



# वार्षिक प्रतिवेदन ANNUAL REPORT 1997-98



वार्षिक प्रतिवेदन  
ANNUAL REPORT  
1997-98



राष्ट्रीय शीतजल मात्स्यकी अनुसंधान केन्द्र  
(भारतीय कृषि अनुसंधान परिषद्)  
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Printed at : Yugantar Prakashan Pvt. Ltd.,  
WH- 23, Mayapuri Industrial Area,  
Phase- I, New Delhi- 110064  
Ph: 5135949, 5139018

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- The activities and achievements reflected in this Annual Report covers the period January 1997 to March 1998.
  - This report includes unprocessed or semiprocessed data which would form the basis of scientific papers in due course. The material contained in the report, therefore, may not be made use of without the permission of this Institute, except for quoting it as a scientific reference.

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## PREFACE

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It is a matter of great pleasure for me in presenting the Annual Report 1997-98 for the National Research Centre on Coldwater Fisheries (NRC-CWF) in this Golden Jubilee year of Independence of India. The report contains comprehensive details about research activities and achievements of the Institute in the discipline of temperate openwater fisheries and aquaculture.

Some of the major thrusts of the Institute during the year have been evaluation of cage rearing of golden mahseer fingerlings in Bhimtal lake, standardizing the farming practice with mixed exotic carp for upland agroclimatic situation, biochemical characterisation of mahseer and snow trout to evaluate environmental stress.

National Research Centre on Coldwater Fisheries is involved in promoting and conducting research and training in Temperate water fisheries, Aquaculture and Ecosystem studies. The Institute, during the year continued its service in research and development activities through its various research programmes. I hope that aquatic ecologists and fishery personnel will find the information presented in the publication useful and informative. Valuable suggestions and comments for improvement in subsequent reports are most welcome.

I would like to express my gratitude to Dr. K. Gopakumar, Deputy Director General (Fisheries), ICAR for his constant support, guidance and encouragement and also to Dr. P.V. Dehadrai, Former, DDG (Fy) for his interest in the activities of NRC.

I wish to express my sincere appreciation to my scientist colleagues, officers and other staff members of the Institute for their whole hearted support and co-operation in carrying out the functions and activities of the Institute and for providing requisite material for this report.

I take this opportunity and thank Dr. C.B. Joshi, Senior Scientist and Shri Rajeev Kapila, Scientist for their sincere efforts in compiling the basic draft of this report.

Lastly I thank Dr. H.S. Raina, Principal Scientist for extending full cooperation in pursuing the research activities.

## **EXECUTIVE SUMMARY**

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National Research Centre on Coldwater Fisheries (NRC-CWF) established in 1988 was mainly responsible for promoting and conducting research on coldwater aquaculture. With the advances in fishery science in the country, the Institute, under the changed scenario concentrated on basic, applied and adaptive research programmes in coldwater fisheries and system analysis.

A number of research programmes are undertaken which are broadly grouped into openwater fisheries and aquaculture. During the year under report there were eight ongoing research projects, covering the main thrust areas like artificial propagation of indigenous fishes viz; golden mahseer and snow trout, mixed farming of exotic carps in temperate waters, biochemistry and nutrition of coldwater fishes, ecology and biodiversity of temperate rivers.

### **Cage-culture trials of Golden Mahseer**

With an objective to rehabilitate the declining stocks of mahseer in Kumaon lakes, the Institute carried out trial runs to assess the feasibility of raising the stockable size fingerlings in floating cages in the lake itself. The experiments carried out in Bhimtal lake revealed that good stocking material could be raised in cages at lower stocking density registering 67% survival, 1.13% gain in growth per day during growing period by providing supplementary diets primarily based on soybean flour, wheat bran, rice polish and mustard oil cake.

### **Farming prospects of exotic carps in Kumaon Himalayas**

Six species farming combination of both indigenous and exotic carps in tropical waters has been responsible in achieving quantum jump in aquaculture productivity. But the critical environmental variables do not permit this combination

months. The water temperature during the experimental period ranged between a minimum of 5.5°C to a maximum of 29°C. In comparison the trials of mixed farming with 3 species combination of *Cyprinus carpio*, *Hypophthalmichthys molitrix* and *Ctenopharyngodon idella* with 50% density of silver carp and stocking density of 3 fishes m<sup>-2</sup> recorded a fish production of 1936 kg ha<sup>-1</sup>y<sup>-1</sup>. The production was achieved in running water systems having very low natural productivity but fishes were mainly fed with artificial diets developed at the Institute.

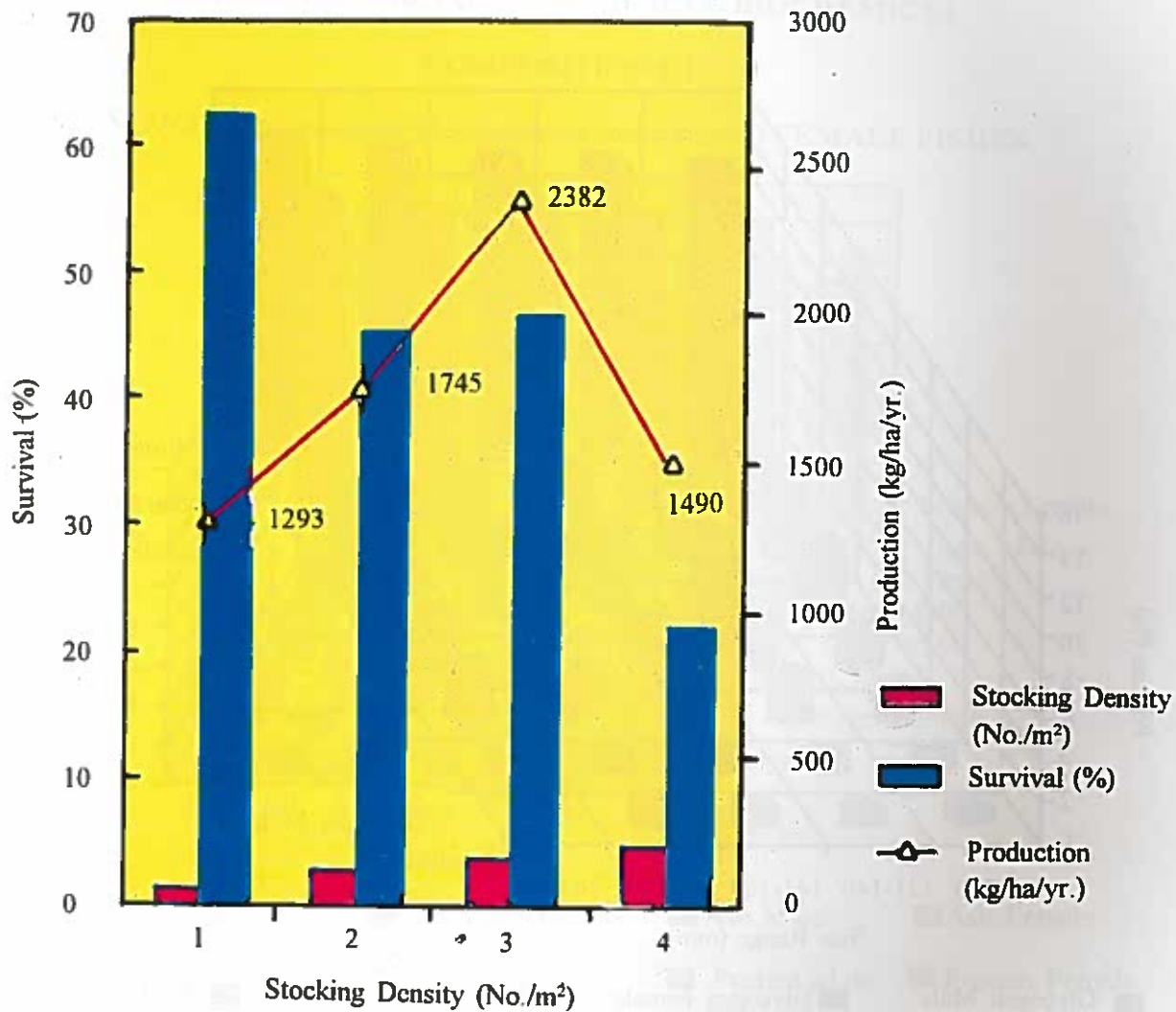
### **Further insight into Snow-trout culture**

Attempts at the Institute were continued to develop the package of practices to rehabilitate the important indigenous fishery of *Schizothorax richardsonii*. In this connection breeding trials with brooders collected from Chirapani and Lohawati streams were undertaken during the breeding season in which successful hatching was achieved. Efforts to develop the brood stock at the Chirapani farm from the germplasm collected from different natural ecosystems were continued at the farm to evaluate their growth performance. The stocks were fed with farm produced artificial diets. Preliminary observation indicate that species is a slow growing one.

### **Nutrition related investigations on Coldwater fishes**

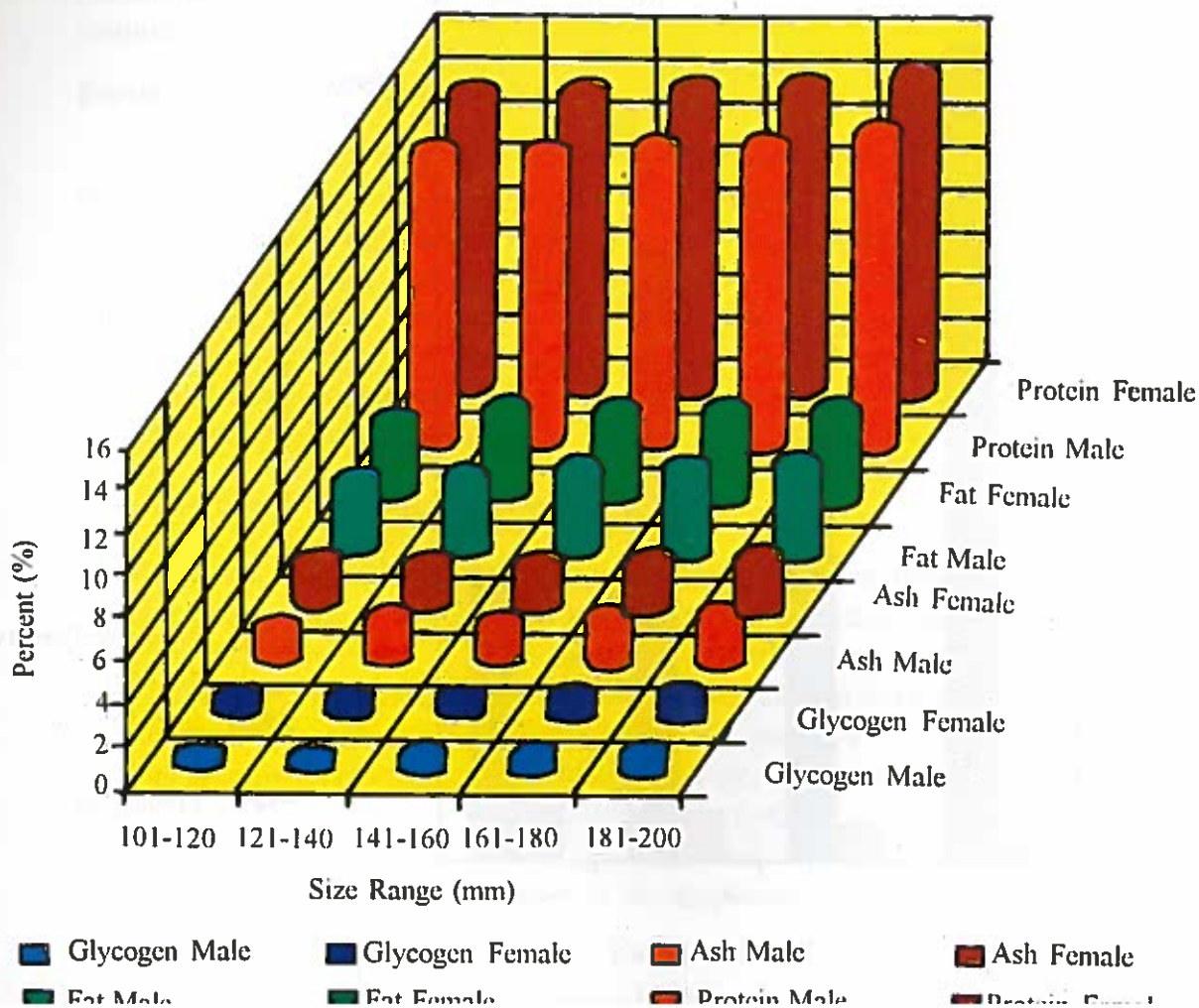
Nutritional trials with basal and various experimental diets using indigenous *Schizothorax richardsonii*, *Tor putitora* and exotic carp species (*Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*) as test fishes were undertaken at our Chirapani fish farm. The studies conducted so far revealed that experimental diet with supplemented mixture of vitamin A+E+C significantly affected the growth, FCR and survival of *Schizothorax richardsonii*. In comparison the experimental diet of vitamin A+C; A+E and A+E+C altered the growth rate, FCR and survival, respectively in case of *Tor putitora*. Among exotic carps only *Cyprinus carpio* responded favourably to the supplemented diet fortified with a mixture of vitamin A+E+C.

