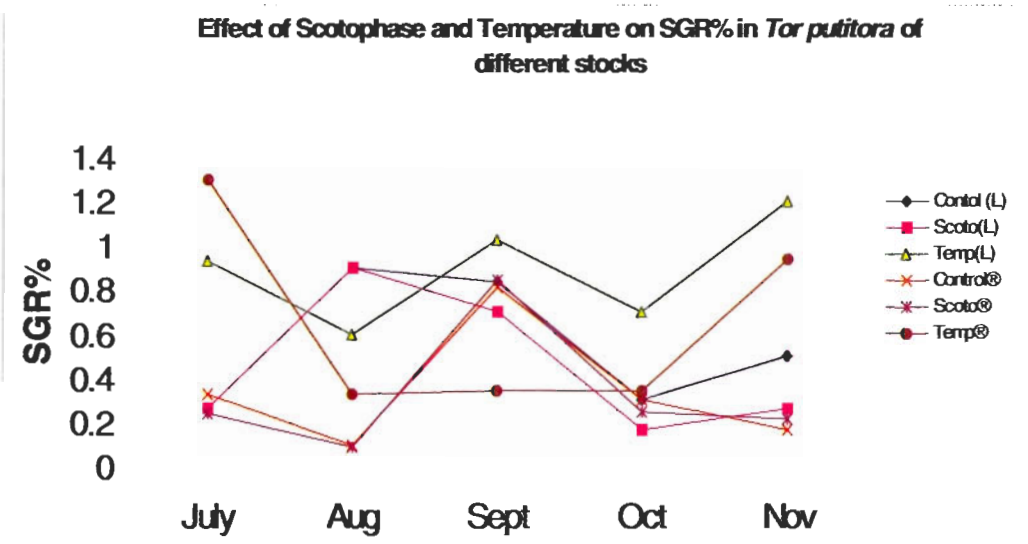
Effect of temperature and scotophase on sex and growth

An experiment was run in glass aquaria and jars to investigate growth pattern and the sex ratio in upland golden mahseer, *Tor putitora* from river

stock as well as lake stock under controlled conditions. The fingerlings collected from rivers and the fry produced by artificial breeding at Bhimtal hatchery were maintained in laboratory conditions. The growth pattern of such river and lake stocks was studied under complete darkness (Scotophase) and temperature (23±1°C). Good quality thermostat heaters were used to control temperature while black sheets were used to cover the glass jars and aquaria for producing darkness. Experiments were run for six months and the effects of scotophase and temperature were studied on both riverine as well lacustrine stocks. Specific growth rate % for length as well as for weight was separately calculated following the formula given by Brown (1957) after monthly sampling and thereafter sex of the fishes were analyzed.

$$SGR\%\ day^{-1} = \frac{\ln W2 - \ln W1}{T2 - T1} \times 100$$

Where W1= initial live weight at time T1 (day) and W2 = final live weight at time T2 (day).



The observations indicated that scotophase brought about more or less depressed growth both in lake and river stocks. Fishes were observed to gradually adjust to the reduced photoperiod since the mortality and food consumption did not vary much as compared to control group. The growth rate percent day^{-1} was significantly influenced by temperature. In the control group the SGR% ranged from 0.266 to 0.90 in the lake stocks while it was 0.095 to 0.81 in the river stocks. It significantly increased when the two stocks were reared at temperature of 23±1°C, which was above 5°C as compared to the control values. The SGR% range in Lake Stock was 0.6 to 1.2 where as it varied from 0.33 to 1.3 in river stocks. The male population ranged from 72-79% for lake stock while it was 63-69% for river stocks under natural conditions. The survival % in different group of experiments was also recoded and it was observed to be maximum (82%) in the experimental group maintained at 23±1°C.

Screening of sex related enzymes

Attempts were also made to investigate the sex-related enzyme activity. The five muscle enzymes were estimated spectrophotometrically as per standard methods. The enzyme values observed did not elicit any significant difference in the various muscle enzymes in relation to sex. One unit of enzyme is defined as the amount, which produced one micromole of product or consumed one micromole of substrate per mg of protein/minute at 37°C.

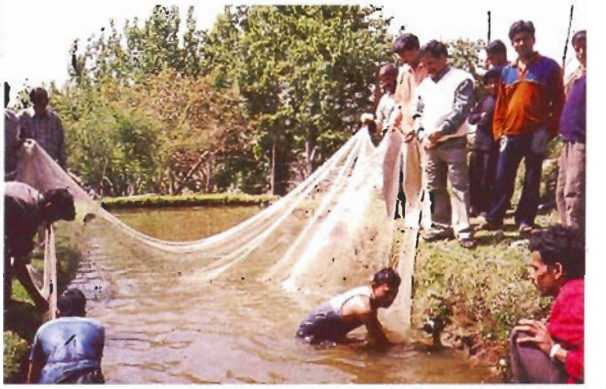
Table 15: Muscle enzyme activities in mature golden mahseer (*Tor putitora*)

Enzyme	Enzyme Commission Number	Units/mg of protein	
		Male	Female
Glutamo oxaloacetate transaminase (GOT)	EC 2.1.1.1	0.165+0.02	0.154+0.02
Glutamo pyruvate transaminase (GPT)	EC 2.6.1.2	0.024+0.03	0.030+0.01
Lactate dehydrogenase (LDH)	EC 1.1.1.27	0.387+0.05	0.402+0.04
Alkaline phosphatase (ALP)	EC 3.1.3.1	0.006+0.001	0.005+0.001
Acid phosphatase (ACP)	EC 3.1.3.2	0.01+0.003	0.015+0.003

Demonstration of exotic carp farming in coldwaters

B.C. Tyagi and K.D. Joshi

The demonstration of exotic carp farming involving grass carp, silver carp and common carp with the provision of supplementary feeding and fertilization was continued in all the 24 ponds located at different altitude (800-1740m asl) in the district of Champawat and Nainital. Fish culture programme were discontinued in 3 ponds located in Bhimtal and Champawat block because of water and other problems. The data collected under this project indicated that these carps can be cultured successfully and achieve good fish production. One of the fish farmers named Shri. Pitamber Datt Gahtodi village Toli, achieved highest estimated fish production of 8100kg/ha/14 month (6942kg/ha/yr) by producing 162kg fish and sold it @ 70/= per kg. For all the ponds the average estimated fish production was calculated at 3508 (n=23) with highest of 8100kg/ha and lowest of 1200kg/ha, depending on the management practices adopted by the farmer's. Regular supplementary feeding @ 2.3% body weight with fertilization resulted in an average estimated fish production of 4271kg/ha/yr. The estimated production decreased as feeding rate was reduced/ and farmers as per schedule did not follow other practices. The use of domestic/ kitchen waste to enrich culture ponds is giving good results, in such ponds the estimated production ranged from 2736 to 4106kg/ha/yr. Among



Neting in a village pond at Toli, Champawat district

Hon'ble Minister Shri Yadav inspecting NRCCWF, demonstration site at Sainik School Road, Gorakhal, Bhowali

different species, grass carp attained the highest weight of 960-1020g during one growing season when fed well. In general, it attained the weight of 372-560g. Common carp also attained the marketable size but silver carp performed averagely as the farmer did not adhere to fertilization schedule to maintain sustained plankton population in the pond.

The programme has motivated number of farmers especially in district Champawat and Bhimtal area. About 11 more fish farmers are likely to join the programme. On site training programme and resolving the problems of the farmers at their door step have encouraged the other farmers to adopt the fish culture for additional farm income. Self help group has been organized in village Toli to conduct TOT programme.

Table 16: Summary of fish production under TOT programme

Total ponds adopted (No.)	:	31
Fish culture in progress (Pond No.)	:	23
Estimated Average production (kg/ha/yr)	:	3508
Estimated Highest production (kg/ha/yr)	:	8100
Estimated Lowest production (ka/ha/yr)	:	1200
Estimated Production under intensive farming (ka/ha/yr)	:	4271
Estimated Production under semi-intensive farming (ka/ha/yr)	:	3100
Estimated Production under moderate farming (ka/ha/yr)	:	2386
Estimated Production under casual farming (ka/ha/yr)	:	1200
Estimated Production under using the kitchen waste farming (ka/ha/yr)	:	3421

Table 17: The Details of ponds under TOT programme and their fish production

S.No.	Farmers Name	Location	Water area (m^2) & (No. ponds)	No. of Crops	Duration of each Crop (months)	Production		Practice adopted	Present status
						kg/m^2/yr	kg/ha/yr		
Pati block, Champawat (1600-1640m asl)									
1.	PitamberGahtodi	Toli	300 (3)	2	8-12	0.42-0.80	4200-6942	Intensive	Restocked
2.	Krishnand	Toli	530 (3)	2	12	0.36-0.62	3600-6205	Intensive	Restocked
3.	Lakshmi Dutt	Barola	330 (2)	1	14	0.34	2914	Semi-intensive	Restocked
4.	Chintamani Bhatt	Gadaiar	260 (2)	1	13	0.32	2964	Semi-intensive	Restocked
5.	Santosh Ram	Lauda	300 (2)	1	10	0.31	3720	Semi-intensive	Restocked
6.	Mahesh Chandra	Toli	200 (1)	1	12	0.38	3800	Intensive	Restocked
7.	Chintamani	Niloti	150 (1)	1	18	0.41	2733	Intensive	Restocked
8.	Shyam Singh	Raulmela	200 (1)	1	12	0.32	3207	Semi-intensive	Restocked
9.	Haridutt	Toli	130 (1)	-	-	-	-	Intensive	In progress
10.	Kishor Chand	Toli	200 (1)	-	-	-	-	Intensive	In progress
11.	Bikram Singh	Jaulodi	200 (1)	-	-	-	-	Intensive	In progress
12.	Suresh Ram	Jaulodi	580 (4)	-	-	-	-	Intensive	In progress
13.	Chatar Singh	Jaulodi	200 (1)	-	-	-	-	Intensive	In progress
Kapkot block, Champawat (1500m asl)									
14.	Hyat Singh Mehra	Izra	200 (2)	1	17	0.24	1698	Semi-intensive	Restocked
Champawat block, Champawat (1600m asl)									
15.	Ishwari Dutt	Phunger	300 (2)	2	9-12	0.40-0.39	3900-5333	Intensive	Restocked
16.	Lakshman Singh	Phunger	180 (1)	1	12	0.28	2800	Intensive	Restocked
17.	Mrs. Manju Tadagi	Champawat	200 (1)	1	9	0.12	1200	Casual	Discontinued
18.	Ambadutt	Kharakbang	300 (2)	1	14	0.20	1842-2000	Moderate	In progress

S.No.	Farmers Name	Location	Water area (m^2) & (No. ponds)	No. of Crops	Duration of each Crop (months)	Production		Practice adopted	Present status
						kg/m^2/yr	kg/ha/yr		
Bhimtal block (800 – 1400m asl)									
19.	Sanik School	Ghorakhal	886 (2)	2	16-18	0.27-0.41	2025-2737	Using kitchen waste and fertilizer	Discontinued for remodeling
20.	Mission Pond	Gethia	180 (1)	1	26	0.60	2769	Moderate	In progress
21.	Birla Instt.	Bhimtal	1056 (1)	1	10	0.15	1938	Moderate	Discontinued due to water problem
22.	J.S. Bisht	Nisola	440 (2)	1	12	0.28	2870	Moderate	Discontinued due to water problem
23.	Pradhanjee	Vohrakund	124 (2)	1	12	0.37	3702	Moderate	To be restocked
24.	S. Narang	Dogaon	62 (1)	2	9-12	0.20-0.48	3768-4800	Intensive	Discontinued due to water problem
Khunt area, Almora (1470 – 1600m asl)									
25-31.	Six farmers	-	120(6)	Due to insufficient water farmers could not initiate the operation.					

Computer application in coldwater fisheries resource assessment and management

A.K. Nayak and K.K. Vass

- **Computerized database for Coldwater Fisheries Resource & Management:**

Initiating resource survey with regard to fisheries in the new State of Uttaranchal required its collection and developing computerized database. In this context the Institute undertook an exercise and developed a methodology which was explained to the State officials involved in survey work. This computerized database contains formats and menus, which were designed in Microsoft Visual Basic 6.0 and the relative tables were designed in Microsoft Access for developing a fully computerized databank for coldwater fisheries resource & management. Different forms for entering data on lakes, rivers, reservoirs, ponds etc. were developed. This database format contains different type of data entry fields. The primary data is being collected to feed on the form for the databank. Initially the data for lakes were fed to the format.

