ICAR-DCFR
NEWSLETTER
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# FROM DIRECTOR'S DESK

Fish is a vital source of food and livelihood for the people living in remote mountainous terrains. Coldwater fish farming has played an essential role in providing food and livelihood security to the local inhabitants. ICAR-DCFR has been taking up research and development programs for delivering solutions to the problems, faced by fish farmers of this region and, during Jan-Jun 2021, we offered number of solutions. A technology for captive maturation and multiple breeding of endangered golden mahseer (*Tor putitora*) was developed and a patent has been filed. A comprehensive transcriptomic data set for *Tor putitora* was generated by sequencing the gonads and brain of both sexes to characterize differential expression of their genes. Gender specific transcriptomic response to environmental stress in golden mahseer (*Tor putitora*) revealed significant changes in gene expression upon exposure to high-temperatures. Morphometric characterization of the Ladhiya and Saryu river basins, in Uttarakhand was carried out. Besides efforts were made to rehabilitate and conserve the golden mahseer by its stocking and ranching in Lake Naukuchiatal and in River Suyal. Certain natural plant compounds curcumin, cinnamaldehyde, stigmasterol and eugenol were tested against pathogenic *Saprolegnia* spp, and their immunostimulatory potentials were investigated. For the first time, our scientists found a unique pathogenic fungus from rainbow trout. Our institute developed its first cell line from rainbow trout heart that was characterised and authenticated by National Repository for Fish Cell lines (NRFC), NBFGR Lucknow.

Collaborative programmes were taken up under SCSP, TSP and NEH. To improve the livelihood of Scheduled Caste fish farming communities, aquaculture-based programmes were taken up along with Fisheries College, Raha and Nowgong Girls' College, Nagaon, Assam. The project was implemented in Sonitpur, Biswanath Lakhimpur districts Nowgong, Assam. Under TSP, training and field demonstration programme were organized at Kohima, Nagaland; Munshyari, Uttrakhand; Ri-Bhoi, Meghalaya and Mamit in Mizoram besides training and capacity building programs at Dharchula in Uttrakhand and Anantnag in Kashmir. For popularization of fish farming, leaflets were prepared in English, Hindi, Khasi and Urdu to create awareness on the best management practices for the culture of rainbow trout and alternate candidate carps. Under NEH programme, the diversity of mahseer in the North Eastern Hill and Central Himalayan region is being investigated for exploring the intraspecific population structure and gene flow patterns in mahseer species besides habitat mapping. Hands-on training on molecular techniques in DNA barcoding was also organized. About 4.5 lakh eyed ova of rainbow trout were provided to the Department of Fisheries, Govt. of Arunachal Pradesh, 0.5 lakhs to the Department of Fisheries & Aquatic Resources, Govt. of Nagaland and, 3.5 lakhs to the Department of Fisheries, Govt. of Sikkim for the development of rainbow trout. Intriguingly for the first time, rainbow trout breeding was successfully achieved in Nainital District where conditions are not quite favourable for trout farming.

Kisan mela and awareness cum Farmers Goshti were organised at Bhimtal. Awareness programs were conducted on feed management

and polyculture of carps in mid hills, water quality management of carp ponds, breeding of rainbow trout and common carp at Experimental Field Facility, Champawat. About a thousand fingerlings of common carp and rainbow trout were distributed to the fish farmers of Champawat District. The centre generated a revenue of Rs 2.42 lakh by selling farm raised rainbow trout and advanced fingerlings. Training programmes on Integrated Coldwater Fish Farming and Freshwater Aquaculture Farmer, under Pradhan Mantri Kaushal Vikas Yojana were also conducted.

The Institute's Scientists and Staff actively participated to commemorate the Republic Day and International Yoga Day. I am proud to express that our Scientists and Staff left no stone unturned for the development of the institute however, still a lot needs to be done reminding me the famous poet and Pulitzer Prize winner Robert Frost, who said-

**The woods are lovely, dark and deep,**
**But I have promises to keep,**
**And miles to go before I sleep,**
**And miles to go before I sleep.**

**Pramod Kumar Pandey**
(Director)

## FISHERIES RESOURCE MANAGEMENT

# Morphometric characterisation of the Ladhiya and Saryu river basins, Uttarakhand

Advanced Space Borne Thermal Emission and Reflection radiometer ASTER DEM (30 m) satellite data was investigated. Survey of India topographic maps (1: 50,000) drainage delineation and corresponding analysis for quantitative morphometric analysis were employed in the investigation. In this study, D8 method, a multi-direction method, was used to delineate the hierarchical orders of the drainage network using hydrology tool in ArcGIS software from the ASTER DEM (30 m). Strahler (1964) stream ordering system was used for extracting the stream segments from the filled DEM.

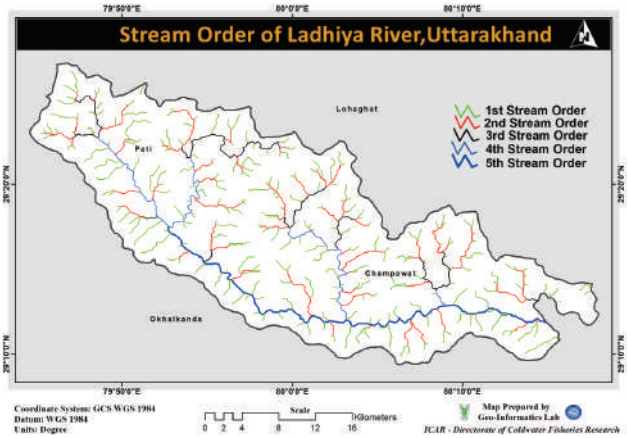



Fig: Stream order map of Ladhiya river basin

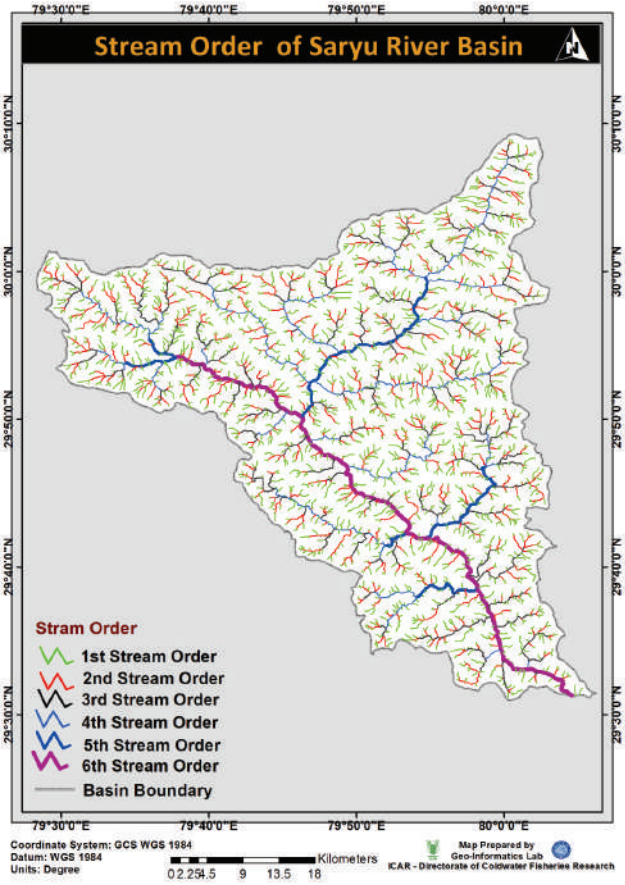



Fig: Stream order map of Saryu river basin

Ladhiya river was characterized as a 5th order basin with a stream network length of 577.171 km, while as Saryu river basin was found to be 6th order basin with a stream network length of 2889.26 km.

## Rehabilitation and conservation efforts of golden mahseer

Golden mahseer, *Tor putitora* has been the icon of recreational and sport fisheries in India and the Indian subcontinent. It is a popular game fish that attracts anglers worldwide and has immense potential for fish-based eco-tourism generating sufficient employment opportunities for local inhabitants. The much-admired tiger of the rivers, *T. putitora* is under threat due to anthropogenic activities, and its population has been declining in natural water bodies. Therefore, rehabilitation and conservation of golden mahseer are essential for its sustainability.

