ICAR-DCFR
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FROM DIRECTOR'S DESK

The current ICAR-DCFR newsletter summarizes the ongoing research and advancements in the domain of coldwater fisheries and aquaculture, emphasizing sustainable practices, technological progress, and the conservation of fish species. Advanced GIS techniques, specifically the D8 method and SRTM DEM data in ArcGIS software, were employed to outline the hierarchical orders of drainage networks. Additionally, the newsletter reports the successful completion of captive breeding and seed production for *Barilius vagra*. The introduction of an efficient brooder feed for golden mahseer, named, "DCFR-MAHA-Brood" is highlighted for its positive impact on reproductive traits and larval quality. A recently tested antimicrobial peptide, RH12, exhibits robust antibacterial activity against fish pathogens. In the realm of fish health management, a multiplex PCR assay is developed for detecting major bacterial pathogens in rainbow trout, and selenium nanoparticles are identified for their anti-oomycete properties against *Saprolegnia* species. The ongoing research also focused on the antimicrobial resistance surveillance in Uttarakhand, emphasizing the importance of addressing this global concern. The National Surveillance Programme for Aquatic Animal Diseases is highlighted, with ongoing efforts to monitor and mitigate potential disease threats in coldwater fisheries through the 'Report Fish Disease' App.

The directorate has marked a significant achievement with the acquisition of its first patent for the invention titled "System for Year-Round Repeated Breeding and Enhanced Fry Production of Golden Mahseer" which carries immense promise for the conservation of the golden mahseer population. The last six months have been very dynamic for the directorate as it carried out several activities across various programs, focusing on capacity building programmes, surveys, and developmental initiatives. Several training programs were conducted, covering

topics such as indigenous coldwater fish species, rainbow trout genetics, ornamental fish farming, nutrition in coldwater aquaculture, and molecular techniques in fisheries science. These initiatives showcase the ICAR-DCFR's commitment in advancing fisheries research, technology, and sustainable practices. Besides, extension activities also featured field days and farm advisories. The commitment to sustainable coldwater aquaculture practices and the dissemination of knowledge is evident throughout the diverse range of activities undertaken. I appreciate the overall efforts of all the scientists and staff of this directorate. Moreover, I sincerely urge the entire research team to aspire and achieve more in their future endeavours.

At last, I extend my heartfelt gratitude to Dr. Himanshu Pathak, Secretary DARE and Director General, ICAR, and Dr. J.K Jena, Deputy Director General (Fisheries Sciences) for their encouragement and valuable guidance. The editorial team deserves commendation in compiling and presenting the scientific achievements of the directorate.

(Pramod Kumar Pandey)
Director

Fisheries Resource Management

Methodology for extraction of stream networks from digital elevation models

We employed the D8 method (multi-direction method) within the ArcGIS software and used SRTM DEM (30 m) data to delineate the hierarchical orders of the drainage network. To enhance the precision of the Digital Elevation Model (DEM), we applied pixel-based error removal techniques, which involved addressing issues like sinks and peaks to eliminate any interruptions in the drainage network. We adopted the Strahler stream ordering system (Strahler, 1964) to extract the stream segments from the filled DEM. Constructing the drainage network involved a sequence of GIS functions, including pixel filling, computation of flow direction and accumulation, and defining the contributing regions where water flows into outlet grid cells.

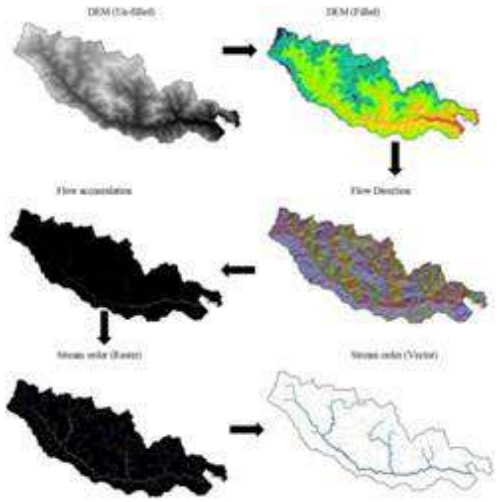


Fig. D8 point methodology for stream

An essential aspect of establishing the drainage network was determining the "cell threshold" value, indicating the minimum number of raster cells required to initiate a stream grid. For determining the flow directions of streams, we utilized a D8 pour point model, wherein surface water from eight adjacent pixels converged into a central pixel during DEM analysis. Following this, we computed flow accumulation and created the stream network by setting a threshold of 200 pixels. The selection of this threshold value resulted from thorough visual comparisons between the drainage network derived from toposheets and streams generated with various thresholds. It's worth noting that the optimal threshold value of 200 cells is specific to toposheets with a 1:50,000 scale and may vary for toposheets of different scales. Moreover, we defined the boundaries of watersheds (WS) by establishing pour points where water from the entire watershed eventually discharged into the main river. We calculated the area and length of watersheds using geometric data obtained from generated polygons and the length of the mainstream channel, respectively. The accuracy of the drainage network produced from the DEM was validated and confirmed using the Survey of India (SOI) toposheets.