- **Computerization of on – going research projects:**

Database formats have been developed to computerize the ongoing research projects of this Institute. The formats were developed in Microsoft Visual Basic 6.0 and the relative tables were designed in Microsoft Access and they are linked with each other for making a computerized research project database. The project data of this Institute has initially been fed to it. It will be helpful for the scientist to collect the project related information through computerized databank.

- **Computer training Facility:**

During the year, in-house training programme on "Microsoft PowerPoint 2000" and "Advances in Microsoft Word" was organized for the scientist/staff of this Institute. The training was imparted to Scientific, Technical & Administrative staff of this Institute at Bhimtal and its research Unit at Champawat as given below:

i) A special training programme on **"Microsoft PowerPoint 2000"** was organized from 3rd & 4th July 2002 for the scientific category of staff of NRCCWF, Champawat. This training was useful for developing the presentations in the meeting, seminar/symposium etc. and other related works.

ii) Another training was organized on **"Advances in Microsoft Word 2000"** for 17 technical and administrative staff of this Institute during July-September 2002 at NRCCWF, Bhimtal. This training was useful for day-to-day official work and other related works.

- **Web page designing**

The website of this Institute was developed, containing relevant information about the Institute. The site contains information about the institute with photographs of the new complex, experimental fish farm/ hatchery at Bhimtal and field station Champawat. The mandate of the institute with organizational structure and manpower is also reflected. The website also contains the information about the institutional projects and

externally aided projects of the Institute. The major achievement of the Centre on golden mahseer, carps, exotic trout, indigenous snow-trout and the technology generated by this institute is being incorporated in the site. The consultancy services ongoing & finished by this Institute are also being added. The Angling information is being incorporated in the site. It will be helpful for the user to know more about this Institute and coldwater fisheries resources, cultural avenues in Himalayan upland and its management strategies, etc.

The website is being upgraded by adding more information with additional photographs & tables with animation effects. 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/index.html.

Aquaculture management in coldwaters - Evaluation of mahseer fishery potential and its feasibility for conservation in Himalayan region

National Agricultural Technology Project

C.B. Joshi, Shyam Sunder, Pushpesh Sanga and A.U. Khan

Under this network project scientific information on ecological status, catch estimates of mahseer streams including their migration, spawning, seed resources, sanctuaries and sport fisheries potential were evaluated. Based on different data sets, viz., availability of fish species, natural food estimates and productivity status the streams have been identified for mahseer sports as well as commercial fishing. The brief achievements are highlighted here under:

Mahseer seed resources

During the period, collection of mahseer seed (fingerlings) was made from the various lotic water bodies by using the cast net, drag net, and happas. For the collection of mahseer fingerlings the rivers/ streams selected were River Kosi near Dhikala, River Western Ramganga near Marchula in Nainital district and River Ladhiya near Chlathi, in

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Champawat district. The intensity of seed availability in these streams ranged from 95-260 per sq m, which has been depicted along with their size range and water quality in the tables 18 & 19.

Mahseer seed collection in Himalayans river

Table 18: Mahseer seed collection from various river stretches in Kumaon

Rivers	Place	Total No.	Length (mm)	Weight(g)
Kosi	Garjia temple	95	50-125	3-15
	Tiger top	102	60-125	3-25
W. Ramganga	Marchula	252	50-140	3-20
	Devta Gadhera	260	85-350	8-250
	Ban Ganga	176	100-250	10-150
Ladhiya	Chalthi	204	90-200	10-80

Table 19: Range and average of water quality parameters of different rivers at mahseer seed collection sites

Parameters	West Ramganga	Kosi	Ladhiya
Air Temperature (^{0}C)	28.0-34.0 (31.0)	33.0-38.8 (35.9)	18.0-32.6 (25.3)
Depth(cm)	40.0-150.0 (95.0)	50.0-110.0 (80.0)	60.0-100.0 (80.0)
Rate of Flow(m/sec.)	0.6-0.8 (0.7)	0.5-0.8 (0.6)	0.6-1.7 (1.2)
Transparency(cm)	40.0-150.0 (95.0)	50.0-110.0 (80.0)	10.0-90.0 (50.0)
Water Temperature (^{0}C)	19.4-28.6 (24.0)	29.0-32.1 (30.6)	20.2-26.3 (23.2)
pH	7.4-7.6 (7.5)	7.2-7.4 (7.3)	7.4-7.8 (7.6)
Dissolved Oxygen (mg/l)	7.6-9.8 (8.7)	7.8-8.2 (8.0)	7.4-8.0(7.7)
Free Carbondioxide (mg/l)	0.00 (0.00)	0.4-1.2 (0.8)	1.0-1.6 (1.3)
Total Alkalinity(mg/l)	56.0-68.0 (62.0)	68.0-70.0 (69.0)	52.0-66.0 (59.0)
Chloride(mg/l)	8.0-9.2 (8.6)	8.4-10.6 (9.5)	7.2-9.8 (8.5)
DOM(mg/l)	40.0-52.0 (46.0)	24.0-28.0 (26.0)	32.0-58.0 (45.0)
TDS (mg/l)	30.2-34.4(32.3)	38.0-44.6 (41.3)	42.4-48.6 (45.5)
Conductivity(µ mhos) at 25^{0}C	60.6-69.29 (64.9)	75.6-83.5 (79.6)	85.0-97.2 (91.1)
Hardness(mg/l)	36.0-40.0 (38.0)	28.0-30.0 (29.0)	32.0-46.0 (39.0)
Calcium(mg/l)	8.4-9.2 (8.8)	10.6-11.2 (10.9)	6.2-18.4 (12.3)
Magnesium(mg/l)	4.26-4.54 (4.46)	6.40-6.86 (6.63)	5.86-8.24 (7.05)

Migration of mahseer

The mahseer has migratory behavior, it travels long distances from main rivers to the hill streams in the upper reaches and ascends to the smaller tributaries for spawning during monsoon months and return back to the main river/stream after breeding. The Himalayan mahseer are also known to migrate for feeding and breeding up and down streams and for shelter in deeper pools. Figures given below depicts the migration and sanctuaries of Himalayan mahseer in R. Western Ramganga and R. Saryu in Kumaon hills.

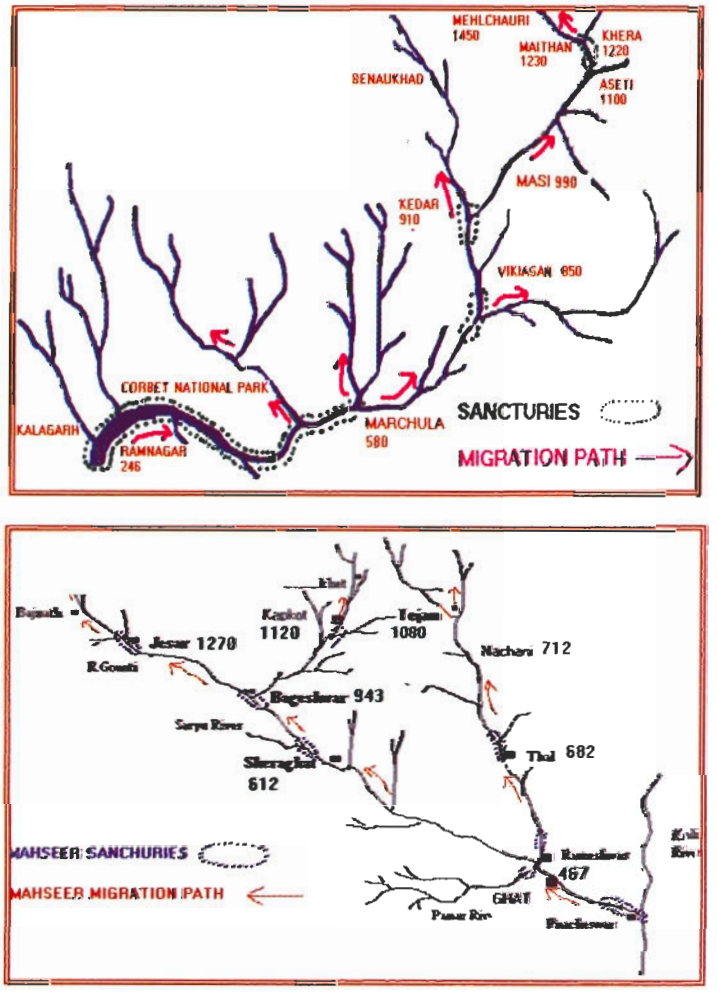


Fig. 2. Sketch map of W. Ramganga and Saryu rivers showing migration route and sanctuaries of mahseer

Mahseer sanctuaries

Not many mahseer sanctuaries exist in Kumaon region, to conserve this under threat germplam, the studies carried out so far in the region enlist the existing and proposed potential sanctuaries in the Kumaon rivers which are tabulated as under.

Table 20: Existing and proposed mahseer reserves/ sanctuaries in Kumaon Himalaya.

	River system	Existing	Proposed
1	Kali	- Temple area at Pancheshwar - Tal near Jhulaghat - Below Dharchula bridge	5 km upstream from the confluence with R. Gori at Jauljibi
2	Saryu	- Near temple at Pancheshwar - Near the confluence with Ramganga (E) at Rameshwar - 5 km upstream Sheraghat - Near Bhageshwar town temple - 10 km downstream Kapkot	5 km downstream Bageshwar
3	Ramganga (E)	- Near Rameshwar temple, Ghat - Below the bridge at Thal	5 km stretch upstream Nachni town
4	Ramganga (W)	- National Corbett Park - Near Khera village - Baijnath temple tank	10 km downstream Maithan
5.	Gomti	- Near it's confluence with R. Saryu	2 km up and down stream of Baijnath temple
6.	Kosi	- In the vicinity of Garjia temple - Near Reetha Sahib	Between Ramnagar barrage to Dhikala
7.	Ladhiya	_____	10 km upstream from Chalthi up to Amori
8.	Gori	----------	5 km down stream Madkot

Identification of sites for mahseer angling and sport

It has been revealed from the studies that there are certain stretches in Kumaon rivers which can be developed as sport waters to give boost to the tourist industry which will ultimately help in upgrading the economic status of the society. The stream stretches identified for mahseer angling are given below.

Table 21: Mahseer sport/ angling sites identified in Kumaon Himalaya

S.No	River / stream	Stretch/ Area
1.	Kali	From Pancheshwar upto Boom 5 km upstream Jhulaghat bridge
2.	Saryu	5 km upstream Pancheshwar 5 km upstream Bhageshwar town 5 km up- and down stream Sheraghat
3.	Ramganga (E)	2 km upstream Thal upto Nachni
4.	Ramganga (W)	From Bhikiyasen to Chaukhutia
5.	Kosi	From Betalghat to Kherna bridge

Development of new conservation site

Shyamlatal lake- District Champawat

As a part of conservation and rehabilitation initiative, a natural lake-Shyamlatal in Kumaon hill was identified for this activity in the year 2000. The netting operations carried out during the year revealed that the mahseer stocked in the lake in the first phase of the study has established itself well in the lake and now constitutes a good fishery of golden mahseer in this lake with 97.62% in experimental fishing (120-700 g in weight). With the development of brood stock in the lake, the availability of mature spawners for artificial propagation will be ensured in the region, which will help in its propagation for conservation and revival of this endangered

species. Moreover, the raising of mahseer in the ponds or with running water facilities in hill areas will be helpful to assess its growth performance and survivability in different eco-climatic zones. Its compatibility in farming with other species like common carp, grass carp and silver carp, which have proved themselves as good candidate species in hill farming, can also be evaluated. With the fabrication and installation of a mahseer hatchery at all the cooperative project centers, the seed production programme for mahseer will get a boost.

Shyamalatal lake-a new conservation site developed

Ecological status of conservation site

Water quality

During the period under report, the water quality parameters of lake Shyamlatal were recorded in optimal range with moderate summer water temperatures ranging 20.0-25.0^{0}C with slightly low concentration of dissolved oxygen 6.8-7.6 mg/l as compared to the winter months. The water was alkaline with pH values 7.6-8.0 and total alkalinity 44.0-52.0 mg/l. Maximum depth 8.0 m was recorded during the monsoon with the transparency ranging 0.15- 0.70 m. Occurrence of free carbon dioxide was also recorded in the lake water with the values ranging from 1.0-2.2 mg/l. The dissolved solids and total dissolved organic matter ranged 34.2-46.0 mg/l and 30.0-44.0 mg/l, respectively. The respective values of calcium, magnesium and chloride ranged as 5.82- 6.84 mg/l, 1.78-2.62 mg/l and 16.0-26.0 mg/l. Total hardness of the lake water was 18.0-24.0 mg/l, whereas the specific conductivity ranged 70-92 µ mhos at 25^{0}C. The lake water seems to be conducive for rearing of mahseer and other carps.