In this context, ICAR-DFCR has consistently been undertaking rehabilitation and conservation efforts for several years employing ranching of hatchery-bred fry and fingerlings in rivers, lakes, and reservoirs of the Himalayan region. Like previous years, the Directorate successfully organized seed ranching and stocking programme in Naukuchiatal lake, Nainital, and Suyal river (at Vishwanath ghat), Almora on 17th and 23rd February 2021 for the conservation of golden mahseer. In these two events five thousand fry were stocked in Naukuchiatal lake and two thousand fingerlings in Suyal river.

Dr. Dilip Kumar, Former Director, ICAR-CIFE, Mumbai, Dr. S. N. Ogale, Lonawala, and Sh. Anil Chanotiya, Member, Bhimtal Nagar Panchayat graced the occasion at Naukuchiatal and emphasized upon the need of people's participation in the conservation of mahseer. An awareness programme emphasising upon the of conservation and protecting its breeding grounds was also organized at Vishwanath ghat (Suyal river). On this occasion, aquaculture inputs such as feed and aqua-medicine were also distributed among farmers. Dr. Debajit Sarma, Principal Scientist, the then Officiating Director ICAR-DCFR, expressed his concerns to save golden mahseer in the natural water bodies of Kumaun region.

More than 30 participants at Naukuchiatal and 100 at Suyal river joined these events including Scientists, officials of State Fisheries Department and Farmers. The programmes were coordinated by Dr.

Golden mahseer fingerlings for ranching in Naukuchiatal lake, Nainital

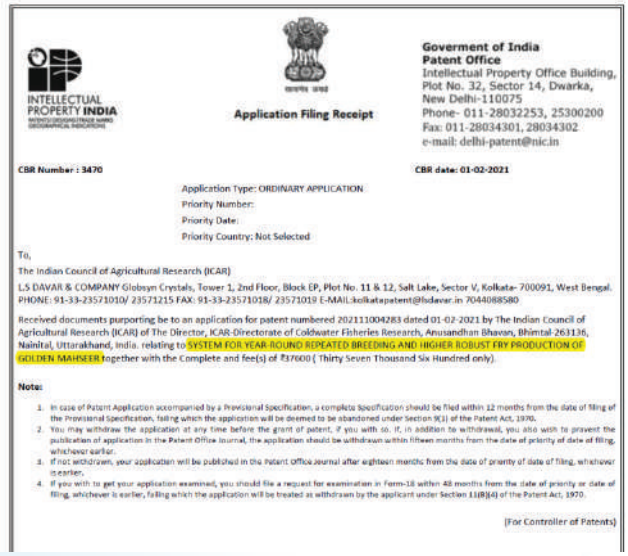
Ranching of golden mahseer fingerlings into Suyal river at Vishwanath ghat, Almora

M. S. Akhtar, Senior Scientist and Dr. Suresh Chandra, Principal Scientist.

# Aquaculture

## Technology for captive breeding of golden mahseer

A technology for captive maturation and multiple breeding of endangered golden mahseer (*Tor putitora*) has been developed. This technology would ensure sustainable seed production for its rehabilitation and conservation. An Indian patent entitled "*System for year-round repeated breeding and higher robust fry production of golden mahseer*" has been filed by the inventors Dr. M. S. Akhtar, Dr. Rajesh M, Dr. Ciji Alexander and Dr. Debajit Sarma. An application for



INTELLECTUAL PROPERTY INDIA

**Application Filing Receipt**

**Goverment of India**
**Patent Office**
Intellectual Property Office Building,
Plot No. 32, Sector 14, Dwarka,
New Delhi-110075
Phone- 011-28032253, 25300200
Fax: 011-28034301, 28034302
e-mail: delhi-patent@nic.in

CBR Number : 3470

CBR date: 01-02-2021

Application Type: ORDINARY APPLICATION
Priority Number:
Priority Date:
Priority Country: Not Selected

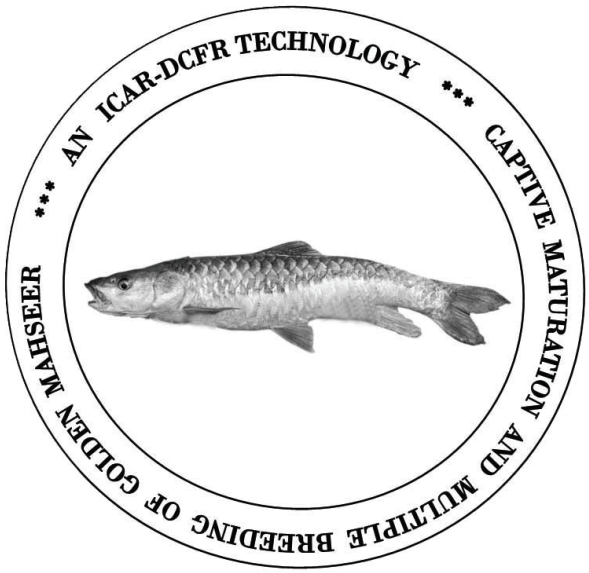
To,
The Indian Council of Agricultural Research (ICAR)
L5 DAVAR & COMPANY Globsyn Crystals, Tower 1, 2nd Floor, Block EP, Plot No. 11 & 12, Salt Lake, Sector V, Kolkata- 700091, West Bengal.
PHONE: 91-33-23571010/ 23571215 FAX: 91-33-23571018/ 23571019 E-MAIL:kolkatapatent@lsdavar.in 7044088580

Received documents purporting be to an application for patent numbered 202111004283 dated 01-02-2021 by The Indian Council of Agricultural Research (ICAR) of The Director, ICAR-Directorate of Coldwater Fisheries Research, Anusandhan Bhavan, Bhimtal-263136, Nainital, Uttarakhand, India. relating to SYSTEM FOR YEAR-ROUND REPEATED BREEDING AND HIGHER ROBUST FRY PRODUCTION OF GOLDEN MAHSEER together with the Complete and fee(s) of ₹37600 ( Thirty Seven Thousand Six Hundred only).

Note:

1. In case of Patent Application accompanied by a Provisional Specification, a complete Specification should be filed within 12 months from the date of filing of the Provisional Specification, failing which the application will be deemed to be abandoned under Section 9(1) of the Patent Act, 1970.
2. You may withdraw the application at any time before the grant of patent. If you with so. If, in addition to withdrawal, you also wish to prevent the publication of application in the Patent Office Journal, the application should be withdrawn within fifteen months from the date of priority or date of filing, whichever earlier.
3. If not withdrawn, your application will be published in the Patent Office Journal after eighteen months from the date of priority of date of filing, whichever is earlier.
4. If you with to get your application examined, you should file a request for examination in Form-18 within 48 months from the date of priority or date of filing, whichever is earlier, failing which the application will be treated as withdrawn by the applicant under Section 11(B)(4) of the Patent Act, 1970.