Ichthyofaunal diversity and health assessment of Central Himalayan River Saryu, Uttarakhand

Different physico-chemical and biological parameters were studied to assess the habitat conditions in the drainage. The water quality index was analyzed to find the level of pollution in the area. The value of the water quality index shows the condition of water quality from good to poor based on its physico-chemical characteristics. Based on the diversity indices of phytoplankton, all the stations can be designated as unpolluted and pristine. A total 15 species of fishes were identified with the clear dominance of *Schizothorax richardsonii, Naziritor chelynoides, Barilius bendelensis* and *Garra gotyla*. The identification was made based on barbels and mouth patterns.

Aquaculture

Thermal and size-dependent fertility traits of male golden mahseer brooders in captive conditions

Although male golden mahseer brooders complete testicular development in pond/captive conditions, oozing males are required throughout the year to achieve year-round breeding and seed production of golden mahseer. Further, it is grossly observed during the hatchery operation that the size of the male brooders impacts the milt quality. Therefore, an experiment on size-dependent fertility traits has been conducted to understand the optimum size of male brooders for maximizing hatchery output and to assess the reproductive efficiency. There were three size treatment groups (200 - 350g, 500 -600g, and 900 - 1200g), each containing eight male brooders and were reared in 1000L circular FRP maturation tanks installed with gravel-bed substratum along with photo-thermal manipulations. An assessment of size-dependent sperm count and sperm morphology was done. The effect of milt (in vivo milt quality

assessment/validation) from different size groups on the breeding efficiency in terms of fertilization, hatching, survival, and growth has also been assessed. Results showed comparatively higher reproductive efficiency in terms of sperm count, spermatocrit, morphology, viability and environmental fitness (of fry) among the mid-size group. Therefore, it is suggested to use mid-size group male brooders to obtain higher hatchery output.

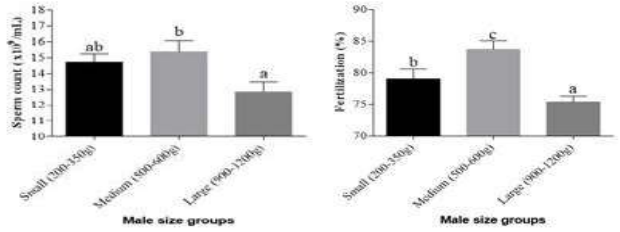


Fig. Sperm count and Fertilization rate in different size groups of golden mahseer

ICAR-DCFR receives its first patent

The ICAR-DCFR has achieved a significant milestone by securing its first patent for an invention titled "System for Year-Round Repeated Breeding and Enhanced Fry Production of Golden Mahseer" Dr. M.S. Akhtar, Senior Scientist and his team, including Dr. Ciji Alexander, Scientist, Dr. Rajesh M, Scientist and Dr. Debajit Sarma, Principal Scientist at ICAR-DCFR, have pioneered this invention. It brings a promising outlook for the golden mahseer (*Tor putitora*) population, potentially poised to shift its conservation status from "Endangered" to "Abundant" in the near future. This invention is centered on the development of an efficient and effective system and methodology for achieving captive maturation and year-round multiple breeding of golden mahseer in compact indoor tanks. It facilitates separate rearing of male and female fish to enable multiple breeding cycles, resulting in higher fecundity and increased fry production. The approach involves creating specific conditions that mimic natural breeding grounds, implementing maturation diets, and carefully managing temperature and photoperiod at various stages of hatchery operations. Significantly, this environmentally friendly invention contributes to water resource conservation and holds the potential to revive the golden mahseer population. The impact of this invention is already apparent, as ICAR-DCFR has successfully commercialized this technology to M/s. Das and Kumars Pvt. Ltd. Varanasi, Uttar Pradesh, through ICAR-Agrinnovate. This represents a major achievement in translating research findings into practical applications, thereby broadening the influence and reach of ICAR-DCFR's inventive work.

Breeding and seed production of indigenous hill stream ornamental fish

Captive breeding and seed production of *Barilius vagra* were carried out successfully in multiple locations to validate the protocol. Broodstock were raised at the ICAR-DCFR Experimental Field Centre in Champawat and at a farmer's site at Khernaula Pandey Village, Bhimtal. For egg production, the pairs were injected in a 1:1 ratio with a standardized ovatide dose. Approximately 85% of the eggs were found to be fertilized. For the first ten days, hatching larvae were fed Chlorella powder and egg yolk suspension. Following that, powdered ornamental feed was administered.

Fig. Field trial of Barilius vagra seed production

Standardization of biofilter media in Recirculating Aquaculture System (RAS)

The sizing of a biofilter for effective removal of ammonia and nitrite is crucial for the success of small-scale Recirculating Aquaculture Systems (RAS). In commercial RAS setups, well-designed biofilters are commonly employed, utilizing engineered plastic media (Moving Bed Biofilm Reactor - MBBR) to eliminate ammonia and nitrite efficiently. However, these media tend to be expensive and are often imported. Consequently, we explored the feasibility

of utilizing locally available media, such as gravel and expanded clay aggregates (ECA) of varying size grades. The findings indicate that the volumetric ammonia rates for crushed gravel, ECA, and K5 media ranged from 100 to 300 g, 200 to 500 g, and 500 to 1200 g of TAN/day/m^3, respectively. These results were obtained under different TAN loading doses ranging from 1 to 4 mg/L.