### **Understanding Biochemical physiology of Mahseer and Snow-trout**

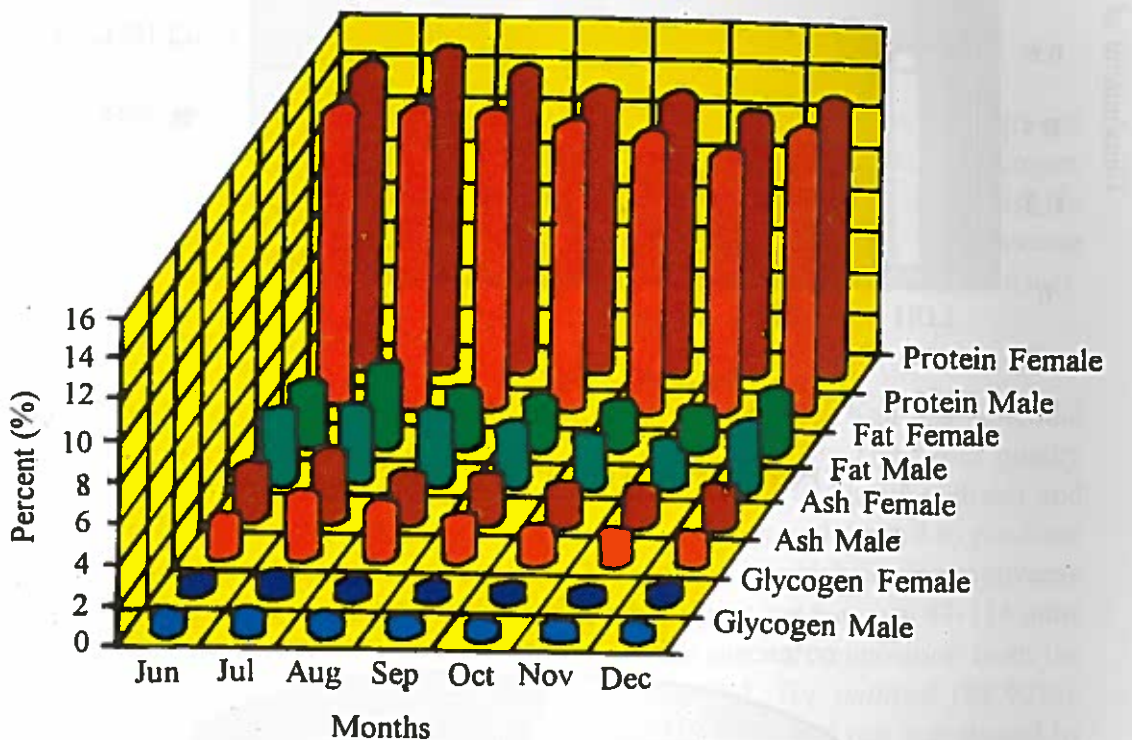




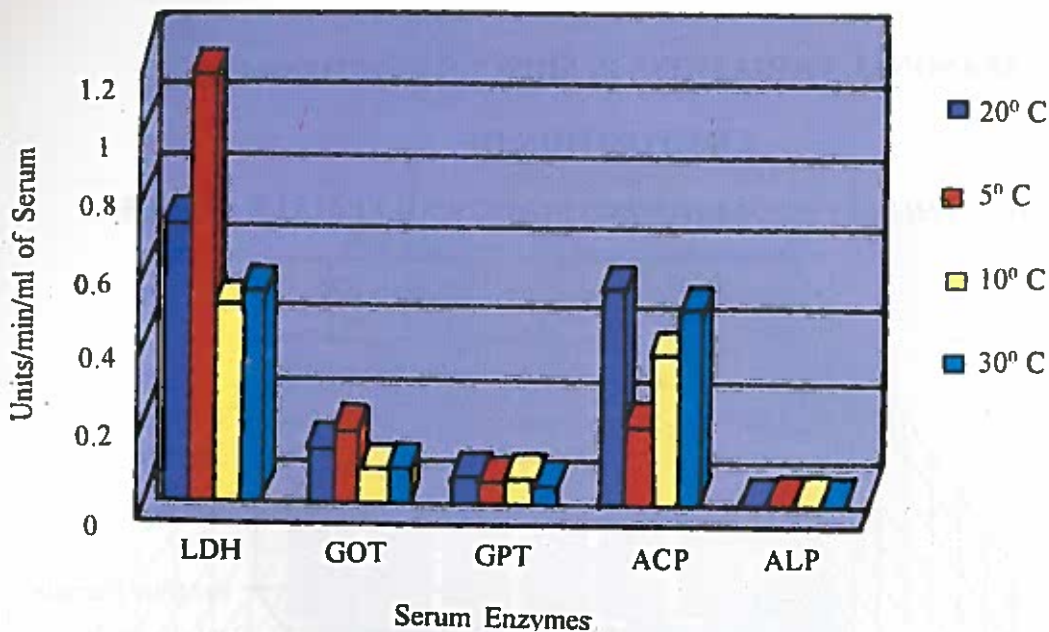
**BIOCHEMICAL COMPOSITION OF MUSCLES OF  
*SCHIZOTHORAX RICHARDSONII* MALE AND FEMALE FISHES OF DIFFERENT  
SIZE GROUPS**



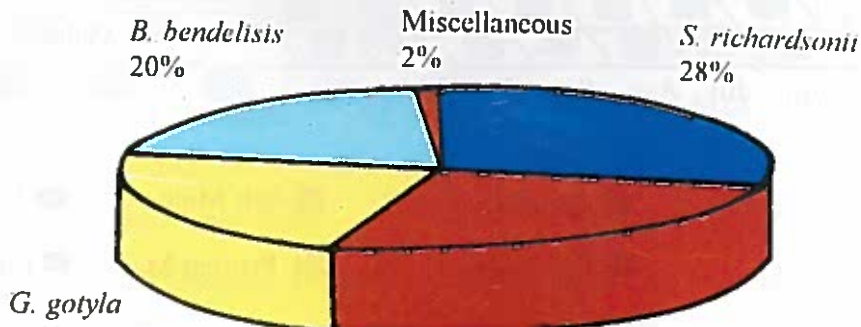
**SEASONAL VARIATIONS IN MUSCLE BIOCHEMICAL  
COMPOSITION OF  
*SCHIZOTHORAX RICHARDSONII* MALE AND FEMALE FISHES**



## IMPACT OF TEMPERATURE VARIATIONS ON SERUM ENZYMES ACTIVITIES OF *S. RICHARDSONII*



## FISH COMPOSITION OF RIVER LADHIYA



of *Schizothorax richardsonii* no differences in various enzymatic activities were noticed during pre-and spawning seasons in both sexes. Similarly, haematological parameters too did not record any significant drop in values. The observations have also been made in the lab experiments carried out with test fishes, maintained at different water temperatures and pH.

The comparative electrophoretic pattern of blood protein in case of *Tor putitora*, *Schizothorax richardsonii*, *Garra gotyla* and *Barilius bendelisis* revealed maximum bands in *G.gotyla* and minimum in *T.putitora*. Further, some of the protein bands exhibited almost similar values of relative mobilities.

### **Evaluation of chemistry in Coldwater fishes**

Different sexes of *Schizothorax richardsonii* belonging to different size groups upon chemical evaluation revealed that protein, total lipids, ash, glycogen, phospholipids and energy contents increased significantly with the size of fish. In comparison moisture content and cholesterol decreased significantly with increase in size. Changes were also noticed prior to and after spawning season of the fishes.

### **Ecodynamics of a coldwater river**

The river Ladhiya is an important tributary of the river Kali and potential mahseer streams of the Ganga system in Central Himalayas. The water quality parameters at different centres of the river are conducive to sustain mahseer and other coldwater fishes. The system has good biodiversity with regard to plankton population recording a density range of 22-28 units/l in which Bacillariophyceae dominated to the tune of 81%. Macroinvertebrate density ranged between 43-116 units m<sup>-2</sup> with a good diversity at genera level. The fish species composition from the system revealed *Schizothorax richardsonii* (28.69%), *Tor putitora* (28.92%), *Garra gotyla* (23.07%) and *Barilius bendelisis* (19.82%) and rest constituted by other miscellaneous species.

The scientists of the Institute participated in number of workshops and seminars related to the field of coldwater fishery and other connected disciplines.

## INTRODUCTION

---

### **Brief History**

The Institute made a modest beginning in 1963 as a Research Unit under Riverine Division in the then Central Inland Fisheries Research Institute to assist initially the State of Himachal Pradesh and subsequently Jammu & Kashmir State in providing research inputs to the departmental trout hatcheries and study other trout related problems in these states. The activities of the unit increased rapidly and the scope of the work was enlarged. Subsequently to give necessary thrust to the research and development activities of coldwater fisheries in the country, the Indian Council of Agricultural Research carved it out of CIFRI as an independent Institute in the year 1988 and was named as NRC-CWF with its temporary HQ at Haldwani (U.P.). Dr. K.L. Sehgal was the first regular Director of the Centre, who steered it upto October 1992. Subsequently, the Institute passed through a spell of Acting Directors and it was only on 20.11.1997 that the Council appointed second regular Director for the Institute. The Institute has till date been able to establish its experimental fish farm at Chirapani in Champawat district of U.P. However, other infrastructural facilities are in the process of creation.

The primary objective of the Institute was to address various problems related to research activities specific to coldwater fisheries with a focus on indigenous and exotic species available in the upland region of the country. During the decade of its existence the Institute has made significant contribution both under capture and culture fishery programmes.

### **Capture fishery**

The Himalayan openwater areas have been surveyed and suitable areas have been identified for developing aquaculture of coldwater fish species. Ecological investigation of various lentic and lotic systems have been undertaken to evaluate their production functions in order to formulate rational management practices. In this connection, as case studies, the work has been conducted on a few Central Himalayan lakes especially in Kumaon region. With regard to river systems the estimation of carrying capacity of Himalayan stream in Chirapani in Champawat

## Culture fishery

Package of practices have been developed for artificial breeding and nursery rearing of indigenous coldwater fish species which are under threat of becoming depleted from openwaters.

A flow-through hatchery for production of mahseer seed has been designed and established at Bhimtal (U.P.). This is the first attempt in the country to produce the seed of *Tor putitora* under controlled conditions. A record survival of 90% was achieved upto fry stage at this Bhimtal hatchery. The model hatchery has the capacity of hatching 2.5 lakh eggs and rearing facility for 2 lakh swim-up fry, 1-1.5 lakh advance fry. The flow-through model is more efficient and amenable to management. The design of hatchery has opened up the possibility of raising mahseer seed on large scale for ranching in depleted openwater stretches.

A nutritive pelletized diet (casein based) having 45% crude protein level fortified with vitamins and minerals has been formulated and trial tested to achieve better growth and higher survival of mahseer juveniles.

Attempts to fecund the wild brooder of *Schizothorax richardsonii* from Kumaon water have been undertaken. The species is amenable for egg taking/artificial fecundation and fry rearing under controlled conditions. Rearing experiments have been undertaken at Chirapani fish farm.

The trials to raise Common carp (*Cyprinus carpio*) under pond conditions have proved to be successful in sub-temperate zones of Himalayas. The growth rate and production of this fish under monoculture was much lower in comparison to when cultured with other candidate species such as *Hypophthalmichthys molitrix* and *Ctenopharyngodon idella*.

Under the conservation programme of golden mahseer the hatchery produced seed has been stocked in different Kumaon lakes in close collaboration with the State Fisheries Department. The seed has also been supplied to various R & D organisations.

Under transfer of technology programme, the Institute has been extending

## **Heads of the Institute**

Dr. K.L. Sehgal	01.04.1988 - 30.09.1992
Shri Madan Mohan (Act.)	01.10.1992 - 02.09.1993
Dr. H.S. Raina (Act.)	03.09.1993 - 19.11.1997
Dr. K.K. Vass	20.11.1997 onwards

## **Mandate**

The mandate of the National Research Centre on Coldwater Fisheries (NRC-CWF) is to promote and conduct research, training and extension in temperate aquaculture and openwater fisheries. To achieve these objectives, the NRC- CWF has the following functions.

- evaluate and assess the coldwater fishery resources in upland areas
- 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 biodiversity 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.

## **Organisational set-up**

In the absence of any permanent infrastructural facilities the Institute is presently operating in different rented accommodations located at Bhimtal (Distt. Nainital) and Champawat (Distt. Champawat), U.P. In tune with above mandate, the research activities of NRC-CWF have been organised into different projects corresponding to research needs under temperate aquaculture and openwater

**The Research & Development Centre** is located in Bhimtal (Distt. Nainital) U.P. The scientists here are pursuing research activities related to investigations on biochemistry, nutrition with a focus on indigenous fishes both snow trout and mahseer. Apart from different labs that have been established at this centre, it also houses the basic library facilities created for the Institute. Other supportive facilities such as continuous computerised monitoring of weather data. Computers have also been provided for efficient execution of project programmes.

**The Director's main office complex** is also located at Bhimtal (Distt. Nainital) in a separate building. It apart from having the administrative unit, audit wing and Director's office also houses different scientific sections and extension, concentrating on various project programmes and TOT activities of the Institute.

**Experimental farm complex** the facility has been created by the Institute on its own acquired land which is located at Chirapani in the district of Champawat (U.P.). All aquaculture experimental trials with respect to both indigenous and exotic fish species are being undertaken at this farm. The farm has facility for hatchery rearing, nursery rearing and fingerling raising tanks with a flow-through system.

**Mahseer hatchery complex** this temporary facility on the strip of land owned by U.P. State Fisheries Department has been established at Bhimtal, Distt. Nainital (U.P.). It has nursery rearing facility to produce mahseer seed primarily to provide livestock for undertaking aquaculture experiments under various projects while remaining seed is used for ranching programme. This complex also houses the field laboratory.

### **Library Services**

The NRC-CWF library is providing its services to the scientists of the Headquarter and Research Centre, apart from scholars and students from other local organisations interested in pursuing the research activities in inland fisheries and aquatic ecology. The library during the year added 26 scientific books, 17 journals (both Foreign and Indian), 70 other documents. The library facilities at our Research Centre has also been strengthened. The library has also been provided with reprographic facilities for the benefit of scientists. The current holdings of the library comprises 1091 books, 920 Indian journals, 1394 Foreign journals, 687 miscellaneous publications and documents. The library continued its efforts in collecting, processing and disseminating scientific/technical information to the potential users.