(For Controller of Patents)



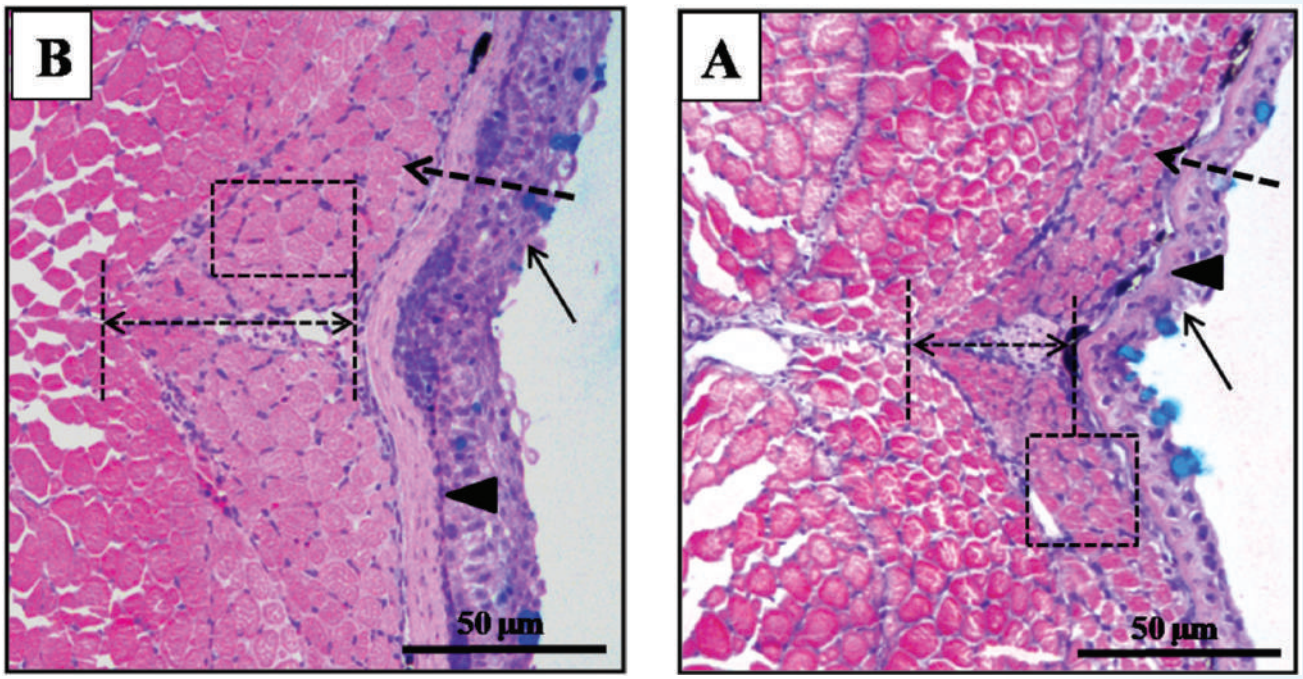

*Patent filed (left) and Trade Mark applied for registration (right)*


*The technology on ICAR-Agrinnovate platform for commercialization*

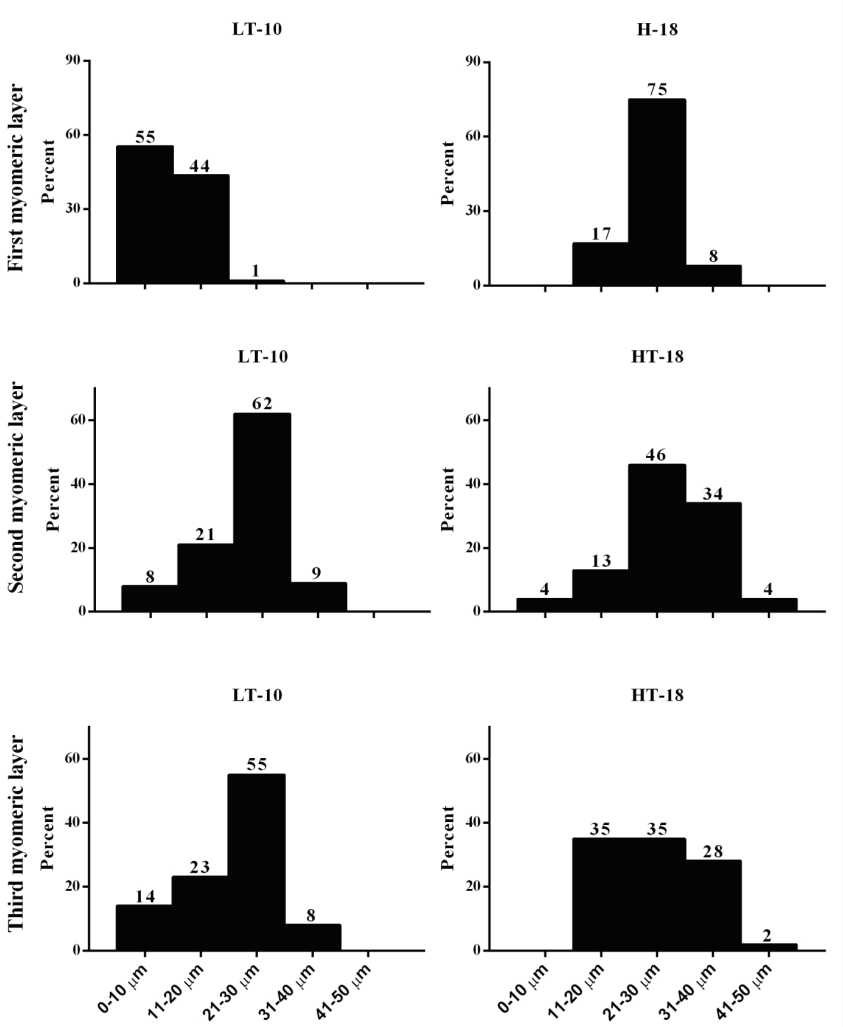
the registration of a 'trade mark' for this technology has also been submitted. Furthermore, the technology has also been evaluated by Agrinnovate India for its commercialisation.

## Study of temperature-responsive muscle cellularity in rainbow trout in its early stage of development

Muscle cellularity, up to three myomeric layers from the periphery, at four different locations namely mediodorsal (near the dorsal fin), mediolateral (lateral side below dorsal fin), caudodorsal (dorsal side of the caudal peduncle region) and caudolateral (lateral side of the caudal peduncle region) was studied in rainbow trout in its early stage of development (52 days post-hatching), incubated and reared at two temperature regimes, 10 and 18°C. It was observed that high incubation and rearing temperature-induced myofibrillar hypertrophy compared to a lower temperature. Consequently, fishes incubated




Photomicrographs showing the caudolateral region of muscle (in between the dorsal and caudal fin, a region without body cavity) of rainbow trout juveniles at 52 days post-hatching (dph) exposed to two different incubation and rearing temperatures, 10 and 18°C (A and B). Solid arrows indicate epidermis, broken arrows indicate the first layer of myomere from the peripheral side (the difference in its thickness among different treatment groups indicated by broken double arrows) along the horizontal septum. Arrowheads indicate dermis (connective tissue layer, stratum compactum), broken inset show differences in the thickness of myofibrillar bundles.




Frequency distribution of myofibrillar size (diameter) in first, second and third myomeric layer (from the periphery) of caudolateral muscle, from rainbow trout incubated and reared at 10 and 18°C.

and reared at high temperature were heavier than those from low, despite their equal length.

### Breeding of rainbow trout at Ramgarh, District Nainital, Uttarakhand

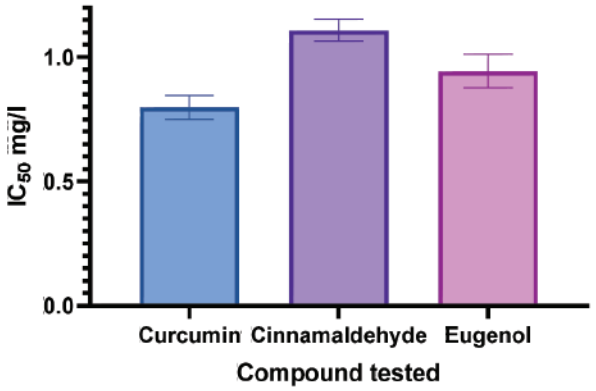
Rainbow trout breading was achieved for the first time in village Ramgarh, District Nainital, on 2nd January, 2021. About 200 fingerlings were stocked in the raceways of Mr. Jagat Singh Harnwal, in February 2019 and fed on trout feed prepared by DCFR. Within 22 months of rearing, the fishes attained 1200-1450 g and were used for stripping. Five female fish were stripped and the eggs were fertilized using the milt from the same stock. About 5000 eggs were fertilized and kept in temporary established trout hatchery for further development/ hatching. During stripping, water temperature was recorded 9.5°C. Utmost care was taken by following best hatchery management practices during the hatching period. After successful hatching, about 4000 seed was transferred in the nursery pond. Finally, 2500 fingerlings were sold by Mr. Jagat Singh to different trout growers in the locality and rest 1000 fingerlings are being reared by him in his own raceway. On an average, these fish attained a weight of about 100 g in four months and were fed on trout feed prepared DCFR. For this endeavour, the technical and financial inputs were provided by ICAR-DCFR. The programme was coordinated by Dr. R. S. Haldar, Chief Technical Officer and In-charge, Extension Activities.