Fish Nutrition and Feed Development

Nutritional intervention for improving reproductive competence and larval quality traits of golden mahseer, *Tor putitora* in captivity

An effective brooder feed for mahseer, "DCFR-MAHA-Brood", was developed. The said brooder feed facilitates year-round multiple breeding of golden mahseer with an improved spawning response, fecundity (by 10 -15%), egg quality (egg size 2.54 Vs 2.73 mm, carotenoid content, etc), sperm quality & quantity (spermatocrit and sperm count by 5 -10% and sperm viability by 10%; while reduced abnormalities in the sperm by 3%), fertilization (by 12 -18%) and hatching (by 4-5%) rates, larval quality (improved growth by 20-22%, survival by 7-10%, and fitness (CTmax by 0.8 to 1.0 ºC). DCFR-MAHA-Brood enables the production of robust and healthy mahseer stocking material for replenishing its population in the natural water bodies through ranching and rehabilitation/conservation. The feed is now being considered for commercialization through ICAR-Agrinnovate.

Molecular Genetics & Biotechnology

Development of antimicrobial peptide by de-novo designing approach

In recent days, antimicrobial peptides (AMPs) have attracted the interest of many researchers due to their potential applicability in many fields, including aquaculture. Using the de-novo designing approach, a short and compositionally simple peptide, RH12 was developed, which exhibits potent antibacterial activity against fish pathogens. RH12 is amphipathic and has a net charge of +4.3. The peptide was synthesized using Fmoc-chemistry, and its antimicrobial activity was evaluated against *Aeromonas sobria, A. salmonicida, A. hydrophila, Edwardsiellatarda, Vibrio parahaemolyticus, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus epidermidis* and methicillin-resistant *S. aureus*. The RH12 showed good antibacterial activity against the tested bacteria, as shown by the Minimum inhibitory concentration (MIC) and Minimum Bactericidal Concentration (MBC) values, which ranged from 0.98 to 500 µM and 8 to 600 µM, respectively. The peptide was resistant to high temperatures and retained its antimicrobial properties even in the presence of serum and salt, indicating its stability. The peptide also showed minimal hemolysis in fish red blood cells, even at higher concentrations. These results suggest that the de-novo designing approach may be employed to develop potent novel AMPs in the future.

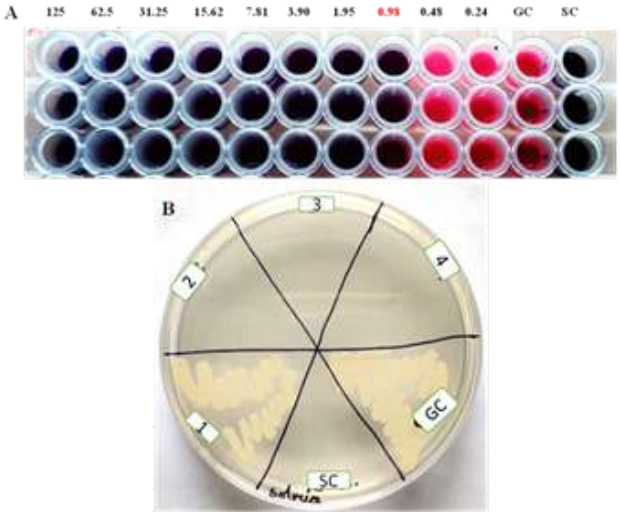


Fig. Minimum inhibitory concentration (MIC) (A) and Minimum Bactericidal Concentration (MBC) (B) of RH12 peptide against A. sobria estimated by colorimetric method using resazurin dye. SC: Sterility control, GC: Growth control

Acute hypoxia up-regulates Hypoxia-inducible factor mRNA transcripts in golden mahseer (*Tor putitora*)

Golden mahseer (*Tor putitora*) is an important cyprinid species in the upland fisheries of the Himalayan sub-continent for its economic, ecological, recreational, cultural and food values. The availability of dissolved oxygen (DO) in the aquatic system is the basis of life, which supports the metabolic requirements of the organisms, including their growth, development and reproduction. In most cases, a sudden decrease of DO level in waters will stimulate stress in fish. Different genes involved in hypoxia/anoxia processes have gained importance due to the growing interest in the role of oxygen in the development and pathology of organisms at the molecular level. In this study, we examined the mRNA expression level of hypoxia-inducible factor (*hif2α* and *hif3α*) in liver and

brain tissues of golden mahseer under acute hypoxia over a period of 96 hr exposure. The *hif2α* showed a significant increase in brain tissues, while *hif3α* expressions were significantly higher in both the liver and brain compared to control samples at normoxic levels. Further, the expression of both *hif2α* and *hif3α* down-regulated and became normal after the recovery of the fish to normoxic level. Hypoxia-inducible factors (HIFs) are heterodimeric transcription factors or DNA binding complex that mediates changes in gene expression during the adaptation of animals to low oxygen conditions. It has been reported that *hif-2* and *hif-3* are found in vertebrates and are expressed in a cell-type specific manner. The present study demonstrated that when *Tor putitora* was exposed to short-term hypoxia, an increase in *hif2α* transcript levels was observed in the brain, and *hif3α* transcript levels were observed in both tissues as an immediate response. The expression pattern of these genes indicated that they play an important role in the adaptive response to tissue hypoxia in golden mahseer.