## Financial Statement

### Budget statement for the year 1997-98

(Rupees in lakhs)

Code	Head of Account	Budget		Expenditure	
		Plan	Non-Plan	Plan	Non-Plan
02	Pay & allowances	0.80	38.60	0.77	38.40
06	Overtime allowance	-	-	-	-
10	T.A.	1.10	0.75	1.10	0.74
15	Other charges including equipments	10.35	5.65	9.99	3.67
20	Works	2.75	-	2.74	-
20 01 01	Land				
25	Other items: Fellowship/scholarship/ Awards	-	-	-	-
Grand total		15.00	45.00	14.60	42.81

### Abstract

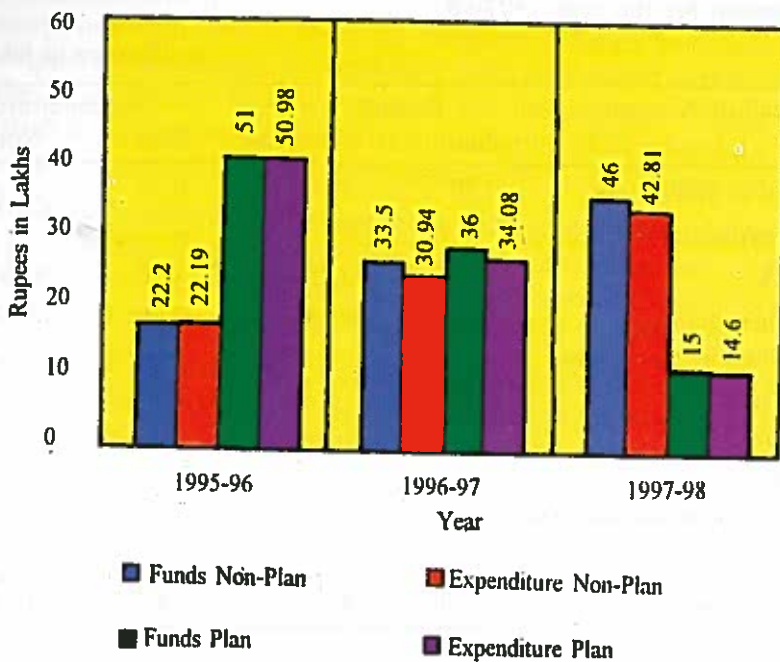
(Rupees in lakhs)

	Budget	Expenditure (upto 31.3.98)
Plan	15.00	14.60
Non-Plan	45.00	42.81
	60.00	57.41

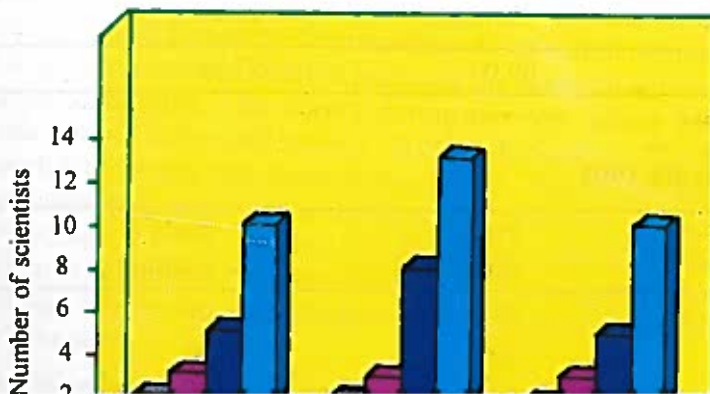
### Staff Position as on 31.03.1998

S.No.	Category	Posts sanctioned	Posts in position
1.	R & M (Director)	01	01
2.	Scientific	20	10
3.			

**BUDGET/EXPENDITURE FOR THE YEAR 1995-96 TO 1997-98**



**SCIENTIFIC STAFF IN POSITION AS ON 31<sup>ST</sup> MARCH AT NRCCWF, BHIMTAL DURING 1995, 1996 & 1998.**



## RESEARCH ACHIEVEMENTS

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<b>PROJECT</b>	:	NRCCWF- 04
		<b>PRODUCTION OF STOCKING MATERIAL OF GOLDEN MAHSEER (<i>TOR PUTITORA</i>).</b>
<b>Personnel</b>	:	H.S. Raina, Shyam Sunder and C.B. Joshi.
<b>Duration</b>	:	July 1991 to June 1997
<b>Location</b>	:	NRCCWF, Bhimtal

### Accomplishments

Under this programme package of practices for artificial propagation and seed production of this endangered fish species has been standardized in the flow-through hatchery unit at Bhimtal. The work is being continued as a seed production activity and evolving culture practice for this important indigenous fish. During the period under report, efforts were initiated to develop brood stock of this species under farm conditions. This aspect of the project is very important because lot of difficulties have been experienced in the past, to get the assured quantity and quality of wild spawners of either sex from the natural waters, for artificial propagation. In Kumaon severe scarcity of spawners has been experienced. To overcome this problem, work on raising of brood stock of this species was undertaken at Chirapani fish farm of NRCCWF. To assess and evaluate the best possible stock for the above purpose rearing of fingerlings and adult fishes collected from different habitats was initiated under farm condition along with the seed produced artificially at the hatchery. The fishes were regularly fed on the artificial feed formulated in the laboratory. Other management practices in the farm

## SEED PRODUCTION



**Mahseer Alevins**



**PROJECT** : NRCCWF- 07  
**CULTURE AND BREEDING OF CULTIVABLE  
CARPS IN HIMALAYAN UPLANDS**

**Personnel** : B.C. Tyagi, S.K. Bhanja and K.D. Joshi

**Duration** : April, 1996-December, 1998

**Location** : Experimental farm, Champawat

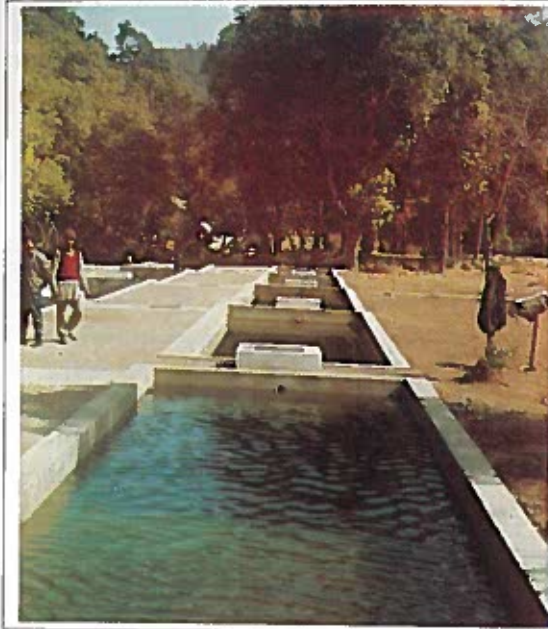
### **Accomplishments**

Among the cultivable carps, the Indian major carps (Catla, Rohu and Mirgal), the phenotypes of common carp (*Cyprinus carpio*) and the Chinese carps (silver and grass carps) are the candidate species generally used for composite culture in warm water aquaculture system which have significantly helped in enhancing the fish production in the country. In coldwater aquaculture, this approach of composite culture using indigenous and exotic carps have not been tested except, the monoculture of common carp is being practiced in many Himalayan states as well as in the uplands of Deccan plateau. To assess the feasibility of the composite culture in temperate and sub-temperate climates of Himalayas, trials have been undertaken by NRCCWF to rear these fishes in running water ponds at Chirapani, Champawat, so as to evolve package of practices. Hence, the trial experiments on monoculture of common carp and its mixed culture with Chinese carps at varied stocking densities and species composition were continued for the year 1997 also at Chirapani, fish farm in Champawat district in central Himalaya.

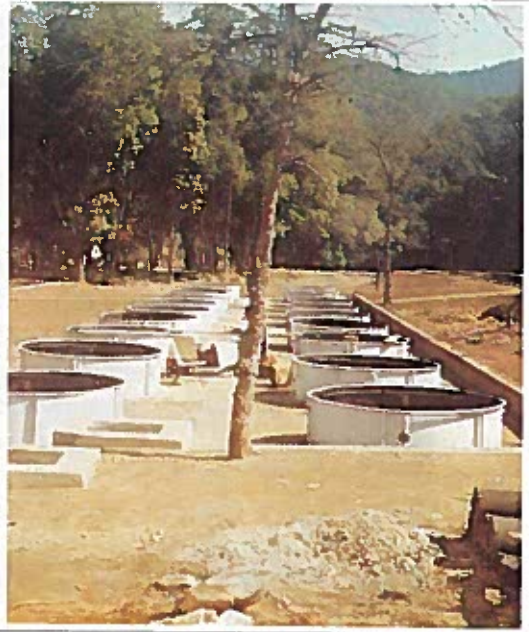
### **Monoculture of common carp (*Cyprinus carpio*):**

Common carp reared at different stocking density of 1, 5, 3, 4 and 5 fishes  $m^{-2}$  in small cemented ponds of the size 30  $m^2$  registered growth of 0.239, 0.173, 0.118-0.178 and 0.085g/day with the net weight of 62.5, 45.2, 30.5-46.7 and 22.2g, respectively during 260 days (April-December 1997). It indicates an inverse relationship between fish growth and stocking density. It has also been observed that the water temperature has the profound role in determining the growth of the fish in this sub-temperate climate, where the higher growth rate (0.14-0.34 g/day) was recorded during May to September at the water temperature ranging between 20.0-25.9°C, while it was 0.02-0.11g/day at 9.2 - 18.1°C during October to December 1997, indicating impact of the winter season (low water temperature) on the growth of carps. The survival rate of 77.3% to 100% recorded during trials did not exhibit any relationship with the fish stocking density.

## FARM AND HATCHERY FACILITY



**Rearing tanks**



**Nursery tanks**



## BROOD STOCK REARING



**Mahseer (*Tor putitora*) haul**



**Table 1. Growth of cultivable carps at varying temperature in different months during 1997.**

	June/July	August	September	October	November	December
Temperature (°C)	22-28	27-29	25-27	18.2-22	16-18.4	8.2-10
Fish species	Growth/day (g)					
<i>C. carpio</i>	0.18	0.39	0.24	0.21	0.09	0.09
<i>C. idella</i>	0.20	0.37	0.30	0.18	0.13	0
<i>H. molitrix</i>	0.23	0.37	0.41	0.22	0.12	0

*carpio*), silver carp (*Hypophthalmichthys molitrix*) and grass carp (*Ctenopharyngodon idella*). The experiments were initiated in four cemented ponds each having a size of 3x10x0.66m. The stocking of common carp, grass carp and silver carp was done @ 1.5, 2.0, 3.0 and 5.7 fish m<sup>-2</sup> in the combination of 50, 25, 25; 50, 20, 30; 25, 25, 50 and 21, 21, 28%, respectively. The ponds with higher stocking density (5.7 fishes m<sup>-2</sup>), were also stocked with the snow trout (*Schizothorax richardsonii*) contributing 29% to the total stocked numbers, to observe the behaviour of indigenous cold water species under mixed rearing of exotic carps.

The experimental fishes were fed twice a day @2% of their body weight with the supplementary feeds constituted from mustard oil cake (30%), soya flour (25%), rice polish (15%), wheat bran (20%) and fish meal (10%) in addition 0.001gm. cobalt chloride was also mixed with the feed as a growth promoting substance. The water quality parameters during the period of experiment ranged as follows: water temperature 5.6-27.5°C; pH, 7.4-8.8; dissolved oxygen, 8.0-11.8 mg/l; free carbon dioxide, nil- 2.4 mg/l and total alkalinity, 22.0-56.0 mg/l.

The analysis of data on growth and survival of various carps with different



respectively. In general the highest growth rate 0.27g/day was recorded with the stocking density of 2 fish m<sup>-2</sup> while it was lowest (0.02g/day) at a higher density of 5.7 fish m<sup>-2</sup>. Among all the fish species used for the mixed culture at Chirapani farm, silver carp exhibited the higher growth rate (0.27g/day) at the stocking density of 2 fish m<sup>-2</sup> as compared to common carp which recorded growth of 0.25g/day at the density of 1.5m<sup>2</sup> and grass carp 0.20 g/day at the density of 2.0 fish m<sup>-2</sup>. It has been inferred from the experiments that the density has an inverse relationship with the growth, however, the density does not seem to impact the survival rate.

It has been observed that all the carps registered higher growth rate during summer months at higher temperatures whereas zero/negative growth was recorded during winter months at low temperature range (18.2°C, Table 1). Hence it can be summarised that the duration of eight months period (April to October) is most suitable for growing the fish in the temperate climate prevalent at Champawat.

**PROJECT** : NRCCWF- 10  
**AQUACULTURE OF GOLDEN MAHSEER (*TOR PUTITORA*).**

**Personnel** : C.B. Joshi, Shyam Sunder and B.C. Tyagi

**Duration** : July 1996 to June 1999

**Location** : NRCCWF, Bhimtal

### Accomplishments

Cage culture experiments were initiated in Bhimtal lake during the year 1997, by installing two small nylon cages having dimensions of 2.5x1.5x1.0m (3.75 m<sup>2</sup> area) and each made of monofilament cloth. These were stocked with 263 fry (Av. wt. 0.28g.) and 112 fry (Av. wt. 0.88g.) at the stocking density of 70 nos. m<sup>-2</sup> and 30 nos. m<sup>-2</sup>, respectively. These fry of *Tor putitora* were fed with laboratory formulated feed comprising soybean flour (20%), wheat bran (20%), rice polish (20%), mustared oil cake (25%) and fish meal (15%), fortified with vitamin and mineral premix. The rate and frequency of feeding ranged between 2-10% of the body weight spread over three times a day, which was, regulated according to water temperature.

by using the bigger (40-62 mm) size of fry/fingerlings as compared to the smaller fry (25-39 mm), which virtually could not withstand the conditions prevailing in the cage. Moreover, higher density in the cage resulted in maximum mortality (Table 2).