## Fish Health Management

### The activity of natural plant extracts compounds against *Saprolegnia* sp.

Effectiveness of natural plant compounds curcumin, cinnamaldehyde, stigmasterol and eugenol were tested against *Saprolegnia* sp., isolated from rainbow trout, *O. mykiss*. The immunostimulatory potential of natural compounds was also evaluated in head kidney leukocytes. Selective compounds were screened for anti-Saprolegnia efficacy against different life stages of *Saprolegnia* sp. Curcumin and cinnamaldehyde demonstrated the best activity against *Saprolegnia*. With curcumin there was an increase in nitric oxide production suggesting possible immunostimulatory activity.

Breeding of rainbow trout at Ramgarh




### First case report of isolation of pathogenic fungi, *Basidiobolus* sp. Ind SN1 from clinical samples of ascetic fluid of rainbow trout, *Oncorhynchus mykiss*

*Basidiobolus* species was isolated from ascetic fluid of moribund rainbow trout, *Oncorhynchus mykiss*. Upon microbiological examination of aseptically collected ascite, sparsely septate, thin walled, spore forming fungal hyphae of diameter 25.6 ± 4.9 µm was observed. Microscopic examination of the 72 to 96 h old, cream coloured, furrowed, waxy colonies with raised centre and flat edges, revealed the presence of thick walled zygospore with outer beak like projections. A 680 bp amplicon of RNA internal transcribed spacer (ITS) segment was obtained by PCR, the nucleotide sequence analysis of which of confirmed the isolate as *Basidiobolus* sp. The deduced nucleotide sequence was submitted to GenBank (Accession number MW928426) and isolate was designated as *Basidiobolus* sp. Ind SN1. This is the first report of genus *Basidiobolus* as a causative agent of fatal fungal disease in teleosts.

Rainbow trout with advanced clinical signs of Basidiobolus infection. Colony of Basidiobolus sp. Ind SN1 on potato dextrose agar (PDA) plates after 24 h of incubation at 28 °C, showing flat swarming edges and raised dome shaped centre.

## Fish Genetics and Biotechnology

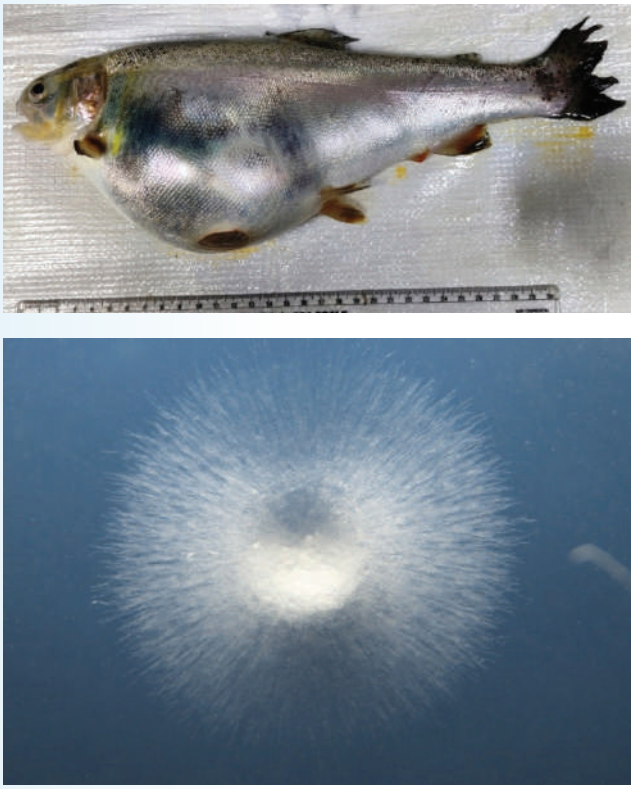
### Transcriptome based sex specific marker discovery in golden mahseer (*Tor putitora*)

Golden mahseer (*Tor putitora*) a preferred game fish and regional table delicacy, is considered as India's national heritage. In the last decade, skewed sex ratios have been reported in various populations of golden mahseer. However, the molecular mechanisms governing this process remain a mystery. In order to study the molecular mechanisms underlying sex determination and to unravel the molecular differences between males and females, a comprehensive transcriptomic data set was generated for *Tor putitora* by sequencing the gonads and brain of both sexes using the Illumina Hiseq 2500 system. The clean reads were mapped, assembled and used to characterize differential gene expression. Through a *de novo* assembly approach, we obtained 316,548 transcripts of which 78306 transcripts had significant alignments (e-value ≤ 1e – 05) to known proteins in public databases. From these transcripts, approximately 92.5% were functionally annotated allowing the identification of several candidate genes that are likely to play a central role in developmental processes, sexual reproduction, gamete generation, meiosis, sex differentiation, sperm motility, male courtship behaviour and fertilization.

Additionally, comparisons of ovaries and testes revealed several conserved orthologous genes known to be involved in sex differentiation, gonadal development and gametogenesis. Furthermore, we have also identified several important pathways enriched in male and female gonads. Highly reliable transcriptome assembly developed in our study will be useful for future genomic and genetic studies of golden mahseer and related species. In addition, the present study also provides an archive for further studies on sex differentiation and gonadal maturation in golden mahseer.

### Gender specific transcriptomic response to environmental stress in golden mahseer (*Tor putitora*)

Freshwater fishes are ectotherms, and thus, metabolically sensitive to environmental temperature. Rising temperatures have substantial consequences on the biology and ecology, such as metabolism, phenology, and behavioural response to the environment. It was found that climate induced changes of the physiology of fishes are not uniform, and thus vary within species (sex and life stage) and across geographic regions due to local adaptation of populations. It was observed that the golden mahseer (*Tor putitora*) exhibits a skewed sex ratio where males are mostly predominant than females. In order to understand how different sexes of the golden mahseer respond to environmental stress (for example, temperature) transcriptomics profiling of different tissues (e.g. gonads and brain) was caried out to identify sex specific stress responsive transcripts. DEseq was used to screen differentially expressed genes (DEGs) in gonads with a false discovery rate (FDR) adjusted p value £0.05. The results revealed significant gene expression changes during the course of the high-temperature treatment. However, while comparing gonads of fish exposed to normal and high temperatures, 24 DEGs were found in both sexes, suggesting that there is likely a



Rainbow trout with advanced clinical signs of Basidiobolus infection. Colony of Basidiobolus sp. Ind SN1 on potato dextrose agar (PDA) plates after 24 h of incubation at 28 °C, showing flat swarming edges and raised dome shaped centre.

common genetic mechanism to cope with exposure to high temperature. These DEGs were enriched in the KEGG pathways related to sex differentiation, nitrogen metabolism, glucagon signalling pathway, protein digestion and absorption, phototransduction, and adipocytokine signalling pathway. Therefore, exposure to high temperature influenced metabolism, signal transduction, cell growth and proliferation.