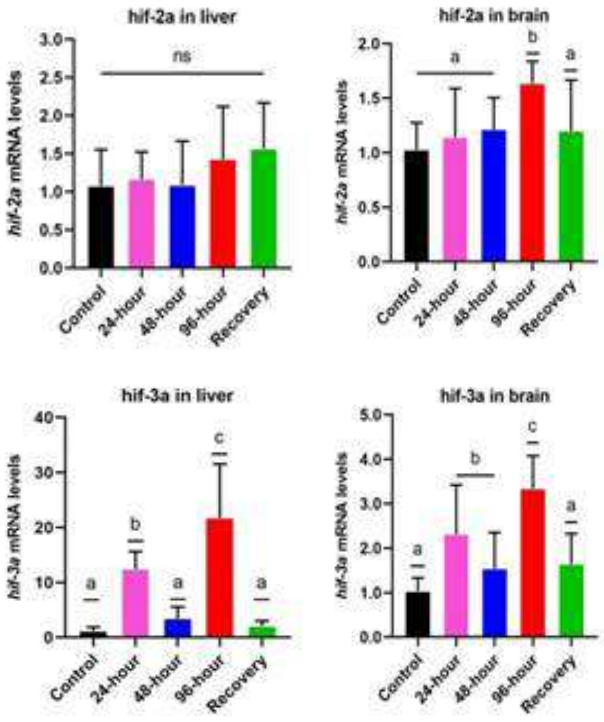
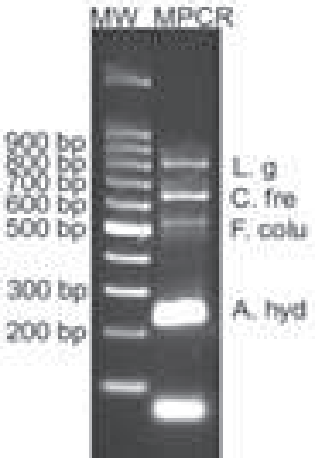


Fig. mRNA expression of Hypoxia-inducible factor in golden mahseer under acute hypoxia

Fish Health management

Multiplex PCR for detection of fish pathogens

We developed a multiplex PCR assay for the specific and simultaneous detection of four major bacterial pathogens of rainbow trout *Lactococcus garvieae*, *Citrobacter freundii*, *Aeromonas hydrophila* and *Flavobacterium columnare*. These four bacteria are the important pathogens of economic importance in farmed rainbow trout of India. The developed assay can detect these four bacterial pathogens from clinical samples as well, with high specificity and sensitivity.



The anti-oomycete activity of selenium nanoparticles

Selenium nanoparticles (SeNPs) are known to have good antimicrobial and antioxidant properties with the least toxicity. There are reports that SeNPs have broad-spectrum activity against Gram-positive and negative bacteria and some fungus species. Hence, to evaluate the anti-oomycete activity, SeNPs were prepared in the laboratory and tested against different *Saprolegnia* species. Among the tested species, *Saprolegnia parasitica* was found to be the most sensitive, with the lowest minimum inhibitory concentration (MIC). At higher concentrations, the nanoparticles produce a killing effect, which is evident from the absence of radial hyphal growth in the treated *Saprolegnia.* As SeNPs were found to be effective against *Saprolegnia* in *in vitro,* the same will be tried *in vivo* as well to determine the effective dose for control of Saprolegniasis in fishes.

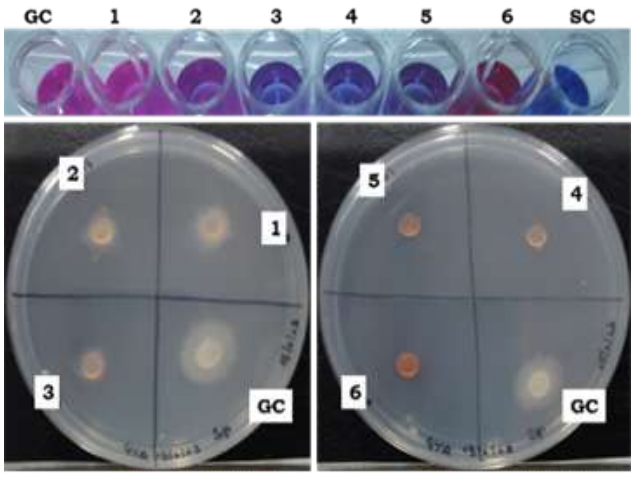


Fig. MIC and MOC of SeNP against Saprolegnia parasitica

Antimicrobial resistance surveillance conducted in Uttarakhand

Antimicrobial Resistance (AMR) Surveillance conducted by ICAR-DCFR in aquaculture ponds of various districts in Uttarakhand stands as a pioneering effort in safeguarding the sustainability of coldwater fisheries in this ecologically sensitive region. The surveillance program is a proactive response to the escalating global concern of antimicrobial resistance. Through rigorous data collection, analysis, and collaboration with local stakeholders, ICAR-DCFR is able to monitor and address the use of antimicrobials in aquaculture, working towards sustainable and responsible practices. In the effort, more than 140 fish farms in districts Nainital, Pithoragarh, Bagheshwar and Dehradun were brought under antimicrobial surveillance. More than 330 isolates of *Aeromonas*, *Staphylococcus* group and *Escherichia coli* were isolated and subjected to antimicrobial resistance analysis against a panel of antibiotics. By doing so, it not only ensures fish health management but also contributes to the broader global effort in combating antimicrobial resistance, protecting both aquatic biodiversity and public health in these picturesque Himalayan landscapes of Uttarakhand.