During the experiment it was observed that mortality of fry inside the cages was mainly due to deposition of silt, waste material and algal blooms on the cage meshes inspite of regular cleaning. It appears that the cage material or its sitting place needs to be improved.

**Table 2. Growth and survival of fry/fingerlings of *Tor putitora* (Hamilton).**

Parameters	Cage- I	Cage - II
Area of the cage (m <sup>2</sup> )	3.75	3.75
Stocking density (No./m <sup>2</sup> )	70	30
Initial individual weight (Av.g.)	0.28	0.88
Total duration of rearing (days)	260	260
No. of fry/fingerling survived	37	73
Final individual weight (Av.g.)	1	3.5
Average weight gain (g./day)	0.003	0.01
% growth/day in g.	1.07	1.14
Survival (%)	14.07	65.18

The water quality parameters inside the cage as well as in Bhimtal lake did not exhibit significant changes during the day between 1000- 1700 hrs. Water temperature, 11.0- 27.5°C, pH 6-8, free carbon dioxide, nil- 3.0 mg./l; dissolved oxygen, 6.6-10.0 mg./l and total alkalinity, 64.0-92.0 mg./l were recorded for both the cages.

**PROJECT :** NRCCWF- 12

**ANALYSIS OF BLOOD OF SOME IMPORTANT UPLAND FISHES.**

**Personnel :** Rajeev Kapila, Suman Kapila and Yasmeen Basade.

employed on an increasing scale in fishery sector for assessing the health status of fishes in response to various pathogens, pollutants and environmental stresses. In coldwater fishes also, such studies are being encouraged for establishing certain reference values for these biochemical analytes which can be used for proper health management of fish stocks to reduce the incidence of fish mortalities in the hatcheries, farms and other aquatic resources. Various experiments conducted on these aspects at research laboratory of NRCCWF, Bhimtal during 1997 are summarized below.

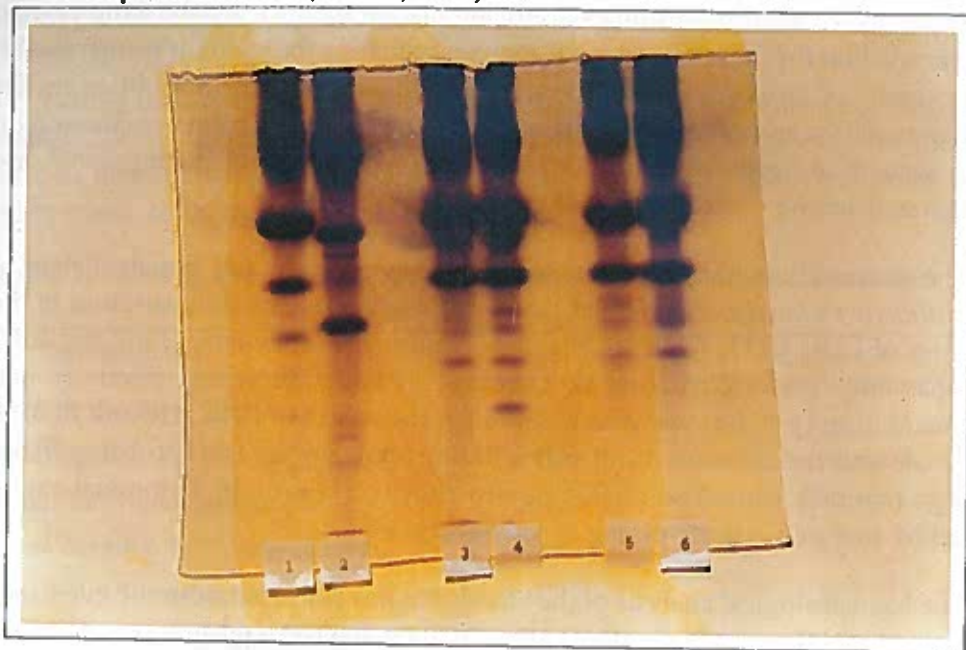
The seasonal analysis of enzymatic activities in male and female fishes of *Schizothorax richardsonii* revealed that there was no remarkable variation in the activities of LDH, GOT, GPT, ACP and ALP during prespawning (June and July) and spawning seasons (August to October) in both the sexes. Similarly non significant drop ( $p < 0.05$ ) was also recorded in the values of RBC, Hb and PCV in both male and female snow trout fishes during spawning season probably fishes undergo naturally caused starvation due to paucity of space in abdominal cavity caused by matured gonads during breeding season.

The haematological analysis of the blood samples collected from the live fishes maintained at different temperatures after 30 hrs exhibited a progressive decrease ( $p < 0.05$ ) in RBC count, Hb concentration and PCV at low temperature ( $5^{\circ}$  and  $10^{\circ}\text{C}$ ) as compared to the control ( $20^{\circ}\text{C}$ ) which can be attributed to the reduced oxygen demand of the animal due to the decrease in the metabolic rates. At higher temperature ( $30^{\circ}\text{C}$ ), though the RBC count and PCV values exhibited a significant drop ( $p < 0.05$ ), haemoglobin concentration also declined insignificantly by 8.25% after 6 hrs (as the fish could not survive beyond 8 hrs at  $30^{\circ}\text{C}$ ). On the other hand remarkable increase ( $p < 0.05$ ) was observed in the activities of LDH and GOT at low temperature ( $5^{\circ}\text{C}$ ) which may be either due to the higher production of enzymes or activation of multimolecular forms of enzymes in the tissues which were subsequently released in blood under cold stress. Further, it has been observed that GPT and ALP changes insignificantly at different temperatures while the activities of ACP were highest at higher temperatures ( $20^{\circ}$  and  $30^{\circ}\text{C}$ ).

The blood samples collected from the test fishes (T.L. approx. 150 mm) maintained at  $20^{\circ}\text{C}$  with different pH values (5.0, 6.0, 7.0, 8.0 and 9.0), when analysed after a period of 24 hrs, showed remarkable increase ( $p < 0.05$ ) in the values

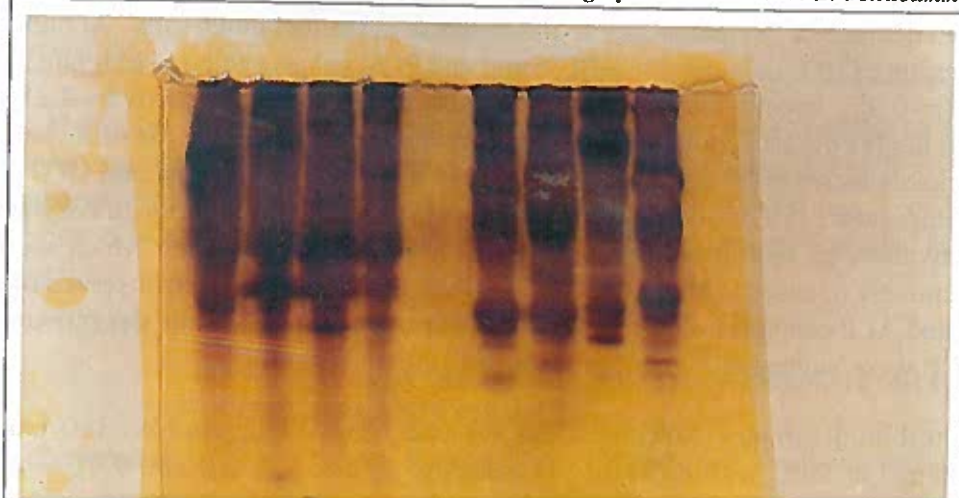
## BIOCHEMICAL INVESTIGATION

Electrophoretic Profile (PAGE, 7.5%)

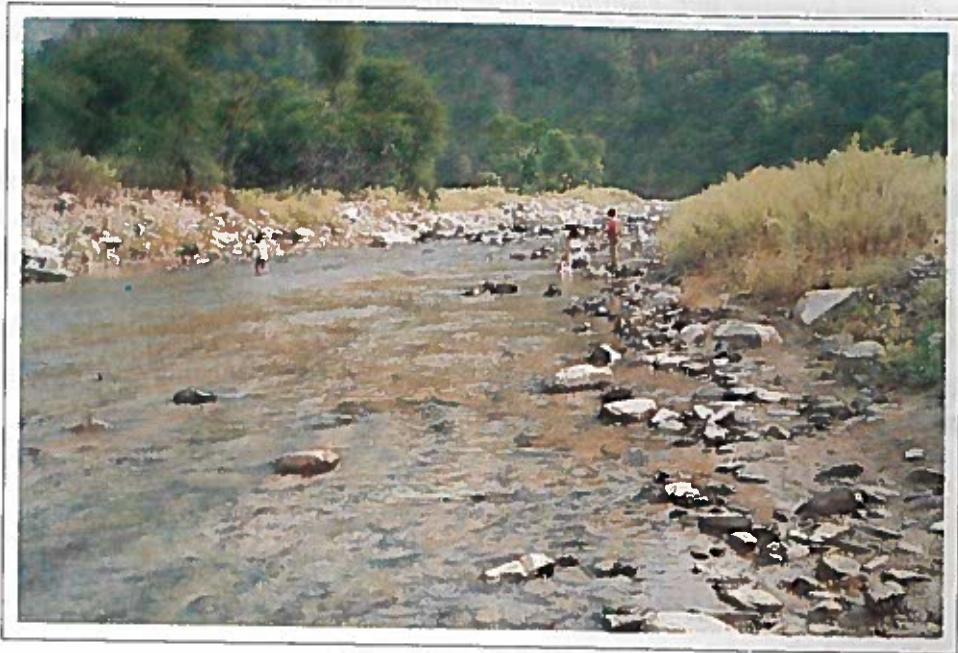


A= Soluble Muscle Tissue Proteins

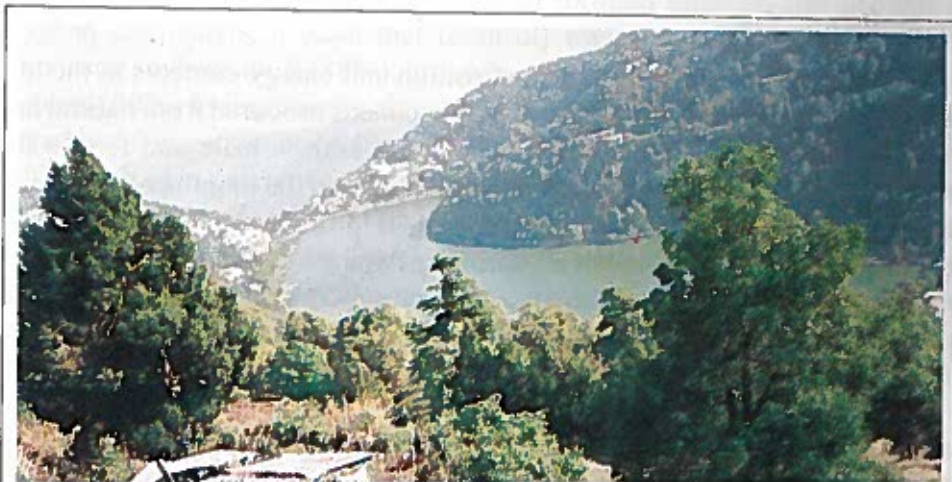
1. *T. putitora* 2. *S. richardsonii* 3. *G. lamtu* 4. *G. gotyla* 5. *B. bola* 6. *B. hendelisis*.



## COLDWATER FISHERY RESOURCES



A temperate stream



The comparative electrophoretic pattern of blood plasma proteins and soluble heart tissue proteins of *Tor putitora*, *Schizothorax richardsonii*, *Garra gotyla* and *Barilius bendelisis* collected from natural habitat revealed that the overall number of bands vary with genera. The variations in band pattern of an animal species mostly occurred as a result of their genetic constitution and the influence of environmental and physiological factors. The maximum number of protein bands appeared in both the tissues of *G. gotyla* and minimum in *T. putitora*. The interesting aspect was that some of the protein bands exhibited almost similar values of relative mobilities (Rf) irrespective of the genera of fish due to their same ratio of charge and molecular weights based upon which they moved under the electric field during PAGE. This indicated that the tissues of these fish species have proteins of identical nature and function probably due to the same ecological and environmental conditions in which they live.

- PROJECT** : NRCCWF- 13  
**BIOCHEMICAL COMPOSITION OF SOME  
IMPORTANT UPLAND FISHES.**
- Personnel** : Yasmeen Basade, Suman Kapila and Rajeev Kapila.  
**Duration** : March 1996 to February 1998  
**Location** : NRCCWF, Bhimtal

### Accomplishments

Seasonal profile of proximate composition and energy contents in the muscle tissues of adult *Schizothorax richardsonii*, specimens procured from natural habitat in Kumaon hills, exhibited almost similar trend both in male and female fishes. Except, for moisture content which declined by 2% in the months of June and July (pre-spawning season), the other constituents viz. protein, total lipids and glycogen were on the higher level. However, during spawning season (August to October) the values for these biochemical analytes and energy content decreased significantly ( $p < 0.01$ ) and moisture content continued to increase till November. In post-spawning season (November and December), protein ( $p < 0.01$ ) in female and ash ( $p < 0.01$ ) and glycogen ( $p < 0.05$ ) in males decreased significantly compared to spawning season, while as compared to pre-spawning season, protein, total lipids, ash, glycogen and energy contents fell significantly ( $p < 0.01$ ) indicating their

Changes in proximate composition and energy content of muscle tissues have also been observed with different size groups of male and female *Schizothorax richardsonii*. Among both the sexes protein, total lipids, ash, glycogen, phospholipids and energy contents increased significantly with increase in size of fish from 100 mm to 200 mm. However, moisture and cholesterol decreased significantly with increase in size of fishes. Comparatively, in either sexes of different size groups only glycogen and phospholipids were significantly higher in females ( $p < 0.01$ ) and moisture in males ( $p < 0.01$ ), though other muscle constituents did not exhibit any significant variations.