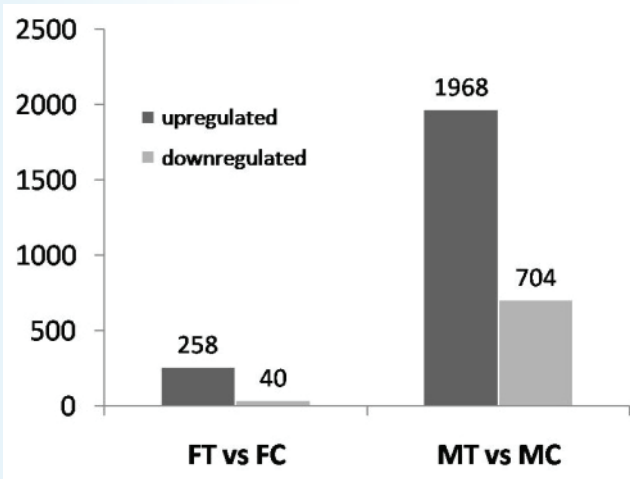



Fig.: The numbers of differentially expressed genes (DEGs) in the comparison pairs

## Development of cell lines from different organs of Rainbow trout

Fish cell lines are important as they are being used in understanding different biological processes. In an attempt to develop a cell line from rainbow trout, heart explants were set up and stable cells were obtained after a series of passages. The cell lineage from rainbow heart, named as RBT-H is the first cell line to be developed by ICAR-DCFR. The characterization of these cells was facilitated by NRFC, NBFGR Lucknow. The cells were free from mycoplasma, the common contaminant of cell lines with a number of chromosomes ranging from 60-63. Thus, results of karyotyping suggested its possible origin from rainbow trout. Further, to authenticate the cell line, DNA bar coding was employed. The nucleotide sequence of the partially amplified mitochondrial cytochrome c oxidase sub unit I (COI) closely resembled rainbow trout COI, thus authenticating its origin. The cell line is deposited in the National Repository for Fish Cell Lines, ICAR-NBFGR, Lucknow and has been placed in the list of authenticated cells with an accession number, NRFC075.

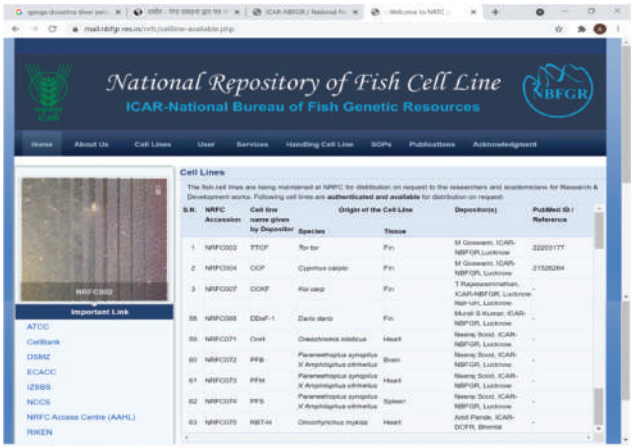



Fig.: Cells deposited in NRFC-NBFGR Lucknow

## Activities under SCSP

- A collaborative programme was undertaken by ICAR-DCFR with College of Fisheries, AAU, Raha, Assam on "Improving livelihood pattern of Scheduled Caste fish farming communities in foothill regions of northern bank of Brahmaputra valley through scientific aquaculture-based avenues". The project was implemented in Sonitpur, Biswanath and Lakhimpur districts of Assam to strengthen the household income of the Scheduled Caste communities besides improving their rural livelihood. At present, out of 50 targeted beneficiaries of the three districts of Assam, 35 were selected under the said project. Remaining 15 are proposed to be selected later.




Selection of beneficiaries in Assam under SCSP

The project aims to develop existing backyard or community ponds of the selected beneficiaries in a scientific manner and provide scope for generation of income and employment. The targeted beneficiaries who were involved in fishing of mahseer and other fish species inhabiting the foot hills, were guided to undertake alternate livelihood such as scientific fish farming. Only small and marginal farmers are selected for providing technical guidance through training and demonstration activities under the project.

- A collaborative programme was undertaken by ICAR-DCFR with Nowgong Girls' College, Nagaon, Assam on "Rural Livelihood and Socio-Economic improvement among Scheduled Caste population of Nagaon district, by adapting scientific interventions in fish farming practices". Three villages namely Rangalumukh, Lomati and Sukotipota were visited under Tulshideuri Gaon Panchayat belonging to Pakhimoriya Development Block of Nagaon district, Assam. The residents of these villages belong to Schedule Caste community, from which 40 fish farmers were selected for the implementing the project. An introductory meeting was held to explain the objectives of the programme for the villagers. The meeting was held at Bir Lachit Lomati ME School, Lomati village where more than 30 representatives of the selected families participated in the meeting.


**Fig.: Meeting with the villagers under SCSP**

Selection of beneficiary in Nagaon Dist. Assam

## Farmers Meet and Kisan Mela

Two days Orientation Workshop cum Farmers' Meet and Kisan Mela was organized during 17-18th March, 2021 under the SCSP activity of this Directorate. About 150 Scheduled caste fish farmers participated in the programme from different parts of Uttarakhand state. Shri Arvind Hayanki, Commissioner, Kumaun Region, Uttarakhand state graced the occasion as Chief Guest. Shri Basir Bhatt, Director, Department of Fisheries, Govt. of Jammu and Kashmir; Dr. A.K. Singh, Former Director, ICAR-DCFR; Dr. R. S. Chauhan, Dean, College of Fisheries, GBPUAT, Pantnagar; Shri Amit Tandon, Growel Feeds Pvt. Ltd, Andhra Pradesh were also present in the said programme as a Guests of Honour. On this occasion, an awareness cum training programme was organized for the SC fish farmers. Hands on training for preparing fish value added products like fish cutlet and fish pickle was also organized. A quiz competition was also organized for the farmers. During the programme, fish carp and trout feed, water testing kit, $KMnO_4$ etc. were distributed among SC farmers. For holistic benefit of the farmers, a Kisan mela was also organized with the participation of ICAR-IVRI, Mukteswar, ICAR-CITH, Mukteswar, ICAR-VPKAS, and GB Pant Institute of Himalayan Environment & Development, Almora.


Farmers Meet and Kisan Mela

# Activities under TSP

## Training and Field demonstration programme at Kohima, Nagaland

Two days Training and Field demonstration programme was organized at village-Kohima, Nagaland during 29-30th January, 2021, with a participation of 30 tribal fish farmers. The program was coordinated by Dr. R.S. Haldar along with the other members of TSP.

Training and Field demonstration programme

## Demonstration program on breeding and culture of rainbow trout in Munshyari

ICAR-DCFR organized a demonstration program on breeding and culture of rainbow trout in remote tribal area of Munshyari, Pithoragarh for the promotion of trout culture enabling livelihood security of the local farmers. The program was organised during 4-6th February, 2021 in collaboration with Department of Fisheries, Pithoragarh. A raceway of Mr. Aanad Singh was selected for conducting a breeding trial of rainbow trout and maiden breeding trial was conducted. The breeding trial was successfully demonstrated to four trout farmers with a production of about 3000 eggs. The farmers were made aware about management practices such as brood stock management, breeding, feed preparation etc. for being self-reliant in rainbow trout farming. The program was coordinated by Dr. R.S. Patiyal along with the other members of TSP team.

Breeding demonstration to participants

## Training-cum-Input distribution program at Ri-Bhoi, Meghalaya

Two days orientation cum training and input distribution programme coordinated by Mr. A.K. Giri and Dr. R.S. Haldar was organized in the premises of KVK, Ri-Bhoi on 09th and 15th April 2021 for the fish farmers of villages Madan Nonglakhiat and Poham Shkem. From each village, 25 participants attended the programme. During the programme, inputs like fish seed, 10ton carp feed, lime and nets were distributed to the participating farmers.

Input distribution to participants

## Training-cum-Input distribution program at Mamit, Mizoram

One day Training and feed distribution program was organized at village-Darlak, District Mamit, Mizoram on 13th April 2021 with the participation of 62 tribal fish farmers. During the program, 10ton of carp feed was distributed to the farmers. The program was coordinated by Dr. R.S. Haldar and Mr. A.K. Giri.


Input distribution to participants

## Training and capacity building program at Dharchula, Pithoragarh

Two days Training and capacity building programme was organized for the tribal fish farmers of villages Pangu and Dugtu of Dharchula block in district Pithogarh, Uttarakhand on 17th and18th June, 2021. From village-Pangu, 25 tribal fish farmers participated in the said programme while 40 from village Dugtuhad. The programme was coordinated by Dr. R.S. Patiyal along with other members of TSP.