Fig. Collecting fish samples for AMR from aquaculture ponds in Pithoragarh district, Uttarakhand

National surveillance programme for aquatic animal disease (NSPAAD)-II

Under the National Surveillance Programme for Aquatic Animal Diseases, ICAR DCFR has done vital work in disease surveillance in the Coldwater fisheries sector. In recent months, our surveillance teams have been actively engaged in monitoring aquatic ecosystems in Uttarakhand and are closely monitoring viral, bacterial, parasitic, and fungal diseases. Through these activities, we strive to proactively identify potential disease threats and deploy targeted interventions to mitigate their impact. In the past months 6 months, i.e. from January 2023 to June 2023, our surveillance team actively monitored Nainital, Chamoli and Champawat districts and collected Baseline data of 71 farms from 12 villages in Nainital, three farms from two villages in Champawatand13 farms from three villages in

Fig. Awareness meeting at Darima, Nainital, Uttarakhand

Fig. Internal organ haemorrhages in Oncorhynchus mykiss

Chamoli district. In addition to the surveillance work, we have conducted two awareness programmes to enhance the knowledge and skills of farmers for better disease management practices. Furthermore, we have been promoting the use of the "Report Fish Disease application" for more effective disease reporting.

Shri Parshottam Rupala launched the 'Report Fish Disease' App developed by ICAR- National Bureau of Fish Genetic Resources (ICAR-NBFGR) under the National Surveillance Programme for Aquatic Animal Diseases (NSPAAD). This app is being popularised among the fish farmers of Uttarakhand.

Activities under Scheduled Caste Sub-plan (SCSP)

Advanced fingerlings of exotic carp (grass carp, silver carp and common carp) in species composition of 30SC/40GC/30CC were stocked in the ponds of 55 fish farmers of the adopted village, Darim. Field demonstrations with vegetable production have been

conducted at the 14 farmers' fields. A major technical intervention has been done for stocking with advanced fingerlings in proper species composition, appropriate supplementary feeding and regular health care with targets to achieve optimum production and better income with integrated fish farming. Adopted farmers of the Harinagar village are getting around 25-30 kg/100m^2 fish production with carp farming.

Activities at Experimental Fish Farm, ICAR-DCFR, Champawat

Rainbow trout breeding

During January to March 2023, breeding and seed production of rainbow trout was carried out at the farm. A total of about 12,50,000 eggs were produced from 1200-1500 brooders. Around 11,00,000 eyed ova were supplied to Leh (Ladakh), Dibrugarh (Asom), Bagdogra (West Bengal), West Sikkim, Bomdila, Mechuka (Arunachal Pradesh) and DCFR, Bhimtal from Experimental Fish Farm, ICAR-DCFR, Champawat.

Fig. Rainbow trout breeding at EFF, ICAR-DCFR, Champawat

Common carp and ornamental fish breeding

In the mid-Himalayan region, the common carp (*Cyprinus carpio*) is a candidate species that can be cultured to enhance fish production. Due to its superior growth and low maintenance requirements, it is popularly farmed in the central and lesser Himalayan region, either alone or in polyculture systems, in cemented as well as earthen tanks or ponds. Around 1,00,000 of 30 dph larvae were produced during May–June 2023 at EFF, ICAR-DCFR, Champawat. Goldfish and Koi carp breeding was also carried out, and around 5,000 and 10,000 fingerlings, respectively were produced.

Fig. Common carp and other ornamental fish breeding at EFF, Champawat

Farm advisories and field days organized

- Field Day on "Pond preparation and seed stocking" was conducted on 15th March 2023 at Village Mudiyani, Champawat.
- Farm advisory on "Water quality monitoring and maintenance of fish pond" was organized on 11th May 2023, at Village Bajrikot.
- Field Day on "Water quality monitoring, feeding, and maintenance of fish pond" was organized on 8th June 2023, at Village Chaeukoni bora.
- Farm advisory on "Water quality monitoring, soil testing, and maintenance of fish pond" was organized on 13th June 2023, at Village Chaeukoni bora.

Awareness programme organized

- An awareness program under 'Namami Gange' was held at EFF Champawat on 27th March 2023, and a pledge was taken for the conservation of natural water resources.

Events, Training and Meetings organized

Republic Day Celebration

The 74th Republic Day was celebrated with a flag hoisting ceremony attended by all scientists and staff of the Directorate. Dr. Parmod Kumar Pandey, Director, ICAR-DCFR, unfurled the national flag and paid tribute to the patriots who fought for our freedom, emphasizing the significance of 26th January. In his address to the staff of DCFR, he laid stress upon working in harmony and putting up the best for the progress of the organization and the country. Likewise, Republic Day was celebrated at Experimental Fish Farm, Champawat, with great fervour. Mr Kishor Kunal, Scientist and Officer In-charge, EFF, hoisted the national flag. Scientists and staff of the centre also expressed their pride for being part of such a glorious occasion.