Biotic communities

Phytoplankton

In lake Shyamlatal, among the phytoplankton Bacillariophyceae was found to be dominant group contributing 54.94% in the total plankton biomass during the study period. The other groups as per their percent composition were Chlorophyceae (42.81%), Cyanophyceae (1.98%) and Dinophyceae (0.27%). The abundance of various phytoplankton groups are depicted below:

Table 22: Phytoplankton group-wise density.

Groups	Range and average (units/l)
Total phytoplankton	14,868-19,680(17,274)
Bacillariophyceae	6,258-13,340(9799)
Chlorophyceae	5,680-8,439(7060)
Cyanophyceae	90-660(375)
Dinophyceae	0-81(41)

Zooplankton

Zooplankton, populations are represented by the four groups i.e. Protozoa (16.66-25.00%), Rotifera (47.50-53.03%), Cladocera (17.50-19.70%), and Copepoda (10.00-10.61%), besides some miscellaneous forms. The average density of zooplankton recorded from the lake was 212 units /l. The average density of zooplanktonic groups recorded from the lake is set in table below:

Table 23. Zooplankton group-wise density.

Groups	Range and average (units/l)
Total zooplankton	160-264(212)
Protozoa	40-44(42)
Rotifera	76-140(108)
Cladocera	28-52(40)
Copepoda	16-28(22)

Periphyton

The Bacillariophyceae with the contribution 50.16 % population ranked first in the total microfloral group of periphyton followed by Chlorophyceae (46.72 %) and Cyanophyceae (2.57 %). The density of important microfloral and microfauna groups recorded from lake are tabulated below:

Table 24: Density of major microfloral groups.

Groups	Range and average (units/l)
Total	1,62,000-1,63,800 (1,62,900)
Bacillariophyceae	62,400 - 1,00,800 (81,600)
Chlorophyceae	58,200 - 94,200 (76,200)
Cyanophyceae	1,800 - 6,600 (4,200)
Dinophyceae	600 - 1,200 (900)

Table 25: Density of major micro-faunal groups.

Groups	Range and average (units/l)
Total	13,200 - 18,600 (15,900)
Protozoa	5,400 - 7,800 (6,600)
Rotifera	3,000 - 3,600 (3,300)
Cladocera	1,800 - 2,400 (2,100)
Copepoda	3,000 - 4,800 (3,900)

Benthic fauna

The benthic fauna of lake Shyamlatal is represented mainly by the groups, Oligochaeta, insects and Mollusca with few miscellaneous forms. In total benthos, the contribution of aquatic insects was 47.07%: Oligochaeta was 40.44%, Mollusca was 5.14% and miscellaneous forms 7.35%. Among insects, the predominant groups represented in the samples were Ephemeroptera (14.72%), Diptera (13.97%), Coleoptera (7.35%), Odonata (7.35%) and Plecoptera (3.68%) in order of their abundance. A total of 7.35% miscellaneous forms included the leeches and Planarians, etc. The important forms encountered in the samples include the *Tubifex*, *Aelosoma*, *Chaetogaster* and *Branchiura* among Oligochaeta; *Antocha*, *Atherix*, *Blepherocera*, *Chironomus*, *Tabanus* and *Simulium* among Diptera; *Baetis*, *Caenis*, *Ephemerella* and *Iron* among Ephemeroptera; *Perla and Chloroperala* among Plecoptera; *Dytiscus*, *Gyrinus* and *Psephanus* among Coleoptera; *Agrion*, *Gomphus* and *Ophiogomphus* among Odonata and *Lymnaea*, *Gyraulus* and *Stagnicoala* among Mollusca.

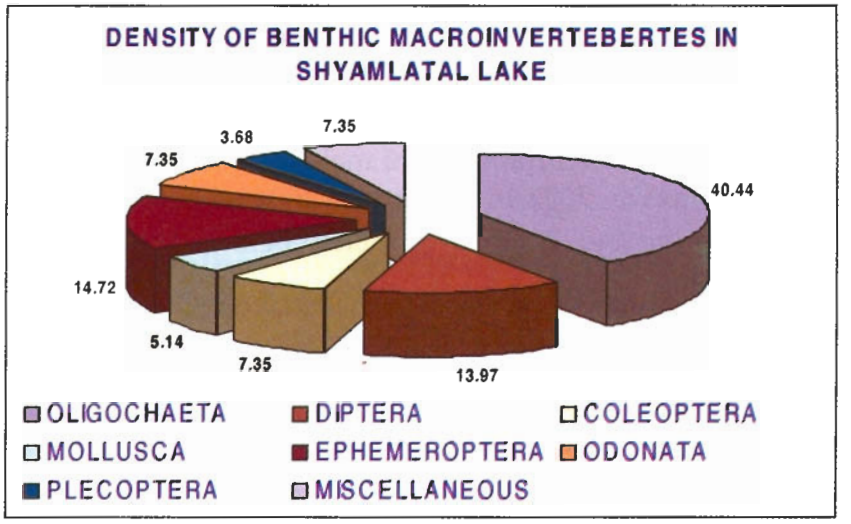


Fig 3. Density of benthic macroinvertebrates in Shyamalatal lake.

Fish and fishery

The Shyamlatal lake has been developed so far from fishery point of view. Though long back *Cyprinus carpio* seed were introduced in the lake but due to lack of management its fishery couldn't come up at par with other lakes in Kumaon. Besides common carp, the cat fishes and *Puntius* spp. formed the major ichthyofauna of the lake. During the preliminary experimental fishing trials, not even a single specimen of mahseer was caught from the lake. Hence mahseer (*Tor putitora*) fingerlings collected from the nearby streams were stocked in the lake with conservation and development point of view.

Table 26: Fish inventory of Shyamlatal lake

Species	Numbers	Percentage
Cyprinus carpio communis :	11	34.375
Cyprinus carpio specularis :	02	6.25
Clarias batrachus :	01	3.125
Heteropneustes fossilis :	01	3.125
Puntius sp. :	10	31.25
Barilius sp. :	05	15.625
Channa sp. :	02	6.25

Recovery of mahseer from the lake

It has been observed that the mahseer fingerlings stocked during 2000-2001 has established well in the lake with 97.62% return in the catches during Dec. 2002. The maximum size of mahseer caught during the trials in gill net operations was 700 g in weight and 260 mm in length. The details of fish catches during Dec. 2002 are tabulated below:

Table 27: Recovery of mahseer from Shyamlatal lake

Date of Sampling	: December-2002			
Gears used	: Gill net -mesh size 3" (1 No.) and mesh size 1" (4 No)			
Name of species	**Total no.**	**Size range**		**Occurrence (%)**
		Weight (g)	**Length (m)**	
Cyprinus carpio	2	200-600	180-310	2.38
Tor putitora	82	120-700	180-260	97.62

Seed production of mahseer, *Tor putitora*

Artificial propagation of Himalayan mahseer has been a positive approach towards rehabilitation of dwindling stocks of mahseer in the Himalayan waters. The seed fry / fingerlings produced in the hatchery will be stocked in the streams and lakes identified for stock building and further to conserve the germplasm of the species.

The project staff, presently is participating in the regular breeding programme of *Tor putitora* (golden mahseer) carried out by NRCCWF at Bhimtal. However, installation of a separate hatchery at Champawat has been initiated for using brood stock of Shyamalatal lake.

5. TECHNOLOGY ASSESSED & TRANSFERED

FARM ACTIVITIES

Breeding and culture of *Tor putitora*

The seed production activities carried during the year is given below.

Brood stock and fertilization:

During mahseer breeding season, a total of 11 ripe female brooders were collected by operating gill nets in nearby lakes. Their size ranged in length 410-580 mm and 600-1700 g in weight. A total of 29,680 ripe eggs were stripped from these females. The males contributing milt ranged 345-450 mm in length and 300-1000 g in weight. The ripe eggs were fertilized by ' dry method' both the gametes were mixed gently with the aid of a bird's feather. Contact of water was avoided until the eggs and sperms were properly mixed. The rate of fertilization ranged between 82.0-96.60%.

Incubation and hatching:

The incubation period varied between 112-136 hours at temperature range of 16.5-24.5^{0}C during breeding season. The yolk sac was fully absorbed in 11 to 12 days. and rate of hatching was 78.1-94.2% with cumulative survival from fertilized eggs to swim up fry stage ranging between 75.2-93.70% with the average of 84.6%.

Larvae and fry raising:

The newly emerged larvae after transferring in fry rearing tanks were fed with finely ground and emulsified egg yolk, which can be easily consumed by the larvae. After a week, they were fed on minced goat's liver for about a week. During this fortnight of rearing, the larvae attained a size of 8-12 mm. The early fry were reared to large size in tanks of 200 x 200 x 45 cm size on laboratory made artificial diet fed at the rate of 10-15%

of body weight. After 2-3 months rearing they grew to 35-40 mm in length and 0.4 - 0.8 g in weight. A total of 20400 advanced fry were produced.

The shortfall in fry production was due to less availability of mature female brooders during breeding season of 2002.

Raising of mahseer broodstock

The experiment initiated during October 2001 for raising of brood stock of mahseer in the earthen ponds with stocking of 4000 golden mahseer fry at mahseer hatchery site in Bhimtal, was continued for the current year 2002-2003. The fry initially of the size ranging from 15-20mm (0.03-0.062g) attained the size of 150-260mm in length and 35-125g in weight by the end of January, 2003 in approximately 15 months duration. The low water temperature of 1.5-12.0^{0}C in winter months has been observed as a limiting factor in culture of mahseer fry during this period. In the five months rearing period of winter season only about 20% of the stock survived and the growth was poor ranging from 40-60mm in length and 0.70-2.40g in weight. While in summer months when the water temperature was 17.0-24.0^{0}C good growth was observed, the fish attained a size of 90-150mm in length and 35-125g in weight.

During April 2002, about 80 specimen of golden mahseer were collected from riverine habitats and stocked in earthen pond (10m X 5m in size) at mahseer hatchery. The fish of two size range being 150-220mm in length and 25-50 g in wt. and 280-300mm in length and 250-325 g in wt. were stocked. After nine months of rearing, these specimens attained a size of 224-296mm in length and 105-195 g in first group and 300-395mm in length and 325-420g in weight for second group of fishes.

Incubation and rearing of rainbow trout at Bhimtal

The attempt to rear brown trout in Kumaon region of Central Himalayas was initiated in 1910, when 10,000-eyed ova of trout from Kashmir were planted in the Bhowali hatchery near Nainital. In a subsequent attempt in 1912, trout seed was introduced in a few oligotrophic Kumaon lakes on trial basis. But these attempts met with no success, possibly due to the comparatively high summer temperatures. However, in the year 2002, the NRC on Coldwater Fisheries with some modification

in the rearing system, renewed the efforts to evaluate hatching and rearing of rainbow trout in its hatchery located at Bhimtal (1470 m asl), District Nainital, under comparatively higher temperature regime. In January 2002, eyed ova of fast growing strain of rainbow trout – *Oncorhynchus mykiss* (Jorghensin strain of Norway) were procured from Patlikuhl trout hatchery of Himachal Pradesh. For the first time, eyed ova of this strain were incubated under warmer conditions of Bhimtal region. The trials were conducted at the mahseer hatchery in pre-fabricated FRP tanks of various dimensions. Fry, advance fry and fingerlings were reared in 1.0m^2 and 2.0m^2 area tanks with proper water renewal facilities. During maximum experimental period, water from the tube well was used, having a thermal regime of 5.0-21.0^{0}C, which is usually on the higher side of the optimal thermal range for this species.

Rainbow trout raised in FRP tank at Bhimtal

Hatchery raised rainbow trout weighing 300 gm and 290 mm in total length

Hatching was successful and fingerlings (average length 45mm and weight of 5.65g) were produced within a period of 80 days of rearing while table size (average length 290mm and weight of 300g) was attained just within a period of one year of rearing. The fishes were initially fed on wet feed for about a week and subsequently on dry feed. During the experiments two types of feed having different protein levels were tried. The fish stocks were fed mainly with balanced artificial diets, the ration of feed varying with size of the test fishes and water temperature.