## Training and feed distribution programme at district Anantnag of Kashmir valley

Three days training programme on best management practices (BMPs) in rainbow trout farming was conducted for the tribal fish growers of district Anantnag, Kashmir valley. During this program feed was also distributed. The programme was carried out from 20th to 22nd March 2021. Ten tribal fish growers including two female trout growers of Anantnag district attended the training programme. An interactive meeting was held with trout farmers to create awareness on breeding and seed production of trout, culture practices, water quality and health management. Fish farmers highlighted the number of constraints like non-availability of quality trout seed, feed, disease besides problems encountered in treatment and larval rearing. The fish farmers were assured about resolution the said issues. This was followed by the feed distribution programme wherein two tons of rainbow trout feed was distributed among ten farmers. The feed was distributed in packages for different fish size in order to effectively utilise the feed with minimal wastage. The programme was coordinated by Raja Aadil Hussain Bhat, and Parvaiz Ahmad Ganie, Scientists from ICAR-DCFR, Bhimtal.

Interaction with the participants

Certificate and feed distribution

## Leaflets form TSP

For the popularization of aquaculture under the TSP, leaflets were prepared in English, Hindi, Khasi and Urdu to create awareness among farmers on issues like best management practices for the culture of rainbow trout, alternate candidate carps for polyculture in mid altitudinal thermal regimes.






## Activities under NEH

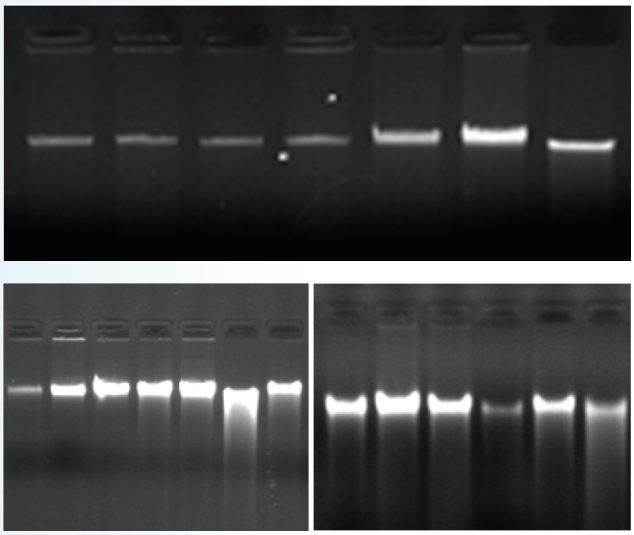
### North Eastern Hill Region (NEH)

A study on the diversity of mahseer in the North Eastern Hill and Central Himalayan region is being carried out for exploring the intraspecific population structure and gene flow patterns in populations of *Tor* and *Neolissochilus* besides investigating the diversity of mitochondrial DNA. Habitat mapping of mahseer resources through GIS platform to develop strategies for conservation and propagation are some other areas being probed.

A hands-on training on Molecular Biology techniques in DNA Bar coding was also organised for the participants of the North Eastern Region besides the young professionals.

**Collection of mahseer from river basin**

**Some of the collected species of Mahseer from different River**



Gel image of DNA extracted of *Neolissochilus hexagonolepis* Collected from Umngi River

## Hands-on Training on Molecular Biology Techniques in DNA Barcoding

Under network programme on "Species and stock validation of mahseer species of genus *Tor* and *Neolissochilus* from western and eastern Himalayan region of India for its propagation and conservation", ICAR-Directorate of Coldwater Fisheries Research, Bhimtal organised six days hands-on training on "Molecular Biology Techniques in DNA Barcoding" from 1st to 06th March 2021. This training was organised for seven young professionals of four partner institutes from north-east states of College of Fisheries, Raha, Assam; D.M. University, Manipur; Manipur University, Manipur and St. Anthony's College, Shillong, Meghalaya. Under this training programme, trainees were given the exposure of isolation of DNA from fish samples, PCR, agarose gel electrophoresis, sequencing procedure, bioinformatic analysis of sequence and habitat mapping. This programme was coordinated by Dr. Debajit Sarma, Dr. Neetu Shahi, Dr. R.S. Haldar, Mr Sumanta Kumar Mallik and Mr. Parvaiz Ahmad Ganie.

Hands on Training on "Molecular Biology techniques in DNA Barcoding"

## Distribution of Rainbow trout eyed ova:

About 4.5 lakh eyed ova of Rainbow trout were supplied in January, 2021 to the Department of Fisheries, Govt. of Arunachal Pradesh for development of rainbow trout farming in Tawang and West Kameng district.



Rainbow trout seed being reared in in Tawang and West Kameng district

About 0.5 lakh eyed ova of rainbow trout were supplied to the Department of Fisheries & Aquatic Resources, Govt. of Nagaland in January, 2021 for the development of rainbow trout farming in Kohima district. The said eyed ova were hatched in the Dzuluke trout hatchery. The fingerlings are being reared in the Govt. trout raceways in Dzuluke, District Kohima.

Hatching of rainbow trout eyed ova Dzuluke, District Kohima.

Hatching of rainbow trout eyed ova Dzuluke, District Kohima.

About 3.5 lakh eyed ova of Rainbow trout were supplied to the Department of Fisheries, Govt. of Sikkim in February, 2021 for the development of rainbow trout in Districts of West and North Sikkim.

Further, DCFR prepared 10kg Starter feed of Rainbow trout has been provided to the Department of Fisheries & Aquatic Resources, Government of Nagaland in January, 2021 for rainbow trout stocks being reared in raceways at Dzuleke, Kohima district for better growth and survival of the species.

The distribution and hatching of rainbow trout ova was coordinated by Dr. R. S. Haldar Chief Technical Officer.

## Other programmes organized

### Collaborative work in PPP mode with ICICI Foundation:

ICAR-DCFR has undertaken collaborative work in PPP mode with ICICI Foundation for upliftment of rural livelihood security of hill fish farmers in different villages of Nainital and Almora districts of Uttarakhand. Under this programme one day training was organized in March 2021 for selected farmers to disseminate the knowhow of scientific fish farming.

Training of selected fish farmers at Molekhal Block, Almora

First training was organized at Kothalgaon village of Molekhal Block (Almora District) of Uttarakhand on 28th March 2021 in collaboration with the ICICI Foundation. Sixteen farmers participated from Kothalgaon, Bairangkhal, Basadi, Kotali Mali, Musauli, ArariRijwar, Dugholi and Arari Bisht village of Molekhal Block.

Second training was organized for the selected fish farmers of Ramnagar Block, District Nainital District, Uttarakhand with the participation of 26 selected fish farmers. The farmers were from Udaipuri Bando Basti, Berajhal, Nathupur Chhoi, Shankarpur Bhud, Rajpur, Malpuri, Shivnathpur, Jassa Ganja, Narayanpur Muliya and Nandpur villages. The training was organized at National Rural Livelihood Mission (NRLM) Meeting Hall at Ramnagar.

During the occasion, the trainees were trained about the primary requirements for fish farming, construction of different type of ponds, eradication of aquatic weeds, cleaning of unwanted fishes from culture ponds. Production of natural food for fish, water quality management, stocking of fish ponds with quality seed, enhancement of productivity of pond, feeding of fish, integrated fish farming with poultry, overall management of fish ponds, common diseases of fish and their control, harvesting of fish and marketing etc. were some other dimensions in which the fish farmers were trained. The farmers were also briefed about the MGMG programme. The programs were coordinated by Dr. R.S. Haldar, Chief Technical Officer and Mr. Santosh Kumar, Technical Officer, from ICAR-DCFR. Mr. Rahul Saxena, Development Officer, ICICI Foundation was also present during the training programme.

## Technical guidance for implementing biosafety measures and rearing imported eyed ova of rainbow trout

The Government of Uttarakhand was provided technical guidance to implement biosafety measures for rearing eyed ova imported from Denmark. Six lakh orange eyed ova transported from Denmark were received at Bairangana trout farm, Chamoli on 24th January 2021. About 0.01% eggs were damaged during transportation and the remaining eggs were quarantined by rearing in an isolated hatchery facility with a provision of disinfecting the outgoing water. A batch of eyed eggs was reared indoor for 33 days under controlled conditions at Bhimtal. A survival rate of 62.38% from eyed stage to fry was achieved at a rearing temperature of water ranging from 10.1-12.0°C. In a duration of first 25 days of rearing, average growth was 66.5 mg. In prolonged water temperature range of 23°C, reared rainbow juveniles exhibited stress with unique mortality. The growth and survival data from trout farm of Chamoli was monitored by Dr Suresh Chandra, Principal Scientist.