Fig. Republic Day celebration at ICAR-DCFR, Bhimtal and Experimental Field Centre, Champawat

Webinar on SAMARTH by PMO

An online webinar on "Sustainable Application in Mission Approach through Research and Technology based Holistic Interventions - SAMARTH" was organized by the Ministry of Agriculture and Farmer's Welfare, Govt. of India on 24th February 2023 to prepare an actionable road map for Digital Public Infrastructure for Agriculture. It was inaugurated by the Hon'ble Prime Minister, Shri Narendra Modi. The program was chaired by Shri Narendra Singh

Tomar, Union Minister, Ministry of Agriculture and Farmers Welfare and Shri Purushottam Rupala, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying. At ICAR-DCFR, this meeting was attended by progressive farmers and staff of the directorate virtually.

International Women's Day Celebration

ICAR-DCFR organized the International Women's day-2023. Various events such as extempore, musical chair, and poem competitions were organized on this day. The celebration activities also included two lectures on this year's theme, "DigitAll Innovation and technology for gender equality". Dr. Anjuli Agarwal, Professor and Officer In-charge, GB Pant University of Ag & Tech, Nainital, Dr. Java Singh, Nainital, sessioned the programme as Chief guest and Guest of Honor. All the scientific, technical, contractual staff and students of this Directorate participated in the programme. At the end, prizes were distributed to the winners of various events.

Global Millet (Shree Anna) Conference, PM programme on Millet

As a part of the festivities marking the "International Year of Millets-2023', a two-day 'Global Millet (Shree Anna) Conference' took place on March 18-19, 2023. On March 18, a programme was organized at ICAR-DCFR, Bhimtal, for virtually attending the live telecast of the Global Millet (Shree Anna) Conference opening ceremony. The Prime Minister of India, Shri Narendra Modi, inaugurated the Conference at Subramaniam Hall, NASC Complex, Pusa, New Delhi. Several International leaders conveyed their messages on the occasion. In ICAR-DCFR, the programme was attended by farmers, institute staff and state government officials.

Research Advisory Committee (RAC) meeting

The 36th RAC meeting was held on 23-24th March 2023 under the Chairmanship of Dr. A.G. Ponniah, Former Director, ICAR-CIBA & ICAR-NBFGR. The meeting was attended by other RAC members Dr. B.P. Mohanty, ADG (I.Fy), ICAR; Dr. Kuldeep Kumar, Former Principal Scientist, ICAR-CIFA, Dr. K.D. Joshi, Former Principal Scientist, ICAR-NBFGR, Dr. Ashoktaru Barat, Former Principal Scientist, ICAR-CIFA, Dr. P. Mukhopadhaya, Professor & Head, Department of Economics, Goa University, Dr. Pramod Kumar Pandey, Director, ICAR-DCFR, and Dr. S. Ali, Member Secretary, ICAR-DCFR. The Director presented a brief account of the directorate's profile, activities, achievements

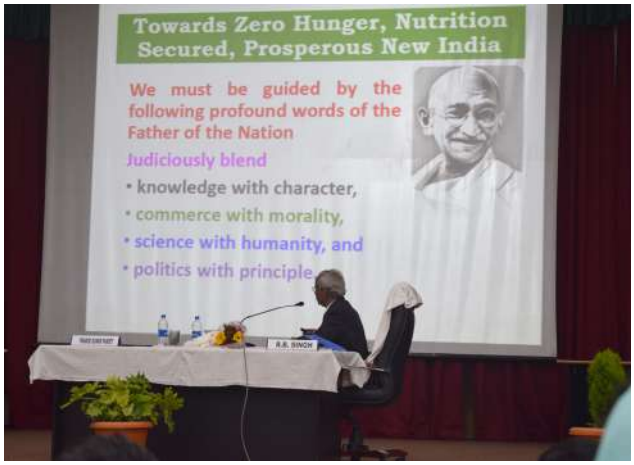
and milestones and future plan of action. All the scientists of the directorate attended the meeting, and progress was discussed and deliberated in the two-day meeting. The Chairman, RAC, congratulated the Director and scientists of ICAR-DCFR for the commendable achievements of the directorate. He emphasized producing public goods or deliverables as an outcome of the research, along with publications in high impact factor journals. He further clarified the role of RAC in suggesting, shaping and deliberating upon the research programmes of an organization and its other activities, such as extension and community development programmes.

World Intellectual Property Day Celebration

On 26th April 2023, the ICAR-DCFR, Bhimtal, celebrated "World Intellectual Property Day" with the theme 'Women and IP: Accelerating Innovation and Creativity'. This event was celebrated by the Institute Technology Management Cell by raising awareness about intellectual property (IP) and emphasizing the role of women in driving innovation and creativity in the field. On the occasion, Dr. Biju Sam Kamalam delivered a lecture on 'The significance of institution-industry partnerships in promoting targeted aquaculture innovations', while Dr. Ann Pauline gave an overview of various aspects of Intellectual Property rights.

First P.V. Dehadrai Memorial Lecture

The ICAR-DCFR organized the first P.V. Dehadrai Memorial Lecture on 17th May 2023. A talk on the topic "Science, Technologies and Innovations for Agricultural Transformation" was delivered by Padma Bhushan Dr. R.B. Singh, Former Chairman, ASRB, New Delhi. The programme was organized in collaboration with the Coldwater Fisheries Society of India (CFSI). During the programme, the work and contribution of Dr. P.V. Dehadrai in the field of fisheries development of the country was highlighted. The memorial lecture was instituted in his remembrance and honour. All the scientists and staff of the directorate attended the programme. The programme was also attended by faculties and staff of other sister organizations through the virtual platform.