Table 28: Details of rainbow trout rearing at Bhimtal.

Developmental stages	Rearing period	Size of test fishes	% survival	Range of water temperature
Incubation	(15 days)			
Fertilized-ova	24.01.2002	5.0mm		
to	to		89.0%	5.0-13.0°C
Hatchling (alevin)	08.02.2002	10.0-12.0mm		
Initial fry rearing	(15 days)			
Alvein	08.02.2002	24.0-30.0mm		
to	to	(av. 0.130g)	93.0%	7.0-15.0°C
Fry stage	22.02.2002			
Fry	(4 days)			
to	23.02.2002	45.0-50.0		
Advanced fry stage	to	(0.950-0.1720g)	90.0%	7.5-20.0°C
	26.02.2002			
Fingerling production				
Advance fry	(24 days)			
to	26.03.2002	70-85mm		
Fingerling stage	to	(3.40-6.10g)	95.0%	7.5-20.0°C
	18.04.2002			
Table-fish production				
Fingerling stage	(255 days)			
to	20.04.2002	285.0-300.0mm		
Table fish	to	(270-320g)	95.0%	5.0-20.0°C
	04.01.2003	Average 300g fish		

Transport of live stock

On 18th April 2002, six hundered fingerlings of rainbow trout reared at mahseer hatchery, Bhimtal having total length of 70-85mm and weight of 3.45-5.90g were transported to Chirapani fish farm, Champawat located approx. 200km from Bhimtal. The live stock was transported in office vehicle under proper oxygen packed containers. The stock after covering the distance within 7 hrs reached to the destination without any mortality. Approx. 250 fingerlings were transported in a container having 6 liters of water and required quantity of dissolved oxygen.

Water quality

The physico- chemical features recorded during the trial periods ranged between: water temperature 5.0-20.0^{0}C, pH 7.4-7.8, dissolved oxygen 5.8-7.6 mg/l, free carbon dioxide 1.0-1.8 mg/l and total alkalinity 80-84 mg/l.

Conclusions

The success of hatching and production of rainbow trout under agro-climatic conditions prevailing at Bhimtal assumes added importance in view of the sharp diurnal water temperature variations in the hatchery. It was possible to adjust the acute fluctuations due to the regular flow of clean and fresh water and slight adjustment of water flow pattern in the rearing units. The rearing success at Bhimtal opens up the possibility of initiating rainbow trout raising at different altitudes with similar water temperature regime, for pilot scale production for table and for commercial use at different places, provided adequate rearing facilities are created.

Breeding and rearing of rainbow trout at Champawat

The rainbow trout (*Oncorhynchus mykiss*) stock was successfully reared in Chirapani experimental fish farm, Champawat. The potential male and female brooders of rainbow trout segregated and stocked in two nursery ponds during November 2002, were sampled regularly to find fully mature specimens of both the sexes.

Six fully mature females (4 years old) in 1350-2500g weight range and males in the weight group 1000-1800g were netted out from the pond in mid of December 2002, both the sexes were stripped and eggs were fertilized following "dry method". Females had an average fecundity of about 1400 eggs/kg. A total of about 15200 eggs were stripped from the six selected females. The fertilized eggs were incubated in hatching troughs with in-built hatching trays having a capacity of 2400

Rainbow trout broad stock

eggs/tray. The eyed ova stage apperead after about 10 days. The water temperature during incubation was 4.5 – 7.5^{0}C. Rate of survival was 42.6% only.

Fertilized eggs started hatching after 61 days of fertilization in the first week of February 2003 and hatching was complete within a week's time. The water temperature during this period ranged from 4.5 – 7.5^{0}C. When 3/4th of the yolk was absorbed the spawn were fed with finely minced goat liver and powdered trout feed. A total of 4320 fry were produced. Rate of survival from stripping to fry stage was 28.42%.

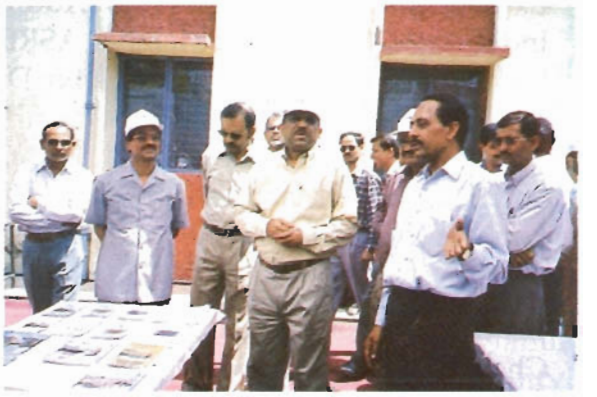
Fertilized eggs under incubation

The rainbow trout bred during the previous year at Chirapani experimental fish farm, Champawat were reared at the farm and they attained a size of 230g in weight and 200-290mm in total length. While the eyed ova brought from Patlikuhl and incubated at Mahseer Seed Production Unit, Bhimtal attained an average weight of 320g and total length of 230-330mm till March 2003 after being transported from Bhimtal at a size range of 3.5-6.0g in weight on April 18, 2002.

Common carp seed:

20,000 common carp fry were produced at the Chirapani experimental fish farm, Champawat. About 6000 fry of common carp were distributed to the fish farmers in that region under TOT programme of the Institute.

- In the Kisan Mela organized by VPKAS, Almora on April 11, 2002 at Hawalabag, Almora, the Institute's activities were displayed. The DM, Almora, other State official, Scientists, farmers, etc. were apprised by the staff of the Institute on their visit to the stall.

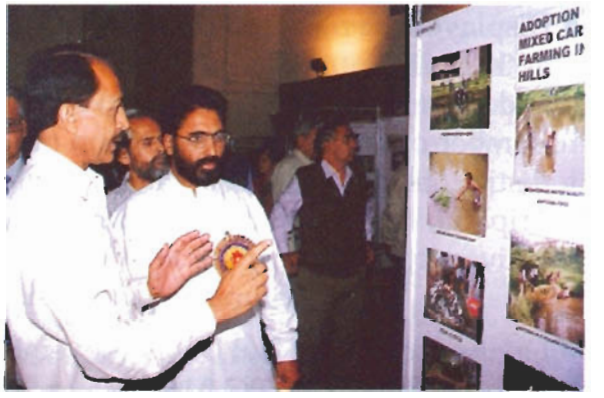


Kisan Mela participation by NRCCWF at Almora

- In 'Aqua Fair' organized on the eve of National Symposium on "Fisheries Enhancements in Inland Waters- Challenges Ahead" by the Inland Fisheries Society of India at Central Institute of Capture Fisheries Resources, Barrackpore from April 27-28, 2002, the Institute's activities were exhibited. Many distinguished Scientists, students and farmers visited the stall.

- Charts displayed institute's activities, posters and publications at Kisan Mela organized by World Vision India, an NGO during April 29-30, 2002 at Dhari Block (Nainital).

- The Institute at ATI, Nainital organized Matsya Pradarshani, during the National Seminar on "Aquatic Resources Management in Hills" organized by National Research Centre on Coldwater Fisheries, from October 4-5, 2002. The exhibition was inaugurated by Hon,ble Minister Shri Mantri Prasad Naithani Ji, Minister of Animal Husbandry, Dairying, Co-operatives and Fisheries, Government of Uttaranchal. The achievements and other activities of NRCCWF were



Dr. Tyagi briefingHon'ble Minister of Fisheries, Uttaranchal at "Matsya Pradarshani"

shown through exhibits and were appreciated by distinguished fishery Scientists like Dr. S.N. Dwivedi Ex-Director General, MPCS&T, Bhopal; Ex-Director, CIFE, Mumbai; Ex-Additional Secretary, Government of India; Dr. S.A.H. Abidi, Member ASRB, New Delhi; Dr. P.V. Dehadari, Former DDG (Fy), ICAR, New Delhi; Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi; Dr. V.P. Agarwal, Secretary General, Society of Biosciences, Muzaffarnagar; Dr. K.L. Sehgal, Former, Director, NRCCWF, Bhimtal; Shri S.N. Ogale, Manager (Environment), Tata Power Company Limited, Lonavla (Maharashtra) and other scientists from ICAR Institutes, SAU's, etc.

- On the occasion of 'Rabi Gasthi' organized at Ban Panchayat Bhawan, Champawat on October 17, 2002 Dr. K.D. Joshi, Scientist (SS) appraised a gathering of development and extension officials, Gram Pradhans and farmers about "Parvatiya kshetron main matsya palan kaishe Karen". The function was presided over by Shri. J.C. Joshi, CDO, Champawat.
- The breeding and culture techniques of Himalayan mahseer were demonstrated through exhibits at the National Seminar organized by Indian Society of Fisheries Professionals at Bhopal during October 26-28, 2002. Hon'ble Chief Minister of Madhya Pradesh, Shri. Digvijay Singh; other Ministers of the State; the eminent scientists Dr. S.N. Dwivedi Ex-Director General, MPCS&T, Bhopal, Ex-Director, CIFE, Mumbai, Ex-Additional Secretary, Government of India; Dr. P.V. Dehadari, Former DDG (Fy), ICAR, New Delhi; Dr. G.P. Dubey Former Director, Madhya Pradesh State Fisheries Department, Bhopal and the University students showed a keen interest in the Institute's activities.
- Displayed the publications and activities of the Institute through posters at 'Kisan Mela' organized by KVK, G.B. Pant University of Agriculture and Technology, Sui (Lohaghat) on October 30, 2002. Apart from large number of farmers and extension officials the stall was visited by the distinguished guests viz., Dr. P. Gautum, Vice-Chancellor; Dr. N.C. Tripathi, Director Extension; Dr. Ram, Director Research of G.B. Pant University of Agriculture and Technology, Pantnagar; Shri. Tarkendra Vaishnav, DM, Champawat and Shri. J.C. Joshi, CDO, Champawat.
- On the occasion of 'Bal Divas' November 14, 2002 the students, teachers and Principal's of ABC Alma Mater School, Champawat and Universal Green School, Champawat were appraised about the various fish species, their feeding practices, rearing practices, food value, economic

importance, sport value and importance of conservation of fisheries resources. The programme was organized at Chirapani experimental fish farm of NRCCWF.

NRCCWF stall being visited by Dr. Abidi, Member, ASRB

- An exhibition was arranged at CIFE, Mumbai during the seminar of Sixth Indian Fisheries Forum conducted from December 17-20, 2002.Many eminent Scientists like Dr. S.Z. Qasim, Ex- Vice Chancellor, Jamia Millia Islamia University, Delhi; Dr. S.N. Dwivedi Ex-Director General, MPCS&T, Bhopal; Ex-Director, CIFE, Mumbai; Ex-Additional Secretary, Government of India; Dr. Panjab Singh, Secretary DARE and Director General, ICAR, New Delhi and Dr. S. Ayyappan, DDG (Fisheries), ICAR, New Delhi along with the other Professors, Scientists and students of CIFE and SAU's visited the stall .

- To commemorate the Kisan Samman Week, on December 20, 2002 a workshop was organized by Uttaranchal State Horticulture Department and Champawat District Administration at Ban Panchyat Bhawan, Champawat. Dr. K.D. Joshi, Scientist (SS) delivered a lecture on "Prospects of fish culture in Champawat District". The function was presided over by Shri. J.C. Joshi, CDO, Champawat and attended by Dr. S.S. Solanki, Joint Director (Research), Department of Horticulture, Uttaranchal, Scientists and extension officers from DARL, Pithoragarh; KVK, G.B. Pant University of Agriculture and Technology, Sui (Lohaghat) and a large number of farmers, extension and development officials.

- At a special stall exhibited the Institute's activities and publications during Kisan Samman Week organized in IARI, Pusa campus, New Delhi to mark the birth centenary of Shri. Chaudhary Charan Singh during December 20-23, 2002. Hon'ble Minister of State for Agriculture, Shri. Hukumdeo Narayan Yadav and DDG (Fisheries), ICAR, New

Hon'ble Minister Shri Yadav visiting NRCCWF stall during Kisan Samman Divas

Delhi, Dr. S. Ayyappan and farmers from various states visited the stall.