Acclimatization of imported eyed ova at Bairagna trout farm,Chamoli

## Seed stocking and growth monitoring in farmers ponds

During COVID-19 lockdown, fish farmers of the adjacent villages were unable to stock healthy fish seed in their ponds. To help them, pond to pond seed stocking was taken up in April, 2021 and cage reared stunted grass carp, silver carp and common carp fingerlings ranging between 15-20 g were transported to the farmers' ponds located in Saladi, Harinagar, Berijala and Boherakun villages. Fish ponds/tanks of thirty-six Schedule Caste farmers' besides four others were selected for stocking fish seed and, the growth and health status of the fingerlings was monitored. Regular interactions with farmers, their sensitization and motivation were carried out to reduce the post-harvest losses. This resulted in development of a fish farming cluster comprising 50 ponds in Harinagar area of Bhimtal inhabited by SC farmers. Critical inputs like pelleted feed bags and fish medication were also provided to farmers and the village is gradually developing in fish farming hub. This activity was coordinated by Dr Suresh Chandra.

Stunted fingerlings distribution to SC farmers of Harinagar on 13.04.2021

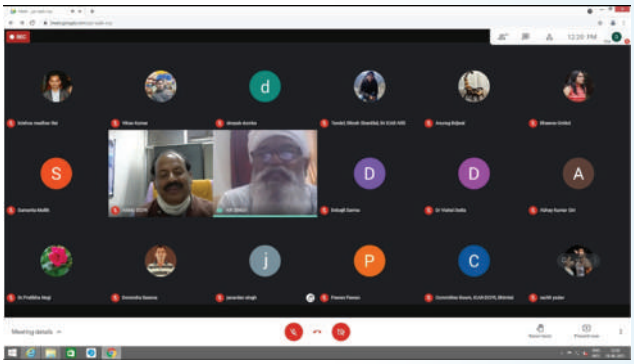
A newly developed polylined carp tank in Village Berijala

## Initiation of Trout Farming in Bhimtal

Under the guidance of ICAR-DCFR, a farmer established trout farming. Two farmers of Ghatigarh village in Harinagar near Bhimtal initiated trout farming in their newly constructed raceways. Advanced rainbow trout fry were stocked in their raceways in the month of April-May, 2021. The new entrepreneurs were provided technical knowhow on construction of raceways, stocking, feeding and raceway management. For supporting them in their endeavour, feed was provided to the farmers. These farmers were trained and guided from Dr. S. Chandra.

## Awareness cum Farmers Goshti on Balanced use of fertilizers in aquaculture

One day webinar cum physical training on "Balanced use of fertilizers in aquaculture" was organized on 18th June, 2021 by the Directorate and Dr S. Chandra co-ordinated the programme. Forty-eight fish farmers of Uttarakhand and Uttar Pradesh besides staff of UP Department of Agriculture took part in the Awareness cum Goshti. Dr K.M. Rai, Scientist ICAR-NBPGR, Bhawali delivered a talk on importance of using balanced manures and fertilizers in aquaculture and agricultural crops. Dr D. Sarma welcomed the participants and highlighted the importance of organic farming. Sri Hem Chandra Joshi, Asst. Agriculture Officer demonstrated physically the collection of soil samples and their analysis to fourteen farmers. An interaction meet was also arranged and farmer's queries were addressed.



Screen shot of the webinar

# Activities of Experimental fish farm, ICAR-DCFR, Champawat

An awareness programmes were conducted on "Feed management of carps in mid hills" at Village Doodhpokhra on 2nd Jan 2021 and "Polyculture of carps in mid hills" at Village Chaeukoni bora on 04th Jan 2021. Farm advisories were provided on "Water




Glimpses of activities including Farm advisories, Awareness programmes etc carried out in District Champawat.

quality management of carps ponds" at Village Shaktipur-Bunga on 07th Jan 2021, "Brood stock management of carps" on 19th Jan 2021 at village Banlekh, Champawat and "Nursery management of carps" on 20th 2021 at village Kaflang of Champawat

## Rainbow trout breeding:

Breeding, seed production and culture of rainbow trout is an important activity at the Experimental Fish Farm, ICAR-DCFR, Champawat. The farm raised rainbow trout brooders were used for breeding and seed production during Jan-March 2021. From 600 brooders a record production of around 800000 was achieved. The rainbow trout eyed ova were distributed to different trout growing states of the country. Around 600000 eyed ova, were supplied to Munsiyari (Uttarakhand), Munnar (Kerala), Sikkim, Arunachal Pradesh and DCFR Mahaseer Hatchery, Bhimtal. The activities were coordinated by Mr. Kishor Kunal, Parvaiz Ahmad Ganie, Garima, technical and supporting staff of the farm.

Rainbow trout eyed ova supply to different trout growing states of the country

## Common carp breeding:

Common carp (*Cyprinus carpio)* is a very important candidate fish in mid Himalayan region. It is being cultured widely either alone or in polyculture system in the central and lesser Himalayan region in cemented as well as earthen tanks or ponds due to its better growth and minimal maintenance. During May-June 2020-21, breeding and seed production of improved common carp was carried out at EFF, ICAR-DCFR, Champawat following old conventional hapa breeding and 40000-500000 of 15 dph larvae were produced. Breeding of Koi carp and Gold fish was carried out during the same period with a production of 8000-10000 larvae. The breeding activities were coordinated by Mr. Kishor Kunal and Ms. Garima.

Battery of breeding hapa

## Training programmeon Integrated Coldwater Fish Farming

Under outreach cum extension training programme of the Directorate, a training cum awareness programme on "Integrated Coldwater Fish farming" was organised by Experimental Fish Farm, ICAR-DCFR, on 21st January 2021 at village Chowki, Champawat. The program had 125 participants including active fish farmers, entrepreneurs, students and officials of the fisheries department. A detailed lecture was delivered by Mr Kishor Kunal, Scientist, who highlighted the prospects and challenges of integrated Coldwater fish farming. Mr Parvaiz Ahmad Ganie, Scientist addressed the audience on the activities of the farm and the role of ICAR-DCFR in promoting Coldwater fish farming in the hill sates of the country. Mr Sanjeev, Kumar, District Fisheries Development officer, Department of Fisheries, Uttarakhand provided detailed information about PMMSY along with other schemes of the state government for the promotion fish farming. The programme concluded with a vote of thanks by Ms Garima, Scientist. The programme was coordinated and conducted by the Scientists Mr Kishor Kunal, Mr Parvaiz Ahmad Ganie, and Mrs Garima. Mr Hansa Dutt, Technical officer and other supporting staff of the EFF, ICAR-DCFR, Champawat assisted the Scientists during the programme.


Interaction with the farmers at village, Chowki

## Training programme on "Freshwater Aquaculture Farmer" Under Pradhan Mantri Kaushal Vikas Yojana (PMKVY)

Under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) -a flagship scheme of the Ministry of Skill Development & Entrepreneurship (MSDE) implemented by National Skill Development Corporation, a training programme on "Freshwater Aquaculture Farmer" was conducted from 8thto 16th March, 2021 at EFF, ICAR-DCFR, Champawat in collaboration with Agricultural Skill Council of India. Twenty participants from different villages of Champawat District attended the training programme. A number of theoretical, practical and demonstration sessions were arranged for the participants on farming of rainbow trout, common carp, grass carp, silver carp etc., pond management, nutrition and feed management, health management as well as seed

Interaction with the trainees under PMKVY training programme

production. The training programme was coordinated & conducted by Mr Kishor Kunal, Scientist, Ms Garima, Scientist, ICAR-DCFR, Champawat.