Institute Research Committee (IRC) meeting

The 16th IRC meeting (mid-term) was held on 16th March 2023 at ICAR-DCFR, Bhimtal, under the Chairmanship of Dr. Pramod Kumar Pandey, Director, ICAR-DCFR. Scientists of the institute presented the progress of the ongoing research programmes. The 17th IRC meeting was organized on 19-20th June 2023 at ICAR-DCFR, Bhimtal, under the chairmanship of the Director. All the scientists presented their project progress report and also discussed the future plan of work. The NEH, TSP, SCSP programme and farm activities at Experimental Fish Farm, Champawat were also discussed. All the scientists of ICAR-DCFR participated in the meeting.

International Yoga Day Celebration

All the staff and research scholars at the Directorate and its Experimental Field Centre, Champawat, came together to observe the 9th International Yoga Day on 21st June 2022. The practice of yoga proves advantageous in maintaining both physical and mental well-being. "Yoga for Vasudhaiva Kutumbakam," which beautifully encapsulates our collective aspiration for "One Earth, One Family, One Future," was the theme for International Day of Yoga, 2023.

Fig. International Yoga Day Celebration at ICAR-DCFR, Bhimtal

Training programme on "Culture and breeding of indigenous coldwater fish species"

ICAR-DCFR, Bhimtal organized a three-day training on "Culture and breeding of indigenous coldwater fish species" for fish farmers from January 18-20, 2023, in Harinagar village of Nainital district. The major technical points focused were stocking of advanced fingerlings in proper species composition, appropriate supplementary feeding and value addition with the target to achieve optimum production and better income with carp farming. It was attended by 38 fish farmers, including farm women. It was coordinated by Dr. N.N Pandey, Dr. Renu Jethi, Dr. Shahnawaz Ali, and Mr. Santosh Kumar.

Training programme on "Genetic aspects and hatchery management for seed production of rainbow trout

A three-day training programme on "Genetic aspects and hatchery management for seed production of rainbow trout" was organized from 6 – 8 February 2023 at ICAR-DCFR, Bhimtal. A total of 13 participants participated in the training programme. The training programme was on a self payment basis. The training comprised lectures and discussions on various aspects of rainbow trout culture, breeding and seed production. The general management measures required for GMP were also discussed. Lectures were delivered on genetic aspects of breeding, breeding designs, sex manipulation, triploidy induction and health management of rainbow trout. A visit to the Re-circulatory aquaculture system was made to introduce intensive rainbow trout farming. It was coordinated by Dr. Shahnawaz Ali and co-cordinated by Mr. Siva C., Dr. N.N. Pandey and Dr. Renu Jethi.

Training programme on "Livelihood generation through fisheries"

A three-day training programme on "Livelihood generation through fisheries" was organised in collaboration with SSB, Champawat, for 18 villagers

from bordering areas of Champawat district at Experimental Fish Farm, Champawat from 10th to 12th March 2023. Lectures on rainbow trout and ornamental fish farming prospects in hilly regions were highlighted. Visits to rainbow trout farms & hatchery, and ornamental fish ponds were carried out. The training was coordinated by Dr. Kishor Kunal and Mrs. Garima

Training programme on "Ornamental fish farming in upland areas for livelihood generation"

A three-day training programme was organized for fish farmers on "Ornamental fish farming in upland areas for livelihood generation" on15, 17 and 18 March 2023 at ICAR-DCFR. It was attended by 23 fish farmers. Different aspects of ornamental fish culture, such as tank fabrication, tank setup and maintenance, ornamental fish feed preparation, and ornamental fish breeding and larval rearing, were discussed. It was coordinated by Dr. Pragyan Das, Dr. N.N Pandey and Dr. Renu Jethi.

Training programme on "Nutrition and feed management in coldwater aquaculture"

A three-day training programme on "Nutrition and feed management in coldwater aquaculture" was organized from 13-15 March 2023 at ICAR-DCFR, Bhimtal. A total of 19 participants, including progressive farmers, entrepreneurs, students, and scientists, attended the training. Training comprised lectures and practical demonstrations on rainbow trout nutrition and feeds, evaluation and selection of feeds and feed ingredients, feeding biology and nutritional requirements of coldwater fish, etc. It was coordinated by Dr. Biju Sam Kamalam, Dr. Rajesh M, Dr. Prakash Sharma, Dr. Ciji Alexander and Dr. Renu Jethi.

Training programme on "Basic molecular techniques in fisheries science"

A five-day training programme was conducted on "Basic molecular techniques in fisheries science" at ICAR-DCFR, Bhimtal, during 17-20 April 2023 for students of Baba Saheb Bhimrao Ambedkar University, Lucknow. It was coordinated by Dr. Kh Victoria Chanu, Dr. Amit Pande, Dr. Dimpal Thakuria and Dr. Renu Jethi. Training comprised of lectures and practicals on various topics *viz.* over view of coldwater fisheries, reagent preparation, nucleic acid, basics of protein chemistry, gene cloning and recombinant proteins, gene amplification and electrophoresis, real-time PCR and its application and basics of bioinformatics.