- The Institute's activities were displayed at Ban Panchyat Bhawan, Champawat on the occasion of 'Kisan Samman Divas'organized by Champawat district administration on December 23, 2002. Dr. H.P. Singh, District Horticulture Officer, Champawat, Dr. Gaur, DAO, Champawat and Pithoragarh, Dr. R.C. Sharma, OIC, KVK, G.B. Pant University of Agriculture and Technology, Sui (Lohaghat) were among the distinguished guests at the function. The function was also attended by a large number of farmers from various parts of the district. During this occasion Dr. K.D. Joshi, Scientist (SS) delivered a lecture on "Fish farming in Uplands".

DDG (Fy) and others being briefed about NRCCWF activities at Kisan Samman Divas

- At the Institute's Chirapani Experimental Fish Farm, Champawat a basic training programme was organized jointly by SIDBI and NIDHI an NGO on February 6 and 18, 2003. Practical demonstrations and lectures were arranged on site selection, pond construction, suitable cultivable species, pond preparation, liming, fertilization, feeding and water quality management in fish ponds.

6. EDUCATION & TRAINING

Training

Dr. A.K. Singh, Senior Scientist participated in the short term training "Launch workshop on library improvement and networking with ICAR/ SAU's libraries" organized by IASRI (ICAR), New Delhi from June 17-19, 2002.

Shri Baldev Singh, Technical Assistant attended the programme on "Library automation and resource Sharing" organized by Indian National Scientific Documentation Centre, New Delhi during July 15-19, 2002.

Dr. K.D. Joshi, Scientist successfully completed the summer school on "Methods of assessment of aquatic ecosystem for fish health care" organized by CIFRI, Barrackpore from July 18 – August 16, 2002.

Shri. A.K. Nayak, Scientist and Shri Pratap Singh, Junior Clerk attended training programme on "Computerized financial management systems" conducted by PIU Cell, NATP and ICAR at Central Soil and Water Conservation Research and Training Institute, Dehradun from August 1-2, 2002.

Training was imparted to Nagaland State Fisheries Department personnel from July 29 – August 8, 2002.

Field visit cum training programme on "Augmentation of income through aquaculture in hills" was organized by NRCCWF at Bhimtal for 35 farmers of Dhari/ Bhimtal block on September 27, 2002.

"Fish culture in uplands and need for conservation of sport fisheries resources". A basic training programme was organized by the Institute at its experimental fish farm, Chirapani, Champawat for the NCC cadets from Almora, Nainital and Pithoragarh areas in batches during June, September and October 2002. A total of 2050 cadets attended the training programme.

Training was imparted to State Fisheries personnel of Arunachal Pradesh on various aspects of coldwater fisheries especially on trout culture at different coldwater fish farms in the state from March 12-14, 2003.

Shri. A.K. Nayak, Scientist attended training programme on "Web designing" at Indian Agricultural Statistical Research Institute, New Delhi from March 24-29, 2003.

7. AWARDS & RECOGNITION

Dr. K.K. Vass, Director was awarded "Nature Conservator & Excellency Award" for the year 2001 by the Nature Conservators Society (India). The medal was conferred to him by Acharya and Vice-Chancellor of Gurukul Kangri University Prof. Ved Prakash Shastri at the inaugural function of the National Seminar on "Relevance of Biosphere Reserve, National Parks and Sanctuaries" on May 25, 2002 at Haridwar.

Shri Rajeev Kapila, Scientist was awarded Doctorate degree by G.B. Pant University of Agriculture and Technology, Pantnagar in the month of August 2002 for his thesis work "Molecular genetic characterization of coldwater fish, *Schizothorax richardsonii* (Gray) with protein(s) and DNA based markers".

Dr. K.K. Vass, Director received Norman Dill Memorial Gold Medal Award for the year 2001, from of Society of Biosciences, Muzaffarnagar for his contribution to Inland Fisheries Research and Development in the country on October 4, 2002 from the Hon'ble Minister of Fisheries, Government of Uttaranchal, Shri Naithani Ji.

Dr. K.K. Vass receiving Norman Dill Memorial Gold Medal from Hon'ble Minister, Uttaranchal

The Institute NRCCWF (ICAR), Bhimtal was awarded the best performance award by the society of Biosciences for most successfully organizing the National Seminar on Aquatic Resource Management in Hills during October 4-5, 2002 at Nainital.

Shri. A.K. Nayak, Scientist received "Young Scientist Award" from the Society of Biosciences, Muzaffarnagar for his paper entitled "Computerized database for fishery resource survey in Uttaranchal" presented at National Seminar on "Aquatic Resource Management in Hills" organized by National Research Centre on Coldwater Fisheries at Nainital from October 4-5, 2002.

Dr. C.B. Joshi, Principal Scientist was nominated as Judge at the District Inter College Science Competition held at Lilawati Pant Inter College, Bhimtal on October 28, 2002.

Dr. K.D. Joshi, Scientist headed the panel of judges at the District level to screen the projects/ models on the occasion of 'Bal Vigyan Congress' organized by the District authorities on November 11, 2002.

8. LINKAGES & COLLABORATION

State Agriculture Universities

The project on "Aquaculture in Coldwaters – Evaluation of Mahseer Fishery Potential and its Farming Feasibility for Conservation in Himalayan Region" funded by the World Bank under NATP approved by the Council with NRCCWF as a lead centre. The project aims at evaluation of mahseer fishery potential in the different Himalayan zones i.e. Kumaon, Garhwal, Himachal Pradesh and Jammu and Kashmir Himalayas with an integrated approach to generate reliable database on its status. The collaborating institutions–G.B. Pant University of Agriculture and Technology, Pantnagar (Uttaranchal), H.P. Krishi Vishwavidyalaya, Palampur (Himachal Pradesh) and S.K. University of Agricultural Sciences and Technology, Srinagar (Jammu and Kashmir) bear the responsibilities to enumerate the data on ecology and fishery of various mahseer waters in the respective regions. In addition, the culture technology will be evolved in each of the Himalayan region for conservation of this prized germplasm and to rejuvenate mahseer fishery in the depleted waters in Himalayas.

Sister Institutes and Outside ICAR

- The Institute have linkages with other sister Institutes – CIFA, Bhubaneswar; NBFGR, Lucknow; GBPUAT, Pantnagar; G.B. Pant Institute of Himalayan Environment and Development, Kosi and DARL, Pithoragarh for the various coldwater fisheries research and development activities including fish feed, nutrition, cryopreservation of milt and other fish conservation and development aspects for reviving the hill fishery.

- The Institute has developed linkages with the States Fisheries Department of Uttaranchal, Himachal Pradesh and Arunachal Pradesh for various research and development activities.

- The Institute have strong linkages with regards to transfer of technology programme for aquaculture in hills with - Sainik School, Ghorakhal;

Birla Institute, Bhimtal; District Development Department, Champawat; Village Panchayats in Pati and Bhimtal Block and NGO's (Girideep, Bhimtal and HOPE, Pilkholi, Ranikhet).

- The Institute established linkages for the usage of watershed programmes in development of coldwater fisheries with CSWCR & TI, Dehradun.

9. PUBLICATIONS

Books

Year 2002

Vass, K.K and Raina, H.S. 2002. Highland Fisheries and Aquatic Resources Management. Published by NRCCWF (ICAR), Bhimtal, India. pp.

Vass, K.K., Shyam Sunder, Singh, A.K., Joshi, A. 2002. Abstract: proceedings of the National Seminar on "Aquatic Resources Management in Hills" National Research Centre on Coldwater Fisheries, Nainital during 4 –5 October 2002. pp. 102.

Year 2003

Mohan, M., Joshi, C.B. and Joshi, A.K. 2003. Parvatiya Skhetron Main Matsya Anusandhan Evam Vikas. Published by NRCCWF (ICAR), Bhimtal, India. pp. 119.

Book chapters

Year 2002

Joshi, C.B. 2002. Artificial seed production of golden mahseer in Kumaon upland. In : Highland Fisheries and Aquatic Resources Management. Edited by K.K. Vass and H.S. Raina . NRCCWF, (ICAR) Bhimtal, India. p. 275-283.

Joshi, C.B. and Raina, H.S. 2002. Disease in coldwater aquaculture. p. 316-326. Ibid.

Joshi, K.D., Joshi, C.B. and Shyam Sunder.2002. Ecology and fishery of the rivulet Ladhiya in Uttaranchal. In: Coldwater Fish Genetic Resources and their Conservation. Edited by P. Das, J. R. Dhanje, S. R. Verma, D.S. Malik. NATCON Publication No. 7: 189-194.

Kapila, R. 2002. Biochemistry and coldwater fisheries. In : Highland Fisheries and Aquatic Resources Management. Edited by K.K. Vass and H.S. Raina. NRCCWF, (ICAR) Bhimtal, India. p. 306-315.

Madan M. 2002. Nutrition and feed development for coldwater fishes. p. 284-305.Ibid.

Nayak, Ashok. K. 2002. Internet Application in Fisheries. p. 360-363. Ibid.

Raina, H.S. 2002. State of art of Schizothoracid in Indian sub-continent. p. 102-119. Ibid.

Shyam Sunder. 2002. Rehabilitation of snow-trouts in Indian uplands. p. 347-359. Ibid.

Shyam Sunder and Joshi, C.B. 2002. State-of –art on the threatened fishes of Himalayan upland and strategies for their conservation. In: Coldwater Fish Genetic Resources and their Conservation. Edited by P. Das, J. R. Dhanje, S. R. Verma, D.S. Malik. NATCON Publication No. 7:101-111.

Shyam Sunder and Raina, H.S. 2002. Fishery resources and their management in Kashmir Himalaya – a profile. In: Natural Resources of Western Himalaya. Edited by A.K. Pandit. Valley Book House, Srinagar (Jammu and Kashmir). p.222-243.

Singh, A.K. 2002. Biotechnology in coldwater fishery development, molecular biology and fish genetics. In: Coldwater Fish Genetic Resources and their Conservation. Edited by P. Das, J. R. Dhanje, S. R. Verma, D.S. Malik. NATCON Publication No. 7:75-88.

Vass, K.K. 2002. Practical concepts of trout farming- its status and potential in India. In : Highland Fisheries and Aquatic Resources Management. Edited by K.K. Vass and H.S. Raina . NRCCWF, (ICAR) Bhimtal, India. p. 223-241.

Vass, K.K. and Gopakumar, K. 2002. Coldwater fisheries and research status in India. p. 3-29. Ibid.

K.K.Vass – 2002 – Water Management and Fishery Development – Problems and Issues, pp 338-344. In Riverine and Reservoir Fisheries in

India (Eds. Bhopendranath, M.R. et al) Society of Fisheries technologists, India, Cochin. p 1-458.

K.K.Vass – 2002 – Management of fishery resources in wetlands an overview . pp 73-92. In role of Biosciences in New Millenium (Eds. V.P.Agrawal & S.V.S. Chauhan). P 1-158.

K.K.Vass – 2002 – Environmental considerations in management of fisheries in small water bodies . pp 62-66. In Culture-based Fisheries for Inland Fisheries Development. (Eds. V.V. Sugunan, B.C.Jha & M.K.Das) p 1-197.

K.K.Vass and H.S. Raina – 2002 – Prospects and Problems of Angling Tourism with regard to Golden Mahseer (*Tor putitora*) in India, pp 47-61. In Biodiversity & Conservation of Aquatic Resources with regard to fish Mahseer . (Eds. H.P.Garg, G.Singh, J.Singh & P.Tamot), M.P.C.S.T., Bhopal, p 1-192.

Year 2003

Haldar, R. S. and Mohan, M. 2003. Himalayee mahseer ke kritim prajnan ki takniki ka vikas. In: Proceedings of Hindi workshop "Parvatiya kshetron Main Matsya Anusandhan Evam Vikas" Edited by Madan Mohan, C.B. Joshi and Amit Joshi, NRCCWF (ICAR), Bhimtal, India. p. 69-75.

Joshi, A. K. and Mohan, M. 2003. Parvatiya kshetro mein matsya anusandhan evam vikas ke prachar- prasar ki disha mein sansthan dwara Hindi ka prayog. p. 115-119. Ibid.

Joshi, C.B. 2003. Sunhari mahseer machhaliyon ka prajnana evem palan poshan. p. 27-29. Ibid.

Joshi, K.D. 2003. Parvatiya kshetro ke liya trisatariya matsya palan. p. 49-56. Ibid.

Khan, A.U. and Sanga, P. 2003. Kumaon kshetro ki jal sampada. p. 107-114. Ibid.

Mohan, M. 2003. Sheetjal matsya krishi vikas avam sambhavnaye. p. 16-21. Ibid.