**PROJECT :** NRCCWF- 14

**STUDY ON THE EFFECT OF SUPPLEMENTAL VITAMINS ON THE GROWTH AND SURVIVAL OF UPLAND FISHES**

**Personnel :** S.K. Bhanja, B.C. Tyagi and K.D. Joshi

**Duration :** July 1996 to June 1998

**Location :** NRCCWF, Research Centre, Champawat

**Accomplishments**

In order to assess the impact of vitamin fortified diets on fish growth and survival in coldwaters, a basal diet (control) was prepared having 32% crude protein using soybean meal (38%), groundnut oil cake (20%), fish meal (20%) and rice polish (20%) as ingredients along with mineral mixture (20%). The test diets prepared by adding vitamin - A (8000 IU/Kg,) vitamin - E (100 IU/Kg) and vitamin - C (400 mg/Kg) in different combinations, were trial tested. The fry of snow trout (*Schizothorax richardsonii*) and fingerlings of golden mahseer (*Tor putitora*) and exotic carps (*Cyprinus carpio*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix*) were stocked in circular tanks at the rate of 20 fry  $m^{-2}$ , 2 fingerlings  $m^{-2}$  and 5 fingerlings  $m^{-2}$ , respectively. After nine months of experiment the dietary groups having combination of vitamin E+C and vitamin A+E+C exhibited significantly higher ( $P < 0.05$ ) growth by 10.2% and 17.4%, respectively as compared to control in *Schizothorax richardsonii*. Similarly higher weight gain of 21.2% and 32.9% was recorded in golden mahseer fed with diets fortified with

**Table 3. Specific growth rate, feed conversion ratio and survival of indigenous and exotic fishes fed on vitamin supplemented diets.**

Parameters	Control	Vitamin C	Vitamin A+C	Vitamin E+C	Vitamin A+E+C
<b>Initial weight (g)</b>					
<i>Schizothorax richardsonii</i>	0.30±0.011	N.D.	0.30 ± 0.006	0.30 ± 0.014	0.30±0.011
<i>Tor putitora</i>	20.8±1.24	20.8±0.88	20.8 ± 0.80	20.8 ± 0.40	20.8±0.73
<i>Cyprinus carpio</i>	14.5	15	14.5	14.5	14.5
<i>Ctenopharyngodon idella</i>	5	5	5	5	5
<i>Hypophthalmichthys molitrix</i>	3.4	3.31	3.4	3.31	3.31
<b>Final weight (g)</b>					
<i>Schizothorax richardsonii</i>	3.22±0.11	N.D.	3.0 ± 0.11	3.55 ± 0.06	3.78±0.05
<i>Tor putitora</i>	28.33±0.44	30.83±0.33	34.33 ± 1.57	28.83 ± 0.60	32.0±0.76
<i>Cyprinus carpio</i>	34.0±1.22	40.4±1.43	38.4±2.33	46.0±1.05	41.0±1.45
<i>Ctenopharyngodon idella</i>	11.2±0.37	11.4±0.24	12.0±0.70	14.8±0.97	13.0±0.44
<i>Hypophthalmichthys molitrix</i>	24.8±0.48	22.6±0.87	26.0±0.70	24.6±0.40	25.0±0.83
<b>Specific growth rate (%/day)</b>					
<i>Schizothorax richardsonii</i>	0.86±0.007	N.D.	0.84 ± 0.006	0.90 ± 0.007	0.93±0.005
<i>Tor putitora</i>	0.43±0.03	0.53±0.03	0.60 ± 0.02	0.49 ± 0.03	0.49±0.01
<i>Cyprinus carpio</i>	0.38±0.026	0.50±0.022	0.45±0.029	0.57±0.014	0.52±0.003
<i>Ctenopharyngodon idella</i>	0.52±0.022	0.49±0.036	0.49±0.036	0.59±0.038	0.54±0.024
<i>Hypophthalmichthys molitrix</i>	1.12±0.012	1.07±0.008	1.15±0.016	1.14±0.012	1.11±0.005
<b>Feed conversion ratio</b>					
<i>Schizothorax richardsonii</i>	8.38±0.16	N.D.	9.19 ± 0.06	6.99 ± 0.11	6.47±0.14
<i>Tor putitora</i>	13.98	11.38	9.75	12.45	12.87
<i>Cyprinus carpio</i>					
<i>Ctenopharyngodon idella</i>	6.06	5.62	5.43	4.81	4.98
<i>Hypophthalmichthys molitrix</i>					
<b>Survival (%)</b>					
<i>Schizothorax richardsonii</i>	81.6±1.90	N.D.	75.0 ± 1.0	88.3 ± 1.90	90.0±2.88
<i>Tor putitora</i>	100	83.3	100	83.3	100



the various dietary groups supplemented with vitamins in comparison to control. Poor or negative growth was also observed in snow trout and golden mahseer during winter season (Oct.- Dec.) when the water temperature in ponds dropped down to 5.1°C. Further, there was steep difference in phyto and nycto-temperatures with a difference of 13°C which greatly affected the physiology of fishes.

The water flow in the tanks was maintained at 3-5 l/min. during summer and 10-15 l/min during winter to reduce the fluctuation of temperature as far as possible. The other physico-chemical features of water during the experimental period ranged as follows: water temperature 5.1-26.5°C; pH 7.2-9.2; dissolved oxygen 6.4-10.4 mg/l; free carbon dioxide nil- 1.2 mg/l and total alkalinity 13-26 mg/l.

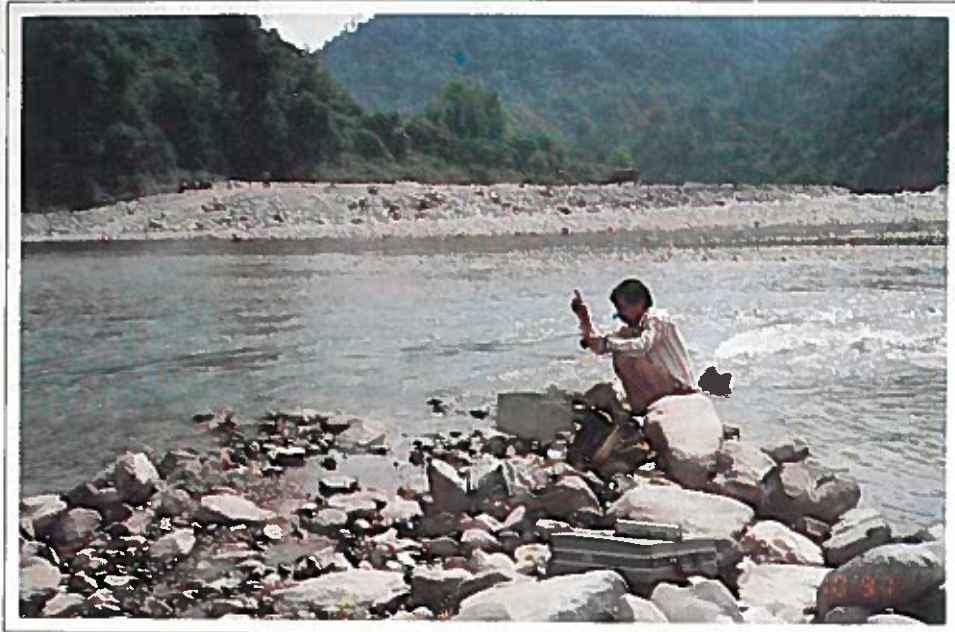
- PROJECT** : NRCCWF- 15  
**BREEDING AND CULTURE OF  
*SCHIZOTHORAX RICHARDSONII* (GRAY).**
- Personnel** : Shyam Sunder, H.S. Raina, C.B.Joshi, B.C.Tyagi and K.D. Joshi.
- Duration** : August 1997 to July, 2000
- Location** : NRCCWF, Bhimtal and experimental farm, Champawat.

### **Accomplishments**

In openwaters the population balance of snow trout (*Schizothorax richardsonii*), the principal indigenous fish of Himalayas, has so far been dependent on natural recruitment. But the recent threats posed to its stocks in various upland resources due to environmental degradation and many man-induced changes has made its rehabilitation in depleted waters a priority activity. Thus mass scale production of its seed for stocking the natural waters is one of the strategies to revive this important fishery in the Himalayan uplands.

In order to buildup stock of snow trout for artificial propagation, the rearing of naturally produced fry collected from the various streams in the vicinity of Chirapani fish farm was taken-up as a project activity at NRCCWF, Champawat.

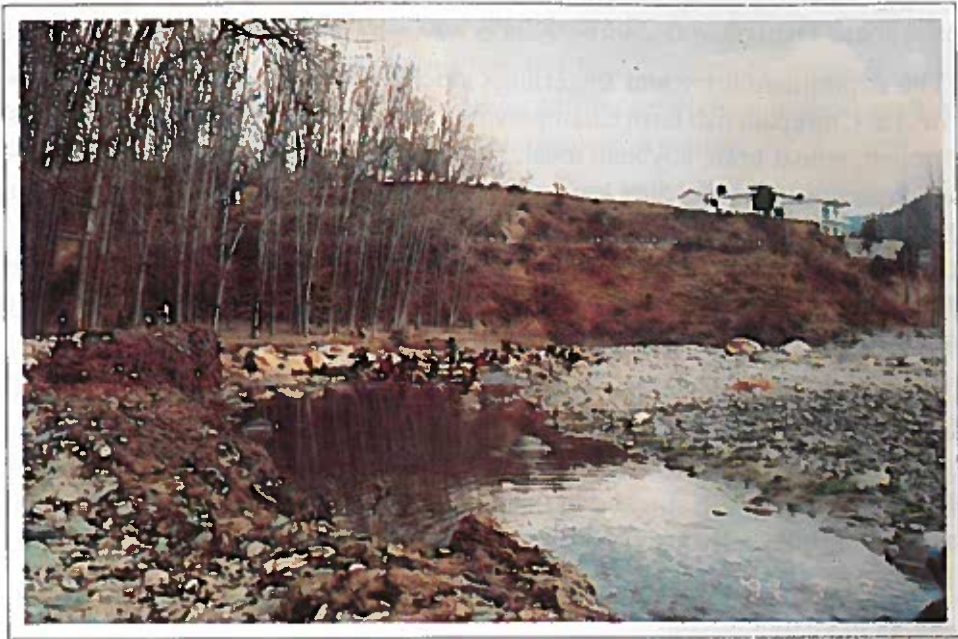
## ESTIMATION OF PRODUCTIVE POTENTIAL



Water quality analysis



## ECODEGRADATION OF RESOURCES



**Impacts of human habitation**



month of July/September, 1997 the observed growth increment was 85.7g, 38.5g and 15.7g, from the initial weight range of 12.8g to 75.5g. The respective survival rate for these test fish was 27.5%, 89.3% and 20.0%.

The experimental fry and fingerlings stocked in the cemented nursery ponds (30 m<sup>2</sup>.) at Chirapani fish farm Champawat, were fed with artificial diets comprising rice polish, wheat bran, soybean meal, mustard oil cake fortified with vitamin and mineral premix. The feeding rate and schedule was maintained as per water temperature, turbidity level in rearing tanks and fish biomass of experimental fish stocks. The loss of fry recorded during experimental period was mainly due to bacterial infection and choking of gills caused by heavy silt brought in through catchment water during the rainy season.

The breeding trials with five female fishes (size range of 80-125g) were undertaken at the river side in Chirapani and Lohawati streams. The calculated total yield of eggs was 3225/Kg. body weight and the range of fertilization was between 60-85%. The eggs were stocked in the hatching trays at Chirapani farm for future development, but the stock could not survive for a longer period.

The water quality parameters of the ponds during the experimental period ranged as indicated below:

Water temperature 4.9-27.3°C; Dissolved oxygen 7.6-10.3 mg/l; Free carbon dioxide nil-2.8 mg./l; Total alkalinity 13.0-32.0 mg./l; TDS 11.9-22.8 mg/l and specific conductivity 24.0-45.0 micro mhos/25°C.

**PROJECT :** NRCCWF- 16  
**BIO-ECOLOGY AND FISHERY OF THE RIVER LADHIYA**

**Personnel :** K.D. Joshi, C.B. Joshi, and Shyam Sunder

**Duration :** July 1997 to July 1998

**Location :** NRCCWF, Research Centre Champawat.

### **Accomplishments**

The river Ladhiya, an important tributary of river Kali in Kumaon Himalayas after originating from the southern slopes of Mornaula hills at an elevation of about

of the Ganges system in central Himalayas, the Ladhiya was taken up as a case study for ecobiological and fisheries investigations. The data generated will be helpful in development of required strategy for conservation of declining fisheries in the region. Three sampling sites in the upper and lower stretches representing the varied catchment zones of the river including a tributary in the middle stretch were investigated to generate necessary ecobiological information.

The data generated during the period revealed that among the water quality parameters, the mean values of water temperature, pH and dissolved oxygen did not exhibit much variations. However, total alkalinity, total dissolved solids and specific conductivity were on the higher side in the lower segment of the river. Similarly in the Kwerala tributary, the values for most of the water quality parameters were almost similar to the main river at its lower stretch (Table 4).