Training programme on "Recirculating aquaculture system for intensive farming of fish"

Hands-on training on "Recirculating aquaculture system for intensive farming of fish" was organized at ICAR-DCFR during May 1-3, 2023. It was attended by 23 participants, including 20 officials from the fisheries department, Jammu-Kashmir and 3 entrepreneurs from Gujarat and Himachal Pradesh. Participants were made aware of different aspects of RAS like different designs and models, water quality monitoring, standard operating procedures and risk

management in RAS, bio-security and treatment of diseases in RAS, feed management, strategies to improve flesh quality in RAS-grown fish, utilisation of RAS effluent as nutrients for agriculture and aquaponics, bio-planning, and techno-commercial feasibility of RAS along with practical exercises. It was coordinated by Dr. Rajesh M, Dr. Biju Sam Kamalam, Dr. Renu Jethi, Dr. Debajit Sarma and Dr. Prakash Sharma.

Training programme on "Recent advances in farming and health management of carp and trout farms"

A five-day training programme was conducted by ICAR-DCFR on "Recent advances in farming and health management of carp and trout farms" during 22-26 May 2023. Deliberations were made on the major bacterial, viral, and fungal diseases of coldwater fishes, their epidemiology, field-level diagnostic and management measures, etc. The training was coordinated by Dr. Suresh Chandra, Dr. S.K Mallik, Dr. R.S Tandel and Dr. Renu Jethi.

Training programme on "Recirculating aquaculture system for intensive farming of fish"

A three-day hands-on training on "Recirculating aquaculture system for intensive farming of fish" was organized during 5-7 June 2023. It was attended by 20 officials from the state fisheries department, Jammu-Kashmir and three entrepreneurs from Telangana. During the programme, all the aspects of RAS were covered through lectures and practical demonstrations. It was coordinated by Dr. Rajesh M, Dr. Biju Sam Kamalam, Dr. Renu Jethi and Dr. Prakash Sharma.

Training programme for B.F.Sc students of GADVASU, Ludhiana

A fifteen-day training on "Coldwater Fisheries" was organized for nineteen B.F.Sc students of Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, at ICAR-DCFR, Bhimtal and Experimental Fish Farm at Champawat during 8-22 June, 2023. This training was sponsored under IDP-NAHEP. During the training programme, students were made aware of various topics related to coldwater fisheries resources and their management, ornamental fisheries, aquaponics, nanotechnology in aquaculture, histology techniques, Recirculating Aquaculture Systems, health management in trout and carp farms, application of artificial intelligence in fisheries and aquaculture, integrated fish farming practices, coldwater fish nutrition and feed management, captive breeding and conservation of endangered golden mahseer, reproductive physiology and larval development of coldwater fishes, an outlook of genomics and transcriptomics approaches and applications in fisheries etc. Students got the opportunity to visit river Gauri located in Champawat, Sattal & Naukuchiatal Lakes in Bhimtal and Nainital Lake for water & soil sampling and plankton sample collection. This training was coordinated by Dr. Biju Sam Kamalam, Dr. Rajesh M, Dr. Renu Jethi, Dr. Prakash Sharma and Dr. Kishor Kunal.

Participation in exhibition

Name of the programme	Organizer	Duration	Place/venue
Kisan Mela	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, (ICAR-VPKAS) Almora, Uttarakhand	27 March, 2023	ICAR-VPKAS, Almora
Goral Chaur Field	District Administration, Champawat, Uttarakhand	3 June, 2023	Champawat
Goral Mahotsav	Municipal Council, Champawat, Uttarakhand	22 June - 02 July, 2023	Champawat

Fig. ICAR-DCFR Stall

Important Visitors

▪ B. Tech Agriculture Engineering students of Mahamaya College of Agriculture Engineering & Technology, Acharya Narendra Dev University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, visited ICAR-DCFR, Bhimtal.	6th January 2023
▪ B.F.Sc students of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, visited ICAR-DCFR, Bhimtal.	27th January 2023
▪ Shri. Sandeep Tewari (IAS), Chief Development Officer, Nainital, visited ICAR-DCFR, Bhimtal.	23rd February 2023
▪ B.F.Sc students of Chandra Shekhar Azad University of Agriculture & Technology, Etawah Campus, Uttar Pradesh, visited ICAR-DCFR, Bhimtal.	27th February 2023
▪ Students of High School, Mehra Gaon, visited ICAR-DCFR, Bhimtal.	13th March 2023
▪ Students of Inter College, Jangliagaon, visited ICAR-DCFR, Bhimtal.	13th March 2023
▪ Students and teachers of Government High School, Dhari Block, Nainital, visited ICAR-DCFR, Bhimtal.	28th March 2023
▪ M.Sc students of the Department of Zoology, University of Burdwan, West Bengal, visited ICAR-DCFR, Bhimtal.	17th April 2023
▪ Padam Bhushan Dr R.B. Singh, Former Chairman, ASRB, New Delhi and Former ADG, FAO (Asia and the Pacific), visited ICAR-DCFR, Bhimtal.	17th May 2023

Fig. Glimpse of visitors at ICAR-DCFR, Bhimtal

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