Mohan, M. 2003. Sheetjal machhliyon ki ahar avashayaktaye. p. 30-36. Ibid.

Sanga, P. and Khan, A.U. 2003. Uttaranchal ke arthic utthan mein sheetjal matsyaki ka yogdan- sithithi evam sambhavanaei. P. 103-106. Ibid.

Shyam Sunder. 2003. Sheetjal matsyaki par aavkramit prasthitiki ka prabhav. p. 37-40. Ibid.

Singh, A.K. 2003. Sheet jal matsya samvardhan mein anuvanshiki. p. 45-48. Ibid.

Singh, A.K. 2003. Implications of intensive carp and catfish culture and sustainable fish production. In: Proceedings of Brainstorming Session, "Production and Potential of Fisheries in U.P.: Constraints and Opportunities". Edited by G.B. Singh and S.C. Tripathi, U.P. Council of Agricultural Research, Lucknow. p. 94-103.

Tyagi, B.C. 2003. Parvatiya Kshetro Mein Mishrit Matsya Palan ke nayai Ayam. In: Proceedings of Hindi workshop "Parvatiya Skhetron Main Matsya Anusandhan Evam Vikas" Edited by Madan Mohan, C.B. Joshi and Amit Joshi, NRCCWF (ICAR), Bhimtal, India.p. 41-44.

Vass, K.K. and Kapila, R. 2003. Role of biotechnology in coldwater fisheries research and development. In: Souvenir, National Symposium on Genetics and Gene Banking of Fish and Shellfish. Central Institute of Fisheries Education (ICAR), Mumbai. March 28-29, 2003.

Seminar/Symposium/ Workshops

Year 2002

Basade, Y. 2002. Fish abundance and its relationship with environmental variables in a freshwater Himalayan lake- Bhimtal. National Seminar on "Aquatic Resources Management in Hills" National Research Centre on Coldwater Fisheries, Nainital during 4 –5 October 2002. Abstract No. B-8.

Joshi, C.B. 2002. Mahseer fishery in Himalayas : Recent advances and research needs. Workshop on "Development of Research Strategies for Aquafarming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract. No. 31-32.

Joshi, C.B. 2002. Conservation and Management Priorities for Fisheries Development in Himalayas. National Seminar on "Aquatic Resources Management in Hills" National Research Centre on Coldwater Fisheries, Nainital during 4 –5 October 2002. Abstract No. C-22.

Joshi, K.D. 2002. Research needs for the cultivable fish species in uplands of Uttaranchal. Workshop on "Development of Research Strategies for Aquafarming in Uttaranchal". G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract page No.38.

Joshi, K.D. 2002. Wanton destruction of fishery resources in upland streams- a case study. National Seminar on "Relevance of Biosphere Reserve, National Parks and Sancturies in Present Context". Gurukul Kangri University, Haridwar. April 26-27, 2002.

Joshi, K.D. 2002. Migratory behavior of the fishes in relation to thermal variation in an upland rivulet- Ladhiya. National Seminar on "Biodiversity and Resource Management". National Bureau of Fish Genetic Resources, Lucknow. September 11-13, 2002.

Joshi, K.D., Raina, H.S. and Vass, K.K. 2002. Growth performance and conservation efficiency of rainbow trout, *Oncorhynchus mykiss* (Walbaum) fed with pelleted diet at different rates. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. A-12.

Joshi, K.D. and Tyagi, B.C. 2002. Experiment on carp culture in upland stream conditions. National Symposium on "Fisheries Enhancements in Inland Waters- Challenges Ahead". Inland Fisheries Society of India, Central Institute of Capture Fisheries Resources, Barrackpore. April 27-28, 2002. Abstract page No.45.

Kapila, R. and Mishra, D.P. 2002. Genetic variability in coldwater fish, *Schizothorax richardsonii* (Gray). National Seminar on "Biodiversity and Resource Management". National Bureau of Fish Genetic Resources, Lucknow. September 11-13, 2002. Abstract page No.12.

Kapila, R. and Mishra, D.P. 2002. Intraspecific genetic variation of coldwater fish, *Schizothorax richardsonii* (Gray) in the Kumaon streams assessed by randomly amplified polymorphic DNA (RAPD) analysis. "71st Annual

Meeting of Society of Biological Chemists (India)."Department of Biochemistry, CBS&H, PAU, Ludhiana. November 14-16, 2002. Abstract page No.142.

Khan, A.U., Sanga, P., Shyam Sunder and, Joshi, C.B. 2002. Macrobenthic Invertebrates fauna of River Saryu in Kumaon Himalaya. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. B-7.

Khan, A.U., Sanga, P., Shyam Sunder and Joshi, C.B. 2002. An appraisal of mahseer fishery in river Saryu of Kumaon Himalayan region. Abstract No. C-13. Ibid.

Mohan, M. 2002. The diversity in biological life in a lesser Himalayan river. National Seminar on "Environmental Awareness, Education and Management for Sustainable Rural Development". Sri Venkatesh University, Tirupati during August 26-28, 2002. Abstract No. 75.

Mohan, M., Basade, Y. and Bhanja, S.K. 2002. Performance of different feeds on growth of juvenile Snow Trout, *Schizothorax richardsonii* (Gray) in Shiwalik Himalayas. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. A-11.

Mohan, M. and Haldar, R.S. 2002. Rehabilitation of golden mahseer, *Tor putitora* (Ham.) through large-scale seed production Abstract No. A-13. Ibid.

Mohan, M., Bhanja, S.K. and Basade, Y. 2002. Effect of chitin on growth performance of the indigenous Kumaon Himalayan fishes- Snow trout, *Schizothorax richardsonii* (Gray) and Golden Mahseer, *Tor putitora* (Hamilton). Sixth Indian Fisheries Forum, Central Institute of Fisheries Education (Deemed University), Mumbai. December 17-20, 2002. Abstract No. NP-21.

Nayak, Ashok. K. and Vass, K.K. 2002. Computerized database for fishery resource survey in Uttaranchal. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. C-11.

Raina, H.S. 2002. Fish biodiversity in aquatic resources of Himalayan highlands. Workshop on "Development of Research Strategies for Aquaforming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract page No.19-20.

Sanga, P., Khan, A.U., Joshi, C.B. and Shyam Sunder. 2002. Fish and Fisheries of River western Ramganga in Kumaon Himalaya. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. B-5.

Sanga, P., Khan, A.U., Joshi, C.B. and Shyam Sunder . 2002. Occurrence and abundance of phytoplankton in Saryu River system on Kumaon Himalaya. Abstract. No. B-6. Ibid.

Shyam Sunder. 2002. Status and prospects of snow-trout fishery in Himalayan waters. Workshop on "Development of Research Strategies for Aquaforming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract page No.35.

Shyam Sunder. 2002. Snow-trout fishery in Himalayan uplands. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002.Abstract. No. A-22.

Singh, A.K. 2002. Fish germplasm and its conservation in Himalayan waters. Workshop on "Development of Research Strategies for Aquafarming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract page No.19-20.

Singh, A.K. 2002. Environmental stress and adaptability in coldwater fishes with special reference to pineal gland. Proceedings of the "22nd Annual Session of the Academy of Environmental Biology and Symposium on "Biodiversity and Resource Management". National Bureau of Fish Genetic Resources, Lucknow. September 11-13, 2002. Abstract No.112.

Singh, A.K., Joshi, K.D. and Kapila, R. 2002. Trait enumeration in endangered upland golden mahseer, *Tor putitora* (Hamilton) from different habitats for genetic up gradation. National Seminar on "Aquatic Resource Management

in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. C-14.

Singh, A.K. 2002. Impact of exotic fish culture and biodiversity conservation in northeastern region for sustainable production. Proceedings of the "National Academy of Sciences, India, 72nd Annual Session and Symposium on the Biodiversity". Northeast Hill University, Shillong. October 25-26, 2002. Abstract page No. 7-8.

Singh, A.K., Shyam Sunder and Raina, H.S. 2002. Icthyo-benthic faunal diversity and eological data patterns of aquatic resources in Uttaranchal hills for identifying priority areas for conservation. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. B-9. Ibid.

Tyagi, B.C. and Joshi, K.D. 2002. Studies on exotic carp based aquaculture in the hill state of Uttaranchal. Workshop on "Development of Research strategies for Aquafarming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002. Abstract page No.39.

Tyagi, B.C. and Joshi, K.D. 2002. Maturation and spawning behavior of exotic Chinese carps in coldwaters at high altitudes. Abstract page No.52. Ibid.

Tyagi, B.C. 2002. Prospects of exotic Chinese carp breeding and aquaculture in temperate conditions. National Symposium on "Fisheries Enhancements in Inland Waters- Challenges Ahead". Inland Fisheries Society of India, Central Institute of Capture Fisheries Resources, Barrackpore. April 27-28, 2002.

Tyagi, B.C. 2002. Evaluation of indigenous and alien invasive fish species in aquaculture in the hills. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002. Abstract No. A-19:37.

Tyagi, B.C. and Joshi, K.D. 2002.Studies on induced maturation, spawning and embryonic development of grass carp (*Ctenopharyngodon idella*) in coldwaters. Sixth Indian Fisheries Forum, Central Institute of Fisheries

Education (Deemed University), Mumbai. December 17-20, 2002. Abstract No. GB-7: 233.

Vass, K.K., Raina, H.S. and Haldar, R.S. 2002. Hatching and rearing of rainbow trout, *Oncorhynchus mykiss* (Walbaum) at Bhimtal in Kumaon Himalayas. Sixth Indian Fisheries Forum, Central Institute of Fisheries Education (Deemed University), Mumbai. December 17-20, 2002. Abstract page No. 12.

Vass, K.K., Raina, H.S., Joshi, C.B. and Haldar, R.S. 2002. Fishery potential and its enhancement in Nainital lake. Abstract page No. 64. National Seminar on "Aquatic Resource Management in Hills". National Research Centre on Coldwater Fisheries, Nainital. October 4-5, 2002.

Year 2003

Joshi, C.B., Shyam Sunder, Sanga, P. and Khan, A.U. 2003. Development of mahseer fishery in Shyamlatal lake in Kumaon hills. National symposium on the "Ecology and Biodiversity of Aquatic Environment (SEBAE)" held at Allahabad (U.P.) during 15-17 February 2003.

Kapila, R. and Mishra, D.P. 2003. Randomly amplified polymorphic DNA (RAPD) fingerprinting of coldwater fish *Schizothorax richardsonii* (Gray). National Symposium on "Genetics and Gene Banking of Fish and Shellfish." Central Institute of Fisheries Education (Deemed University), Mumbai. March 28-29, 2003.

Mohan, M., Kapila, and R. Basade, Y. 2003. Feed development for indigenous coldwater fishes in Himalayan region. National Conference on "Aquaculture Nutrition". Central Marine Fisheries Research Institute, Kochi. March 12-14, 2002.Abstract No. 28.

Singh, A.K. and Raina, H.S. 2003. Biological habitat and distributional diversity of chocolate mahseer in Indian uplands. National symposium on the "Ecology and Biodiversity of Aquatic Environment (SEBAE)" held at Allahabad (U.P.) during 15-17 February 2003. Abstract page No.32-33.

Vass, K.K. and Singh, A.K. 2003. Sheet jal mein matsya samvardhan vikas ka vivechan. Rashtriya Sangishthi "Bhartiya Matsikiya Ka Vistar". Kendriya Matsya Kshiksha Sansthan, Mumbai. January 15-16, 2003.

Research articles

Kapila, R., Kapila, S. and Basade, Y. 2002. Impact of temperature on haematology and serum enzymes of coldwater fish, *Schizothorax richardsonii* (Gray). Indian Journal of Fisheries, 49(2):187-192.

Popular articles

Basade, Y. and Tyagi, B.C. 2003. Kitna mahtavpurn hai paripurak ahar. Kheti, 55(11): 7-8 &12.

Joshi, K.D. 2003. Prospects of fisheries development in Uttaranchal State. Fishing Chimes, 22(10-11): 62-66.