**Table 4. Ranges of main physico-chemical parameters in the river Ladhiya between July to November, 1997**

Parameters	Sampling Stations		
	Ritha Sahib (1)	Belkhet (2)	Kathaula (3)
Channel width (m)	18.00-31.80	12.50-22.50	13.10-42.50
Maximum depth (cm)	40.15-45.00	39.35-53.10	54.60-100.00
Mean depth (cm)	25.00-31.20	20.15-30.15	35.70-49.10
Water volume (cu. ft./sec.)	59.34-1831.50	54.29-2217.70	79.38-5352.00
Water velocity (m/sec.)	0.25-0.40	0.58-0.83	0.38-1.00
Air temperature (°C)	23.60-29.00	23.00-35.50	24.00-31.70
Water temperature (°C)	18.30-27.40	20.50-28.40	23.20-28.10
pH	8.20-8.60	8.00-8.60	8.00-8.60
Total alkalinity (ppm.)	28.00-52.00	36.00-56.00	40.00-72.00
Dissolved oxygen (ppm.)	7.20-10.00	8.00-9.80	8.00-9.60
Specific conductivity (µmhos/cm)	0.80-1.60	0.0-2.00	0.0-1.80

The plankton population analysed from different sites comprised mainly phytoplankton. The average phytoplankton density ranged 26 and 88 units/l in the upper and lower stretch of the river, while density in the tributary ranged between 30 to 74 units/l. Among different groups, the populations were dominated by Bacillariophyceae (81.11%), Chlorophyceae (13.50%) and Cyanophyceae (5.39%). These groups were mainly represented by *Cymbella*, *Navicula*, *Amphora* and *Synedra* among bacillariophyceae while chlorophyceae was dominated by *Zygnema*, *Spirogyra*, *Ulothrix* and *Anabaena*, *Oscillatoria* represented cyanophyceae.

The macrobenthic fauna at various zones ranged from 43-116 unit  $m^{-2}$  while their wet biomass varied between 3.120-9.530  $g m^{-2}$ . The major benthic groups recorded were Ephemeroptera (7.08-24.13%), Odonata (nil-4.01%), Coleoptera (nil- 14.22%) Plecoptera (0.92-12.41%), Trichoptera (5.69-32.08%), Diptera (0.81- 28.07%) and miscellaneous groups (0.63 - 6.89%). The most abundant taxa encountered were *Epeorus*, *Baetis*, *Ephemerella*, *Iron*, *Heptagenia*, *Rithrogena*, *Gomphus*, *Perla*, *Chloroptera*, *Nemoura*, *Psephenus*, *Gyrinus*, *Elmis*, *Hydropsyche*, *Atherix*, *Rhyacophila*, *Phylopotamus* and *Culicoides*.

The investigations on experimental fishing revealed an average fish catch per unit effort of 6.44g. and 840g. in the Ladhiya and Kwerala streams, respectively. Species composition in experimental fishing was *Schizothorax richardsonii* (28.69%), *Tor putitora* (29.92%), *Garra gotyla* (23.07%) and *Barilius hendelisis* (19.82%) followed by other fishes (1.50%) comprising mainly *Glyptothorax pectinopterus*, *Puntius chihnoides*, *Nemacheilus rupicola* and *Mastacembalus armatus*.

## TECHNOLOGY ASSESSED AND TRANSFERRED

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### Assessed

- \* Artificial breeding technique in case of golden mahseer (*Tor putitora*) was developed and its reproducibility assessed under different ecological conditions.
- \* A flow-through hatchery for mass scale production of mahseer seed has been designed and fabricated at Bhimtal in U.P. Its functioning has been trial tested number of times and its efficiency assessed for application by various users.
- \* A mixed farming system based on exotic carps viz.. *Cyprinus carpio*, *Hypophthalmichthys molitrix* and *Ctenopharyngodon idella* has been evolved for uplands in running water conditions and this is under pilot testing.

### Extension activities

The following services were imparted through the extension activities of the institute

#### Extension activities

1. Advisory services

2. Communication services through literature, video cassettes, etc.

3. Talks/Mass media coverage

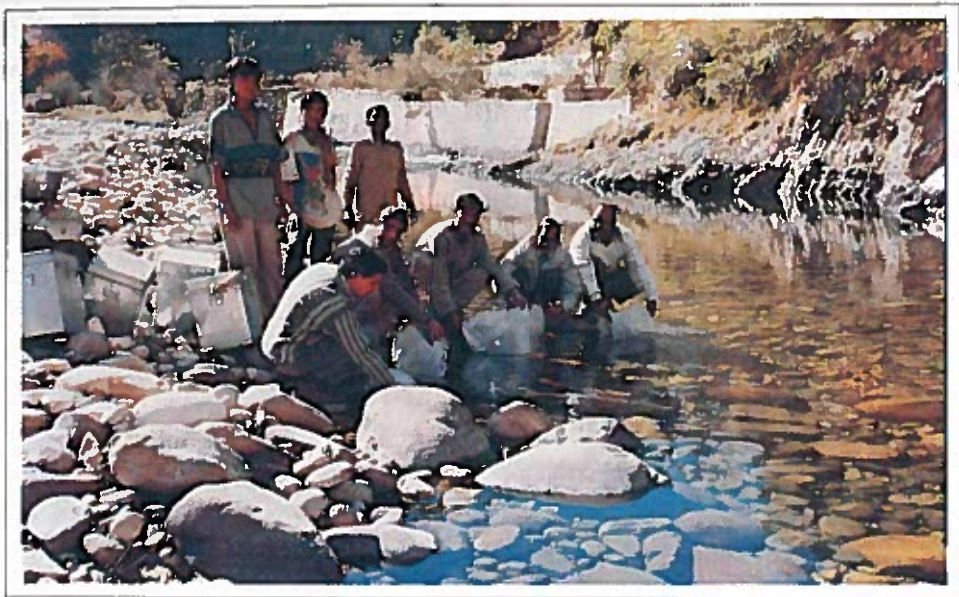
#### Beneficiaries

The technical know-how on rearing/seed production of mahseer was provided to different NGO's, Panchayats and local farming community.

Govt. agencies, NGO,s and other development departments.

Radio talks were given by the scientists of this Institute from local

## MAHSEER RANCHING

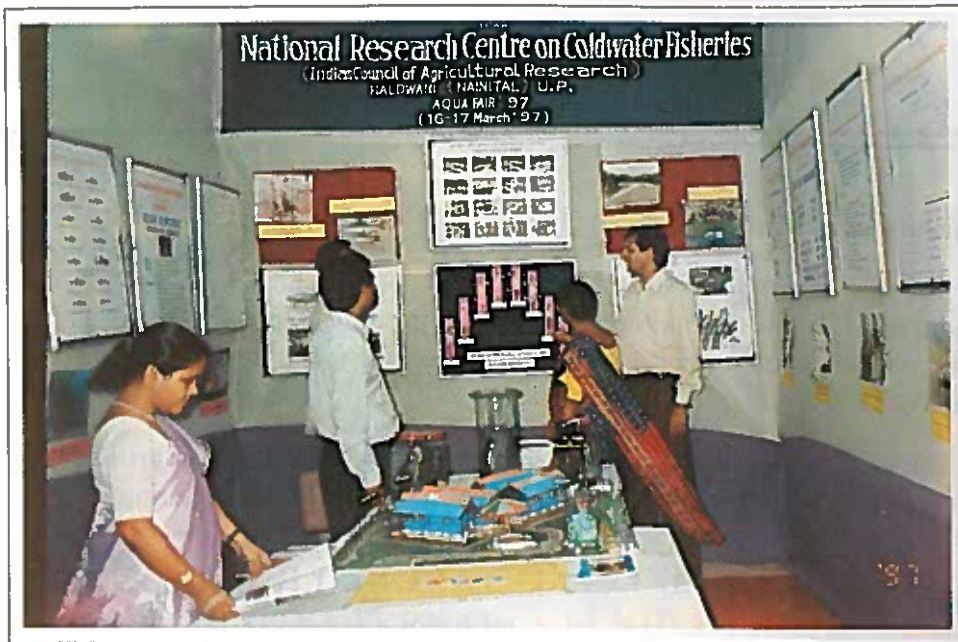


Ranching of Mahseer seed





## EXHIBITIONS



Scientists explaining the exhibits to visitors at NRC- CWF stall



## **EDUCATION AND TRAINING**

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### **Training (within the country)**

Shri Rajeev Kapila, scientist underwent practical training programme in "Radio and Enzyme-Immunoassay techniques in animal reproduction" held at the Embryo Biotechnology centre of National Dairy Research Institute, Karnal during January, 1997.

The member secretary of Hindi implementation committee, Shri Kapila was deputed to participate in Hindi workshop at NAARM, Hyderabad during December, 1997.

### **Training (Abroad)**

Ms. Yasmeen Basade, scientist was deputed by DARE (ICAR) to Iran to attend the training programme on "Breeding, hatchery practices and culture of rainbow trout" during January, 1997.

### **Hindi celebration**

Regular quarterly meetings of official language implementation committee were conducted and the progress made in Hindi implementation was reviewed. A Hindi fortnight was celebrated in which all members of staff were impressed upon the benefits of greater use of Hindi in day to day working. In order to promote the use of Hindi in this institute, efforts were made to correspond in Hindi during the period. About 702 communications were received in Hindi and the institute sent nearly 506 communications in Hindi to various Hindi knowing organisations.

## **AWARDS AND RECOGNITIONS**

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Dr. K.K. Vass, was elected to the Central Executive Council of National Institute of Ecology for two year term 1997-99.

## **LINKAGES & COLLABORATION IN INDIA AND ABROAD INCLUDING EXTERNALLY FUNDED PROJECTS**

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The institute is participating in NATP programme in which we are the lead centre and are having linkage centres with five organisations in the country to implement the project.

The institute has initiated efforts to improve the existing fish germplasm for coldwater regions. In this connection we are taking steps to import better strains through NACA, Thailand in close co-operation with NBFGR.

## LIST OF PUBLICATION

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- Raina, H.S., Sunder, S. and Naulia, U. Nutritional requirements for the juveniles of golden mahseer, *Tor putitora* (Ham.). In Third Indian Fisheries Forum Proceedings (11-14, October, 1993). Pantnagar: 5-8. (Published in 1997).
- Sunder, S. 1996. Biotic communities of Kumaon Himalayan river-the Gaula. 1. Macro-benthic invertebrates. *Nat. Acad. Sci. India* **67** (B) II.; 157-160.
- Sunder, S. 1996. Biotic communities of Kumaon Himalayan river-the Gaula. 2. Plankton. *Uttar Pradesh. J. Zool.* **16** (1); 39-45.
- Sunder, S., Raina, H.S., Mohan, M., Singh, B and Haldar R.S. Culture of golden mahseer, *Tor putitora* (Ham.) in Kamaon Himalaya. 1. Mass scale seed production of stocking material. In Third Indian Fisheries Forum Proceedings (11-14, October, 1993). Pantnagar: 45-48. (Published in 1997).
- Sunder, S., Raina, H.S., Mohan, M. and Singh, B. 1995. Ecology and fisheries potential of Gaula river with speical reference to proposed impoundment (Jamrani Dam) on the system. *J. Inland Fish. Soc. India.* **27** (2); 33-45.
- Sunder, S., 1995. Composition, distribution and seasonality of benthic invertebrates in two important Kumaon Himalayan lakes. *Indian J. Fish.* **43** (2); 187-194.
- Sunder S. 1995. Some consp...

### Popular Article

Kapila, R. and Kapila, S. 1997. Monoclonal antibody technology and its applications in fisheries science. *Fishing Chimes*. 17 (5): 21-24.

Raina, H.S. 1996. Conservation of world renowned sport fish golden mahseer. ICAR News Letter 2 (1): 5.

Raina, H.S. 1997. National Research Centre on Coldwater Fisheries: Mandate and Achievements. *Fishing Chimes*. 17 (9): 41-44.

### Book Chapters

Mohan, M., Raina, H.S. and Sunder, S. 1997. Management of fisheries for sustained yields in a Himalayan lake- Khurpatal. Pathak, P.S. and Gopal, B. (Eds.). *Studies in Indian Agroecosystem*. Indian Institute of Ecology. 129-136.

Sunder, S. 1997. Status and management of endangered coldwater fisheries from Himalayan uplands. Pathak, P.S. and Gopal, B. (Eds.). *Studies in Indian Agroecosystem*. Indian Institute of Ecology. 115-127.

### Paper Presented in Symposia/Seminars

Joshi, C.B., and Raina, H.S. 1997. Impact of degraded habitats on mahseer fishery in Indian uplands with special reference to Kumaon Himalaya CICFRI/IFSI. *Seminar on changing perspectives of Indian Fisheries*. 16-17 March, 1997, Barrackpore. p.1.

Joshi, C.B. 1997. The fishes of U.P. hills. *Workshop on Conservation Assessment and Management Plan (CAMP)*. NBFGR, Lucknow. September, 1997.

Joshi, K.D. and Bhanja, S.K. 1998. Piscine diversity composition and status in Lohawati river. *National Symposium on Faunistic Bio-diversity, Environment Monitoring and Biotechnology*. Gurukul Kangri University, Hardwar 6-9 February, 1998.

### Research Abstracts

Basade, Y., Kapila, S. and Kapila, R. 1998. Inorganic constituents- calcium phosphorus and iron in muscle tissues of *Tor putitora* (Ham.) *National Symposium on Faunistic Bio-diversity, Environment Monitoring and Biotechnology*. Gurukul Kangri Univeristy, Hardwar 6-9 February, 1998.

Bhanja, S.K., Joshi K.D. and Tyagi, B.C. 1998. Effect of dietary vitamins on growth, survival and feed conversion of cultivable fishes in Himalayan region, coldwater fishes *Tor putitora* and *Schizothorax richardsonii*. *National Seminar on Aquaculture in Changing Environmental Perspectives*. University of Kerala, Thiruvananthapuram. 25-27, March, 1998.