## Fish sale and distribution

Fish seed distribution is an important out-reach activity of the farm. Under this activity, fish seed was distributed in different farmer-oriented awareness and training programmes of the Directorate. During the reporting period, about 1000 fingerlings of common carp and rainbow trout were distributed to the fish farmers of Champawat District. Moreover, farm raised rainbow trout (table size: 480 kg) were sold to generate a revenue of Rs 1,92,000.00 (Rupees one lakh ninety-two thousand only). About 5000 advanced fingerlings of rainbow trout were sold and a revenue of Rs 50000/- (Rupees Fifty thousand only) was generated.

Fish seed distribution to the farmers

Selling of the fish at the farm

### Farmer Scientist meet cum Fish Seed & Fish Feed Distribution

A farmers-scientist interactive meet and fish seed-feed distribution program was arranged on 29th June 2021 at EFF, Champawat. Farmers were distributed with 80 kg fish feed and 50 fish seed. Farmers were made aware about fish farming, fish diseases, and their treatment. Various problems faced by farmers during fish culture were also discussed during the meet. Twenty-two farmers from Mudiyani, Pati, Bigrakot, Khunari, Salli, and Lohaghat participated in the program. A tree plantation programme was also organised to mark the visit of Dr Pramod Kumar Pandey, Director ICAR-DCFR. Dr N. N. Pandey, Principal Scientist, and other Scientists Mr. Kishor Kunal, Mr. P. A. Ganie and Ms. Garima, participated in the said program along with the staff.

Group photograph with the farmers


Dr Pramod Kumar Pandey Director, ICAR-DCFR planting the "*Tejjpatta*" at EFF, Champawat.

## Important Events

### Republic Day celebration

The Republic Day was celebrated with great enthusiasm. The Scientists and staff of the Directorate attended the flag hoisting ceremony. Dr D Sarma, Director (Acting) unfurled the National Flag and saluted the patriots who fought for our freedom besides highlighting the importance of 26th January. In his address to the staff, he laid stress upon working in harmony and putting up the best for the progress of the organization and the Country. Likewise, the Republic Day was celebrated at Experimental Fish Farm, Champawat with great fervour. The National Flag was unfurled by Mr. Kunal Kishore, Scientist. Both permanent and contractual staff were sensitized on the importance of celebrating 26thJanuary, as the Republic Day.

Republic day celebration at ICAR-DCFR, Bhimtal


Republic day celebration at EFF, ICAR-DCFR, Champawat

### International Yoga Day celebration

Yoga has been beneficial in keeping the body and mind in sound health. International Yoga Day was celebrated by the staff and research scholars of the Directorate on 21st June 2021. The United Nations' theme for this year is "**Yoga for well-being**", which takes into account how Yoga can promote the holistic health of every individual.

International Yoga Day

## Publications

- Tandel, R. S., Dash, P., Bhat, R. A. H., Thakuria, D., Sawant, P. B., Pandey, N., Chandra, S. and Chadha, N. K. (2021). Anti-oomycetes and immunostimulatory activity of natural plant extract compounds against *Saprolegnia* spp.: Molecular docking and *in-vitro* studies. Fish and Shellfish Immunology, 114: 65-81.
- Tandel, R. S., Shah, T. K., Kumar, A., Sarma, D. and Bhat, R.A.H. (2021). Chemical composition, antifungal activity and molecular docking of Himalayan thyme leaf extract (*Thymus linearis*) against fish pathogenic oomycete *Saprolegnia parasitica*. Aquaculture, 543: 736988.
- Dash, P., Tandel, R.S., Pandey, N.N., Sawant, P. B., Sarma, D., Rawat, K.D. and Chadha, N.K. (2021). Effects of rearing temperature on egg incubation, growth, standard metabolic rate, and thermal tolerance of chocolate mahseer, *Neolissochilus hexagonolepis*. Journal of Thermal Biology, 98: 102942.
- Shah, T.K., Kumar, A., Tandel, R. S., Sarma, D., Bhat, R.A.H. (2021). Evaluation of the acute toxicity of Thymus linearis ethanol extract and its effect on the hemato-biochemical and behavioural response of the Golden mahseer, *Tor putitora* (Hamilton, 1923). Environmental Science and Pollution Research.
- Ciji, A. and Akhtar, M. S. (2021). Stress management in aquaculture: a review of dietary interventions. Reviews in aquaculture.

## Awards

### Best worker award:

Dr. R. S. Haldar, Chief Technical Officer was conferred the "**Best Performance Award"** for the year 2020-21 by the Institute for outstanding contribution in the field of Fish and Fisheries on the occasion of Orientation Workshop cum Farmers' Meet and Kisan Mela organized by this Directorate during 17-18th March, 2021.

Dr. R. S. Haldar, Chief Technical Officer receiving "Best Performance Award"

## Joining

Dr. Pramod Kumar Pandey, joined as the Director of the Institute on 13.05.2021. Before joing ICAR-DCFR, Dr Pandey was serving as Dean, College of Fisheries, Central Agricultural University Agartala, Tripura.

## Promotions

1. Shahnawaz Ali, Scientist (SS) as Senior Scientist (w.e.f. 26.02.2017)
2. Sumant Mallik, Scientist (SS) as Scientist (Selection Grade) (w.e.f. 07.01.2018)
3. Neetu Shahi, Scientist (SS) as Senior Scientist (w.e.f. 21.04.2018)
4. Mohd.Shahbaz Akhtar, Scientist (SS) as Senior Scientist (w.e.f. 15.12.2018)
5. Rajenra Kumar Arya, Senior Technical Assistant to Technical Officer (w.e.f. 22.09.2020)
6. Hansa Dutt, Senior Technical Assistant to Technical Officer (w.e.f. 22.09.2020)
7. Trivani Madhav Sharma, Senior Technical Assistant to Technical Officer (w.e.f. 22.09.2020)

## Under Important Events

### International Webinar on Fish Reproduction

An international webinar on fish reproduction was organized through virtual mode on 22nd January 2021. In this webinar different issues of reproduction and maturation of coldwater fishes were discussed in details. An invited lecture on the topic "Germ cells in fish: basic to application" was delivered by Dr. Tapas Chakraborty, Assistant Professor, Kyushu University, Japan. A talk on "Thyroid and its role in fish reproduction" has also been delivered by Dr. Prakash Sharma, Scientist, ICAR-DCFR. The programme was attended by more than 50 participants from India and abroad. Dr. Prakash Sharma coordinated the programme.

## Under COMBATING COVID-19

The ICAR-DCFR remained instrumental in providing all support for combating COVID-19. Since the outbreak of pandemic, the directorate provided work force to assist different activities related to the corona testing. In continuation, the ICAR-DCFR deputed four scientists at ICAR-IVRI, Mukteshwar for RT-PCR based corona testing. Mr. Sumanta Kumar Mallik, Mr. Abhay Giri, Dr. Prakash Sharma and Dr. Shahnawaz Ali, Scientists, ICAR-DCFR provided their services from April to June 2021at ICAR-IVRI, Mukteshwar for corona testing. ICAR-DCFR places on record its appreciation for the commendable service done by these scientists during the difficult time.



## OBITUARY

Sri Gopal Chandra, Technical Officer left for heavenly abode after bravely fighting COVID-19 for nearly two weeks. Gopal breathed his last at Brijlal Hospital, Haldwani on 13th May 2021. A few months before his death, he had been engaged in COVID testing at IVRI Mukteshwar for a month. Gopal was humble, generous, sincere and an excellent colleague who will be missed by everyone at ICAR-DCFR.

**ICAR-Directorate of Coldwater Fisheries Research**
(Indian Council of Agricultural Research)
Bhimtal-263 136, District-Nainital (Uttarakhand)

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|---|---|---|
| **Direction & Guidance** | : | Dr. Pramod Kumar Pandey, Director, ICAR-DCFR |
| **Editorial committee** | : | Dr. Amit Pande, Dr. Shahnawaz Ali, Dr. Dimpal Thakuria, Mr. Parvaiz Ahmad Ganie |
| **Computer assistance** | : | Sh. Amit Saxena, Sr. Technical Assistant |
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