10. LIST OF ONGOING PROJECTS

Title of the Projects	Project Leaders & Associates	Year of Start	Likely year of termination
Ecological modeling and fishery enhancement in lakes/ wetlands in Himalayan/ sub-Himalayan region	Dr. K.K. Vass Dr. H.S. Raina Dr. C.B. Joshi	1998	2003
Establishment of baseline information with respect to aquatic resource assessment and bio-diversity with application of GIS	Dr. H.S. Raina Dr. S. Sunder Dr. A.K. Singh	1998	2003
Nutrition and feed development For upland fish with the focus On indigenous species	Dr. M. Mohan Dr. Y. Basade	1998	2003
Studies on induced ovarian Development, maturation And spawning of grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmicthys molitrix*) in coldwaters.	Dr. B.C. Tyagi Dr. K.D. Joshi	2000	2004
Conservation and genetic Upgradation of golden mahseer, *Tor putitora*	Dr. A.K. Singh Dr. K.D. Joshi	2001	2004
Demonstration of exotic carp Farming in coldwaters	Dr. B.C. Tyagi Dr. K.D. Joshi	1998	2003
Computer application in Coldwater fisheries resource assessment & management	Mr. A.K. Nayak Dr. K.K. Vass	2000	2003

11. CONSULTANCY, PATENTS, COMMERCIALIZATION OF TECHNOLOGY

The Institute is rendering consultancy services as per the guidelines of the ICAR to various organizations.

"Hatchery Designing of Himalayan mahseer *Tor putitora* (Ham.) for seed production" at Tehri, Garhwal, Uttaranchal. In this connection a layout design of hatchery, farm and other components / facilities has been prepared and submitted to the authorities of Tehri Hydro-Development Corporation Ltd., Tehri for implementation.

Action Plan Document on "Fishery enhancement in Nainital and other Kumaon lakes" was prepared for Alternate Hydro Energy Centre (AHEC), Indian Institute of Technology, Roorkee, Uttaranchal. (Contract was duly accepted and report already submitted to the sponsoring agency).

For establishment of mahseer hatchery and small farm at Pookote lake, Wyanand, Kerala, a consultancy proposal has been prepared and submitted to State Fisheries Management Society (FIRMA), Kerala.

To prepare layout plan/ design of trout hatchery, farm and other relevant activities on trout propagation in Kerala, a consultancy proposal is being processed with the NGO- Tranvancore Leisure Management, Trivuananthapuram, Kerala.

For development of mahseer farm in upper reaches of Western ghats a consultancy proposal is being processed with Government of Tamil Nadu.

12. RAC, IMC, SRC, QRT MEETINGS

Research Advisory Committee (RAC)

The Research Advisory Committee meeting was held on October 3, 2002. The meeting was attended by the following committee members:

Dr. S.N. Dwivedi	Former Director General, MPCS&T, Bhopal; Former Director, CIFE, Mumbai; Former Additional Secretary, Government of India.	Chairman
Shri. S.N. Ogale	Manager (Environment), Tata Power Company, Lonavla	Member
Dr. U.P. Singh	Dean College of Fisheries, G.P. Pant University of Agriculture and Technology, Pantnagar	Member
Dr. V.R. Chitranshi	ADG (Inland Fisheries), ICAR, New Delhi	Member
Dr. K.K. Vass	Director, NRCCWF, Bhimtal	Member
Dr. Madan Mohan	Principal Scientist, NRCCWF, Bhimtal	Member Secretary

After a brief welcome by the Director and the introductory remarks by the members of the committee the progress made under each research project of the Institute for the year 2001-2002 was discussed. The Chairman and the members of the committee were satisfied with the progress made under each activity; however, the

RAC Meeting

members gave certain suggestions to be implemented by respective Principal Investigators. The Chairman and other Members finalized recommendations for the year 2002-2003. The meeting ended with vote of thanks proposed by the Member Secretary.

Staff Research Council (SRC)

SRC Meeting

Annual Staff Research Council meeting of the Institute was held on 18th May 2002 at Bhimtal under the Chairmanship of Dr. B.N. Singh, Officiating DDG (Fisheries), ICAR, New Delhi. In the meeting the progress of each on-going research project during the year 2001-2002 was critically discussed and evaluated. The work programme for the year 2002-2003 was finalized.

Fishery Policy Committee

The Government of Uttaranchal constituted a committee on May 5, 2002 for developing a draft policy for adoption by the State. The committee comprised the following members.

Dr. K.K. Vass	Director, NRCCWF, Bhimtal	Chairman
Dr. A.S. Negi	Chief Conservator of Forest, Uttaranchal	Member
Dr. U.P. Singh	Dean, Fisheries College, G.B. Pant University Of Agriculture and Technology, Pantnagar	Member
	The Secretary, Department of Tourism, Government of Uttaranchal (or his representative)	Member

	The Secretary, Department of Irrigation, Government of Uttaranchal (or his representative)	Member
Shri. S.R. Chanyal	Jt. Director, Uttaranchal Fisheries Department, Uttaranchal	Member
Dr. (Ms) Kumkum Shah	Assistant Professor,Zoology Department, Degree College, Pithoragarh	Member
Brig. Jasbir Singh	President Environment Protection Organization, Dehradun	Member
Shri. R.S. Rautela	Angler's Association, Dehradun	Member
Shri. Nanu Kashyap		Member
Shri. Surinder Kumar		Member
Dr. Shyam Sunder	Principal Scientist, NRCCWF Bhimtal	Co-opted Member
Dr. B.C. Tyagi	Principal Scientist, NRCCWF Bhimtal	Co-opted Member
Shri. R.C. Pokhariyal	Assistant Director, State Fisheries Department, Uttaranchal	Co-opted Member

Meeting of Fishery Policy Commitee of Uttaranchal

The meeting was attended by seven members including Shri. C.M.S. Bisht, Joint Secretary (representative of The Secretary) Department of Tourism, Government of Uttaranchal; Shri. D.C. Pandey, Executive Engineer (representative of The Secretary) Department of Irrigation, Government of Uttaranchal; Shri. M.M. Nath

(Fish Angler); Shri. Tota Ram (representative of Shri. Nanu Kashyap), a fish farmer and three co-opted members. During their two day deliberations and detailed discussions on May 22-23, 2002 at NRCCWF, Bhimtal. The final draft policy both in English and Hindi versions were submitted to Dr. R.S. Tolia, IAS, Principal Secretary and Commissioner Forest and Rural Development Department, Government of Uttaranchal on May 28, 2002 for consideration at Government level. The draft policy was discussed further under the Chairmanship of Hon'ble Minister of Fisheries, Government of Uttaranchal at Dehradun. Subsequently the Government of Uttaranchal has adopted this policy and released the publication both in Hindi and English version.

Uttaranchal Fishery Act

As per the Government of Uttaranchal notification a committee was constituted to draft the 'Fisheries Act' for the State. The committee comprised of the following:

Dr. K.K. Vass	Director, NRCCWF, Bhimtal
Dr. U.P. Singh	Dean, Fisheries College, G.B. Pant University of Agriculture and Technology, Pantnagar
Dr. (Ms) Kumkum Shah	Assistant Professor, Department of Zoology, Degree College, Pithoragarh
Shri. S.R. Chaniyal	Jt. Director, State Fisheries Department, Uttaranchal
Dr. C.B. Joshi	Principal Scientist, NRCCWF, Bhimtal
Dr. Shyam Sunder	Principal Scientist, NRCCWF, Bhimtal
Shri. R.C. Pokhariyal	Assistant Director, State Fisheries Department, Uttaranchal

The committee held detailed discussions at NRCCWF, Bhimtal between August 16-24, 2002. The draft of Fisheries Act was prepared and sent to the Additional Secretary (Fisheries), Government of Uttaranchal for finalization and approval of the competent authority in the Government.

Sports Meet

The staff of the Institute participated in the Zone IV. Inter-Institutional Sports Meet held at National Dairy Research Institute, Karnal, Haryana during December 2-5, 2002.

Joint Staff Council (IJSC)

The Institute's Joint Staff Council's 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	Staff side
Dr. K.K. Vass, Director & Chairman	Shri. Harish Ram, Asst. & Member CJSC
Dr. Madan Mohan, Principal Scientist	Shri. T.M. Sharma, T-2 & Member
Dr. Shyam Sunder, Principal Scientist	Shri. Baldev Singh, T-3 & Member
Dr. A.K. Singh, Senior Scientist	Shri. J.C. Bhandari, LDC & Member & Secretary
Dr. K.D. Joshi, Scientist (SS)	Shri. Ravinder Kumar, SSG-III & Member
Shri. R.L. Raina, AAO & Member Secretary	Shri. H.S. Bhandari, SSG-II & Member

Rajbhasha Committee

The regular quarterly meetings of the Hindi cell of the Institute were convened under the Chairmanship of the Director. In the meetings it was decided to celebrate the year as *Hindi chetana varsh* in order to bring awareness among the staff members about our National language. The Committee members include the following:

Dr. K.K. Vass	Director	Chairman
Dr. A.K. Singh	Senior Scientist	Member Secretary
Shri. A.K. Nayak	Scientist	Member
Smt. Susheela Tewari	Stenographer	Member
Shri. Harish Ram	Assistant	Member
Shri. Amit Kumar Joshi	Hindi Translator	Member
Shri. Ravinder Kumar	SSG-III	Member

13. PARTICIPATION IN CONFERENCES, SEMINARS, MEETINGS &WORKSHOPS

Conferences/ Meetings/ Symposiums/ Seminars/ Workshops	Participants
Workshop on "Development of Research Strategies for Aqua-farming in Uttaranchal" G. B. Pant University of Agriculture and Technology, Pantnagar (U.A) on April 22, 2002.	Dr. K.K. Vass Dr. H.S. Raina Dr. C.B. Joshi Dr. Shyam Sunder Dr. B.C. Tyagi Dr. A.K. Singh Dr. K.D. Joshi
National Symposium on "Fisheries Enhancements in Inland Waters- Challenges Ahead". Inland Fisheries Society of India, Central Inland Capture Fisheries Research Institute, Barrackpore. April 27-28, 2002.	Dr. B.C. Tyagi
National Seminar on "Relevance of Biosphere Reserve, National Parks and Sanctuaries" Gurukul Kangri University, Haridwar. May 25-26, 2002.	Dr. K.K. Vass
National Seminar on "Environmental Awareness, Education and Management for Sustainable Rural Development". Sri Venkatesh University, Tirupati during August 26-28, 2002.	Dr. Madan Mohan
22nd Annual meeting of the Academy of Environmental Biology and the National Seminar on "Biodiversity and Resource Management". National Bureau of Fish Genetic Resources, Lucknow. September 11-13, 2002.	Dr. A.K. Singh
National Seminar on "Aquatic Resources Management in Hills" National Research Centre on Coldwater Fisheries, Nainital during 4 –5 October 2002.	Dr. K.K. Vass Dr. H.S. Raina Dr. C.B. Joshi Dr. Shyam Sunder Dr. B.C. Tyagi

	Dr. A.K. Singh Dr. K.D. Joshi Dr. Yasmeen Basade Dr. Rajeev Kapila Sh. A. K. Nayak
"72nd Annual Session and Symposium on the Biodiversity" National Academy of Sciences, India, Northeast Hill University, Shillong. October 25-27, 2002.	Dr. A.K. Singh
National Seminar organized by Indian Society of Fisheries Professionals at Bhopal during October 26-28, 2002.	Dr. B.C. Tyagi
Symposium on "Moving towards the sustainable agricultural development in Uttaranchal". G. B. Pant University of Agriculture and Technology, Pantnagar. November 12-13, 2002.	Dr. K.K. Vass Dr. B.C. Tyagi Sh. A.K. Nayak
"71st Annual Meeting of Society of Biological Chemists (India)."Department of Biochemistry, CBS&H, PAU, Ludhiana. November 14-16, 2002.	Dr. Rajeev Kapila
Workshop on "Mountain Environment and Development: Potential and Prospects".G.B. Pant Institute of Himalayan Environment, Kosi, Almora. December 9-10, 2002.	Dr. K.K. Vass
Sixth Indian Fisheries Forum, Central Institute of Fisheries Education (Deemed University), Mumbai. December 17-20, 2002.	Dr. K.K. Vass Dr. Madan Mohan Dr. B.C. Tyagi
National Conference on "Aquaculture Nutrition". Central Marine Fisheries Research Institute, Kochi. March 12-14, 2003.	Dr. Madan Mohan
Review Workshop on "Hill and mountain agro-ecosystem PSR sub projects". Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.). March 21-22, 2003.	Dr. C.B. Joshi