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Joshi, C.B. 1998. Loss of habitat and its impact on mahseer fishery in Kumaon waters of U.P. Himalaya. *National Seminar on Aquaculture in Changing Environmental Perspectives*. University of Kerala, Thiruvananthapuram. 25-27, March, 1998.

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Kapila, R., Kapila, S. and Basade, Y. 1998. Sex related haematological variations in Himalayan golden mahseer, *Tor putitora* (Ham.). *Fourth National Symposium on fish and their environment*. University of Bangalore, Karnataka, 21-23 January, 1998.

Kapila, R., Kapila, S. and Basade, Y. 1998. Serum enzymes activities and haematological stuides in *Schizothorax richardsonii* (Gray). *National Symposium on Faunistic Bio-diversity, Environment Monitoring and Biotechnology*. Gurukul Kangri University, Hardwar 6-9 February, 1998.

## LIST OF APPROVED ONGOING PROJECTS

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<b>Project No.</b>	<b>Title of project</b>
NRCCWF/04	Production of the stocking material of Endangered species of coldwater fishes
NRCCWF/07	Breeding and culture of Carps in Himalayan uplands
NRCCWF/10	Aquaculture of golden mahseer, <i>Tor putitora</i> (Ham)
NRCCWF/12	Analysis of blood of some important upland fishes
NRCCWF/13	Biochemical composition of some important upland fishes
NRCCWF/14	Study on the effect of supplemental vitamins on the growth and survival of coldwater fishes
NRCCWF/15	Breeding and culture of <i>Schizothorax richardsonii</i>
NRCCWF/16	Bio-ecology and fishery of the river Ladhiya

## **RAC, MANAGEMENT COMMITTEE, SRC, QRT, ETC, MEETINGS**

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The third meeting of NRCCWF management committee was held during December, 1997 under the chairmanship of Director in which various agenda items were discussed and decisions were taken for smooth functioning of the Institute. The following members of management committee attended the meeting.

1. Dr. K.K. Vass  
Director, NRCCWF,  
Bhimtal  
Chairman
2. Prof. I.J. Singh,  
Associate Professor,  
G.B. Pant University of Agric. & Tech.,  
Pantnagar  
Member
3. Sh. H.C. Pathak,  
Chief Finance & Account Officer,  
I.V.R.I., Izzatnagar.  
Member
4. Dr. C.B. Joshi  
Senior Scientist,  
N.R.C.C.W.F., Bhimtal  
Member
5. Dr. Shyam Sunder,  
Senior Scientist,  
NRCCWF, Bhimtal  
Member



The staff research council (SRC) meeting of the Institute was held on 9 June, 1997 under the chairmanship of Director to evaluate the progress made under various projects during 1996-97 and to discuss the new project proposals submitted by the scientists for 1997-98 which were subsequently approved.

A mid-term review meeting of (SRC) was held on November 24, 1997, the progress under these programmes was critically reviewed and changes in some of the programmes were suggested.

A senior officers meeting was held on 22.11.1997 in which various urgent policy decisions were discussed for their proper implementation.

The election for reconstituting the members for joint staff council was held at Bhimtal and Champawat on December 27, 1997. The elected members will hold office for three years. Sh. R.L. Raina and Sh. Harish Ram from administrative category, Sh. R.S. Haldar and Sh. Bhagwan Singh from technical group and Sh. Manoj Kumar and Sh. Ravinder Kumar from supporting staff, were elected as members. The first meeting of newly constituted IJSC was held in January, 1998 in which Sh. R.S. Haldar was elected as secretary staff, IJSC and Sh. R.L. Raina was elected member to CJSC. The regular quaterly meeting of IJSC was held on March 9, 1998.

## PARTICIPATION OF SCIENTISTS IN CONFERENCES MEETINGS, WORKSHOPS SYMPOSIA, ETC IN INDIA AND ABROAD

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Conferences/Meetings/ Symposia/ Workshops	Paper Presented	Authors/Participants
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### Seminars/Symposia

Seminar on changing Perspectives of Inland Fisheries, 16-17 March 1997 at CICFRI, Barrackpore	Impact of degraded habitats on mahseer fishery in Indian uplands with special reference to Kumaon Himalayas	C.B. Joshi & H.S. Raina
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National Symposium on Faunistic Bio-diversity, Environmental Monitoring and Biotechnology, 6-8 February, 1998 at Deptt. of Zoology, & Env. Science, Gurukul Kangri University Haridwar.	Piscine diversity- composition and status in Lohawati river	K.D. Joshi & S.K. Bhanja
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### Workshops

Workshop on Freshwater Fish Conservation Assessment and Management 22-26 september, 1997 at NBFGR, Lucknow	The fishes of U.P. hills	C.B. Joshi
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National Hindi Workshop on

Prinsep, Kanika

## Meetings

Directors' meeting, 5-6 May 1997 at ICAR, New Delhi	-	H.S. Raina
Meeting of the committee on introduction of exotic aquatic species in Indian Waters, 14-16 July, 1997.	-	H.S. Raina
Meeting of Fisheries Research Institute at CIFRI, Barrackpore, 19-20 September, 1997	-	H.S. Raina
Inter-institutional linkages and collaboration meeting at VPKAS, Almora, 21-22 October, 1997	-	H.S. Raina
Technical Meeting at Champawat Research Centre & with District Migistrate Champawat, Govt. of U.P. December. 10, 1997	-	K.K. Vass
Meeting with Adll. Director of National River Conservation Directorate, Department of Environment Ministry of Environment & Forests, New Delhi, 2nd Jan., 1998	-	K.K. Vass
Attended the meeting of National Institute of Ecology JNU, New Delhi Jan., 3, 1998.	-	K.K. Vass
ICAR Director's meeting, 4-5 March, 1998	-	K.K. Vass
Fisheries Divisional meeting 6 <sup>th</sup> March, 1998	-	K.K. Vass
Meeting with Chief Development officer Distt. Nainital	-	K.K. Vass

## DISTINGUISHED VISITORS

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The following is the list of distinguished visitors, who visited the Institute during the year 1997-98

Dr. P.V. Dehadrai	Former Deputy Director- General (Fisheries) Indian Council of Agricultural Research, Krishi Bhavan, New Delhi
Sh. Sunil Sood	Former Joint Secretary, (Fisheries) Deptt. of Agriculture, & Cooperation, Ministry of Agriculture, Govt. of India
Sh. Diwakar Vikram Singh	Hon'ble Minister of Agriculture & Incharge Nainital District, Uttar Pradesh Govt, Lucknow
Dr. A.K. Bandopadhyay	Director, CARI for ANGI, Port Blair
Mrs. Beena Arya	Chairperson Jila Panchayat, Nainital, U.P
Sh. S.R. Arya	MLA Khatima (Udham Singh Nagar), U.P.
Dr. P.S. Gusain, PCS	Chief Development Officer Nainital, Govt. of U.P.
Dr. A.P. Sharma	Incharge FRTC G.B. Pant University for Agri. & Tech. Pant Nagar
Sh. N.C. Sharma, IAS	District Magistrate Champawat, Govt. of U.P.

## VIP VISITS



**Honourable Minister of State for Agriculture (U.P.) Shri Divakar Vikram Singh being explained NRC-CWF activities by the Director during his visit**





## PERSONNEL (as on March 31, 1998)

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### Director

Dr. K.K. Vass

With effect from November 20, 1997.

### Scientific

Dr. H.S. Raina

Principal Scientist

Shri Madan Mohan

Principle Scientist (on study leave)

Dr. C.B. Joshi

Senior Scientist

Dr. Shyam Sunder

Senior Scientist

Dr. B.C. Tyagi

Senior Scientist

Shri Rajeev Kapila

Scientist

Smt. Suman Kapila

Scientist

Ms. Yasmeen Basade

Scientist

Dr. S.K. Bhanja

Scientist

Dr. K.D. Joshi

Scientist

Dr. D.N. Das

Scientist (Inter-institutional transfer to  
NRC Yak, Dhirang, Arunachal Pradesh)

Dr. R.S. Pawaiya

Scientist (Inter-institutional transfer to  
CSWRI, Avikanagar, Rajasthan)

Shri Rahual Behl

Scientist (Inter-institutional transfer to  
NBAGR, Karnal)

### Technical

Shri R.S. Haldar

T-4 (Farm Manager)

Shri Soumitra Roy

T-4 (Inter-institutional transfer to CIFRI,  
Barrackpore)

Shri Amit Joshi

T-II-3 (Appointed from November, 1997)

Shri Baldev Singh

T-1-3

Shri T.M. Sharma	T-1
Shri Bakshi Ram	T-1
Shri Bhagwan Singh	T-1

### **Administrative**

Shri Prakash Chandra	Asst. Audit & Accounts Officer
Shri B.R. Chaterjee	Asst. Administrative Officer (Superannuated on 31.1.1998)
Shri R.L. Raina	Superintendent Administration
Smt. Susheela Tewari	Stenographer
Shri Harish Ram	Assistant
Shri Manni Lal	Senior Clerk
Smt. Khilawati Rawat	Junior Clerk
Shri P.C. Tewari	Junior Clerk
Shri Partap Singh	Junior Clerk
Shri J.C. Bhandari	Junior Clerk

### **Supporting**

Shri Japhu Ram	SS Gr. IV
Shri Madan Lal	SSG Gr. III
Shri Sant Ram	SS Gr. III
Shri Ravinder Kumar	SS Gr. II
Shri Om Raj	SS Gr. II
Shri H.S. Chauhan	SS Gr. II
Shri H.S. Bhandari	SS Gr. I
Shri Sunder Lal	SS Gr. I
Shri Hem Chandra Bhakt	SS Gr. I
Shri Dharam Singh	SS Gr. I
Shri Manoj Kumar	SS Gr. I
Shri Pooran Chandra	SS Gr. I
Shri Prakash Akela	SS Gr. I



## **ANY OTHER RELEVANT INFORMATION SUCH AS SPECIAL INFRASTRUCTURAL DEVELOPMENT**

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At the Institute's Research and Development Centre a computerised weather monitoring facility has been established for continuous recording of local weather data at an interval of every half an hour.

## हिन्दी सारांश

### भूमिका

भारत के पर्वतीय क्षेत्रों में मछली पालन को एक व्यवसाय के रूप में उभारने तथा विभिन्न प्राकृतिक जल स्रोतों में मछलियों का उत्पादन बढ़ाने के लक्ष्य को ध्यान में रखते हुए भारतीय कृषि अनुसंधान परिषद् द्वारा राष्ट्रीय शीत जल मात्स्यकी अनुसंधान केन्द्र की संस्तुति के फलस्वरूप सन 1987 में पश्चिमी उत्तर प्रदेश के कुमाऊँ क्षेत्र की तराई में हल्दानी (जिला नैनीताल) नामक स्थान में इस केन्द्र की अस्थायी स्थापना की गई। ताकि अन्तः स्थलीय मात्स्यकी अनुसंधान की दृष्टि से उपेक्षित पर्वतीय क्षेत्रों में उपलब्ध सभी जल स्रोतों में विभिन्न मात्स्यकी परियोजनाओं को सुचारु रूप से कार्यान्वित किया जा सके और इस क्षेत्र में मछलियों के विकास सम्बन्धी सभी समस्याओं के समाधान हेतु उपयुक्त अनुसंधान कार्य किए जा सकें। इस उद्देश्य की प्राप्ति के लिए कुमाऊँ क्षेत्र में इस अनुसंधान संस्थान के मुख्यालय के अलावा भीमताल (नैनीताल) एवं चम्पावत नामक स्थानों पर दो उपकेन्द्रों की स्थापना की गई। भीमताल में विलुप्त होती माहसीर मछलियों के बीज उत्पादन एवं संरक्षण हेतु नई-नई पद्धतियों की खोज के कार्य को सम्पादित करने के साथ-साथ इस मछली के विकास हेतु विभिन्न जल स्रोतों को सर्वेक्षण व अध्ययन कार्य किया जाता है। इसी स्थान पर माहसीर मछलियों के बीज उत्पादन हेतु एक बीज पोषशाला "हैचरी" की भी स्थापना की गई है। जबकि चम्पावत जिले में छीड़ापानी नामक स्थान पर एक प्रक्षेत्र बनाकर अन्य भांति-भांति की मछलियों का प्रजनन व पालन पोषण किया जा रहा है।

संस्थान की क्विनक्यूनियल रिव्यू टीम (क्यू आर टी) के अनुमोदन एवं भारतीय कृषि अनुसंधान परिषद् की संस्तुति के उपरान्त मई 1997 में संस्थान का मुख्यालय हल्दानी से भीमताल स्थानान्तरित किया गया है। जहां पर संस्थान द्वारा करीब एक हैक्टर भूमि क्रय की गई है। ताकि संस्थान द्वारा भीमताल में स्थायी रूप से अपने प्रशासनिक भवन, प्रयोगशालाओं, पुस्तकालय, अतिथिगृह, प्रशिक्षण

अध्ययन, शीत जल मछलियों के कृत्रिम अहार, ठण्डे पानी में पायी जाने वाली मछलियों की जैव रासायनिक संरचना आदि प्रमुख हैं। इसके साथ-साथ हिमालय के विभिन्न भौगोलिक परिस्थितियों में पाए जाने वाले जल स्रोतों का सर्वेक्षण भी लिया जा रहा है।

### अधिदेश उद्देश्य

पर्वतीय क्षेत्रों के ठण्डे पानी के स्रोतों में मछलियों के पालन पोषण व संग्रहण के तौर तरीकों को वैज्ञानिक अनुसंधान की सहायता से उचित दिशा में निर्देशन हेतु तथा शीत जल मत्स्यकी को व्यवस्थित व विकसित करने की दृष्टि से संस्थान निम्नलिखित लक्ष्यों की प्राप्ति के लिए प्रयत्नरत है।