Meetings

Meeting of NATP Project held at G.B. Pant University of Agriculture and Technology, Pantnagar on April 22,2002.	Dr. C.B. Joshi Dr. Shyam Sunder
Meeting with Hon'ble Minister of Co-operative, Animal husbandary, Dairy and Fisheries, Uttaranchal On May 19, 2002 at Champawat.	Dr. K.D. Joshi
Meeting on Draft Policy at Uttaranchal Government, Secretariat on June 9, 2002.	Dr. K.K. Vass
Meeting of "Uttaranchal Fisheries Act" at NRCCWF, Bhimtal from August 16-24, 2002.	Dr. C.B. Joshi Dr. Shyam Sunder
NATP (H&M) Peer Review Team meeting held at G.B. Pant University of Agriculture and Technology, Pantnagar from November 28-30, 2002.	Dr. C.B. Joshi Dr. Shyam Sunder
Brainstorming session on "Potential of fisheries in Uttar Pradesh: Constraints and opportunities organized By Uttar Pradesh Council of Agricultural Research at IISR, Lucknow on January 22, 2003.	Dr. A.K. Singh
Meeting at SMD with DDG (Fy) at KAB-II, Pusa, New Delhi. December 3, 2002 - February 25, 2003.	Dr. Madan Mohan Dr. C.B. Joshi Dr. B.C. Tyagi Dr. A.K. Singh Dr. K.D. Joshi Dr. Yasmeen Basade Dr. Rajeev Kapila
"District Plan Meeting" held on December 29, 2002 at DM Office Champawat.	Dr. K.D. Joshi
Meeting of Working Group for "Fisheries development in Uttaranchal" held on January 27,2003 and February 13, 2003 at G. B. Pant University of Agriculture and Technology, Pantnagar.	Dr. Madan Mohan

14. WORKSHOPS, SEMINARS & FARMER'S EVENTS ORGANIZED

National Seminar

The National Seminar on Aquatic Resource Management in Hills was organized by NRCCWF in collaboration with the Society of Biosciences, Muzaffarnagar; UTDASP, Government of Uttaranchal and National Institute of Ecology, Jaipur at the Administrative Training Institute, Nainital from October 4-5, 2002. Shri Mantri Prasad Naithani Ji, Minister of Animal Husbandry, Dairying, Co-operatives and Fisheries, Government of Uttaranchal was the Chief Guest at the inaugural function. Dr. S.N. Dwivedi Ex-Director General, MPCS&T, Bhopal; Ex-Director, CIFE, Mumbai; Ex-Additional Secretary, Government of India presided over the function. Other guests of honour at the function were Dr. S.A.H. Abidi, Member ASRB, New Delhi; Dr. P.V. Dehadari, Former DDG (Fy), ICAR, New Delhi; Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi and Dr. V.P. Agarwal, Secretary General, Society of Biosciences, Muzaffarnagar. At the inaugural function the Chief Guest felicitated eminent fishery scientists of the country and also released a book "Highland Fisheries and Aquatic resource Management" edited by Dr. K.K. Vass and Dr. H.S. Raina. Dr. S.N. Dwivedi and Dr. P.V. Dehadrai released other

Dignitaris at the dias

Hon'ble Minister lightening the lamp

Hon'ble Minister delivering his address

publications on this occasion. At this function the **Best Fish Farmer Award** was presented to Shri Krishna Nand Gahtori by the Hon'ble Minister Shri Naithani ji, for his achievements in fish farming in hills under the technical guidance of NRCCWF. The Chief Guest after his address to the participants inaugurated the "**Matsya Pradershani**" organized especially for the seminar. Other dignitaries who attended the seminar were Dr. B.N. Singh, Ex-DDG (Fy), ICAR, New Delhi; Dr. D.P.S. Chauhan, Dy. Commissioner, Fisheries, Government of India; Dr. G.P. Dubey Former Director, Madhya Pradesh State Fisheries Department, Bhopal; Dr.Saharan, Director Fisheries, Government of Haryana; Dr. Brij Gopal, Secretary General, National Institute of Ecology, Jaipur; Dr. K.L. Sehgal, Former Director, NRCCWF, Bhimtal; Dr. D.P. Zutshi, Former Director, CORD, Kashmir University, Srinagar (J&K); Dr. V.V. Sugunan, Director, CICFRI, Barrackpore (West Bengal); Dr. D. Kapoor, Director, NBFGR, Lucknow; Dr. V.R. Chitranshi, ADG (IFy), ICAR, New Delhi; Shri S.N. Ogale, Manager (Environment), Tata Power Company Limited, Lonavla (Maharashtra); Shri Vijay Soni, President, Anglers Association, Delhi; Dr. U.P. Singh, Dean and Dr. C.S. Singh, Former Dean, College of Fisheries, G.B. Pant University of Agriculture and Technology, Pantnagar; Profs. Sarvesh Kumar, P.K. Gupta and S.P. Singh of Kumaon University, Nainital. During the two days seminar, apart from the inaugural session, special lectures, three technical sessions, Young Scientist Award presentation session and the plenary session were held.

Dr. Sehgal receiving memento from Hon'ble Minister

The plenary session was conducted on October 5, 2002

Dr. S.N. Dwivedi delivering his address

Dr. Abidi, Dr. Dwivedi and Dr. Dubey
at Plenary session

and was chaired by Dr. S.A.H. Abidi, Member, ASRB, ICAR, New Delhi. The recommendations based on the two days deliberations and the reports submitted by different session chairpersons for the development of hill fisheries and aquatic resource management were discussed in detail, finalized and approved by the house. Dr. Abidi in his concluding remarks congratulated the Director and Staff of NRCCWF for excellent conduct of this seminar.

Hindi pakhwada

Institute celebrated the Hindi week from September 14-21, 2002 at Bhimtal. During this week various Hindi related activities were organized. Essay writing and drafting competition in Hindi was conducted among the staff members of the Institute. The staff members participated in the events with great zeal and winners were awarded.

Hindi week celebrations

15. DISTINGUISHED VISITORS

Following distinguished dignitaries visited the Institute during the year 2002 – 2003.

Shri. Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture, Govt. of India and Vice-President of Indian Council of Agricultural Research, New Delhi.

Shri. Nav Prabhat, Hon'ble State Minister of Forest and Environment, Government of Uttaranchal.

Shri. Govind Singh Kunjwal, Minister for Industries, Government of Uttaranchal.

Dr. R.S. Tolia, IAS, Principal Secretary and Commissioner, Department of Forest and Rural Development, Government of Uttaranchal.

Dr. S.A,H. Abidi, Member, ASRB, Indian Council of Agricultural Research, New Delhi.

Dr. S.N. Dwivedi, Ex-Director General, MPCS&T, Bhopal; Ex-Director, CIFE, Mumbai; Ex-Additional Secretary, Government of India.

Dr. S. Ayyappan, DDG (Fisheries), Indian Council of Agricultural Research, New Delhi.

Shri. Tarkendra Vaisnava, IAS, District Magistrate, Champawat.

Shri. Hemesh Kharkwal, MLA, Champawat.

Shri. Kumar Vineet, ASDM, Champawat.

Dr. Narendra Kumar, Director, Defense Agricultural Research Laboratory Pithoragarh.

Dr. B.N. Singh, Officiating DDG (Fisheries), Indian Council of Agricultural Research, New Delhi.

Dr. Acharya and other PRT members (NATP)
on a visit to lead centre Bhimtal

Hon'ble MOS on a visit of NRCCWF Bhimtal

Dr. V.R. Chitranshi, ADG (Inland Fisheries), Indian Council of Agricultural Research, New Delhi.

Shri. S.N. Ogale, Manager (Environment), Tata Power Company Ltd., Lonavla (Maharashtra).

Dr. R.M. Acharaya, Former DDG (Animal Science), Indian Council of Agricultural Research, New Delhi.

Shri. A.S. Negi, chief Conservator of Forest, Uttaranchal.

Dr. U.P. Singh, Dean Fisheries, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttaranchal).

Dr. R.L. Sharma, Dean (Retd.), Horticulture University, Solan.

Dr. V.N. Sharda, Director, CSWCRT&I, Dehradun.

Dr. P.C. Tyagi, PPSS NATP (H&M), CSWCRT&I, Dehradun.

Shri. S.R. Chanyal, Joint Director, Department of Fisheries, Uttaranchal.

Shri. R.C. Pokhariyal, Asstt. Director, Uttaranchal Fisheries.

Dr. (Ms.) Kumkum Shah, Degree college, Pithoragarh (Uttaranchal).

Brig. Jasbir Singh, President Environmental Protection Organization, Dehradun.

Shri. R.S. Rautela, Angler's Association, Dehradun.

Dr. Amita Saxena, Associate Professor, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttaranchal).

Cdr. A.B. Bhattachary, Rashtriya Indian Military College, Dehradun.

Lt. Colonel Amitab Negi, Commandant NCC Battalion, Almora.

Shri. J.C. Joshi, Chief Development Officer, Champawat.

16. PERSONNEL AS ON MARCH 31, 2003

SCIENTIFIC

1. Dr. K.K. Vass, Director
2. Dr. Madan Mohan, Principal Scientist
3. Dr. H.S. Raina, Principal Scientist
4. Dr. C.B. Joshi, Principal Scientist
5. Dr. Shyam Sunder, Principal Scientist
6. Dr. B.C. Tyagi, Principal Scientist
7. Dr. A.K. Singh, Senior Scientist
8. Dr. K.D. Joshi, Scientist (Senior Scale)
9. Dr. Yasmeen Basade, Scientist (Senior Scale)
10. Dr. Rajeev Kapila, Scientist
11. Shri. A.K. Nayak, Scientist

ADMINISTRATIVE

1. Shri. R.L. Raina, AAO
2. Shri. Harish Ram, Asstt.
3. Shri. Manni Lal, Asstt.
4. Smt. Susheela Tewari, Stenographer
5. Smt. Khilawati Rawat, Senior Clerk
6. Shri. P.C. Tewari, Junior Clerk
7. Shri. Pratap Singh, Junior Clerk
8. Shri. J.C. Bhandari, Junior Clerk
9. Smt. Munni Bhakt, Junior Clerk

TECHNICAL

1. Shri. R.S. Haldar, T-5
2. Shri. Amit Kumar Joshi, T-3 (Hindi Translator)
3. Shri. Baldev Singh, T-3

4. Shri. Santosh Kumar, T-3
5. Shri. Ravinder Kumar, T-2
6. Shri. Gopal, T-2
7. Shri. R.K. Arya, T-2
8. Shri. Hansa Dutt, T-2
9. Shri. T.M. Sharma, T-2
10. Shri. Bakshi Ram, Driver (T-1)
11. Shri.Bhagwan Singh, Driver (T-1)

SUPPORTING

1. Shri. Japhu Ram, SSGr IV
2. Shri. Sant Ram, SSGr IV
3. Shri. Ravinder Kumar, SSGr III
4. Shri. Om Raj, SSGr III
5. Shri. H.S. Chauhan, SSGr III
6. Shri. H.S. Bhandri, SSGr II
7. Shri. Dharam Singh, SSGr I
8. Shri. Sunder Lal, SSGr I
9. Shri. Manoj Kumar, SSGr I
10. Shri. Pooran Chandra, SSGr I
11. Shri. Kuldeep Kumar, SSGr I
12. Shri. Bhola Dutt, SSGr I
13. Shri. Chandra Shekhar, SSGr I
14. Shri. Prakash Akela, SSGr I
15. Smt. Basanti Devi, SSGr I

CASUAL LABOUR WITH TEMPORARY STATUS

1. Shri. Mangala Prasad.

17. SPECIAL INFRASTRUCTURAL DEVELOPMENT

The construction of NRCCWF Phase-I complex at Industrial Area, Bhimtal is progressing as per schedule . The inspection of construction site was carried out by the Hon'ble MOS, DARE, Shri Hukumdeo Narayan Yadav during his visit to NRCCWF on June 18, 2002. He was briefed about the progress of work by the CPWD authorities and the Director. He impressed upon the CPWD that project should be completed on time so that staff of the institute may shift from their rented accommodations as soon as possible. The concerned authorities assured the Hon'ble Minister that all out efforts will be made to complete the project on time. The progress on initiating the work on Phase-II was also discussed during the inspection. The progress of work is regularly being monitored by a joint committee of NRCCWF and CPWD officers. Apart from major works under execution, minor works at mahseer hatchery and experimental farm at Chirapani were also initiated / completed.

Hon'ble MOS, DARE, Shri Hukumdeo Narayan Yadav visiting newly contructed NRCCWF (Phase I) complex at Bhimtal