- 1- मत्स्य संदोहन व संरक्षण के लिए ऐसी प्रबन्ध पद्धति विकसित करना जिससे पर्वतीय क्षेत्रों में उपलब्ध सभी जल स्रोतों में क्षमतानुसार समुचित मात्रा में मछलियों का उत्पादन किया जा सके।
- 2- वाणिज्यिक दृष्टि से महत्वपूर्ण सभी देशी व विदेशी किस्म की ठण्डे पानी में पायी जाने वाली मछलियों के पालन पोषण की लाभकारी व दीर्घकालिक तकनीक विकसित करना।
- 3- शीत जल मत्स्य पालन के क्षेत्र में विकसित प्रौद्योगिकी को प्रशिक्षण शिक्षा, तथा विस्तार माध्यमों द्वारा सभी इच्छुक व्यक्तियों, विभागों तथा संस्थानों को हस्तांतरित करना।

## अनुसंधान उपलब्धियाँ

### माहसीर मछलियों का प्रजनन व पालन पोषण

शीत जल मत्स्य पालन केन्द्र में माहसीर मछली के कृत्रिम प्रजनन की तकनीक विकसित कर उत्कृष्ट कार्य किया है। परन्तु कृत्रिम प्रजनन के समय अनेक कठिनाइयों का सामना करना पड़ता है। जैसे नर व मादा प्रजनक का एक साथ न मिलना और उनके साथ घटती हुई मादा प्रजनकों की संख्या। इन सभी समस्याओं को ध्यान में रखते हुए इस अवधि के दौरान माहसीर मछलियों के पालन पोषण की तकनीक से प्रजनकों की पैदावार बढ़ाने का प्रयास किया गया ताकि भविष्य में माहसीर मछलियों की बढोत्तरी में आशातीत प्रगति की जा सके।

माहसीर मछलियों की अंगुलिकाओं व बढी मछलियों को प्राकृति स्रोतों से व शीत जल मत्स्य पालन केन्द्र की हैचरी में पैदा किए हुए बीज को एकत्रित कर छीड़ापानी मत्स्य प्रक्षेत्र पर संचय किया गया। मछलियों को प्रयोगशाला में निर्मित कृत्रिम भोजन दिया गया। इस अध्ययन के ज्ञात हुआ कि ग्रीष्म ऋतु (मई से अक्टूबर) में माहसीर मछलियों की बृद्धि दर 5-8 ग्राम प्रति मास थी।

### पर्वतीय क्षेत्रों में कार्प मछलियों का पालन पोषण

पर्वतीय क्षेत्रों में भारतीय व विदेशी कार्प मछलियों के मिश्रित मछली पालन की तकनीक अभी विकसित नहीं की गई है। जबकि एकांकी मछली पालन में कामन कार्प का उपयोग हिमालय के विभिन्न क्षेत्रों व दक्षिणी पठार में काफी हो रहा है। मिश्रित मछली पालन को हिमालय के सम-शीतोष्ण जलवायु में विकसित करने के लिए संस्थान के छीड़ापानी मत्स्य प्रक्षेत्र में भारतीय और विदेशी कार्प मछलियों की अंगुलिकाओं का संचयन किया गया ताकि यहां से जनमानस को कम दामों पर प्रोटीन उपलब्ध कराया जा सके और साथ ही साथ उनकी आय के स्रोतों में मत्स्य पालन द्वारा बढोत्तरी की जा सके।

कामन कार्प मछलियों का एकांकी पोषण विधि में प्रति तालाब (3x 10x 0.66 मी०) 1.5, 3.0, 4.0 तथा 5.0 अंगुलिकाएं प्रति वर्ग मीटर के हिसाब से संचित की गई तथा 260 दिनों के पालन

प्रति वर्ग मी० 25, 25, 50% कामन कार्प, ग्रास कार्प व सिल्वर कार्प वाले समूहों से व 3 मछली प्रति वर्ग मीटर की दर से संचित की गई मछलियों में हुयी।

गर्मी के महीनों में सभी तरह की कार्प मछलियों में वृद्धि दर अच्छी रही जबकि सर्दी में शून्य वृद्धि दर देखी गई। इन मछलियों को कृत्रिम खुराक में दिए जाने वाले भोज्य पदार्थों में सरसों की खली, 30%, गेहूँ का चोकर (20%), सोयाबीन (25%), चावल की भूसी (15%), तथा मछली का चूरा (10%), प्रमुख थे और प्रतिदिन 2% की दर से दिन में दो बार खुराक दी गयी।

### माहसीर मछलियों का पालन पोषण

माहसीर मछलियों के बीज के अधिकाधिक उत्पादन की तकनीक को सफलता पूर्वक करने के पश्चात यह बहुत आवश्यक हो गया है कि कोई ऐसी तकनीक/प्रणाली विकसित की जाए जिसके द्वारा नियन्त्रित परिस्थितियों में फ्राई से अंगुलिकाओं तक के पालन पोषण की तकनीक विकसित की जा सके। ताकि अधिकाधिक मात्रा में स्वरथ व रोग निरोधक मछलियों का उत्पादन करके उन्हें प्राकृतिक नदी, नालों व अन्य जल स्रोतों में प्रत्योरोपित किया जा सके।

इन्हीं बातों को ध्यान में रखते हुए भीमताल झील में नाइलोन केज (2.5x1.5x1.0) बनाकर इन मछलियों के पालन पोषण की व्यवस्था की गयी। जिनमें 263 फ्राई औसतन भार 0.28 ग्राम व 112 फ्राई औसतन भार 0.88 ग्राम 70 फ्राई प्रति वर्ग मीटर व 30 फ्राई प्रति वर्ग मीटर की दर से संचित किया गया। और इन मछलियों को सोयाबीन (20%), गेहूँ का चोकर (20%), चावल की भूसी (20%), सरसों की खली (25%), व मछली का चूरा (15%), विटामिन व खनिज लवण को मिलाकर दिन में तीन बार खुराक दी गयी। 260 दिन के उपरान्त माहसीर मछलियों की वृद्धि दर औसत वजन बढ़ने के हिसाब से 0.003 ग्राम -0.010 ग्राम प्रतिदिन प्राप्त की गई। तथा इन केजों में रखी गई मछलियों की जीवन दर 14.01% एवं 65.18% प्राप्त हुयी।

### पर्वतीय क्षेत्रों में पायी जाने वाली प्रमुख मछलियों के रक्त का सूक्ष्म विश्लेषण

मछलियों के रक्त-रखाव व संरक्षण हेतु हिमेटोलौजिकल, सिरोलोजिकल तथा इलैक्ट्रोफोरेटिक तकनीकों का उपयोग रक्त विश्लेषण के लिए अधिकाधिक किया जा रहा है। पर्वतीय क्षेत्रों में विलुप्तप्राय मछलियों की सुरक्षा के लिए भी इन तकनीकों का उपयोग किया जा रहा है।

इस अध्ययन से पता चला कि स्नो ट्राउट की नर तथा मादा मछलियों में लाल रक्त कोशिकाएं, हिमोग्लोबिन व कोशिका आयतन की मात्रा में विशेष अंतर नहीं है। ऋतुओं के आधार पर अध्ययन करने पर ज्ञात हुआ कि लाल रक्त कोशिकाएं, हिमोग्लोबिन व कोशिका आयतन दोनों लिंगों में प्रजनन

एवं क्षारीय परिस्थिति (पी०एच० 5,6,7,8 और 9) में रखकर हिमेटोलोजिकल और एंजाइम स्तर पर अध्ययन भी किया गया। इसके अतिरिक्त छः विभिन्न मछलियों का इलैक्ट्रोफोरेटिक विधि द्वारा तुलनात्मक अध्ययन भी किया गया।

### पर्वतीय क्षेत्रों में पायी जाने वाली प्रमुख मछलियों की जैव रासायनिक संरचना

इस परियोजना के अर्न्तगत स्नो ट्राउट या असेला मछली के मांस-पेशियों की संरचना को ऋतुओं, लिंग और आकार के आधार पर अध्ययन लिया गया। इस अध्ययन से ज्ञात हुआ कि प्रोटीन, वसा, व ग्लाइकोजन की मात्रा मादा व नर मछलियों में प्रजनन अवधि से पूर्व अधिक होती है। जबकि प्रजनन अवधि में इनकी मात्रा कम हो जाती है। प्रजनन अवधि के उपरान्त मादा मछली में प्रोटीन की मात्रा तथा नर मछली में राख और ग्लाइकोजन की मात्रा काफी कम हो जाती है। जोकि इस बात को दर्शाती है कि इनका प्रयोग प्रजनन प्रक्रिया में होता है।

फास्फोलिपिड और ग्लाइकोजन की मात्रा को छोड़कर जोकि मादा मछली में अधिक होती है अन्य सभी तत्वों में दोनों लिंगों में कोई विशेष अन्तर नहीं है।

मछली के आकार बढ़ने के साथ-साथ प्रोटीन, वसा, राख, ग्लाइकोजन, फास्फोलिपिड काफी मात्रा में बनते हैं। जबकि कोलस्ट्रॉल और नमी कम हो जाती है।

### पर्वतीय क्षेत्रों में पाई जाने वाली प्रमुख मछलियों की वृद्धि में प्रतिपूरक

#### विटामिनों के प्रभाव का अध्ययन

पर्वतीय क्षेत्रों में पायी जाने वाली मछलियों की न्यूनतम वृद्धि दर व निम्न जीवितता की समस्या के समाधान हेतु कुछ अतिरिक्त प्रतिपूरक विटामिनों (विटामिन ए, सी, व ई) को मत्स्य आहार के साथ भिन्न भिन्न मात्रा एवं सांद्रता में मिलाकर दिया गया। प्रतिपूरक आहार के लिए सोयाबीन का आटा (38%), मूंगफली की खली (20%), फिश मील (20%), तथा चावल की भूसी (20%), व खनिज लवण (2%) मिश्रित किया गया। उक्त आहार में विटामिन ए - 8000 यूनिट/कि०ग्रा०, विटामिन ई- 100 यूनिट कि०ग्रा० तथा विटामिन सी- 400 मि०ग्रा० कि०ग्रा० की दर से विभिन्न सांद्रता में मिलाकर मछलियों को दिया गया।

असेला मछली की फ्राई को 20 फ्राई प्रति वर्ग मीटर की दर से तथा माहसीर व कामन कार्प की अंगुलियों को 2 और 5 अंगुलिकाएं प्रति वर्ग मीटर की दर से फार्म में स्थित वृत्तकार टैंको के

## असेला मछली का प्रजनन व पालन पोषण

असेला पर्वतीय क्षेत्रों में पायी जाने वाली प्रमुख मछलियों में एक है। किन्तु प्रतिकूल वातावरणीय कारणों के प्रभाव के कारण यह सीमित स्थानों में ही शेष रह गयी है। इन्हीं बातों को ध्यान में रखते हुए असेला मछलियों के प्रजनन तैयार करने की दृष्टि से छीड़ापानी मत्स्य प्रक्षेत्र में इनकी जीरा व अंगुलिकाओं का संचय किया गया है ताकि भविष्य में इन मछलियों से उपलब्ध बीज को पर्वतीय क्षेत्र के अन्य नदी-नालों व तालाबों में प्रत्यारोपित किया जा सके।

इन मछलियों के सही पालन पोषण के लिए इन्हें उचित मात्रा में खुराक दी गयी थी। कृत्रिम भोज्य पदार्थों में चावल की भूसी, गेहूँ का चोकर, सोयाबीन, सरसों की खली, विटामिन व खनिज लवण प्रमुख है।

प्रजनन के लिए 5 मादा मछलियाँ जिनका भार 80-125 ग्राम था, से 3225 अण्डे प्रति कि० ग्राम मछली भार के हिसाब से उपलब्ध हुए। इन अण्डों में निषेचन प्रतिशत 60-85 तक रहा। इन निषेचित अण्डों को स्फुटन के लिए रखा गया परन्तु सफलता दर कम रही।

## लधिया नदी का पारिस्थितिकीय अध्ययन

पर्वतीय क्षेत्रों में प्राकृतिक झीलों, नदी, नालों आदि में मछलियों की उत्पादन क्षमता बढ़ाने की दृष्टि से कूमाऊँ क्षेत्र की महत्वपूर्ण नदी काली की प्रमुख शाखा लधिया का पारिस्थितिकीय अध्ययन किया गया। इस नदी में तीन चुने गए प्रमुख स्थानों (शीठा साहब, काथाउला व बेलखेत) पर सर्वेक्षण कार्य किया जा रहा है। अभी तक किए गए अध्ययन से ज्ञात हुआ है कि इस नदी में असेला, माहसीर, गारा व बरिलियस प्रजाति की मछलियाँ प्रमुख है।

लधिया नदी में प्लैक्टोन में फाइटोप्लैक्टोन की मात्रा जूप्लैक्टोन की अपेक्षा अधिक पायी गई जिनमें डाइटमस, क्लोरोफाइसी और सियानोफाइसी मुख्य थे। नदी की सतह पर पाए जाने वाले जीव जन्तुओं में मैफलाई, स्टोन फलाई, कैडीपलाई तथा बीटलस की बहुतायात थी प्रति वर्ग मीटर में इनकी संख्या 43-116 प्रति वर्ग मी० और इनका भार 3.120-9.530 ग्राम था।

उपरोक्त अनुसंधानिक गतिविधियों के अतिरिक्त संस्थान के वैज्ञानिकों ने शीतजल मत्स्यिकी के अन्तर्गत होने वाली विचार गोष्ठियों व सेमीनार में भाग लिया और कई शोध पत्र भी प्रकाशित किये। इस अवधि में केन्द्र द्वारा टकनालजी के विस्तार हेतु कई प्रदर्शनियाँ भी लगाई गयी और वैज्ञानिकों ने पर्वतीय क्षेत्रों में मछली पालन हेतु आकाशवाणी पर कार्यक्रम दिये।